Firm failure processes and determinants of failure in EU countries and UK regions: a quantitative analysis of SMEs.

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FIRM FAILURE PROCESSES AND DETERMINANTS OF FAILURE IN EU COUNTRIES AND UK REGIONS: A QUANTITATIVE ANALYSIS OF SMEs.

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A thesis submitted in partial fulfilment of the requirements of the Robert Gordon University for the degree of Doctor of Philosophy

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ABSTRACT

Firm Failure Processes and Determinants of Failure in EU Countries and UK Regions: A Quantitative Analysis of SMEs.

By

Alexios Makropoulos

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This thesis is motivated by the fact that small and medium sized enterprises (SMEs) are of vital importance to most European countries collectively and to each country individually. For these reasons, understanding SME failure is an integral part of decision and policy making. Firm failure can be regarded as a multi-year process that develops over time. Yet, there has been limited work in the area of quantitatively identifying and analysing SME failure processes. In particular, despite evidence from the qualitative firm failure process literature on the importance that non-financial, firm-specific characteristics have on firm failure processes, the quantitative firm failure process literature has largely ignored this aspect. Likewise, the determinants of firms' transition to failure within potential alternative firm failure processes and the importance of geographical location are often overlooked in the firm failure process literature, despite evidence in the wider firm failure literature for the contrary. For these reasons, the current evidence in the quantitative firm failure process literature is quite isolated from wider firm failure studies. This thesis aims to investigate alternative SME failure processes, the determinants of firms' transition towards failure and the importance of firms' geographical location by bringing evidence from other parts of the firm failure literature in the quantitative study of firm failure processes. The sample analysed consists of SMEs in eight EU countries covering the period from 2004-2013. In addition to analysing the whole sample, the failure processes and failure determinants of UK failed SMEs are also investigated.

The dataset of this study covers firm-specific characteristics such as financial ratios and directors' characteristics, and information about the macroeconomic and business environment. In addition, the impact of geographical location is considered.

The key results of the analysis identify the existence of 4 alternative firm failure processes (new firms with inexperience boards, high growth firms, old firms, firms without board diversity) which apply across EU countries and UK regions. A number of other characteristics are also present in the alternative firm failure processes: directors characteristics are of primary importance for firm failure processes as well as firms' transition to failure. So are the age of the firm, the legal tradition of the country, the levels of business growth and the intensity of competition due to new business entrants in an area and the geographical location of firms.

There are a number of contributions that this thesis makes to the quantitative firm failure process literature. First, given that the different failure processes were found to have differing determinants, the results show the importance of looking at individual firm failure processes rather than simply analysing all failed firms together. Second, this thesis is the first to quantitatively analyse the impact of directors' characteristics in the identification of the alternative firm failure processes in EU and UK firms. Third, it is the first study to investigate the determinants of firms' transition to failure within the alternative firm failure processes context where both financial distress and liquidations are considered in the definition of failure. Fourth, this thesis identifies the importance of geographical location and the existence of spatial interactions in some parts of firms' transition to failure. As such, this thesis consolidates and analyses evidence from qualitative firm failure process studies and from wider firm failure studies in the context of quantitative firm failure process. In doing so, it applies spatial panel data analysis for first time in a firm failure process study. A number of policy implications result from these findings. Given the differences in firm-specific characteristics, the differences in the determinants of transition to failure and the geographic sensitivities that the alternative firm failure processes have, policies and decisions designed to support SMEs to avoid failure should be more targeted according to the characteristics of the firm and the process towards failure it is mostly associated with.

Keywords: SMEs, Firm failure, Firm failure process, Firms’ transition to failure, spatial analysis, directors’ characteristics.

CHAPTER 1: INTRODUCTION AND THE RESEARCH CONTEXT

1.1. Outline of the Chapter

This chapter presents an introductory overview of the purpose and scope of the thesis. Section 2 outlines the background of the study. It introduces the approaches that have been taken to firm failure and highlights areas that require further analysis. Section 3 sets out the motivations behind the study: first, whether or not firm failure processes are present in a sample of failed EU SMEs and second to investigate the extent to which different factors affect the different failure processes. Section 4 sets out the specific research questions in terms of the thesis' aim and objectives. Section 5 defines a number of key concepts. Finally, the structure of the thesis is outlined in Section 6.

1.2. Background of the Study

1.2.1 Business Failure

Entrepreneurs, investors, employees and business suppliers and stakeholders incur significant costs when a business fails. For this reason, business failure[1] has been a particularly active research area over the last fifty years and particularly since the seminal works of Beaver (1967) and Altman (1968). However, most of the research in the wider area of business' failure has focused on failure prediction (see for example Altman, 1968; Edmister, 1972; Altman, 1984; Dimitras et al., 1999; Wu et al., 2014). This literature has concentrated almost solely on the use of financial information. However, as Argenti (1976) notes, business failure becomes evident in financial information at the penultimate stage of failure and therefore utilizing only financial information ignores the question of what were the underlying conditions that put the firm into a failure trajectory in the first place (Zavgren 1985; Argenti, 1985; Balcaen and Ooghe, 2006). One can define the failure process as a number of pre-existing, firm-specific characteristics that develop over time and result in firm failure (Argenti, 1976; Laitinen, 1991).

[1] The generic term "failure" has been used, by different authors, to describe company liquidations/bankruptcies, insolvencies or financial distress.

1.2.2 *Business Failure Process*

On the other hand, there has been a parallel stream of research that has observed that business failure is not an isolated or sudden event that is necessarily similar between different businesses. Instead, business failure may be regarded as a multi-year process that evolves over a period of time prior to the final failure of the firm as defined by liquidation or a bankruptcy filing (see for example Platt, 1989; Hall, 1992; Ooghe and De Prijcker 2008; Argenti, 1976; Laitinen, 1991). In other words, there is a failure process (or trajectory) that businesses follow over a number of years prior to them actually failing.

Within the area of business failure process, a significant part of research has taken a qualitative approach, using observations on the qualitative characteristics of predominantly large failed businesses over a period of years prior to their eventual failure. These studies (see for example Argenti, 1976; Richardson et al., 1994; Ooghe and De Prijcker, 2008) have focused on firm-specific characteristics as the underlying causes of business failure. Qualitative firm failure studies identified firm-specific characteristics such as the firms' director characteristics, the growth strategy of the firm as well as the firms' financials as significant factors in the alternative firm failure processes.

1.2.3 *Financial Ratios and Research Approach*

A number of researchers (see for example Laitinen, 1991; Laitinen et al., 2014; Lukason et al., 2016) have taken a different research approach when considering the business failure process. Using quantitative analytical techniques, the identification of alternative business failure processes has been investigated by using solely financial ratios, similar to the original approaches of failure prediction studies. This research stream may have been motivated by both Argenti's (1976) work which found that financial ratios, the "symptoms of failure", captured the underlying causes of firms' failure, as well as from the extensive firm failure prediction literature (see for example, Altman, 1968, Altman et al., 2010). The latter, used financial ratios as predictors of the failure event. The failure prediction literature has developed to include studies analysing different countries, industries, firm sizes and quantitative techniques in addition to the financial ratios.

The wider business failure literature has employed a number of research methodologies. On the qualitative side, case studies and observations have been mostly used in the context of the failure process. On the quantitative side, the wider business failure literature has used a number of statistical techniques, from multivariate discriminant analysis, logistic regression and panel logistic regressions, as well as survival analysis with the main motivation being the identification of determinants that discriminate between failed and non-failed firms. On the other hand, the failure process area has traditionally considered only failed firms in the research, given that the main aim was to identify alternative processes of failure. However, the quantitative failure process literature has limited itself to a combination of factor and cluster analysis in the attempt to identify key characteristics that differentiate the alternative failure processes. This literature, however, has limited evidence on the determinants of businesses' transition to failure in the alternative firm failure processes.

Regardless of the methodological approach undertaken, the business failure process literature has identified a number of failure processes. Such findings have come from a number of single country studies (see for example Argenti, 1976; Laitinen, 1991) as well as from some multi-country studies (see for example Laitinen et al., 2014; Laitinen and Lukason, 2014) which looked to see whether failure processes differ between countries. Typically, such studies suggest that, depending on the country and on the type of the firm that every study considers, there are typically between 3-6 distinct firm failure processes.

1.2.4 The Introduction of Non-Financial Characteristics

Whilst business failure process studies have been looking at samples of liquidated firms to understand the pre-existing conditions that the alternative firm failure processes could have in common, a wider firm failure literature has also developed. Financial ratios as predictors of business' failure have been well established as an important source of information, despite the fact that there has been no common agreement on which particular financial ratios should be used in order to better identify businesses that are about to fail (Charitou et al., 2004). This has led to the criticism that financial ratio-only driven studies have limited theoretical foundations and therefore their results may be inherently unstable if not used in specific timeframes prior to the failure event (Balcaen and Ooghe, 2006; Laitinen, 1993).

Nevertheless, within the wider business failure prediction literature, there has been increasing evidence that the management of the businesses can also be used as a predictive indicator or can, in general, be a determinant of failure (Franco and Haase, 2010; Ropega, 2011; Wilson et al., 2014). The foundations of this argument were based on the wider corporate governance literature as well as from empirical evidence showing that certain characteristics of businesses' directors and board structures may contribute to business' performance as a consequence of increased social and human capital and to improved group dynamics at board level (Wilson et al., 2013; Shehata et al., 2017).

Other studies have showed the importance of sectoral impacts on firm failure. In addition, macroeconomic conditions, the availability of finance and the legal environment, particularly when comparing business failures in different countries, have included in studies looking at business failure. This has been particularly true since the financial crisis of 2007-2008 and the associated credit crunch that led businesses to fail (see for example, Carling et al., 2007; La Porta et al., 1997; La Porta et al., 1998; Wang 2012). These characteristics have been also identified as significant determinants of firm failure in aggregate business failure studies, which, however, are primarily limited to the corporate sector (see for example, Liu, 2006; Jones, 2013) rather than SMEs.

A number of the above firm-specific characteristics have been used in qualitative firm failure process studies together with environment-specific characteristics (see for example Ooghe and DePrijcker, 2007; Richardson et al., 1994) as differentiators of alternative failure processes. However, these elements have been ignored by quantitative firm failure process studies.

1.2.5 Conclusion

Overall, wider firm failure studies focus on a number of determinants that assist the prediction, or explanation, of business failures. These include firm-specific characteristics that emphasise on financial ratios and the business' management.

Factors external to the business are also frequently considered as determinants of business failure. These studies focus on failure as a time-specific event. On the other hand there is a view that firm failure is a process that evolves over a number of years. The qualitative business failure literature included non-financial characteristics into the identification of the alternative firm failure processes but has not considered SMEs; instead most of the research focus has been on large corporates. On the other hand, the quantitative firm failure process literature has occasionally considered SMEs but has neglected any non-financial information when identifying the alternative firm failure processes. In both cases, the firm failure process literature identifies alternative failure processes but stops short of investigating whether any of the factors included in the identification of the alternative failure processes are also determinants of the businesses' transition to the ultimate failure stage that is liquidation. Moreover, despite the existence of studies including firms from a number of countries, little attention has been given to the role of geographic/ spatial effects on businesses' transition towards failure.

1.3. Motivation of the Study and Framework

This study is motivated by three main factors. The first is based on the fact that small and medium sized enterprises (SMEs) are of vital importance to most European countries. The second relates to the importance of identifying the alternative business failure processes, and their determinants, in order to inform better decision-making and better, more relevant polices that will support them and help them to thrive. The third is related to the importance of geographical location and potential interactions that may occur between firms in nearby areas.

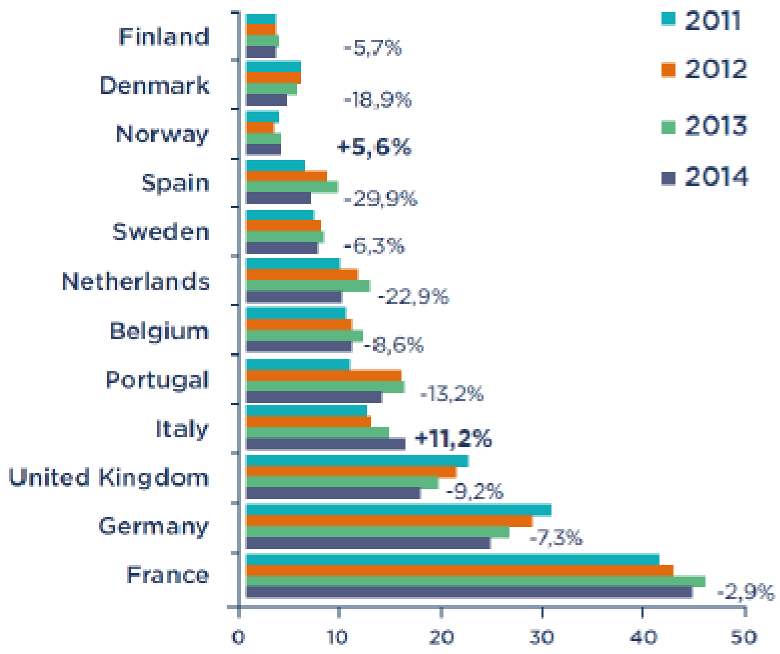
First, the EU has introduced many policies designed to support and encourage SMEs. The aim of these policies is to promote business success and avoid business failure. For example, policies to support SME growth such has the "Think Small First", the "Small Business Act" (Commission of the European Communities, 2008), the "Entrepreneurship 2020 Action plan", and the "Competitiveness of Enterprises and small and medium-sized Enterprises" program (2013) have all been designed to support SME growth and to avoid SME failure. Policies that support SMEs are important because SMEs represent the majority of the business population in the European Union. In addition, they are also a major source for peoples' employment. In the U.K., SMEs accounted for 59.3% of the private sector employment (Federation of Small Businesses, 2013). In the EU, SMEs account for c.66% of the private sector employment (European Commission, 2018).

Second, in relation to the failure process research on SMEs, one can observe that whilst the wider business failure literature has evolved with alternative methodologies and consideration of non-financial characteristics as determinants of failure. However, there has been no such progress in the failure process literature where alternative failure processes have been identified solely in terms of financial ratios. Further, no analysis has been undertaken to understand which of these are actually determinants of the firms' transition to failure. Yet, the identification of failure processes is important because failure is a situation that evolves over a number of years and needs to be understood before any avoidance actions can be taken. Such knowledge can then inform policy and decision-making.

Third, in a business environment where business interact with each other via their business networks, aggregate firm failures in one location can affect firm failures in other locations. Such information is also important for policy making at country and regional levels.

Overall, despite the European Union's (EU) efforts to avoid business failures by supporting and giving alternative opportunities to entrepreneurs with failed firms, SME bankruptcies in the EU show clear signs of differences between some key European countries (Figure 1.1). One can see that, for example, liquidations in the U.K. and Germany on the one hand and Sweden and Netherlands, on the other hand are having quite different levels which are not just simply correlated with their country level economic conditions. The former two (UK and Germany) have higher bankruptcy rates in 2011 compared to 2013, while the latter two (Netherlands and Sweden) have the opposite trend. Therefore this raises the question of whether SME support policies could be better managed if a better understanding of the underlying reasons of SMEs' failure was available. This has to be considered in the context of the current research that, particularly on the quantitative side, treats the business failure as a sudden event. Likewise, the failure process literature neither considers non-financial characteristics in the alternative failure processes nor considers the determinants of the firms' transition towards failure between the failure processes.

Figure 1.1: Business liquidations in some European countries



Source: Company Insolvencies in Europe, (Coface, 2015; p.1)

Likewise, there is limited evidence on whether the geographical location within one country has any significance in firms' failure. The wider business failure research provides evidence that the spatial location of the firm does matter if one has to distinguish between (for example) different regions as the business environment (such as the competition from new firms) may differ in each region (Lane and Schary, 1991; Keeble and Walker, 1994). In that sense, there is evidence that within the United Kingdom (UK), the percentage of failed businesses may differ substantially (figure 1.2) between different regions (within England and Wales in this case). There also appears to be some correlation with the percentage of new business in these areas, in line with the literature observations (Lane and Schary, 1991; Keeble and Walker, 1994). This can be observed in figure 1.2 which shows that the percentage of business failures (in 2010-2011) differed between different regions in England. London was the region with the most failures. Additionally it was the region with the most start-ups.

Figure 1.2: Changes in business failures (deaths) and births in England 2010-2011.

Source: Business births, deaths and survival rates, ONS (2012)

Despite the evidence, the aspect of location, expressed by different countries or by different areas (for example regions) within a country has been largely neglected, especially when the determinants of businesses' transition to failure are considered. Yet, such findings could help entrepreneurs, investors and decision makers to better allocate resources and improve policy design accordingly. Additionally, the identification of failure processes and their determinants could assist further in the wider failure literature as failure prediction applications could be more targeted to certain firm failure processes.

To conclude, the key motivator is understanding SMEs failures processes in different locations: within EU countries and within a country - the UK. This is because failure is not a sudden event, identical for each business and therefore should not be treated as such. The importance of location, be it between countries or within a country (at regional level) has received little attention in the context of SME failure processes. In this context there appears to be some neglect of alternative quantitative techniques that could provide further insights in the current quantitative firm failure process literature.

There are two additional issues that motivate the analysis. First, the current literature relating to business failure processes has somewhat neglected the importance of not only identifying the alternative failure processes but also of identifying the determinants of the transition towards failure – within the population of businesses that belong to the alternative failure processes. This is crucial because, having identified different failure processes, it may be that the determinants of the transition to failure differ across different processes.

Second, aside from financial ratios, the quantitative failure process literature has neglected key firm-specific characteristics and their role in firm failure. This is in spite of the findings in the qualitative failure process literature that they significantly affect failure. Further, there is no evidence of how, or if, non-financial ratio determinants are significant contributors to businesses' transition to failure between EU countries and within different areas of one country - the UK.

1.4. The Research Problem and the research plan

As described in the previous section, a number of salient areas remain under-developed in the current literature. First, the majority of the qualitative work on firm failure processes considers large corporations rather than small and medium sized- businesses (hereafter called "firms" or SMEs).

Second, the quantitative literature has focused solely on financial ratios when investigating firm failure processes for both large corporations and for SMEs. As such, the current quantitative research on firm failure processes ignores findings from qualitative studies in the same area, that suggest that non-financial characteristics, especially related to the management of the business, are important when one wants to identify the alternative failure processes. In addition, evidence from the wider business failure literature is also ignored.

Third, whilst the wider business failure research considers the determinants of business failure, quantitative firm failure process studies have so far identified a number of firm failure processes in different countries but there has been limited analysis of the extent to which the characteristics that differ between alternative firm failure processes are actually statistically significant determinants of the firms' failure when firms are transitioning towards their terminal failure (liquidation) state.

Fourth, whilst firm failure process studies have taken place in a number of different countries (including a number of multi-country studies), the geographic element has received relatively limited attention, and then only from a firm-specific perspective. The geographical location is associated with observed and unobserved characteristics. For the former, there is limited evidence on whether firm failure processes differ between countries or within different regions of a country. In addition the current failure process literature does not explain what role, if any, country-specific characteristics (such as the legal environment) or region-specific characteristics (such as the competition from newly established firms) play in the firms' transition towards failure within these failure processes.

Fifth, the methodologies that have been used so far in firm failure process studies are restricted to the identification of the alternative failure processes by using factor and cluster analysis. Therefore, further insights may be gained by employing additional techniques, for example, panel data regression analysis and by assessing the importance of spatial location, using spatial data analysis. This may provide a better understanding of the factors that determine the path of firm failure.

The study aims to address the above issues by using a sample of failed firms from 8 European countries, covering the period 2004-2013. This period (the maximum number of years available in the Amadeus database) covers the financial crisis that resulted in a number of failed firms in the subsequent years. Moreover, it allows each firm in the sample to have a substantial number of observation years prior to failure. The countries were selected so as for each country represented in the sample to have a substantial number of failed businesses. The selected sample of countries ensures that a diverse business economic and legal tradition background is represented in the sample. As such the sample represents 8 countries with different economic environments during the period under investigation. These countries are also representative of the key legal traditions that exist in EU. The sample size in terms of firms' numbers and number of countries presents an improvement and an extention of the current quantitative firm failure process literature. Further details on the sample are given in Chapter 4. This thesis seeks to address the following aims and objectives:

Main Aim:

To enhance the quantitative firm failure process literature on SMEs, by incorporating elements from the qualitative failure process and the wider firm failure literature.

Objectives:

1) To investigate the alternative firm failure processes between EU countries and within one country's regions - the UK, by considering financial ratios and the age of the firm.
2) To investigate the impact of firms' management characteristics, in addition to the financial ratios and the age of the firm, in the identification of failure processes and their transition to failure between EU countries and within one country's regions - the UK.
3) To investigate the influence of business environment factors, management characteristics and excessive growth, in firms' transition towards failure in the alternative failure processes in EU countries and within one country's regions - the UK.
4) To investigate the influence of location at firm level and aggregate firm transitions towards failure in the alternative failure processes between EU countries and within the UK.

In order to achieve the aim and objectives, the thesis is structured around a number of hypotheses. The hypotheses associated with the alternative firm failure processes and with firms' transition to failure are developed in the literature review section. Once the alternative firm failure processes are identified (from the financial ratios and the age of the firm) these hypotheses consider wider comparisons both for the firm specific characteristics that were used to identify the alternative processes and for characteristics associated with the economic and business environment of the firms in the alternative processes. The hypotheses associated with the influence of the geographical (spatial) location and firms' aggregate transition towards failure are developed in the methodology chapter. Subsequently, these hypotheses are analyzed in three empirical chapters; one analyses the firm failure process and determinants of transition to failure in EU countries; the second analyses the firm failure process and determinants of the transition towards failure in the UK regions; the third uses aggregated failures across the EU countries and the UK regions, to investigate the influence of geographic (spatial) effects in firms' failure.

As a result, the thesis makes a number of contributions. The first is to extend the quantitative firm failure process literature by incorporating and quantifying elements from the wider firm failure process and firm failure literature. It does so by looking for evidence across a number of EU countries and also within the regions of the UK. The second contribution is to consider the determinants of firms' transition to failure, for first time in a quantitative firm failure process study. The third is to investigate the importance of geographical location in firms' failures between EU countries and within the UK is investigated for first time in the firm failure process context. The findings of this study should provide contributions and implications for policy and decision makers. The identification of the firm failure process that firms belong to and the identification of its determinants of transition to failure can provide a valuable insight to initiate failure avoidance actions and policies.

1.5. Definitions

In business failure studies, authors have used a number of different definitions for similar things. In order to avoid confusion, this section provides definitions for all the terms that are used in this thesis.

1.5.1 Defining Small and Medium Sized Firms and Businesses

There is a wide variety of definitions in the literature for the SMEs. This study uses the EU definition for micro, small and medium sized firms as presented in Table 1.1.

Table 1.1: Upper limits to be considered as a micro, small or medium sized firm

Category	Employees	Turnover	Total Bal. Sheet
Medium	<250	≤ € 50 million	≤ € 43 million
Small	<50	≤ € 10 million	≤ € 10 million
Micro	<10	≤ € 2 million	≤ € 2 million

Source: Official Journal of the European Union L 124, p. 36

Both EU and UK firms in the sample are using the same criteria (see for details Chapter 4 - Data). The terms “SME” and “firm” are used interchangeably in this study.

1.5.2 Defining Bankruptcy, Liquidation and Failure

The definition of failure has been used in many alternative ways in business failure studies. On occasion the term “failure” has been used to denote financial distress (see below). On other occasions “failure” has been used as synonymous with business exits from the industry, including business mergers and acquisitions as well as simply the ceasation of trading. Finally, the term “failure” has been used to denote bankruptcy or liquidation of a business[2].

Therefore, in this thesis the term failure is used to denote bankruptcy/liquidation. This is regarded as the terminal stage of a firm’s operation. In this thesis, there is no direct distinction between compulsory and voluntary liquidations because such procedures differ between countries and as such this type of information is of limited use. In any case this study is interested in identifying the processes and determinants of failure (liquidation) and as such the initiator of the procedure is not the point of interest. However, the study does control for the interim status of financial distress (see below) to control for the firms’ whose transition to failure was due or partly due to financial distress.

[2] The term bankruptcy and the term liquidation are broadly similar and are used interchangeably in this thesis. Some countries use the term liquidation and others the term bankruptcy. Whilst this study makes no distinction between them, the term failure is used instead.

1.5.3 Defining Financial Distress

Financial distress is a situation that precedes bankruptcy in many cases (Platt and Platt, 2002). However, there is not a consistent definition of financial distress in the literature. For example, negative equity may be defined as the situation where a firm has negative net operating income over a number of years (Hofer, 1980) or major restructuring and layoffs (Hill, 1996). In the context of this thesis the term financial distress is used to denote firms with negative equity positions. In such firms the liabilities are greater than their total assets and as such their owners are in negative equity and therefore financially distressed. Altman (2000) has used also the same definition for a failure prediction study. Financial distress is used as an interim status in the transition towards failure; a number of firms first go into negative equity and then fail. However, some firms fail without being in financial distress first.

1.5.4 Defining the Failure Process and the Transition to Failure

The term "Failure Process", was first introduced by Argenti (1976) and has subsequently been adopted by much of the literature in this area (see for example Laitinen, 1991; Ooghe and De Prijcker, 2008; Lukason et al., 2016). As mentioned above, a firm's failure process is defined as a number of pre-existing, firm-specific characteristics that develop over time and result in failure. For example, the existence of a board of directors with little experience in a firm with weak returns on investment (ROI) is a combination of existing firm-specific characteristics that evolve over time. These characteristics may interact with the firm's external environment and lead to failure. The term "Failure Trajectory" is sometimes used sometimes in the literature (see Argenti 1976) interchangeably with the Failure Process. This study however will use the term failure process.

In this thesis, the term "transition to failure" is used to denote the interim stages that a firm may encounter across time as it moves towards its eventual failure. The transition to failure describes the firm's journey under two conditions: first, from being active and under no financial distress to becoming bankrupt and second, being potentially financially distressed prior to becoming bankrupt. The term is used in this study when consideration is given not in the characteristics of the alternative firm failure processes but to the determinants of failure; that is the characteristics that are statistically significant determinants of the firms' transition from commercially active to failure.

1.5.5 Defining Management

This thesis examines the firms' directors' characteristics and gender diversity as proxies of a firm's management knowledge, experience and social and human capital. The definition of directors for the EU countries implies ownership to the firm and is related to people that are on a firm's board. The UK firms, however, include a wider definition of directors in the main section of the analysis that includes managers in senior positions (such as chief accountant) but not necessarily ownership or board presence. However, a strict definition (that implies ownership), of directors in UK firms has also been used in an additional robustness analysis with no material differences in the results.

1.6. Structure of the Thesis

The rest of the thesis is outlined below. Chapter 2 provides a literature review. The chapter first considers the characteristics and the determinants that have been associated with firm failure. The chapter provides a synthesis and critical analysis of the determinants of firms' failure from the wider failure literature and then proceeds with looking at cross country comparisons. Subsequently, the chapter presents and evaluates the current literature on firm failure process. Finally the chapter summarises evidence on the same characteristics but for studies that cover intra-country comparisons.

In doing so, chapter 2 covers the areas that firm failure studies have historically identified as important determinants of firm failure. As such, the chapter starts with the external environment, looking at the legal aspects of firm failure in the countries that the sample of this study covers. Then, the chapter proceeds with a section dealing with the external environment of the firms and then considers the firm-specific characteristics such as the firms' financials, the management characteristics and the presence of excessive growth that has been frequently mentioned in firm failure process studies. This chapter also sets the hypotheses in relation to the alternative firm failure processes and the determinants of firms' transition to failure. These are to be tested in Chapters 5 and 6 and are used to enable the thesis to reach its aim and objectives.

Chapter 3 describes the research methodology that this thesis has adopted. The research philosophy and the design of the study are presented. The techniques that are used are discussed together with a brief historical review on the techniques that have been previously used in the area of firm failure and firm failure process. This chapter also sets the hypotheses in relation to the existence of geographical (spatial) effects in aggregate firm failures in the failure processes of the EU countries and the UK regions. These hypotheses are to be tested in Chapter 7.

Chapter 4 presents the data used in the study. It presents the data sources and some basic descriptive statistics. The chapter also defines the dependent and independent variables used in the study.

Chapter 5 is the first empirical chapter. It presents the analysis and the discussion of the results associated with the country-level firm failure process and the determinants of transition to failure of the EU firms of the sample. The relevant hypothesis are also discussed.

Chapter 6 is the second empirical chapter. It presents the analysis and the discussion of the results associated with the regional-level firm failure process and the determinants of transition to failure for the UK firms in the sample. The relevant hypothesis are also discussed.

Chapter 7 is the third empirical chapter. The chapter presents the analysis and the discussion of the existence of spatial effects in firms' transition towards failure. This is undertaken both for the firms in the EU countries and for firms in the UK regions. The relevant hypothesis are also discussed.

Chapter 8 concludes the Thesis. It provides a summary, evaluation and critical analysis of the findings and discusses their policy implications. The chapter also acknowledges the limitations of the research and proposes possible areas for future research.

CHAPTER 2: FIRM FAILURE AND PROCESS: A REVIEW OF THE LITERATURE

2.1 Introduction

The main aim of this study is *to enhance the quantitative firm failure process literature on SMEs, by incorporating elements from the qualitative failure process and the wider firm failure literature. This aim is to be achieved within the context of a number of different EU countries and within the regions of one country, the United Kingdom.* The key objective of this chapter is to introduce the key aspects of the wider firm failure literature that are involved in a cross-country and in a within-country context. In addition, emphasis will be given to the literature on firm failure process. Hypotheses in relation to firm failure process and the determinants of firms' transition to failure are also introduced in this chapter, aligning it with the aim of the study. The hypotheses related to the spatial and geographical location of the firm are introduced in Chapter 3 as they are more technical in nature.

Comparing the failure processes of firms across European countries and within one European country (the U.K.) requires a compilation of different literature sources around the topic of firm failure. This is because there appear to be three key parallel frameworks in the wider firm failure literature: the firm failure process literature, the failure prediction literature and the wider failure literature. The failure process literature includes qualitative and quantitative studies and considers firms' failure as a multi-year process that evolves due to a number of underlying reasons within a firm. The failure prediction literature mainly considers failure as an event and usually employs quantitative techniques. The failure prediction literature is particularly important in terms of the selection of financial variables. The wider failure literature may consider both the failure event and the process and usually analyzes one particular characteristic that may be associated with firms' failure, for example, the association of firms' failure with the origins of a country's legal framework.

The perspective this chapter discusses is a blend of the literature coming from the failure prediction studies as well as from the failure process and wider firm failure studies. In particular, the qualitative firm failure process framework that considers the firm's management, the firm's age, the firm's financials and the economic and business environment is used as the basic framework on which evidence from wider failure studies are adding evidence. Whilst there is evidence of firm failure and firm failure process studies that consider different countries, the spatial impact of location has not received much attention in the literature. In particular, there is no evidence of spatial analysis within the context of firm failure process studies. On that end, the methodology chapter (Chapter 3) offers some technical guidance on spatial analysis and proposes the hypotheses for that part of the thesis.

A major distinction in firm failure studies lies on the size of the firms. Corporate failure studies tend to be distinctive to SME failure studies. This is because of the different characteristics that SMEs have compared to large corporates. In fact, SMEs tend to be more owner-centric and more opaque than their bigger (and possibly listed) counterparts. SMEs are also riskier with much higher population and higher probabilities of default (Dietsch and Petey, 2004) and therefore failure. In line with the aim and objectives of this study, the emphasis of this chapter is on the SMEs. However, references are made to the large corporate literature in cases where there is a lack of evidence from the SMEs. Such references are therefore made in order to assist hypothesis formulation and the drawing of inferences. In terms of defining the SMEs, Ooghe and DePrijcker (2008) classified SMEs as firms those with less than 100 employees while Richardson et al. (1994) did not give a clear definition on "small firm". In any case, given the nature of the research that compares European SMEs, the European definition of SMEs is adopted and presented in Chapter 1.

The legal entity of the firms is generally ignored in both aspects of the literature while the distinction between listed and non-listed firms is rarely the case, especially in the SMEs' literature where the vast majority of firms are assumed to be non-listed. However, the legal aspects of the failure definition may be of interest as they are related with the definition of the liquidation status.

The literature of the firm failure process has shaped the framework of this study. The qualitative firm failure process literature suggests that a firm's failure is caused by management issues, combined with weak financial performance, often unsustainable growth and greater adversity of sector and business environment characteristics. From the above, only the weak financial performance has been empirically used in quantitative firm failure process studies (see for example Laitinen, 1991; Laitinen et al., 2015).

On the other hand, the wider firm failure literature that investigates single determinants that are linked to firm failures is much wider than the literature for the failure process. For this reason, each of the literature sections provides evidence from the wider stream of firm failure literature. For example, the concept of rapid growth is fundamental in the failure process literature while at the same time the closely related concept of unsustainable growth is also related to firm failure without considering the wider failure process concept. One should be careful with the literature's definition of the firms' failure process (described in section 2.2) and with its stages. The latter describes the transition between a firm being "healthy", a firm being in financial distress and a firm becoming bankrupt and being liquidated.

The remainder of the chapter is organized as follows. Section 2.2 explains the distinction between failure event and failure process and discusses and evaluates the literature on the firm failure process. Section 2.3 provides evidence on the legal origins of the legal legislation that shapes different kinds of firms failure across countries; section 2.4 presents the financial and economic drivers of firms' failure; section 2.5 presents the management of small firms and its connection with failure whereas section 2.6 presents the concept of sustainable growth and its connection with failure. Finally section 2.7 presents the reasons why intra-country failure comparisons may be of interest to the academic literature and extends the discussion of the previous sections but in an intra-country context. Section 2.8 concludes the chapter. In each section, research hypothesis are formed, where relevant. These are analysed in the empirical chapters of this thesis.

2.2 Firm Failure and Firm Failure Processes

2.2.1 Introduction to Firm Failure

The research perspective around firm failures can be categorized in two different types. The first presents firm failure as an event that "happens" and it is a matter of research to find the appropriate predictors of the failure event which are effectively the symptoms of the failure. Therefore, this body of research aims to identify failure factors. That research has been greatly influenced by the seminal works of Beaver (1966) and Altman (1968), it is largely quantitative in nature and has been most effectively expressed in the failure prediction literature.

In failure prediction studies, the failure is an event that happens at a specific time and the research focuses on the effort to identify financial ratios, and later other variables, that predict firm failure. In this view, the failure event (that is the liquidation or the financial distress) of the firm was defined as a specific point in time and therefore the research focuses on the years just before the event in order to identify the best determinants of the firm failure. Traditionally statistical analysis has been used in order for the determinants of the failure event to be identified.

Naturally, the selection of financial ratios that measure the basic financial dimensions of a firm (such as the total liabilities to total assets ratio, the sales to total assets ratio and the quick ratio) are particularly important in that respect. In other words, researchers strived to select the most appropriate financial ratios for input into an econometric model that would in turn give a score according to which a firm could be classified as risky/ not risky to fail. Gradually, this type of research evolved into the inclusion of variables other than financial ratios in the econometric model. Consequently, macroeconomic, industry-related and management-related variables were included in the econometric models alongside the traditional financial ratios. Likewise, researchers started using alternative econometric techniques to achieve the most accurate model. Such techniques included multiple discriminant analysis, logistic regression with pooled data where data from few years before the failure event were analyzed so as to identify the most important determinants of failure. Later approaches, still very much viewing the failure as a defined event, applied survival analysis (also referred as event history analysis) and failure events across wider periods of time were researched (see for example Gupta et al., 2015) that allowed for time-varying determinants of failure. Within this context, panel regressions as well as computational techniques based on neural networks (see for example Tsakonas et al., 2006; Ciampi and Gordini, 2013) have been used. Financial ratios are identified as key determinants of failure prediction but there is no conclusive evidence on which particular combination of financial ratios is preferred (Balcaen and Ooghe, 2006).

2.2.2 The Firm Failure Process

The second type or research stems from the qualitative work of Argenti (1976) which considered firm failure as a result of a combination of underlying reasons that have been part of a firm for a long time, including the management of the firm and its financial characteristics (using financial ratios as symptoms of failure), leading to its failure. The firm failure process literature suggests that firms generally do not fail instantaneously but they are experiencing a failure path (the failure process) that can be very lengthy for corporates and quicker in SMEs (Laitinen, 1991). Generally, literature suggests that a firm's failure is rarely caused by a single reason (Mellahi and Wilkinson, 2004) but in extreme cases failure can be the result of a severe management mistake (Lukason, 2013). Within the failure process, liquidation is seen as the final stage of the declining process (Lukason and Hoffman, 2014). Often, failure processes are attached to this type of study in order to categorize a number of firm failure processes to a small number of failure processes.

All in all, few researchers have been involved in the explicit analysis of failure as a process (Ooghe and DePrijcker, 2008) and most of them focused their analysis on large companies. In many respects, the failure process type of research can be described as a more "holistic" approach in assessing firm failure as it largely emphasizes the underlying causes of failure and the financial effects (Ooghe and DePrijcker, 2008). The general view in all failure process studies is that a firm's failure is the result of management issues combined with external factors. In other words, there is a variety of underlying reasons that may lead a firm to fail and therefore any firm failures are not simple events that happened at some point in time (Argenti 1976; Argenti 1976b). However, in contrast to failure prediction and generally failure event studies, this research area is often characterized by qualitative studies (see for example Argenti, 1976; Ooghe and Prijcker, 2008) and fewer quantitative studies (see for example Laitinen et al., 2014). Within the firm failure process literature there can be a further distinction of researchers that propose a specific set of failure paths (or failure processes) (Argenti, 1976; Laitinen, 1991; Ooghe and De Prijcker, 2008) and of researchers that represent the failure process in a general way (Mellahi and Wilkinson, 2004; Hambrick and D'Aveni, 1988).

The early studies within the firm failure process literature were mainly qualitative in nature, focusing on lager corporates and a number of characteristics were considered as being distinct between the alternative firm failure processes. In addition, in these studies there was no distinction between the characteristics of the alternative firm failure processes and the determinants of firms' failure (see for example Argenti, 1976, Argenti 1976b, Richardson et al., 1994). Later studies focused on the quantitative identification of the alternative firm failure processes (see for example Laitinen, 1991). However, there has been little discussion on which (if any) of the characteristics of the alternative firm failure processes were also determinants of firms' failure. Therefore there is scope to try to quantify this research area's observations within a cross-country and intra-country context and additionally investigate the determinants of firms' transition to failure within the alternative firm failure processes.

The first and most widely known evidence of research into the firm failure process was provided by Argenti (1976). This type of research, which views firm failure as a process, tends to categorise firms into several categories (the firm failure processes), depending on their characteristics. In Argenti's (1976) view, the three elements in the firm failure sequel are: managements' deficiency and inability to adapt to change; potential overtrading; and the financial ratios as symptoms of failure. Despite the fact that there has been surprisingly limited research that followed Argenti's rationale, several parts of his failure categories have been researched independently outside the context of the firm failure process. This supports the conceptual importance of his contribution which is centered on the idea that by studying the financial ratios alone, only the symptoms of failure are examined. The underlying conditions of failure though are not directly identified in a ratio analysis as the latter only capture the financial outcomes of management actions.

Argenti (1976; 1976b) identified three different failure processes that cover the vast majority of firms' failures:

i) The first failure process is the relatively new, low profile and low performance firm that did not become successful and failed (Argenti,1976);

ii) The second failure process is the rapid growth firm before it fails (Argenti, 1976; Argenti, 1976b);
iii) The third failure process is the case of an old firm that performed well for a period before its performance deteriorated and it eventually failed (Argenti, 1976a).

Failure processes have been further supported by Ooghe and DePrijcker (2008) who argued that the essence of the failure process is the existence of management issues combined with external factors that lead to four distinct failure processes, including:

i) The unsuccessful start-ups;
ii) The rapid growth companies;
iii) The dazzling growth companies;
iv) The apathetic but well-established companies.

Critical evaluation of the above failure process frameworks shows that by effectively revising the failure process framework, Ooghe and DePrijcker (2008) added the dazzling growth companies as a separate failure process where the firm's growth path is a key aspect of the failure. However, the key elements of a few firm failure processes where management and external factors decide the firm's failure process persist. In addition, growth can be described as an outcome of management actions and external environment conditions. Essentially the same can be argued for the financial ratios. In fact, each of these failure elements has more complicated underlying dimensions. One can critically suggest that financial ratios and excessive growth are symptoms of failure. Whilst they may be useful characteristics for identifying a number of alternative firm failure processes, the underlying causes of them are usually related to the management of the firms and the business and economic environment. In addition, the evaluation of the above propositions for the firm failure processes shows that there is a relatively weak link between characteristics of alternative firm failure processes and determinants of firms' transition to failure within these processes.

Although the key elements of the failure process have been the same, other authors have used slightly different definitions of the failure processes. One criticism of Argenti's (1976) work is that his discussion of the financial health of the company and its management deficiencies is quite vague. Another is that there are no specific financial indicators used in the definition of the "financial health" of the company. Ooghe and DePrijcker (2008) provided a clearer definition by arguing that profitability and debt/equity figures together with a relationship between the turnover of the firm and its expenses are important indicators that have been (qualitatively) used in the 4 processes of the failure process while the capitalization structure is also important for new/young firms. Laitinen (1991), on the other hand, identified the existence of three alternative firm failure processes in Finland, namely the "chronic failure firm", the "revenue financing failure firm" and the "acute failure firm" by using largely financial information-related evidence, in a quantitative methods approach. According to Laitinen (1991) the three alternative firm failure processes have the following characteristics:

i) the first failure process is the firm which underperforms for at least 4 years before its failure;
ii) the second failure process is the firm with very average financial performance but revenues that were too weak to support finance the firm's debt and to accumulate earnings;
iii) the third failure process is where the firm shows no signs of financial distress in any year but the last one before failure.

One could therefore argue that Laitinen's (1991) approach has been largely influenced by the early developments of the failure prediction literature where the usage of financial ratios was dominant. This is in fact one of the few attempts to bridge the gap between the two types of firm failure research and to use a financial ratio-driven evidence to derive conclusions on the failure processes. Despite that, Laitinen's (1991) failure process, and especially the last process, can be linked to Argenti's (1976) three concepts of a firm's failure where it was suggested that "creative accounting" may be a factor that influences financial ratios and makes the failure seem impossible when it is actually the case. In defining more specifically management problems in the failure process, Ooghe and DePrijcker (2008) gave also some specific evidence that managerial inexperience is a key driver of management errors and problems especially in the process that involves the failure of new firms.

Nevertheless, within the firm failure process literature, examples that focus only on small firms have been few (see for example, Laitinen, 1991; Ropega, 2011) and with a varied definition of what a small firm is and what is defined as failure. Laitinen (1991), for example, defined failure as the situation where a firm cannot pay its financial obligations, a definition most closely related to financial distress as opposed to bankruptcy. Later studies have defined failure as a firm's bankruptcy (see for example, Lukason et al., 2015).

In the case of SMEs, in particular, the owner seems to be the most important person whose relationship with the company may be too close such that he causes functional problems in the firm (Ropega, 2011). Deficient management was also linked to neglected financial information (Argenti, 1976). Naturally, financial ratios can capture parts of the deteriorating performance of a firm as it slides down the path to failure but they may occasionally be the last to be affected as "creative accounting" and "window dressing" techniques that involve a superficial improvement of the financial results, may have been employed at some stage.

Although most of the evidence around the failure process has been related to large corporations, Richardson et al., (1994) considered firms of different sizes and categorised them in the following processes:

i) Those that are old and with a gradually deteriorating performance;
ii) Those that experience rapid growth, leading to failure;
iii) Those that have an autocratic entrepreneur who set-up the company that he no longer can manage.
iv) For the smaller firms, there is the case of firms that underperform permanently without ever achieving acceptable performance to survive (Richardson et al., 1994).

One particular characteristic of the firm failure process is the exclusion of SMEs or their inclusion within a larger sample (see for example Richardson et al., 1994; Ooghe and DePrijcker, 2008). Ropega (2011) linked the failure process literature with the wider literature of SME failures but the definition of SME is also absent, probably because it varies significantly between authors. Laitinen et al., (2014) and Ropega, (2011) proposed their own views of the failure process, but they all contain broadly similar underlying characteristics. The key characteristics of the alternative failure processes are:

i) the young firm that never really performed;
ii) the unsustainable/extreme growth firm;
iii) the apathetic old established company with deteriorating performance.

Similar evidence exists in more recent quantitative firm failure process studies where SMEs are considered in a multi-country assessment. For example Laitinen et al., (2014) quantitatively analysed SME failure processes in six European countries (Belgium, Croatia, the Czech Republic, Estonia, Russia, United Kingdom) using firms' financial ratios. It identified four firm failure processes that shared similar characteristics with those identified in earlier studies:

i) The first process was characterized by firms with high revenues to total assets. These firms were identified as normal growth firms.
ii) The second process was characterized by firms whose cash flows to operating revenues were high but return on investment becomes negative in the year prior to failure. These firms were identified as high growth firms with a sudden failure occurring. Similar high growth processes were identified in Argenti (1976), Richardson et al., (1994) and Ooghe and De Prijcker (2008).
iii) The third process was characterized by firms whose all financial ratios were gradually deteriorating. This trajectory was identified by Argenti (1976) and Ooghe and De Prijcker (2008) as the trajectory of an apathetic firm.
iv) The fourth process was characterized by firms whose performance was weak across all the years of study. Similar processes have been identified by Richardson et al., (1994) for young firms, an element that Laitinen's et al., (2014) work does not control for.

Similar results were identified in other single or multi-country quantitative firm failure process studies including SMEs (see for example Laitinen et al., 2015; Lukason and Laitinen, 2016; Lukason and Laitinen, 2018). In all cases, a critical evaluation of the quantitative firm failure process literature and some synthesis with the qualitative firm failure process literature implies that there are management issues that lead to problematic financial performance. These underlying factors are connected to external factors and lead to firm failure. Yet, whilst there is some evidence of identifying alternative firm failure processes in the quantitative literature, there is still a gap between linking the characteristics of the alternative firm failure processes with characteristics that are critical into making a firm fail.

2.2.3 Evaluation Overview

From the above, one can conclude that firm failure has been a particularly active area of research. It appears to be separate streams of research in the firm failure literature, and it is frequently the case that one approach uses evidence from the other. The failure event studies and especially the failure prediction studies only focused on identifying failure determinants.

On the other hand, the firm failure process literature assesses the failure path and the underlying characteristics either on generic terms or by specifying distinct failure processes. Despite the fact that the literature presents a variety of failure processes with small differences between them, evidence suggests that the early stages of the failure process is characterized by organizational and managerial deficiencies whereas the later stages of the firm failure process are characterized by the symptoms of failure (the financial ratios) (Crutzen and Van Caillie, 2008). Regardless of the size of the firm, the qualitative firm failure process literature (see for example Argenti, 1976, Argenti, 1976b, Richardson et al., 1994, Ooghe and De Prijcker, 2008) takes a more holistic view, arguing that management errors are the main determinants of firms' transition to failure. These are portrayed via a number of deficient strategies where firms have, for example, unsustainably high growth levels, or deteriorating performance. On the other hand, the quantitative literature mainly assesses the symptoms of failure. These are the results of the deficient strategies, usually portrayed via financial ratios. The latter are therefore used to identify the alternative firm failure processes. However, despite the focus of the qualitative firm failure process literature on the management characteristics as key elements of the alternative firm failure processes, the quantitative firm failure process literature has not yet included them in the identification of the alternative firm failure processes. In addition, there seems to be a disconnect between the characteristics of the alternative firm failure processes and the determinants of firms' transition to failure. This link has been implied in the qualitative firm failure process literature. Management decisions and characteristics are portrayed in a number of alternative strategies. These are then sufficient to identify alternative firm failure processes. Likewise these characteristics and their associated strategies are implied as being the determinants of firms' failure. However, that link is less clear in the quantitative firm failure literature where the symptoms of the management actions (usually the financial ratios) are used to identify the alternative firm failure processes. Yet, there is little empirical investigation on whether these (or any other) characteristics are also (statistically significant) determinants of firms failure.

Therefore, in order to identify and analyse the presence of alternative firm failure processes between different European SMEs and those in different regions of a country, it is essential that the elements that characterize the firm failure process should be addressed. In line with the quantitative and qualitative firm failure literature, these are firm-specific characteristics, the management of the firm and the effects of the managements' decisions, usually portrayed in financial ratios. In addition, the determinants of firms' transition to failure can include the wider economic and business environment. The following sections elaborate to each of these elements by drawing references from the wider body of firm failure research.

2.3 Definition and Legal Aspects of Failure

2.3.1 Definition of Failure

"Failure" is a term that has been dominant in the literature and has been used to describe both financial distress[3] and any status of liquidation[4] of a firm. In the literature, different authors use different definitions of "failure". A large part of the literature (see for example Peel, 1989; Amendola et al., 2013; Pindado et al., 2008) actually classifies financial distress as "failure". Financial distress is itself a financial condition that doesn't have a clear definition. Generally though, financial distress is considered the situation where the firm has negative equity, that is, its total liabilities exceed its total assets.

Other definitions of "failure" include the formal legal procedure of liquidation and bankruptcy (also known as insolvency procedure) that can be either voluntary

[3] Financial distress is defined as Total Liabilities >Total Assets

[4] This can be for example an active firm undergoing liquidation procedures or a finally liquidated firm.

(decision of a firm's management) or compulsory (creditor or state initiated) (see for example Argenti, 1976; Richardson, 1994, Ooghe and DePrijcker, 2008). Amongst the definitions of "failure", one should be careful with the classification of business exits or closures as "failures". In some cases firm closures for any reason other than financial distress and liquidation problems have been branded as "failure". However, firm closure may happen due to withdrawal of capital from the firm's owners or shareholders. For example, Silviano et al (2010), analyse the determinants of alternative business exits in a Spain. One business exit route was by liquidation/bankruptcy; the other was by acquisition/merger. Clearly, a merger with another firm is not a status where the firm was under financial distress necessarily. As Watson and Everett (1996) mentioned, the closure of a firm may have happened for reasons unrelated to any financial difficulty and therefore firm closures or exits should not be related to failure, at least for the purposes of this study.

The "bankruptcy" definition of failure has been particularly popular in the failure process research but also in failure prediction studies (see for example Altman et al., 2010) but Lin et al., (2012) showed that at least some key financial determinants of firm failure (such as profitability and growth variables) can be common drivers of both financial distress and bankruptcy types of "failure".

Although financial distress is a firm-specific financial situation with no particular legal attributes, the liquidation (or bankruptcy or insolvency)[5] state has a legal aspect which is related to laws and rules of a firm's country of operation. There is limited evidence on the links between alternative definitions of failure. In this thesis, financial distress (defined as negative equity in the financial statements) is a distinct stage of "failure" (the financial distress-related failure) and does not preclude any further deterioration of a firm's financial performance that may lead to the next stage of "failure" that is the liquidation/bankruptcy and includes legal procedures. Liquidation/bankruptcy is therefore a separate and distinct stage of "failure" (the bankruptcy failure) in which the firm is not simply in a potentially temporary financial distress but legal liquidation procedures have begun.

[5] "Bankruptcy" and "Liquidation" are used interchangeably together with "Insolvency" as different countries are using these terminologies to denote the same outcome.

As it is explained in the following section, some countries may have more than one insolvency procedure. However, the dataset for the European countries classifies any bankruptcy-related failures under the same (bankruptcy) failure classification, possibly in order to simplify facts and to make the data across countries more easily comparable. Therefore, in this study there are two states of "failure", namely financial distress (defined as total liabilities being greater than total assets) and the bankruptcy/liquidation. It is worth noting that the financial distress-related failure is a state that does not necessarily lead to the bankruptcy-related failure as the firm under financial distress may overcome the financial distress through increasing its assets or decreasing its liabilities in subsequent years and become financially healthy again. Additionally the failure process research has not considered the financial distress as a stage of failure despite parts of the failure events literature doing so. It is therefore, important to establish the link between failure process and the alternative stages of failure defined as the financial distress and the bankruptcy/liquidation.

Although the bankruptcy/liquidation state of failure will effectively have the same treatment across all countries, it is worth considering the legislation that applies in the countries under consideration.

2.3.2 Insolvency Procedures of Countries

Firm failure includes an element of legal procedure when we are discussing the liquidation/bankruptcies in different countries. This is known as the insolvency procedure. In fact, each country has different insolvency procedures and stages so as to finally liquidate a firm. Generally, liquidations in many countries can be debtor initiated (when the company's directors are initiating the liquidation procedures) or compulsory (when creditors are initiating the liquidation procedure). Liquidation of any sort (voluntary or compulsory) can all be part of a country's insolvency procedures and legislation. Therefore, the legal context in different countries may be linked with the failure process. In fact, Balcaen et al., (2012) provided evidence that 41% of financially distressed firms faced exit from doing business through court-driven procedures whereas Daskalakis and Psillaki (2008) stressed the relevance of bankruptcy and insolvency procedures to the risk-taking of behavior when researching a sample of French and Greek SMEs. Every country has different insolvency procedures and legislation that may change periodically. The current legislation for each of the sample's countries is presented below.

i) Spain

The Spanish bankruptcy system was based on the 22/2003 insolvency act (Ley Concursal) where both the creditors and the debtors can initiate the insolvency proceedings and there was one insolvency system for both individuals and firms until 2013. Therefore, this is the period that covers the vast majority of the data sample which has entries, until December 2013. In 2013 8,934 Spanish companies went bankrupt, up from 14% in 2012.

Until 2013 there is evidence suggesting that bankruptcy costs were high and complex as well as uncertain (Garcia-Posada and Mora-Sanguinetti, 2014). Data from the Doing Business (2015) index reveal that these costs may account for up to 15% of the firm's total assets while the median duration of the bankruptcy procedure lasted for up to 23 months before the financial crisis (Van Hemmen, 2008) and up to 48 months in 2011 (Ven Hemmen, 2012). In addition the law does not provide any debt relief for any individuals who are self-employed or small limited-liability firm owners that have given personal guarantees for loans to their firms in order to obtain funding for their businesses. Therefore, there is little incentive for small firm owners to file for bankruptcy. In late 2013 there has been a legislative change that came into effect with the 11/2014 law which introduces some limitations on the liability of the entrepreneur or the self-employed individual. According to this change up to 300m Euros invested in the primary property of home residence of the firm owner could be exempted in the case of insolvency. Moreover, the entrepreneur may be discharged from any previous debts that belong to a pre-bankruptcy era until the new legislation established a new insolvency procedure coordinated by a public administrator. If this process fails then judicial procedure will follow.

Additionally, according to Garcia-Posada and Mora-Sanguinetti, (2014) the limited liability principle, meaning that the debtor is legally partially or fully released from his debts, is generally not applicable to Spain. Finally, post-2013 there have been some legislative changes that extends from one to three the minimum number of loan repayments that should be missed before the foreclosure procedure can start and allows a two year suspension of the evictions of the debtors when they are considered vulnerable (Garcia-Posada and Mora-Sanguinetti, 2014 The data of the study include only one category of "bankruptcy" failed firms (apart from the financial distress state of failure).

ii) France

French law states that in order for insolvency proceedings to begin, it should be impossible for a debtor to meet the current liabilities with the available assets of the firm (European Commission. European Judicial Network, 2004). French legislation has effectively two treatments for insolvency situations. The first (redressement judiciaire) relates to the business and all the legal parties. For this category, the proceedings involve a judicial settlement and a winding-up procedure. The second insolvency situation is for natural persons only. However, according to (Garcia-Posada and Mora-Sanguinetti, 2014) small business owners and self-employed may have incentives to file for bankruptcy due to the discharge of a firm's debt that they may have as owner. Before any judicial settlement for businesses, French law provides an informal restructuring procedure where, if a business enters a period of financial distress in which it can still meet its obligations to the creditors, it can ask for the initiation of an amicable settlement procedure which may not last more than three months subject to agreement with the president of the court (European Commission. European Judicial Network, 2004). During this period a conciliator is appointed by the court to try to reach settlement with the creditors. For the formal proceedings, the French systems has two options of a judicial settlement and a winding up. The judicial settlement is aiming at maintaining the business and jobs and clearing the liabilities (European Commission. European Judicial Network, 2004).

According to the European Commission, European Judicial Network (2004, online), "*the proceedings consist of the adoption by the court of a judicial settlement plan either involving the continuation of the undertaking (creditors are obliged to accept certain deadlines) or the transfer of the business (the undertaking and its main contracts are sold to a third party who accepts certain commitments*)". When judicial settlement is impossible then a winding-up is declared and "*the company's business is halted or sold to a third party in line with more flexible arrangements* *than in the judicial settlement procedure*" (European Commission. European Judicial Network, 2004, online). The insolvency law of France was amended in March 2014. However, this falls beyond the period that this study covers.

French proceedings have been characterized as relatively cost effective (direct costs of around 9% of total assets) and the average duration has been estimated at 14 months (Garcia-Posada and Mora-Sanguinetti, 2014). There were 60,787 business bankruptcies in 2013 in France, 2.1% above the 2012 numbers.

iii) Netherlands

In the Netherlands the three different types of insolvency proceedings are bankruptcy, moratorium and debt restructuring, all of which are judicial proceedings. The Dutch Bankruptcy Act has its roots in the Bankruptcy Code (Faillissementswet) of 1896 and changed in 2014. In the case of bankruptcy, the debtor (which can be a company or an individual) should be unable to service its debts. In the case of a moratorium, the firms' directors should foresee that there will be a problem in meeting their financial obligations and the scope of this procedure is to allow the debtor a temporary debt relief in order to achieve a reorganization of the business. In Dutch law, the emphasis is focused on the satisfaction of the creditors' claims as opposed to the debt relief of the debtor so as to achieve a "fresh re-start" (Claassens and Klapper, 2005). Suspension of payments under a moratorium agreement can lead to bankruptcy procedure, if it becomes obvious that the debtor cannot satisfy the creditors' claims. Bankruptcy can be initiated by any creditors (compulsory), by the debtor (voluntary) or by the public prosecutor in special cases.

The Dutch courts require the debtor to have at least two creditors and at least one debt should be due and payable. If the petition for bankruptcy is granted the court appoints a trustee and a judge to supervise the trustee's actions. The trustee should establish together with the judge whether any part of the firm should remain temporarily in operation and this can only be allowed if there is no detrimental impact on the creditors (Claassens and Klapper, 2005). If the business is not continued, the trustee may sell the assets and liquidate the company. The number of bankruptcies in the Netherlands in 2013 was 9,456, a 9.7% increase from the 2012 equivalent.

iv) Italy

The main source of the Italian Insolvency law is the insolvency act of 1942 (16-3-1942,n. 267, "Legge Fallimentare"). The act involves three different insolvency procedures of bankruptcy, involving a compulsory administrative liquidation, a bankruptcy agreement, and a pre-bankruptcy agreement with extraordinary administration proceedings (Prodi's or Marzano's). Prodi's and Marzano's administration proceedings as well as the pre-bankruptcy agreement form essentially a restructuring process on the basis of a "going concern" (Bisogno, 2012; Mendola and Pappalardo, 2015). A firm may be considered for insolvency procedures if it is unable to fulfil its obligations and also when the debtor sells some of the company's assets below their value so as to obtain cash or when the debtor pays its creditors by means other than cash (in kind payments).

From the different insolvency processes the firm may be placed in to bankruptcy if its annual assets were more than €300,000 or its revenues were more than €200,000 in the last three years before a petition for bankruptcy started or if there are more than €500,000 of debt. The compulsory administrative liquidation process can start if the firm is insolvent. A pre-bankruptcy agreement may be considered if the debtor is in crisis or proposes to creditors a plan that includes restructuring of debts and repayment with any possible means (including sales of assets). The plan should also categorise the creditors into different categories according to their legal status and have different treatment for the creditors according to their legal status (Mendola and Pappalardo, 2015).

Bankruptcy agreement may occur if during the bankruptcy process one or more creditors propose a plan that includes the characteristics of the pre-bankruptcy agreement. The extraordinary administration procedures may be relevant to firms with more than 200 (Prodi's) or 500 (Marzano's) employees and total indebtedness of more than €300,000 (Marzano's) and the business can be preserved and restructured within 2 years. There had been 14,272 bankruptcies in Italy within 2013. This represents a 15% increase compared to 2012 numbers.

v) United Kingdom (UK)

The Insolvency procedures in the UK are based in the Insolvency Act 1986 with some amendments in the Insolvency Act 2000 and the Enterprise Act 2002. In the UK there are pre-insolvency proceedings in which firms may enter into formal arrangements with their creditors to accept less than the full amount they are owed, such arrangements are not binding and there is no obligation for creditors to accept an arrangement (European Commission. European Judicial Network, 2004). For businesses, the three different insolvency procedures are administration, administrative receivership and liquidation (winding-up) which can be either compulsory or voluntary. The insolvency procedures are broadly similar between England & Wales and Scotland.

The administration procedure should "*rescue the company as a going concern*"; "*achieve a better result for creditors than if the company were wound up*"; "*realise property to make a distribution to one or more secured or preferential creditors*" (European Commission. European Judicial Network, 2004, online).

In the case of the administrative receivership, or administration since the Enterprise Act 2002, "*an insolvency practitioner is appointed by the holder of security under a floating charge that covers the whole or substantially the whole of the company's assets. A floating charge is one that does not give the charge holder any immediate right in rem*[6] *over the assets covered by the charge. The company is free to deal with the charged assets until such time as the charge crystallises. The administrative receiver's task is to realize those assets on behalf of the charge holder and is primarily answerable only to the appointing floating charge holder*" (European Commission. European Judicial Network, 2004, online).

Administration is the most common insolvency procedure for SMEs in the United Kingdom and it is usually initiated by a secured creditor who appoints the "administrative receiver" with the purpose to liquidate the firm's assets so the debt can be repaid to the benefit of all creditors (Davydenko and Franks, 2008).

[6] Claim "in rem" is a term used to describe the rights to dispose an asset and obtain satisfaction from the proceeds.

Finally, liquidation "*involves the realization and distribution of a company's assets and usually the closing down of the business. There are three types of liquidation: Compulsory – where the court makes a winding-up order on the application of, usually, a creditor; Creditor's Voluntary – where the company is insolvent and decides to wind itself up; and Member's Voluntary – where the company is solvent and decides to wind itself up*" (European Commission. European Judicial Network, 2004, online). There have been 16,013 insolvencies in 2013 in the UK compared to 17,765 in 2012.

vi) Germany

Germany has one insolvency procedure for firms that tries to achieve an "*equal satisfaction of the creditors*" (European Commission. European Judicial Network, 2004, online). Any procedures are based around the Insolvency Statute of 5 October 1994 as amended by the Act of 20 December 2011. The inability to make payment and evidence of over-indebtedness can be sufficient grounds to initiate any insolvency proceedings. The definition of over-indebtedness is where the assets of the debtor cannot cover the obligations. It is up to the creditor to provide evidence that the grounds of insolvency exist and that he owns a claim against the debtor (European Commission. European Judicial Network, 2004). Moreover, "*it is necessary for the financing of the insolvency proceedings to be secured. The application to open proceedings is therefore rejected if the debtor's assets are unlikely to be sufficient to cover the costs of the proceedings (first sentence of Section 26(1) InsO)*" (European Commission. European Judicial Network, 2004, online). The whole insolvency procedure is monitored from the insolvency court which appoints an insolvency administrator.

Creditors have also significant influence over the insolvency proceedings and the regulations also have provisions for creditors' meetings with the main purpose to decide the process for realizing the assets. The creditors' meeting is convened and conducted by the insolvency court and consideration is given to whether a business should close down or if it should temporarily continue to be operated by the debtor (European Commission. European Judicial Network, 2004). Based on these decisions an insolvency scheme is submitted. If no insolvency scheme is submitted, the administrator can realize the assets of the firm so as to distribute the funds to the creditors. The administrator can also decide if it is optimum to sell the whole business or to break it up and sell off the separate parts. Germany realized 26,120 insolvencies in 2013 compared to 28,720 in 2012.

vii) Ireland

In Ireland there are three key mechanisms related to companies' insolvency, namely, liquidation, examinership and receivership (Companies Act (Ireland), 1990; Tiernan and Benson, 2009). Liquidation is governed by the Irish Companies Act (1963) and its aim is to liquidate a company's assets so as to pay the creditors and dissolve the company. Liquidation can be voluntary (members' liquidation) when the company is solvent and is winding down due to other reasons; a creditors' voluntary liquidation is when the company is insolvent and a court liquidation is where creditors apply to the court seeking the winding-up of the company due to the company's inability to service its debts. In the case of a creditors' voluntary winding-up, the process typically starts by a creditor in an effort to prompt the company's directors to start the winding-up process in situations where the firm cannot service its liabilities and it is insolvent.

A key difference between the court and the creditors' voluntary liquidation is that in the second case, the creditors are in control of the liquidation process as opposed to the court (which is the case in the court liquidation). In the creditors' voluntary liquidation the creditors may appoint an alternative liquidator in place of the one appointed by the firms' shareholders (Tiernan and Benson, 2009). Irrespective of who is appointed as the liquidator, his/her main role is to identify and take control of the company's assets and liquidate them in order to satisfy the company's creditors. In both the court and creditors' voluntary liquidation, unless there are secured creditors that can directly rely on the security, the creditors must prove the legality of their claims and they may appoint a receiver to take control of the creditors' potential fixed charges and their claims.

Under Irish law, examinership can be an alternative to liquidation (Companies Act, 1990). Under the examinership condition, the firm is given 100 days in which a court official (the examiner) takes control of the company in order to make it fit to continue to trade (Tiernan and Benson, 2009). The examinership can be initiated by either the company's directors or its creditors.

Finally the receivership is relevant to secured creditors where a receiver is appointed by the court to take control of the company's assets "*with a view to ensuring the repayment of the debt owed to the debenture holder, either through receiving income or realising the value of the charged asset*" (Tiernan and Benson, 2009, p.7). In receivership the receiver-manager appointed by a debenture-holder is the most usual approach (Tiernan and Benson, 2009). Company insolvencies decreased by 18.9% in 2013 reaching a total of 1,365 firms.

viii) Sweden

"*Insolvency is defined in the Swedish Bankruptcy Act (1987:672) as being unable to pay one's debts in a proper manner where such inability is not temporary. Persons who are insolvent can be declared bankrupt (i konkurs) irrespective of whether they are legal or natural persons*" (European Commission. European Judicial Network, 2004). Bankruptcy in Sweden is a judicial procedure and is administered by the receiver who is in charge of selling the debtors' assets and protecting the creditors' common rights. However, both businesses and individuals can take advantage of voluntary arrangements with creditors which are not specially regulated. Moreover, and as an alternative to bankruptcy, businesses can apply for reorganization under the company Reorganization Act (1996:764) if they can demonstrate that they are unable to re-pay their debts and if the reorganization can achieve the purpose of securing the continued operations of the business (European Commission. European Judicial Network, 2004). In either of the two procedures (reorganization or bankruptcy), an agreement should be reached with the creditors concerning the amount of the debt that will be repaid. This agreements could be on a voluntary basis or can be enforced by the court.

The insolvency procedures above seem to have certain similarities in the routes that are available to a troubled firm. In particular, in most countries there are alternative procedures that business could follow depending on their circumstances. Additionally personal bankruptcy procedures may also be relevant for SMEs partly because creditors and financial institutions require personal guarantees when lending to SMEs (Claessens and Klapper, 2005). There were 8,015 Swedish firms' insolvencies in 2013, representing a 3.6% increase compared to 2012.

ix) Overview, Discussion and Critique

In general, the particular procedures that apply in each insolvency process in each country vary in the detail[7]. For example, France's insolvency process was deemed relatively unfriendly to creditors and the state is heavily involved in the procedure by imposing court-administered process with the main interest of keeping the business as a going process and maintain employment (Davydenko and Franks, 2008) with the informal restructuring process being an exception to this rule. At the same time, under the French process, the creditors have a secondary (advisory) role in the insolvency process and liquidating the assets to the highest bidder is not the priority of the court (Davydenko and Franks, 2008).

On the other hand, the insolvency procedures of the United Kingdom appear to be more creditor oriented and less court-driven since the court-driven procedures provided by the state can be vetoed by the creditors (Davydenko and Franks, 2008) and therefore creditors' rights appear to be more effectively protected (Blazy et al., 2013). Ireland's insolvency procedures seem also broadly similar to those of the U.K. Germany's single insolvency procedure, appears to be in the middle ground between the United Kingdom and the French system since Germany's insolvency procedure with court-driven, state-imposed insolvency gives creditors' significant control over the process but they cannot strip-out completely the firm from its necessary assets while going concern status is still important (Davydenko and Franks, 2008). France and Germany have nevertheless in common the requirement of collective procedures between creditors and courts and the requirement for court-supervision whereas the United Kingdom's insolvency process does not require any of them (Davydenko and Franks, 2008).

All the alternative legal procedures above are grouped into the "bankruptcy" failure state of the data that this study uses. Some of the above similarities and differences of the insolvency procedures can be summarized in collective groups of countries with similar, though not identical, characteristics. These can assist in the extraction of valuable information relating to the legal aspect of the business environment in the countries under consideration. This can be helpful as the discussion above reveals that some countries have amended their insolvency

[7] All the "failure" stages in the insolvency procedures above are included in the "bankruptcy failure" state of the dataset.

procedures within the period that this study covers whereas other countries amended their insolvency procedures just after the period that this study covers. The legal origins can therefore be used for this purpose.

2.3.3 Legal Origins

The possibility of organizing the countries under consideration into groups of one or more than one that share at least some common elements in their legislation with long standing effects can be beneficial. This is because the particulars of an insolvency procedure in a country may change but the underlying philosophy of its legal system is much more difficult to alter and it is considered (together with the legislation itself) as an integral part of the business environment whose contribution to firm failure has been well established both in failure event studies as well as in failure process studies.

The literature on legal origins demonstrates a link between the origins of a country's legislation and its application and it is therefore used as an analytical tool. The details around the insolvency procedures mentioned above, seem to conclude that separate elements of the insolvency procedures of different countries may have some impact on the actual insolvency outcome and the time required. However, the literature suggests that the individual countries' insolvency procedures can be grouped into certain categories based on their legal origins. In fact, current legislation (including legislation around insolvencies) in any country is related to, and influenced by, the country's legal origins (La Porta et al., 1997; La Porta et al., 1998) and there is evidence from the empirical literature that, by controlling for a country's legal origins, certain idiosyncrasies arising from a country's insolvency procedures (such as the power of creditors' rights) are accounted for (La Porta et al., 1997). Likewise, Wang (2012) provided evidence from 30 countries across the world showing that the legal origin of a country's bankruptcy code was an important factor in determining if the firm will be liquidated once it was under distress or if other actions would be taken to avoid liquidation.

Legal origin is the terminology used in order to describe the origins of the legal systems of different countries. The literature identifies four legal origins namely, the English, the German, the French and the Scandinavian (La Porta et al., 1997). The English legal origin is common law made by judges and subsequently incorporated in the country's legislation (La Porta et al., 1997). On the other hand, French, German and Scandinavian law are legislator-sourced and follow the civil law tradition which can trace its roots back to Roman law (La Porta et al., 1997). It is believed that most countries have adopted their legal systems through occupation or colonization (La Porta et al., 1997).

From the countries under consideration in this study, France, Spain, Netherlands are classified as having adopted the French legal origin while the United Kingdom and Ireland are classified under English common law. Germany has its own legal origin which has similar Roman law roots as the French tradition but it has greater judicial law-making (La Porta et al., 2008). Sweden follows Scandinavian legal origin that is considered as part of civil law origins (as are German and French) but has the characteristic of being more distinct from other civil law traditions (La Porta et al., 2006). Italy, on the other hand, is classified by legal scholars under the French law tradition but it does also have German law tradition influences (La Porta et al., 1998). Therefore, considering the EU countries that this thesis analyses, one can summarise that common law is associated with the United Kingdom and the Republic of Ireland and the Roman-based civil law legal tradition is associated with France, Germany, Spain, Italy, Sweden and the Netherlands.

Each legal origin has some particular characteristics that apply, to some extent at least, to the legislation (and consequently the insolvency procedures) of the countries that have adopted it. Countries with civil law origins have weaker investor and creditor protection, compared to common law countries (La Porta et al., 1998). From the civil law countries, those with French origin tend to have the weakest creditors protection and they have the most state-dependent procedures while the civil law countries of German and Scandinavian origins seem to be somewhere between the French and the common law origin (La Porta et al., 1998; La Porta et al., 2008). This is in line with the critical observation that the insolvency procedures in France tend to be much more state-driven (through courts) compared to the U.K. where insolvency procedures are much more creditor-driven (also through courts) with the German and Swedish procedures being somewhere in the middle. The legal origins also appear to influence, and to be connected with, the legislation and the regulations of each country and consequently to dictate creditors' protection and the power of law enforcement (La Porta et al., 2008). Most importantly, evidence from the literature suggests that legal origins are related to historic economic impact (Sgard, 2008; La Porta et al., 2008) whereas insolvency procedures in particular, tend to be linked to the economic growth of a country where overly punitive legislation may deter entrepreneurs from investing in new ventures (Succurro, 2010).

Additionally, literature evidence suggests that the quality of law enforcement is highest under the Scandinavian and German tradition, followed by the common law origins with the French tradition being the (comparatively) lowest in the ranks (La Porta et al., 1998). However, for insolvency procedures, evidence suggests that the common law countries tend to have more efficient judicial systems which may result in more successful reorganization processes compared to countries with German and French legal origins (Wang, 2012). This is to some extent supported by World Bank data which show that common law countries (such as the UK, Ireland, Canada) have the fastest insolvency resolving times.

2.3.4 Evaluation Overview and Hypothesis

To conclude, the insolvency legislation has always been considered as an important factor in resolving firms' financial distress (Gutierrez et al., 2012) and failure. Moreover, there is sufficient evidence from the literature which supports the argument that, while there may be differences in the details of the insolvency legislation between countries, there are also some common underlying characteristics that can be described under the term of *legal origins* (see for example LaPorta et al., 1998; Glaeser and Shleifer, 2002; Sgard, 2006). Legal origins are effectively the underlying legal traditions that have been carried over the years and have influenced countries' legislation and consequently economic outcomes. This statement is supported by the observation of analyzing the insolvency procedures of the countries under consideration. It has been well established and it is evident from the discussion above that countries that follow the common law origin are more creditor friendly and less state-driven and have been viewed as "market-friendly" whereas civil law countries are more state-driven with the French legal origin being the most state-driven and the Scandinavian and

German legal origins being in the middle ground between the common law countries and the French.

One can therefore argue that legal origins are effectively part of a country's business environment and as such they may affect the firm failure process of firms that are operating in these countries despite that they are not a firm-specific characteristic, used to identify the processes. This is also implied because there appears to be an observed correlation between the legal origins and the time to resolve insolvency. In the context of alternative firm failure processes within the sample of EU countries this thesis proceeds with the following hypothesis:

Hypothesis 1: *Countries' legal origins differ between firms in the alternative failure processes in the EU countries under consideration; they are also determinants of firms' transition to failure.*

2.4 Financial and Economic Drivers of Firm Failure

As mentioned in the previous section, there are two main approaches of research in firm failure studies, namely the failure events approach, as expressed in the failure prediction studies, and the firm failure process approach, as expressed in the failure process literature. In addition, wider firm failure studies that consider certain determinants of firms' failure exist. One can argue that these studies consist of a third approach which, however, see the firm failure as an event. Elements of the individual determinants of failure will be examined in the general literature that considers the determinants of firm failures. Both approaches are trying to identify the key determinants that can predict or explain firm failures. It is worth remembering that the failure events literature considers financial ratios and other similar metrics as determinants of failure whereas the qualitative firm failure process approach considers management characteristics (discussed in the next section) and other firm-specific characteristics as well as the environment as part of the failure path. This section deals with the financial and other firm-specific metrics that have been identified as failure determinants in any of the failure pillars.

Most of the current literature is focused on specific countries. Some inter-country comparisons have only recently been researched in the literature and any inferences from inter-country comparisons are linked to firm performance or firm exit from the business. Such examples are however, briefly mentioned so as to assist with inferences and hypothesis formulation. The few examples of inter-country comparisons directly linked to small firms are between countries that have been researched on a stand-alone basis, such as the U.S. and the U.K. (see Altman et al., 2010 as an example). This section will therefore present evidence on the reasons why inter-country comparisons for business failure processes appears to be a significant matter. Key differences between key stand-alone firm failures studies will also be presented.

2.4.1 Firm-Specific Financial Characteristics

i) The Size and the Sector of the Firm

The size of the firm has been associated with firm failure. In fact, Gupta et al (2014) employed the definition provided by the European Union to distinguish between 'micro', 'small' and 'medium' sized firms and used both financial and nonfinancial information to predict a firm's failure hazard and concluded that the size of the firms can be an important determinant of failure as 'micro' firms tend to be different than the rest of the SMEs. However, the importance of a firm's size has been further linked with firm failure when it is combined with the sector classification and the return on assets and cash ratio in Spain as well (Camacho-Minano et al., 2015). In other words, size appears to be sector-specific where the norms of some sectors may be (on average) larger firms. The size of the firm appears also to be country-specific to some extend as evidence from Italy suggested that within the medium sized firm sector, the size of the firm can be positively associated with a firm being unable to repay its loan obligations (Bottazzi et al., 2011), evidence that contrasts with other findings that suggest that the size of the firm is negatively associated with failure in the UK (see for example Altman et al., 2010).

The industry of a firm itself has been also seen as an important determinant of business failure. Different industries have different business cycles and the financial structure of the firms operating in them tends to be materially different.

From the failure prediction literature, the industry of the firm (and in particular of the small firm) was one of the first non-financial variables that entered failure prediction models (see for example, Watson and Everett, 1999). Literature suggests that the manufacturing sector tends to have the highest bankruptcy rates partly due to the capital commitment it requires (Watson and Everett, 1999) with service businesses and retail to follow (Lowe et al., 1991).

Platt (1989), produced modelling evidence at an industry level from a sample of US firms of all sizes. 16 Industries participated in that research covering most of the possible sectors. That was useful since different industries have different averages for financial ratios Platt (1989) and that resulted in modelling approaches with greater overall predictive accuracy. Most importantly that study highlighted the fact that failure rates depend also on industry financial conditions and on the state of the economy and that firm failure rates in vertically associated industries[8] may be correlated. Similarly, further evidence suggested that industry-adjusted financial ratios could be better predictors of firm failure at industry level, when the calculation of these ratios is possible (Platt and Platt, 1991). The industry-adjusted ratios that Platt and Platt (1991) used were Cash Flow to Sales (also multiplied by the Industry output), Fixed assets to Total Assets, Total Debt to Total Assets (also multiplied with the Industry output), Short Term Debt to Total Debt and Sales Growth. From these ratios the Cash Flow to Sales was the only one that had a negative relationship with the failure propensity as the decreasing ability of a firm to generate sufficient cash from its sales can have an impact on its self-financing.

In the wider SME failure literature, there is evidence from Italy that shows defaulted firms are less profitable than their industry peers for a number of years before any default occurs, making it an important determinant of default in their loan obligations (Bottazzi et al., 2011) and potentially leading to firm failure. Moreover, firm failure in different industries within the same country have found to have different failure processes within a sample of Italian firms because apart from the country-specific economic conditions, there appear to be industry-specific "distress-cycles" (Zeli, 2014).

[8] Platt (1989) defines vertically associated industries the industries that have buying/selling relationships.

Critically evaluating the evidence from the above studies, one can conclude that the industry classification of a firm could affect firm failure. In addition to a number of firm-specific characteristics such as the financial ratios' performance or the impact of human capital in a firm (Platt and Platt, 1991; Laing and Weir, 1999) which all affect firms' performance and failure, industry can be a significant characteristic to control for. In addition, one can assume that since the industry classification of the firm affects firm failure, in may also be a determinant of firms' failure in alternative firm failure processes. Critically, there is little evidence in the quantitative firm failure process literature to suggest whether the industry classification of the firm differs in any alternative firm failure processes, especially in a multi-country analysis because a number of studies are sector-specific (see for example Laitinen et al., 2015; Lukason and Laitinen, 2016; Lukason et al., 2016). As such, this thesis proposes the following hypothesis to be tested:

Hypothesis 2: *Industry classification differs between firms in the alternative firm failure processes in EU firms; it also differs as a determinant of firms' transition to failure in the alternative firm failure processes.*

ii) Financial Ratios and the Age of the Firm

Firms' financial ratios and the age of the firm represent elements of firm-specific quantitative information which is distinguished from firm-specific qualitative information, such as firms' director characteristics. From the financial perspective, the capital structure, firms' financing and the financial performance have been related to SMEs' failure. Likewise, insolvency and its costs are amongst the important determinants of SMEs' capital structure (Michaelas et al., 1999). Low levels of capital has been seen as a factor affecting firm failure. However, it is often difficult to prove if this is caused by management's inability to predict the capital needs of the firm (Hall, 1992). Philosophov and Philosophov (2005) found that the chances of a firm going bankrupt depend not only on its debt to equity ratio but also on its debt maturity and quality. Moreover, evidence in the literature suggests that small firms are reliant to a certain extent on bank credit and trade credit (Cressy and Olofsson, 1997; Berger and Udell, 2006). As a result, inadequate access to bank credit can lead smaller firms, whose owners tend to borrow from friends and family, to consider alternative sources of finance (Bitzenis and Nito, 2005). Financial distress or severe credit restrictions are negatively related to the size of the firm (Calomiris and Hubbard, 1990; Lopez-Gracia, Aybar-Arias, 2000) with SMEs suffering the most. This is in line with findings from the failure prediction literature around the role of firm financing and trade credit in small business failure (Altman et al., 2010).

In fact, most of the literature on the financial characteristics of failed firms is derived from, or related to, the failure prediction literature. Failure prediction studies aimed to capture the financial characteristics described above so as to predict firm failure. In the context of this study, this is significant in the identification of the key financial measures that can be determinants of firms' transition to failure in quantitative analysis. Additionally, these characteristics can be beneficial to help identify the alternative firm failure processes.

Originally, most of the research in this area was based around large and usually stock exchange listed firms. From the early works of Beaver (1966) and Altman (1968), evidence showed that business financial characteristics, expressed in the form of financial ratios, are closely related to firm failure and can therefore be used to assess a firm's propensity to fail. Despite the fact that most of the literature used financial ratios as predictors of failure, it has become clear that financial ratios can at least provide information on the financial condition of the company. However, there has been no specific consensus regarding how financial ratios most effectively mirror a firm's financial health. Some of the most commonly used ratios appear to be the *Total Liabilities to Total Assets ratio* and *the working capital to total assets ratio*, which are mentioned in a number of research papers (see for example, Beaver, 1966; Altman, 1968, Deakin, 1972, Ohlson, 1980; Gloubos and Grammatikos, 1988; Altman et al., 2010; Wu et al., 2010; Lin et al., 2012). The *Total liabilities to Total Assets ratio* is expected to have a positive relationship with the probabilities of failure. On the other hand, the *Working Capital to Total Assets* ratio is expected to have a negative relationship with the probabilities of failure; that is, the lower the ratio, the higher the propensity for failure as firms do not have sufficient levels of working capital to finance the asset side of their balance sheet.

The typical model inputs included various combinations of financial ratios whose aim is to account for financial-related, firm-specific characteristics. For example, Taffler's (1983) model, which was one of the first models to consider companies in the United Kingdom, used financial ratios which cover the areas of profitability (*Profit before Tax to Current Liabilities*), working capital (*Current Assets to Total Liabilities*), financial risk (*Current Liabilities to Total Assets*) and liquidity (*Quick assets-Current Liabilities to Daily Operating Expenses*) of which only the financial risk ratio was positively related with the probability of failure. However, Taffler's (1983) model was mostly build for manufacturing companies as Altman's (1968) z-score did.

However, despite extensive corporate failure research, the equivalent research that dealt with SMEs has been less wide-ranging. This has happened despite early evidence from U.S. firms which showed that the application of similar types of technique using financial ratios is possible (though more difficult) in small firm failure by using a longer period with financial information (Edmister, 1972). Keasey and Watson (1986) also tried a modelling approach in the U.K. but their results were similar to that of Edmister (1972) in recognizing difficulties in modelling SMEs failure due to the nature of the firms. In terms of the financial ratio selection for SME failure, Pindado and Rodrigues (2004) concluded that the best way to quantitatively analyse and model SME financial ratios against failure is to have a parsimonious model with few financial ratios that can be interpreted in the light of financial theory. This was a requirement that most research that focused on failure prediction did not apply. Pindado and Rodrigues, (2004) included Interest Charges/Total Income, a ratio that has been positively associated with firm failure, Return on Assets and Accumulated Earning/Total Assets (both negatively associated with firm failure) as financial ratios while their analysis considered Spanish SMEs.

Likewise, Atlman and Sabato (2007) provided evidence that financial ratios can be used as predictive determinants of SME failures in the USA whereas Altman et al (2010) expanded the research into U.K. SMEs and found evidence that trade credit payments behavior can be a significant predictor among age of the firm, sector and audit reports. In terms of the traditional financial ratios, Altman et al (2010) included Cash/Total Assets, EBITDA/Total Assets , EBITDA/Interest Paid, Retained Earning /Total Assets and Short Term Debt/Equity in one version of their model and Capital Employed / Total Liabilities, Current Assets/ Current Liabilities, Trade

Creditors/ Total Liabilities, Trade debtors/ Total Assets, Cash/ Total Assets, Retained Profit/ Total Assets, Quick Assets/ Current Assets, Total Liabilities/ Quick Assets, Trade Creditors / Total Liabilities, Inventory/ Working Capital, Net Cash/ Net Worth, Short Term Debt/ Net Worth together with credit bureau data in a second version of their model aiming at medium sized firms.

However, the Altman et al., (2010) approach is not as parsimonious as the one that Pindado and Rodrigues (2004) suggested but is in line with most of the modelling literature, the focus of which is to try alternative combinations of ratios. Such an approach highlights the criticism that the failure prediction literature lacks a sufficient theoretical framework in the selection of its financial ratios (Platt, 1989; Pindado and Rodrigues, 2004; Crutzen and Caillie, 2008).

More recent evidence did provide some links between financial ratios and the finance literature. For example, Wilson and Altanlar (2013) noticed that firms which have relatively high total asset figures in their first annual accounts tend to fail more frequently and they interpreted this as a sign that undercapitalized firms or firms unable to attract capital investment dissolve without insolvency proceedings. On the other hand, larger firms have higher insolvency risks due to the fact that there is more pressure from creditors. Non-insolvency related dissolutions are not regarded as failure but they are regarded just as critical for the year of dissolution.

Non-financial information in Wilson's and Altanlar's (2013) study included County Court Judgements (CCJs). Charges on company's assets (from creditors) were also taken into consideration together with late filings of accounts as they are considered indicators of financial distress. Interestingly for the purpose of our study, regional location was also taken into consideration by using the company's address and thus its UK region. Moreover, both Altman et al., (2010) as well as Wilson and Altanlar, (2013) noted that newly incorporated (young) firms and very small firms have too few, or not any financial data and some fail without have any filings of financial information.

For cross-country comparisons, Laitinen and Suvas (2013) and Wang (2012) analysed the predictability of financial distress in different European countries

(Laitinen and Suvas, 2013) and compared it across countries (Wang, 2012) by using a fairly simplistic analytical approach of cross-section logistic regression. Likewise, Ferreira Filipe et al. (2014) performed a comparison between European firms, including country-specific effects from the Czech Republic, France, Germany, Italy, Poland, Portugal, Spain and the UK. The authors split their distressed population into two categories (healthy and distressed) where the distressed situation is defined as the case where firms have final financial statements before it leaves the sample and the status of the firm is defined as "in receivership", "bankrupt" or "in liquidation". Furthermore, for cases where there is no status information, Ferreira Filipe et al., (2014) consider as "distressed" cases where the firm left the sample by having negative equity in the last year with available information. These definitions are similar to this project's approach.

The conclusions of Ferreira Filipe et al., (2014) were that SMEs in different European regions and countries are exposed to different systematic factors according to region-specific conditions and characteristics while SMEs themselves are vulnerable to the same idiosyncratic factors (profitability, coverage, leverage, cash flow). This ties in well with the evidence from failure prediction studies as despite the lack of agreement on the precise selection of financial ratios, in most cases the selected ratios are measuring profitability, leverage and cash flow.

Despite the limitations of Ferreira Filipe et al., (2014) research due to their simplified methodology (cross-section logistic regression), their evidence is important. This is because firms' idiosyncratic (financial) factors that they found as important determinants have been reflected in earlier country-specific literature on financial ratios. Moreover, a key finding of this research has been the notion that idiosyncratic factors are relatively stable over time but systematic factors are more volatile according to macroeconomic conditions. However, in addition to any financial ratios, Ferreira Filipe et al (2014) mentioned some governance related characteristics that are of particular importance as failure determinants.
The economic and business environment, including the local legislation and culture directly affect the characteristics of the failure event while differences in accounting practices jeopardize the ability of the financial predictors to reflect these characteristics in an identical way. This is a comment which is in line with the argument of Choi and Levich, (1991) that accounting practices can alone

destroy international comparability between firms. However, the fact that the research of Laitinen and Suvas (2013) used only financial ratios exaggerated the problem of dependency on the specific type of information. Perhaps most importantly, their paper was not restricted to SMEs. In fact, smaller firms were excluded from the analysis as the authors argued that financial information alone is not sufficient for the very small firms (Laitinen and Suvas, 2013) and therefore any outcomes from their research are fairly generic in nature.

Hall et al., (2004) and Daskalakis and Psillaki, (2008) argued that SMEs' financial structure, while influenced by firm specific-characteristics, is also impacted by country-specific characteristics. Such characteristics can be differences in taxation and the relationship with banks that is the norm in a country, as well as the wider economic and cultural-related issues that cannot be measured directly. Similarly countries with high investment to GDP ratios appeared to have highly efficient bankruptcy procedures (Succuro, 2012) which may in turn have an impact on the firm failure process across different countries. Therefore, one can conclude that there is scope for further investigation of the failure process across Europe whereas Pindado and Rodrigues' (2004) arguments for the use of parsimonious models as far as financial ratios are concerned should be considered.

The studies that have included SMEs and are mentioned above have been, by and large, single-country studies in the US (Altman and Sabato, 2007), Spain (Pindado and Rodrigues, 2004) and the UK (Altman et al., 2010; Keasey and Watson, 1986) with limited conclusions on the choice of financial ratios as failure determinants. The limited evidence from cross country comparisons suggests that there are country specific factors that affect firm failure on top of the idiosyncratic financial characteristics (expressed in the form of ratios) of the firms that are however similar between countries. This is in line with the nature of the failure prediction studies where the emphasis is on the failure event using ratios as detectors of the symptoms of failure.

For firm failure process, there has been evidence that profitability, debt/equity ratio and the relationship between turnover and expenses do affect firm failures in alternative firm failure processes (Laitinen, 1991). Therefore, despite the lack of a universal agreement on the ratios that are the most effective determinants of firm failure and considering the fact that the aim of this study centers around a cross country and within country comparison of alternative firm failure processes and firms' transition to failure, one can conclude that a profitability ratio, a debt to equity ratio and a ratio that considers the relationship between turnover and expenses should be used in firm failure comparisons, particularly where the failure process is a matter of interest.

Looking at the profitability ratios, Return on Assets has been employed by a number of studies both in SMEs and the larger firms (see for example, Pindado and Rodrigues, 2004; Altman et al., 2010; Altman, 1968; Deakin, 1972; Wu et al., 2010) which indicate it is a valid determinant of firm failure. Likewise, Debt to Equity ratio has been used by Lin et al (2011) in large firms as well as by Altman et al., (2010) in SMEs. Linked with Ooghe and De Prijcker's (2008) failure process, the Debt to Equity ratio also appears to be a sound determinant of failure. In terms of the relation between turnover, expenses and the propensity for failure, Ooghe and DePrijcker (2008) defined a combination of (low) sales and increased liabilities as a crucial combination in their failure process. It has been expressed as Gross Income to Total liabilities in Gloubos and Grammatikos (1988).

In addition to that, evidence suggests that the younger the age of the firm (including large firms) is a contributing factor of failure (Evans, 1987; Thornhill and Amit, 2003; Ropega, 2011). Increased firm age tends to increase firms' survival propensity when is combined with high capital intensity (Harris and Li, 2010). Young firms tend to fail after a few years from their inception due to a number of resource, business and financial reasons, when the entrepreneurs can no longer support the firm as a going concern. The age of the firm and in particular, the younger the age, has also been consistently identified as a separate firm failure process in the qualitative and quantitative firm failure process literature (Argenti, 1976; Ooghe and De Prijcker, 2008; Richardson et al., 1994; Lukason, 2018).

Critical evaluation of the above suggests that there is not a clear theory on which financial ratios or combination of financial ratios are the ideal in order to identify the alternative firm failure processes between countries or even within a country. Nevertheless, the previous research agrees that financial ratios can be good predictors of firms' failure and as such determinants of firms' transition to failure.

They can also be used successfully in order to identify alternative firm failure processes. The same applies for the firms' age. Critically, for this thesis, both financial ratios and the firm age are firm-specific characteristics that will be used to identify the alternative firm failure processes that co-exist in the countries that this research considers. However, one can assume that the financial ratios and the age of the firm, should differ between the alternative firm failure processes. Therefore, in a cross-country comparison the following hypothesis can be established:

Hypothesis 3: *Financial performance represented by key financial ratios and the age of the firm, differ in the alternative firm failure processes of EU firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

2.4.2 Economic & Business Environment Characteristics

The economic and business environment (other than the legal origins) affect the firm failure process (Ooghe and DePrijcker, 2008). This can be of a particular importance at a country level. 30%-50% of UK SME failure appeared to be related to macroeconomic factors such as interest rates and unemployment rates (Everett and Watson, 1998). Similar evidence from other countries also seem to confirm that notion.

Studying large Portuguese businesses bankruptcies, Jardim and Pereira (2013) concluded that macroeconomic factors such as the differences in GDP, the inflation rate, the level of Foreign Direct Investment and the differences in the level of domestic credit availability are the most significant determinants of firm bankruptcy in that country. These macroeconomic factors, together with taxation effects are also to some extent confirmed by studies on aggregated firm failure (see for example Wadhavani, 1986; Vlieghe, 2001; Jones, 2013).

The economic environment was shown to be an important determinant of firm failure with Carling et al (2007) providing evidence that the inclusion of macroeconomic variables could enhance a model's performance compared to similar models without such variables. However, this observation applied to a sample of large European firms. Similarly, although for the larger companies, Castren et al., (2010) found evidence that major shocks in GDP can affect default failures at firm level. Park and Han (2002) also focused on non-financial information which can be helpful in failure prediction by considering, size, growth and profitability, competitive advantages, management capacity and reliability, concluding that such characteristics can be associated with firms' failure.

Research around the association of business environment with SMEs' failure is less extensive. For the SMEs in particular, weak business infrastructure, bureaucracy, levels of taxation, inadequate access to loans and instability in tax regulations and procedures are regarded as factors that influence negatively the small firm sector (Bitzenis and Nito, 2005). Likewise, Somoza (2011) provided evidence that a common reason of small and medium sized firm failure in Spain, during the recent recession period, was the unavailability of credit from the financial institutions whereas similar conclusions were drawn from Irish SMEs during the recent financial crisis (Kelly et al., 2015). This is despite evidence from the firm performance literature which suggests that especially under adverse economic conditions, such as the financial crisis, firm-specific effects are determining firms' fate (and performance) to a larger extent than environment-related effects (Bamiatzi et al., 2016). During the crisis, successful SMEs outperformed the failed SMEs in profitability, assets turnover, liquidity and leverage (Ma and Lin, 2010).

Despite the importance of these firm-specific conditions, the SMEs business environment in the UK has been considered as one particularly important factor that affects SMEs survival (Ma and Lin, 2010). In particular the overall economic conditions and the downturn in trade led in an overall reduction to the firms' turnover, cash flow and consequently to their ability to generate internal funds. This came on top of limited bank credit availability even towards successful SMEs that were managing to grow during the crisis. Of equal importance was the delay of payments that many firms experienced and that had further knock on effects on their cash flow and in their ability to repay their credit obligation (Ma and Lin, 2010).

Credit (un)availability has been a persistent problem in SMEs regardless the period of time and the wider economic conditions. In Spain, credit unavailability had adverse effects in SMEs due to their financing structure (Somoza, 2011). Credit unavailability can also heighten due to creditors' coordination when a firm is in financial distress (Hertzberg et al. 2011). Under these circumstances financiers have limited appetite to provide finance to the firm, leading it to failure (Hertzberg et al. 2011).

Gries and Naude (2009) found that the increased physical proximity to banks affects small business start-ups at a country level as well. This highlights the importance of the business and macroeconomic environment in an individual country. From another perspective, Bosma and Schutjens (2009) argued that high population density within a region or within a country may stimulate competitiveness because of the need for suppliers to achieve economies of scale and/or scope. In addition, Bosma and Schutjens (2009) investigated the association between business (increased) population and failure, arguing that such conditions can be created when there are low entry bariers in an industry or an area. Such conditions can have an adverse effect on firms' failure.

Longhi et al. (2014) assessed the structural change in European major cities under the economic integration process. That research was inspired by Krugman and Venables (1996) who pointed out that there are emerging industrial districts in Europe, characterised by increased specialization. Longhi et al., (2014) used a Gini index to measure specialization in major European countries and cities. Their main conclusion was that country specialization is emerging in Europe, pointing out also that there are spatial patterns of agglomeration of economic activity. In particular, large metropolitan areas with more than 500,000 inhabitants appear to be more specialized in services whereas medium sized cities (of between 50,000 and 500,000 inhabitants) tend to specialize in traditional manufacturing activities such as textiles and food whereas similar sized cities tend to have similar specializations (Henderson, 1997).

Critically evaluating the above, one can argue that cross-country comparisons are relatively limited in the literature but it appears to be a growing area of interest. However, most of the comparisons in the literature above uses cross-sectional analytical tools that lack time effects and panel dynamics. Moreover, there is no distinction between the different stages of failure (such as financial distress and bankruptcy/liquidation) and therefore failure is viewed as a single stage event.

Despite the fact that the qualitative firm failure process literature suggests that the economic environment is important, economic environment characteristics cannot be used to identify the existence of alternative firm failure processes between countries because they are not firm-specific events. However, the economic and business environment can affect firms' decision making and performance. Argenti (1976) noted that management deficiencies in a firm may get exaggerated by a changing economic environment to which the management cannot adapt. Therefore one can assume that the economic environment can determine firms' transition to failure in the alternative firm failure processes. Given the evidence that key macroeconomic factors such as GDP growth and other economic environment characteristics (credit availability) have had significant attention in the small firm failure literature, the following hypothesis can be established on a cross country comparison basis:

Hypothesis 4*: In a cross country context, macroeconomic conditions differ between firms in the alternative firm failure processes in EU firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

2.4.3 Evaluation Overview

It is evident from the literature that, although there is no universally accepted combination of financial ratios, the ratios measuring the basic financial dimensions of firms' profitability, leverage and liquidity appear to be particularly popular in firm failure studies. Likewise, there is evidence of the impact of local economic conditions on firm failure propensity whereas the external business and economic environment also impact on firm failures. Therefore, we concluded that financial ratios related to profitability and indebtedness are important firm-specific financial determinants of failure. On top of that the industry of the firm can also be important failure determinants. On the external environment, the macroeconomic conditions are of particular importance, with changes on GDP being the most commonly used determinant.

2.5 SMEs Management and Failure

2.5.1 Management Characteristics: Background on SME Management

In the framework presented, the characteristics of management appear to be one of the internal factors of firm failure. In fact, SMEs tend to have their owners as managers or, in some occasions, a small team of managers and directors whereas whole families may assume the role of the board of directors. These characteristics make SMEs different to corporates in terms of the relationship between governance and firm failure.

Directorship in SMEs is frequently associated with ownership and there is usually little or no distinction between the two (see for example Banham and He, 2010). Usually in SMEs the owners of the firm are also its directors. In SMEs, directors may have relatively limited power compared to the founder management affecting firm performance (Gabrielsson, 2007; Motwani et al., 2006; Zeitun, 2009) if these persons are different. In small firms in particular, the presence of a major shareholder appears to ensure stability and lowers the conflicts between directors and owners, resulting in a decreased failure propensity (Ciampi, 2015). Likewise, evidence from French SMEs suggests that family owned firms have a propensity to deliberately slow their growth by adopting a very conservative strategy that protects firm survival at the expense of firms' growth (Hamelin, 2013). However, quantitative information on ownership is very difficult to be obtained in SMEs.

Whilst there is little evidence in the literature that certain management structures improve firms' performance (Weir, 1999; Weir and Laing, 2001), manager and director characteristics and management capability overall can affect firm performance and failure (Ma and Tiang 2014). However, the literature evidence is much weaker when SMEs are specifically considered against failure. With respect to the classification of the management issues for SMEs, the "*Board Demography Approach*" (Gabrielsson, 2007, p.517) was chosen. The arguments of relating board demography with firm performance is that "*behavioural processes – such as communication, collaboration and information sharing – are assumed to take place automatically among board members. This means that scholars in the board* *demography approach generally agree that the board–performance link operates through some set of 'intervening' behavioural processes*" (Gabrielsson, 2007, p.518). According to this approach, the number of directors and the existence of non-executive[9] directors are considered. In addition, the ownership of the firms will be discussed. The following sub-sections discuss the management characteristics and the ownership characteristics that affect SME failure.

2.5.2 Management Characteristics: Age and Number of Directors

SMEs can be significantly affected by management's inability to adapt their practices in an evolving business environment (Jumpponen et al., 2008) or simply managerial incapability (Ma and Lin, 2010). For example, a usual reason of firms' failure is associated with inability to manage change (Hambrick and Crozier, 1985). Such lack of managerial skills affects firms more in uncertain business environments (Venkataraman et al., 1990). A firm's governance itself influences the likelihood of survival (Parker et al., 2002) as firms with weak governance appear to be particularly vulnerable in economic downturns (Lee and Yeh, 2004). Therefore the issue is the choice of measure to quantify management ability. Experience has been used as a proxy in a number of cases (see for example Wilson et al., 2013) and it can have two aspects namely, the years of experience of a director and the collective experience of the board. In fact, Ohlson and DePrijcker (2008) argued that managerial or industry related experience is the single most important managerial issue that affects the firm failure process. In such occasions the age of directors is used as a proxy for the experience of the board of directors.

The number of directors that a firm has, has been usually used as a proxy for the management's ability to direct and to control effectively the firm (Bennett and Robson, 2004; Daily et al., 2002), reflecting the breadth of knowledge and business and social networks. Firm directors can have broader experience and broader knowledge of the industry depending on their age and on their number. Evidence from the wider corporate literature suggests that directors with wider experience, such as those (non-executive directors) who have experience in other firms' boards have a positive effect in firms' performance (Murayev et al., 2016) and as such, one can argue, have a reduced propensity to fail. Among the specific

[9] For this study, the terms "non-executive" and "external" directors will be used interchangeably.

experience that firm directors may have is on past firm failures. Past failure experience, appears to be useful for small business directors but it can also act as a reputation destroyer for financiers and suppliers (Wilson et al., 2013). Therefore the experience of past failure does not always provide positive effects to the firm (Ucbasaran et al., 2010; Coad, 2013). A crucial point for firms that have directors with failure experience would be their firm's financing at the early stages when lenders are unwilling to support them. On the other hand, one can critically assume that past failures can also be helpful experience but the relationship is not always easy to establish.

Excluding the experience of past business failures, directors who have general previous directorship experience may have more effective networks that can be useful for the company, particularly for a new firm. These networks may provide young firms with access to external resources that are not otherwise easily accessible (Watson, 2007). Such external sources can include contacts with suppliers and market knowledge (Wilson et al., 2013). However, Zhao and Aram (1995) noted that any benefits associated with director experience diminish after a certain level. Too many directors are not necessarily a positive development in the knowledge and network base of the firm.

In terms of the board composition of SMEs, there is evidence that a strong and vigilant board of directors can significantly affect the potential of the firm (Huse, 2000) and perhaps reduce its failure propensity. In fact, when a small firm grows, it is expected that a board can offer advice on critical issues (Motwani et al., 2006; Stavrou, 2003) and direct the company appropriately so as to respond to changes in the market place (Zahra et al., 2009). As a result, the number of directors in a firm may add to the overall management experience and ability to make decisions. In fact, the number of business directors together with the duality at the top (the CEO and the chairman's positions are taken by the same person) has been of special interest for many years in the corporate literature (for duality at the top see for example, Jensen and Meckling, 1976; Daily and Dalton 1994; He and Wang, 2009; Quigley and Hambrick, 2012; Krause et al., 2014; Murayev et al., 2014) although the application to SMEs is quite different due to the owner-centered nature of the smaller firms.

In the small firm failure area, De Maere et al., (2014) found evidence that Belgian unlisted firms with boards where the CEO is independent of the board chair are less likely to become bankrupt, although this holds for firms where the directors are also longer-tenured with few additional directorships. Interestingly, De Maere et al., (2014) also found evidence that bankrupt firms tend to have a (marginally) larger board size compared to non-bankrupt examples. This finding contradicts the assumption that more directors increase the overall ability of a firm's management and also contradicts earlier findings from the larger end of companies which found a positive association between board size and firm performance (Dalton et al., 1999). This might suggest that SMEs are different to corporates when the relationship between board size and failure propensity is concerned.

The size of the SMEs and the fact that they generally operate at a local or regional level has given rise to research on the locality of the directors. In other words, it is of importance for a director to know the local market, especially when the SME is quite new. The locality of the directors especially in young firms can reduce the failure risk as it has been suggested that local directors tend to know the market well, have more effective networks locally and can access more support from the local economy (Wilson et al., 2013). Local knowledge, and professional networks in an area gives an advantage to SMEs especially in the early stage of their development through enhanced understanding of the local customer base, the supplier relationships and the regulators (Johanson and Vahlne, 2009; Wilson et al., 2013). This local knowledge ultimately leads to a reduced probability of failure for small firms (Wilson et al., 2013). In the wider context of directors' knowledge and experience, Zahra et al., (2009) suggested that these are particularly important directors' characteristics in new SMEs since they are developing and providing human and social capital in the early stages of the business development.

Likewise, to the extent that duality at the top concerns the larger end of SMEs, evidence suggests that this, together with outside directors that represent up to half of the board seats, is negatively correlated with failure in small firms (Ciampi, 2015). This is contrasted to cases where there is duality at the top but outside directors represent over half of the board seats; in such cases the presence of outside directors is positively associated with small firm failure, possibly due to external directors depriving the internal directors of the majority vote (Ciampi, 2015).

2.5.3 Management Characteristics: Gender Diversity

Generally, it has been noted that management groups with gender diversity have been considered as more able in problem solving (Jehn et al.,1999) and that can be the case in boards well. One of the most researched areas of board diversity has been gender and especially the presence of women in the board or in charge of firms. However, board heterogeneity can arise from differences in many areas as well as the gender, such as director education, experience, profession, and age (Adams and Ferreira, 2009). Anderson et al., (2011) found evidence that shareholders place greater value on heterogeneity that comes from experience and professional practice than on heterogeneity based on directors' gender, age and ethnicity. However, age is generally used as a proxy of a director's experience while only gender has been explicitly researched in connection with firm failure (see for example Wilson et al., 2013), possibly due to the difficulty associated with obtaining data on the profession, education and perhaps ethnicity of a firm's directors.

Gender diversity within a board has been viewed as adding experience in the broadest sense. Early research on women in charge of firms found no evidence that women-led firms were more prone to failure (Kalleberg and Leicht, 1991) and board heterogeneity had no influence on firm performance (Farrell and Herch, 2005). On the aggregate level though, it has been noted that women, as firm owners, tend to be frequently involved in industries with relatively high failure (such as retail and services) rates and less frequently in industries with lower failure rates (such as manufacturing) (Watson, 2003). However, controlling for the industry, there has been little evidence of an association between gender and different failure rates (Watson, 2003).

More recently, it has been shown that the presence of women on the board of directors is associated with reduced risk of insolvency (Adams and Ferreira, 2009; Wilson et al., 2013) at least in newly incorporated SMEs. This is down to women being described as more risk aware (Adams and Funk, 2012) and more astute in managing credit and cash flows (Wilson et al., 2013). In addition, female directors tend to bring a different dimension of human capital and change the dynamics in the board (Adams and Ferreira, 2009). Due to their female nature, women can provide insights unique to them (Brammer et al., 2009) while, due to their participation in certain consumer markets, women directors may have specialist knowledge and skills in product positioning (Wilson and Altanlar, 2013).

2.5.4 Evaluation Overview and Hypothesis

To conclude this part of the literature, there is evidence that firms' management, ownership and directors' characteristics can be linked with the likelihood of firm failure, especially when they are already in financial distress. This "demographic" approach (Gabrielsson, 2007) to the measurement of management characteristics includes a number of important attributes.

First management experience (proxied by the age of directors) is a factor that has a negative association with firm failure since more experienced managers can better manage a firm in order to avoid failure whereas the locality of directors is also negatively associated with firm failure as local directors tend to know the market when the (usually local market oriented) firm better. Second, a higher number of directors is usually negatively associated with the firm failure as more directors are expected to add experience to the board. However, there are some contradictory results in the literature where large boards result in management conflicts resulting in an increased propensity for failure. Thirdly, the gender of directors and particularly the existence of women in the directorship of the firm is negatively associated with failure due to the social capital that board heterogeneity offers.

As seen above, most of the research in the literature is related to firms from one country without any specific reference on whether these management characteristics are different in firms from different countries. Regardless of the country dimension, critical evaluation of the above in the context of firm failure process implies that the experience, the diversity and the breadth of knowledge and networking of directors could be associated with firms' transition to failure in alternative firm failure processes since all these characteristics have been identified as determinants of firms' failure, outside the firm failure process framework. In addition, evidence from the qualitative firm failure process literature suggests that management is a key element in firm failure process, both in identifying the alternative firm failure processes and also to determine failure. Critically, for this thesis, directors' characteristics are firm-specific characteristics that will be used to identify the alternative firm failure processes that co-exist in the countries that this research considers. Therefore, this thesis proposes the following hypothesis to be tested in the context of alternative firm failure processes in the EU firms that this study considers:

Hypothesis 5*: Directors' Characteristics such as the presence of women in SMEs' management, director age as a proxy of director experience and the number of directors, differ in the alternative EU firm failure processes; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

2.6 Sustainable Growth and Firm Failure

2.6.1 The Concept of Sustainable Growth

Sustainable growth has been one characteristic that Argenti (1976) observed as a reason why firms in some failure processes fail. In the context of the qualitative firm failure process work, certain firm failures were associated with overtrading. This section aims to present the key literature findings in this area and to formulate the hypothesis that links the rapid growth as a determinant of failure coming from the qualitative aspects of the firm failure process literature with the concept of unsustainable growth in firms.

Evidence from the firm failure process literature (see Argenti, 1976; Argenti, 1977; Ooghe and DePrijcker, 2008; Richardson et al., 1994) suggests that firms that are growing rapidly, in terms of turnover for example, have an increased probability of failure. However, one limitation of the above mentioned literature is that it has been qualitative in nature. On the other hand, research that links unsustainable growth to SMEs failure is limited. Going back to the fundamentals of firm-specific characteristics of failure, a number of research papers on the firm failure process (Argenti, 1977; Argenti, 1976; Richardson et al., 1994; Ooghe and DePrijcker,

2008) argued that overtrading[10] and a rapid increase in firm leverage (as a result of lack of financial skills and of defective cash flow planning), as well as investment in overambitious projects, have been mentioned as potentially serious triggers of firm failure. The rate of growth combined with an autocratic entrepreneur may be also fatal for a firm. Most of the failed firms are actually small firms with less than 50 employees. Relevant to Argenti's (1977) overtrading argument is the work of Higgins (1977) who introduced the concept of the sustainable growth of firms of any size. The definition of the term was given as "*the annual percentage of increase in sales that is consistent with the firm's established financial policies*" (Higgins, 1977 p.7). Higgins (1977) noted that inflation generally reduces the real sustainable growth rate. The concept of sustainable growth rate was further investigated by Platt et al., (1995) in the context of smaller private firms, including those in financial distress.

Sustainable growth problems and, in particular, the case when the realized growth rate is higher than the sustainable growth rate, were considered to be important for a firm's financial stability. In such cases of greater actual than sustainable growth, the issue of new equity was considered as an alternative choice in order to effectively balance the capital structure. However, this is not an option that many firms can choose.

Other ways to manage excessive growth relate to the increase of leverage to finance growth or an increase in product prices (which may reduce sales and increase the profit margin) or a reduction in the range of products or services that a firm offers. However, these strategies can be harmful for the business as they effectively give market share to competitors. For sustainable growth under inflationary conditions Higgins (1981) noted that inflation makes firms more dependent on external sources of debt. Ooghe and De Prijcker (2008) extended the work in this area with particular reference to Argenti's work. Ooghe and De Prijcker (2008) also emphasized the failure process framework and identified four key categories[11].

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[10] Aiming at challenging sales targets without equivalent profit targets.

[11] 1) The failure of an unsuccessful company start-up.
2) The failure of ambitious company growth (which leads to failure).
3) The failure of a dazzled growth company
4) The failure process of an apathetic established company

Among these the rapid growth category implies that a firm has been in existence for some years and an experienced but highly optimistic management sets an over-optimistic plan (perhaps due to wrong demand/market size estimations) which is not achievable with the firm's capability and resources. While these companies may be able to reorganize due to the experience of their management, they are nevertheless vulnerable to external conditions from their environment due to their insufficient financial structure. Ooghe and De Prijcker (2008) contrasts their views of high growth risk with Argenti who relates the growth risk with insufficient skills in operational financial and administrative policy. Relevant to Argenti's (1977) note around defective cash flows, a firm's ability to create their own cash flow so as to sustain its growth has been named as self-financeable growth in the literature.

While the concept of sustainable growth appears to have an important part in a firm's path to failure, the self-financeable growth rate (SFG) is a newer concept which may also be relevant to firm failure and small firm failure in particular. Somoza (2011) suggested that internally generated funds are crucial for small firms in order to have a healthy growth and to avoid bankruptcy. Somoza (2011) suggested that small firms that are unable to generate internal funds from retained profit are particularly vulnerable to failure. This is because of SMEs' difficulties to obtain external equity finance and potentially bank debt financing. Likewise, Gupta et al., (2014) provided empirical evidence that small firms unable to generate sufficient operating cash flow are prone to bankruptcy. Nevertheless, SFG has been seen an indicator of a firm's ability to secure sound business conditions in some sectors (Lund, 2014). Marks et al., (2009) used SFG to define the desired rate of growth for a company without it running out of cash and risking failure.

A company's operating cash cycle is related to the amount of cash needed to finance sales and this, together with the amount of cash generated from each pound of sales are the key figures that are used to calculate the SFG (Churchill and Mullins, 2001; Marks et al., 2009). The operating cash cycle, effectively measures the length of time that cash is tied up in stock and receivables as working capital before the customers pay for the products/services sold. The amount of cash needed to finance sales is effectively the cash value that is involved in each operating cycle while the amount of cash generated from each pound of sales is the amount of cash generated in each cycle (Churchill and Mullins, 2001).

Churchill and Mullins (2001) argued that a balance between cash generating and cash consuming (due to a firm's growth) should be defined in order for a firm to avoid financial distress. From an inter-country perspective, Evans et al. (2010) argued that SMEs which experience growth may be able to do so because of favourable market conditions and because they are able to take advantage of local niche markets. However, Evans et al. (2010) also state that, despite the above mentioned advantage that local markets can give to local SMEs, firms must be aware of business and political environment changes in order to see if their growth is sustainable. Therefore, an empirical investigation of the SFG across countries and regions could add value to an understanding of business failure.

2.6.2 Evaluation Overview and Hypothesis

To conclude on the link between a firm's growth and the firm failure process, the work of Higgins, (1981), Churchill and Mullins, (2001), Marks et al., (2009) could be indicative of a potential link between rapid growth and the likelihood of failure: Firms that are growing rapidly without being in a position to self-finance their growth have an increased likelihood of failure. At a European Union level there have been efforts to support business growth. However, excess growth at a firm level may be short-lived and one could also argue that, due to local regulations, industry structures and macroeconomic conditions, it seem possible that different levels of individual business growth rates are sustainable in different countries with respect to failure risk. Local market knowledge can be an advantage to medium and small sized firms but the firms should also be aware of business and macro-environment changes in order to ensure that their level of growth is sustainable (Evans et al., 2010).

Critically evaluating the above, one can conclude that, in line with the findings of the qualitative firm failure process literature, excessive growth can be associated with firms' failure in some firm failure processes. One can argue that this implies that unsustainable growth is a determinant of firms' transition to failure since a number of studies from the wider firm failure literature have found evidence on that (Higgins, 1977; Platt et al., 1995). The level of growth (in total assets) is a financial ratio and as such differences in the overall level of growth in alternative firm failure processes would be captured in that ratio. After all evidence from the qualitative firm failure process literature suggest that increased growth or very slow growth can be both characteristics of alternative firm failure processes. On the other hand, the unsustainable growth, (partly) implies sales growth beyond the sustainable levels of a firm. Given the above, one can argue that whilst the existence of unsustainable growth may not in itself be a characteristic to define the alternative firm failure processes, it could differ between firms in these processes. In addition, it is not clear whether unsustainable growth is a determinant of firms' transition to failure in alternative firm failure processes. As such this thesis proposes the following hypothesis:

Hypothesis 6*: The distribution of firms with unsustainable levels of growth differs between the alternative firm failure processes in EU firms; unsustainable levels of growth are also determinants of firms' transition to failure*

2.7 The Regional Context: Intra-Country Firm Failure

Since the 1960s most of the literature around firm failure has been country-specific. Researchers focused their studies on either of the two firm failure research areas in one country, each time ignoring any spatial-regional effects. Most studies were undertaken on firms from the United States of America, the United Kingdom and often Germany. However, some evidence suggests that local business and economic conditions may vary within a country. Although part of the intra-country literature uses definitions that do not match this study's definition of failure (such as firm exits), it is still worth considering the fact that their findings may provide some evidence that failure determinants can also differ between countries. This variation can add some value to the failure process analysis as some countries tend to have regions that are non-homogenous. For example in some countries such as the UK, the south tends to be more affluent than the north while in Italy the north is considered more affluent.

This section aims to link evidence from firm failure at country level to potential regional specific effects on firm failure. The literature provides evidence on intra-country studies although the research for this thesis and the hypotheses are based on the United Kingdom. This is because the U.K. is has the richest data per region but most importantly because it is formed by different countries (Scotland, England Wales, Northern Ireland) each having some distinct economic characteristics and industry concentrations and with some (though limited) policy-making ability. Likewise, England is further divided into regions that are considered to be relatively diverse from an economic perspective. However, evidence of regional dynamics in firm failure can be drawn from other countries where some research has taken place. The remaining part of this section presents the current literature around regional/intra-country comparisons and presents the hypothesis around the link between failure process and the U.K. regions and countries.

2.7.1 The Regional Context: New Businesses and Firm Failure

There is a growing body of research that analysed the determinants and the survival of new business creation in the U.K. (see for example Ganotakis, 2010). Likewise, there is evidence that there are regional effects within the UK which affect new business creation (see for example Fotopoulos, 2013; Keeble and Walker, 1994). Region-specific characteristics may be different whereas start-up costs may vary considerably between regions in a country (Gries and Naude, 2008). Moreover, there appears to be a distinctive regional variation in the industries of new firms (Keeble and Walker, 1994). Similarly, Buenstorf and Klepper (2009) found evidence that firms located in regions with more concentrated economies have fewer probabilities of exit since they suggested that the most productive firms located in these regions are less vulnerable to economic shocks. Buehler et al (2012) also noted that culture could vary across regions and that can affect the attitude towards failure and consequently the bankruptcy rates.

At the UK level, most of the underlying rationale for any regional effects on business creation is related to the fact that most small firms created in British regions and countries aim to serve the local population, especially during their first few years of operation (Love, 1996). However, there appears to be a link between new firm creation within a region and firm exit (defined as any business closure and including but not limited to failure). In particular, evidence from the literature suggests that business entry rate is affected by the exit rate of firms within a UK region. Most importantly for the purposes of this study is the evidence that business exits are influenced by business entry rates and changes in unemployment rates whereas the local economic infrastructure may also be important (Love, 1996). Moreover, the economic and business environment determinants of firm exits appear to be broadly similar with the determinants of new business formation. This is the case because the same geographical areas that have certain environment characteristics that support new business formation have also a higher population of new firms. These are prone to fail on average three years after their formation due to their young age (Keeble and Walker, 1994). In that sense an element of endogeneity in the entry-exit relationship of firms in a certain geographical area potentially exists.

Most of the studies mentioned above focus on the business environment as the key determinant of business generation and failure within a certain geographical area in the same way as the national and regional business failure literature. In particular, the unemployment rate, local GDP, household disposable income, the local population change and the potential impact of net migration are all economic factors that have been associated with the local business environment which affects business creation and exits at a regional level (Keeble and Walker, 1994; Love, 1996).

From the firm-specific perspective, the age and size of the firm are two determinants that have been associated with the link between firm entry, exit and also failure as per this study's definition. The literature evidence around firm failure suggests that new firms are prone to fail due to an inverse relationship between a firm's age and failure propensity (Dunne et al., 1988) particularly after their first two years of existence which is often described as a "honeymoon period" and up to their seventh year of survival (Wilson et al., 2014). As the probability of failure is larger in new firms, the age distribution of firms' population becomes an important determinant of failure with an impact in regions with a high percentage of new firms. As such, regions that have high new business growth will have a higher percentage of exits or VAT de-registrations as well (Lane and Schary, 1991; Keeble and Walker, 1994). Likewise, most new firms tend to be small and that has adverse consequences with regards to their failure propensity (Love, 1996).

The current literature has therefore provided some evidence on the relationship between new business formation and firms' exit at a regional level by considering elements of the local business and economic environment. However, findings related to business exits (see for example Love, 1996) should be interpreted carefully as a firm's exit (for any reason, including but not restricted to failure) can happen for reasons not related to financial difficulties. In fact, if a firm ceases trading for reasons not related to failure and given that SMEs tend to serve the local market mostly, then it is quite possible that new firm(s) are created so as to fill that gap in the local market.

On the other hand, firms' exits for reasons including failure can be interpreted as a sign of a very competitive market where only the most efficient firms can survive but at the same time they can be viewed as a sign of market weakness in the sense that the market is not strong enough to support many firms (Love, 1996). Moreover, whereas a number of regional economic factors have been analysed as co-determinants of the entry-exit link, the evidence on the this link is less substantive and is focusing at the macro-level. At the same time, it approaches the firm failure as an event (that is, an active firms fail or exit the market) but not as a process where a firm may first enter into financial distress before it fails. Therefore the link between new firms' entry and failure at a regional level need further investigation as prior researches were based on fairly old evidence.

The determinants of new firm creation at a regional level and firm exits at UK regional level have been shown to have some contradictory findings. On one hand, they have been identified as being non-time variant. In a study of the determinants of firm entry and exit in the UK regions from 1994-2007 Fotopoulos (2013) found evidence that both the determinants and also the inter-regional variations remained time-persistent. This finding implies that any efforts to boost small firms at a local level may not necessarily be successful given that the entry-exit link is associated with time-persistent determinants. On the other hand, recent evidence from UK regions suggested that there was a temporary regional variation during the first period of the financial crisis in the performance of the firms possibly due to differences in the industry composition that different UK regions have (Martin et al, 2016).

In the context of alternative firm failure processes within the UK regions, one can assess whether the percentage of new firms in a region could be a determinant of firms' transition to failure in some or all the firm failure processes. The percentage of new firms in a region is not a firm-specific characteristic. Instead it is a business environment characteristic. As such it cannot be used as a key characteristic to identify alternative firm failure processes. However, one can argue that the percentage of new firms in a region is effectively part of a region's business environment and as such the identification of the alternative firm failure processes may result in processes that include firms from business environments that differ on that aspect. This leads to the next hypothesis:

Hypothesis 7*: The number of new firms as a percentage of the existing business population in a UK region differs between the alternative firm failure processes in UK firms; it is also a determinant of firms' transition to failure.*

2.7.2 The Regional Business Environment: The Industry of the firm

The literature on firm failure at a country level has given evidence of some key firm-specific and environment-specific determinants. Glauben et al. (2006) found differences in firm exits in different regions of Germany. It has been discussed in section 1.3 that the scope of cross country comparison may have policy implications at the EU level. Similarly, there appears to be scope to investigate potential differences and similarities in the firm failure process within a country using the U.K. as an example. Intra-country determinants of firm failure, are therefore a relatively unexplored area despite evidence that the consideration of macroeconomic conditions of a country without any determinants related to the economic geography at local level may provide misleading results (Buehler et al., 2012).

At the wider economic and business environment level, local economic conditions (such as unemployment, GDP and local GVA growth, industry concentration, and business population) have been associated with firm failure at regional-level and since such conditions may vary locally these have also been linked with firm failure at the regional level. For example, the industrial concentration in some countries may differ significantly between different regions (for example, in the UK, Greater

London is more oriented towards financial services and the North is more traditionally linked to manufacturing) whereas other countries have to some extent devolved governments (Spain, the UK, Germany). This can have certain effects on the local firm failure process.

Research on business bankruptcies dating back to the period 1839-1913 in Scotland provided evidence that there are local determinants which can affect firm failure at least at the aggregate level (Moss and Hume, 1983). Such determinants included the local business population, potential overtrading, the local availability or lack of financing and the concentration of certain industries in certain cities. Such concentration had resulted in a downturn in a specific industry leading to increased failure rates in cities or regions within the country. More recent evidence also suggest the increasing industrial specialization and dissimilarity in the industrial structure in major European countries and cities seem to bring forth the emergence of US-like industrial districts in European countries that can lead to spatial patterns of agglomeration of economic activity in Europe (Longhi et al., 2014). In particular, some metropolitan areas appear to be more specialized in financial services while others appear to be more specialized in 'other services'. In fact, Lane and Schary (1991) pointed out that business failures in the United States are more affected by local rather than national economic conditions. Since Longhi et al., (2014) and Krugman and Venables (1996), research has been extended into cities within a country and they viewed Europe as a collection of smaller regions. We can adapt the above hypothesis and test it within the United Kingdom's regions and cities at intra-country level.

Critically evaluating the evidence from the above studies, one can conclude that, in line with the hypothesis between the EU countries, the industry classification of a firm within a country could affect firm failure. In addition, one can assume that since the industry classification of the firm affects firm failure, in can be a determinant of firms' failure in alternative firm failure processes. The critical evaluation and research on the literature shows that there is little evidence in the quantitative firm failure process literature to suggest whether the industry classification of the firm differs in any alternative firm failure processes. The industry of the firm is not a firm-specific characteristic and as such it cannot be used to identify the alternative firm failure processes. However, the distribution of alternative industries may differ in the alternative firm failure processes, once they are identified. Most studies are sector-specific (see for example Laitinen et al., 2015; Lukason and Laitinen, 2016; Lukason et al., 2016) and do not allow for a multi-industry comparison. As such, this thesis proposes the following hypothesis to be tested:

Hypothesis 8: *Industry classification differs between the alternative firm failure processes in UK firms; it also differs as a determinant of firms' transition to failure in the alternative firm failure processes.*

2.7.3 The Regional Context: Financial Ratios and the Age of the Firm

Given the macro-focused evidence of the literature, the financial firm-specific characteristics by means of financial ratios may need further investigation given that most of the firm failure literature has been developed by using financial ratios as predictors.

As already discussed in section 2.4, the critical evaluation on the literature around the usage of financial ratios in firm failure shows that there is not a clear theory on which financial ratios or combination of financial ratios are the ideal in order to identify the alternative firm failure processes. Nevertheless, it has been discussed that the previous research agrees that financial ratios can be good predictors of firms' failure and as such determinants of firms' transition to failure. They can also be used successfully in order to identify alternative firm failure processes. However, one can assume that the financial ratios, being symptoms of firms' failure, and metrics of firms' financial performance should differ between the alternative firm failure processes in UK regions.

Likewise, the age of the firm has been identified as a quantitative firm-specific characteristics that affects firms' failure. In the UK, during the recent financial crisis, the younger SMEs have been among the most vulnerable firms (Orton et al., 2015; Helmers and Rogers, 2008). In addition, the qualitative firm failure process literature suggests that the age of the firm is a key characteristic of certain firm failure processes in a country (Argenti 1976; Richardson et al., 1994). Critically, for this thesis, both financial ratios and the firm age are firm-specific characteristics that will be used to identify the alternative firm failure processes that co-exist in the countries that this research considers. Therefore, this thesis proposes the following hypothesis:

Hypothesis 9: *Financial performance represented by key financial ratios and the age of the firm, differ in the alternative firm failure processes of UK firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

Generally, the business environment is usually seen as having a significant impact on the cross-regional variability of firm failure with the availability of financing but also the presence of personal financial resources (proxied by house values) to be associated with firm failure (Keeble and Walker, 1994). In fact, evidence from the failure prediction area of research provided some evidence that a model developed in a specific geographic area can perform more effectively than a wider reaching version (Ciampi and Gordini, 2013). However, most of the literature which suggests that the local economic environment affects business failures at a local level is based on studies with limited or no firm-specific information. One exception in the failure prediction literature suggested that macroeconomic data revealed very different company survival and failure rates over time and across regions and it was desirable to control for local economic conditions (Wilson and Altanlar, 2013). Specifically researchers calculated aggregate company failure rates in each of the regions and constructed a regional Weight of Evidence for each year separately and for each region. This evidence can initiate further research in to the impact of local economic conditions on the failure process.

Critically evaluating the evidence of the impact of the economic environment in firm failure within a country one can argue that it may affect indirectly the alternative firm failure processes. Argenti (1976) noted that management deficiencies in a firm may get exaggerated by a changing economic environment where the management cannot adapt to. Moreover, whilst the economic environment characteristics cannot be used to identify the existence of alternative firm failure processes between countries because they are not firm-specific events, they may determine the firms' transition to failure. On the other hand, one needs to consider whether each of the alternative firm failure processes includes firms whose economic environments differ between the alternative processes. Therefore this thesis proposes the following hypothesis:

Hypothesis 10*: In an UK regional context, macroeconomic conditions differ between firms in the alternative firm failure processes in UK firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

2.7.4 The Regional Context: Firm specific Management Characteristics

At the firm-level, firm management has been already discussed as a potentially important determinant of firm failure at a country level. As such, directors' characteristics are areas of consideration at a cross-country comparison. For the intra-country comparison, there is evidence that an entrepreneur's experience in related geographic or product markets when entering a specific market affects both the probability and the mode of exit (Dunee et al., 2005).

As discussed earlier the exit is not necessarily the same as a firm's failure but this ties in well with evidence from the governance literature which suggests that directors' local market experience is beneficial for a firm to avoid failure[12]. Moreover, evidence from the failure prediction literature also shows that the presence of female directors is negatively associated with firm failure due to the social capital that gender heterogeneity brings (Wilson and Altanlar, 2013). Likewise, the number of directors is also negatively associated with firm failure due to the experience that the additional directors bring. As such it has a positive impact on firms' survival by reducing failure rates in firms located in different regions in the UK (Helmers and Rogers, 2008). Therefore these can all be indicators of firm failure in regional comparison.

As in the case of the discussion about alternative countries, and regardless of the regional or country dimension, critical evaluation of the above in the context of firm failure process implies that the experience, the diversity and the breadth of knowledge and networking of directors could be associated with firms' transition

[12] For further details, please see the Governance paragraph.

to failure in alternative firm failure processes since some of these characteristics have been identified as determinants of firms' failure outside the firm failure process framework. In addition, evidence from the qualitative firm failure process literature suggests that management is a key element in firm failure process, both in identifying the alternative firm failure processes and also to determine failure. Critically, for this thesis, directors' characteristics are firm-specific characteristics that will be used to identify the alternative firm failure processes that co-exist in the countries that this research considers. Given that a direct comparison between firm failure processes in different regions within a country has not be performed yet, this thesis proposes the following hypothesis:

Hypothesis 11: *Directors' Characteristics such as the presence of women in SMEs' management, director age as a proxy of director experience and the number of directors, differ in the alternative UK firm failure processes; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

2.7.5 The Regional Context: Unsustainable growth

With respect to the note of Moss and Hume (1983) on overtrading, their research did not include any regional comparison. However, one can assume that different local economic and business environments may be able to support varying levels of growth in companies that are operating in that area. In fact, Evans et al (2010) supports the argument that local market knowledge can give an advantage to medium and small sized firms but that firms should also be aware of business and macro-environment changes in order to ensure that their level of growth is sustainable (Evans et al., 2010). Evidence from the Department of Business Enterprise and Regulatory Reform in the U.K. (2013), suggests that UK SMEs have had very different average turnover dynamics between 2009 and 2012. Given that turnover is a key metric in measuring business sustainable growth (Higgins, 1977), it would be interesting to investigate if different regions within the United Kingdom support different growth levels at an individual firm-level.

Critically evaluating the above, together with the evidence provided in section 2.6.1, one can conclude that, in line with the findings of the qualitative firm failure process literature, excessive growth can be associated with firms' failure in some firm failure processes. One can argue that this implies that unsustainable growth is a determinant of firms' transition to failure since a number of studies from the wider firm failure literature have found evidence of that (Higgins, 1977; Platt et al., 1995). It is not clear whether unsustainable growth is a determinant of firms' transition to failure in alternative firm failure processes. It has been associated with firm failure but not with the identification of alternative firm failure processes. In line with the arguments on unsustainable growth levels presented in section 2.6.1 for the firm failure processes between firms in the EU countries, one can also argue that whilst the existence of unsustainable growth may not in itself be a characteristic to define the alternative firm failure processes, it could differ between firms in the alternative firm failure processes between a firms of on country. Likewise it can be a determinant of firms' transition to failure. As such this thesis proposes the following hypothesis:

Hypothesis 12*: The distribution of firms with unsustainable levels of growth differs between the alternative firm failure processes in UK firms; unsustainable levels of growth are also determinants of firms' transition to failure.*

2.8 Conclusion

This chapter provided a review and evaluation of the existing firm failure and firm failure process literature that is relevant to the purposes of this thesis. There has been evidence from the qualitative firm failure process literature that management characteristics do affect the alternative firm failure processes. However this has not been tested in the existing quantitative firm failure process literature. In addition, a number of financial, firm-specific and business and economic environment characteristics, such as the legal traditions in a country, the economic growth in a country or a region, the credit availability, the new firms in a region and the excessive levels of growth of a firm have been identified from the wider firm failure literature as determinants of firm failure. However, this has not been contextualized within a firm failure process framework yet.

In the context of the main aim of this study, which is to identify alternative SME failure processes, investigate the determinants of firms' transition towards failure, within these processes and investigate the importance of geographic (spatial) location in the transition to failure, this chapter has analysed the main characteristics of failure processes and determinants of failure. In addition, a number of research hypotheses were established. These hypothesis include firm-specific characteristics (financial ratios, the firm age and directors' characteristics) that will be used to identify the alternative firm failure processes. These, characteristics, together with a number of additional characteristics from the firms business and economic environment will then be tested to identify if they differ in the alternative firm failure processes and whether they are determinants of firms' transition to failure in these processes. The investigation of the alternative firm failure processes in the EU firms and the UK regions' firms, together with the test of the hypotheses are presented in the following empirical chapters.

CHAPTER 3: RESEARCH METHODOLOGY

3.1. Introduction

This chapter explains the research design and research philosophy of this thesis. In addition, the quantitative methodologies that the study uses are presented, together with some background information from applied research in the area of firms' failure. Further details on the techniques applied are also provided in each individual empirical chapter. The structure of this section is as follows. Section 3.2 presents the research philosophy and design of this study; Section 3.3 defines the nature of the dependent variable used in the quantitative analysis, something which affects the analytical tools that this study uses; Section 3.4 reviews the rationale of quantitative techniques selection in this study with supportive evidence from the previous literature; Section 3.5 presents the application of these quantitative techniques in this study. This section also introduces two hypotheses, related to the existence of geographical (spatial) effects in aggregate firm failures in the failure processes of the EU countries and the UK regions. These hypotheses are more technical in nature and as such this chapter is more appropriate for their introduction. Section 3.6 concludes the chapter.

3.2. Research Philosophy and Design

Research designs are plans that dictate the form that a study will take. There are three key types of research design: quantitative, qualitative and mixed methods (Creswell, 2009). The distinction between these research designs maybe sometimes difficult to discern as many studies may be mainly of a quantitative nature but include some elements of qualitative methods as well and vice versa.

A qualitative research design usually involves the collection of data by the researcher who is central into the interpretation of the data usually through an inductive style (Creswell, 2009). A quantitative research design is more focused on testing theories by examining relationships within various datasets. Usually quantitative researchers make assumptions about testing theories in a deductive style such that this research approach enables researchers to generalize and replicate their findings (Creswell, 2009). Finally, mixed-methods research is an approach that combines quantitative and qualitative forms and may involve philosophical assumptions (Creswell, 2009).

In practice the choice of the methodology is influenced by the assumptions of the researcher and the nature of the research aims. There are mainly four research philosophies that researchers tend to adopt so as to explain the different phenomena of their research. These are positivism, constructivism, pragmatism and realism.

The positivist (also known as post-positivist research; empirical science or post - positivism) research philosophy employs empirical observations and measurement, as well as theory verification to interpret research results. The researcher is external to the problem that is being researched and remains objective (Saunders et al., 2009). In addition, there is a deterministic philosophy in which some causes are potentially associated with some outcomes and therefore the problems that the research addresses represent the need to identify and investigate the causes that influence the outcomes (Creswell, 2009). As a result, only observable and measurable phenomena can provide credible facts to address the research problem and for that reason highly structured large samples are most commonly used to analyse the research problems (Saunders et al., 2009). As a result the positivist researcher usually employs quantitative research methods (Creswell, 2009; Saunders et al., 2009).

In the constructivist research philosophy (sometimes used interchangeably with the term interpretivism or it is combined with it), the researcher holds assumptions that "*individuals seek understanding of the work in which they live and work*" (Creswell, 2009, p.8). As a result the researcher seeks to understand the participants of the research. The aims of theory generation are based on social and historical observation and construction while the researcher is part of what is being researched (Saunders et al., 2009). In this philosophy of research, the researcher may be subjective in the way he or she interprets the world and there may be subjective meanings and social phenomena (Saunders et al., 2009). As a result, the research techniques that are adopted in this philosophy are usually qualitative in nature, possibly with in-depth interviews.

Pragmatism is another research philosophy which arises out of actions, situations and consequences as opposed to previous objective conditions (Creswell, 2009). In the pragmatist research philosophy, the researcher may adopt multiple views in order to answer the research questions whereas observable phenomena as well as subjective meanings can provide acceptable knowledge to answer the research questions (Saunders et al., 2009). The values of the research play a special role in analyzing and interpreting the results of the research and during this process, the researcher may adopt both objective and subjective interpretations (Saunders et al., 2009). Due to the mixed nature of objective and subjective interpretation of the observable phenomena, mixed methods are frequently used when the researcher adopts this research philosophy.

Finally, in the research philosophy of realism, the researcher is objective and independent of beliefs or knowledge. Phenomena are interpreted through social conditioning and the phenomena themselves provide credible data (Saunders et al., 2009). Research under the philosophy of realism is value laden and the researcher is biased by world views and cultural experiences which in turn may have an impact on the interpretation of the research (Saunders et al., 2009). Both quantitative and qualitative methods can be adopted in this research philosophy.

The majority of the studies in the broader area of finance tend to use a positivist research philosophy where the researcher is external to the observed phenomena with a clear focus on causality. In the firm failure literature, the majority of the previous studies have adopted positivism research philosophy and they rely on the measurement of large, structured data, with the researcher being independent of any social factors. As a result, most researchers used quantitative research methods to achieve their research objectives (see for example, Laitinen, 1991; Camacho-Minano et al., 2014; Pindado and Rodrigues, 2004). However, in the failure process literature, there has been evidence of qualitative research as well (see for example Argenti, 1976; Ooghe and De Prijcker, 2008; Richardson et al., 1994). Nevertheless, the research philosophy adopted from the researchers in firm failure studies, even when the methodology was of qualitative nature, was that of the positivism, since the researchers remained external and objective to the research phenomena and there was a particular focus on causality of phenomena and results.

Given the nature of this study, the positivist research philosophy is adopted. This study aims to compare firm failures between countries and within a country. There is a clear element of structured large samples of data where the researcher maintains an external and objective view. Naturally the focus is on causality and making generalizations on the observed phenomena in order to draw objective conclusions. Consequently, quantitative research methods will be adopted.

In terms of the research design, a deductive approach has been used. That means the hypotheses that drive this research will be developed; the quantitative methods will be used to test the hypothesis; and finally draw conclusions that will allow this research to achieve its research aims and objectives.

3.3. The Dependent Variable and Discrete Response Models

This study compares firm failures across different European countries and also across different countries and regions of the United Kingdom. The most common approach that quantitative studies in this research area adopt for the definition of their dependent variable, is the binary classification (see for example Altman 1968; Altman et al, 2010). This means that, at the cross-section, firms can be either failed or not failed.

However, this study uses more classifications for the failed firms. All eventually failed firms in the sample have been classified into three categories depending on the point in time of the observation. There are three possible outcomes for each firm-year observation in the sample and these outcomes can be denoted with a number that can be linked with their status.

i. The first category includes firms that have not failed at the given year when the observation takes place. This means that these firms are not in financial distress and have not been under insolvency procedures for liquidation at that time. Such firm-year observations have an event_failure status of zero.
ii. The second category includes firms that are in financial distress in a given year. These are firms that are not under liquidation but they have negative equity which means that their total liabilities exceed their total assets. For

the year when these firms are in financial distress their firm-year observation has the event_failure status of one.

iii. Finally, the third category relates to firms that are insolvent and are liquidated (in some countries the equivalent term is bankrupt) or are in the process of liquidation in the year observed. Such firm-year observations have the event_failure status of two.

The chosen states of the dependent variable in the present study have been established with a clear rationale. Non-failed firms are financially healthy firms that have no particular adverse financial or legal information against them at the time of observation. Financially distressed firms, are weak financially (being in negative equity) but their performance is not at a stage where their creditors or their owners have not entered the legal process of insolvency that will lead to the liquidation of the firm (at the time of observation). With little hope for the firm to perform well again, it is expected that liquidation is the last resort for creditors and owners. This classification is similar to the classification that Tsai (2013) adopted when researching corporate financial distress and bankruptcy, and to Johnsen and Melicher (1994). There is, however, a difference in that their "financially distressed" category contained firms that had defaulted on their loan obligations or that were reducing dividend payments, whereas this study uses negative equity as the measure of financial distress. A further difference is that their studies were focused on listed companies whereas this analyses SMEs.

Given the three possible states of the dependent variable, the traditional binary classification of the dependent variable would not be sufficient to accommodate effectively three potential states for each firm. Instead, multinomial responses are preferable because they are able to accommodate multiple outcomes. Multinomial dependent variables can use similar econometric techniques as are available for binary dependent variables although with certain modifications, which are explained in the following sections.

One significant characteristic of multivariate discrete-responses is that the dependent variable may be either ordered or unordered in nature. In situations where there is no natural ordering of the alternative stages of the dependent variable, unordered models should be preferred. The key characteristic of unordered responses is that neither their chosen values, nor their particular order signals a specific status for the dependent variable whereas they have no effect on the estimation inference or interpretation (Wooldridge, 2010).

The second category of multinomial responses is the ordered response. This type of ordered response dependent variable is effectively used in ordered response (also known as discrete-choice) models which are effectively generalizations on the simple binary models (Brooks, 2008) and dependent variables specifications. The ordered response (also known as ordinal response) can take values {0,1,2,3…n} for some known value of n (Wooldridge, 2010). In this case, the numbers that are selected as states of the dependent variable cannot be arbitrary and while they do not have to have a specific meaning themselves, they need to have an ordered and specified hierarchy between them. The dependent variable should therefore behave in an ordinal fashion with respect to each predictor (Harrell, 2015).

When the stages of the dependent variable have a logical or natural order, ordered response models should be preferred. For example, when there is a monotonic increase or decrease in the credit quality of a firm, this order should be reflected in the dependent variable (Brooks, 2008). If the credit quality for a company is ranked in a scale from zero to six where zero is the lowest ranking and six is the highest ranking, the fact that six is better than five or zero contains important information for the credit quality of the company even if the chosen numbers of the dependent variable have only ordinal meaning (Wooldridge, 2010). However, with an ordered response dependent variable, one cannot make inferences with regards to the difference between the ordinal scales. For example one cannot conclude that the difference between credit quality rankings four and two is somehow twice the difference between one and zero (Wooldridge, 2010). That means that in substantive terms the difference between zero and two on the coded response may be different from the difference between four and six (Jackman, 2000).

In statistical terms, one can check the consistency of the order if there is an independent variable X that is related to the log odds of an event Y (that is, the dependent variable). One can then plot the mean of X stratified by the alternative levels of Y which should be in a consistent order (Harrell, 2015).

Given the nature of the research, the ordered response fits better the definition of this study's dependent variable. Selecting an unordered response would result in loss of efficiency with the use of unordered response dependent variable (Johnsen and Melichen, 1994) models. In the context of this study's data, one would expect that a non-failed firm (event_failure=0) is "better" than a firm into financial distress (event_failure=1) which is "better" than a firm into liquidation (event_failure=2). Conceptually, ordered response models have the ability to classify different states in a firm's financial situation. This is a useful characteristic because not all firms that are financially distressed end up bankrupt and not all bankrupt firms have been in financial distress. In the context of ordered response dependent variables, it is important that the discrete responses should not be close substitutes as this will increase the errors in the model (Johnsen and Melicher, 1994). This is a requirement that complies with the nature of the data used in this study. Therefore, there is some usefulness to treat financial distress and liquidation differently as two distinct statuses of firms' failure.

In the quantitative literature on firm failure there have been examples of ordered response dependent variables although mostly from the corporate failure literature (Johnsen and Melichen, 1994; Tsai, 2013) as opposed to the SMEs literature. Nevertheless, the validity of the ordered response dependent variable model remains the same, from a statistical perspective. Johnsen and Melichen (1994) used an ordered-response approach, provided evidence that a further category of financially weak companies that sits between the non-bankrupt and the bankrupt firms is a valid option, and it may result in better model accuracy. In their research, the particular classification of the dependent variable reduced classification errors from the econometric model. In addition, the authors noted that in the large companies of their sample, the three states of financial health of the companies appeared to be statistically independent.

In summary, there is evidence from the literature that considers a binary status for the dependent variable. However, given the comparative nature of this study and the inclusion of alternative states for the failed firms, a multinomial dependent variable will be used. Given the directional nature of the failure event (where a liquidated firm is in a worse state than a firm which is under financial distress), the ordered response specification is chosen for the dependent variable. This specification will be used for the modelling approaches that are discussed in the following sections.

3.4. Quantitative Techniques of Firm Failure

3.4.1 Introduction to Methodological approaches

The firm failure literature is composed of two types of research. The first type analyse the characteristics of the firm failure process while the other identifies the determinants of firms' failure, often in the context of firm failure prediction. Both areas of research use quantitative techniques. Therefore, to some extent, similar quantitative methodologies have been applied to both areas of research. Due to the nature of the failure prediction literature, where small improvements in the prediction accuracy are important, that area gives a more rigorous review and application of the quantitative techniques that have been used in the wider firm failure literature.

From a literature point of view, a number of techniques have been used to develop prediction models. Kumar and Ravi (2007) classified these models into two broad areas of statistical and intelligence/computing techniques. This classification in practice excludes the market-based model approaches which are not applicable to SMEs given that a large proportion of these firms are not listed in any stock exchanges. Statistical techniques are applicable to SMEs and they appear both in the failure prediction area and in the quantitative firm failure process area. Therefore, these statistical techniques will be the main focus of this analysis. Multiple Discriminant Analysis (MDA) and Logistic Regression (logit) have been the most popular applications, with panel data techniques recently appearing increasingly in the literature. However, other techniques such as factor analysis have also been used in the firm failure determinants literature (see for example Gaskill et al., 1993; Modina and Pietrovito, 2014), but with relatively limited applications as a standalone technique in the firm failure prediction area. However, these techniques are a useful tool to reduce an initially large number of potential independent variables to more manageable levels.

Multiple Discriminant Analysis (MDA) has been extensively used, starting from Altman's (1968) z-score model. Many other authors followed the very same example (see for example Deakin, 1972; Edmister, 1972; Blum, 1974; Taffler, 1982). The first Z-score has the following form (Altman, 1968):

$$Z = v_1\chi_1 + v_2\chi_2 + \cdots + v_n\chi_n$$

The z-score was based on the linear general formulae of the Multiple Discriminant Analysis (MDA) which was according to Lachenbruch, (1975) was:

$$D_i = d_0 + d_1\chi_{i1} + d_2\chi_{i2} + \cdots + d_n\chi_{in}$$

MDA as a modelling technique had a number of advantages that made it appealing to researchers. It can discriminate between distinct populations, allowing it to distinguish between two different population outcomes (failure and non-failure) by using linear combinations of variables (Taffler, 1983). Moreover, MDA is relatively easy to use, making it an appealing solution to academics and risk professionals. It can also work with relatively small samples. In addition, the failure prediction accuracy results presented in the literature are adequate. In fact, Balcaen and Ooghe (2006) argued that MDA was the most popular application in the failure prediction literature. However, MDA has also a number of disadvantages. MDA's assumption on the multivariate normal distribution of variables is quite strong and frequently violated in the applied failure research (Deakin, 1976; Taffler and Tisshaw, 1977) increasing the risk of producing biased error estimates (Eisenbeis, 1977). However, Lachenbruch (1975) demonstrated that the MDA estimations can be practically robust regardless of the violation in the assumptions. A limitation of the MDA technique is that it discriminates between binary outcomes which are usually two extreme business cases such as failure and non-failure. MDA examples in the literature have been applied in a cross-sectional data specification only. However, within the firm failure literature logistic regression applications largely replaced the MDA due to enhanced performance when larger datasets became available.

Ohlson (1980) provided the first empirical evidence that used logistical regression (logit) in a pooled data sample to predict firm failure. Logit applications need larger data samples than, for example multiple discriminant analysis, something that was becoming gradually possible due to advances in technology and data availability. The advantages of the logit method is that it gives a probability of an outcome (such as failure) without strong assumptions of prior probabilities of failure or strict assumptions on the distribution of predictors. Typically, logit models (in their basic form) assume a binary outcome in the dependent variable, although multinomial applications can also be applicable. In any case the dependent variable outcomes should be non-overlapping and discrete.

On the other hand, logit applications are more sensitive to multicollinearity. This characteristic can provide challenges when financial ratios are the main independent variables because they tend to have some degree of correlation with each other. In addition, the larger datasets that the logit applications require tend to generate some issues associated with the sample selection. These are related to the inclusion of disproportionate numbers of failed firms in the sample. This issue is referred to as "choice-based sample bias" or "oversampling" (Zmijewski, 1984). Over-sampling affects both logit and probit coefficients (Dietrich, 1984). However, evidence suggests that the above characteristics of logit applications do not reduce materially the performance of such models in the context of firm failure prediction (Balcaen and Ooghe, 2006; Zmijewski, 1984). The sampling bias however, is not relevant in studies that analyze the determinants of firms' failure but instead for those that deal with failure prediction. Therefore it can be argued that it is not a limitation in such studies. The overall capability of logit models has been proved through their continuous popularity as they are still used extensively in research studies. Most of the applications of logit techniques has been associated with cross sectional data structures and this continues to be the case to a large extend.

3.4.2 Factor Analysis and Cluster Analysis

The combination of factor analysis and cluster analysis has been the most frequently used analytical tool in quantitative firm failure process studies (see for example Laitinen, 1991; Laitinen and Lukason, 2014; Laitinen et al., 2014; Laitinen et al., 2015; Lukason and Laitinen, 2016; Lukason, 2018). This is because this combination allows a number of firm-specific characteristics, observed over time, to be regrouped into smaller set of variables (the factors).

Most of the assumptions around the use of factor analysis are conceptual as opposed to purely statistical (Hair et al., 2006). In that context, the researcher assumes that some underlying structure exists in the set of the selected variables that will enter the factor analysis. Previous research in the area of firm failure processes provides evidence that this can be done by utilizing characteristics that have been associated with failure, in wider firm failure studies. In addition, the qualitative firm failure literature does provide the conceptual structure on which quantitative research can be based (see for example Ooghe and DePrijcker, 2008). In addition, the underlying sample that is used for the purposes of factor analysis should be homogeneous with regards to the potential factor structure (Hair et al., 2006). In quantitative firm failure process studies this typically happens by only utilizing failed firms. However, this is conceptually valid because the failure process of any firm requires the firm to fail eventually.

From a statistical point of view, departures from normality, homoscedasticity and linearity have limited application in factor analysis if the conceptual requirements for the variables that are included exist (Hair et al., 2006). However, the variables included in factor analysis need to be intercorrelated to some extent (Hair et al., 2006) and for that reason Chapters 5 and 6 perform correlation and partial correlation analyses. Additional tests like the Bartlett test of sphericity was used to statistically assess if the levels of correlations among the variables are adequate for the factor analysis to proceed. In firm failure process studies, some correlation between the variables that enter the factor analysis exists partly because a number of lags of each variable are included in the analysis (see for example Laitinen et al., 2014; Laitinen, 1991). This is useful because the firm failure process evolves across a number of years thus this information should be included in the factors.

Once the conceptual framework is determined and the correlations are assessed, one has to decide on the criteria that will be used to extract the factors. The latent root criterion is the most commonly used technique in factor analysis (Hair et al., 2006). Under this criterion, each factor should at least account the variance of a single variable, in order to be retained in the analysis (Hair et al., 2006). For this reason an eigenvalue criterion by means of the Kaiser test (Kaiser, 1960), is employed in the analysis. In such cases, only factors with eigenvalues above 1 should be allowed to return to the second step of the factor analysis which is the

VARIMAX rotation. The rotation of the factors is useful because it simplifies the factor structure. Subsequently, factor scores obtained from the analysis above are standardized and uncorrelated. These are useful characteristics which enable the use of cluster analysis after the factors are scored based on their factor loading (Hair et al., 2006).

The factor scores are subsequently used as inputs to the cluster analysis. Cluster analysis is able to classify objects into groups that share similar characteristics. In particular, a partition cluster analysis approach can be employed due to its characteristic of breaking any observations into a number of non-overlapping groups. K-medians and k-means are two similar processes that are used to calculate the clusters. The methods differ in the estimation of the "centre" of the cluster. The k-medians uses the median while the k-means uses the mean (Whelan et al., 2015). Cluster analysis also requires stopping rules which are used to identify the number of clusters. There is no evidence supporting any particular stopping rule from the many that are available (Hair et al., 2006). One of the most well-known partitioning criteria is the Calinski and Harabasz (1974) index (Vendramin et al., 2010). It will be used in this research to define the appropriate number of clusters.

The Calinski and Harabasz (1974) Pseudo-F formula is defined as follows:

$$\frac{trace(B)/(g-1)}{trace(W)/(N-g)}$$

Where B is the in-between clusters sum of squares and W is the within clusters sum of squares; g is the number of groups and N is the number of observations.

3.4.3 Cross-Section Logistic Regression Models

As discussed in sections 2.4.1 and 3.4.1, the logistic regression has been a popular analytical tool with its binary form in firm failure studies. Although one of the main analytical tools for this study is the panel data ordered regression at firm-year observations, the key properties of the simple logistic regression and of its ordered logistic regression extension are presented as this methodology can be used as a baseline benchmark on firm-level results.

The logistic regression model with the traditional binary dependent variable specification has been used extensively in applications where the outcome from the dependent variable lies between 0 and 1. As it was discussed in Section 3.3, this binary classification does not mean that the numbers itself have a particular interpretation; it is the attributes attached to them that matter. Logistic Regression (logit) models have been particularly popular in the literature. One can broadly argue that logit effectively replaced multiple discriminant analysis as the benchmarking technique in the failure prediction literature while it has also been particularly popular in non-prediction studies.

The logistic regression model (logit) is able to estimate probabilities that are between the 0 and 1 threshold, which is a traditional weakness of the ordinary least squares estimated linear regression model. In the firm failure literature 0 is usually used to denote the non-failed firms and 1 to denote the failed firms. Some of the key advantages of the logistic regression model is that it is relatively easy to implement, it does not make any assumptions on the multivariate normality and the equality of variance, and covariance between the groups that are analyzed while its statistical tests are easy to be implemented (Hair et al., 2006). The logistic function effectively transforms the traditional regression model, which limits its outcomes to be bounded within the (0,1) interval (Brooks, 2008).

The form of the logistic model would be

$$P_i = \frac{1}{1 + e^{-(\beta_1 + \beta_2 \chi_{2i} + \cdots + \beta_k \chi_{ki} + u_i)}}$$

Where the P_i is the probability, and e is the exponential number. Using the firm failure studies as an example, P will be the probability that a firm fails and the χs in the parenthesis of the denominator represent potential determinants of the firm failure and u is the error term.

The logit model is, therefore, not a linear model, and as a result the maximum likelihood estimator is usually used for its interpretation. The principle for the maximum likelihood estimator is that the parameters are chosen to jointly maximise the log-likelihood function (Brooks, 2008), which means that the logistic regression aims to maximise the likelihood that an event occurs (Hair et al., 2006). In order to assess the goodness of fit of a logit model one can examine the predictive accuracy of the model (Hair et al., 2006). The likelihood value is the best measure of how well the model fits the data but pseudo R^2 measures can also be used. For the likelihood value, a perfect model will, in theory, be the one with the lower -2 log likelihood where the minimum value of -2LL is 0 which corresponds to the perfect fit (Hair et al., 2006). In order to assess the accuracy of the model one can use the classification matrix which measures how well the allocation to a specific group has been done by the model (for example allocation between failed and non-failed group of companies).

The principles that apply to the binary logistic regression models can be generalised to apply to the ordered logistic regression models. In the corporate failure literature Johnsen and Melicher (1994) and Tsai (2013) are examples of the few studies that have used an ordered response logit model. These studies suggested that between the non-failed firms and the liquidated firms, there is an important interim stage of firms in financial distress that is not captured in a binary specification and therefore significant information around the determinants of the three stages of the firms is lost.

A key advantage of the ordered logistic regression is that it can accommodate more than two outcomes and therefore it can enable the researcher to explain cases that fall between the two outcomes of the binary classification. It is important to note that in the ordered logistic regression there is no assumption around the spacing between the responses (Harrell, 2015). This means that in cases of the potential outcome takes the value of 0, 1 and 2, there is no assumption that the distance between 0 and 1 is the same as is between 1 and 2. Despite this notion, whereas in the binary model we can observe that $y_i = 1$ when $y_i^* > 0$, the ordered response logit model needs to generalise this concept to introduce multiple thresholds for the alternative states of the dependent variable (Baum, 2006). For example, when there are three potential outcomes in the dependent variable we will have two thresholds over the variable. The generalisation of this notion is:

$P_r(y_i = i) = P_r(K_{\iota-1} < x_i\beta + u_j < K_i)$.

This means that the probability of an individual j takes outcome i depends on the $x_i\beta$ falling between the cutpoints $(i-1)$ and i. This represents the generalisation with regards to the dependent variable from the binary model when it has one threshold at zero (Baum, 2006).

3.4.4 Panel Data Logistic Regressions

Relatively recently, there has been a growing interest around the use of panel data structures in the literature. The nature of panel data and its structure made it appealing since they are able to incorporate the time dynamics that are particularly helpful in failure studies which are related to the macroeconomic and business environment. In the failure prediction literature, panel data analysis was applied in the context of duration models with a binary outcome. For example, Shumway (2001) argued the panel structure could produce superior performance. Similarly, Nam et al., (2008) successfully used panel structures to get very strong results in terms of the model's performance. Nam et al., (2008) in particular presented evidence that the panel approach outperformed a similar (in variables) cross-sectional logit application. However, one should note that these panel applications were based on duration (also known as hazard) models.

The determinants of firm failure literature (without the prediction element) also broadly followed similar quantitative techniques although with less emphasis on duration techniques. Bridges and Guariglia (2008) allowed for a panel logit specification while panel probit applications were also tested. They found no significant differences in the estimations. In other specifications of panel data, the discussion of the choice of panel data analysis techniques ranges between fixed effects and random effects models. Pindado and Rodrigues (2004) argued that in failure studies there is no clear answer on the choice between fixed-effects and random effects models. They opted for both specifications but found no evidence of material differences in the reported results between the two.

3.4.4.1 Key characteristics

Panel data analysis is used in situations where we have both cross sectional and time series data. Panel data can accommodate a large number of observations (for example firms or individuals) over multiple periods and therefore they accommodate both space and time (Brooks, 2008). For example, a sample of panel data may represent multiple observations on the same firms' failure situation over a period of years. In order for panel data methods to be applicable, a dataset should have the same objects (in this case firms) and measurement across time.

Panel data models may be based on balanced or unbalanced panels. Balanced is a panel when each unit (for example firms) is present in every time period across the sample, while unbalanced means each unit is not present in every time period (Gujarati and Porter, 2010). The mechanics of the balanced and unbalanced models are similar but a careful assessment of why the panel is unbalanced is required.

There are a number of advantages associated with the use of panel data analysis. Panel data is similar to pooled data where observations from the same units from different points in time are pooled together in a single dataset. However, when the parameters of a model are estimated by ordinary least square regressions, it is assumed that two aspects remain constant over time and across the cross-section. The first is the average value of the variables; the second is the relationships between them (Brooks, 2008). This is an oversimplified assumption that does not hold.

Panel data are related to units' (for example, individuals, firms', counties) observations over time and can control the heterogeneity associated with these units (Gujarati and Porter, 2009). This important feature enables the researcher to effectively control for unobserved variables that are specific to the unit. For example, when modeling firm failure with financial variables as independent variables, the problem will be for the model to account unobservable factors that affect a firm such as managerial capability, etc. Therefore any results from a cross-sectional analysis may be biased due to the lack of information on an unobservable variable. Panel data models are able to control for unobservable variables (also known as latent variables) by introducing fixed or random effects for each unit (in the example's case, in each firm) of the sample. In addition, panel data can capture effects that cannot be observed in pure cross-sectional data or in pure time series data alone.

The combination of cross-section observations with time series, gives "*more informative data, more variability, less collinearity among variables, more degrees of freedom and more efficiency*" (Guajarati and Porter, 2009, p.592). Baltagi (2001) suggests that the variability in a panel can be separated into variation between different cross-sectional units and variability within each unit. Likewise, by studying the repeated cross-section of observations, panel data can capture the changing dynamics in the data (Guajarati and Porter, 2009).

In terms of limitations, panel data may be difficult to collect and manage due to the need of a rich cross-sectional with time series sample. Many of the limitations are related to the data collection in surveys. These problems include issues of non-response in surveys or problems with insufficient coverage of the population of interest (Baltagi, 1995). Typically, panels cover a relatively short period of time in their time-series element for each unit. This means that the analysis is based on the number of units participating in the sample. Extending the time-series element of the sample may be costly. Likewise, the problem of attrition, where units are leaving the sample at some point may be relevant to panel data. This may be of significance if there is an unobservable reason why this is actually happening (Baltagi, 1995). In order to overcome this problem, we can assume random sampling in the cross-section dimension.

3.4.4.2 Panel Data and the Ordered Response Logit

One of the advantages that panel data models have is their treatment of unobserved variables. This is called unobserved heterogeneity. The treatment of these unobserved effects in a panel model can be done either by using a fixed effects or random effects treatment.

According to Wooldridge (2010), a basic unobserved effects model for a randomly chosen cross section unit i can be written as:

$$y_{it} = x_{it}\beta + c_i + u_{it}, \qquad where\ t = 1, 2 \ldots., T$$

Where, i represents an individual (for example a firm) and t indicates the period (for example, the year); x_{it} is 1×K, and can contain observable variables that change across t but not across i; variables that change across i but not across t and variables that change across both i and t. The u_{it} in the equation above are called idiosyncratic errors or idiosyncratic disturbances because they change across t and i. The c_i in the equation above is the unobserved heterogeneity element, also known as individual effect. The discussion on whether a panel model is a fixed effects model or a random effects model is related to the treatment of the individual effect.

The broad direction is that c_i should be treated as a random effect when c_i is viewed as a random variable and as a fixed effects when it is treated as a parameter to be estimated for each cross-sectional observation. A random effects framework means that the c_i should experience zero correlation between itself and any of the observed explanatory variables (Wooldridge, 2010). However, for the fixed effects treatment, the c_i is allowed to be correlated with the observed independent variables. In every case the potential existence of non-time varying independent variables points to the usage of random effects panel models.

Due to the importance of the choice between fixed and random effects treatment for the individual heterogeneity, the Hausman test can be applied in linear panel models. The Hausman test is based on the difference between fixed and random effects estimates. However, there are limitations on the potential applicability of the Hausman test.

- The assumption of strict exogeneity. That means that $E(y_{it}|x_{it,}c_i) = E(y_{it}|x_{it,}c_i)=x_{it}\beta + c_i$.

  When this assumption holds we say that the independent variables x_{it} are strictly exogenous conditional on the unobserved effect c_i (Wooldridge, 2010). Given the equation $y_{it} = x_{it}\beta + c_i + u_{it}$ the strict exogeneity assumption can also be stated in terms of the idiosyncratic errors as: $E(u_t|x_{i1,} \dots x_{iT}c_i) = 0 \; with \; t = 1,2, \dots, T$. This implies that the individual effect and the idiosyncratic disturbance are uncorrelated. Moreover, this implies in turn, that independent variables in each period are uncorrelated with the idiosyncratic error in each period and therefore $E(x'_{is}u_{it}) = 0 \; where \; s, t = 1,2,, T$ (Wooldridge, 2010).
- Since the fixed effects identify the coefficients on time-varying explanatory variables, we cannot compare fixed effects with random effects on time-constant variables.
- Assumes homoscedastic behaviour of the individual effect.

Despite the above, evidence from the failure literature shows that it is sometimes difficult in practice to discriminate between fixed effects and random effects models. Pindado (2004) argued that using both specifications can produce similar results. The above panel data model characteristics are particularly applicable in linear models, such as the ones that will be used in spatial analysis, but are less relevant to non-linear models such as ordered logistic regression.

For panel ordered logistic regressions, Greene and Hensher (2010) proposed a test for the choice between fixed and random effects when the time invariant variables are excluded from the model. It is based on a likelihood ratio test and can be used instead of the Hausman test (Greene and Hensher, 2010). This test has two steps:

i. First, a random effects model with the time varying independent variables should be used. A second model containing the same variables and additionally including the group means of the variables should be employed. The purpose of the means is to control the correlation between individual effects and the independent variables. Therefore, the group mean of variables should account the correlation between the individual effect and the regressors (Greene and Hensher, 2010).
ii. Second, a likelihood ratio test should be carried out as a variable addition test of joint significance of the group means. Specifically, the estimates of the two models with and without the group means of the time-varying variables should be compared with the likelihood ratio, on the null hypothesis that the coefficients on the means are all zero. If this null hypothesis is rejected then the fixed effect approach should be undertaken. If such a correlation does not exist then the random effects model should be appropriate (Greene and Hensher, 2010).

3.4.5 Spatial Panel Regressions

The advantages of introducing a spatial effects into a panel data model are related to the likelihood that the units (such as countries, regions) differ in geographical backgrounds, with unobserved variables that are space-specific and time-invariant. These are hard to measure but may affect the dependent variable (Elhorst, 2014). Such examples include variations in culture/people across different areas, or different social interactions and behavioral norms between individuals in different places. For panel data, spatial panel analysis may be relatively complicated as it usually requires inclusion of location metrics (such as geographical co-ordinates).

Spatial panel data have the same distinctions with the panel data as far as the panel element is considered, with the choice between fixed or random effects models. However, there are also distinctions regards to the treatment of the spatial element. Some of these restrictions have implications on the fixed and random effects selection. Mutl and Pfaffermayr (2008) considered the estimation of spatial panel data models using both fixed and random effects specifications, and propose a Hausman-type specification test to test for the nature of the individual effect. However, Elhorst (2004) argued that fixed effects spatial panels can only be meaningfully estimated when the time element is sufficiently large. On the other hand, a random effects model does not have this requirement.

There are mainly two key categories on the types of spatial dependence, with some further variations. Spatial dependencies may lie on the disturbances (known as the spatial error model - SEM) or on the dependent variable, known as a spatial lag or spatial autoregression model (SAR) (LeSage and Pace, 2011; Anselin, et al., 2008; Coughlin et al., 2003). In spatial model specifications, the dependent variable and/or the error terms are correlated across space (Coughlin et al., 2003). Anselin et al., (2008) suggest that the spatial lag model is appropriate when the focus of the analysis is on the assessment of the existence and the strength of the spatial interaction. The spatial error model on the other hand, is appropriate when the aim of the analysis is to correct the potential biases arising from spatial autocorrelation due to the usage of spatial data.

For the estimation of spatial panels there is not a widely acceptable estimation method. While in theory a spatial panel can be estimated in a similar way to a cross-sectional or any linear panel model, collecting data in that way may result in loss of information around the spatial effects (Elhorst, 2014). There are broadly three methods to estimate models that account for mixed dynamics in space and time (Elhorst, 2014). The first method is to bias-correct the maximum likelihood (ML) or quasi-maximum likelihood (QML) estimator (Elhorst, 2014). The second method is based on instrumental variables or generalized method of moments (IV/GMM). The third method utilizes the Bayesian Markov Chain Monte Carlo (MCMC) approach (Elhorst, 2014). Although there are considerable debates over the choice of the best estimator for spatial panel logistic regression, some authors argue that despite the computational heaviness that is requested under a maximum likelihood estimator, this is an efficient estimator that has been popular both in cross-section logistic regressions as well as in panel logistic regressions. Therefore, for comparability purposes, the maximum likelihood estimator will be used in this study.

Pinkse and Slade (1998), Kelejian and Prucha (1998), and Klier and McMillen (2008) proposed a Generalized Methods of Moments (GMM) as a robust estimator. However, the correct application of GMM requires orthogonality conditions that are not easily applicable to multiple-response models (Wang et al., 2012). Bayesian frameworks have also been proposed in the wider literature (Wang et al., 2012) but with few applications in the firm failure area due to the complexities and the subjectivity of applying such techniques. In particular Bayesian applications have been criticized for the subjective elements of the Bayesian inference (Gelman, 2008).

3.5. Quantitative Approaches used in this Study

The aim of this study is t*o enhance the quantitative firm failure process literature on SMEs, by incorporating elements from the qualitative failure process and the wider firm failure literature.*

To achieve this aim , a number of different techniques will be used. First, factor and cluster analysis will be performed to identify the alternative firm failure processes in firms from the EU countries and within the UK regions. Secondly, panel data ordered logistic regression will be used to investigate the determinants of firms' transition to failure in the alternative firm failure processes, both in the EU countries and within the UK regions. Finally, linear spatial panel data analysis will be used to investigate the potential existence of spatial effects between firm failure processes in the EU countries and within the UK regions. Such a technique is used for the first time in the quantitative firm failure process literature and the wider SME failure literature. For this reason the hypotheses associated with this are introduced in this chapter. A number of associated statistical tests are also performed prior to these techniques. The statistical tests are discussed in each individual empirical chapter.

i) Factor and Cluster Analysis

Factor and cluster analysis will be used to identify the alternative firm failure processes that are present in EU and UK firms, using a number of firm-specific characteristics proposed in the literature. This is associated with the main aim of the study and the first/second objectives. It considers financial ratios and the impact of firms’ management characteristics to identify alternative firm failure processes in the EU and the UK. It also investigates the determinants of firms’ transition to failure in the EU and the UK. The combination of factor and cluster analysis has been selected as a way to identify firm failure processes (Laitinen, 1991; Lukason and Hoffman, 2014; Lukason and Laitinen, 2016; Laitinen et al., 2014).

Factor analysis is a technique *whose purpose is "to define the underlying structure among the variables in the analysis"* (Hair et al., 2006, p.104). In this thesis, factor analysis is used to summarize the firm specific-characteristics to reduce the number of variables that enter the cluster analysis process. Cluster analysis will then be used identify the alternative firm failure processes for the firms in the EU countries and the UK regions.

ii) Panel Data Ordered Regression

Panel data ordered regression models will be used to investigate the determinants of firms’ transition to failure in the alternative firm failure processes. This will enable the thesis to address part of its aim which is to identify the determinants of firms’ transition towards failure. Moreover, panel ordered regressions will assist in addressing the second and third objectives related to the impact of firms’ management characteristics (in addition to the financial ratios), and the influence of business environment and excessive growth in firms’ transition to failure.

The advantages of panel data analysis in business finance and firm failure studies are well documented in the literature as discussed in section 3.4.4. However, there has been limited work undertaken to identify the determinants of firms’ transition to failure in the quantitative firm failure process studies. Panel data can add value by controlling the existence of individual heterogeneity between firms. In addition, the traditional logistic regression based on cross sectional data remains one of the most popular techniques in firm failure studies (Balcaen and Ooghe, 2006).

Results from simple ordered regression without the panel element will be used as benchmark for robustness checking purposes. One should note that the majority of the firm failure studies use binary definitions for the dependent variable (usually within the context of logistic regression). As it was explained in Section 3.3, this study uses ordered logistic regression in panel and spatial panel contexts.

iii) Linear Spatial Panel Analysis

The aim of the third empirical chapter (Chapter 7) is associated with the fourth objective of this study. In particular, it employs spatial panel data analysis to investigate the impact of spatial location in aggregated firm failures from the sample.

The quantitative approach that is chosen is a linear spatial panel model. The theoretical advantage of this approach is associate with the advantages of spatial data in general. Spatial panel data account for potentially spatially correlated disturbances (across European countries and U.K. countries/regions) in addition to the normal time wise correlation (Arnold and Wied, 2014).

The usage of spatial econometric techniques has seen growing interest within economic studies because these models introduce a different angle to the analysis of relationships between agents. In fact, the focus is shifted from the individual agent (in this case the firm) where decisions are made in isolation to an approach where the interaction between agents matters (Anselin, 1999; Diggle, 2013). Wang et al. (2012) argued that spatial data are particularly relevant for economic-related studies, especially when considering different geographical locations. In an increasingly inter-connected economy the cross-sectional independence assumption between a sample's observations (e.g. firms) is becoming less relevant (Wang et al., 2012). Similarly Cravo et al., (2014) showed the presence of spatial dependence in growth patterns on a sample of Brazilian SMEs. Likewise, spatial interactions could be due to competition between cross sectional units (in this case, businesses), business network issues, spill-overs of issues affecting firms' failure, and regional issues (Kapoor et al., 2007).

For the purpose of this study, the focus on the spatial effects will be at firm failure process in EU countries' and the UK regions' level. Firm failures are therefore aggregated at the alternative firm failure processes of the EU countries and at the alternative firm failure processes of the UK regions. However, the focus of the spatial analysis (which is discussed in Chapter 7) is on the existence of spatial effects. As such this chapter introduces 2 hypotheses, with two variations each, which will be further investigated in Chapter 7:

Hypothesis 13a*: There are statistically significant spatial effects associated with EU firm failures.*
Hypothesis 13b*: Spatial effects are the same between alternative firm failure processes in EU firms, in terms of statistical significance.*

Hypothesis 14a*: There are statistically significant spatial effects associated with the UK firm failures.*
Hypothesis 14b*: Spatial effects are the same between alternative firm failure processes in UK firms, in terms of statistical significance.*

In order to investigate and address the above hypotheses, a maximum likelihood estimator will be used, in line with STATA 15 procedures for spatial panel data analysis. In addition, the Greene and Hensher (2010) likelihood ratio test as well as the Hausman test for the existence of fixed or random effects will be employed. The model specification will include a spatial weights matrix and will control for spatial dependencies in the dependent variable and in the error terms. This approach is chosen because the study is interested in identifying the existence of spatial interaction in firm failures in the alternative firm failure processes. As such, Anselin et al., (2008) suggest that the spatial lag model is appropriate in that case. On the other hand, controlling for spatial effects in the residuals is also helpful for ensuring there is no bias arising from spatial autocorrelation resulting from the use of spatial data (Elhorst, 2014). In addition, a simple, non-spatial model will be used for robustness check purposes.

3.6. Conclusions

This Chapter discussed the key statistical techniques that have been used in the literature of firm failure studies. It also explains the rationale of methodologies that will be used in this thesis. Factor and Cluster Analysis, Ordered Panel Logistic

Regression and Spatial Panel Analysis will be the primary econometric techniques used to test this study's hypotheses. These techniques are discussed further and are used in Chapters 5, 6 and 7.

CHAPTER 4: DATA

4.1 Introduction

The aim of this chapter is to explain the sources of the data used in this study. The firms' data have been sourced during 2014 – 2015 from the Amadeus (Bureau Van Dijk) database. They were then saved and analyzed in STATA 14 and subsequently STATA 15. Macroeconomic data for the EU countries have been collected from the World Bank database (http://data.worldbank.org/) in 2016. Some additional macroeconomic data for the UK regions were obtained from the Office of National Statistics (ONS), over the same period. Further discussion and analysis of these data is presented in the relevant sections of Chapters 5, 6 and 7.

The remaining of this chapter is structured as follows. Section 4.2 presents the process and the criteria of the data collection; Section 4.3 discusses the dependent variable; Section 4.4 presents the independent variables; Section 4.5 discusses the missing values and Section 4.6 concludes the chapter.

4.2 Firm Dataset creation

The firm-specific data for this study were sourced from the Amadeus database. The Amadeus database provides multi-year information for the financial accounts, the directors' characteristics and the date of the status of the company. The year of the financial information was used to match the financial accounts data with the directors' information and the date of the status of the firm.

At the time of the data collection, the Amadeus database included financial and directors' characteristics from the last 10 years. As a result firms' data covering the period from 2004 to 2013 were available and formed the data period of the study. Status information (and date) for the firms covers year 2014. This was the maximum number of years that was available from the database. However, this period is useful for the purpose of the study for a number of reasons. It covers a business cycle that includes a financial crisis. As a result, a satisfactory number of firm failures was recorded in the database. The vast majority of firms started to enter liquidation from 2008 onwards. In addition, due to the changes in the economic environment over this period, the dataset allows a number of hypotheses around the business, economic and legal traditions environment to be tested. Moreover, this is one of the longest periods that has been covered in quantitative firm failure process studies.

The data collection for the firms used in this study used a multi-step process to select a sample that would be able to support the aim and objectives of the thesis. The data needed to include failed SMEs from a wide range of EU countries that would be of sufficient diversity in order to cover different business and economic environments, including legal traditions (see Chapter 2 for discussion). For these reasons the following steps were taken:

- The first step was to identify failed firms in the Amadeus database. This was achieved by using the relevant field selection in the database. This selection used the legal definition of "failure" that includes firms in liquidation (active and non-active), in receivership, or under bankruptcy. Each of the participating countries has slightly different legal terminology for the firms that are in a terminal stage of their business cycle. The Amadeus database provides the appropriate terminology. For the purpose of this study, receivership, liquidation and bankruptcy are deemed as equivalent legal statuses in nature and are considered as the terminal stage of firm failure. The status of the firms is identified from the relevant (status) field of the Amadeus database. Firms "in liquidation", "in receivership", "in bankruptcy" (active or dissolved) and firms under insolvency proceedings are classified as liquidated (status 2) for the purposes of this study, in line with other studies in the area (see for example Filipe et al., 2016). The approach of using the legal definition as a failure definition is consistent with other firm failure studies (see for example Charitou et al., 2004). For any firm to be eligible for selection and download from Amadeus, it should have at least one year's data prior to the liquidation date in order to have some pre-insolvency information for the identification of the failure processes. By using liquidation status dates firm data are matched with the status of the firms at the t-1 year (one year prior to the insolvency date) in line with Laitinen et al., (2014) and Appiah (2013).

- The second step was to identify firms whose size was within the SME definition. The choice of firms from the various countries were selected to have less than (or equal to) €43m in total assets or less than €50m turnover, in line with the European Union (EU) definition (European Commission, 2015). The selection of firms is not based on the maximum number of employees (which is a further EU criterion for SMEs having up to 250 employees) as this criterion is not always disclosed for all firms (Laitinen et. al., 2014). In order to comply always with at least one of the above criteria, total assets have been identified as a variable that is always available in all the firms of the sample and does not have any missing values. Therefore the total assets of a firm being up to or less that €43m always applies.

- The third step was to filter out firms which had all of their financial and director information values missing (see section 4.5 for missing values).

- The fourth step was to keep only countries that had at least 100 firms in the sample once the filtering process decribed above had been completed. The selected minimum number of firms from each country matches or exceeds the average number of failed firms that typical firm failure process studies use (see for example Laitinen et al., 2014) and it is regarded as a sufficient sample in this type of studies.

The countries that resulted with firms that complied with the above selection process were the UK, Spain, Italy, Germany, Sweden, Netherlands, Ireland and France. A review of these countries demonstrates that their selection fulfils the diversity criteria for the business and economic environment. The UK and Ireland are under the common law legal tradition whilst the other countries in the sample are under the civil law legal tradition. Within the civil law tradition all the major distinctions (French, German and Scandinavian) are represented (see section 4.4.6). Likewise, the economies of these countries are diverse in terms of their GDP growth and credit availability in the period that this study covers. For example, some countries such as Ireland, Italy and Spain had a more pronounced GDP reduction in 2008-2009 compared to countries such as Germany and Sweden. Similarly, the credit availability (as a percentage of GDP) differs significantly between these countries. For example Ireland's, Germany's, Spain's, Netherland's, Sweden's and UK's credit availability to private sector reduced after 2009. By contrast, Italy's and France's credit availability (as a percentage of GDP) increased after 2009 and started deceasing in 2013. The resultant 8 countries compare favourably with current evidence in the quantitative firm failure process literature. A number of studies tends to focus on one country (see for example, Lukason, 2018; Lukason et al., 2015). From the few studies that perfrom a multi-country comparison, most compare between 2 and 6 countries (see for example, Laitinen et al., 2014; Laitinen and Lukason, 2014), and the exceptions which investigate more than 6 countries point to the fact that some countries are represented with less that 100 firms and as such they focus on the countries that have sufficient representation in the sample (see for example Lukason and Laitinen, 2016).

As a result, the sample of this study provides an improvement over samples that have been used in the existing quantitative firm failure process literature. In addition, the composition of the 8 countries in the sample varies from the current literature and as such, the sample extends the quantitative firm failure process comparison within EU countries, where the evidence is currently insufficient. The Netherlands, Germany, Sweden and Ireland are currently examples of EU countries whose firms have not been considered in the context of firm failure process studies.

However, whilst the sample of firms from 8 EU countries with sufficient representation of firms in each country is an improvement over the current quantitative firm failure process literature, there is still a certain limitation associated with it. Generalization of results for every EU country should be made with caution, especially if the results show that there is an association between firm failure processes and countries. However, the key conclusions around the importance of the determinants should provide a good basis for further research (see Chapter 8 for further discussion).

Once the sample was put together, following the steps described above, an audit on missing values at firm level was performed. Some liquidated firms remained in the sample after the year of the liquidation event with all of their financial information missing. Thus years post-liquidation were removed from the sample if there was no financial information available. This is consistent with the panel data structure where firms leave the dataset once they fail. Therefore the final dataset covers 5,195 firms which have failed at some point during the period of the study. This makes a total of 40,122 firm-year observations. Table 4.1 provides information for the distribution of firms across the countries in the sample. Further details about the dataset used in this thesis are given in each of the empirical chapters.

Table 4.1: Distribution of Firms in Each country

Country	Number of Firms	%
France	774	14.90%
Germany	736	14.17%
Ireland	114	2.19%
Italy	1,245	23.97%
Netherlands	185	3.56%
Spain	1,042	20.06%
Sweden	120	2.31%
United Kingdom	979	18.85%
Total	**5,195**	**100.00%**

One of the objectives of this study is to investigate the firm failure processes within the UK. In order to do so, a filter was applied to select the UK firms. Therefore, a sub-set of the 979 UK firms was created for Chapter 6. The area within the UK was identified by using the "region" filed in the Amadeus database. The definition of Amadeus "region" was then standardized according to the NUTS-1 definition. In order to do so, a mapping between the Amadeus' "region" filed and the first level of the European Commission NUTS-1 identifier (for UK regions) was used. NUTS-1 was initially defined with the EC No 1059/2003 and later had a number of amendments until its most recent (EC 2016/2066). This thesis uses the latest version of the NUTS-1 classification. The distribution of UK firms in the regions (under the NUTS-1 definition) is shown in Table 4.2.

Table 4.2: Distribution of Firms in UK region

UK areas	Number of Firms	%
Yorkshire & Humber	104	10.62%
East Anglia	41	4.19%
East Midlands	33	3.37%
London	369	37.69%
N. Ireland	20	2.04%
North East	17	1.74%
North West	153	15.63%
Scotland	54	5.52%
South East	74	7.56%
South West	25	2.55%
Wales	18	1.84%
West Midlands	71	7.25%
Total	**979**	**100.00%**

4.3 The Dependent Variable

The sample of the study has been selected in a way that gives information on the year and firm's status. A new variable called event_failure has been created to be the dependent variable for the study.

The new firm-year variable ("*event_failure*") is defined as follows:

i) It takes the value "2" at the year when the status information of the firm is classified as *in liquidation/bankruptcy/receivership*. As mentioned above, this is matched with financial information from the year before, incorporating the t-1 rule of matching firms' data with their status. That is consistent with other quantitative examples from the failure process studies (see for example Laitinen et al., 2014; Laitinen 1991) as well as with failure prediction studies (see for example Altman et al., 2010). A firm which went into liquidation in 2013 will be marked as "2" in the *event_failure* in the year that is using 2012 financial data. Following Ferreira Filipe et al., (2014), the *event_failure* also takes the value "2" in the last observation with available financial data of a firm that is marked as "liquidated" or "bankrupt" before it leaves the sample, in cases where the status date is not available. For the years prior to a firm becoming liquidated (excluding the year t-1), *event_failure* takes the value of 0 or 1 (see following paragraph).

ii) The study considers the financial distress as an additional "failure" status. The literature review section showed that firms in financial distress are defined as those which have negative equity in a year. Therefore, the *event_failure* variable takes the value of 1 for any year in which a firm is in negative equity and is not under *event_failure* status of 2.

Table 4.3 shows the distribution of the newly defined *event_failure* variable across countries. The average time in the sample for any firm is 8.5 years.

Table 4.3: Distribution of Firm- Year Observation across event_failure values.

Event_failure in Firm Year Observations				
Country	**0**	**1**	**2**	**Total**
FRANCE	3,959	956	774	5,689
GERMANY	3,087	758	736	4,581
IRELAND	514	398	114	1,026
ITALY	7,420	768	1,245	9,433
NETHERLANDS	890	203	185	1,278
SPAIN	6,097	504	1,042	7,643
SWEDEN	606	140	120	866
UNITED KINGDOM	6,913	1,714	979	9,606
Total	**29,486**	**5,441**	**5,195**	**40,122**

From Table 4.3, one can observe that the *event_failure=2* matches the total number of firms. This is because once each firm eventually failed and left the sample in the following year, creating an unbalanced panel where the reason of firms leaving the sample is known. In addition, one can observe that, a number of firms enter the financial distress (*event_failure=1*) status. In some countries such as Ireland, Sweden, France, Germany, the Netherlands and the UK firms stay in financial distress for a year or more, on average. In other countries, such as Italy and Spain, not all firms enter the stage of financial distress.

4.4 Independent & Control Variables

The study uses a number of independent variables based on the literature review and with data availability. The independent variables that are used in this study are broadly in three categories:

i) **Firm specific characteristics:** the financial ratios, the age of the firm, directors' characteristics.
ii) **Economic and Business Environment characteristics:** the GDP and GVA growth, the credit availability, the legal tradition of each country and the percentage of new firms in a UK region.
iii) **Wider control variables:** the industry, the location of the firm and the presence of excessive growth in firms.

Firm specific characteristics are used for the identification of the alternative firm failure processes in the EU countries and the UK regions. Economic and Business environment characteristics, together with the wider control variables are used, in addition to the firm specific characteristics, to analyse the firms' transition to failure in the alternative firm failure processes.

This chapter presents and defines the variables that are available from the sample and will be used to test the research hypotheses. The purpose of this chapter is not to provide specific analysis on any of these variables. This is done in the analysis chapters (Chapters 5-7). However, the source of the data is explained, where relevant.

4.4.1 Financial Ratios

The sample includes balance sheet and profit-loss account data that can be used to formulate financial ratios. Different authors have proposed different financial ratios and the literature does not provide a definite answer to which ratios are the best to be used. However, financial theory suggests that the basic financial dimensions of growth, efficiency, profitability, cash flow, leverage and liquidity are important determinants of a firm's financial performance and failure propensity (Laitinen et al., 2014; Laitinen 1991). Financial ratios that have been used in previous studies fall into the above categories.

i) Return on Investment

Return on Investment (ROI) belongs to the category of profitability ratios that measure the return earned by a firm in a period. It is defined as profit (loss) before tax, divided by total assets (Robinson et al., 2009). Its inclusion in the analysis is motivated by Laitinen et al., (2014), Altman et al., (2010) and Pindado and Rodrigues (2004). The rationale for using the ratio is that firms should provide sufficient returns to their owners in order to remain viable.

ii) Growth Rate in total assets

Rate of growth in total assets (Growth_rate) is defined as the year on year percentage growth in a firm's total assets. Its inclusion in the analysis is motivated by Laitinen et al (2014) and Argenti (1976). Growth rate has been one of the fundamental drivers in Argenti's (1976) failure trajectories, it is also linked with the sustainable growth concept (see below).

iii) Net Sales to Total Assets

Net sales to total assets (NSTA) is motivated by Laitinen (1991) and Altman (1968). This is a capital turnover ratio that demonstrates a firm's ability to generate sales from the given firm's assets (Altman, 1968).

iv) Cash Flow to sales ratio

Cash flow to sales ratio (CFTS) has been one of Laitinen et al (2014) ratios and one of the first financial ratios that Beaver (1966) proposed. The motivation behind the consideration of the CFTS ratio is that a cash flow ratio shows the ability of the firm to build a cash buffer against any variations of cash inflows and outflows, and therefore the solvency of the firm can be defined in terms of the probability that this buffer may be insufficient leaving the firm unable to pay for its obligations (Beaver, 1966).

v) Total Liabilities to Total Assets

An alternative definition in the literature has been the total liabilities (also known as total debt) to total assets (TLTA) ratio (Altman et al, 2010; Deakin, 1972; Shumway, 2001; Appiah, 2013). TLTA directly measures the total debt of a firm compared to its total assets. Theory suggests that a firm's indebtedness is a determinant of firms' failure (Appiah, 2013).

vi) Quick ratio & Quick Assets to Current Assets

The quick ratio is a measure of a firm's liquidity and its usage has been motivated by the work of Deakin (1972), Laitinen (1992) and Pindado and Rodrigues (2004). The quick ratio considers the cash available in a firm and the accounts receivable divided by the current liabilities of the firm. A similar in nature ratio has been used by Altman et al (2010) in the form of the quick assets to current assets (QACA) which reflects the working capital of the firm.

vii) Trade Credit as a proportion of Total Liabilities

Trade Credit to total liabilities (TCTL) is a measure of trade credit (as opposed to bank credit) as a percentage of the total debt of the firm. The rationale for including the TCTL ratio is to control for the usage of trade credit that firms use between countries as this is a source of credit that small firms rely on when bank credit is not available to them (Altman et al., 2010).

4.4.2 The Age of the Firm

The age of the firm ("firmage") is a characteristic that has been associated with alternative firm failure processes in the qualitative failure process literature (see for example Argenti, 1976). Young firms, defined as those that are younger than 10 years old (Wagner, 2004; Davidsson and Klofsten, 2003) are additionally regarded as more likely to fail (Fichman and Levinthall, 1991) and as such, the age of the firm can also be a determinant of firms' transition to failure.

4.4.3 Directors' characteristics

i) Measuring the Directors' Experience: Age of directors

The age (Avg_dir_age) has been used as a proxy of the experience of the management of the firm in a number of studies (see for example Zhao and Aram, 1995; Watson, 2007). The dataset provides information for the number of directors and the age of each of them. For practical reasons the average age of directors is used as the "Avg_dir_age" for each firm. This is calculated by summing the total age of all the directors of the firm and dividing it with the total number of directors.

ii) Measuring the Directors' Knowledge and Networks: The Number of directors

The number of directors ("Total_Dir_Nr") has been used as a proxy the for the social and human capital, the knowledge and range of business and social networks of the board in line with evidence in a number of studies (see for example Zhao and Aram, 1995; Watson, 2007). The dataset provides information about the number of directors for all the EU firms. The number of directors is checked and implies ownership in most firms. This is consistent with the SME literature were firm directors are usually co-owners of the firm. Meanwhile, the UK firms are using a slightly wider definition of directors that may include directors without ownership of the firm. For this reason, a number of robustness checks are performed in Chapter 6.

iii) Measuring Directors' Diversity: Number of Female Directors

The number of female directors (female_nr) have been used as an indicator of board gender diversity. The existence of a diverse board of directors in terms of sex (measured by the number and/or the existence of female directors) has been associated with fewer firm failures – even in the small firms (see for example Altanlar and Wilson, 2013).

4.4.4 Macroeconomic Environment

Two key metrics have been used to control for the economic environment in the EU firms. These are the GDP growth and the credit availability to the private sector expressed as a percentage of a country's GDP. In addition, for the UK firms, GVA growth has been used because of its advantage of being available at regional (as opposed to country) level. According to the UK Office of National Statistics (ONS) the GVA plus taxes and less subsidies on products is equivalent to gross domestic product (GDP) (ONS, 2016, pp. 2). GDP growth (GDP_Growth) and credit available to the private sector information have been collected from the World Bank database and covers all countries in the sample. GVA growth has been obtained from the UK Office of National Statistics (ONS).

Including these variables will enable this analysis to evaluate, for the first time in a quantitative firm failure process study, the effects of the macroeconomic environment on firms' transition to failure. GDP growth as a key macroeconomic variable has been used in Casten et al. (2010) (for corporate defaults) and credit availability has been cited by a number of authors as a trigger of small firms' failure (see for example Somoza, 2011). Credit availability is expressed as a percentage of a country's GDP. In particular, it is defined as the credit available to the private sector divided by a country's GDP. In addition, for the analysis of UK firms' transition to failure (including the spatial analysis), the GVA growth at regional level has been used instead of the GDP growth for robustness checks (in Chapter 6) and for the spatial analysis (Chapter 7).

4.4.5 Industry

The sample provides information for the sector of the firm ("gensic") by using the US SIC code classification. The classification available in the sample includes the division level and the more granular group-code level. Table 4.4 presents the distribution of EU firms for each industry classification.

Table 4.4: Description of industry variables and number of failed EU firms in each industrial classification.

US SIC code at division level	Group Codes	Var. Name	Nr. Of firms	Percentage
Division A: Agriculture, Forestry, And Fishing	01-09	gensic 1	243	4.7%
Division B: Mining	10-14	gensic 2	16	0.7%
Division C: Construction	15-19	gensic 3	912	17.6%
Division D: Manufacturing	20-39	gensic 4	1,074	20.7%
Division E: Transportation, Comm. & Sanitary Serv	40-49	gensic 5	403	7.8%
Division F: Wholesale Trade	50-51	gensic 6	841	16.2%
Division G: Retail Trade	52-59	gensic 7	271	5.2%
Division H: Finance, Insurance, And Real Estate	60-67	gensic 8	669	12.9%
Division I: Services	70-89	gensic 9	766	14.7%
Total			**5,195**	**100.0%**

As Table 4.4 shows, firms tend to be concentrated around the manufacturing, construction, wholesale trade, finance, insurance and real estate and other services sectors. Most of the firms in category gensic 8 (finance, insurance, real estate) tend to be real estate agents and brokers as opposed to finance firms as the criteria on size of SMEs does not allow for any financial institutions to participate in the sample.

4.4.6 Legal Tradition

The legal origins of the firms is one of the fundamental variables that are used to identify whether the legal tradition of the country where a firm is based influence its transition to failure. The legal origins of the firms in the study will be defined by the country where a firm operates. A new variable "leg_trad" is created and is defined based on the legal tradition of each country. It takes the value of 1 for firms associated to common law (UK, Ireland) and 0 for firms associated to legal traditions of civil law tradition (French, Scandinavian or German law and therefore the remaining countries).

4.4.7 Competition from New firms in a UK region

For the analysis of firms' transition to failure in UK regions, an additional variable for the economic environment is considered (as a replacement for the legal tradition variable that is no longer valid within a same-country analysis). The UK-region-specific variable measures the number of new firms (in a UK region) as a proportion of the existing number of firms in that area. As it will be explained in Chapter 6, the motivation for using this variable is related to evidence from the qualitative failure process literature (Argenti, 1976; Ooghe and De Prijcker, 2008) that included increasing competition as an influencing factor in firms' failure. As such, the percentage of new firms in a region ("new_firms_perc"), sourced from UK's Office of National Statistics (ONS), is used and is tested to identify whether it is a determinant of firms' transition to failure for any of the firms in the alternative firm failure processes.

4.4.8 Sustainable growth

The concept of sustainable growth ("SGR") has been linked to the firm failure. The growth of a firm has been seen as a determinant of the failure process (Argenti, 1976; Laitinen, 1991; Laitinen et al., 2014). Higgins (1977) introduced the concept of the optimum growth of the firm. The representation is (Higgins, 1977 p.8):

$$sustainable\ growth\ rate\ in\ sales = \ g^* = \frac{p(1-d)(1+L)}{t-p(1-d)(1+L)}$$

Where:

p : the profit margin on sales;

d : the target dividend payout ratio;

L: the total debt to equity ratio;

t : the ratio of total assets to net sales;

s : sales at the beginning of the year;

Δs : increase in sales during the year.

Platt et al., (1995, p.148) provided an alternative SGR calculation for firms that do not have access to equity and debt markets. This definition may be closer to SMEs and is as follows:

$$\Delta A = \Delta R + \Delta R(\frac{D}{E_{bop}})$$

Where:

Δ: Difference operator;

R: Retained Earnings;

D: Total Debt;

A: Total Assets;

E: Equity;

bop: stands for the beginning of the period.

This can be written as:

$\Delta RT_{bop} = A(\frac{\Delta S}{S})$ *and* $g^* = \frac{\Delta RT_{bop}}{A}$ where

Where:

Tbop: Ratio of total assets to Equity;

S: Sales;

g*: the sustainable level of sales growth.

The SGR dummy variable takes the value of 1 if the firm’s total sales exceed the sustainable growth rate (g*) and the value of 0 otherwise.

4.4.9 Geographical Coordinates

In order to make the spatial analysis of Chapter 7 possible, the geographical locations of the EU countries and UK regions were represented by their geographical coordinates: their longitude and their latitude. For each EU country and UK region, the centroid coordinate was identified and its longitude and latitude was obtained. These data were downloaded from the LatLong.net database. LatLong.net is an online geographic database that provides the latitude and longitude of any country and/or city and region in the world. The data are based on GPS coordinates and comply with the World Geodetic System (WGS) standard and the data collected were verified in Google Maps.

4.5 Missing Values treatment

Missing data is an issue when dealing with financial data (Tucker, 1996; Wilson and Summers, 1999) and researchers tend to ignore or not report missing values information (Saunders et al., 2002). In this research, the sample has excluded firms that have permanently all their financials missing during all years. However, some missing values still exist (Table 4.5). Eliminating missing data completely has material disadvantages as it causes sample-selection bias. This means that failed firms are more likely to have some missing values and omission of firms with some missing observations could cause estimation errors (Zmijewski, 1984) as small firms are more likely to have incomplete data partly because not all of them are obliged to file full accounts (Balcaen and Ooghe, 2006; Wilson and Summers, 1999).

Table 4.5: Missing Values (%) in the Independent Variables

Missing Values in Independent Variables	
Variable	**Missing %**
ROI	5%
total_assets (and growth)	0%
NSTA	4%
CFTS	8%
TLTA	0%
QACA	5%
TCTL	5%
SGR	7%
Quick_ratio	4%
Avg_dir_age	6%
Total_dir_Nr	5%
Female_nr	5%
US_SIC_code	0%
GDP_Growth	0%
Leg_trad	0%
New_Firms_perc	0%
GVA	0%
Credit	0%

The degree of randomness in missing values should be considered if any remedy action is to be taken. However, evidence from the literature suggests that low levels of missing values do not generally require treatment, especially in large samples. Hair et al., (2006) suggests that the researcher should seek whether there are specific patterns on the missing data and consider two options in general. The first is to ignore the missing data considering that this may create some noise in the accuracy of the results. The other is to use some remedy for substituting the missing values. However, substitution of missing values can create bias in the data. The definition of an optimal cut-off, below which no missing values is required has been debated in the literature. Hair et al., (2006) and Bennett (2001) suggest that, as a rule of thumb, variables with up to 10% missing values do not require treatment while Schafer (1999) recommends 5% as a maximum percentage of missing values and Peng et al., (2006) recommends a 20% maximum missing value percentage for no action.

The missing values in the sample are closer to the lower of the above recommendations and there is no evidence of an existence of a non-random pattern in the missing data[13]. As a result, there will be no action for treating missing values.

4.6 Conclusion

The data sample for this study has been collected and data-managed. A number of firm-specific, business and economic environment-specific and wider control variables have been identified/collected. These will be used and analysed in the following empirical chapters in order to identify the alternative firm failure processes and the determinants of firms' transition to failure in the EU countries (Chapter 5), the UK regions (Chapter 6). In addition, the role of location is further analysed by using geographical location information in Chapter 7.

[13] A tabulation of the missing values suggested no concentration related to the status of the firm, the year, or the country of the firm.

CHAPTER 5: EU COUNTRIES' FIRM FAILURE PROCESSES

5.1 Introduction

The previous chapters set out the research questions and hypotheses, the analytical methodology of the research and the data that are going to be used. A number of this thesis' objectives are looking at the SMEs in the EU countries that this study considers. In particular, the first objective is to investigate the alternative firm failure processes between EU countries by considering financial ratios and the age of the firm; the second objective is to investigate the impact of firms' management characteristics, in addition to the financial ratios and the age of the firm, in the identification of failure processes and their transition to failure between EU countries; the third onjective is to investigate the influence of business environment factors, management characteristics and excessive growth, in firms' transition towards failure in the alternative failure processes in EU countries.

This chapter analyses the factors that affect the different firm failure processes in EU firms. It uses firm specific characteristics (the financial ratios, the age of the firm and directors' characteristics) to identify the alternative firm failure processes. Subsequently, it assesses whether these characteristics, as well as a number of non firm-specific characteristics differ in the alternative firm failure processes. Finally, the chapter analyses the influence of, financial ratios, the age of the firm, directors' characteristics and business environment factors in firms' transition towards failure for each of the identified failure processes.

The combination of factor and cluster analysis has been used as an initial analytical technique to determine the existence failure process clusters. For the analysis of firms' transition to failure, a panel data ordered regression is used. This methodology allows for the control for the firms' individual heterogeneity and the cross-time effects of a number of explanatory variables from the business and economic environment. In the second part of the analysis, the purpose of the panel ordered regression is to identify the determinants of firms' transition to failure. This chapter proceeds as follows. Section 5.1 presents the subset of the data that this chapter uses and proceeds with the necessary tests for normality. Section 5.2 presents the data that are used in this chapter. Section 5.3 presents the factor analysis. Section 5.4 presents the cluster analysis and identifies the firm failure processes. Section 5.5 presents the results of the panel data analysis and the determinants of firms' transition to failure. Section 5.6 discusses the robustness checks for the analyses. Section 5.7 discusses the results of the previous sections in the context of the hypotheses. Section 5.8 concludes the chapter.

5.2 General Data Description

This chapter uses the sample of the data described in Chapter 4. This sample considers all the EU firms that went into liquidation at some point during the period that the data cover. This means that the firms whose dependent variable, (event_failure) eventually takes the value of 2 are considered. Therefore there are 5,195 firms in the sample covering the period from 2004 to 2013. Status information (and date) for the firms also covers year 2014 but no financial or directors information is included for that year. Instead, there is a one-year lead in the dependent variable. As such, firm-specific information of 2013 is matched with an event_failure status of the following year, in this case 2014. This is common practice in firm failure studies (see for example Altman, 1968; Altman et al., 2010). The firms that have an event_failure = 2 firm-year observation in the sample, also have observations for the years that they were not in liquidation. As such, all firms start participating in the sample as event_failure = 0 (healthy) "progressing" to event_failure = 2 (liquidation) with some of them (c.25%) having the interim status of financially distressed (event_failure = 1). That is, the sample includes evidence for what we will refer to as the *failure status progression* of the (eventually) liquidated firms. Therefore, the total number of firm-year observations is 40,122 and the median time for each firm's participation in the sample is 7 years.

5.2.1 Descriptive statistics of failed firms

The descriptive statistics of the failed firms are displayed in Table 5.1 and the descriptive statistics for firms in each country are presented in Appendix A, Table A1.

Table 5.1 Descriptive statistics of main continuous variables for firms that eventually failed.

Variable	Mean	Std. Dev.	Min	Max
ROI	-0.16	6.54	-1272.00	107.18
growth_rate	5.30	45.82	-1.00	769.79
NSTA	2.38	13.45	-1.38	267.20
CFTS	-0.49	17.43	-822.67	295.00
quick_ratio	6.82	11.64	-17.67	155.00
TLTA	1.03	10.10	0.00	170.00
QACA	0.84	0.39	-7.90	18.59
TCTL	0.26	0.23	-1.54	1.00
Firmage	11.75	33.27	1.00	110.00
Avg_dir_age	48.45	11.65	18.00	90.00
Nr_Female_Dir	1.11	1.73	0.00	7.00
Total_Dir_Nr	7.16	7.41	1.00	24.00
credit	124.04	40.15	67.91	200.61
GDP_gr	0.97	2.58	-5.64	6.33

The results show that there are variations in the explanatory variables' means. Considering the mean financial ratios of firms in each country (Appendix A; Table A.1), the mean Return on Investment (ROI) is negative in firms across all countries and therefore in the full sample. One reason for this is that the time period that the sample covers, includes the financial crisis of 2007-2008. Total assets' mean growth rate in firms in Ireland is 28.28% compared to the sample mean of 5.30%. Firms in other countries record more modest total assets growth rates ranging from 0.27% in Spain to 6.30% in the United Kingdom. The higher total asset growth in Irish SMEs can be seen as a reaction to challenges the firms faced due to a prolonged period of instability and as such are explained from external factors related to market changes in Ireland, combined with fluctuating economic conditions (Kidney et al., 2017). However, Irish firms had the highest (2.21) mean total liabilities to total assets (TLTA), implying that the total assets were financed by significant leverage. Swedish firms had the lower TLTA (0.76).

The highest mean net sales to total assets (NSTA) ratios are recorded in Germany (4.35) with firms in other countries ranging from 1.44 (Spain) to 3.00 (United Kingdom) resulting in a sample mean of 2.38. The higher average ratio in Germany is mainly driven by strong sales of German firms. This is mainly driven by overall economic conditions in Germany whose economy was less affected from the financial crisis due to strong usage of production capabilities in Germany (Funk, 2012). This is partly reflected in mean quick ratios were German firms have significantly higher quick ratios, effectively measuring firms' liquidity, than firms in other countries with Netherlands' firms having the lower mean quick ratios. Likewise, quick assets to current assets (QACA) were relatively similar in the alterative countries, ranging from 0.69 in Spain to 0.96 in the United Kingdom. The sample mean for QACA is 0.84.

On the other hand, cash flow to total sales (CFTS) is ranging from -1.13 in Spain to 0.02 on France with a sample average of -0.49. Spanish firms were particularly badly affected due to the credit crunch is the SME sector during the financial crisis. This was particularly the case in Spain because Spanish caja's banks, effectively small savings banks, suffered significant losses and were unable to lend to small businesses (Illueca et al., 2014), resulting in a credit crunch for the SME sector (Carbo Valverde et al., 2016), affecting cash flows. Mean trade credit to total liabilities (TCTL), is relatively consistent across all countries, ranging from 0.17 in Germany to 0.39 in France driven mainly from marginally higher trade credit usage in France. TCTL's sample mean is 0.26.

In terms of the board composition, firms in Ireland and the United Kingdom have had more female directors in their firm boards on average (2.64 and 2.50 female directors respectively, compared to the sample mean of 1.1), while Germany was the country whose firms had fewer total number of directors on average (2.33 for German firms against 7.16 for the mean of all countries' firms).

Credit availability between countries also varies. France, Germany and Italy have had credit availability compared to their GDP that was well below the 124.04 average at 89.76, 95.59 and 83.67 respectively. This is due to relatively conservative credit expansion in Germany and France combined with the effects of the credit crunch in Italy. The average GDP growth is positive in all countries with the exception of Italy.

5.2.2 Data and normality

The distribution of the continuous variables in the population of firms is a necessary step before we proceed with the factor and the cluster analysis. Skewness and Kurtosis are the two main statistical metrics to assess the distribution of the explanatory variables in the data.

"Skewness is a measure of asymmetry and kurtosis is a measure of tallness or flatness of a Probability Distribution Function" (Gujarati and Porter, 2010, p.449). Skewness is defined as the third moment and Kurtosis is the fourth moment (Park, 2008). For all symmetrical probability distribution functions, the third moment is zero and in such a case the Skewness is also zero. If the skewness is greater than zero the distribution is positively skewed and if it is less than zero the distribution is negatively skewed.

Kurtosis, on the other hand, measures the thinness of the tails of the probability distribution. Distributions with Kurtosis of less than 3 are called platykurtic (that is they have a fat and/or short tale) and distributions with kurtosis of greater than 3 are called leptokurtic. The Kurtosis of a normal distribution is 3 (Gujarati and Porter, 2010).

The simplest way to detect any evidence of Skewness and Kurtosis are the normality plots. In terms of statistical metrics, the Skewness and Kurtosis tests of normality, the Shapiro-Wilk (Shapiro and Wilk, 1965) and the Shapiro-Francia (Shapiro and Wilk, 1972; Royston, 1983) tests of normality are applied. The Skewness and Kurtosis is a standard normality test. The Shapiro-Wilk is a frequently used test for normality and it is very powerful in a range of symmetric distributions (Mbah and Paothong, 2015) but it may be sensitive in large samples (Hair et al., 2006). The Shapiro-Francia test of normality is more appropriate for larger samples and according to Mbah and Paothong (2015) is the best statistic in detecting deviation from normality.

The Skewness and Kurtosis plots are presented in Appendix A (Chart 1) and show evidence of non-normal distribution in all the tested explanatory variables. Table

A.2 (in Appendix A) presents the results of Skewness and Kurtosis analysis of the main data variables, applied to the firms in the sample. The null hypothesis that each of the explanatory variables is normally distributed is rejected at the 0.01 level of significance. Table A.3 (Appendix A) presents the Shapiro-Wilk W test of normality results. Consistent with the results from the Skewness/Kurtosis test, Shapiro-Wilk test results show that the null hypothesis of each of the variables to be normally distributed is rejected at the 0.01 level of significance. Finally the Shapiro-Francia test of normality also confirms that the hypothesis of a normal distribution is rejected at 0.01 level of significance, for each one of the variables in the sample (Appendix A, Table A.4).

The presence of non-normally distributed variables in the sample has two potential implications. First, the use of the mean when clustering to create the failure processes can be problematic. Therefore the median will be used instead (in a k-medians clustering approach). Second, the violation of the normality assumption potentially compromises the normality assumption in the ordered logistic regression. However, evidence suggests that logistic regression is relatively robust even in the presence of non-normally distributed data (Appiah, 2013). Therefore, no further actions are proposed with regards to the normality of the data.

5.2.3 Correlation and Statistical Tests

Exploring the correlations between independent variables is necessary in order to determine whether factor analysis can be actually used. Factor analysis requires the existence of some degree of collinearity between the variables that will enter the factors. For this reason the results of correlation analysis and partial correlation analysis are useful. Correlation analysis, partial correlation analysis, the Bartlett test of sphericity and the Kaiser-Meyer-Olkin measure of sample adequacy are used to investigate whether the level of potential correlations between the explanatory variables is sufficient to proceed with factor analysis.

Correlation of the independent variables has been tested in the sample of event_failure status=2 at two stages. The first stage includes all of the potential independent variables at levels. The second stage includes the financial ratios (independent variables) and the country-specific macroeconomic variables (GDP growth and Credit Availability) lagged at t, t-1, t-2…t-7. This will capture the financial situation of firms up to 7 years before the failure event. The analysis tests for 7 year lags because the median time of firms before they enter the event_failure=2 status is 7 years and as a result the factor/cluster analysis will use these 7 years of historical information in the formation of failure process clusters. The director-related variables are only tested at levels as there is very little or no variation on director composition across time in most firms. Correlation above 30% can be regarded as sufficient for the purpose of factor analysis (Hair et al., 2006). The results (Appendix A, Table A.5) demonstrate that there is evidence of a sufficient level of correlation in a number of variables.

Partial Correlations between variables have also been calculated (Appendix A, Table A.6). A partial correlation of a variable is the correlation that is left unexplained when the effects of the other variables are taken into consideration (Hair et al., 2006). Partial correlations between variables that would be potentially used in the factor analysis should be small and few. In particular, partial correlations of above 0.7 should question the application of factor analysis (Hair et al., 2006). Partial correlation results showed that there is little evidence of high partial correlations between potential variables into the factor analysis and therefore factor analysis can be used.

Bartlett Sphericity is a statistical test that also investigates the existence of correlations between the variables that could allow a meaningful application of Factor analysis by examining the entire correlation matrix. STATA 15 applies the Bartlett test of sphericity together with the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (MSA) which measures the degree of inter-correlations among the variables and therefore assists with the assessment of the appropriateness of the Factor Analysis.

The results of the Bartlett test of sphericity suggest that the hypothesis of no correlation between the variables is rejected at the 0.001 level. Moreover, the KMO MSA show that the variables are adequate for factor analysis having an overall KMO MSA score of 0.687 Table A.8 (Appendix A). These results include the complete variable input (with lags). Therefore the statistical assumptions to proceed with factor analysis are satisfied.

5.3 Factor Analysis for Firm Failure Process

The combination of factor and cluster analysis has been selected as a way to create firm failure processes (Laitinen, 1991; Lukason and Hoffman, 2014; Lukason and Laitinen, 2016). Factor analysis is used to summarise the firm specific-characteristics of the firms in order to reduce the number of variables that will subsequently enter the cluster analysis process. Factor analysis only uses firm-specific characteristics because the purpose of the failure process creation is to investigate which firm-specific characteristics determine the failure process of the firms. The factor analysis is used in two parts.

In the first part, the financial ratios of each firm are used for up to 7 years (lag=7; t, t-1, t-2, t-3, t-4, t-5, t-6, t-7) prior to event_failure=2, together with the age of the firm at the time of the liquidation. This is then followed by the associated cluster analysis to identify the firm failure processes.

The second part includes three directors-related variables (total number of directors, number of female directors in the board and average age of directors) in addition to the variables used in the first part. This factor analysis is then followed by the associated cluster analysis to identify the firm failure process.

The rest of the section presents the results of the factor analysis without directors' characteristics and with directors' characteristics as determinants in the failure process formation; it then compares findings with the literature.

5.3.1 Factor Analysis without Directors' Characteristics

The first stage of the factor analysis (hereafter factor analysis without directors' characteristics) examines the financial ratios from the 5,195 event_failure=2 (liquidated/bankrupt) firms for up to 7 years prior to the failure event. That is, the financial ratios are lagged up to lag 7. Additionally, the factor analysis includes the firm age at the last year with available data before it entered liquidation. The age of the firm is not lagged as any such attempt would create a completely linear result. This part of the analysis aims to use metrics that have been previously used in the quantitative firm failure process literature, in order to offer a basis of comparison for the analysis with directors' characteristics that follows.

An eigenvalue criterion by means of the Kaiser test (Kaiser, 1960), has been applied to factor analysis. Only factors with eigenvalues above 1 are allowed to return to the second step of the factor analysis which is the VARIMAX rotation. The first part of the factor analysis shows (Appendix A, Table A.9) that there are 12 factors with an eigenvalue >1. These initial factors explain the 89% of the total variation of the initial variables, higher than previous studies where Factor Analysis explained 80% of the variables' variation for Lukason and Laitinen (2016), 69% for Laitinen et al., (2014) and 52% for Laitinen (1991). This potentially indicates that the additional time periods that this study uses add value to the failure process extraction given that Laitinen (1991) used a six year period in his analysis but with two-year intervals while Laitinen et al., (2014) used a four year period (with yearly intervals) and Lukason and Laitinen (2016) used a five year period (with yearly intervals).

The VARIMAX orthogonal rotation is then applied to the 12 factors in order for factors to be uncorrelated throughout the rotation process. VARIMAX rotation is perceived as the most popular (Hair et al., 2006) and best orthogonal rotation (Fabrigar, et al., 1999) to assist the interpretation of factors. Initial factors have cross-loadings and therefore the rotation technique should assist to develop a clear set of factor loadings. Consequently that would assist the development of reasonably separate failure processes. Table A.11 (Appendix A) presents the loadings of the factor analysis after the VARIMAX rotation. The interpretation of the first round of factor analysis is as follows:

- The first factor is associated with the time series development of the trade credit to total liabilities ratio (TCTL).
- The second factor is associated with the time series development of the Quick assets to current assets (QACA) ratio.
- The third factor is associated with the total liabilities to total assets (TLTA) ratio between the 4^{th} and the 7^{th} year prior to failure. The same factor is also correlated with the return on investment (ROI) on the 7^{th} year before the failure (Lag=7).
- The fourth factor is associated with the net sales to total assets (NSTA) ratio between the years 4 and 7 before failure.

- The fifth factor is associated with QACA ratio between years 4 and 7 and with the TCTL ratio between years 5 and 7 prior to the failure event.
- The sixth factor is correlated with TLTA on the 3rd year prior to failure and with ROI at the same time period.
- The seventh factor is associated with the growth rate of the firm, 3 years prior to failure and with the NSTA (same as what you have done with in previous sentences, put full name here) ratio, also 3 years prior to failure.
- The eighth factor is associated with ROI 1 and 2 years prior to failure, TLTA up to 2 years prior to failure and with NSTA just on the failure time.
- The ninth factor is associated with the time series development of ROI and with TLTA on year 5.
- The tenth factor is associated with the development of the quick ratio between years 2 and 5 from the time of failure.
- The eleventh factor is associated with the development of NSTA ratio up to 4 years before and up to the time of failure.
- The twelfth factor is associated with the development of cash flow to total sales ratio (CFTS) between years 7 and 3 prior to the failure event.

5.3.2 Factor Analysis with Directors' Characteristics

The second part of the factor analysis (hereafter factor analysis with directors' characteristics) includes directors' characteristics in addition to the previous analysis. The inclusion of director characteristics aims to capture some of the observations of the qualitative firm failure process literature within a quantitative approach. As such, the directors' characteristics include a proxy for gender heterogeneity in the board as measured by the number of female directors. In addition, a proxy for the breadth of social capital that directors bring to the board is captured by the total number of directors. Finally, the experience of the board is captured by using the average age of directors as a proxy.

The financial ratios were treated in the same way as in the first round of factor analysis. Firm age was also treated on the same way with the only the age of the firm at the year of failure entering the data. The directors' characteristics were included at the time of failure and were not lagged. A specification with lagged directors' characteristics was tested and returned broadly similar results. This is because there was very limited variation in the structure of the board in the 7 years prior to failure. In many firms there was no variation while the average age of directors had a linear relationship across the years. Therefore, only the results with directors' characteristics that do not include lags in the directors are reported.

The results demonstrate that there are again 12 factors with an eigenvalue above 1 (Appendix A, Table A.13). With the inclusion of the directors' variables the 12 factors explain 87.67% of the total variance, slightly less than the 89% that was achieved without the directors' variables. However the difference is relatively small to be a reason for not proceeding further with this classification. Therefore, we proceed to analyse the factors after the VARIMAX rotation is performed. Following the VARIMAX rotation the factors are presented in Table A.15 (Appendix A) and can be explained as follows:

- The first factor is characterized by the time-series development of the trade credit to total liabilities ratio (TCTL). This is **similar** to the first factor without the directors' characteristics.
- The second factor is associated with the time series development of the Quick assets to current assets (QACA) ratio. This is also **similar** to the second factor on the factor analysis without directors' characteristics.
- The third factor is partly associated with the total liabilities to total assets (TLTA) ratio between the 4^{th} and the 7^{th} year prior to failure. It is also associated to some extend with the return on investment (ROI) on the 7^{th} year before the failure (Lag=7) and it is broadly **similar** to the factor analysis without director characteristics.
- The fourth factor is associated with the net sales to total assets (TLTA) ratio between the years 4 and 7 before failure. There is a weak association with the same ratio in years 0 to 3. The factor is **similar** to the one without the director characteristics.
- The fifth factor is associated with QACA ratio between years 4 and 7 and has a weaker association with the TCTL ratio between years 6 and 7 prior to the failure event. In terms of the financial ratios this factor is broadly **similar** to the one in the analysis without the directors' characteristics. Moreover, the firm age is more significant in factor 5 when the directors' characteristics are included (-46.8% against -24.8% in the non-directors' analysis). However, this factor is **differentiated** from its non-directors

characteristics counterpart because of its association with the number of female directors and the total number of directors.

- The sixth factor is correlated with TLTA on the 3rd year prior to failure and with ROI at the same time period; **similar** to the 6th factor from the analysis without the directors' characteristics.
- The seventh factor is associated with the growth rate of the firm, 3 years prior to failure and with the NSTA ratio, **similar** to the 7th factor from the analysis without the directors' characteristics.
- The eighth factor is associated with ROI 1 and 2 years prior to failure, TLTA up to 2 years prior to failure and a weaker association with NSTA just on the failure time; broadly **similar** to the eighth factor in the analysis without directors' characteristics.
- The ninth factor is associated with the time series development of ROI (although not in lag 3) and with the growth rate at lag 6. In the case of ROI, there are similarities with the ninth factor in the analysis without the directors' characteristics but here, there is evidence of an association with growth rate (**6** years before failure) as **opposed to the** TLTA **(5** years before failure) in the analysis without directors' characteristics.
- The tenth factor is associated with the development of the quick ratio between years 2 and 5 from the time of failure; **similar** to the tenth factor in the analysis without directors' characteristics.
- The eleventh factor is associated with the development of NSTA ratio up to 4 years before and up to the time of failure, broadly **similar** to the eleventh factor in the analysis without directors' characteristics.
- The twelfth factor is associated with the development of CFTS between years 7 and 3 prior to the failure event, broadly **similar** to the eleventh factor in the analysis without directors' characteristics.

One can conclude that the inclusion of directors' characteristics has modified the fifth factor by adding the board dimension to some of them. In particular, the fifth factor (with directors' characteristics) is associated with the number of female directors and the total number of directors in firms and therefore captures most of the effects of the board variables.

5.4 Cluster Analysis

Factor scores obtained from the analysis above are standardized and uncorrelated. These are useful characteristics which enable the use of cluster analysis after the factors are scored based on their factor loading (Hair et al., 2006).

As discussed in chapter 3, the adopted clustering method follows Laitinen et al., (2014) in applying a partition cluster analysis approach due to its characteristic of breaking any observations into a number of non-overlapping groups. K-medians and k-means are two similar processes that can be used to calculate the clusters. The methods differ in the estimation of the "centre" of the cluster. The k-medians uses the median while the k-means uses the mean (Whelan et al., 2015). K-means can be affected by outliers even when operating in large data sets as one outlier may pull the "mean" value away from the majority of the dataset (Whelan et al., 2015). For that reason, we employ k-median, following Lukason and Laitinen, (2016) in the clustering analysis with Euclidean distance. This is the most commonly used approach to partitioning (Whelan et al., 2015) and is also supported in Stata 15.

Stopping rules are used to identify the number of clusters that the analysis might give. There is no evidence supporting any particular stopping rule from the many that are available (Hair et al., 2006). One of the most well-known partitioning criteria is the Calinski and Harabasz (1974) index (Vendramin et al., 2010) and it will be used in this application to define the appropriate number of clusters.

The Calinski and Harabasz Pseudo-F formula is defined as follows:

$$\frac{trace(B)/(g-1)}{trace(W)/(N-g)}$$

Where B is the between clusters sum of squares and W is the within clusters sum of squares; g is the number of groups and N the number of observations.

5.4.1 *Clusters without Directors' Characteristics*

The factors from the factor analysis without directors' characteristics are used in the first part of the cluster analysis (hereafter cluster without directors' characteristics). In line with Calinski and Harabasz (1974), the results suggest that there are 4 potential clusters and therefore 4 distinct failure processes. The index gave a Pseudo-F of 261.93 which was the largest value, indicating that that the four-clusters solution is the most distinct compared with potential solutions ranging from 2 to 12 clusters. When the potential number of clusters exceeded 4, the Pseudo-F values started gradually declining. The clusters' characteristics define the failure processes which have the following broad characteristics (Appendix A, Table A.12):

The first process is characterized by relatively new firms (median age 8 years old) that have had negative growth in the 5 years prior to failure, improving liquidity and working capital (expressed with the quick ratio and the QACA ratio) prior to failure.

The second process is characterized by firms with wide-ranging financial difficulties. These firms have on average, negative returns (ROI) in the last 3 years prior to failure and negative growth rates (growth_rate) for most of the last seven years (years 3-7 prior to failure). This cluster's firms have low sales for their assets (NSTA) in all years before failure and negative cash flows two years prior to failure. Liquidity and working capital issues are the worst from all the clusters and liabilities have been growing rapidly during the seven years prior to failure. The average age of these firms is 18 years and therefore they are not new firms.

The third process is characterized by firms with negative growth few years before failure (3-7 years prior to failure), high sales compared to their assets but weak cash flows. These firms are making extended use of trade credit to finance their working capital cycle but their total liabilities appear to be relatively stable. Firms in this process are fairly matured with an average age of 18 years.

The fourth process is characterized by firms with negative returns (ROI) in the year prior to failure and slow or negative growth across the seven years prior to failure. Similar to the third process, the fourth process' firms have relatively high level of sales (NSTA) for their assets and negative cash flow in the year of the failure. In contrast with the firms in the third process, these firms do not have high usage of trade credit, have good liquidity but growing total liabilities. Firms in this cluster are on average 10 years old.

The distribution of clusters in countries is presented in table 5.2.

Table 5.2: Distribution of firms in clusters (Clusters without directors' characteristics).

	Country																	
Cluster	FRANCE		GERMANY		IRELAND		ITALY		NETHERANDS		SPAIN		SWEDEN		UK		TOTAL	
1	223	28.8%	385	52.3%	11	9.6%	251	20.2%	61	33.0%	174	16.7%	31	25.8%	15	1.5%	1,151	22.2%
2	44	5.7%	158	21.5%	16	14.0%	241	19.4%	34	18.4%	409	39.3%	26	21.7%	41	4.2%	969	18.7%
3	388	50.1%	50	6.8%	20	17.5%	559	44.9%	50	27.0%	223	21.4%	28	23.3%	296	30.2%	1,614	31.1%
4	119	15.4%	143	19.4%	67	58.8%	194	15.6%	40	21.6%	236	22.6%	35	29.2%	627	64.0%	1,461	28.1%
TOTAL	774		736		114		1,245		185		1,042		120		979		5,195	

The total column shows that most firms were found in cluster 3 with cluster 4 showing slightly fewer firms. Cluster 2 had the lowest number of firms. There appears to be some differentiation in the concentration of failed firms between countries and failure processes. In particular, there is a relatively low (5.72%) concentration of UK firms in clusters 1 and 2. In contrast, 73.77% of the German firms belong to clusters 1 and 2. Italian firms are slightly more concentrated in cluster 3 (44.90%) with the remaining firms to be relatively similarly concentrated in the other clusters. Irish firms are more concentrated in cluster 4 (58.77%) and less concentrated in cluster 1 (9.65%) with clusters 2 and 3 having a 14.04% and 17.54% concentration of firms respectively. French firms are more concentrated in cluster 3 (50.13%) and less concentrated in cluster 2 (5.68%) with cluster 1 and 4 having 28.81% and 15.37% firm concentrations respectively. Netherlands' firms are slightly more concentrated in cluster 1 (33%) followed by cluster 3 (27%) and then cluster 4 (21.6%) and cluster 3 (18.4%). Spanish firms are more concentrated in cluster 2 (39.25%) with the remaining of the clusters ranging from 16.70% (cluster 1) to 22.65% (cluster 4). Swedish firms are relatively evenly concentrated across all clusters with concentrations raging form 21.67% (cluster 2) to 29.17% (cluster 4).

5.4.2 Clusters with Directors' Characteristics

The second stage of the cluster analysis includes the directors' characteristics (hereafter clusters with directors' characteristics) in addition to the previous analysis.

Calinski and Harabasz (1974) suggests that there are 4 potential clusters and therefore 4 distinct failure processes for the factors that included the directors' characteristics; the same number of clusters as in the analysis without directors' characteristics. The Calinski and Harabasz index in this case gave a Pseudo F of 225.57 which was the largest value, indicating that that the four-clusters solution is the most distinct compared with potential solutions ranging from 2 to 12 clusters. When the potential number of clusters exceeded 4, the Pseudo-F values started gradually declining. The firm failure process clusters' are having the following broad characteristics (Appendix A, Table A.16):

The first process is characterized by relatively new firms (median age 8 years old) that have had negative returns (ROI) in the year prior to failure, high sales but deteriorating cash flows that turned negative prior to failure and at the year of failure. Despite these firms having increasing liquidity, they also have increasing total liabilities. These firms have had volatile quick assets given their current assets implying volatile working capital. There were on average 3 female directors and 14 directors in total with an average age of 49 years.

The second process is characterized by firms with negative growth 3 to 7 years before they fail and low cash flows that turn negative in the year of failure. Their liquidity is slightly stretched but there are wide variations in some of the firms of this cluster (standard volatility of quick ratio). These firms have reducing trade credit usage compared to their total liabilities which is however higher than that in the other clusters' firms. These firms, on average, have been active for 20 years and have 5 directors, none of whom is a female, with average age of 48 years.

The third process is associated with firms that have very few directors (3 on average), none of whom is female, and have an average age of 48 (broadly similar to other clusters). These firms have low returns (ROI) that turns negative one year prior to failure. However, this group of firms has got increasing sales (NSTA) but weak cash flows that turn negative in the failure year. Severe liquidity problems have been present in all years prior to failure even though they were improving marginally towards the final years prior to failure. The average firm age of this group is 11 years.

The fourth process is associated with firms that also have only 3 directors on average and have no females in the board. The average firm age is 13 years. In terms of financials, the fourth group's firms are characterized by low ROIs, especially prior to failure, and negative or very low growth. Net sales are very high and increasing in the years prior to failure but these increases are not reflected in improving cash flows. Liquidity ratios are strong, in contrast with the firms in the third process. These firms have increasing usage of trade credit in the years to failure. The distribution of clusters in countries is presented in Table 5.3.

Table 5.3: Distribution of firms in clusters (with directors' characteristics).

	Country																	
Cluster	FRANCE		GERMANY		IRELAND		ITALY		NETHERANDS		SPAIN		SWEDEN		UK		TOTAL	
1	90	12%	4	1%	48	42%	81	7%	6	3%	73	7%	7	6%	625	64%	934	18%
2	389	50%	49	6%	17	15%	517	42%	42	23%	243	23%	29	24%	148	15%	1,434	28%
3	168	22%	345	45%	16	14%	396	32%	67	36%	434	42%	43	36%	34	3%	1,503	29%
4	127	16%	338	44%	33	29%	251	20%	70	38%	292	28%	41	34%	172	18%	1,324	25%
TOTAL	774		736		114		1,245		185		1,042		120		979		5,195	

As in the distribution of clusters without directors' characteristics, there appears to be some differentiation in the concentration of failed firms between countries and failure processes. The clusters, signifying the alternative firm failure processes, in the two cluster analyses are not the same. All clusters in both analysis differ from each other. It is particularly important in the case of the first cluster which, in the analysis with directors' characteristics, includes the existence of a female directors in the board and the total number of directors as a key characteristics of the cluster.

Nevertheless, there is a persistent trend of UK and German firms having opposite concentrations in clusters. In the cluster analysis with directors' characteristics, UK firms are highly concentrated in clusters 1 and 2 (78.96%) whereas German firms only have 7.20% concentration in these two clusters. The different profile of cluster 1 may have been a material determinant of the distribution of firms in these two countries, implying that board composition and experience are key differentiators in explaining failure processes in these countries. Netherlands' firms have a very low concentration in cluster 1 (3.24%) with the remaining clusters ranging from 22.70% (cluster 2) to 37.84% (cluster 4). Irish firms are more concentrated in cluster 1 (42.11%) with the other clusters ranging from 14.04% (cluster 3) to 28.95% (cluster 4). French firms are mostly concentrated in cluster

2 (50.26%) with the remaining clusters having from 11.63% (cluster 1) to 21.71% (cluster 3) of the firms. Spanish firms are more concentrated in cluster 3 (41.65%) and less concentrated in cluster 1 (7.01%) with clusters 2 and 4 having 23.32% and 28.02% of the firms respectively. In contrast with the cluster analysis without directors' characteristics, Swedish firms are not as evenly concentrated in the clusters' with directors' characteristics. Swedish firms are less concentrated in cluster 1 (5.83%) with the rest of the clusters ranging from 24.17% (cluster 2) to 35.83% (cluster 3).

Some inferences can be drawn from the distribution of firms in the alternative clusters and therefore between firm failure processes. The majority of UK and Irish firms' characteristics in the sample fit in the first firm failure process, characterized by relatively new firms with negative returns, increasing debt but also gender diversity on the board. These characteristics are consistent with the observations from the firms' descriptive statistics for these countries where UK and Irish firms have the higher means for female directors and TLTA. The majority of Italian and France firms are concentrated in the second firm failure process which in turn is characterized by firms with low liquidity that are older. Indeed, on average Italian firms have the lowest mean quick ratios whilst France firms have slightly higher average quick ratios, although far from the highest in the sample. The third firm failure process has the majority of German, Swedish and Spanish firms. This is a process characterized by very few directors, increasing sales but weak cash flows. German firms' descriptive statistics show that these firms have on average the highest NSTA ratios and fewest directors whilst Spanish firms have the lowest CFTS ratios, on average. Swedish firms, on the other hand have one of the lowest numbers of directors, high NSTA (compared to other countries) and weak cash flows. Finally, the fourth firm failure process whose characteristic is the increased trade credit usage, high net sales but low ROI is dominated by firms from Netherlands whose low ROI and high TCTL are key characteristics on average.

5.4.3 Hypothesis Testing on Clusters

Having developed the clusters of the firm failure processes (with and without directors' characteristics) and having discussed some observable differences in the concentration of firms among different clusters, the chapter proceeds to analyze whether there are any statistically significant differences between the failure processes as expressed in the two versions of the clusters. These tests include both the firm-specific (financial ratios, firm age and directors' characteristics) characteristics that were used in order to identify the alternative firm failure processes as well as a number of additional characteristics, associated with the economic and business environment. The latter have been discussed in the development of the Hypotheses (Chapter 2).

The approach undertaken to test the Hypotheses relating to the cross-country comparison of the firm failure processes applies the median test for continuous variables**.** For categorical variables, the Pearson chi square test of the independence of rows and columns in a two-way distribution table is employed. Table 5.4 presents the results of the chi-square tests and Table 5.5 the results of the median test

Table 5.4: Pearson Chi-Square on Differences in Firms' Characteristics between Firm-Clusters

Firm Clusters (Failure Processes)	Legal Origins	Industry	Countries	SGR
	Chi-Squared statistic/p-value			
Clusters without Directors' characteristics	705.17 / 0.000	122.45 / 0.000	189.16 / 0.000	13.93 / 0.003
Clusters with Directors' characteristics	429.32 / 0.000	875.81 / 0.000	125.97 / 0.000	9.32 / 0.025

Table 5.5: Median test- Pearson Chi-Square values on Differences in Financial Ratios between Firm-Clusters

Firm Clusters (Failure Processes)	ROI	GROWTH RATE	NSTA	CFTS	QUICK RATIO	TLTA	QACA	TCTL	FIRM AGE	GDP Growth	Credit Availability	Women	Age of Directors	Nr. Of Directors
	Chi-Squared statistic/p-value													
Clusters without Directors' characteristics	245.79 / 0.000	221.49 / 0.000	308.79 / 0.000	283.39 / 0.000	647.04 / 0.000	192.82 / 0.000	887.37 / 0.000	111.03 / 0.000	284.84 / 0.000	338.88 / 0.000	560.70 / 0.000	88.80 / 0.000	102.95 / 0.000	343.76 / 0.000
Clusters with Directors' characteristics	391.99 / 0.000	445.78 / 0.000	343.78 / 0.000	491.94 / 0.000	561.72 / 0.000	414.93 / 0.000	608.86 / 0.000	697.95 / 0.000	343.08 / 0.000	500.07 / 0.000	579.62 / 0.000	140.00 / 0.000	13.08 / 0.004	120.02 / 0.000

The first step, is to ascertain whether the firm failure processes are independent to the countries. In addition, it is tested whether the (mainly) business environment characteristics that are categorical variables in nature differ between the alternative firm failure processes (with and without directors' characteristics). The results for the independence between countries and firm failure processes are assessed with a Pearson chi-square test (Table 5.4). The null hypothesis of the Pearson Chi-square is that there is no difference in the distribution of firms between the rows (countries) and the columns (firm failure processes).

Consequently, the alternative hypothesis is that there is a difference in the distribution between firm failure processes and countries and as a result firm failure processes differ between countries. The results, reported in Table 5.4, show the chi-square test is significant at the Sig. <0.01 level. Therefore one can reject the null hypothesis. This applies to both analyses with and without directors' characteristics. In addition, a number of hypotheses that were set in earlier chapters are tested.

Hypothesis 1: *Countries' legal origins differ between firms in the alternative failure processes in the EU countries under consideration; they are also determinants of firms' transition to failure.*

In the context of the Chi-square test, the null hypothesis is that the rows (legal origins) and columns (failure process clusters) do not differ in the distribution of firms. The alternative hypothesis is that there is a difference in the distribution of firms between failure processes and legal origins and therefore that countries' legal origins differ between firms in the alternative firm failure processes.
The Pearson Chi-square is significant (at p level<0.01), confirming that the null hypothesis is rejected and therefore there are statistically significant differences in the distribution of firms' legal origins in the failure clusters (Table 5.4). Therefore, this part of the analysis accepts the first part of Hypothesis 1 that countries' legal origins differ between the alternative failure processes in the European countries under consideration. The results are consistent irrespective of whether the clustering has been with or without directors' characteristics.

Hypothesis 2: *Industry classification differs between firms in the alternative firm failure processes in EU firms; it also differs as a determinant of firms' transition to failure in the alternative firm failure processes.*

In the context of the Chi-square test, the null hypothesis is that the rows (industries) and columns (failure process clusters) have no difference in the distribution of firms.
The alternative hypothesis is that there is a difference in the distribution of firms between failure processes and the industries they belong to. The Pearson Chi-square is significant (Table 5.4) with 27 degrees of freedom (p-value <0.01),

rejecting the null hypothesis. Therefore one can conclude that there is a statistically significant difference in the industry distribution across the failure clusters. As such the first part of Hypothesis 2 is accepted: *Industry classification differs between firms in the alternative firm failure processes in EU firms.* The results are consistent for both sets of clusters, with and without directors' characteristics.

Hypothesis 3: *Financial performance represented by key financial ratios and the age of the firm, differ in the alternative firm failure processes of EU firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

The financial ratios and the age of the firm are firm specific characteristics that were used to identify the alternative firm failure processes. As such one would expect that these will differ in the alternative firm failure processes. The median test (using a Pearson chi square statistic) has been applied to compare the medians of all financial ratios across the different clusters. In the context of the median test, the null hypothesis is that there is no statistical difference in the medians of the financial ratios and of the firms' age between failure clusters. The alternative hypothesis suggests there is a difference in the medians of the financial ratios and of the firms' age in the alternative firm failure processes. The results (Table 5.5) for both failure clusters (with and without directors' characteristics) reject the null hypothesis and therefore they indicate that there are statistically significant differences between firm failure clusters' in all financial ratios' and the firm age medians. Therefore, the medians of financial ratios and of the age of the firms are not the same across firm failure clusters. As such, this part of the analysis accepts the first part of Hypothesis 3: *Financial performance represented by key financial ratios and the age of the firm, differ in the alternative firm failure processes of EU firms*. The results are consistent for both sets of clusters, with and without directors' characteristics.

Hypothesis 4*: In a cross country context, macroeconomic conditions differ between firms in the alternative firm failure processes in EU firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

GDP growth and the credit availability are both continuous variables. The median test (Pearson chi square) has been applied to compare the median GDP growth and credit availability between difference clusters. The null hypothesis of the median test suggests that there is no statistical difference in the medians of GDP growth and credit availability between failure clusters. The alternative hypothesis suggest that there is a difference in the medians in the alternative firm failure process clusters. The results (Table 5.5) in both failure clusters (with and without directors' characteristics) indicate that there is statistically significant difference between firm clusters' in both the GDP growth and the credit availability as the null hypothesis is rejected for both economic metrics. Therefore, the first part of Hypothesis 4 is accepted: *In a cross country context, macroeconomic conditions differ between firms in the alternative firm failure processes in EU firms.*

Hypothesis 5*: Directors' Characteristics such as the presence of women in SMEs' management, director age as a proxy of director experience and the number of directors, differ in the alternative EU firm failure processes; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

The directors' characteristics are firm specific characteristics that were used to identify the alternative firm failure processes. As such one would expect that these will differ in the alternative firm failure processes. The median test (Pearson chi square) has been applied to compare the median number of women in the board, median age of directors and median number of directors across the 4 different failure clusters (with and without directors' characteristics). The null hypothesis of the median test suggests that there is no statistical difference in the medians of the director characteristics between failure clusters. The alternative hypothesis suggests that there is a difference in the medians of the director characteristics in the alternative firm failure process clusters.

The result (Table 5.5) in both failure clusters (with and without directors' characteristics) indicate that firm failure clusters have statistically different median number of women in the board, age of directors and total number of directors. Therefore, the first part of Hypothesis 5 is accepted: *Directors' Characteristics such as the presence of women in SMEs' management, director age-as a proxy of* *director experience and the number of directors, differ in the alternative EU firm failure processes.* The results are consistent for both sets of clusters, with and without directors' characteristics. This is a further indication that the inclusion of directors' characteristics is important in the identification of firm failure processes in the quantitative failure process literature and confirms the evidence from the qualitative failure process literature (see for example Argenti, 1976; Richardson et al., 1994; Ooghe and DePrijcker, 2008).

Hypothesis 6*: The distribution of firms with unsustainable levels of growth differs between the alternative firm failure processes in EU firms; unsustainable levels of growth are also determinants of firms' transition to failure.*

The Sustainable growth variable (SGR) has been developed by employing the formulae presented in Chapter 4. The SGR takes the value of 1 if a firm's annual growth in sales exceeds the calculated sustainable growth level and 0 otherwise. A rapid increase of a firm's sales, beyond the sustainable levels has been associated with firm failure (Argenti, 1976; Richardson et al., 1994; Higgins, 1977). The null hypothesis of the chi square is that there is no difference in the distribution of firms in the rows (SGR) and columns (failure clusters). The alternative hypothesis is that there is a difference in the distribution of firms between failure processes and the SGR.

The results (Table 5.4) demonstrate that the Pearson Chi-square is significant with 3 degrees of freedom (p-value <0.01). Therefore, one can accept hypothesis 6: *The distribution of firms with unsustainable levels of growth differs between the alternative firm failure processes in EU firms.* This is because there is a statistically significant difference in the distribution of firms where SGR=1 and therefore with unsustainable levels of growth across the failure clusters.

5.5 Panel Data Analysis

5.5.1 Introduction

After reviewing the results of the hypothesis tests on clusters, the results of panel data logistic regressions are presented. Panel data ordinal logistic regression has been applied to the 8 different failure processes (four for with directors' characteristics and four for without directors' characteristics) in order to identify whether the independent variables that are identified in the hypotheses are significant determinants of firms' transition to failure. That is, the transition from a healthy firm status, to financially distressed and ultimately to liquidation, and therefore failure. In addition, one can compare the differences between the alternative firm failure processes when firms' transition to failure is concerned.

There are two reasons why a panel ordered specification was used. First, the focus is to investigate whether the variables that have been used to cluster firms in the alternative failure processes are significant in all firm failure clusters. It will be assisted by using a number of control variables to provide an additional angle in answering the research hypotheses. Secondly the dependent variable of the model is ordered where 0 is when the firm is still healthy; 1 is when the firm is in financial distress; 2 is when the firm is bankrupt.

All the firms that are participating in this analysis eventually went into liquidation. The application of ordered panel regressions assists in identifying whether the explanatory variables are determinants for the failure status progress of a firm (from a healthy status to liquidation). This is a salient issue that has not been discussed in the failure process literature where firms are classified/clustered based on their final failure status. This thesis has already provided evidence that the failure process takes a number of years and involves a number of firm-specific characteristics. However, little is known about the role of the intermediate status of the firm (the financial distress) which has been a major part of research in the failure prediction literature.

Therefore, the panel structure is used to check whether there is a difference between the clusters (and in the full firms' population) and between the failure status progress. It also gives the ability to test in a more dynamic structure all of the characteristics that were used in the factor/cluster analysis given that the dimensions of a) the firms' individual heterogeneity, b) the intermediate stages of failure are considered and c) the effects of time are explicitly considered. This section's results do not attempt to re-assess the potential independent variables in the context of whether they are determinants between firms that failed and firms that never failed. Such an attempt is outside the scope of this thesis. This chapter analyses the determinants of firms' transition to failure in the context of the alterative firm failure processes in order to identify potential differences between them. The next section of the analysis presents the results of the panel ordered logit model.

5.5.2 Fixed or Random Effects Test

The use of panel data analysis for ordered logistic regression leads to the question of whether a fixed or random effects estimator should be used. Should we proceed by using a fixed-effects ordered logistic regression, the "blow-up and cluster" (BUC) approach would have to be used (Baetschmann et al., 2015) due to the fixed effects estimator for the nonlinear ordered model being inconsistent. The BUC estimator has been shown to outperform other available fixed effects estimators for panel ordered logistic regressions, such as the FF estimator from Frijters et al., (2004) and the Das and Van Soest (1999) estimator, both in terms of bias and consistency (Baetschmann et al., 2015).

Nevertheless, an assessment of the characteristics of the data suggests that a random effects ordered panel model should be used for two reasons. First, the regressors will include time invariant characteristics (eg. industry, country, legal tradition). These cannot be treated in a fixed effects model but only in a random effects context (Greene and Hensher, 2010). Second, evidence also shows that even when only the time-varying variables are included in an ordered panel logistic model applied to all firms in the sample (and separately in each of the clusters), the random effects estimator was still preferred (Greene and Hensher, 2010).

The test for the existence of fixed or random effects when the time invariant variables are excluded from the model was the one proposed by Greene and Hensher (2010). This is based on a likelihood ratio test and can be used in the place of the Hausman test, when ordered logistic regressions are concerned (Greene and Hensher, 2010). The Hausman (1978) test is only effective for linear regression techniques. The steps of this approach are as follows.

First, a random effects model with the time varying independent variables has been used to which we add the group means of the variables. The purpose of the means is to control for correlation between the individual effects and the independent variables. Therefore, the group mean of variables should account for the correlation between the individual effect and the regressors (Greene and Hensher, 2010). If this correlation is confirmed then the fixed effect approach should be undertaken. If such a correlation does not exist then the random effects model should be appropriate (Greene and Hensher, 2010). The random effects model was run in all the failed firms' data (and then separately in each cluster) and included all the time varying variables (financial ratios, firm age, credit availability, GDP growth and directors' characteristics) and their means. These models' estimates were then stored and a similar random effects model without the means was also run (and its estimates were also stored).

Second, a likelihood ratio test was carried out as a variable addition test of joint significance of the group means. Specifically, the estimates of the two models with and without the group means of the time-varying variables were compared with the likelihood ratio, on the null hypothesis that the coefficients on the means are all zero, following Greene and Hensher (2010).

The results (not reported) did not reject the hypothesis (at $p=0.01$ with 10 degrees of freedom) and therefore this suggests that the random effects specification should be used. The same approach was then applied to the individual failure clusters which are essentially smaller subsets of the main dataset. There are no significant differences in the results.

5.5.3 Independent Variables in the Panel Ordered Logistic Regression

A few notes about the independent variables should be made. The regressions use the firm-specific characteristics such as the financial ratios, the firm age and the directors' characteristics that have already been discussed in the factor and cluster analysis. The number of female directors has been tested in two alternative specifications. The first specification reports the number of female directors in the board (Female_nr). The alternative specification includes a dummy variable which takes the value of 1 if a firm has any female member on the board and 0 otherwise. Both specifications gave similar results in terms of statistical significance at the Sig.<0.05 level across all the data splits (full data and splits in clusters). The specification with the number of female directors (female_nr) is only reported in the analysis section (5.5.5; Table 5.7).

A number of additional control variables are used in the regressions. The legal tradition variable is used in order to control for the legal tradition each firm is associated to (based on the country it belongs to) for relevant hypothesis testing purpose. The specification of this variable was attempted with two formats. In the format reported here the leg_trad variable takes the value of 1 for firms associated to common law and 0 for firms associated to legal traditions of civil law tradition (French, Scandinavian or German law).

Table 5.6: Description of gensic variable and number of failed firms in each industrial classification.

Description of dummy variable	Industrial Classification (SIC)	Number of firms
gensic 1	Agriculture, Forestry & Fishing	243
gensic 2	Mining (incl. Oil&Gas)	16
gensic 3	Construction	912
gensic 4	Manufacturing	1,074
gensic 5	Transportation & Communications	403
gensic 6	Wholesale Trade	841
gensic 7	Retail Trade	271
gensic 8	Finance, Insurance & Real Estate	669
gensic 9	Services	766

Industry variables (gensic) are used as control dummy variables for the industrial classification of the firms. The sample includes 9 industrial classifications and for that reason 8 dummy variables (gensic1-gensic8, with service as the reference) have been used. Table 5.6 provides a description of the industry that each dummy variable covers. The Services industry is used as a reference dummy variable due to its fast growing importance in the EU economy (Muller et al., 2015).

Control dummy variables also include 8 countries (Italy, Spain, Germany, Sweden, The Republic of Ireland, The Netherlands, France and the United Kingdom). Therefore 7 dummy variables for the countries have been used (country1 – country7) as presented in table 5.7. The United Kingdom is the reference and as such, it does not have a dummy variable per se; when all the country dummy variables=0, this means that the firms are belonging to the UK. The UK is set as the reference country for two reasons. The first is that it has been one of the most widely researched countries in the firm failure literature (see for example Altman et al., 2010; Laitinen, 1992; Keasey and Watson, 1991). The second is that the UK is further analyzed for its regions' firm failure processes in the following chapter.

The sustainable growth dummy variable (SGR) represents the situation where a firm's growth has exceeded the sustainable growth level. The SGR takes the value of 1 when the firm's growth exceeds its sustainable level and 0 when it doesn't.

Finally, variables that control for the wider economic environment of the country have been used by means of the GDP growth (GDP_gr) variable and the credit availability as a percentage of GDP in a country (credit) variable.

5.5.4 Statistical Assumptions of the Panel models

Econometric theory suggests that the parallel regression assumption is one of the assumptions that one has to test when applying an ordered logistic regression model (panel or not). This can be done either conceptually or statistically by using tests such as the Brant (1990) test. Woolridge (2010) points out that a statistical rejection of the parallel assumption *"…need not imply that ordered probit or ordered logit estimates of the response probabilities are poor estimates of the true response probabilities"* (Woolridge, 2010 p.658). Additionally, *"if logic dictates that the dependent variable is an ordered response, the possibility that estimated probabilities* $\hat{P}(y \leq j|x)$*, are not increasing in j for all values of x- which can happen if the* β_j *are allowed to differ- does not make sense and it makes little sense to estimate an unordered model…"* (Woolridge, 2010 p.658). Given the assumption that the event_failure =2 (liquidation) is conceptually a higher status than the event_failure=1 (financial distress) in a sample where all firms eventually fail in their final year in the sample, there is little to gain by proceeding with further parallel regression tests as it is conceptually unclear what the alternative specification might be. The regressions in this section, use standard errors.

5.5.5 Panel Data Results

The main objective in this section is to investigate the determinants of firms' transition to failure in the alternative firm failure processes of EU firms when firm-specific characteristics and business and economic environment specific characteristics are considered. As such, this section focuses on the second and third objective of this study, in the context of EU firms' transition to failure. The independent variables were previously introduced. This part of analysis is not intended to calculate partial or marginal effects of the independent variables or to interpret the threshold parameters of the panel ordered logit models.

Nine Ordered Random Effects Panel Logit regressions were run by using information for all the firm-year observations in the sample. The first considered all the firms, grouped together ignoring the firm failure process (cluster) allocations. Eight further regressions with the same explanatory variables were run for each of the four clusters (with and without directors' characteristics) separately. The results are presented in Table 5.7. The Likelihood Ratio test in the panel indicates that there is enough variability between firms in the sample to favor the panel specification over a simple ordered logistic model.

Table 5.7: Panel Data Regression across failed firms and clusters.

Column: 1	2	3	4	5	6	7	8	9	10
		Failure Processes w/out Directors' Characteristics				Failure Processes with Directors' Characteristics			
Independent Variables	All Firms	Process 1	Process 2	Process3	Process4	Process 1	Process 2	Process3	Process4
					Coeff. *P>|z|*				
					Main Independent Variables				
ROI	-0.084***	-0.187***	-0.107**	-0.316**	0.011	-0.120***	-0.013	-0.136***	-0.241***
growth_rate	0.163***	0.037**	0.192**	0.322**	0.160**	0.166**	0.363**	0.180***	0.069***
NSTA	-0.026***	0.008*	-0.020	-0.053**	-0.034**	-0.077***	0.007	0.008	-0.011***
CFTS	-0.007**	-0.001	-0.006**	0.001	-0.032**	-0.022*	-0.006	-0.004**	-0.020**
quick_ratio	-0.004**	-0.001	-0.002	-0.020**	-0.009**	-0.059**	-0.099**	-0.001*	-0.002**
TLTA	0.008***	0.020**	1.714**	-0.001	0.009*	0.157**	-0.010	0.040**	0.016**
QACA	-0.173***	0.193**	-0.327**	0.192*	-0.860**	-0.135	0.550**	0.041	-0.797**
TCTL	-1.178**	-0.353**	-0.912**	-1.300	-2.415**	-1.570**	-1.980**	-0.372**	-0.020
Firmage	-0.002***	0.001	0.001	0.002*	-0.002**	-0.009***	0.003**	0.004	-0.004***
Avg_dir_age	-0.004***					-0.007	-0.004	0.002	-0.007***
Nr_Female_Dir	0.001					-0.004	0.043	-0.078**	-0.067*
Total_Dir_Nr	-0.006***					-0.004	-0.025**	-0.022**	-0.002
Credit	0.020***	0.020**	0.029**	0.069**	-0.002	-0.002	0.092***	0.035**	0.002
GDP_gr	-0.043***	0.050**	-0.081**	-0.001	-0.098**	-0.088**	0.002	-0.025**	-0.051**
Leg_trad.	-2.147***	-1.714**	-2.980**	-5.854***	-0.985**	-1.310***	-7.372***	-2.555***	-0.413*
SGR	0.434***	0.649**	-0.089	0.642**	0.452**	0.525***	0.501***	0.187***	0.438***
					Control Variables				
Control_Ind (Agriculture)	-0.838**	0.069	-0.095	-0.029	-1.339**	-1.733*	-0.095	-0.007	-0.429
Control_Ind (Mining)	-0.771	-0.406	-0.693	0.181	-1.162*	-1.073	-1.354	-0.755	-0.733
Control_Ind (Construction)	-1.012**	-0.242**	-0.149	-0.378**	-1.419**	-1.974**	-0.265**	-0.175*	-1.005*
Control_Ind (Manufacturing)	-0.915**	-0.018	-0.154	-0.335**	-1.208**	-1.642*	-0.256**	-0.183*	-0.829
Control_Ind (Trasp. & Comm.)	-0.730*	-0.042	-0.061	-0.085	-1.075**	-1.598*	-0.111	0.144	-0.725
Control_Ind (Wholesale)	-0.878**	-0.167*	-0.209	-0.063	-1.328**	-1.812*	-0.034	-0.248**	-0.924*
Control_Ind (Retail)	-0.814**	-0.052	-0.090	-0.025	-1.342**	-1.868**	0.015	-0.011	-0.815
Control_Ind (R. Estate)	-0.728*	0.210**	-0.025	-0.067	-1.150**	-1.525	-0.028	0.071	-0.525
Country1 (France)	0.353**	0.440**	0.279	1.630**	-0.206	-0.436	2.349**	0.630**	0.298*
Country2 (Germ.)	0.220**	0.007	-0.036	0.940**	-0.376*	0.063	1.659*	0.402**	0.210
Country3 (Ireland)	1.389**	0.863**	1.216**	3.062**	0.767**	0.938**	4.403**	1.390**	0.961**
Country4 (Italy)	0.110	0.419*	-0.095	1.694**	-1.086**	-1.100**	2.555**	0.657**	-0.172
Country5 (Netherl.)	-0.321**	-0.313	-0.662**	-0.954**	-0.312	-1.034	-0.419*	-0.253	-0.187
Country6 (Spain)	-1.666**	-1.445**	-2.253**	-3.858**	-1.107**	-1.235**	-5.075**	-2.093**	-0.407**
Country7 (Sweden)	0.246**	0.014	0.000	0.042**	0.000	0.058**	1.465**	0.506**	0.243**
\cut1	1.611***	3.127	4.772	8.669	-2.172	-2.518***	11.266***	4.637***	-0.581***
\cut2	2.212***	3.702	5.412	9.121	-1.300	-1.291***	11.683***	5.227***	-0.010*
Sigma_2u	0.403	0.005	0.002	0.134	0.296	-2.518	0.102	0.731	0.015
std. Error Sigma_2u	*0.015*	*0.000*	*0.002*	*0.037*	*0.037*	*1.124*	*0.038*	*0.068*	*0.025*
LR test vs. ologit model	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.047	0.057
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10									

Glossary

ROI	Return in Investment	TLTA	Total Liabilities to Total Assets	Nr_Female_Dir	Number of Female Directors
growth_rate	Growth Rate (in total assets)	QACA	Quick Assets to Current Assets	Total_Dir_Nr	Total Number of Directors
NSTA	Net Sales to Total Assets	TCTL	Trade Credit to Total Liabilities	Credit	Credit availability (% GDP)
CFTS	Cash Flow to Total Sales	Firmage	Firm Age	GDP_gr	GDP Growth (%)
quick_ratio	Quick ratio	Avg_dir_age	Average age of Directors	Leg_trad.	Legal Tradition
SGR	Dummy for unsustainable growth rate				

5.5.5.1 Results

The results in the full sample regression (Table 5.7, column 2) show all the independent variables on the first half of the table and the control variables in the second half. The signs of the coefficients are important to explain the direction of the effects for each independent variable. A positive sign in the coefficient signals an increased propensity for firms' transition to failure. Therefore if an independent variable has a positive sign on the coefficient that means that an increase in that variable is associated with an increased tendency towards failure. On the other hand, a negative coefficient suggest that a decrease in an independent variable is associated with increased tendency towards failure.

Table 5.7, column 2, shows that all financial ratios are significant (at Sig.<0.05 level or Sig.<0.01) determinants of the failure status of the firm. A number of financial ratios are negatively associated with firms' transition to failure, as demonstrated by their negative coefficients. A reduction in ROI, NSTA, CFTS, quick ratio, QACA and TCTL are associated with an increased propensity for firms to transition to failure. As such, a reduction on the return on investment that a firm produces; a reduction in its sales compared to its total assets; a reduction to the cash flows it generates from its sales; a reduction in liquidity; a reduction in working capital and a reduction in trade credit compared to its total liabilities are all financial symptoms that are associated with increased propensity for firms' transition to failure.

The experience in the board of directors as measured by the average directors' age and the total number of directors is negative and significant at the Sig.<0.01 level. This means that firms' transition to failure is associated with boards that have younger directors as well as fewer directors. On the other hand, the number of female directors is not significant (p-value 0.912). This has also been the case if the dummy variable of any women on the board was used instead.

Credit availability and the GDP growth in the country where the firms operate are both significant determinants (at Sig.<0.01 level) of the firms' transition to failure. Reduced GDP growth is associated with an increase in a firm's likelihood of failure. The credit availability coefficient is positive because GDP growth fell faster than credit availability. This resulted in a rise in the ratio. Therefore, lower credit availability is associated with an increase in firms failing. A country's legal tradition is a highly significant dummy variable (Sig.<0.01) (here discriminating between common law and Roman-based French, Scandinavian and German). The negative sign of the coefficient shows that firms in countries under the common law system are less likely to fail. The results have been tested with further dummy variables for French, Scandinavian and German law separately but the results were quantitatively similar. In any split, the legal traditions are a significant determinant of the failure status progression of failed firms (from healthy to financially distressed and then liquidated/bankrupt).

The age of the firm is also a significant determinant of the failure status progression as is the SGR. Considering the negative and positive signs of the coefficients, respectively, the results suggest that the younger firms and firms whose rates of growth (in sales) exceed the sustainable level are more stongly associated with failure. The presence of unsustainable levels of growth appears to be a significant determinant of the failure status progress for the firms regardless of the economic, or legal environment. The country dummy variables are generally significant with the exception of Italy. The presence of industry dummy variables for control gives mixed results. All industry classifications are significant at the Sig.<0.10 level but not everyone is at the Sig.<0.05 level, with exception of Mining.

5.5.5.2 Results on Failure Processes w/out Directors

We are now moving to the clusters that were developed without considering the directors' characteristics. These are reported in columns 3-6 in Table 5.7. The analysis without directors' characteristics is used to establish a reference point with the existing firm failure process literature before proceeding to the analysis with directors' characteristics and the additional insights that it offers for SME board structure.

In the first firm failure process (Table 5.7; column 3), not all financial ratios are significant. Net sales to total assets (NSTA), Cash flow to total sales (CFTS) and the quick ratio are not significant at 0.05 level (although NSTA is significant at Sig.<0.10 level).

On the other hand, ROI and TCTL are significant determinants of firms transition to failure with a negative sign in the coefficient, implying that decreasing return on investment (ROI) and decreasing usage of trade credit are associated with increased propensity for firms' transition to failure. In contrast, the growth rate (in total assets), TLTA and QACA are significant with a positive coefficient. As such increasing total liabilities are associated with increased propensity towards failure.

However, the sign of the coefficient for QACA is not in line with expectations. This is because firms in this process are characterised by a decreasing trend on QACA, on average, wich temporarily improves prior to failure. Such a behaviour may imply firms' efforts to impove their working capital conditions before their failure at a time when it is too late to save the (young) firm.

The economic and legal environments are highly significant as are credit availability, the GDP growth and the legal tradition, all significant at the 0.05 level. SGR is highly significant at the Sig.<0.05 level. For the control variables, results on the countries' and the industry dummies are mixed. From the countries' dummies, Germany, Netherlands and Italy are not significant even at the Sig.<0.10 level despite the finding that Germany and Italy include the highest concentration of firms in that cluster. This indicates that within this cluster the failure status progress from a healthy status to liquidation is not necessarily country specific. Cluster 1 firms were entities that were relatively new that were characterized by having sufficient liquidity. It therefore appears that the determinants for failure status progression are mainly related to the macroeconomic environment and their growth-related issues.

In the second firm failure process (Table 5.7; column 4), financial ratios are significant at the Sig.<0.05 level of significance with the exception of the quick ratio and the NSTA and the quick ratio. The firms in this cluster were characterized by their low NSTA and their worse liquidity issues relative to the all clusters results (in terms of quick ratio). Therefore, it is possible that NSTA and quick ratio (whilst characteristics of this firm failure process) were not sufficient to further determine their failure status progression. The other financial ratios are significant and in line with expectations. A reduction in ROI, CFTS, NSTA, QACA and TCTL is associated with increased propensity for firms' transition to failure. In contrast, an increase in total assets' growth rate and in total liabilities (TLTA) is associated with increased propensity for firms transition to failure.

Firm age is also not significant at the Sig.<0.05 level. The legal tradition and the economic environment variables are all highly significant. A reduction in GDP and in credit availability (shown with a positive coefficient due to it being expressed as a percentage of GDP) are associated with an increased propensity to fail. On the other hand, the SGR variable is not significant in this cluster. For the control variables, the industrial classification is not significant and the countries of operation are mixed (France, Germany and Italy are not significant). Therefore, it can be concluded that the determinants of transition to liquidation for this group of firms is largely related to the economic environment and the financial performance of the firms. In addition, unsustainable levels of growth do not appear to be significant determinants of firms' transition to failure for these firms.

In the third firm failure process (Table 5.7; column 5), ROI, NSTA and the quick ratio, are significant (Sig.<0.05) and negatively associated with firms' transition to failure. As a result, a decrease in these ratios is associated with an increase in firms' propensity to fail. On the other hand, the growth rate (in total assets) and the QACA are significant and positively associated with failure.

The firms' age is not significant at Sig.<0.05 level but it is at the Sig.<0.10 level of significance. This result still implies that the younger the age of the firm, the higher the propensity to fail. GDP growth is not significant. However, credit availability and the legal tradition are significant determinants of the failure status progression as is the sustainable growth (SGR). As such, a decrease in the levels of available credit (due to credit availability being expressed as a percentage of GDP) is associated with increased failure risk. Likewise, firms with unsustainable levels of growth (SGR=1) and firms whose legal tradition is the civil law (Leg_trad=0) are associated with a higher likelihood of firms' transitioning to failure.

From the control variables, all countries appear significant but the industrial classification is mixed. In the third firm failure process, firms were characterized by their extensive usage of trade credit and yet it does not appear to be a significant determinant of the transition to failure. In contrast, the availability of credit in the economy and the unsustainable levels of growth are both significant determinants of firms' transition to failure.

In the fourth firm failure process (Table 5.7; column 6), all the financial ratios are significant with the exception of the return on investment (ROI). Cluster 4 was characterized by firms that had negative ROI. A number of financial ratios were significant with negative coefficients. NSTA, CFTS, quick ratio, QACA and TCTL were negatively associated with firms' transition to failure. As such a reduction in these ratios is associated with increased propensity for firms' transition to failure in this failure process. On the other hand, growth rate (in total assets) and TLTA were (as in other firm failure processes) positively associated with firms' transition to failure. Therefore, an increase in these ratios is associated with increased propensity to failure.

GDP growth, the legal tradition and the SGR are all significant determinants of the failure status progression but credit availability is not. Reduced levels of GDP growth and increasing growth in sales, beyond the sustainable levels (SGR=1) are both associated with an increased propensity to failure. For the control variables, the industry classification appears to be generally significant in this cluster but the country of origination is mixed. Therefore, one can conclude that firms' transition to failure in this cluster is related to the observed financial ratios and also the industry they belong to, as this is the only firm failure process where most of the variables controlling for the industry are significant.

5.5.5.3 Results on Failure Processes with Directors

We are now moving to the clusters that were developed by considering the directors' characteristics. These results constitute the main contribution of this thesis as there is currently no evidence on the impact of including directors' characteristics in the quantitative firm failure process literature. The results are reported in columns 7-10 in Table 5.7.

The first firm failure process (Table 5.7, column 7) is characterized by the significance of all financial ratios with the exception of quick assets to current assets (QACA). This is a financial ratio that was identified as having increased volatility in the cluster's medians. The investigation of firms' transition to failure in the first firm failure process shows that decreased levels (negative coefficients) of return on investment (ROI), net sales to total assets (NSTA), cash flow to total assets (CFTS), liquidity (quick_ratio) and trade credit to total liabilities (TCTL) are all significant determinants of firms' transition to failure. As a result when these financial ratios are falling, the firm's propensity to transition to failure is increased.

On the other hand, increased rates of growth in total assets, and increased liabilities (TLTA), demonstrated by the positive coefficients in these financial ratios, are determinants of firms' transition to failure in the first firm failure process. As a result, an increase in these financial ratios is associated with increased propensity for firms to transition to failure.

In contrast to the first firm failure process without directors' characteristics, firm age is a negative and significant determinant of the failure status progression in this case despite this cluster having, on average, fairly young firms. As a result, the younger the age of the firm, the higher the propensity for transition to failure. Credit availability is not a significant determinant of the failure status progress and none of the directors' characteristics are either. It therefore appears that although this cluster is characterized as having female directors and a larger total number of directors, these are not significant characteristics that determine the failure status progression. The legal tradition and GDP growth are determinants, negatively associated with firms' transition to failure in the first failure process. This implies that lower GDP growth in a country is associated with increased propensity for transition to failure. In addition, the negative sign of the coefficient for the legal tradition dummy variable suggests that firms in countries under the common law system are less likely to enter liquidation. SGR's positive association with the transition to failure implies that firms that have SGR=1 and therefore unsustainable levels of (sales) growth are associated with transition to failure. The control variables are mixed in their significance.

In the second firm failure process (Table 5.7; column 8), an increase in the growth rate, and in the Quick Assets to Current Assets (QACA) as well as a decrease in the quick ratio, and in the Trade credit to Total Liabilities (TCTL) are all significant ratios associated with firms' transition to failure. In addition, increasing firm age and the decreasing levels of directors' experience proxied by a lower total number of directors are associated with increased propensity towards failure. This is a cluster that was characterized by a large volatility in liquidity and it appears that this volatility actually determines the failure status progression.. As shown above, this cluster includes some signs in the coefficients that are not entirely expected and vary from the signs that have been observed in the all firms sample (Table 5.7, column 2). Increased firm age is positively associated with increased propensity for firms' transition to failure. This contradicts the common view that firms' age is negatively associated with failure due to the young age of the firm being an indicator of an unestablished firm. However, Argenti (1976) suggests that there is a firm failure process for old firms that have become "apathetic" and fail because of that. This finding fits in that context as the second firm failure process is associated with some of the oldest firms in the sample. Moreover, increased working capital (QACA) is positively associated with firms' transition to failure. This can be explained in the context of the second firm failure process. Firms in this process have improving working capital in the years towards failure. On the other hand, decreased liquidity (quick ratio) and trade credit usage compared to their total liabilities (TCTL) (a sign that suppliers do not trust these companies and so are less willing to extend them credit) are negatively associated with firms' transition to failure.

Credit availability in the economy is a significant determinant of failure progression. Decreasing levels of credit and number of directors (the positive sign here is due to the credit availability being calculated as a percentage of GDP; GDP was reducing more aggressively than the credit availability for a number of years resulting in an increasing ratio) are also associated with firms' transition to failure. This cluster is characterized by firms that, on average (median), had high, though reducing, trade credit usage (TCTL).

Both the legal tradition and SGR are significant at the Sig.<0.01 level. The negative sign of the coefficient for the legal tradition dummy variable, suggests that firms in countries under the common law system are less likely to enter liquidation. Likewise the positive sign of SGR suggests that firms with unsustainable levels of (sales) growth (SGR=1) are associated with an increased propensity for transition to failure.

From the control variables the countries are generally significant but the industrial classification is mixed.

In the third firm failure process (Table 5.7; column 9), increased growth rates in total assets and total liabilities to total assets (TLTA), are associated with an increased propensity for firms' transition to failure.

On the other hand,decreased ROI, CFTS, liquidity and TCTL on the other hand, are significant determinants of firms' transition to failure at Sig. <0.01 and Sig.<0.05 levels (with TLTA, QACA and the quick ratio significant at Sig.<0.10 significance level). As a result, when return on investment, cash flow generation as a percentage of the total sales liquidity and trade credit usage are decreasing, the propensity for firms' transition to failure is increasing. This cluster is characterized by constant liquidity problems and therefore it appears that liquidity alone is not the main determinant of the failure status progression (quick ratio significant at Sig.<0.10 level).

In terms of the directors' characteristics, fewer directors and therefore reduced social capital as proxied by the total number of directors and reduced gender diversity in the board, proxied by the number of female directors (also tested with a dummy variable for the existence of any female directors with similar results) are further significant determinants of firms' transition to failure at the Sig.<0.05 level despite the fact that this is a cluster that is characterized by a small total number of directors. Given the negative signs of the coefficients in both characteristics, one can assume that further reduction in board social capital and heterogeneity is a determinant associated with firms' transition to failure for the firms in this process. Given that the clusters considered directors' characteristics at the last year (of failure) it looks plausible that variations in the number of directors might be significant determinants of failure status progression for these firms. The economic and legal tradition environment are significant determinants of failure status progression in these firms (at Sig.<0.05 level) as is the SGR. The sign of the coefficient for the legal tradition variable implies that firms in countries under a civil law system have a higher propensity towards failure. Moreover, firms with unsustainable levels of growth (SGR=1) are also more likely to fail. Control variables' significance is mixed for this cluster.

In the fourth firm failure process (Table 5.7; column 10), all financial ratios are significant, with the exception of TCTL. This cluster's firms are characterized by relatively increasing usage of credit in the years prior but this does not appear to be a key determinant of the failure status progression. ROI, NSTA, CFTS, quick_ratio and QACA have all negative coefficients, implying that a reduction in these financial ratios is associated with transition to failure. Growth rates in total assets and TLTA are determinants of firms' transition to failure, with a positive coefficient. This implies that an increase in these ratios is associated with an increased propensity for firms' failure.

Firm age is a significant determinant of failure status progression with the expected negative sign. As such, younger firm age is associated with the transition to failure. In terms of the management structure, reduced presence of female directors and therefore gender diversity as well as reduced average age of directors and therefore experience are all associated with firms' transition to failure. Likewise, reduced GDP growth and increased levels of unsustainable growth (SGR=1) are both associated with the transition to failure. As in the case of the firm failure process 3, it appears that changes in the directors across time affect the failure status progression. The legal tradition is significant at the Sig.<0.10 level (p-value=0.053) implying that firms in countries under the common law tradition are less likely to be associated with transition to failure. Most of the control variables appear insignificant at the Sig.<0.05 level.

The results of the analysis of the determinants of firms' transition to liquidation for the full sample and for the alternative firm failure processes where directors' characteristics are included, demonstrate that the inclusion of directors' characteristics is statistically significant. In the full sample (table 5.7, column 2) the total number of directors and their average age are significant determinants of firms' transition to failure. This implies that the experience of directors and the additional dimension of social and human capital that they provide in a firm are determinants of transition to failure. However, the results differ in the alternative firm failure processes. These results, further illustrate that the inclusion of directors' characteristics is significant in a firm failure process study.

5.5.5.4 Marginal Effects of Failure Processes with Directors' Characteristics

This section looks at the marginal effects of firms' transition to failure in the alternative countries and the alternative firm failure processes. The results derive from the panel regressions and, by extension, show a comparison for the firms of each country compared to the UK, which was the reference country in the regression analysis' dummy variables. The aim of this section is to provide a breakdown of the relative magnitude of the country effects (that were shown as significant in the regression analysis) for each one of the alternative firm failure statuses as this is not explicitly obvious in the panel regression results. Effectively the marginal effects capture the magnitude of change in the dependent variable (firm failure status) for a change in the independent variable (country). In this section, these are presented as probabilities of each country to be in a firm failure status (0: healthy; 1: financial distress; 2: liquidation). Table 5.8 shows the results.

Table 5.8: Marginal effects – All EU firms

Marginal Effects in EU Countries (All firms/ UK as reference country)							
Firm Failure Status	France	Germany	Ireland	Italy	Netherlands	Spain	Sweden
0	-8.1%	-5.0%	-31.8%	-2.5%	7.4%	38.1%	8.0%
1	1.7%	1.0%	6.5%	0.5%	-1.5%	-7.8%	-1.6%
2	6.4%	4.0%	25.3%	2.0%	-5.9%	-30.3%	-6.4%

The following are some observations to be made when looking at the marginal effects at means for each country separately. The percentages are capturing the magnitude of change in the firm failure status (the dependent variable) for each country (therefore for a change in the dummy variable representing each country). These are translated as percentages against the average firm. The structure of the regression represents that with UK firms which were the reference dummy variables.

- French firms' probability for the terminal status is 6.4%; 1.7% higher for financial distress and -8% for financial health, at means.
- German firms' probability for the terminal status is 4%; 1% for financial distress and -5% for financial health, at means.
- Irish firms' probability for the terminal status is 25%, higher than the average (UK) firm and than any other country. This means that firs located in Ireland "cause" a 25.3% increase (on average) in the dependent variable. Therefore Irish firms are much more likely to be in liquidation (firm failure status = 2). Likewise, the marginal effect of 6.5% for financial distress and -32% for financial health, show that Irish firms are more likely to be associated with financial distress and less likely to be associated with financial health.

- Italian firms' probability for the terminal status is 2%. In contrast, Italian firms' probability for financial distress is 0.05% and -2.5% for financial health at means.
- Netherland firms' probability for the terminal status is -6%; -1.5% for financial distress and 7% for financial health, at means.
- Spanish firms are associated with a -30% lower probability for the liquidation status; -8% for financial distress and 38% with financial health status, at means.
- Swedish firms are associated with a -6.4% probability for the liquidation status; -1.6% for financial distress and 8% probability for financial health status, at means.

Table 5.9: Marginal effects – EU firms by Firm Failure process

Firm Failure Status	France	Germany	Ireland	Italy	Netherlands	Spain	Sweden
Marginal Effects in EU countries (FIRST PROCESS WITH DIRECTORS/ UK as reference country)							
0	-4.8%	-3.0%	-18.9%	-1.5%	4.4%	22.7%	5.2%
1	-1.9%	-1.2%	-7.6%	-0.6%	1.8%	9.2%	2.1%
2	6.7%	4.3%	26.5%	2.1%	-6.1%	-31.8%	-7.3%
Marginal Effects in EU countries (SECOND PROCESS WITH DIRECTORS/ UK as reference country)							
0	-5.7%	-3.6%	-22.4%	-1.8%	5.2%	26.9%	5.5%
1	1.9%	1.2%	7.4%	0.6%	-1.7%	-8.8%	2.0%
2	3.8%	2.4%	15.1%	1.2%	-3.5%	-18.1%	-7.5%
Marginal Effects in EU countries (THIRD PROCESS WITH DIRECTORS/ UK as reference country)							
0	-6.8%	-4.3%	-26.9%	-2.1%	6.2%	32.3%	6.9%
1	1.9%	1.2%	7.6%	0.6%	-1.8%	-9.2%	-1.8%
2	4.9%	3.1%	19.3%	1.5%	-4.5%	-23.1%	-5.1%
Marginal Effects in EU countries (FOURTH PROCESS WITH DIRECTORS/ UK as reference country)							
0	-6.9%	-4.3%	-27.3%	-2.2%	6.3%	32.7%	6.7%
1	1.9%	1.2%	7.6%	0.6%	-1.8%	-9.1%	1.4%
2	5.0%	3.1%	19.6%	1.6%	-4.5%	-23.6%	-8.1%

On the other hand, one can observe some differentiations on the countries' marginal effects when the alternative firm failure process are concerned (Table 5.9). All other things, being equal, in the four alternative firm failure processes, firm failure processes, Spanish firms have the highest probabilities in the firm failure status of the healthy firm (event_failure=0). This is because in all the alternative firm failure processes, Spansh firms have the highest percentage in Firm Failure Status=0. In contrast, Irish firms are the ones with the lowest probabilities of being in the firm failure status of the healthy firm in all the alternative firm faiure processes.

On the other hand, in the case of firms transition to financial distress (event_failure=1), Irish firms are the ones that have the lowest probability (7.6%) in the first firm failure process. As such Irish firms are the least likely to be associated with financial distress in the first firm failure process. Spanish firms have the lowest probabilities from all countries' firms to be in the firm failure status of financial distress in the second, third and fourth firm failure process.

When, liquidation is considered (event_failure=3) Irish firms have the highest probabilities in all firm failure processes (26.5%, 15.1%, 19.3% and 19.6% higher than the UK firms in the first second, third and fourth firm failure process respectively).

Therefore, evidence from the marginal effects at means analysis shows that firms from different countries have different distribution of propensities for transition to failure for each of the alternative failure stages (financial distress and then liquidation) when all other independent variables take their mean values.

5.5.6 Panel Regression Results' implications on the Hypotheses

Table 5.10 summarises whether the hypotheses relevant to this chapter are accepted.

Table 5.10: Summary table for Chapter 5 Hypotheses

Table of Hypotheses for EU firms		
Nr.	**Hypothesis Statement**	**Accepted?**
H1	Countries' legal origins differ between firms in the alternative failure processes in the EU countries under consideration; they are also determinants of firms' transition to failure.	Yes
H2	Industry classification differs between firms in the alternative firm failure processes in EU firms; it also differs as a determinant of firms' transition to failure in the alternative firm failure processes.	Yes
H3	Financial performance represented by key financial ratios and the age of the firm, differ in the alternative firm failure processes of EU firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.	Yes
H4	In a cross country context, macroeconomic conditions differ between firms in the alternative firm failure processes in EU firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.	Yes
H5	Directors' Characteristics such as the presence of women in SMEs' management, director age as a proxy of director experience and the number of directors, differ in the alternative EU firm failure processes; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.	Yes
H6	The distribution of firms with unsustainable levels of growth differs between the alternative firm failure processes in EU firms; unsustainable levels of growth are also determinants of firms' transition to failure	Yes

Hypothesis 1: *Countries' legal origins differ between firms in the alternative failure processes in the European countries under consideration; they are also determinants of firms' transition to failure.*

The first part of Hypothesis 1 has already been accepted on the basis of the cluster analysis. Consistent with this, the evidence from the panel regressions show additionally that a country's legal origins is a statistically significant determinant of firms' transition to failure in all firm failure processes. Therefore Hypothesis 1 is fully accepted.

Hypothesis 2: *Industry classification differs between firms in the alternative firm failure processes in EU firms; it also differs as a determinant of firms' transition to failure in the alternative firm failure processes.*

With regards to the industry classification, it has been already reported that there is a statistically significant difference in the industry distribution across the failure clusters on the basis of the cluster analysis results. Evidence from the panel regression show that the significance of the industry effects in firms' transition to failure does differ between clusters and is also industry-specific. Therefore Hypothesis 2 is fully accepted.

Hypothesis 3: *Financial performance represented by key financial ratios and the age of the firm, differ in the alternative firm failure processes of EU firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

Based on the cluster analysis it has already been evidence that the medians of financial ratios and of the firm age are not the same across firm failure clusters. The panel regressions also show that the significance of financial ratios differs between clusters. There are differences between the financial ratios that are significant determinants firms' transition to failure for each of the alternative firm failure processes. The same applied for the firm age. The firm age is significant determinant of firms' transition to failure for the first, second and fourth firm failure process as well as for the full EU firms' sample. Therefore Hypothesis 3 is fully accepted.

Hypothesis 4*: In a cross-country context, macroeconomic conditions differ between firms in the alternative firm failure processes in EU firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

The results in the cluster analysis indicated that there are statistically significant differences between firm failure processes in both GDP growth and in the credit availability. The results from the panel analysis show that, even when controlling for the country of the firm's operation and its financial ratios, GDP growth and the credit availability are significant determinants of firms' transition to failure in a number of firm failure processes. However, they are not significant determinants of firms' transition to failure in all the firm failure processes. As such, there are differences in their significance between the alternative firm failure processes. Therefore Hypothesis 4 is fully accepted.

Hypothesis 5*: Directors' Characteristics such as the presence of women in SMEs' management, director age as a proxy of director experience and the number of directors, differ in the alternative EU firm failure processes; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

The result from the cluster analysis indicated that firm failure processes have statistically different median numbers of women in the board, statistically different ages of directors and statistically different total number of directors. Evidence from the panel analysis further indicates that the directors' characteristics are significant determinants of firms' transition to failure in a number of firm failure processes. However, different combinations of directors' characteristics are statistically significant determinants of firms' transition to failure in the alternative firm failure processes. Therefore Hypothesis 5 is fully accepted.

Hypothesis 6*: The distribution of firms with unsustainable levels of growth differs between the alternative firm failure processes in EU firms; unsustainable levels of growth are also determinants of firms' transition to failure.*

The results from the cluster analysis indicate that there is a statistically significant difference in the distribution of firms with sustainable growth levels across the alternative failure processes. This is consistent with the panel regression results which show that unsustainable growth levels are a significant determinant in a number of firm failure processes. Therefore Hypothesis 6 is fully accepted. The SGR is a significant determinant of firms' transition to failure in most of the alternative firm failure processes.

5.6 Robustness Checks

Two additional analyses for robustness were undertaken. The results are presented in Table 5.11.

First, the ordered random effects panel model was bootstrapped (100 iterations with replacement) in order to test whether the results remain the same and that there is no bias in the error components. The results (Table 5.11, column 3) indicate that the directors' characteristics, the legal tradition, the age of the firm, the sustainable growth indicator and all the industry-specific and country-specific control variables have practically the same results. There is some small variation in some financial ratios (ROI, NSTA, CFTS, Quick Ratio) which are now significant at the 10% level. The only material difference is the TLTA financial ratio that is not significant at 5% or 10% level. However, this does not affect the overall conclusion of the study.

Second, a simple (non-panel) ordered logit model with the same variables is applied to all firms. Although there are some small variations in the level of significance of the quick ratio and some of the control variables such as Ireland, the results (Table 5.11, column 4) indicate the same variables were determinants of the firms' transition towards failure as in the original panel random effects ordered model. The direction of the coefficients is also the same. However, the reported Likelihood Ratio test (Sig.<0.01) indicates a significant variability between firms in the sample which makes the panel data approach the preferred specification (if comparing panel and simple ordered logit).

Table 5.11: Robustness checks and comparison with the results of the original regression.

Column:	1 2	3	3	4
Independent Variables	All Firms Random Effects Ordered Panel	All Firms Random Effects Ordered Panel Bootstrap	All Firms Random Effects Ordered Panel Robust Errors	All Firms Simple Ordered Logit
		Coeff. *P>|z|*		
		Independent Variables		
ROI	-0.084***	-0.084*	-0.084	-1.429***
growth_rate	0.163***	0.163***	0.163***	0.064***
NSTA	-0.026***	-0.026*	-0.026***	-0.010***
CFTS	-0.007**	-0.007*	-0.007**	-0.005**
quick_ratio	-0.004**	-0.004*	-0.004**	-0.001*
TLTA	0.008***	0.008	0.008	5.690***
QACA	-0.173***	-0.173**	-0.173***	-0.105***
TCTL	-1.178**	-1.178**	-1.178**	-0.727**
Firmage	-0.002***	-0.002*	-0.002	-0.002***
Avg_dir_age	-0.004***	-0.004***	-0.004**	-0.004***
Nr_Female_Dir	0.001	0.001	0.001	-0.003
Total_Dir_Nr	-0.006***	-0.006*	-0.006*	-0.007***
Credit	0.020***	0.020***	0.020**	0.020***
GDP_gr	-0.043***	-0.043***	-0.043**	-0.043**
Leg_trad.	-2.147***	-2.147**	-2.147**	-2.360**
SGR	0.434***	0.434***	0.434***	0.249***
		Control Variables		
Control_Ind (Agriculture)	-0.838**	-0.838*	-0.838**	-1.615**
Control_Ind (Mining)	-0.771	-0.771	-0.771	-1.481**
Control_Ind (Construction)	-1.012**	-1.012**	-1.012**	-1.929**
Control_Ind (Manufacturing)	-0.915**	-0.915**	-0.915**	-1.663**
Control_Ind (Trasp. & Comm.)	-0.730*	-0.730*	-0.730*	-1.836**
Control_Ind (Wholesale)	-0.878**	-0.878**	-0.878**	-1.762**
Control_Ind (Retail)	-0.814**	-0.814*	-0.814*	-1.701**
Control_Ind (R. Estate)	-0.728*	-0.728*	-0.726*	-1.497**
Country1 (France)	0.353**	0.353**	0.353**	0.204**
Country2 (Germ.)	0.220**	0.220**	0.220*	0.137**
Country3 (Ireland)	1.389**	1.389**	1.389**	1.921*
Country4 (Italy)	0.110	0.110	0.110	-0.389
Country5 (Netherl.)	-0.321**	-0.321**	-0.321*	-0.463**
Country6 (Spain)	-1.666**	-1.666**	-1.666**	-1.664**
Country7 (Sweden)	0.246**	0.246**	0.246*	0.221**
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10				

The results of the above tests are also repeated at firm failure process level without material variations from the original regressions. Therefore the results of the robustness tests confirm that a panel ordered random effects model captures the dynamics of the firms' individual heterogeneity in a better way than the non-panel approach. At the same time, there is evidence that the use of the panel specification does not alter the conclusions of the study from a statistical perspective. Likewise, although there are some evidences of a weaker significance in some of the financial ratios under the bootstrap application, the primary conclusions of this analysis are confirmed since these variations do not affect the overall conclusion or direction of the results.

5.7 Discussion

The objective of this chapter is to identify and compare SMEs' failure processes in European Union countries and to either confirm or reject the hypotheses. This section discusses the findings with the existing evidence from the literature.

The factor/clustering analysis results with and without directors' characteristics show evidence that indeed firm failure is a process that develops across a number of years. The above results concluded that there are four main failure processes, broadly in line with the qualitative (eg. Argenti, 1976; Ooghe and DePrijcker, 2008) and quantitative literature (eg. Laitinen et al, 2014; Laitinen et al., 2015; Lukason and Laitinen, 2016) that has historically identified between 2 and 6 firm failure processes. In addition, once directors' characteristics are included in the formation of the firm failure processes, the total number of processes remains the same.

As discussed above, the inclusion of directors' information adds further insights into the formation of the failure processes. In addition, the inclusion of directors' characteristics is a significant determinant of firms' transition to failure for a number of alternative failure processes as well as for the full sample of the firms. For these reasons the focus on the discussion will be given on the failure processes with directors' characteristics. For this reason the focus on the discussion will be given on the failure processes with directors' characteristics.

5.7.1 Discussion on Firm Failure process

5.7.1.1 Critique on Failure Processes

This section provides a critical evaluation of the four firm failure processes that are identified in the EU countries and discusses the similarities with the processes analysed in the qualitative and quantitative literature in other countries.

One of the key differences between the processes for the results with and without directors' characteristics is that the first firm failure process with directors' characteristics includes female directors. This differs from any other cluster in this analysis and provides an addition to the existing literature that so far does not consider directors' characteristics as a potential explanatory variable in the firm failure process.

The rest of the results of the analysis can be linked to the broad classification of the failure processes that the qualitative literature describes. The qualitative firm failure process literature proposes broadly four types of failure processes. The first type of failure process is the relatively new firm that never becomes successful and fails; the second type of failure process is that of an ambitious growth company; the third type of failure process is that of a dazzled growth company and the fourth type of failure process is that of the established apathetic company (Ooghe and De Prijcker, 2008; Argenti, 1976). SMEs of up to 10 years old are generally defined as new (Wagner, 2004; Davidsson and Klofsten, 2003).

The young age of the firm is one of the first characteristics that have been identified as determinants of firm failure processes. According to Ooghe and De Prijcker, (2008) the relatively new firm that never succeeds, fails within five years of its launch, after having a period of limited growth and a lack of profitability. That failure process can be broadly linked with the first failure process of this analysis. That is, the relatively new firm that never becomes successful. The results show that the firms in this process have historically low returns. Firms in the first cluster had growing sales but failed to convert them to increased cash flows or overall growth rates (in assets), which is consistent with Ooghe and De Prijcker, (2008) who argued that firms in such a failure process suffer from weak cash flows and profitability. The average age of these firms (in the first failure process) in this analysis is 8 years, which is slightly higher than the 5 years that Ooghe and De Prijcker, (2008) suggest but in both cases they are classified as young firms. The presence of female directors in the board and the relatively high total number of directors in these young firms, may imply that management experience and diversity are not a problem in the first firm failure process. There is sufficient social and gender diversity on these firms' boards.

The process of an "apathetic" old firm (Argenti, 1976) could be relevant to firms that are older and performing in a stable manner for many years. Such a process resembles to the second firm failure process of this analysis. Firms in the second failure process have the highest average age of all the failure processes. These firms are on average 20 years old and had a number of years with mainly negative or borderline positive financial metrics. In fact, the second firm failure process is the only one where firms' age is a significant determinant of transition to failure and with a positive sign, further supporting the qualitative observation of Argenti (1976) that in some cases the age of the firm can be linked to management apathy and dis-interest towards the firm's viability.

On the other hand, the failure process of an ambitious company (Ooghe and De Pricker, 2008) is possibly related to the third firm failure process. These are firms that have increasing sales compared to their assets and increased usage of trade credit compared to their liabilities (TCTL). The latter may imply difficulties of obtaining bank finance as their total liabilities are generally increasing. As a result these firms turn to their suppliers to achieve trade credit. The fact that these firms can increase their use of trade credit signals trust from their suppliers who are willing to extend credit in situations where banks are not willing to do so (Berger and Udell, 2006). Nevertheless, the cash flows and the returns for these firms remain low although there is a mild improvement in their working capital (QACA). These firms have a small management team that lacks depth and potentially management experience. As such firms in this failure process are particularly vulnerable to the economic conditions. This is evidenced from being the only failure process where both the GDP growth and the Credit availability are both highly significant determinants of transition to failure, in addition to the characteristics of their management.

Finally, the failure process of a dazzled growth and apathetic firm (Ooghe and De Prijcker, 2008; Argenti, 1976b) can be linked to the fourth failure process. These firms had positive total assets growth 6-7 years prior to failure and rapidly increasing net sales which however were not converted to sustainably high returns on equity or cash flows. In line with Ooghe and De Prijcker (2008), these firms' total liabilities are gradually increasing and cash flows are decreasing as the firms cannot pay their liabilities. These firms also have fewer managers, potentially highlighting less available experience on the board. Lack of management depth though has been one of the key characteristics of failure in firms of any size (Argenti, 1976b; Ross and Kami, 1973; Hambrick and D'Aveni, 1992). This is empirically confirmed in this study, because the number of directors is a determinant of firms' transition to failure in this process.

5.7.1.2 Discussion on Hypotheses

In relation to the hypotheses testing, the identification of four firm failure processes without directors' characteristics has been in line with the academic literature that identified between 3 and 6 firm failure processes (see for example Laitinen et al, 2014; Laitinen and Lukason, 2014; Lukason and Laitinen, 2016). The results of this study also suggest that the inclusion of directors' characteristics in a firm failure process study adds further insight in the firm failure processes. The study provides evidence that the first firm failure process that is characterized by young firms is also characterized by diversity in the board of directors in the form of female directors. The wider SME literature and the qualitative firm failure process literature implies that firms' directors' characteristics is a differentiating factor between some firm failure processes (Argenti 1976; García-Olalla and García-Ramos, 2010).

Whilst the average age of directors in the firms of the first firm failure process is broadly the same with the others, the results provide evidence that these firms also have more directors on their board, which suggests significant experience in the management team. This is the first time that such evidence is produced in the context of a quantitative study of SMEs' failure processes. The qualitative firm failure process literature provided early evidence that a firm's management is a key characteristic of a firm's failure process. Argenti (1976) argued that management is one of the three key components of firm failure, where for example, the management of the firm lacks experience or is resistant to change. In addition to that, there are sufficient evidences in the wider firm failure literature that the gender diversity of the board (proxied by the existence of female directors) and the breadth of knowledge and experience (proxied by the number of directors) on firms' board of directors is (negatively) associated with firm failure (see for example, Adams and Ferreira, 2009; Wilson et al., 2014). This study therefore confirms that directors' characteristics differ between alternative firm failure processes. The following section will further discuss whether directors' characteristics are determinants of the firms' transition towards failure.

The financial ratios that measure the basic dimensions of a firm's liquidity, indebtedness, profitability and working capital are also differ across various alternative firm failure processes. This is broadly in line with the quantitative firm failure process literature that used primarily financial ratios to establish the firms' failure processes (see for example Laitinen, 1991; Laitinen et al, 2014; Laitinen and Lukason, 2014; Lukason and Laitinen, 2016). This result is also consistent with the qualitative firm failure literature (Argenti, 1976; Richardson et al., 1994; Ooghe and De Prijcker, 2008), which provided evidence that firm growth, limited profitability and liquidity determine firm failure processes. Each of the firm failure processes are characterized by one or more of the basic dimensions of financial ratio issues.

Section 5.4.2 discussed the characteristics of the alternative firm failure processes. The firms' transition to failure analysis, using panel data, shows that financial ratios differ between the alternative firm failure processes. In the first firm failure process all the financial ratios are significant with the exception of QACA. As such the financial dimensions of profitability, efficiency, liquidity, leverage, growth and cash flow are significant determinants of the transition to failure but the working capital, expressed by QACA, is not. In contrast, in the second firm failure process only the dimension of liquidity (quick ratio), working capital (QACA), growth and trade credit are significant. The third firm failure process has most of the ratios as significant determinants of firms' transition to failure with the exception of the NSTA, a measure of efficiency and QACA (for working capital). Likewise the fourth firm failure process has all the financial ratios as significant determinants with the exception of TCTL. This mixture of financial ratios being significant in the alternative firm failure processes, but without the same ratios always being significant, is consistent with evidence from the quantitative firm failure process literature where there is little consistency in the financial ratios used, (see for example Laitinen, 1991; Lukason and Laitinen, 2016; Lukason et al., 2016). It is also consistent with similar observations from the wider firm failure literature (Ohlson, 1980; Ooghe et al., 1995; Balcaen and Ooghe, 2006).

The countries' legal origins differ significantly between the alternative firm failure processes in the countries under consideration. This is a new finding for a firm failure process study. This finding can be linked with the concentration that firms from different countries have in the alternative firm failure processes. Whilst there is no evidence in the academic literature connecting small firm failure processes with the legal origins, evidence from the wider firm failure literature pointed that legal origins are closely associated with the characteristics of the insolvency legislation in a country (example LaPorta et al., 1998; Sgard, 2006). Moreover, evidence suggested that common law countries have better protection for creditors' and investors (Wang, 2012) and as such the legal origin of a country's bankruptcy code is an important determinant of firms' failure.

With regards to the industry classification, this study found evidence that the industry classification is different between the alternative firm failure processes. Whilst there has been little evidence of such a result in the firm failure process context, evidence from the wider firm failure literature suggested that such results could have been expected. Different industries tend to have different business cycles which in turn are significant determinants of firm failure or financial distress (see for example Watson and Everett, 1999; Lowe et al., 1991; Platt, 1989; Platt and Platt, 1991; Bottazzi et al., 2011; Zeli, 2014).

Evidence from the qualitative literature implied that challenging economic conditions can impact the firms' failure process (Argenti, 1976). The chi-square tests on the underlying economic and credit conditions highlighted that they are significantly different among the alternative firm failure processes. Given the evidence from the wider firm failure literature, and the prior results of this study that have already identified significant differences in the distribution of countries between the alternative firm failure processes, such a result is intuitive. As such it adds to the current body of literature within the quantitative SME firm failure process literature.

The last element that has been tested between the alternative firm failure processes is the sustainable growth dummy variable. Evidence from earlier sections of this study demonstrated that firms' total asset growth is different between the alternative firm failure processes. In addition, the distribution of firms with unsustainable growth levels differs between the alternative firm failure processes. This is a new finding given that previous quantitative firm failure process studies (see for example Laitinen, 1991; Lukason and Laitinen 2016) did not consider the potential differences of sustainable growth levels between alternative firm failure processes. However, Argenti (1976) had identified unsustainable growth as one key characteristic in one firm failure process in the context of qualitative studies.

The above results highlight that there are four firm failure processes for SMEs in the countries under consideration. The firm-specific characteristics that were used to define these firm failure processes are indeed different across the processes. The non-firm-specific characteristics that were tested with the hypotheses discussed above, also provide evidence of wider differences among the alternative firm failure processes. The following section discusses how both the firm specific and the environment specific characteristics determinants the firms' transition towards failure in the alternative firm failure processes.

5.7.2 Discussion on Firms' Transition to Failure

This section discusses the results of the panel regressions that considered the determinants of firms' transition to failure for all the EU firms and for each firm failure process. Since there is no evidence in the quantitative literature of firms' failure processes on the determinants of firms' transition to failure, the discussion is based on evidence from the wider firm failure literature.

The basic dimensions of firms' liquidity, profitability, working capital and leverage (Berk and DeMarzo, 2011) are important contributors to the firm failure processes in EU firms. However, as discussed in earlier sections, the financial ratios and their combinations, differ between the alternative firm failure processes, when firms' transition to failure is considered. Therefore, this further highlights the importance of having separate firm failure processes and not treating all firms that fail in the same way. In this context the fundamental rationale of identifying the alternative firm failure processes is significant. This has been a fundamental motivation behind the firm failure process studies which argued that the different characteristics of firms should be considered carefully as different firm failure processes have different underlying reasons that drive the failure (Argenti 1976; Argenti 1976b; Ooghe and De Prijcker, 2008; Richardson et al., 1994). The differences of the financial ratios and their combinations, as determinants of firms' transition to failure in the alternative firm failure processes, are in line with evidence from the wider firm failure literature that has not managed historically to identify a specific combination of financial ratios that can be used universally to identify or to predict firms' failure (Balcaen and Ooghe, 2006).

In fact, the results of this study support the argument of Argenti (1976) on the necessity of identifying firm failure processes offering a possible explanation for why there cannot be consistency in the financial ratios as predictors of failure. The ratios have always been regarded as symptoms of failure (Argenti, 1976). However, different firm failure processes have different causes of failure that predate the failure event for a number of years. As such the financial symptoms are also different.

In particular, the results of the Ordered Random Effects regression indicate that all financial ratios are significant at the Sig.<0.05 level in the full firms' sample. Reduced profitability, high growth rates, lower sales to assets, lower cash flow to sales, reducing quick ratio, increasing liabilities compared to the assets of the firm, reducing working capital and reducing access to trade credit compared to the total liabilities of the firm are significant determinants of the status transition of firms from being active and financially healthy to being financially distressed and eventually into failure. However, there are differences between the alternative firm failure processes. QACA is not significant in the first process, indicating that working capital is not a determinant of firms' transition to failure in these young firms that the first firm failure process includes. The second firm failure process is the one where firms' transition to failure is less driven by the financial ratios. Only growth rate (in total assets) and working capital are a positive determinants of firms' transition to failure and liquidity and trade credit are negatively associated with transition to failure. These apply to a firm failure process where old firms suffer from negative growth for a number of years, before some positive growth signs a couple of year prior to failure. Net sales to total assets (NSTA) and working capital (QACA) are the only financial ratios that are not significant determinants of firms' transition to failure in the third failure process. This is potentially due to these firms being characterized by increased sales but reduced cash flows and return on investment. Likewise, only TCTL is not a significant determinant of firms' transition to failure in the fourth firm failure process, indicating that trade credit to total liabilities is not a failure transition determinant for these firms which belong to a process, characterized by low growth.

Firm age is also significant indicating that younger firms are more likely to become bankrupt. This applies to the all firms' sample and the first and fourth firm failure processes. These results are in line with prior expectations. The literature suggests that young firms are likely to fail after the first few years of their "honeymoon period" during which the firm's management is able to overcome any financial, personal and business hurdles (Fichman and Levinthall, 1991; Thornhill and Amit, 2003; Cressy, 2006). Firms' age in the second firm failure process however is positively associated with failure. One can conclude that this is because the second firm failure process is associated with old firms (the oldest, on average, in the sample) for which evidence from the qualitative firm failure process literature has suggested that may be prone to failure because of management apathy (Argenti, 1976). Under this theory, these firms' management is no longer interested in the development of the firm and as such these firms eventually fail.

The financial ratios mentioned above as well as the age of the firm have been shown to be useful determinants of SMEs failure in previous studies (see for example Pindado and Rodrigues, 2004; Altman et al., 2010; Wagner, 2004; Davidsson and Klofsten 2003). The results of this study now provide evidence that these metrics are also determinants of the firms' transition to failure when only eventually liquidated firms are considered. This is a new finding because it confirms that these determinants are indeed significant in the firms' transition towards failure. This is significant because it provides statistical evidence that the basic dimensions of firm profitability, liquidity, leverage and growth are important to the development of firm failure processes. Additionally, these results show that these metrics which were previously associated with the wider firm failure prediction literature on (see Balcaen and Ooghe, 2006) are not only useful for differentiating between failed and non-failed firms but they also demonstrate that these metrics are significant in determining firms' transition to failure in alternative firm failure processes.

Moreover, hypothesis 3 that the financial ratios characterizing the alternative firm failure processes differ between them does hold, as already discussed. The panel regression results of the alternative firm failure processes show that the significance of financial ratios differs between the alternative firm failure processes too. Evidence from the qualitative firm failure process literature suggests that not all the basic dimensions of the firms' profitability, leverage, growth, liquidity and working capital are characteristics and determinants that are present in the same firm failure processes at the same time(see for example Argenti, 1976; Laitinen, 1991).

On the other hand, the age of the firm is only significant for processes 3 and 4 and with opposite signs when no directors' characteristics are considered. In the third firm failure process the age of the firm is positively associated with failure (significant at Sig.<0.10). This firm failure process has been associated with older firms (18 years old on average). On the other hand the negative sign of the coefficient in the fourth failure process, is closer to the wider firm failure literature that negatively associates firms' failure with the age of the firm. Firms in the fourth firm failure process are younger and therefore potentially closer to the literature stream of Altman et al., (2010); Wagner, (2004) and Davidsson and Klofsten, (2003).

In addition to the financial ratio and the age of the firm metrics, evidence showed that directors' characteristics are significant determinants of firms' transition to failure. In the all firms' sample, the experience of the directors, as proxied by the average age of directors and the number of directors, are negative and significant indicating that firms with younger and fewer directors are more likely to go bankrupt. However, the significance of these metrics differs in the alternative firm failure processes. The experience (average age) of directors is only significant in the fourth firm failure process. Likewise, the number of social and business contacts that additional directors bring to a board (total number of directors) is significant in the second and third firm failure processes. The interpretation is that younger and fewer directors, with less experience and breadth of networks may lack the depth of experience required to avoid failure. This is consistent with prior evidence from the literature suggesting that more directors are generally bringing more contacts and experience, assisting firms' performance (Cope et al., 2007). These results are also consistent with prior evidence from the qualitative firm failure process literature (see for example Argenti, 1976; Adams and Ferreira, 2009).

In contrast to expectations that the board diversity metric, expressed by the number of female directors, should be a determinant that is significantly and negatively associated with failure, the number of female directors is not a significant determinant of firms' transition to failure in the all firms' sample. An alternative definition of the metric, with a dummy variable taking the value of 1 if a firm has one or more women on their board and zero otherwise was also tested with the same results. Therefore, the conclusion is that although board diversity in the form of female directors is a significant determinant when discriminating between firm failure and survival (see for example, Adams and Ferreira, 2009; Wilson et al., 2014), it is not a significant determinant of the firm's transition towards failure. However, whilst this observation holds for the full firms', the presence (and number) of female directors is a significant determinant of firms' transition to failure in the third and fourth firm failure processes. These are the firm failure processes that are characterized from the smaller board sizes in the sample. Therefore, the implication is that in small boards, gender diversity is important. Reduced diversity (proxied by a negative sign in the coefficient of the number of female directors' variable) is a significant determinant of firms' transition to failure. Therefore, this result further highlights the differences in the determinants of firms' transition to failure between firm failure processes and demonstrates why the identification of the failure process is potentially a significant first step on interpreting and analyzing firms' failure.

In terms of the business environment-related variables the results suggest that credit availability is associated with the firms' transition to failure. The reason for the positive coefficient is that credit availability is expressed as a percentage of GDP in a given country. During the financial crisis the reduction in GDP was greater than the reduction in credit, thus the ratio of credit availability as a percentage of GDP was actually increasing. The interpretation of this result is therefore that reduced credit availability is associated with firms' transition to failure[14]. Berger and Udell (2002), provided evidence that the lack of credit availability is a determinant of SME failure, especially under a financial crisis, such as the period of 2007-2009 that this study partially covers. In addition, there is evidence in the literature that shows that during the 2007-09 crisis, any credit availability was channeled towards larger firms, leaving SMEs with limited access to bank credit (Psillaki and Eleftheriou, 2015). The economic conditions and the credit availability have also been found to be significant determinants in the wider firm failure literature (Bunn and Redwood, 2003; Jardim and Pereira, 2013). The lack of credit availability at firm level has been a key determinant of SME failure (Berger and Udell, 2002) whilst the credit availability at country level may be targeted towards the larger firms during a financial crisis such as the one in 2008-2009, leaving SMEs without access to credit and therefore leading them to financial distress or failure (Psillaki and Eleftheriou, 2015).

As such, the results that a lack of credit availability is a significant determinant of firms' transition to failure in a number of alternative firm failure processes are in line with the wider firm failure literature. On the other hand, GDP growth was negative and significant suggesting that an economic downturn is a determinant of the firms' transition towards failure. This is in line with evidence from the firm failure literature (see for example Bunn and Redwood, 2003). Given the focus of this chapter on firms in the EU countries, one observes that not all countries are significant determinants of firms' transition to failure. In relation to the industry sector, although there are differences between the alternative firm failure processes, the industry is not a frequently significant determinant of firms transition to failure, in the alternative firm failure processes, many countries are

[14] An alternative specification of the model, measuring year on year change in absolute levels available credit was tested. The results showed a negative and significant coefficient. Therefore, that confirms that reduced credit is associated with firms' transition to failure.

significant determinants. The control variables of industry and country are in most cases significant at 0.10 level, which are in line with evidences from the literature (Platt, 1989; Platt and Platt, 1991; Bottazzi et al., 2011).

Likewise, the legal tradition dummy is a significant determinant of firms' transition to failure indicating that the legal system is a significant determinant of the failure status transition of the firms in all firm failure processes. This result is therefore in line with previous literature (see for example La Porta et al., 1997). The negative sign denotes that firms whose countries that have a civil law system are associated with the transition towards failure. Looking at the transition to failure in the four alternative firm failure processes and the hypotheses which concerns the legal tradition of the firms, the legal tradition is highly significant across all firm failure processes. This result largely confirms the evidence from the wider firm failure literature suggesting that the legal tradition affects firms' failures (Wang, 2012). In this case, this thesis shows that the legal tradition is also a significant determinant of firms' transition to failure in a number of EU firms' failure processes.

The results from the regression analysis on the determinants of EU firms' transition to failure also included the SGR dummy variable. The sustainable growth dummy variable is significant and negative suggesting that firms with excessive growth rates (in sales) are more likely to fail. This is in line with evidence from the qualitative firm failure process literature that suggested that overtrading can be a characteristic of failure in certain firm failure processes (Argenti, 1976). In addition, such evidence is in line with evidence from the wider firm failure literature where overtrading is considered as a characteristic that is associated with firms' failure (Higgins, 1977). However, this is the first time that the concept of sustainable growth is directly linked with the firms' transition to failure in the context of alternative firm failure processes. This result is consistent across a number of firm failure processes. In line with evidence from the literature that suggests that increased unsustainable growth (in sales) is an indicator of failure, the sign of the coefficient in the SGR (dummy) is positive, indicating that firms whose growth levels exceed the sustainable level are positively associated with the transition towards failure.

5.8 Conclusion and Chapter Summary

This chapter aims to achieve three research objectives. First, to compare firm failure processes across countries and to test whether firm-specific characteristics differ among alternative failure processes. Second, to investigate the impact of firms' management characteristics in the identification of firm failure processes in EU firms. Third, to test whether the firm-specific characteristics that characterise the alternative firm failure processes, together with variables from the wider business and economic environment (such as the legal tradition) are also determinants of firms' transition to failure.

The results show that there are 4 different failure processes for SMEs. These processes are affected by directors' characteristics but there is no standalone failure process that is solely defined by the directors' characteristics. Instead they are part of the failure process of a firm that is also affected by a number of financial symptoms. Nevertheless, the analysis and the identification of the firm failure processes with directors' characteristics indicates that the inclusion of such characteristics in the firm failure process formation adds value and insight to the identification and the analysis of the alternative failure processes. Additionally, the firm failure process is at least partly related to the country where a firm operates. Although there are no standalone firm failure processes for each country, some countries have significant concentrations in certain firm failure processes. For example there is a concentration of UK, Italian, Spanish and German firms in the first, second, third and fourth firm failure process respectively. This means that a significant proportion of firms that fail in these countries follow the characteristics of the particular firm failure processes. In addition, evidence shows that whilst non firm-specific characteristics were not used in the identification of the alternative firm failure processed, they did differ between them. This implies that the alternative firm failure processes include firms whose business and economic environments differ. Such evidence was implied in the qualitative firm failure process literature (see for example Argenti, 1976) but there has been little such evidence in the quantitative failure process literature.

Firms' transition to failure on the other hand is also determined by the firm specific characteristics. Therefore, financial ratios and directors' characteristics are significant determinants of firms' transition to failure. In addition, a number of business and economic environment characteristics determine firms’ transition to failure. Industry classification, legal origin and the wider economic environment, measured by means of the GDP growth and credit availability determine firms’ transition to failure. However, these characteristics (and the combinations of them) differ between the alternative firm failure processes, when firms’ transition to failure is considered.

CHAPTER 6: UK REGIONS' FIRM FAILURE PROCESSES

6.1 Introduction

The previous chapters set out the research questions and hypotheses, the analytical methodology of the research and the data that are going to be used. Chapter 5 demonstrated that there are four different firm failure processes in EU firms and each country has a different representation across the firm failure processes. Using the same methodology this section aims to address the same three objectives objectives as in chapter 5 but from a UK SMEs' perspective. Therefore this chapter extends the analysis of firm failure process to a within-country context.

The United Kingdom (UK) is one of the countries in the sample with the highest number of liquidated firms covering all of its regions in the period under investigation. Likewise, the UK has been used as the reference country in the chapter 5 analysis of the determinants of firms' transition to failure. In the context of this chapter, UK regions are the regions of England (London, East Anglia, South East, South West, North East, North West, West Midlands, East Midlands), plus the countries of Scotland, Wales and Northern Ireland. The UK and its regions and countries (hereafter referred to as regions) are analyzed to identify whether different firm failure processes occur within the UK regions.

The analytical methodology is similar to Chapter 5. The analysis uses firm-specific characteristics (the financial ratios, the age of the firm and directors' characteristics) to identify the alternative firm failure processes. Subsequently, it assesses whether these characteristics, as well as a number of non firm-specific characteristics from the business and economic environment, differ in the alternative firm failure processes. Finally, it analyses whether these characteristics are determinants of firms' transition to failure. In the first step, the quantitative techniques of factor and cluster analysis are used to identify the firm failure processes. In the second step, an ordered panel regression is used to assess the determinants of the different stages of failure and therefore firms' transition towards failure.

This chapter proceeds as follows. Section 6.2 discusses the subset of the data that this chapter uses and proceeds with the necessary tests for normality. Section 6.3 presents the results of the factor analysis. Section 6.4 performs the cluster analysis for the identification of firms' failure processes and describes the results. Section 6.5 presents the results of the panel data analysis for the determinants of firms' transition to failure. Section 6.6 explains the robustness checks of the panel data analysis. Section 6.7 discusses the results of the regressions in the context of the Hypotheses. Section 6.8 concludes the chapter.

6.2 General Data Description for UK firms

This chapter uses a subset of the data described in Chapters 4 and 5. The particular subset contains firms from the UK that went into liquidation at some point during the full sample period. The dependent variable of the firms in the UK sample denotes the liquidation status of the firm by using the event_failure dependent variable. On the year that the firm enters into liquidation, the event_failure dependent variable takes the value of 2. There are 979 UK firms covering the period from 2004 to 2013. Status information (and date) for the firms additionally covers the year 2014. These event_failure=2 firms in the sample, also have observations for the years that they were not in liquidation. All firms start participating in the sample as event_failure=0 (healthy) "progressing" to event_failure=2 (liquidation). Some firms additionally have the interim status of financial distress (defined as negative equity) and are therefore event_failure=1 for some years prior to their liquidation. That is, the sample includes evidence for what we will refer to as the transition towards liquidation of the (eventually) liquidated firms. The number of firms that become financially distressed prior to liquidation is 175 (approximately 17%) out of the 979 UK firms. The total number of firm-year observations is 7,041. For consistency with the between-EU countries, firm failure process analysis each of the firms in the UK's regions will be assessed for 7 years prior to liquidation.

6.2.1 Regional Splits

The definition of regions has been done by using the first level of the European Commission NUTS-1 classification system. It has been initially defined with the

EC No 1059/2003 and later had a number of amendments until its most recent (EC 2016/2066) version which is adopted for this analysis. The regional split and the number of failed firms for each region are presented below.

Table 6.1 shows the region/country concentration of liquidated/bankrupt UK firms. The majority of firms are concentrated in London (37.69%) followed by the North West (15.63%) and the Yorkshire and the Humber regions (10.62%).

Table 6.1: Regional Concentrations of UK failed firms.

REGION (NUTS-1)	Freq.	Percent (%)	Cum. Percentage (%)
London	369	37.69	37.69
North West (England)	153	15.63	53.32
Yorkshire & the Humber	104	10.62	63.94
South East	74	7.56	71.50
West Midlands	71	7.25	78.75
Scotland	54	5.52	84.27
East (England)	41	4.19	88.46
East Midlands	33	3.37	91.83
South West	25	2.55	94.38
N.Ireland	20	2.04	96.42
Wales	18	1.84	98.26
North East (England)	17	1.74	100.00
Total	979	100.00	

The distribution of firms in the sample is largely representative of the distribution of firms across the UK with London having the biggest proportion of UK business concentration and Wales and North East of England having a smaller business population (Rhodes, 2018).

6.2.2 Descriptive statistics of failed firms

This section presents the descriptive statistics for the failed UK firms in the sample.

6.2.2.1 Main Variables at UK-level

Table 6.2 shows that failed UK firms tend to have, on average, negative (-1.460) return on Investment (ROI), a negative Cash Flow to Total Sales (CFTS) ratio (-1.248) and positive and relatively high (21.528) growth rates (measure in total assets' growth). Net Sales to Total Assets (NSTA), is positive (5.920), demonstrating that, on average across all years, UK firms have the ability to generate sales from the assets they employ. Quick ratio is also positive and high (7.699), highlighting good adequate levels of liquidity. Total liabilities to total assets (TLTA) are above 1 highlighting that, on average across all years, UK firms' are relatively over indebted with their total liabilities exceeding the value of their assets. Trade credit to total liabilities (TCTL: 0.246) and quick assets to current assets (QACA: 0.972) show that trade credit is a relatively limited source of credit for UK firms while their working capital (in terms of quick assets) is relatively high. UK firms tend to have around 2 female directors while the overall managing structure has on average 14 directors with an average age of 51. Economic conditions have been positive on average, with increasing credit availability and an average GDP growth of 1.05%. The level of GDP growth is relatively low due to the sample including the recessionary years of 2008 and 2009 when UK GDP contracted by 0.47% and 4.19% respectively.

Table 6.2: Descriptive statistics of main continuous variables for UK firms that eventually failed.

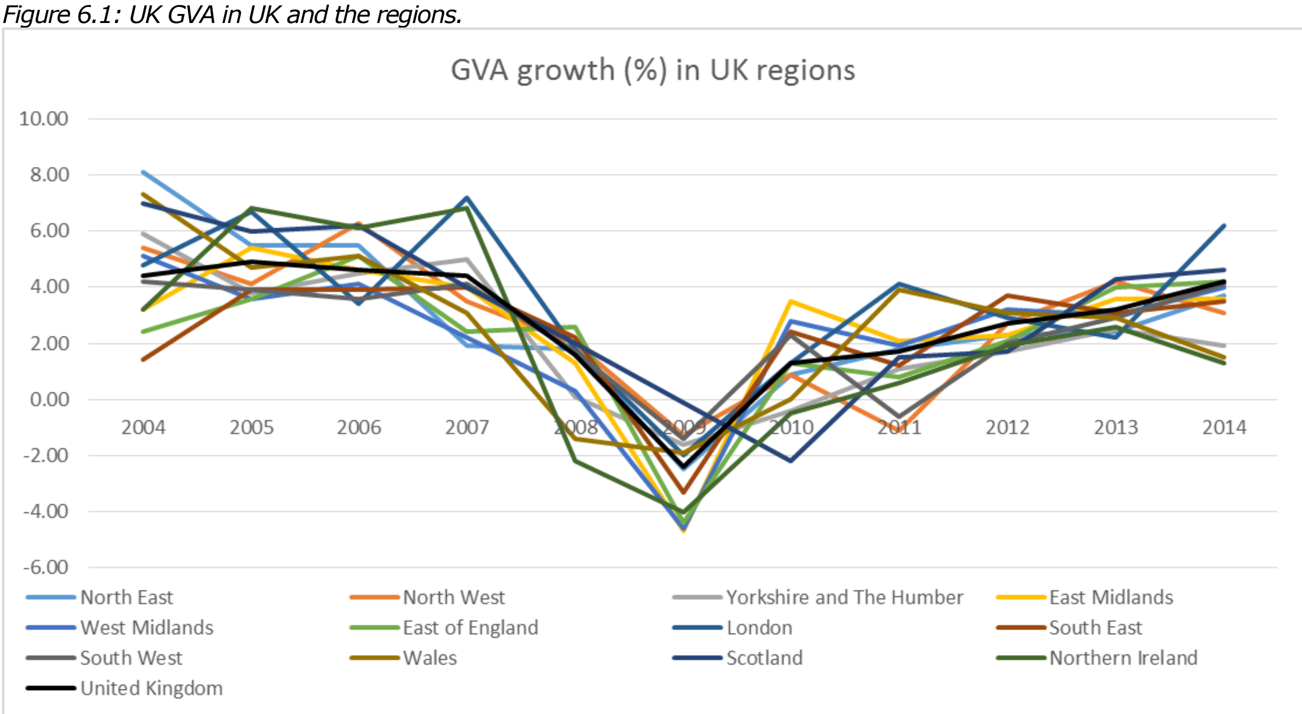
Variable	Mean	St.Dev	Min	Max
ROI	-1.46	40.65	-127.20	25.32
growth_rate	21.52	53.87	-1.00	266.15
NSTA	5.92	79.71	-0.01	251.17
CFTS	-1.25	25.24	-784.45	2.99
quick_ratio	7.70	43.55	0.00	79.00
TLTA	2.90	56.65	0.00	71.00
QACA	0.97	0.34	0.01	2.00
TCTL	0.25	0.25	0.00	1.00
Firmage	18.49	14.90	1.00	83.00
Total_Dir_Nr	14.16	9.93	1.00	24.00
Nr_Female_Dir	2.50	2.15	0.00	3.00
Avg_dir_age	50.85	8.74	20.00	75.00
credit	171.83	19.50	144.51	200.61
GDP_gr	1.30	2.28	-4.19	3.00
new_firms_pc	2.53	2.77	-4.70	8.10

6.2.2.2 Additional Region-Specific Variables

In addition to the above mentioned variables that are used throughout this thesis, this chapter employees two UK regions-specific variables. These are the number of new firms in a region as a percentage of the existing business population in that region (new_firms_pc) and the regional Gross Value Added (GVA) product. The former variable will be used in the main part of this analysis and the latter as an additional robustness check (Section 6.6).

GVA measures the value generated by any unit engaged in the production of goods and services, at regional level. According to the UK Office of National Statistics (ONS) the GVA plus taxes and less subsidies on products is equivalent to gross domestic product (GDP) (ONS, 2016, pp. 2). However, GVA has the advantage of it being available at regional level and can therefore be used as a region-level proxy for the regional GDP growth. Therefore the main part of the analysis will consider GDP growth for consistency with the other chapters of the thesis while GVA growth will be additionally used for robustness checks in this chapter. GVA growth between 2004-2013 has been relatively different between UK regions (Figure 6.1). The South East and East of England, West and East Midlands and the Northern Ireland had a more pronounced reduction in GVA growth during 2009, compared to the UK average. North West and Yorkshire and the Humber and Scotland had a reduced GVA growth decline compared to the UK average over the same year. The remaining regions were broadly in line with the UK average. On the other hand, Scotland had a different trend with a trough in 2010 and a recovery thereafter.

Figure 6.1: UK GVA in UK and the regions.



Source: Adapted graph based on data from ONS.

Table 6.3 presents the average GVA growth (%) across all the years in the sample for each region. The (ONS) data are weighted by the concentration of firms in each region. It can be seen that GVA has been quite different between regions, highlighting the differences in Economic growth that UK regions have. London is the area with the highest GVA growth in the early years that this study covers. East Midlands is the area with the largest GVA drop in 2009. The direction of the means remains broadly similar even when the weighting of firms in each region is not considered. Therefore, it highlights the differences in the regional economic environment in the UK.

Table 6.3: Average GVA growth in UK and the regions.

Yearly UK and Regional GVA growth (%)

Year	North East	North West	Yorkshire & Humber	East Midlands	West Midlands	East of England	London	South East	South West	Wales	Scotland	Northern Ireland	United Kingdom
2004	8.1	5.4	5.9	3.2	5.1	2.4	4.8	1.4	4.2	7.3	7.0	3.2	4.4
2005	5.5	4.1	3.8	5.4	3.6	3.6	6.7	3.9	3.9	4.7	6.0	6.8	4.9
2006	5.5	6.3	4.5	4.6	4.1	5.1	3.4	3.9	3.6	5.1	6.2	6.1	4.6
2007	1.9	3.5	5.0	4.0	2.2	2.4	7.2	4.0	4.1	3.1	4.0	6.8	4.4
2008	1.8	2.0	0.1	1.3	0.3	2.6	1.8	2.2	1.7	-1.4	2.0	-2.2	1.6
2009	-2.5	-1.3	-1.6	-4.7	-4.6	-4.4	-2.0	-3.3	-1.4	-1.9	-0.1	-4.0	-2.4
2010	0.9	0.9	-0.4	3.5	2.8	1.3	1.3	2.4	2.3	0.0	-2.2	-0.5	1.3
2011	1.8	-1.1	1.1	2.1	1.9	0.8	4.1	1.2	-0.6	3.9	1.5	0.6	1.7
2012	2.3	2.7	1.7	2.3	3.2	2.1	2.9	3.7	2.0	3.1	1.7	1.9	2.7
2013	2.4	4.2	2.5	3.6	3.0	4.0	2.2	3.1	2.9	2.9	4.3	2.6	3.2

The number of new firms created in a given year in any given UK region as a percentage of the firm population in that region is also used to test for the first hypothesis. Table 6.4 presents the descriptive statistics at both the UK in full and in regional level.

Table 6.4: Descriptive statistics of new firm creation as a percentage of the firm population in the UK and the regions.

Variable	Mean	Std. Dev.	Min	Max
UK	12.159	1.837	6.530	17.930
London	13.955	0.987	12.570	17.930
North West (England)	11.768	1.358	9.710	14.700
Yorkshire & the Humber	11.284	1.049	9.940	13.700
South East	10.924	0.919	9.670	13.060
West Midlands	10.999	1.219	9.370	13.390
Scotland	10.985	0.949	9.760	13.280
East (England)	10.932	0.955	9.510	13.270
East Midlands	10.956	1.318	9.120	13.680
South West	10.200	1.165	8.620	12.250
N.Ireland	8.791	1.687	6.530	11.060
Wales	10.167	1.458	8.300	13.370
North East (England)	11.828	1.497	9.410	14.160

The highest average new business creation (as a percentage of the local business population) is in London (13.96%) and the lowest in N. Ireland (8.79%). This is largely related to London's economic performance across the years that this study covers, where London has had the highest average GVA growth. In contrast, N. Ireland had the lowest overall GVA growth across all the years that this study covers.

6.2.3 Data and normality

The analysis of the distribution of the continuous variables in the population of firms, in the UK-specific sample is a necessary step before we proceed with the factor and the cluster analysis. Consistent with the methodology that this thesis uses for the firm-level analysis, the Skewness and Kurtosis tests, the Shapiro-Wilk (Shapiro and Wilk, 1965) and the Shapiro-Francia (Shapiro and Wilk, 1972; Royston, 1983) tests of normality are applied in firms-specific characteristics of the UK firms. Additionally the normality plots are presented in Appendix B (Chart 1).

The explanatory variables of the UK firms' sample are not normally distributed. The null hypothesis that each of the explanatory variables is normally distributed is rejected at the 0.01 level in the Skewness/Kurtosis test. The Shapiro-Wilk test results also show that the null hypothesis of each of the variables to be normally distributed is rejected at the 0.01 level of significance. Finally the Shapiro-Francia test of normality further confirms that the hypothesis of a normal distribution is rejected at 0.01 level of significance for each one of the variables in the UK sample.

Table 6.5: Skewness/Kurtosis, Shapiro-Wilk and Shapiro-Francia test of Normality for UK firms

	Skewness/Kurtosis Test				Shapiro-Wilk				Shapiro-Francia			
Variable	Pr (Skewness)	Pr (Kurtosis)	chi2(2)	Prob>chi2	W	V	z	Prob>z	W'	V'	z	Prob>z
roi	0.000	0.000	26238.220	0.000	0.009	3633.819	21.733	0.000	0.009	3982.382	21.438	0.000
Growth Rate	0.000	0.000	21300.750	0.000	0.017	3607.388	21.713	0.000	0.016	3953.153	21.419	0.000
nsta	0.000	0.000	25695.450	0.000	0.018	3603.615	21.711	0.000	0.017	3949.842	21.417	0.000
cfts	0.000	0.000	22772.270	0.000	0.025	3577.111	21.691	0.000	0.024	3921.251	21.398	0.000
quick ratio	0.000	0.000	23651.900	0.000	0.024	3579.634	21.693	0.000	0.023	3923.663	21.400	0.000
tlta	0.000	0.000	26332.410	0.000	0.007	3640.903	21.738	0.000	0.007	3989.699	21.443	0.000
qaca	0.000	0.000	272.680	0.000	0.933	246.567	14.601	0.000	0.933	270.565	14.484	0.000
tctl	0.000	0.000	876.630	0.000	0.925	273.991	14.880	0.000	0.928	290.243	14.665	0.000
firmage	0.000	0.000	1916.830	0.000	0.852	544.116	16.699	0.000	0.852	596.102	16.527	0.000
avg_dir_age	0.000	0.000	406.320	0.000	0.980	74.408	11.425	0.000	0.980	81.436	11.379	0.000
Nr_Female_Dir	0.000	0.000	3256.330	0.000	0.900	366.293	15.650	0.000	0.901	396.951	15.475	0.000
Total_dir_nr	0.000	0.000	2834.630	0.000	0.847	560.597	16.778	0.000	0.847	612.918	16.599	0.000
credit	0.000	0.000	27550.540	0.000	0.951	181.467	13.788	0.000	0.951	198.644	13.685	0.000
GDP_gr	0.000	0.000	1545.740	0.000	0.758	886.467	17.993	0.000	0.758	971.176	17.789	0.000
GVA_gr	0.000	0.000	188.070	0.000	0.980	72.880	11.370	0.000	0.980	78.988	11.300	0.000
New_firms_pc	0.096	0.000	111.540	0.000	0.973	99.050	12.183	0.000	0.973	108.537	12.122	0.000

As in the case of the full sample of failed firms in EU countries, discussed in Chapter 5, the presence of non-normally distributed variables in the sample has two potential implications. First, the usage of the mean when clustering to create the failure processes can be problematic. For that reason, the median will be used instead (in a k-medians clustering approach). Second, the violation of the normality assumption potentially compromises the normality assumption in the ordered logistic regression. However, evidence suggests that logistic regression is relatively robust even in the presence of non-normally distributed data (Appiah, 2013). In addition, robustness checks, utilizing bootstrapping have been used, in order to reduce the risk of invalid results.

6.2.4 Correlation and Statistical Tests

Exploring the correlations between independent variables is necessary in order to determine whether factor analysis can be used. Factor analysis requires the existence of some degree of collinearity between the variables that will enter the factors. For this reason a three step approach is applied. First, correlation analysis between explanatory variables is applied at levels and lags. The correlation analysis includes 7 lags for each independent variable with the exception of directors' characteristics and firm age. The director-related variables are only tested at levels as there is very little or no variation on director composition across time in most firms. Firm age, naturally, has a completely linear function with its lags and therefore the lags were also excluded.

Second, partial correlation analysis is applied between all the independent variables' combinations. Third, the Bartlett test of Sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sample adequacy are used in the UK firm sub-sample to investigate whether the level of potential correlations between the explanatory variables is sufficient to proceed with factor analysis.

Correlation of the independent variables has been tested in the sample of event_failure status=2 at two stages. First, with all the potential independent variables at levels[15] and second with the financial ratios (independent variables) and the country-specific macroeconomic variables (GDP growth and Credit Availability) at t, t-1, t-2…t-7, in order to capture the financial situation of firms up to 7 years before the failure event. We selected to test for 7 year lags in order to be consistent with the length of lags that was adopted in Chapter 5. For the same reason, the director-related variables are only tested at levels as there is very little or no variation on director composition across time in most firms. Correlation above 30% can be regarded as sufficient for the purpose of factor analysis (Hair et al., 2006). The results (Appendix B; Tables B.1 and B.3) demonstrate that there is evidence of sufficient level of correlation between a number of variables.

Partial Correlations between variables have been also calculated. A partial correlation of a variable is the correlation that is left unexplained when the effects of the other variables are taken into consideration (Hair et al., 2006). Partial correlations between variables that would be potentially used in the factor analysis should be small and between few variables. In particular, partial correlations of above 0.70 would question the application of factor analysis (Hair et al., 2006). Partial correlation results demonstrated no evidence of high (>0.70) partial correlations in any of the countries' samples.

[15] The term signifies that no lags have been used for these "at level" variables.

The third step of statistical tests is to confirm whether the Factor analysis is a statistically valid technique for the UK firms' sub-sample include the Bartlett Sphericity test and the KMO Measure of Sampling Adequacy (MSA).

The results of the Bartlett test suggest that the hypothesis of no correlation between the variables is rejected at the 0.001 level. Moreover, the KMO MSA values are above the 0.50 that can be considered as the minimum acceptable cut-off level for factor analysis (Yong and Pearce, 2013). The KMO for the UK firms is 0.715 (Table 6.6). Therefore the statistical assumptions to proceed with factor analysis are satisfied.

Table 6.6: Bartlett test of Sphericity and KMO for the UK Firms.

Determinant of the correlation matrix	Det =0.000
Bartlett test of sphericity	
Chi-square	38642.589
Degrees of freedom	2080
p-value	0.00
H0: variables are not intercorrelated	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	
KMO	0.715

6.3 Factor Analysis for Firm-Specific Characteristics

The establishment of failure processes at regional level is methodologically consistent with the previous chapter. The factor analysis only uses firm-specific characteristics as the purpose of the failure process creation is to investigate which firm-specific characteristics determine the failure process of the firms. Consistently with the analysis in EU firms, factor analysis for the UK firms is applied in two parts.

In the first part, the financial ratios of each firm are used in up to 7 years (lag=7; t, t-1, t-2, t-3, t-4, t-5, t-6, t-7) prior to event_failure=2 together with the age of the firm at the time of the liquidation. In cases where data from the earlier years are not available due to firms being younger in age, the lagged values in these years take the value of 0. The particular value is selected because these are not missing values in the sense of being missing at random. They are instead firms that have been too young or (in some cases) have been insolvent and therefore their accounts are actually nonexistent. However, because STATA does not recognize blank values, the value of zero was selected to effectively denoting that liquidation is the reason for the missing value. This allows the firms to remain in the sample without affecting the performance of the factor analysis at the scoring phase where any missing values would return a blank score for that factor. The factor analysis is then followed by the associated cluster analysis to identify the firm failure processes. The first part of the analysis only utilizes financial ratios and the firm age, in line with evidence from the quantitative firm failure process literature. The aim is to produce a comparable benchmark with the existing body of the quantitative failure process literature before proceeding with the investigation of directors' characteristics' influence in the formation of firm failure processes in UK firms.

The second part adds three directors-related variables: the total number of directors, the number of female directors in the board and the average age of directors to the variables used in the first part. The aim is to analyse the effects that directors' characteristics have on the formation of the alternative firm failure processes and as such add to the existing body of the quantitative firm failure process literature. This factor analysis is also followed by the associated cluster analysis to identify the firm failure process. In this section the focus is at the within-country level.

The rest of the section presents the results of the factor analysis in UK firms where the factors are without directors' characteristics. Section 6.3.2 presents the results of the factor analysis with directors' characteristics as determinants in the failure process formation.

6.3.1 Factor Analysis without Directors' Characteristics

The first stage of the factor analysis (without directors' characteristics) considers the financial ratios from the 979 UK event_failure=2 (liquidated/bankrupt) failed firms for up to 7 years prior to the failure event. That is, the financial ratios are lagged up to lag 7 using the event_failure=2 date as a starting point. Additionally, consistent with the approach used in the previous chapter, the factor analysis includes the firm age at the last year with available data before entering liquidation. The age of the firm is not lagged as any such attempt would create a completely linear result with little added value to the factor creation.

The Kaiser (1960) criterion of retaining factors with eigenvalues above 1 has been applied to the factor analysis of UK firms. Therefore, factors with Eigenvalues >1 return to the second step of the factor analysis which is the VARIMAX rotation. The first part of the factor analysis shows (Appendix B; Table B.4) that there are 12 factors with an eigenvalue >1. These initial factors explain 87.4% (Table 6.7) of the total variation of the initial variables. Although this is lower than the percentage achieved in the full sample with the EU countries' firms (89%), it remains higher than previous studies where Factor Analysis was explaining 80% of the variables' variation for Lukason and Laitinen (2016), 69% for Laitinen et al., (2014) and 52% for Laitinen (1991).

The VARIMAX orthogonal rotation is then applied to the 12 factors in order for factors to be uncorrelated throughout the rotation process.

Table 6.7: Eigenvalues of VARIMAX- rotated factors (with Eigenvalues >1) for UK firms; financial ratios and firm age as variables.

Factor	Variance	Difference	Proportion	Cumulative
Factor1	5.205	0.003	0.138	0.138
Factor2	5.203	0.186	0.138	0.276
Factor3	5.017	2.176	0.133	0.409
Factor4	2.841	0.426	0.075	0.485
Factor5	2.415	0.310	0.064	0.549
Factor6	2.105	0.022	0.056	0.605
Factor7	2.083	0.001	0.055	0.666
Factor8	2.082	0.465	0.055	0.715
Factor9	1.617	0.026	0.043	0.758
Factor10	1.591	0.179	0.042	0.800
Factor11	1.411	0.036	0.038	0.838
Factor12	1.375	.	0.037	0.874
LR test: independent vs. saturated: chi2(2080)= 4.6e+04 Prob>chi2 = 0.0000				

The factor loadings for UK firms after the VARIMAX rotation are presented in Table 6.8. The interpretation of these factors is as follows:

- The first factor is associated with the time series development of the trade credit to total liabilities ratio (TCTL). The first factor's loadings in the UK firms are similar with the first factor's loadings in all (EU) firms as presented in Chapter 5.

- The second factor is associated with the development of NSTA ratio making it relatively similar to the eleventh factor in the all (EU) firms' data set.
- The third factor is associated with the development of the Quick assets to current assets (QACA) ratio across time, which is also similar to the results from all (EU) firms' factor 2.
- The fourth factor is partly associated with the total liabilities to total assets (TLTA) ratio between in the four years prior to liquidation. The same factor is also correlated with the return on investment (ROI) on the year before of event_failure=2. Therefore, this factor is broadly similar with the third factor in the full (EU) data sample although the timing is different as the ROI was more closely associated at the third lag in the all firms' sample while the TLTA was significant up to 3 years prior to failure in that case.
- The fifth factor is solely associated with TLTA from the seventh to the second year prior to event_failure=2 and is quite different compared to the all firms' factors in chapter 5.
- The sixth factor is associated with ROI, CFTS and TLTA, one year prior to event_failure=2. This is also a factor which is not directly comparable with any of the factors in Chapter 5.
- The seventh factor is associated with the quick ratio up to 3 years prior to the event_failure=2. This has some similarities with the tenth factors from the all firms' dataset where the quick ratio was associated with failure 2 to 5 years prior to that.
- The eight factor is associated with ROI 5 and 6 years prior to failure, with TLTA 4 to 6 years prior to failure and with CFTS 5 years prior to failure. This factor is not directly similar with any of the factors identified in the all (EU) firms' data.
- The ninth factor is associated with the ROI 7 years prior to event_failure=2 and with TLTA 7 years prior to failure. This factor has some similarities with the 6^{th} factor in the all firms' sample but with different timing in the financial ratios.
- The tenth factor is associated with the firms' growth rate 6 year prior to the event_faulure=2 status and with NSTA 6 and 7 years and QACA 7 years

prior to that status. There are therefore some limited similarities with the seventh factor in the all (EU) firms' data.

- The eleventh factor is associated with ROI between year 4 and year 2 prior to event_fauilure=2 as well as the growth_rate 4 years prior to that status. This factor is not directly comparable to any of the factors in chapter 5.
- The twelfth factor is associated with the CFTS and the growth rate 7 years prior to the event_failure=2 status without having any directly comparable factor in the all EU) firms analysis.

Table 6.8: Factor Loadings for UK Firms without directors' characteristics (post VARIMAX rotation).

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Factor11	Factor12
roi	-0.005	-0.009	-0.005	-0.971	0.035	0.010	-0.014	-0.025	-0.022	0.037	0.047	0.016
roiL1	-0.007	0.001	0.000	-0.036	0.031	0.519	0.034	0.013	-0.023	0.059	0.192	0.071
roiL2	0.030	0.001	0.047	-0.089	0.057	-0.032	0.006	0.117	-0.066	0.084	0.512	0.222
roiL3	0.087	0.007	-0.029	-0.142	-0.074	-0.001	0.026	0.069	0.073	-0.082	0.633	-0.019
roiL4	0.095	0.007	0.043	-0.215	-0.135	0.031	0.009	0.279	0.054	0.071	0.454	0.124
roiL5	0.036	-0.006	0.061	0.010	0.011	0.014	-0.002	0.820	-0.052	-0.002	0.059	0.108
roiL6	0.026	-0.023	0.073	0.057	-0.261	0.001	-0.016	0.372	0.147	0.161	0.262	0.288
roiL7	-0.013	-0.012	0.029	0.024	0.020	0.004	-0.004	-0.110	0.857	0.020	0.071	0.092
growth_rate	-0.002	-0.008	-0.004	-0.009	-0.031	0.011	-0.002	0.014	0.002	-0.018	0.010	0.001
growth_rateL1	-0.039	0.000	-0.002	-0.004	-0.023	0.007	0.001	0.009	0.000	-0.001	0.010	0.009
growth_rateL2	-0.036	-0.008	0.003	0.139	0.047	-0.109	-0.005	0.044	-0.109	0.102	0.056	0.122
growth_rateL3	-0.046	-0.021	0.036	0.136	-0.008	-0.001	-0.025	0.113	-0.056	0.142	-0.390	0.171
growth_rateL4	-0.076	-0.023	0.032	0.206	0.089	0.011	-0.006	-0.133	0.212	0.022	-0.124	0.237
growth_rateL5	-0.083	0.188	-0.032	0.004	0.101	-0.172	-0.021	-0.259	0.216	0.012	-0.009	0.155
growth_rateL6	0.029	0.005	0.039	-0.014	0.206	-0.075	-0.004	-0.166	-0.092	-0.309	-0.205	0.206
growth_rateL7	-0.151	-0.028	-0.011	0.018	0.243	-0.040	0.048	-0.027	0.089	0.141	-0.041	-0.513
nsta	-0.015	0.025	-0.006	0.006	0.000	-0.008	-0.005	-0.002	-0.013	-0.045	0.003	0.027
nsta_L1	0.029	0.964	-0.002	-0.007	0.014	0.016	0.006	-0.034	-0.017	0.041	-0.010	-0.005
nsta_L2	0.018	0.966	0.006	0.015	0.011	-0.020	-0.003	0.007	-0.035	0.052	0.039	0.014
nsta_L3	0.016	0.946	0.004	0.007	-0.023	0.008	-0.009	0.015	0.009	-0.010	0.004	-0.017
nsta_L4	0.005	0.971	0.003	0.006	-0.028	0.005	-0.003	0.014	0.014	-0.029	-0.008	-0.004
nsta_L5	-0.016	0.940	-0.003	0.002	0.007	0.005	-0.002	0.006	0.023	0.006	-0.006	0.007
nsta_L6	0.150	0.568	0.029	-0.029	0.128	-0.002	0.031	-0.079	-0.017	0.337	-0.059	0.107
nsta_L7	0.076	0.491	0.038	-0.071	0.020	-0.004	0.040	-0.029	0.038	0.673	-0.028	0.015
cfts	0.041	0.014	-0.011	0.001	0.021	0.015	0.003	-0.007	-0.011	0.019	0.015	-0.002
cfts_L1	0.011	0.000	-0.018	0.049	0.113	0.929	-0.014	-0.030	-0.074	0.050	0.074	0.038
cfts_L2	0.021	0.024	-0.050	-0.014	0.005	0.034	0.029	0.045	0.043	-0.096	0.080	0.127
cfts_L3	0.149	0.046	-0.017	-0.103	-0.082	0.065	0.074	0.098	0.055	-0.179	0.196	0.200
cfts_L4	0.045	0.020	-0.048	-0.026	-0.004	0.007	0.021	0.034	0.009	-0.052	0.008	0.167
cfts_L5	0.016	-0.007	-0.014	-0.013	0.223	0.015	0.014	0.698	0.142	0.007	0.039	-0.040
cfts_L6	-0.019	0.013	-0.070	0.004	-0.032	0.000	0.005	0.079	0.025	0.101	0.007	0.089
cfts_L7	0.104	0.031	0.046	-0.015	-0.118	0.013	0.030	0.159	-0.031	0.019	0.077	0.624
quick_ratio	-0.093	-0.007	0.095	-0.025	-0.053	0.043	0.332	0.049	0.008	-0.009	0.022	0.045
quick_ratioL1	-0.040	0.002	0.017	0.002	-0.009	0.002	0.857	0.002	-0.007	-0.001	0.001	0.002
quick_ratioL2	-0.054	-0.001	0.009	-0.001	-0.019	0.014	0.927	0.003	-0.005	0.006	0.010	0.000
quick_ratioL3	-0.070	-0.007	0.007	0.000	-0.017	0.016	0.505	0.010	-0.006	0.049	0.014	-0.018
quick_ratioL4	-0.094	-0.012	0.002	-0.018	-0.057	0.026	0.221	0.022	0.006	0.086	-0.020	0.033
quick_ratioL5	-0.084	-0.010	0.003	0.002	-0.024	0.003	0.114	0.008	-0.008	0.099	-0.023	0.048
quick_ratioL6	-0.044	-0.003	0.113	-0.009	-0.030	0.007	0.019	0.005	-0.002	0.034	0.001	0.001
quick_ratioL7	-0.042	-0.017	0.005	-0.023	-0.036	-0.011	0.128	0.002	0.012	0.132	-0.043	0.048
tlta	0.004	0.009	0.002	0.966	-0.031	-0.083	0.015	0.025	0.025	-0.036	-0.040	-0.011
tltaL1	-0.069	-0.014	-0.007	0.235	0.221	-0.900	-0.030	-0.054	-0.080	0.072	0.111	0.044
tltaL2	-0.108	-0.027	-0.029	0.566	0.460	-0.256	-0.085	-0.155	-0.186	0.146	0.099	0.051
tltaL3	-0.087	-0.021	-0.005	0.441	0.343	-0.081	-0.079	-0.117	-0.081	0.095	-0.145	0.052
tltaL4	-0.036	-0.008	0.003	0.450	0.458	-0.047	-0.064	-0.327	0.044	-0.046	-0.046	0.093
tltaL5	-0.009	0.006	0.026	0.011	0.722	-0.053	-0.020	-0.357	0.212	0.031	0.063	0.031
tltaL6	-0.003	0.014	0.012	-0.041	0.845	-0.021	-0.001	0.357	0.134	-0.076	-0.073	-0.111
tltaL7	-0.055	-0.003	0.010	-0.013	0.483	-0.009	-0.015	0.241	0.746	0.047	-0.055	-0.196
qaca	-0.108	0.014	0.758	0.005	0.032	-0.030	0.022	0.023	-0.025	0.005	-0.027	0.109
qacaL1	-0.074	0.013	0.842	0.006	0.034	-0.039	0.032	-0.004	-0.023	-0.012	0.016	0.103
qacaL2	-0.074	-0.010	0.859	-0.012	-0.010	0.004	0.024	0.003	-0.012	-0.021	-0.022	0.056
qacaL3	-0.080	0.008	0.876	0.003	-0.004	0.009	0.005	0.025	0.002	-0.014	-0.014	-0.004
qacaL4	-0.085	0.011	0.840	-0.005	0.021	0.010	-0.010	0.001	0.028	0.035	-0.030	-0.018
qacaL5	-0.044	-0.010	0.823	0.004	-0.030	0.006	-0.007	0.015	0.017	0.069	0.040	-0.109
qacaL6	-0.039	0.008	0.765	0.010	-0.005	0.017	-0.022	0.001	0.068	0.069	0.047	-0.107
qacaL7	-0.129	-0.014	0.378	-0.052	-0.082	0.005	-0.004	0.066	0.074	0.568	0.069	-0.217
tctl	0.783	0.048	-0.069	-0.018	0.022	0.037	-0.015	-0.015	-0.009	-0.064	0.101	-0.067
tctlL1	0.828	0.036	-0.087	-0.026	0.012	0.050	-0.042	0.003	-0.014	-0.069	0.078	-0.062
tctlL2	0.855	0.028	-0.087	-0.012	-0.002	0.042	-0.036	-0.002	-0.020	-0.060	0.097	-0.049
tclL3	0.885	0.022	-0.070	-0.012	0.013	0.008	-0.008	-0.013	-0.001	-0.053	0.050	-0.006
tctlL4	0.860	0.008	-0.063	-0.006	-0.041	0.021	-0.014	0.044	-0.016	0.089	-0.045	0.020
tctlL5	0.765	0.022	-0.053	0.023	-0.043	0.004	-0.031	0.057	-0.014	0.126	-0.111	0.143
tctlL6	0.736	-0.020	-0.097	0.013	-0.040	-0.045	-0.029	0.005	0.004	0.159	-0.129	0.223
tctlL7	0.486	-0.017	-0.039	-0.046	-0.060	-0.041	-0.010	0.016	0.034	0.527	-0.095	0.147
firmage	0.199	-0.037	-0.128	-0.040	-0.063	0.064	0.057	0.129	0.009	-0.011	0.077	-0.006

6.3.2 *Factor Analysis with Directors' Characteristics*

The second part of factor analysis (with directors' characteristics) includes directors' characteristics in addition to the 7-years of financial ratios the firm age that the factor analysis without directors' characteristics used. Directors' characteristics consist of the number of female directors on the board, the total number of directors and the average age of directors.

The financial ratios and firm age were treated in the same way as in the first part of the factor analysis. The directors' characteristics were included at the time of failure and were not lagged, consistent with the approach used in Chapter 5 for all the (EU) firms.

The results after the VARIMAX rotation (Table 6.9) demonstrate that there are 13 factors with an eigenvalue > 1 (Appendix B; Table B.6) for UK firms. These factors explain 87.6% of the total variance in UK firms; which is slightly more than the 87.4% that the (12) factors with eigenvalue >1 were explaining in the analysis without directors' characteristics.

Table 6.9: Eigenvalues of VARIMAX- rotated factors (with Eigenvalues >1); UK firms' factor analysis with directors' characteristics.

Factor	Variance	Difference	Proportion	Cumulative
Factor1	5.260	0.082	0.135	0.135
Factor2	5.178	0.141	0.133	0.268
Factor3	5.037	2.300	0.129	0.397
Factor4	2.738	0.457	0.070	0.467
Factor5	2.281	0.090	0.059	0.525
Factor6	2.191	0.106	0.056	0.582
Factor7	2.086	0.008	0.054	0.635
Factor8	2.077	0.487	0.053	0.688
Factor9	1.591	0.033	0.041	0.729
Factor10	1.558	0.103	0.040	0.769
Factor11	1.455	0.063	0.037	0.806
Factor12	1.391	0.053	0.036	0.842
Factor13	1.339	.	0.034	0.876
LR test: independent vs. saturated: chi2(2278)= 4.7e+04 Prob>chi2 = 0.0000				

Therefore, we proceed in analyzing the factors after the VARIMAX rotation is performed. Factor loadings are presented in Table 6.10 and can be explained as follows:

- The first factor is characterized by the development of the trade credit to total liabilities ratio (TCTL). This is similar to the first factor without the directors' characteristics and similar to the all firm results in chapter 5. It is also similar with the first factor with directors' characteristics in the all (EU) firms' sample in Chapter 5.
- The second factor is associated with the development of the Net Sales to Total Assets (NSTA) ratio, similar to the results without directors' characteristics. It is also relatively similar to the eleventh factor in the all firms' data set.
- The third factor is associated with the development of the Quick Assets to Current Assets (QACA) ratio and is therefore similar to the third factor without directors' characteristics. It is also similar with the second factor in the all firms' data with directors' characteristics in Chapter 5.
- The fourth factor is associated with return on investment (ROI) at the time when event_failure=2 and the TLTA for the 4 years prior to that status. This factor is also similar to the fourth factor without directors' characteristics and has the same combination of ratios (but different timings) with the third factor with directors' characteristics in Chapter 5.
- The fifth factor is associated with TLTA between 7 and 2 years prior to failure. This factor is similar with the fifth factor without directors' characteristics but with slightly shorter development across time (years 2-4 prior to failure as opposed to all years prior to failure). There is not any significant association with the factors from Chapter 5.
- The sixth factor is associated with the cash flow to sales (CFTS) in the 5th year prior to the status date when event_failure=2 and with TLTA 4 and 5 years prior to that status. There is also an association with ROI between 4 and 6 years prior to failure. This is broadly similar to the eighth factor without directors' characteristics although with slightly different time lags but without any direct association with Chapter 5 factors.
- The seventh factor is associated with the quick ratio up to 3 years prior to the event_failure=2 status and therefore it is broadly similar to the seventh factor without directors' characteristics. There is also some similarity with the tenth factor from Chapter 5 but with different timings.
- The eight factor is associated with ROI, CFTS and TLTA, 1 year prior to the status becoming event_failure=2. This factor is not closely associated with

any of the factors in the part without directors' characteristics but there are some similarities in terms of the combination of ratios with the eighth factor from Chapter 5 (with directors' characteristics). The timings are different though.

- The ninth factor is associated with growth rate 6 years prior to the event_failure=2 status, QACA and TCTL 7 years prior to that status and NSTA 6 and 7 years prior to that status. This factor is similar to the tenth factor without directors' characteristics but there is no direct association with factors from Chapter 5.
- The tenth factor is associated with TLTA and ROI 7 years prior to the event_failure=2 status being, relatively similar to the ninth factor without directors' characteristics and the sixth factor from chapter 5 but with different timings.
- The eleventh factor is associated with ROI, 2-4 years prior to the event_failure= 2 and growth rate 3 years prior to that status. It is additionally associated with the total number of directors, therefore differing from the factors without directors' characteristics. There is no direct association with any of the factors in Chapter 5.
- The twelfth factor is associated with growth rate 7 years prior to event_failure=2 and CFTS at the 3^{rd} and 7^{th} year prior to that status. It is not closely associated with any of the factors in the analysis without directors' characteristics or with any of the Chapter 5 factors.
- The thirteenth factor is associated with ROI 2 years prior to the failure status and TLTA 1-3 years prior to that status. There is also an association with the age of directors and therefore the experience of the board. There is some similarity in the combination of ratios with the fourth factor without directors' characteristics and the third factor in Chapter 5 but the timing is different.

Table 6.10: Factor Loadings with directors' characteristics (post VARIMAX rotation) in UK firms.

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Factor11	Factor12	Factor13
roi	0.003	-0.005	-0.004	-0.983	0.023	-0.014	-0.007	0.016	0.016	-0.003	0.025	-0.001	-0.017
roiL1	0.004	0.008	0.002	-0.067	-0.022	0.042	0.039	0.533	0.012	0.022	0.123	0.033	0.154
roiL2	0.056	0.019	0.052	-0.166	-0.064	0.193	0.019	0.003	-0.025	0.041	0.335	0.134	0.452
roiL3	0.076	0.001	-0.033	-0.130	-0.033	0.082	0.011	-0.011	-0.010	0.038	0.642	0.069	0.002
roiL4	0.103	0.014	0.044	-0.250	-0.134	0.339	0.011	0.042	0.040	0.095	0.360	0.107	0.155
roiL5	0.038	-0.003	0.062	0.006	0.139	0.808	0.000	0.014	-0.020	-0.060	0.009	0.105	-0.001
roiL6	0.037	-0.016	0.074	0.024	-0.248	0.453	-0.009	0.015	0.110	0.203	0.155	0.241	0.144
roiL7	-0.001	-0.002	0.031	0.001	0.013	-0.082	0.003	0.009	-0.013	0.894	0.037	0.044	0.007
growth_rate	-0.004	-0.008	-0.004	-0.005	-0.024	0.017	-0.002	0.012	-0.016	0.000	0.028	0.000	-0.013
growth_rateL1	-0.044	-0.001	-0.001	0.004	-0.015	0.010	0.002	0.009	0.004	-0.005	0.038	0.010	-0.010
growth_rateL2	-0.018	0.004	0.008	0.093	-0.047	0.087	0.009	-0.081	0.005	-0.031	-0.032	0.027	0.298
growth_rateL3	-0.027	-0.011	0.040	0.100	-0.060	0.139	-0.008	0.018	0.044	0.012	-0.475	0.063	0.131
growth_rateL4	-0.080	-0.025	0.032	0.200	0.057	-0.148	-0.006	0.013	0.024	0.219	-0.148	0.213	0.062
growth_rateL5	-0.082	0.188	-0.031	-0.009	0.040	-0.261	-0.019	-0.165	0.007	0.235	-0.029	0.128	0.100
growth_rateL6	0.026	0.008	0.042	-0.014	0.167	-0.215	-0.003	-0.075	-0.307	-0.092	-0.194	0.196	0.026
growth_rateL7	-0.140	-0.020	-0.008	-0.007	0.213	-0.051	0.052	-0.030	0.092	0.101	-0.037	-0.565	0.086
nsta	-0.015	0.027	-0.005	0.002	-0.007	-0.002	-0.005	-0.006	-0.048	-0.008	0.000	0.020	0.016
nsta_L1	0.027	0.962	-0.003	-0.001	0.020	-0.043	0.004	0.014	0.069	-0.028	0.002	0.011	-0.028
nsta_L2	0.023	0.970	0.007	0.002	-0.011	0.017	0.000	-0.014	0.046	-0.017	0.013	-0.003	0.066
nsta_L3	0.018	0.948	0.004	0.006	-0.015	0.016	-0.009	0.007	0.004	0.009	0.006	-0.013	-0.024
nsta_L4	0.008	0.974	0.004	0.003	-0.025	0.018	-0.001	0.006	-0.021	0.020	-0.005	-0.009	-0.016
nsta_L5	-0.014	0.941	-0.002	0.002	0.009	0.006	-0.001	0.007	0.015	0.026	-0.001	0.004	-0.002
nsta_L6	0.139	0.552	0.024	-0.009	0.131	-0.110	0.024	-0.009	0.388	-0.050	-0.061	0.140	0.010
nsta_L7	0.062	0.467	0.030	-0.046	0.043	-0.041	0.029	-0.013	0.736	-0.007	-0.034	0.052	-0.008
cfts	0.044	0.016	-0.011	-0.010	0.004	-0.006	0.002	0.016	0.009	-0.001	-0.012	-0.013	0.043
cfts_L1	0.025	0.010	-0.016	0.015	0.043	-0.017	-0.007	0.944	-0.011	-0.024	0.002	-0.014	0.152
cfts_L2	0.005	0.015	-0.052	0.017	0.057	0.015	0.020	0.022	-0.031	-0.003	0.135	0.178	-0.089
cfts_L3	0.121	0.031	-0.021	-0.048	0.022	0.062	0.057	0.042	-0.060	-0.027	0.292	0.305	-0.203
cfts_L4	0.039	0.014	-0.051	-0.009	0.027	0.021	0.017	-0.003	-0.016	-0.015	0.012	0.207	-0.063
cfts_L5	0.010	-0.009	-0.015	0.003	0.368	0.637	0.009	0.008	0.027	0.096	0.041	-0.012	-0.063
cfts_L6	-0.021	0.009	-0.072	0.008	-0.016	0.084	0.004	-0.002	0.109	0.021	-0.008	0.095	-0.001
cfts_L7	0.091	0.019	0.043	0.006	-0.083	0.168	0.025	0.006	0.067	-0.045	0.044	0.662	0.007
quick_ratio	-0.091	-0.005	0.095	-0.030	-0.049	0.058	0.333	0.043	-0.013	0.015	0.011	0.036	0.002
quick_ratioL1	-0.040	0.002	0.017	0.004	-0.003	0.000	0.857	0.001	0.001	-0.007	0.008	0.005	-0.021
quick_ratioL2	-0.053	0.001	0.009	-0.003	-0.016	0.005	0.927	0.013	0.006	-0.003	0.009	0.001	-0.016
quick_ratioL3	-0.064	-0.003	0.007	-0.017	-0.035	0.021	0.507	0.019	0.030	0.011	-0.021	-0.039	0.044
quick_ratioL4	-0.094	-0.013	0.004	-0.009	-0.052	0.032	0.223	0.030	0.082	0.006	0.011	0.014	0.000
quick_ratioL5	-0.082	-0.011	0.004	0.006	-0.033	0.017	0.117	0.009	0.088	-0.002	-0.009	0.024	0.035
quick_ratioL6	-0.047	-0.004	0.113	-0.006	-0.027	0.006	0.018	0.007	0.040	-0.005	0.013	-0.004	-0.002
quick_ratioL7	-0.043	-0.019	0.005	-0.024	-0.043	0.009	0.129	-0.007	0.128	0.016	-0.046	0.029	0.025
tlta	-0.004	0.005	0.000	0.978	-0.020	0.015	0.008	-0.089	-0.015	0.005	-0.019	0.006	0.024
tltaL1	-0.056	-0.006	-0.005	0.192	0.116	-0.044	-0.022	-0.877	0.004	-0.026	0.024	-0.022	0.359
tltaL2	-0.077	-0.008	-0.023	0.475	0.241	-0.141	-0.068	-0.211	-0.011	-0.066	-0.084	-0.095	0.632
tltaL3	-0.072	-0.013	-0.001	0.399	0.225	-0.134	-0.068	-0.059	0.011	-0.024	-0.235	-0.031	0.315
tltaL4	-0.043	-0.015	0.002	0.456	0.382	-0.402	-0.069	-0.046	-0.023	0.024	-0.040	0.105	0.166
tltaL5	-0.014	-0.001	0.025	0.021	0.647	-0.462	-0.024	-0.049	0.055	0.183	0.075	0.051	0.194
tltaL6	-0.015	0.005	0.010	-0.007	0.935	0.186	-0.009	-0.030	-0.027	0.049	-0.026	-0.054	0.019
tltaL7	-0.053	-0.002	0.010	-0.004	0.569	0.158	-0.016	-0.013	0.051	0.710	-0.032	-0.195	-0.059
qaca	-0.103	0.017	0.760	-0.008	0.005	0.031	0.027	-0.022	-0.020	0.000	-0.055	0.077	0.083
qacaL1	-0.067	0.017	0.843	-0.010	-0.001	0.008	0.037	-0.030	-0.037	0.005	-0.018	0.073	0.096
qacaL2	-0.070	-0.008	0.859	-0.016	-0.019	0.010	0.026	0.006	-0.028	-0.001	-0.034	0.047	0.011
qacaL3	-0.082	0.007	0.876	0.006	0.006	0.020	0.003	0.006	-0.001	-0.003	-0.011	0.002	-0.025
qacaL4	-0.086	0.010	0.839	-0.003	0.027	-0.007	-0.012	0.008	0.046	0.022	-0.027	-0.015	-0.018
qacaL5	-0.049	-0.014	0.822	0.016	-0.004	0.012	-0.011	0.000	0.096	-0.004	0.067	-0.084	-0.062
qacaL6	-0.043	0.003	0.764	0.023	0.023	-0.007	-0.027	0.010	0.101	0.044	0.071	-0.077	-0.068
qacaL7	-0.138	-0.030	0.372	-0.032	-0.040	0.077	-0.013	-0.002	0.605	0.038	0.086	-0.191	-0.041
tctl	0.778	0.047	-0.070	-0.014	0.040	-0.034	-0.023	0.027	-0.032	-0.031	0.109	-0.030	-0.055
tctlL1	0.822	0.035	-0.086	-0.022	0.030	-0.012	-0.047	0.044	-0.046	-0.031	0.096	-0.034	-0.053
tctlL2	0.852	0.027	-0.087	-0.008	0.014	-0.011	-0.041	0.036	-0.038	-0.034	0.108	-0.018	-0.050
tclL3	0.885	0.023	-0.070	-0.009	0.019	-0.018	-0.009	0.006	-0.047	-0.005	0.062	0.007	-0.029
tctlL4	0.865	0.012	-0.061	-0.015	-0.051	0.059	-0.009	0.027	0.060	0.004	-0.058	-0.008	0.021
tctlL5	0.775	0.026	-0.051	0.012	-0.064	0.080	-0.022	0.014	0.083	0.019	-0.142	0.099	0.054
tctlL6	0.742	-0.019	-0.096	0.008	-0.068	0.025	-0.021	-0.035	0.124	0.033	-0.149	0.176	0.068
tctlL7	0.482	-0.030	-0.042	-0.037	-0.067	0.033	-0.009	-0.035	0.525	0.035	-0.104	0.118	0.061
firmage	0.200	-0.045	-0.130	0.012	0.014	0.141	0.064	0.065	0.017	-0.027	0.196	0.045	-0.151
avg_dir_age	0.199	-0.014	-0.091	0.020	0.039	0.097	0.030	0.041	0.026	-0.038	0.112	0.148	-0.243
Nr_Female_Dir	-0.170	-0.027	0.073	0.014	-0.005	0.036	0.036	0.056	-0.053	0.046	0.193	-0.092	0.124
Total_Dir_Nr	-0.077	-0.068	0.103	0.033	0.060	0.088	0.046	0.066	-0.040	0.009	0.379	-0.003	-0.034

The comparison of the results from the factor analysis of the UK firms and with the full sample of firms are presented in Table 6.11. One can conclude that the inclusion of directors' characteristics adds further dimensions to the factor analysis. Comparing the two factor analyses (with and without directors' characteristics) of the UK firms, one can observe that their primary difference is the 11th factor where the analysis with directors' characteristics also includes the total number of directors. Moreover, the analysis with directors' characteristics has got an additional 13th factor. Other factors tend to be broadly similar, although the order may be different. For example the 9th factor in the UK sample without directors' characteristics is similar with the 10th factor in the analysis with directors' characteristics.

Comparing the results with the all (EU) firms' sample, the first and the second factors from the EU firms sample are practically the same with the first and third factors from the UK firms (both with and without considering management characteristics). The fourth factor for the EU firms has similar characteristics with the second factor from the UK firms but with different timing in the Net Sales to Total Assets ratio which is the primary driver of these factors. The other factors are different, demonstrating that the inclusion of directors' characteristics adds further latent dimensions in the factor analysis.

Table 6.11: Comparison of Factors for all firms sample and UK firms.

	All Firms		UK Firms	
Factor	**W/out Directors**	**With Directors**	**W/out Directors**	**With Directors**
1st	TCTL (all years)	TCTL (all years)	TCTL (all years)	TCTL (all years)
2nd	QACA (all years)	QACA (all years)	NSTA (all years)	NSTA (all years)
3rd	TLTA (4-7 years)	TLTA (4-7 years)	QACA (all years)	QACA (all years)
4th	NSTA (4-7 years)	NSTA (4-7 years)	ROI (at failure); TLTA (0-4 years)	ROI (at failure); TLTA (0-4 years)
5th	QACA (4-7 years); TCTL (5-7 years)	QACA (4-7 years); TCTL (6-7 years); Firm age; N. Female Dir.; Total Dir. Nr.	TLTA (2-7 years)	TLTA (2-7 years)
6th	ROI (3rd year); TLTA (3rd year)	ROI (3rd year); TLTA (3 years)	CFTS (1st year); TLTA (1st year); ROI (1st year)	CFTS (5th year); TLTA (4-5 years); ROI (4-6 years)
7th	Growth Rate (3rd year); NSTA (3rd year)	Growth Rate (3rd year); NSTA (3 year)	Quick Ratio (0-3 years)	Quick Ratio (0-3 years)
8th	ROI (1st year); TLTA (0-2 years); QACA (5th year)	ROI (1st year); TLTA (0-2years);	ROI (5-6 years); CFTS (5th year); TLTA (4-6 years)	ROI (1 year); CFTS (1 year); TLTA (1 year)
9th	ROI (4-7 years); Growth Rate (6th year)	ROI (2-7 years); Growth Rate (6th year)	ROI (7th year); TLTA (7th year)	Growth Rate (6th year); NSTA (6-7 years); QACA (7th year); TCTL (7th year)
10th	Quick Ratio (3-6 years)	Quick Ratio (3-5 years)	Growth Rate (6th year); NSTA (6-7 years); QACA (7th year); TCTL (7th year)	ROI (7th year); TLTA (7th year)
11th	NSTA (0-4 years)	NSTA (1-4 years)	ROI (2-4 years); Growth rate (3rd year)	ROI (2-4 years); Growth rate (3th year); Total Dir. Nr.
12th	CFTS (3-7 years)	CFTS (3-7 years)	CFTS (7th year); Growth rate (7th year)	Growth Rate (7th year); CFTS (3rd year); CFTS (7th year)
13th	N/A	N/A	N/A	ROI (2nd year); TLTA (1-3 years)

6.4 Cluster Analysis and the Identification of Firm Failure Processes

Factor scores obtained from the analysis above are standardized and uncorrelated. After the factors are scored, based on their factor loading (Hair et al., 2006), Cluster Analysis is applied.

The clustering method is the k-medians with Euclidean distance for the reasons already explain in Chapter 5. The stopping rules that are used to determine the number of clusters that the analysis might give is again the Calinski and Harabasz (1974) index.

6.4.1 Clusters without directors' characteristics

The factors without directors' characteristics are used in the first part of the cluster analysis. The Calinski and Harabasz (1974) test suggests that there are 4 potential clusters and therefore 4 distinct failure processes for UK firms. The Calinski and Harabasz (1974) Pseudo-F of 58.08 is the highest that can be achieved and is produced when 4 clusters were tested. That indicates that the four-clusters solution is the most distinct compared to alternative clustering tested that ranged from 2 to 12 clusters. The Pseudo-F rose when the number of clusters were increasing up to the 4 clusters and fell thereafter. This result is intuitive because UK firms had also four clusters with failed firms in the all (EU) firms' cluster analysis. Looking at the four clusters of the UK firms, one can observe that the differences between the financial ratios in the alternative clusters are relatively small. Therefore, this is a relatively homogeneous group with regards to financial ratios and the main differentiating factor appears to be the age of the firm. The clusters' characteristics are described as follows (results in Appendix B; Table B.5).

The first process is characterized from firms that are 7 years old, with the lowest ROI compared to the other three clusters. These firms had high growth rates 4-7 years prior to failure which reduced sharply subsequently. Despite these firms' sales generation ability being high (as is in most clusters), their ability to generate cash from their sales was weak and deteriorated in the most recent years. These firms' liquidity used to be very high in 4 to 7 years prior to failure but deteriorated rapidly thereafter. As a result, firms in this cluster have the lowest levels of liquidity. In addition, the firms if this cluster are the most-indebted of this analysis and have very limited usage of trade credit.

The second process is characterized by firms by firms that are 17 years old. These firms have generally negative growth rates for a number of years prior to failure. Similar to firms in cluster 1, these firms have a good sales generation ability for their assets but poor conversion of sales to cash. Liquidity is strong and broadly stable. Total liabilities are also stable without being excessive while these firms are using trade credit more than any other firm cluster.

The third process is characterized by firms that are 14 years old and of negative growth. These firms have the best cash generating ability from their sales compared to other clusters' firms and very limited usage of trade credit but strong working capital.

The forth process is characterized by firms that are 13 years old and of volatile growth. Their cash generating ability from their sales was relatively strong in the 6-7 years prior to failure but deteriorated rapidly closer to the failure event despite increasing sales. The distribution of clusters in the UK regions is presented in Table 6.12.

There appears to be some differentiation in the concentration of failed firms between regions and failure processes. No region has its most significant concertation of firms in the first firm failure process, which is characterized by young firms with low levels of liquidity. One plausible explanation is that (with the young age of the firm being key characteristic of this failure process) firms of young age (less than 10 years old) are not the most significant population in any region. On the other hand, South West (40%), East Midlands (55%), Yorkshire and the Humber (34%), West Midlands (37%), East Anglia (34%) and North West (31%) are more concentrated in the second firm failure process, which is characterized by older firms with negative growth rates. London (34%), N. Ireland (40%), Scotland (43%) and South East (34%) are more concentrated on the third firm failure process which is characterized by firms that have weak cash generating ability. Wales' firms are equally concentrated (33% each) between the second and the third firm failure processes respectively. The fourth firm failure process, characterized by firms of volatile growth, has, in general, the fewer firms, with no particular concentration from any region.

Table 6.12: Distribution of UK firms in clusters (Clusters without directors' characteristics).

Cluster	Yorkshire & Humber	East	East Midlands	London	N.Ireland	North East	North West	Scotland	South East	South West	Wales	West Midlands	Total
1	21 (20%)	12 (29%)	6 (18%)	86 (23%)	4 (20%)	4 (24%)	24 (16%)	7 (13%)	16 (22%)	2 (8%)	5 (28%)	15 (21%)	202 (21%)
2	35 (34%)	14 (34%)	18 (55%)	103 (28%)	5 (25%)	6 (35%)	47 (31%)	13 (24%)	18 (24%)	10 (40%)	6 (33%)	26 (37%)	301 (31%)
3	27 (26%)	12 (29%)	6 (18%)	125 (34%)	8 (40%)	4 (24%)	46 (30%)	23 (43%)	25 (34%)	7 (28%)	6 (33%)	20 (28%)	309 (32%)
4	21 (20%)	3 (7%)	3 (9%)	55 (15%)	3 (15%)	3 (18%)	36 (24%)	11 (20%)	15 (20%)	6 (24%)	1 (6%)	10 (14%)	167 (17%)
Total	104	41	33	369	20	17	153	54	74	25	18	71	979

6.4.2 Clusters with Directors' Characteristics

The second stage of the cluster analysis includes the factors that considered the directors' characteristics (with directors' characteristics). Therefore the 13 factors that included the financial ratios, the firm age and the directors' characteristics of UK firms (number of female directors, average directors' age and total number of directors) were clustered using the same approach.

Calinski and Harabasz (1974) suggest that when analyzing firms with director characteristics the number of the clusters that maximizes the Pseudo-F value is 4; the same number of clusters as in the analysis of UK firms without directors' characteristics. The Calinski and Harabasz index is maximized (56.52) when four clusters are identified after testing alternative potential solutions ranging from 2 to 12 clusters. When the potential number of cluster exceeded 4, the Pseudo-F values fell. The firm failure process with directors' characteristics (clusters) have the following broad characteristics (results in Appendix B; Table B.7):

The first process is associated with firms that are 12 years old and, have 1 female director and 10 directors in total whose average age is 51 years. These are firms with deteriorating growth rate and relatively high usage of trade credit.
The second process is associated with firms that are 11 years old, have 11 directors (2 female) with an average age also of 51 years. These firms are characterized from their inability to create cash flows out of their sales despite their sales generation ability being very strong.
The third process is associated with firms that are 15 years old, have 13 directors (2 of them women) with an average age of 51 years. These firms appear to have limited usage of trade credit but a deteriorating ability to generate cash flows and ROI despite strong growth rates in the years prior to failure.
The fourth process is associated with firms that are 9 years old, have 10 directors (2 women) of an average age of 47 years. These firms are over indebted, have weak cash generating ability and also weak liquidity, ROI and growth.

The distribution of clusters in the UK regions is presented in table 6.13. Similar to the analysis for EU firms with directors' characteristics in chapter 5, UK firms appear to have relatively more limited concentration in one of the failure processes (in that case the fourth failure process).

Some regions also exhibit some cluster-specific concentration. Yorkshire and the Humber (50%), East Anglia (51%), East Midlands (70%) and London (45%), North

East (65%), North West (41%), Wales (56%) and West Midlands (52%), are more concentrated on the first firm failure process which is characterized by firms with one female director that have deteriorating growth. N. Ireland (40%), Scotland (41%), South East (39%) are more concentrated on the third failure process which is characterized by firms that are the oldest (on average), have the largest board of directors and a deteriorating cash generating ability. The second and the fourth firm failure processes are characterized by firms with good sales but poor cash flows and from young firms and have the lowest concentration of failed firms across all regions.

Considering the firm failure processes with directors' characteristics, one can conclude that the inclusion of the directors' metrics has added further insight in the firm failure processes. In particular the failure processes appear to have some differentiation in the firms' board structure and the number of directors. In addition, some key characteristics, other than the directors, that the failure process literature has identified (such as the age of the firm, the growth of the firm and the basic dimensions of liquidity and profitability) still remain differentiators of the alternative firm failure processes even when directors' characteristics are included. However, the differences in such metrics are relatively small in the alternative firm failure processes. As such, the inclusion of directors' characteristics adds a dimension to the firm failure process identification.

Table 6.13: Distribution of UK firms in clusters (with directors' characteristics).

Cluster	Yorkshire & Humber	East	East Midlands	London	N.Ireland	North East	North West	Scotland	South East	South West	Wales	West Midlands	Total
1	52 (50%)	21 (51%)	23 (70%)	165 (45%)	7 (35%)	11 (65%)	62 (41%)	17 (31%)	28 (38%)	11 (44%)	10 (56%)	37 (52%)	444 (45%)
2	20 (19%)	3 (7%)	5 (15%)	58 (16%)	3 (15%)	3 (18%)	36 (24%)	11 (20%)	14 (19%)	7 (28%)	1 (6%)	10 (14%)	171 (17%)
3	27 (26%)	15 (37%)	4 (12%)	119 (32%)	8 (40%)	1 (6%)	50 (33%)	22 (41%)	29 (39%)	6 (24%)	6 (33%)	23 (32%)	310 (32%)
4	5 (5%)	2 (5%)	1 (3%)	27 (7%)	2 (10%)	2 (12%)	5 (3%)	4 (7%)	3 (4%)	1 (4%)	1 (6%)	1 (1%)	54 (6%)
Total	104	41	33	369	20	17	153	54	74	25	18	71	979

6.4.3 Intra-country firm failure processes and Hypotheses

The factor/clustering analysis results, both with and without directors' characteristics, show evidence that UK firms do have 4 different failure processes. The number of firm failure processes identified remains in line with the qualitative (eg. Argenti, 1976; Ooghe and DePrijcker, 2008) and quantitative literature (eg.

Laitinen et al, 2014; Laitinen and Lukason, 2014; Lukason and Laitinen, 2016) that has historically identified between 2 and 6 firm failure processes.

However, the intra-country comparison of the UK firms' failure processes shows that, by large, the failure processes are not region-specific. In other words, when clustering firms with similar firm-specific characteristics, each cluster (firm failure process) has had firms from a number of different regions. Nevertheless, some firm failure processes have a relatively higher concentration in certain regions. In UK firms, the number of directors and the age of the firm appeared to be key differentiators of the alternative failure processes with financial ratios being less different between the alternative failure processes. Nevertheless, the growth rate, the liquidity and the cash flow generation (CFTS) appeared to be the main differentiators of failure processes from a financial ratio point of view while the board diversity did not differentiate between alternative UK firm failure processes.

One important point to be made is that the literature that focuses on regional firm failures is focused around the effects of the economic and business environment that affect different regions. There is limited evidence relating to whether the firm-specific characteristics that determine the firm failure processes are affected differently in different regions. This is discussed in the following section.

6.4.4 Hypothesis Testing on Clusters

Having developed the clusters of the UK firm failure processes (with and without directors' characteristics), and having discussed some observable differences in the concentration of firms between different clusters, we proceed to compare whether there are any statistically significant differences between the failure processes as expressed in the two versions of the clusters and a number of characteristics that have been discussed in the development of the Hypotheses of this study (Chapter 2).

One aim of this chapter is to identify the alternative firm failure processes in the UK regions. In that context, it is important to ascertain whether the firm failure processes are independent of the UK regions. In addition, it is tested whether the (mainly) business environment characteristics, that are categorical variables in nature, differ between the alternative firm failure processes (with and without directors' characteristics). The approach in testing the Hypotheses for the intra-country comparison of the firm failure processes applies the median test for continuous variables to investigate whether the different processes have significant differences across the different metrics that the hypotheses pose. For categorical variables, the Pearson chi square test of the independence of rows and columns in a two-way distribution table is employed. These tests are applied on the firm-specific characteristics that were used in order to identify the alternative firm failure processes as well as on a number of additional characteristics, associated with the economic and business environment.

The null hypothesis of the Pearson Chi-square is that there is no difference in the distribution of firms between the rows (regions) and the columns (firm failure processes). Consequently the alternative hypothesis is that there is a difference in the distribution between firm failure processes and UK regions and as a result firm failure processes differ between them. The results of the hypothesis tests are presented in Tables 6.14 and 6.15.

Table 6.14: Chi-Square results on hypothesis testing for UK firms.

Firm Clusters (Failure Processes)	Industry	Regions	SGR
	Chi-Squared statistic/p-value		
Clusters without Directors' characteristics	124.40/ 0.000	39.41 / 0.203	18.44/0.000
Clusters with Directors' characteristics	98.46/0.000	44.41/ 0.089	24.23/0.000

Table 6.15: Median Test results on hypothesis testing for UK firms for continuous variables.

Firm Clusters (Failure Processes)	ROI	GROWTH RATE	NSTA	CFTS	QUICK RATIO	TLTA	QACA	TCTL	FIRM AGE	GDP Growth	Credit Availability	Regional GVA	New Business	Female Directors	Age of Directors	Nr. Of Directors
	Chi-Squared statistic/p-value															
Clusters without Directors' characteristics	86.79/ 0.000	51.04/ 0.000	30.33/ 0.000	305.35/ 0.000	45.02/ 0.000	137.80/ 0.000	66.68/ 0.000	111.03 / 0.000	291.74/ 0.000	338.88 / 0.000	560.70 / 0.000	52.27/ 0.000	13.84/ 0.003	153.54/ 0.000	95.54 / 0.000	53.81/ 0.000
Clusters with Directors' characteristics	128.55/ 0.000	33.35/ 0.000	12.16/ 0.007	471.12/ 0.000	67.55/ 0.000	208.25/ 0.000	36.33/ 0.000	697.95 / 0.000	223.36/ 0.000	500.07 / 0.000	579.62 / 0.000	20.24/ 0.000	10.56/ 0.014	130.91/ 0.000	56.35/ 0.000	93.89/ 0.000

With regards to the main hypothesis that the firm failure processes are independent of the regions, the results in Table 6.14 show p-values of 0.203 (without directors' characteristics) and 0.089 (with directors' characteristics). This means that in the first case (without directors), the hypothesis cannot be rejected.

When directors' characteristics are included, the hypothesis is still not rejected at the 5% significance level but it is rejected at the 10% significance level (Sig.<0.10). Therefore, when directors' characteristics are used to determine the failure processes then differences between regions are significant at the 10% level. The remaining of the section discusses the separate hypotheses.

Hypothesis 7*: The number of new firms as a percentage of the existing business population in a UK region differs between the alternative firm failure processes in UK firms; they are also determinants of firms' transition to failure.*

The median test (by using a Pearson chi square statistic) compares the medians of new business formation as a percentage of the business population in each region and across all the different firm failure processes. The null hypothesis of the median test is that there is no statistical difference in the medians of the new business formed in each region as a percentage of the regional business population across clusters (the firm failure processes). The alternative hypothesis is that there is a statistical difference between regions' new firms and firm failure processes. The results (Table 6.15) for both failure clusters (with and without directors' characteristics) reject the null hypothesis of no statistical difference in the medians of new firms across the alternative firm failure processes (p value <0.00). Therefore, the first part of the alternative hypothesis (H7) that there is a statistically significant difference between firm failure processes and new firms as a percentage of the existing business population in UK regions is accepted. Therefore, the medians are not the same across firm failure clusters. As such, evidence from the qualitative failure process literature (Argenti, 1976; Ooghe and De Prijcker, 2008) that included increasing competition as an influencing factor in the alternative firm failure processes is confirmed in the quantitative context.

Hypothesis 8: *Industry classification differs between the alternative firm failure processes in UK firms; it also differs as a determinant of firms' transition to failure in the alternative firm failure processes.*

Considering the industry classification, the null hypothesis of the chi square is that the rows (industries) and columns (failure clusters) in the distribution between firms' industry classification and the failure clusters do not differ. The first part of the alternative hypothesis (H8) is that industry differs between firms in the alternative failure processes in UK regions. The Pearson Chi-square is significant (Table 6.14; p-value <0.01) for all the clustering approaches. Therefore we can conclude that there is a statistically significant difference in the industry distribution across the failure processes (clusters). As such, the first part of H8 is accepted. The implication of the acceptance of H8 is that it links evidence from the wider firm failure literature (Watson and Everett, 1999) that highlighted the significance of firm's industry in firms' failure, with the failure process literature. This shows that the distribution of industries can differ between the alternative firm failure processes.

Hypothesis 9: *Financial performance represented by key financial ratios and the age of the firm, differ in the alternative firm failure processes of UK firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

The financial ratios and the age of the firm are firm specific characteristics that were used to identify the alternative firm failure processes. As such one would expect that these will differ in the alternative firm failure processes. The median test (using a Pearson chi square statistic) has been applied to compare the medians of all financial ratios and of the age of the firm across the different clusters (firm failure processes). The null hypothesis of the median test suggests that there is no statistical difference in the medians of the financial ratios and of the firms' age between failure processes. The alternative hypothesis suggest there is a difference in the medians of the financial ratios and of the firms' age in the alternative firm failure processes (clusters). The results (Table 6.15) in both failure clusters (with and without directors' characteristics) indicate that the null hypothesis is rejected. Therefore, there is statistically significant differences between firm failure processes in all financial ratios' medians. Moreover, there is statistically significant difference between the firm failure processes in the firms' age medians. As such the first part of H9 can be accepted, and therefore the results of this study are in line with evidence from the existing quantitative firm failure process literature, which uses only financial ratios and in some cases the age of the firm for the identification of the firm failure processes (eg. Laitinen, 1991; Laitinen et al., 2014; Lukason, 2018). In addition, the results show that even when directors' characteristics are added, the financial ratios remain different in the alternative firm failure processes.

Hypothesis 10*: In an UK regional context, macroeconomic conditions differ between firms in the alternative firm failure processes in UK firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

GDP growth and the credit availability are both continuous variables as are the regional GVA and the number of new business births as a percentage of the existing population at regional level. The median test (Pearson chi square) has been applied to compare the median GDP growth and credit availability between difference clusters. The null hypothesis of the median test suggests that there is no statistical difference in the medians of GDP growth and credit availability between failure clusters. The alternative hypothesis is that there is statistically significant difference in the median GDP growth, GVA growth and credit availability between firms in the alternative firm failure processes.

The results (Table 6.15) in both analyses (with and without directors' characteristics) reject the null hypothesis. Therefore, the first part of the alternative hypothesis (H10) is accepted. Therefore, the results indicate that there is statistically significant difference between firm failure processes and GDP growth, GVA growth and credit availability. These results are quite surprising as the GDP growth and the Credit availability is measured at country level. However, a closer look at the time when firms in failure processes entered the event_failure=2 status provides an explanation for the result. The fourth failure process without directors' characteristics and the second process in the clustering with directors' characteristics are characterized by firms that failed mostly in 2010 and therefore close to where the GPD growth and the credit availability were at their lowest levels (Tables 6.16 and 6.17). These firm failure processes are characterized by firms that have weak cash generation ability from their sales and it is possible that they were the first to go into liquidation due to the financial crisis. It is also possible that these firms had difficulties in accessing credit and as such they were the first to fail. The analysis of firms' transition to failure in the next section provides additional insight into these issues.

Table 6.16: Distribution of firms according to the year of liquidation (clusters without directors' characteristics).

Number of Firms per at Year of Event_failure=2							
Cluster (No Directors)	2008	2009	2010	2011	2012	2013	Total
1	0	0	0	78	108	16	202
2	0	0	2	138	128	26	294
3	0	0	0	134	142	33	309
4	1	2	154	6	9	2	174
Total	1	2	156	356	387	77	979

Table 6.17: Distribution of firms according to the year of liquidation (clusters with directors' characteristics).

Number of Firms per at Year of Event_failure=2							
Cluster (With Directors)	2008	2009	2010	2011	2012	2013	Total
1	0	0	0	203	202	35	440
2	1	2	155	5	13	2	178
3	0	0	1	127	148	31	307
4	0	0	0	21	24	9	54
Total	1	2	156	356	387	77	979

Hypothesis 11: *Directors' Characteristics such as the presence of women in SMEs' management, director age as a proxy of director experience and the number of directors, differ in the alternative UK firm failure processes; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

Directors' characteristics are firm specific characteristics that were used to identify the alternative firm failure processes. As such one would expect that these will differ in the alternative firm failure processes. The median test (Pearson chi square) has been applied to compare the median number of women in the board, median age of directors and median number of directors across the 4 different failure clusters (with and without directors' characteristics). The null hypothesis is that there is no difference in the distribution of women, number of directors and age of directors between the alternative firm failure processes. The first part of the alternative hypothesis (H11) suggest that these characteristics differ in the alternative firm failure processes. The results (Table 6.15) in both failure clusters (with and without directors' characteristics) indicate that firm failure clusters have statistically different median number of women in the board, age of directors and total number of directors. The implication of this finding is that directors' characteristics are an important characteristic of the alternative firm failure processes and as such it should be explicitly used. Moreover, this result confirms evidence from the qualitative firm failure process studies that the management of firms differs between the alternative firm failure processes (Argenti 1976; Argenti 1976b; Ooghe and De Prijcker, 2008).

Hypothesis 12*: The distribution of firms with unsustainable levels of growth differs between the alternative firm failure processes in UK firms; unsustainable levels of growth are also determinants of firms' transition to failure.*

The sustainable growth variable (SGR) has been developed by employing the formulae presented in Chapter 4. SGR takes the value of 1 if a firm's annual growth in sales exceeds the calculated sustainable growth level and 0 otherwise. The null hypothesis of the chi square is that the rows (SGR) and columns (failure clusters) do not differ in their distribution between the alternative firm failure processes. The first part of the alternative hypothesis is that firms with unsustainable levels of (sales) growth differ between firm failure processes. That is, the distribution of firms which have SGR=1, and therefore unsustainable levels of sales growth differs between the alternative firm failure processes. The results (Table 6.14) show that the Pearson Chi-square is significant (p-value <0.01). Therefore, the null hypothesis is rejected and the first part of the alternative hypothesis (H12) is accepted. As such, we can conclude that there is a statistically significant difference in the distribution of firms with unsustainable growth levels across the failure clusters. This confirms evidence from the qualitative firm failure process literature that unsustainable levels of (sales) growth can be a characteristic of some firm failure processes (Argenti 1976b; Richardson et al., 1994).

6.5 Panel Data Analysis for Firms' Transition to Failure

6.5.1 Introduction

After presenting the results of the hypothesis tests on clusters, the results of panel data logistic regressions are presented. Panel data ordinal logistic regression has been applied to the 8 different failure processes (with and without directors' characteristics) of the UK firms, in order to identify whether the independent variables that are posed under the hypotheses are significant determinants of firms' transition to failure. That is, the transition from a healthy firm status to financially distressed and ultimately to liquidation.

The generic form of the model is:

$$FS_{it} = \sum FR_{it} + \sum DIR_{it} + \sum DIND_{it} + \sum DC_{it} + NF_{it} + CR_{it} + GDP\_gr_{it} + SGR_{it}$$

Where FS is the failure status in the form of an ordered choice variable. Similar to the approach that was applied in Chapter 5, the dependent variable of the model is ordered where 0 states the firm is still healthy; 1 indicates the firm is in financial distress; and 2 indicates that the firm is bankrupt. All the UK firms that are participating in this analysis eventually go into liquidation. FR represents the financial ratios entering the model. DIR represents the Directors characteristics. DIND represents the dummy variables for the industrial classification of the firm, DC represent the dummy variables for region. NF (New_firm_percentage) represents the number of new firms in the region. CR represents the credit availability in the UK in a given year. GDP_gr represents the annual GDP growth in the UK in a given year and SGR is a dummy variable that represents firms that have unsustainable growth rates.

The application of ordered panel regressions will assist in identifying whether the explanatory variables are determinants of firms' transition to failure in the alternative firm failure processes (and in the full UK sample). This is a salient issue that has not been discussed in the failure literature where firms are classified/clustered based on their final failure status (see for example Altman et al., 2010; Balcaen and Ooghe, 2008). In addition, there is no evidence in the firm failure process literature that either firm or business environment characteristics determine firms' transition to failure. The characteristics of the alternative firm failure processes discussed in earlier sections may be helpful in identifying the firm failure processes but not necessarily determinants of the transition to failure.

6.5.2 Fixed or Random Effects Test

Consistent with the approach used in Chapter 5, a random effects panel model specification was used for the UK firms. First, the dependent variables of the model include time-invariant (dummy) variables which make the fixed-effects specification unsuitable. Second, the test for the existence of fixed effects on the time varying variables that applied in Chapter 5 was also applied to the sub-set of UK firms.

The results did not reject the null hypothesis (at p=0.01 with 10 degrees of freedom) that the coefficient of the means of the (time varying) independent variables are all zero and therefore we conclude that this is a further reason why the random effects specification should be used. The same approach was then applied to the individual failure clusters which are essentially smaller subsets of the main dataset with no difference in the results.

6.5.3 Independent Variables in the Panel Ordered Logistic Regression

The independent variables that were used in the analysis of the UK firms are the same with those used in Chapter 5 with one exception. The dummy variable for the legal tradition has been removed given that the legal tradition remains the same across the regions of the UK. Meanwhile, a region-specific variable is added in order to test the hypothesis that new business entries affect firm failure. The number of new businesses in each region as a percentage of the total number of businesses in that region was used in order to capture the effects of the business environment at regional level.

The remaining independent variables had the same specification with those in Chapter 5 with the exception of the country-level dummy variables which were replaced by dummy variables representing regional effects. A (regional) dummy variable is taking the value of 1 for firms that operate in the particular region and 0 otherwise. London is the reference region because it is the UK capital and is one of the regions that have one of the best economic performances in terms of GVA_growth and new business formation. In addition, its firms are relatively well distributed between the alternative firm failure processes.

Similarly to Chapter 5, the number of female directors has been tested in two alternative specifications. The first specification reports the number of female directors in the board (Female_nr) and is the one that is reported in the results. The alternative specification includes a dummy variable which takes the value of 1 if a firm has any female member in the board and 0 otherwise.

6.5.4 Panel Data Results

The purpose of this analysis is to consider potential differences in the significance of all the independent variables discussed previously across the clusters in determining UK firms' transition to failure.

Nine Ordered Random Effects Panel Logit regressions were run by using all the firm-year observations of the sample of UK firms. The first considered all the UK firms, grouped together, ignoring the cluster allocations. Eight further regressions with the same explanatory variables were run for each of the clusters with and without directors' characteristics. The clusters that were formed without directors' characteristics are not regressed against directors' characteristics. The results are presented in Table 6.18. The Likelihood Ratio test in the panel indicates that there is enough variability between firms in the sample to favor the panel specification over a simple ordered logistic model.

6.5.4.1 Results

The results of the full sample regression (Table 6.18; column 1) show that, in contrast with all the firms in Chapter 5, not all financial ratios are significant determinants of UK firms' status transition to failure.

A number of financial ratios are significant determinants (Sig.<0.01) of firms' transition to failure and are negatively associated with failure, demonstrated by the negatve coefficients. This implies that a reduction in these financial ratios is associated with an increased propensity for firms' to transition to failure. As such, CFTS, QACA, TCTL are as expected, all significant determinants of the UK firms' transition to failure and negatively associated with it. On the other hand, growth rate (in total assets) is positively associated with the transition to liquidation. As such, the implication is that increasing levels of total assets' growth is associated with increased propensity for firms' transition to failure.

The firm age, the average age of directors, GDP growth and the credit availability are also significant (Sig.<0.01) and negatively associated with the transition to "worsening" event_failure statuses. Therefore, the results imply that, in the full firms' sample, the younger the firm, the higher the propensity for transition towards failure. Likewise, reductions in the GDP growth and the credit availability are associated with increased propensity for firms' to transition to failure.

The percentage of new firms in a region and the presence of (un)sustainable growth are also significant determinants of UK firms' eventual transition to failure with a positive coefficient that is in line with expectations. This means that when the level of firms' (sales) growth exceeds the sustainable level (and therefore SGR=1), there is an increased propensity for firms' to transition to failure. Moreover, the increasing numbers of new firms in a region are also associated with an increased propensity for firms' to transition to failure. On the other hand, the presence of female directors (or their number) is not significant determinant of UK firms' transition to failure.

In terms of the control dummy variables, reported in the second part of the table, it should be noted that regional effects do not appear to be significant variables in that context with the exception of Scotland and N. Ireland. London has been chosen as the reference for the regional dummy variables due to its size and significance for the UK economy. In that respect, both Scotland and N. Ireland have a positive sign in their coefficient, implying that firms in these areas are more likely to transition to failure, compared to London.

Finally, a number of the industry control variables (Agriculture, Construction, Manufacturing, Transportation and Communication, Wholesale, Retail) are only significant at the Sig.<0.10 of significance. Agriculture, Construction and Retail have negative coefficients implying that they are less likely to transition to failure than firms in the Services sector which is the reference industry. Manufacturing, Transportation and Communication and the Wholesale sectors have positive sign in the coefficient and as such they are more likely to transition to failure than firms in the Services sector.

Table 6.18: Panel data analysis results for alternative clusters.

Column:	1	2	3	4	5	6	7	8	9
		Failure Processes w/out Directors' Characteristics				Failure Processes with Directors' Characteristics			
Independent Variables	All Firms	Process 1	Process 2	Process 3	Process 4	Process 1	Process 2	Process 3	Process 4
	Coeff. *P>|z|*								
Main Independent Variables									
ROI	-0.002	-0.077 ***	-0.074	-0.509 ***	-0.313 ***	-0.194 ***	-0.507 ***	0.015	-0.175 ***
NSTA	-0.002	0.003	0.131 ***	-0.073	-0.059 ***	0.017	-0.050 ***	-0.015	0.054
CFTS	-0.012 ***	-0.184 ***	-0.006	-0.012 *	-0.037 ***	-0.067 ***	-0.014	-0.009 **	-0.001
quick_ratio	-0.002	-0.006 *	-0.241 ***	-0.002	-0.009 **	-0.011 *	-0.009 **	-0.006	0.000
growth_rate	0.004 ***	0.108 ***	0.001	0.008 ***	0.349 ***	0.002	0.294 ***	0.005 ***	0.099 *
TLTA	0.001	0.144 ***	-0.052	0.117 ***	0.035 *	0.398 ***	0.418 ***	0.013	0.077 **
QACA	-0.611 ***	-0.335	-0.952 **	-0.946 ***	0.264	-0.457 *	0.412	-0.973 ***	-1.176 **
TCTL	-1.866 ***	-5.160 ***	-0.697	0.852	-0.728	-2.459 ***	0.198	-0.116	-2.212 *
Firmage	-0.036 ***	-0.045 ***	-0.021 **	-0.019 *	-0.052 ***	-0.037 ***	-0.046 **	-0.014	0.016
Avg_dir_age	-0.040 ***					-0.007	-0.002	-0.045 **	-0.048 **
Nr_Female_Dir	-0.060					-0.122 **	0.120	-0.266 ***	0.102
Total_Dir_Nr	0.010					-0.005	-0.010	0.046 ***	-0.043
GDP_gr	-0.051 **	-0.068	-0.059	-0.070	0.123	-0.027	0.132	-0.086 *	-0.152 *
Credit	-0.011 ***	-0.021 ***	-0.016 **	-0.008	0.018 *	-0.012 **	0.023 **	-0.011 **	-0.025 **
new_firms_perc	0.128 ***	0.242	0.286 ***	0.195 ***	0.075 ***	0.113 *	0.005 ***	0.221 ***	0.429 ***
SGR	0.902 ***	0.840 ***	0.972 ***	0.530 ***	0.695 **	0.860 ***	0.467	0.809 ***	0.609
Control Variables									
Control_Ind (Agriculture)	-0.957 *	-0.987 **	1.451 **	-0.695	-3.586	-0.321	-1.698	-0.811 *	-1.073
Control_Ind (Mining)	-0.221	-0.280	1.590	1.472	-26.113	0.343	-24.264	1.790	2.302 *
Control_Ind (Construction)	-0.213 *	-0.249	-0.535	-0.426	-5.206 *	-0.405	-3.036	-0.256	0.126
Control_Ind (Manufacturing)	1.072 *	1.047 **	-0.588	-0.752	-2.862	-0.121	-0.478	-0.507	-1.273
Control_Ind (Trasp. & Comm.)	0.611 *	0.577	-0.572	-0.638	-1.887	-0.377	-0.016	-0.077	-2.049 *
Control_Ind (Wholesale)	0.429 *	0.365	-1.121 **	-0.705	-4.696 *	-0.596 *	-2.574	0.099	-1.395
Control_Ind (Retail)	-0.801 *	-0.818	-0.274	-1.102 *	-3.270	-0.493	-1.302	-0.861	0.280
Control_Ind (R. Estate)	-0.154	-0.158	0.763	0.335	-3.124	-0.052	-0.577	-0.247	0.325
region_York	0.318	0.222	0.501	0.768	-1.854 *	0.474	-2.026 *	0.939 *	1.237
region_east	0.218	-0.098	1.179	-0.473	1.270	0.360	1.239	0.085	-1.705
region_east_midlands	0.661	1.155	0.884	2.005 **	-23.127	0.754	-2.253	0.965	7.775 ***
region_n_ireland	1.049 *	1.787	1.719 **	0.529	-3.622 *	1.603 **	-3.522	2.103 ***	1.050
region_north_east	0.674	-1.729	1.092	2.892 ***	-3.859 *	0.198	-3.830 *	4.416 ***	1.039
region_north_west	0.190	0.131	1.296 ***	-0.041 **	-0.796	0.528	-0.954	0.215	1.271
region_scotland	1.211 ***	1.308 *	2.575 ***	0.873	-0.475	1.315 ***	-0.589 *	1.040 *	2.282 **
region_south_east	0.205	-0.029	0.468	0.896 *	-2.181 *	0.399	-2.817 **	1.285	1.084
region_south_west	-0.401	-0.898	0.958	-0.209	-1.419	-0.032	-1.628	-0.126	-2.774
region_wales	-0.356	0.092	-17.822	-0.778	-25.323	0.059	-24.711	-1.250	0.724
region_west_midlands	0.416	0.719	1.464 **	0.767	-3.974 **	0.865 **	-4.234 **	1.441 ***	3.078 **
\cut1	-5.286	-2.311	2.532	2.211	-3.384	-0.110	0.190	0.236	-2.218
\cut2	-2.916	0.466	4.125	4.618	2.003	2.054	6.028	1.923	2.253
Sigma_2u	3.346	1.645	2.487	2.791	6.006	1.613	6.072	2.398	0.862
std. Error Sigma_2u	0.314	0.360	0.539	0.465	1.628	0.279	1.686	0.433	0.368
LR test vs. ologit model	929.850 ***	84.210 ***	123.030 ***	262.500 ***	130.530 ***	132.720 ***	117.870 ***	200.900 ***	15.760 ***
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10									

Glossary

ROI	Return in Investment	TLTA	Total Liabilities to Total Assets	Nr_Female_Dir	Number of Female Directors
growth_rate	Growth Rate (in total assets)	QACA	Quick Assets to Current Assets	Total_Dir_Nr	Total Number of Directors
NSTA	Net Sales to Total Assets	TCTL	Trade Credit to Total Liabilities	Credit	Credit availability (% GDP)
CFTS	Cash Flow to Total Sales	Firmage	Firm Age	GDP_gr	GDP Growth (%)
quick_ratio	Quick ratio	Avg_dir_age	Average age of Directors	new_firms_perc	Percentage of New firms in a region
SGR	Dummy for unsustainable growth rate				

6.5.4.2 Results on Failure Processes without Directors

Considering the clusters without directors' characteristics, the results in Table 6.18 (columns 2-5) show that the alternative firm failure processes have different combinations of significant financial ratios.

The transition to failure of the firms in the **first failure process (column 2)** are negatively associated with return on investment (ROI), generation of cash flows relatively to their sales, liquidity as expressed from the quick ratio and trade credit relatively to total liabilities (TCTL). As a result, a reduction in these variables is associated with an increase in firms' propensity towards failure. On the other hand, growth rates and total liabilities compared to the total assets of the firm (TLTA) are positively associated with the transition to failure. This implies that increases in growth rates (of total assets) and increased total liabilities are associated with an increased propensity for transition to failure.

The firms in the second failure process (Table 6.18; column 3) are affected by different financial ratios. Liquidity, as measured by the quick ratio, and negative working capital, as expressed by quick assets to current assets (QACA), is a significant determinant of these firms' transition to failure with a negative (as expected) coefficient. A reduction in these financial ratios is therefore associated with an increase in the propensity of firms' transition to failure. On the other hand, net sales compared to total assets (NSTA) is significant with a positive coefficient, implying that an increase in NSTA is associated with higher probabilities for firms' transition to failure. This result is potentially counter-intuitive as it implies that the increase a firm's sales generating activity from its assets is positively associated with the transition to failure. In this firm failure process, the result may be related to two things. First, excessive growth in sales is related to unsustainable growth and the SGR variable is also highly significant and positive, implying that unsustainable levels of growth (SGR=1) are associated with firms' transition to failure. Second, this firm failure process is associated with firms that have strong sales generation but poor conversion to cash (CFTS). In this thesis we have seen that variables that are key characteristics of the failure process identification (in this case poor conversion of sales to cash-CFTS) are not necessarily determinants of firms' transition to failure as all the firms in that process share these.

The financial ratios that determine the transition to failure for firms in the **third failure process** (Table 6.18; column 4), are negative returns on investment (ROI), negative cash flows compared to their total sales (CFTS) and declining working capital (QACA). The negative association with failure is in line with expectations for these financial ratios. On the other hand, increasing growth in total assets and total liabilities compared to their total assets (TLTA) are positively associated with firms' transition to failure and these results are also in line with expectations.

Finally, the financial ratios that have significant impact on the transition to failure for firms in the **fourth firm failure process**, (Table 6.18; column 5), are associated with negative returns on investment (ROI), negative net sales to total assets (NSTA), negative cash flows compared to total sales (CFTS), reducing liquidity (quick ratio) and increasing growth rate and total liabilities compared to their total assets. The signs of the financial ratio coefficients for firms' transition to failure in this failure process are intuitive and in line with expectations. With the exception of TLTA, a reduction in any other significant financial ratio is associated with an increased propensity for firms' transition to failure. In the case of TLTA, increased total liabilities compared to firms' total assets are associated with increased propensity for firms' to transition to failure.

The age of the firm is significant in all 4 firm failure processes. The sign of the coefficient is negative associating younger firms with higher propensity to failure.

Credit availability is also a significant driver of the firms' failure transition in the first, second and fourth firm failure processes. Moreover, whilst the sign of the coefficient is the expected negative in the first three firm failure processes, it is positive in the fourth. This could be explained by the timing of failure (event_failure=2) of the firms in this failure process which was, generally concentrated on 2010. At that time, GDP_growth was falling and as such the credit availability as a percentage of GDP was found to be increasing, despite the fact that, in absolute terms, credit availability was not increasing. Credit availability is not significant determinant of the transition to failure in the third firm failure process.

The percentage of new firms in a region is a significant determinant of the firm failure transition in the second, third and fourth firm failure processes but not in the first. The sign of the coefficient as expected is positive, meaning that increased number of firms in a region can potentially lead to competition and existing firms' transition to failure.

The sustainable growth rate (SGR) metric takes the value of one when firms exceed their (sales) sustainable level of growth. SGR is a significant variable in all firm failure processes. The sign of the coefficient is positive, which is in line with theoretical expectations that an excessive level of growth is positively associated with firm failure.

From the industry control variables there is no particular trend over the significance of the control variables. In the first firm failure process agriculture is negatively associated with the failure transition while manufacturing is positively associated with it. In the second firm failure process Agriculture is positively associated with the transition to failure and wholesale trade is negatively associated with it. In the third firm failure process only retail sector is negatively associated (at 10% level of significance) with the firm failure transition whilst in the fourth firm failure process construction and wholesale ae both negatively associated with the transition to failure.

In terms of the regional control variables, the first firm failure process is characterized by Scotland being positively associated with the firm failure transition; the second firm failure process has N. Ireland, North West England, West Midlands and Scotland, positively associated with firm failure transition; the third firm failure process has East Midlands and the North East and South East as positively associated with the transition to failure and the North West, negatively associated with the transition to failure. The fourth firm failure process has York, N. Ireland, North East, South East and West Midlands negatively associated with the transition to failure.

6.5.4.3 Results on Failure Processes with Directors' Characteristics

The results for the clusters with directors' characteristics (Table 6.18; columns 6-9), show that there are variations between the failure processes with regards to the financial ratios. However, not all the firm failure processes have the same financial ratios as significant.

In the first firm failure process: Looking at the financial ratios first, firms' transition to failure (Table 6.18; column 6) is determined a number of financial ratios with negative coefficients. The return on investment (ROI), cash flow to total sales (CFTS), liquidity (quick ratio), working capital (QACA) and trade credit to total liabilities (TCTL) are all significant determinants of firms' transition to failure. A decrease in these ratios is associated with an increase in firms' propensity to transition to failure,in line with expectations.

On the other hand increasing total liabilities compared to the assets of these firms (TLTA) are positively related with the transition to failure, implying that an increase in TLTA is associated with an increased risk of transition to failure. Considering the board characteristics in the first firm failure process, female directors are negatively associated with transition to failure. In other words, fewer female directors are associated with an increased propensity for firms' to transition to failure in this process. From the economic and business environment, reduced credit availability (as a percentage of GDP) is associated with an increased propensity for firms' to transition to failure whilst increased competition from new firms in the regions is positively associated with firms' transition to failure. Levels of (un)sustainable (sales) growth is also a determinants of transition to failure in the first firm failure process. The positive sign of the SGR coefficient suggests that firms with unsustainable levels of growth are associated with an increased propensity to fail. On the other hand, the age of firm is negatively associated with transition to failure for this failure process. As such, younger firms are likelier to transition to falure.

In terms of the industry control variables, the first firm failure process has wholesale trade as significant at the 10% level with negative coefficient. This implies that wholesale trade have a lower significant association with transition to failure comparing to those in the Services sector which is the reference industry. Finally, the regional control variables demonstrate that the first firm failure process includes the regional control variables of Yorkshire & the Humber, N. Ireland, Scotland, East and West Midlands as significant with positive coefficients and therefore riskier than London which is the reference region.

In the second firm failure process (Table 6.18; column 7): A number of financial ratios have the expected negative coefficient, impying that a decrease in these ratios is associated with an increased propensity for firms' to transition to failure. As such, the statistically significant ROI and NSTA, imply that falling returns and net sales compared to the total assets are linked with the transition to failure. Likewise, the quick ratio is negatively associated with firms' transition to failure, implying that reduced levels of liquidity increase the propensity of transition to failure for these firms.

On the other hand, growth rates and TLTA are positively associated with the transition to liquidation. These results for the financial ratios are in line with expectations. The positive sign in growth rates has been associated with firms' transition to failure in a number of occasions throughout this study, highlighting that firms' growth is not necessarily a positive development in SMEs that eventually fail. The second firm failure process, despite being characterized by young over-indebted firms with a small board that includes female directors, is a process where the directors' characteristics are not significant determinants of firms' transition to failure. However, credit availability and increased competition from new firms are determinants of firms' transition to failure. The positive coefficient in the credit availability is associated with these firms' failure timing (largely in 2010) where GDP_growth was reducing having as a result increased credit availability as a percentage of GDP growth. Nevertheless, credit availability was reducing in absolute terms and as such the positive coefficient is still related to reduced credit availability to firms.

SGR is a significant determinant, positively associated with firms' transition to failure, in line with expectations. As a result, firms with unsustainable levels of (sales) growth (SGR=1) are more likely to transition to failure.

The age of firm is a determinant negatively associated with transition to failure for this failure process. This is in line with expectations as younger firms have an increased risk of failure.

In terms of the control variables, real estate is the only industry that is significant determinant of firms' transition to failure. The negative coefficient implies reduced propensity to failure compared to the services sector. In terms of the regional control variables the second firm failure process has Yorkshire & the Humber, West Midlands and South East as significant with negative coefficients, implying that in this firm failure process these regions are less risky than London for SMEs.

In the third firm failure process (Table 6.18; column 8): There are two statistically significant ratios that determine the firms' transition to failure with a negative coefficient in this process. A reduction in CFTS and QACA is associated with an increased propensity for firms' to transition to failure. On the other hand, an increase in growth rate (in total assets) is associated with increased propensity to failure for these firms. Therefore, the signs of financial ratios' coefficients for firms' determinants of transition to failure are in line with expectations for this firm failure process.

In terms of the board characteristics, all directors' characteristics are significant determinants of firms' transition to failure in this process. The experience of directors (proxied by the average directors' age) has a negative coefficient implying that decreased directors' experience is associated with increased propensity towards failure. Likewise reduced gender diversity (proxied by the number of female directors) is associated with an increased propensity for firms' to transition to failure. On the other hand, the number of directors is positively associated with firms' transition to failure in the third firm failure process. This implies that increasing the number of directors increases the risk of failure in this process. This result contrasts with evidence from other firm failure processes and implies that increased social capital is not helping the firms in this firm failure process to avoid failure. This result is specific to this failure process which is already characterised by a limited number of directors in the board. Nevertheless, the directrors' characteristics in the third firm failure process are all significant determinants of firms' transition to failure.

In addition, the business and economic environment metrics are all significant. Reduced GDP growth, credit availability and increased competition from new firms in a region are all significant determinants of firms' transition to failure and are associated with the increased propensity of firms' to transition to failure. Likewise, unsustainable levels of sales growth (SGR=1) is a positively associated determinant of transition to failure. As such, firms with increased levels of (sales) growth that exceed the sustainable levels, are more likely to fail.

In terms of the control variables, agriculture is the only industry that is significant determinant of firms' transition to failure. The negative coefficient implies reduced propensity to failure compared to the services sector. The third firm failure process has Yorkshire & the Humber, N. Ireland, North East, Scotland, South East and West Midlands as significant regions with positive coefficients, implying that in this firm failure process these regions are more risky than London.

In the fourth firm failure process (table Table 6.18; column 9): A number of financial ratios are statistically significant determinants of firms' transition to failure in this process.The negative sign of the coefficients for ROI, QACA and TCTL are in line with expectations. Reduced levels of returns, reduced liquidity and reduced usage of trade credit (for example when bank credit is unavailable) are associated with an increased propensity for firms' to transition to failure and are significant determinants of firms' transition to failure.

On the other hand, growth and total liabilities to total assets (TLTA) arepositively associated determinants of firms' transition to failure for these firms. As such, an increase in TLTA and growth rate (in total asets) is associated with increased propensity for firms to transition to failure.

In terms of the directors' characteristics, the average age of directors, as a proxy for management experience, is negatively associated with firms' transition to failure. This implies that reduced age of directors and therefore reduced experience, is associated with an increased propensity towards failure. This is expected because reduced directors' experience can adversely affect firms' ability to succeed. Likewise, GDP growth and credit availability are significant determinants with a negative coefficient, impying that a reduction in these variables is associated with increased propensity to failure. On the other hand the increased number of new firms in a region is positively associated with an increased risk towards failure, due to the positive coefficient. A deteriorating economic environment with reduced credit availability and GDP growth and a business environment with increased competition from new firms are all determining these firms' transition to failure.

In terms of the control variables, the Mining industry together with Transportation and Communication are the only industries that are significant determinants of firms' transition to failure. The negative coefficient implies reduced propensity to failure compared to the services sector. The fourth firm failure process has East Midlands, Scotland and West Midlands as significant with positive coefficients. This implies that these regions are riskier than London in firms' transition to failure in the particular firm failure process.

6.5.4.4 Marginal Effects of Failure Processes with Directors' Characteristics

This section looks at the marginal effects of firms' transition to failure in the alternative UK regions and the alternative firm failure processes. The aim of this section is to provide a breakdown of the relative magnitude of the regional effects (that were shown as significant in the regression analysis) for each one of the alternative firm failure statuses as this is not explicitly obvious in the panel regression results. The results derive from the panel regressions and as such they effectively show a comparison for the firms of each region compared to London, which was the reference region in the regression analysis' dummy variables. Effectively the marginal effects capture the magnitude of change in the dependent variable (firm failure status) for a change in the independent variable (region). In this section, these are presented as probabilities of each region to be in a firm failure status (0: healthy; 1: financial distress; 2: liquidation). Table 6.19 shows the results.

Table 6.19: Marginal effects – All UK firms

Marginal Effects in UK regions (All firms/ London as reference region)											
Firm Failure Status	Yorkshire & Humber	East	East Midlands	N.Ireland	North East	North West	Scotland	South East	South West	Wales	West Midlands
0	-3.1%	-2.1%	-6.4%	-10.3%	-6.6%	-2.2%	-11.7%	-2.0%	3.6%	3.4%	-4.1%
1	2.3%	1.5%	4.7%	7.7%	4.9%	1.6%	8.7%	1.5%	-2.7%	-2.5%	3.0%
2	0.8%	0.5%	1.6%	2.7%	1.7%	0.6%	3.0%	0.5%	-0.9%	-0.9%	1.0%

The results in Table 6.19 show the relative differences in the probabilities of firms' transition to the alternative failure stages (firm failure status) in each region associated with a particular firm failure status (0: healthy; 1: financial distress; 2: liquidation). London is not included as it served as reference region in the Panel regressions prior to the marginal effects analysis. It can be seen that South West and Wales are more likely to be associated with the healthy firm failure status while N. Ireland and Scotland with the worse status (liquidation). Specifically, South West and Wales have higher percentage (3.6% and 3.4% respectively) in the firm failure status of the healthy firm (event_failure=0). In other words, they have higher probability than the firms in London (and any other region in this case) to remain in this firm failure status. In contrast, N. Ireland and Scotland are associated with the lowest (-10.3% and -11.7% respectively) change in the depdendent variable at this failure status.

Considering the firm failure status of financial distress (event_failure=1), Scotland (8.7%) and N. Ireland (7.7%) are associated with higher probability (magnitude of change) to transit in this stage of failure. Conversely, Wales (-2.5%) and South West (-2.7) have the lowest probabilities of transition to financial distress. Finally, for the firm failure status of liquidation (event_failure=2) which is the terminal stage of the firms' transition to failure, firms in Scotland and N. Ireland have the highest probabilities of transition to this stage of failure. These results confirm the evidence from the analysis of firms' transition to failure in the full UK firms' sample (Table 6.18; column 1), where the regions of Northern Ireland and Scotland were significant determinants of firms' transition to failure in UK countries/regions.

The analysis of the marginal effects of regions, Table 6.20, considers the marginal effects for each firm failure process. In the first firm failure process N. Ireland (-15.2%), Scotland (-12.5%), West Midlands (-8.2%) and East Midlands (7.2%) are the regions with the lowest probability (magnitude of change in the dependent variable) of remaining in the Firm Failure Status of the healthy firm. Likewise, these are the regions that have the highest probabilities (compared to London and to the rest of the regions) to transit to the firm failure status of financial distress and subsequently to liquidation (failure).

In the second firm failure process (table 6.20) the results between regions are mixed. Scotland's firms have the lowest probability of remaining in the failure status of the healthy firm, followed by Northern Ireland (-9.7%) and the North East (-6.2%). The highest probability for transition to financial distress is with Scotland (8.3%), N. Ireland (7.3%) and East Midlands (4.5%) firms and the highest probability of transition to liquidation is associated with Scottish (2.7%), N. Irish, East Midland's and North East's firms (1.5%). Yorkshire and the Humber, North East, Scotland, South east, and West Midlands regions were significant determinants of firms' transition to failure. In the third firm failure process North East (-34.4%), N. Ireland (-16.4%), West Midlands (-11.2%) are the regions with the lowest probability of remaining in the firm failure status of the healthy firm with South East (-10%), Yorkshire and the Humber (-73%) and East Midlands having also significantly reduced probabilities of remaining in this status, compared to London and other regions. In terms of transitioning to the firm failure status of financial distress, firms in North east (23.3%), N. Ireland (11.1%), East Midlands (5.1%), South East (6.8%), West Midlands (7.6%), and Yorkshire and the Humber (5%) have some of the highest probabilities of being in the firm failure status of financial distress and subsequently transitioning to liquidation. Of those, Yorkshire and the Humber, N. Ireland, North East, Scotland, and West Midlands were significant determinants of firms' transition to failure.

In the fourth firm failure process East Midlands (-156.8%), West Midlands (-62.1% and Scotland (-46%) are the regions whose firms have the lowest probability (compared to London) of remaining in the healthy firm failure status, by some margin. Additionally these regions are also those whose firms' have the highest probability (compared to London) to transition to financial distress (136.1%, 53.9% and 39.9% respectively) and to liquidation (20.7%, 8.2%, and 6.1% respectively). As such the fact that these regions have also been identified as significant determinants of firms' transition to failure makes intuitive sense.

Table 6.20: Marginal effects – Firm Failure Processes with Directors characteristics-UK firms

Failure Status	Yorkshire & Humber	East	East Midlands	N.Ireland	North East	North West	Scotland	South East	South West	Wales	West Midlands
Marginal Effects in UK regions (FIRST PROCESS WITH DIRECTORS/ London as reference region)											
0	-4.5%	-3.4%	-7.2%	-15.2%	-1.9%	-5.0%	-12.5%	-3.8%	0.3%	-0.6%	-8.2%
1	3.6%	2.7%	5.7%	12.1%	1.5%	4.0%	9.9%	3.0%	-0.2%	0.4%	6.5%
2	0.9%	0.7%	1.5%	3.1%	0.4%	1.0%	2.6%	0.8%	-0.1%	0.1%	1.7%
Marginal Effects in UK regions (SECOND PROCESS WITH DIRECTORS/ London as reference region)											
0	-2.9%	-1.9%	-6.0%	-9.7%	-6.2%	-2.1%	-11.0%	-1.9%	3.4%	3.2%	-3.8%
1	2.2%	1.5%	4.5%	7.3%	4.7%	1.6%	8.3%	1.4%	-2.5%	-2.4%	2.9%
2	0.7%	0.5%	1.5%	2.4%	1.5%	0.5%	2.7%	0.5%	-0.8%	-0.8%	0.9%
Marginal Effects in UK regions (THIRD PROCESS WITH DIRECTORS/ London as reference region)											
0	-7.3%	-0.7%	-7.5%	-16.4%	-34.4%	-1.7%	4.4%	-10.0%	1.0%	9.7%	-11.2%
1	5.0%	0.5%	5.1%	11.1%	23.3%	1.1%	3.0%	6.8%	-0.7%	-6.6%	7.6%
2	2.4%	0.2%	2.4%	5.3%	11.1%	0.5%	1.4%	3.2%	-0.3%	-3.1%	3.6%
Marginal Effects in UK regions (FOURTH PROCESS WITH DIRECTORS/ London as reference region)											
0	-24.9%	34.4%	-156.8%	-21.2%	-21.0%	-25.6%	-46.0%	-21.9%	55.9%	-14.6%	-62.1%
1	21.7%	-29.9%	136.1%	18.4%	18.2%	22.3%	39.9%	19.0%	-48.6%	12.7%	53.9%
2	3.3%	-4.5%	20.7%	2.8%	2.8%	3.4%	6.1%	2.9%	-7.4%	1.9%	8.2%

The above demonstrate that the regional effects (captured from the regional dummy variables) are associated with different magnitudes of change in the alternative statuses of the dependent variable. In other words, firms across different UK regions perform (on average) differently with regards to their failure status (stage of the dependent variable) and depending on the firm failure process they are associated with. In addition, certain regions (N. Ireland and Scotland) are characterized by consistently higher probabilities for transition to failure compared to the reference of London, but also the rest of the UK regions. One should note that the significance of these regions were shown to be significant determinants of firms' transition to failure in the panel regressions of the previous section in all the firms and in a number of the alternative firm failure processes. Whilst local economic indicators may have a role to play on that, other unobservable characteristics, related to the spatial location in these geographical areas should also be considered. This is discussed in Chapter 7.

6.5.5 Panel Regression Results' implications on the Hypotheses

Section 6.4.4 discussed the hypotheses in the context of the results from the identification of the alternative firm failure processes and the chi-squared tests that were subsequently used to accept and reject the hypotheses. This section aims to discuss the hypothesis in the context of firms' transition to failure and to untimately conclude whether they are accepted. As such, the key aspects of each hypothesis are discussed in order to compare the determinants of firms' transition to failure in the alternative firm failure processes. Table 6.21 presents a summary of the hypotheses that this Chapter has considered and shows if they are accepted.

Table 6.21: Summary table for Chapter 6 Hypotheses

Table of Hypotheses for UK firms		
Nr.	**Hypothesis Statement**	**Accepted?**
H7	The number of new firms as a percentage of the existing business population in a UK region differs between the alternative firm failure processes in UK firms; it is also a determinant of firms' transition to failure.	Yes
H8	Industry classification differs between the alternative firm failure processes in UK firms; it also differs as a determinant of firms' transition to failure in the alternative firm failure processes.	Yes
H9	Financial performance represented by key financial ratios and the age of the firm, differ in the alternative firm failure processes of UK firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.	Yes
H10	In an UK regional context, macroeconomic conditions differ between firms in the alternative firm failure processes in UK firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.	Yes
H11	Directors' Characteristics such as the presence of women in SMEs' management, director age as a proxy of director experience and the number of directors, differ in the alternative UK firm failure processes; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.	Yes
H12	The distribution of firms with unsustainable levels of growth differs between the alternative firm failure processes in UK firms; unsustainable levels of growth are also determinants of firms' transition to failure.	Yes

Hypothesis 7*: The number of new firms as a percentage of the existing business population in a UK region differs between the alternative firm failure processes in UK firms; they are also determinants of firms' transition to failure.*

The first part of Hypothesis 7 has already been accepted on the basis of the cluster analysis. The evidence from the panel regressions shows additionally that the number of new businesses in a region (as a percentage of the business population in that region) is a significant determinant of firms' transition to failure. In most failure processes a higher percentage of new businesses is positively associated with transition to failure with the exception of the first firm failure process when directors' characteristics are not considered. This result highlights the importance of the business environment, at regional level, to firms' transition to failure regardless of the firm failure process. Therefore Hypothesis 7 is fully accepted.

Hypothesis 8: *Industry classification differs between the alternative firm failure processes in UK firms; it also differs as a determinant of firms' transition to failure in the alternative firm failure processes.*

The first part of the hypothesis was accepted on the basis of the cluster analysis. The regression analysis on the determinants of firms' transition to failure show that the industry to which a firm belongs is a determinant of firms' transition to failure in a number of the firm failure processes. A number of industries were significant (Sig.<0.10) determinants in the full UK firms' sample (Table 6.18; column 1). Therefore, considering the alternative firm failure processes, one can conclude that industrial differenes exist across the different firm failure processes. Overall, the influence of industry classification as a determinant of transition to failure is reduced once firms are allocated into failure processes. However, the industry as a determinant of failure indeed differs in the alternative firm failure processes. Therefore Hypothesis 8 is fully accepted.

Hypothesis 9: *Financial performance represented by key financial ratios and the age of the firm, differ in the alternative firm failure processes of UK firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

Based on the cluster analysis it has already been shown that the medians of the financial ratios and of the firms' age are not the same across firm failure processes. As such the first part of this hypothesis has been accepted in the context of the alternative firm failure processes. In the context of the determinants of firms' transition to failure, the panel regression results also show that the significance of financial ratios as determinants of firms' transition to failure, differ between the alternative firm failure processes. There are differences between the financial ratios that are significant determinants in the failure status progress in each failure process. Likewise, the age of the firm is significant determinant of firms' transition to failure in the first and second firm failure process but not in the third and fourth. As such H9 still stands in the context of the failure determinants. Therefore Hypothesis 9 is fully accepted.

Hypothesis 10*: In an UK regional context, macroeconomic conditions differ between firms in the alternative firm failure processes in UK firms; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

The results from the cluster analysis demonstrated that there is statistically significant difference between failure processes in both the GDP growth and the credit availability. This remains the case for the panel analysis. Economic conditions, captured by the GDP growth and the credit availability are significant determinants of firms' transition to failure in the full UK sample. However, these indicators differ in their significance in the alternative firm failure processes. One, both or none of them can be significant determinants of firms' transition to failure, depending on the firm failure process. As such the macroeconomic conditions differ as determinants of firms' transition to failure in the alternative failure processes. Therefore Hypothesis 10 is fully accepted.

Hypothesis 11*: Directors' Characteristics such as the presence of women in SMEs' management, director age as a proxy of director experience and the number of directors, differ in the alternative UK firm failure processes; they also differ as determinants of firms' transition to failure in the alternative firm failure processes.*

The result from the cluster analysis demonstrated that directors' characteristics differ in the alternative firm failure processes. In the context of the determinants of firms' transition to failure only the average age of directors was a significant determinant of the transition to failure. In the context of the alternative firm failure processes, all three of the metrics of directors' characteristics (number of female directors, total number of directors and average age of directors) are significant determinants of firms' transition to failure, with different combinations in the alternative firm failure processes. Apart from the second firm failure process where no directors' characteristics are significant, the other firm failure processes do have at least of one director characteristic as a determinant of firms' transition to failure. Therefore, one can conclude that board characteristics (with different combinations for each failure process) affect the alternative firm failure processes as determinants of failure. Therefore Hypothesis 11 is fully accepted.

Hypothesis 12*: The distribution of firms with unsustainable levels of growth differs between the alternative firm failure processes in UK firms; unsustainable levels of growth are also determinants of firms' transition to failure.*

The results from the cluster analysis accepted the first part of Hypothesis 12. In the context of firms' transition to failure in the alternative firm failure processes, one can observe that SGR is significant in the full sample and most alternative firm failure processes, with the exception of the second and the fourth, when directors' characteristics are considered. As such, one can observe that the SGR as a metric of firms' unsustainable is a significant determinant of firms' transition to failure in most but not all the failure processes. Therefore Hypothesis 12 is fully accepted.

6.6 Robustness Checks

Additional analysis has been undertaken as a robustness check for the results discussed above. The first test (Table 6.22) involves a rerun of the regression in the firms' failure processes with a regional indicator capturing the state of the economy at regional level. GVA growth has been used instead of GDP growth. The second test (Table 6.23) involves a further regression check in the all firms dataset. Here the panel ordered regression was applied using bootstrapped (instead of standard) errors. The third check (Table 6.23), involved a simple ordered logistic regression model (non-panel).

First, an alternative specification of the model with regional GVA growth instead of the (national) GDP growth has been tested in order to detect whether a more regional oriented metric for the macroeconomic environment at regional level would produce different results (Table 6.22).

At the all UK firms panel regression, the results remain the same when using the GVA growth instead of the GDP growth with the exception of the control variable of East Midlands which becomes significant at Sig.<0.10. However, for the firm failure process without directors' characteristics, the GVA growth is significant in the first, second and third firm failure processes. Additionally, the percentage of new firms in the region is now significant at the 5% level and positively correlated with the transition to liquidation. In the second firm failure process, GVA is also significant and negatively associated with the transition to liquidation with all the other independent variables remaining at similar levels of significance and with the same coefficients. In the third firm failure process, GVA becomes significant as does the credit availability. The fourth firm failure process returns results similar to those of the main analysis (section 6.5) as GVA did not return as significant. Considering the failure processes with directors' characteristics, the main variation is in the first firm failure process. GVA is highly significant in the first failure process (as is credit availability) and is significant at the 1% level in the third and fourth (GDP was significant at 10%).

Table 6.22: Panel data analysis results for alternative clusters using a region-specific metric for macroeconomic conditions.

Column:	1	2	3	4	5	6	7	8	9
		Failure Processes w/out Directors' Characteristics				Failure Processes with Directors' Characteristics			
Independent Variables	All Firms	Process 1	Process 2	Process 3	Process 4	Process 1	Process 2	Process 3	Process 4
					Coeff. P>|z|				
					Main Independent Variables				
ROI	-0.002	-0.080 ***	-0.067	-0.515 ***	-0.312 ***	-0.189 ***	-0.507 ***	0.013	-0.180 ***
NSTA	-0.002	0.002	0.122 ***	-0.068	-0.056 ***	0.016	-0.047 ***	-0.020	0.060
CFTS	-0.011 ***	-0.176 ***	-0.006	-0.011 *	0.036 ***	-0.066 ***	-0.012	-0.009 **	0.000
quick_ratio	-0.002	-0.005 *	-0.241 ***	-0.002	0.009 **	-0.012 *	0.010 **	-0.006	0.000
growth_rate	0.004 ***	0.114 ***	0.001	0.008 ***	0.334 ***	0.002	0.278 ***	0.005 ***	0.090 *
TLTA	0.001	0.151 ***	-0.046	0.111 ***	0.035 *	0.391 ***	0.418 ***	0.012	0.076 **
QACA	-0.615 ***	-0.366	-0.827 **	-0.931 ***	0.264	-0.457 *	0.400	-0.970 ***	-1.063 **
TCTL	-1.881 ***	-5.075 ***	-0.696	0.641	-0.751	-2.416 ***	0.162	-0.333	-2.224 *
Firmage	-0.036 ***	-0.046 ***	-0.021 **	-0.018 *	-0.053 ***	-0.037 ***	-0.047 **	-0.014	0.017
Avg_dir_age	-0.040 ***					-0.008	-0.002	-0.048 **	-0.041 *
Nr_Female_Dir	-0.061					-0.123 **	0.117	-0.281 ***	0.118
Total_Dir_Nr	0.011					-0.006	-0.008	0.048 ***	-0.048
GVA	-0.203 ***	-0.155 ***	-0.271 ***	-0.223 ***	-0.020	-0.185 ***	-0.021	-0.244 ***	-0.253 ***
Credit	-0.023 ***	-0.028 ***	-0.033 ***	-0.020 ***	0.006	-0.025 ***	0.010	-0.023 ***	-0.035 ***
new_firms_perc	0.247 ***	0.231 **	0.445 ***	0.325 ***	0.013 **	0.241 ***	0.043 **	0.373 ***	0.539 ***
SGR	0.685 ***	0.862 ***	0.940 ***	0.574 ***	0.706 **	0.833 ***	0.482	0.839 ***	0.537
					Control Variables				
Control_Ind (Agriculture)	-4.137 *	-0.978 **	1.464 **	-0.712	-3.499	-0.322	-1.613	-0.841 *	-1.131
Control_Ind (Mining)	-3.006	-0.273	1.641	1.522	-26.475	0.333	-23.500	1.655	2.328 *
Control_Ind (Construction)	-4.093 *	-0.242	-0.548	-0.433	-5.101 *	-0.434	-2.937	-0.269	0.127
Control_Ind (Manufacturing)	-3.560 *	1.054 **	-0.546	-0.747	-2.758	-0.131	-0.401	-0.511	-1.313
Control_Ind (Trasp. & Comm.)	-3.597 *	0.576	-0.564	-0.647	-1.804	-0.433	0.044	-0.087	-2.191 *
Control_Ind (Wholesale)	-4.106 *	0.370	-1.112 **	-0.711	-4.569	-0.627 *	-2.461	0.099	-1.513
Control_Ind (Retail)	-4.215 *	-0.822	-0.305	-1.116 *	-3.172	-0.543	-1.217	-0.857	0.147
Control_Ind (R. Estate)	-3.449	-0.156	0.768	0.294	-3.097	-0.051	-0.578	-0.281	0.223
region_York	0.475	0.327	0.702	0.917 *	-1.681 *	0.628 *	-1.844 *	1.098 **	1.348
region_east	0.126	-0.144	1.012	-0.619	1.295	0.291	1.267	-0.040	-1.915
region_east_midlands	0.858 *	1.340 *	1.078	2.180 **	-23.390	0.957 *	-2.064	1.172	7.956 ***
region_n_ireland	1.480 ***	2.075	2.236	0.957	-3.325	2.010 **	-3.203	2.612 ***	1.513
region_north_east	0.868	-1.573	1.360	3.136 ***	-3.662 *	0.407	-3.610	4.584 **	1.281
region_north_west	0.329	0.225	1.414 ***	0.050	-0.634	0.655 **	-0.781	0.309	1.372
region_scotland	1.561 ***	1.470 **	2.981 ***	1.209 **	-0.292	1.602 ***	-0.393	1.380 **	2.636 **
region_south_east	0.338	0.151	0.493	0.955 *	-1.970 *	0.586	-2.574 **	1.393 ***	0.990
region_south_west	-0.119	-0.717	1.237	0.026	-1.215	0.235	-1.404	0.095	-2.537
region_wales	-0.017	0.370	-19.403	-0.428	-25.489	0.397	-23.725	-0.873	0.917
region_west_midlands	0.526	0.825	1.567 ***	0.829	-3.831 **	1.003 **	-4.072 **	1.544 ***	3.140 **
\cut1	-6.196	-2.477	1.252	1.347	-4.788	-1.073	-1.389	-0.543	-2.640
\cut2	-3.781	0.330	2.892	3.809	0.572	1.125	4.419	1.186	1.943
Sigma_2u	3.458	1.663	2.549	2.879	5.854	1.662	5.901	2.582	0.862
std. Error Sigma_2u	0.324	0.363	0.547	0.478	1.582	0.286	1.636	0.464	0.370
LR test vs. ologit model	949.840 ***	85.370 ***	126.590 ***	270.760 ***	129.410 ***	135.450 ***	116.380 ***	211.730 ***	15.470 ***

*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10

Glossary

ROI	Return in Investment	TLTA	Total Liabilities to Total Assets	Nr_Female_Dir	Number of Female Directors
growth_rate	Growth Rate (in total assets)	QACA	Quick Assets to Current Assets	Total_Dir_Nr	Total Number of Directors
NSTA	Net Sales to Total Assets	TCTL	Trade Credit to Total Liabilities	Credit	Credit availability (% GDP)
CFTS	Cash Flow to Total Sales	Firmage	Firm Age	GVA	GVA Growth (%)
quick_ratio	Quick ratio	Avg_dir_age	Average age of Directors	new_firms_perc	Percentage of New firms in a region
SGR	Dummy for unsustainable growth rate				

These results, broadly confirm that the financial ratios and the directors' characteristics remain at the same levels of significance when alternative (localized) macroeconomic environment characteristics are considered instead of the UK- wide macroeconomic characteristics. Furthermore, the two sets of results suggest that there is evidence that certain firm failure processes are more affected by the local economic environment whilst others are more affected by the national economic environment. This also affects the significance of the regions in some firm failure processes, where certain regions are significant determinants and others stop being significant when the local (GVA) economic conditions are considered. The riskiness of regions is considered in the next section.

Second, additional robustness checks were performed in the form of a random effects panel ordered regression with bootstrapped errors in order to check whether any non-normality in the residuals could potentially lead to contradicting results. The results (Table 6.23) for the random effects panel ordered regression with bootstrapped errors are similar with those of the original regression with standard errors therefore confirming the results of the study. There are some differences in the significance of some financial ratios with CFTS and growth rate being significant at the 10% level as opposed to 1% in the non-bootstrapped regression. Additionally, most industry control variables are significant at the 1% in the bootstrapped regression compared to the non-bootstrapped. However, these differences do not alter the overall results.

Third, robustness checks were performed in the form of a simple ordered logit regression produced (Table 6.23). The results were slightly different. In particular, ROI and TLTA were significant in the simple regression but not in the original panel regression. On the other hand QACA, TCTL and average directors' age were not significant in the simple logit but they were in the original panel regression. Likewise average directors' age was not significant in the simple logit but the number of female directors was. Such differences between logit and panel R.E. regression were not observed in the full data with all EU countries. One possible explanation for this discrepancy is the treatment of individual heterogeneity in the panel data. It is possible that the element of individual heterogeneity is particularly pronounced in the UK firms, making the two regressions marginally different in their determinants.

Table 6.23: Robustness checks with simple logistic regression and bootstrapped errors in Panel Random Effects Ordered regression.

Column:	1	2	3
Independent Variables	All Firms	All Firms Random Effects Ordered Panel Bootstrap	All Firms Simple Ordered Logit
		Coeff. *P>|z|*	
Independent Variables			
ROI	-0.002	-0.002	-0.497 ***
NSTA	-0.002	-0.002	-0.024
CFTS	-0.011 ***	-0.012 *	-0.037 ***
quick_ratio	-0.002	-0.002	0.000
growth_rate	0.004 ***	0.004 *	0.010 ***
TLTA	0.001	0.001	8.651 ***
QACA	-0.615 ***	-0.611 ***	0.056
TCTL	-1.881 ***	-1.866 ***	-0.345
Firmage	-0.036 ***	-0.036 ***	-0.016 **
Avg_dir_age	-0.040 ***	-0.040 ***	-0.004
Nr_Female_Dir	-0.061	-0.060	0.096
Total_Dir_Nr	0.011	0.010	0.007
GDP_gr	-0.203 **	-0.051 ***	-0.050
Credit	-0.023 ***	-0.011 ***	-0.009 *
new_firms_perc	0.247 ***	0.113 **	0.236 ***
SGR	0.685 ***	0.691 ***	0.610 ***
Control Variables			
Control_Ind (Agriculture)	-4.137 *	-3.997 ***	3.293
Control_Ind (Mining)	-3.006	-2.860 **	3.814
Control_Ind (Construction)	-4.093 *	-3.953 ***	2.475
Control_Ind (Manufacturing)	-3.560 *	-3.430 ***	2.883
Control_Ind (Trasp. & Comm.)	-3.597 *	-3.448 ***	2.532
Control_Ind (Wholesale)	-4.106 *	-3.965 ***	2.530
Control_Ind (Retail)	-4.215 *	-4.069 ***	2.903
Control_Ind (R. Estate)	-3.449	-3.302 ***	3.392
region_York	0.475	0.318	0.770 **
region_east	0.126	0.218	0.187
region_east_midlands	0.858 *	0.661	0.797
region_n_ireland	1.480 ***	1.049 **	0.955
region_north_east	0.868	0.674	0.736
region_north_west	0.329	0.190	0.387
region_scotland	1.561 ***	1.211 ***	2.101 ***
region_south_east	0.338	0.205	0.871 **
region_south_west	-0.119	-0.401	0.256
region_wales	-0.017	-0.356	-0.200
region_west_midlands	0.526	0.416	1.158 ***
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10			

6.7 Discussion

The first objective of this chapter is to identify SMEs' failure processes in UK regions and to confirm or reject the hypotheses that relate to comparisons between the alternative failure processes. The second objective is to discuss the determinants of firms' transition to failure in the alternative UK firm failure processes.

The literature review section has discussed the relative lack of intra-country firm failure process comparisons. This chapter extends the literature of firm failure processes by providing a regional, intra-country analysis for firm failure processes and their determinants of the transition to failure, using the U.K. as an example. The results of the analysis suggest that when director characteristics are not included, the number of firm failure processes is in line with evidence from the existing quantitative firm failure process literature (Laitinen et al, 2014; Laitinen et al., 2015; Lukason and Laitinen, 2016). In addition, once directors' characteristics are included in the formation of the firm failure processes, the total number of processes remains the same but the inclusion of directors' information adds further insight into the characteristics of the alternative firm failure processes. In addition, the inclusion of directors' characteristics is a significant determinant of UK firms' transition to failure for a number of alternative failure processes as well as for the full sample of the firms. For this reason the focus on the discussion will be given on the failure processes with directors' characteristics.

6.7.1 Discussion on Firm Failure processes

This section provides a critical evaluation of the four firm failure processes that are identified in the UK regions and discusses the similarities with the processes analysed in the qualitative and quantitative literature in other countries. In addition, some differences and similarities between the within the UK regions' and the between the EU countries failure processes are analyzed and evaluated.

The analysis of UK firms' failure processes employed factor and cluster analysis approach to investigate the situation at the UK regional level. This is consistent with evidence from the quantitative firm failure process literature where the same methodology has been used for the identification of the firm failure processes using financial ratios (Laitinen, 1991; Laitinen and Lukason, 2014; Laitinen et al., 2014; Lukason and Laitinen, 2016; Lukason et al., 2016; Lukason and Vissak, 2017).

There has been no evidence in the academic literature for intra-country regional analysis of firm failure processes. Nevertheless, the key characteristics of the age of the firm together with the financial ratios, as symptoms of failure, do characterize the alternative firm failure processes in the UK regions, which is in line with the quantitative literature on firm failure processes. This thesis provided evidence that four firm failure processes co-exist within the UK, which is broadly in line with the qualitative (eg. Argenti, 1976; Ooghe and DePrijcker, 2008) and quantitative literature (eg. Laitinen et al, 2014; Laitinen et al., 2015; Lukason and Laitinen, 2016) that has historically identified between 2 and 6 firm failure processes in country-level studies. One can therefore conclude that, depending on the countries and the sample of firms, there is a finite number of firm failure processes that can be identified. As such, the quantitative literature, including the findings in this chapter, support the qualitative literature that provided a number of descriptions of the alternative firm failure processes that have been identified, regardless of the size of the firms or the country.

The results for the UK firms demonstrated that there are differences between firm failure processes across the UK regions. The inclusion of directors' characteristics in the identification of the alternative firm failure processes differentiates this study from other quantitative firm failure studies. That includes the number of directors, their average age and the number of female directors. These characteristics play the role of proxies for the experience, social network and capital and gender diversity in firms' management. The analysis of the alternative firm failure processes reveals differences on these characteristics within the different clusters that represent the alternative firm failure processes. This provides an addition to the existing literature that so far does not consider directors' characteristics as a potential of the alternative firm failure processes within a country. Moreover, this finding is in line with evidence from the wider firm failure literature which supports the argument that gender diversity on the board can influence firms' failure or even performance (Adams and Ferreira, 2009). Given that gender diversity is an important characteristic of the alternative firm failure processes and given the evidence from the wider failure literature that diversity affects firms' failure, one can infer that gender diversity can also be an additional indicator of management's experience and expertise that the qualitative firm failure literature has used as an identification characteristic for failure processes (Argenti, 1976; Argenti, 1976b). The same can be inferred from the other directors' characteristics, namely the total number of directors as a proxy for the social capital and networks that directors bring to a firm and for the average age of directors as a proxy for directors' experience. Collectively, Argenti (1976; 1976b) argued that management's lack of understanding and experience characterize certain firm failures and lead to bad financial management. In other words, the management of the firm is the most important aspect of a firm's failure, especially in SMEs (Ropega, 2011). Such an argument is in line with the findings reported here. Different firm failure processes are associated with differences in directors' characteristics and as such the inclusion of them in the quantitative firm failure literature provides further differentiate characteristics and additional insight in the failure processes.

The rest of the analysis results can be linked to the broad classification of the failure processes that found in the qualitative literature. The literature proposes a number of characteristics that are associated with alternative firm failure processes in qualitative and quantitative studies. For example, the relatively new firm that never becomes successful and fails; the failure process of an ambitious growth company; the failure process of a dazzled growth company and fourth is the failure process of the established apathetic company (Ooghe and De Prijcker, 2008; Argenti 1976).

The four firm failure processes that the full analysis (with directors) identified in this chapter are consistent with evidence from the qualitative firm failure process literature (Ooghe and De Prijcker, 2008). In addition, a link between the existing qualitative firm failure processes literature is created. As such the findings of this study extend the reach of the quantitative firm failure process literature at the intra-country regional level.

The first firm failure process has deteriorating growth, a relatively small board (compared to other failure processes) and high trade credit usage. This firm failure is associated with the third firm failure process that Argenti (1976) identified where a firm has had some strong years before its performance start deteriorating and eventually fail. Given the small management board, it is possible that the entrepreneur has excessive influence in the firm's decision making to an extent that this excessive influence creates management problems for the firm (Ropega, 2011).

On the other hand, the second firm failure process is associated with firms that have financial management efficiency problems and in particular an inability to generate cash from their sales. Argenti (1976) argues that deficient management is a key characteristic and that could be relevant for firms in this firm failure process. This will be discussed further in the next section which addresses the determinants of firms' failure. However, the combination of that and the "apathetic" (Ooghe and De Prijcker, 2008) or acute failure firms firm that Laitinen (1991) identified in a quantitative firm failure process study resembles the firms in this process. As such these firms have the ability to generate sales but for some reasons, potentially related to the management, they are not able to convert their sales to cash and as such they have relatively weak working capital and liquidity.

The third firm failure process is characterized by the oldest firms in the sample that have a deteriorating ability to generate cash flows from their sales. This description resembles the old firm with a deteriorating performance (Argenti, 1976). However the firms in this failure process do enjoy high and accelerating growth rates in the years prior to failure. Such behavior resembles the "dazzling growth" firm (Argenti, 1976) too.

Finally, the fourth firm failure process is characterized by younger firms with weak finances. This firm failure process can be associated with the new firm that never succeeded from Argenti (1976) or the "Tadpole" firm from Richardson et al., (1994). These firms began as promising start-ups but did not manage to be converted to long term enterprises. SMEs of up to 10 years old are generally defined as new (Wagner, 2004; Davidsson and Klofsten, 2003). Such firms are generally more prone to failure due to an inverse relationship between a firm's age and failure propensity (Dunne et al., 1988) particularly after their first two years of existence which is often described as a "honeymoon period" (Wilson et al., 2014). Likewise, most new firms tend to be small and that has adverse consequences with regards to their failure propensity (Love, 1996).

One can therefore conclude that the key characteristics of the alternative firm failure processes identified in the UK regions are broadly in line with other parts of the literature, mainly in qualitative studies. Furthermore, it can also be concluded that directors' characteristics allow for broader comparisons with the qualitative failure process literature. The results of the UK firms are not only comparable with the existing academic literature (that doesn't include directors' characteristics in quantitative firm failure process studies) but also with evidence from the previous chapter, that considered firm failure processes in a sample of EU countries. Table 6.24 summarizes the comparison between the findings in these two empirical chapters.

Table 6.24: Comparison of clusters in UK firms and all EU firms in the study.

	No Directors		Directors	
Firm Failure Process	EU	UK-only	EU	UK-only
First	Young firms (8 years old) Negative Growth Good liquidity and Working Capital	Young firms (7 years old) Low ROI High Growth rate (years:4-7) Weak cash generation Rapidly deteriorating liquidity	Young firms (8 years old) 3 female directors 14 direcotrs with av. Age of 49 Negative ROI High sales deteriorating cash generation Increasing liablities	Medium age firms (12 years old) One female Director 10 Directors with av. Age of 51 High usage of Trade credit
Second	Older firms (18 years old) Negative ROI and growth Low sales generation Weak liquidity and Working Capital Increasing indebtedness	Older firms (17 years old) Negative growth rates Sales generation ability but bad conversion to cash Good/stable liquidity	Older firms (20 years old) No Female Directors 5 Directors with av. Age of 48 Negative growth Reducing Trade Credit	Medium age firms (11 years old) 2 Female Directors 11 Directors with av. Age of 51 Good Sales Generation Weak conversion to cash
Third	Older firms (18 years old) Negative growth Good Sales generation Weak Cash generation High Trade Credit usage	Medium age firms (14 years old) High cash generating ability Limited Trade Credit usage Negative Growth Relatively strong Working Capital	Medium age firms (11 years old) No Female Directors 3 Directors owith av. Age of 48. Deteriorating sales Liquidity problems	Medium age firms (15 years old) 2 Female Directors 13 Directors owith av. Age of 51. Deteriorating ROI and cash generation Limited Trade Credit usage High growth recent years
Fourth	Medium aged firms (10 years old) Negative growth Deteriorating cash generation ability Increasing liabilities with limited Trade Credit Good liquidity	Medium aged firms (13 years old) Volatile growth Deteriorating cash generation ability	Younger firms (9 years old) 2 female directors 10 Directors with av. Age of 47 High Debt Weak cash generation Weak liquidity, growth and ROI	Younger firms (9 years old) 2 female directors 10 Directors with av. Age of 47 High Debt Weak cash generation Weak liquidity and ROI Rapid growth turns negative

6.7.2 Discussion on Firms' Transition to Failure

This section discusses the results of the panel regressions that considered the determinants of firms' transition to failure for all the UK firms and for each firm failure process. Since there is no evidence in the quantitative literature of firms' failure processes on the determinants of firms' transition to failure, the discussion is based on evidence from the wider firm failure literature.

i. Financial ratios

Financial ratios, the basic dimensions of firms' liquidity, profitability, working capital and leverage (Berk and DeMarzo, 2011) are important contributors to the firm failure processes in UK firms. However, as discussed in earlier sections, financial ratios as determinants of transition to failure and their combinations differ between the alternative firm failure processes. This highlights two points. First, is the importance of having separate firm failure processes and not treating all firms that fail in the same way. In this context the fundamental rationale of identifying the alternative firm failure processes is significant. This has been a fundamental motivator behind the firm failure process studies which argued that the different characteristics of firms should be considered carefully as different firm failure processes have different underlying reasons that drive the failure (Argenti, 1976; Argenti, 1976b; Ooghe and De Prijcker, 2008; Richardson et al., 1994).

Second, the differences of the financial ratios as determinants of transition to liquidation supports evidence from the wider firm failure literature that has not managed historically to identify a specific combination of financial ratios that can be used universally to identify or to predict firms' failure (Balcaen and Ooghe, 2006). In fact, the results of this study support the argument of Argenti (1976) on the necessity of identifying firm failure processes offering a possible explanation for why there cannot be consistency in the financial ratios as predictors of failure. The ratios have always been regarded as symptoms of failure (Argenti, 1976). However, different firm failure processes have different causes of failure that predate the failure event for a number of years. As such the financial symptoms are also different.

In terms of the individual financial ratios, one can observe that ROI, NSTA and CFTS, representing the firms' return on investment, the ability to generate sales from the total assets and the firms' ability to generate cash from their total sales have been key differentiators between the firm failure processes in the UK firms. Low or deteriorating ROI is a key characteristic of the third and fourth firm failure process. NSTA and CFTS make an interesting combination as some failure processes are characterized from firms that have the ability to generate sales but not sufficient cash while other processes have simply deteriorating cash generation with low/stable sales as a percentage of their total assets. ROI is also significant determinant for the firms' transition to failure in all but the third failure processes, in line with evidence from the wider firm failure literature (see for example Ciampi and Gordini, 2013; Pindado and Rodrigues, 2004) which identified these ratios as significant determinants of failure in SMEs in wider firm failure studies. NSTA has been another significant determinant of firms' transition to failure in some of the firm failure processes (second) especially where firms are generally having a strong creation of sales compared to their total assets. Therefore, one can conclude that once firms experience a deterioration in their NSTA, they are likely to failure. This is in line with previous findings in the firm failure process context and the wider firm failure area (Altman, 1968; Laitinen, 1991). An additional characteristic of some firm failure processes has been the poor conversion of their sales activity to cash. As such, CFTS has been also a significant determinant of firms' transition to failure in some failure processes (first and third), in line with observations for the firm failure literature (see for example Beaver 1966; Laitinen et al., 2014). This finding can also be further supported from the qualitative firm failure literature. Argenti (1976) pointed out that poor financial management skills can cause failure due to lack of funds. Therefore, cash flow generation from sales (CFTS) would be a prime financial symptom in such occasions.

As far as issues relating to liquidity (quick ratio), leverage (TLTA), working capital (QACA) and the usage of trade credit as an alternative source of finance (TCTL) is concerned, one can observe that deteriorating liquidity, over indebtedness, reduced working capital and reduced access on (trade) credit are determinants of firms' transition to failure in the alternative failure processes. The financial management characteristics that these financial ratios are capturing have been used in a number of firm failure studies as significant determinants of failure (eg.

Altman et al., 2010; Bastos and Pindado, 2013). Liquidity and firm financing constraints is indeed an issue in SME failure in general (Laitinen et al., 2014; Ooghe and De Prijcker 2006; Ropega, 2011) and more so for young firms that have limited access to financial resources (Beck and Demirguc-Kunt, 2006). High leverage (TLTA) characterizes particularly the fourth firm failure process in UK firms and, whilst it is not a significant determinant for firms' transition towards failure in all the UK firms sample (before considering the failure processes), it does drive firms towards failure in a number of the firm failure processes (first, second and fourth). This implies that over-indebtedness is a determinant of the transition to failure. This is in line with evidence from the qualitative firm failure process literature (Argenti, 1976) but also from wider firm failure studies (Altman et al, 2010; Deakin, 1972; Shumway, 2001; Appiah, 2013).

In addition, working capital (QACA) and the usage of trade credit as a percentage of the total liabilities (TCTL) play a part the first and third firm failure processes. Weak working capital (QACA) has also been a determinant of firms' transition towards failure in a number of firm failure processes for the UK firms (all except the second failure process with directors' characteristics) with the expected negative coefficient as the wider firm failure literature has suggested (Altman et al., 2010). The usage of trade credit on the other hand, affects the same firm failure processes with QACA but in different ways. Some firm failure processes are characterized by increased usage of trade credit compared to their total liabilities while others are the opposite. This implies that financially distressed small companies have higher levels of trade credit obtained from suppliers which is regarded as an alternative source of finance (Altman et al., 2010). Therefore SMEs may substitute bank credit with trade credit where possible, taking advantage of the fact that an individual supplier may be unaware of the total amount of trade credit that the company has received from other suppliers (Altman et al., 2010). Considering the above, one would expect TCTL to have a positive coefficient. Financially distressed firms would be unable to borrow from banks, especially since part of the period that this study covers is during the 2008 financial crisis, and they would utilize trade credit (Bastos and Pindado, 2013; McGuinness and Hogan, 2016). However the results give a negative coefficient for all firm failure processes where TCTL is significant (first and fourth failure processes). A possible explanation is that the evidence from the literature considers studies where the independent variables, the TCTL in this case, are used to discriminate between failed and non-failed firms. This dataset, however covers firms that all eventually fail and the question is whether TCTL keeps increasing in the transition toward liquidation. The answer to this appears to be that Trade Credit as a percentage of the firms' total liabilities is decreasing in the transition towards liquidation. It is therefore possible that trade creditors (who traditionally have close trading relationships with their debtors) at some point are becoming aware of the financial hardship of the firms and are starting to decrease their credit exposure (Petersen and Rajan, 1997). This is perhaps more pronounced in the first firm failure process of UK firms where Trade Credit usage is high (compared to the other processes) yet in the panel regression results of the determinants of firms' transition to failure, the TCTL returns as highly significant and with negative coefficient. Table 6.25 shows the mean TCTL for all UK firms and their clusters 3 years prior to liquidation, showing that there is a declining trend in the trade credit usage.

Table 6.25: TCTL in UK firms and their failure processes in the years prior to liquidation.

	Firm Failure processes with Directors' Characteristics				
Years to liquidation	ALL	First	Second	Third	Fourth
0 (liquidation year)	0.16	0.16	0.26	0.10	0.08
1	0.21	0.31	0.46	0.11	0.10
2	0.22	0.31	0.22	0.13	0.10
3	0.24	0.32	0.28	0.13	0.08

Growth rates in the total assets (growth_rate) ratio have been used in firm failure process formation as well as in the regressions for the determinants of firms' transition to failure. The growth rate has been identified as a characteristic of alternative firm failure processes in quantitative firm failure process studies (Laitinen et al., 2014). The reason for this is an over-commitment from the firms to ambitious growth plans that lead to committing financial resources to expensive projects (Argenti, 1976b). In addition, the Sustainable Growth dummy variable (SGR) indicates whether firms exceeded their sustainable levels of (sales) growth as defined by Higgins (1977 and Platt et. al, 1995). Previous literature on firm failure processes suggests that high growth rates are associated with a separate firm failure process (Argenti, 1976b). In addition, overtrading on sales has also been linked to firm failure (Argenti 1976b, Higgins, 1977). This is due to firms focusing on generating substantial turnover increases without having the ability to sustain them organically in the long term and without having the infrastructure to provide the necessary support for their products. However, there has been no evidence of its impact on firms' transition to failure, especially in the context of alternative firm failure processes. The third firm failure process had elevated growth rates (in total assets) in the years prior to failure. The second, third and fourth firm failure processes had growth rates (of total assets) as significant determinants of transition to failure, similar to that Argenti (1976) had identified in his qualitative study. Increasing growth has been a determinant of firms' transition towards failure with positive sign in most processes. At the same time the SGR dummy variable is a highly significant variable in the all UK firms sample and in the first and third firm failure processes, with the expected positive coefficient implying that the firms with unsustainably high levels of growth are positively associated with worsening failure conditions, consistent with Higgins (1977; 1981). As such, one can conclude that excessive sales growth is an additional determinant of firms' transition to failure in a number of firm failure processes and therefore, the concept of overtrading and unsustainable growth (Higgins, 1977; Argenti, 1976; Argenti, 1976b; Platt and Platt, 1995) is relevant in firm failure process studies.

ii. Age

The regression results for the firms' age show that the age of the firm has been a significant determinant of firms' transition to failure in two of the firm failure processes, the first and the second (with the expected negative coefficient). The fourth failure process in particular presents and interesting example of a process that is characterized by young firms but with (firm) age itself not been a determinant of the transition towards liquidation. As such one can conclude that whilst evidence from the qualitative firm failure process literature that firms with young age can form a separate firm failure process (Argenti, 1976; Richardson et al., 1994), the age of the firm is a significant determinant of firms' transition to failure only in some of the firm failure processes. Nevertheless, in the full UK firms sample as well as in the first and second firm failure processes where the age of the firm is a significant determinant of firms' transition to failure, the results suggest that the younger age of firms is associated with increased propensity towards failure. This is consistent with evidence from the wider firm failure literature where young firms are more prone to fail due to them not achieving sustainable financial returns and market presence in the first few years of their operation (Cressy, 2006; Azoulay and Shane, 2001; Cromie, 1991). As the probability of failure is larger in new firms, the age distribution of firms' population becomes an important determinant of failure with an impact in regions with a high percentage of new firms. As such regions that have high new business growth may have a higher percentage of exits or VAT de-registrations as well (Lane and Schary, 1991; Keeble and Walker, 1994).

iii. Economic and Business environment

In terms of the economic and business environment conditions, evidence from the panel regressions suggest that as indicated from the literature on the effect of new business in an area (see for example Lane and Schary, 1991; Keeble and Walker, 1994), the percentage of new business in a region (as a proportion of the existing ones) is a highly significant determinant of firms' transition towards failure in all firm failure processes (with directors) as well as in the full UK sample. Therefore, the effects generated by intensifying competition are a significant determinant of transition to failure for most UK firms, regardless of the firm failure process they belong to.

On the other hand, GDP growth is a significant determinant of all firms' transition towards failure. Looking into the processes with directors characteristics GDP growth is (at Sig. <0.10) significant in the third and fourth processes and has the expected sign. As discussed in the previous section, a more localized metric of macroeconomic growth was tested in the form of GVA growth at regions. This was found to be a significant variable with the expected signs in most firm failure processes with two exceptions. First, the second process with directors' characteristics; second, the fourth firm failure process without directors' characteristics. In these processes GVA growth was not significant. The relative superiority of GVA (in terms of its significance in more firm failure processes) may be linked to Lane and Schary (1991) who demonstrated in a study of US firms that business failures are more affected by local as opposed to national economic conditions. Nevertheless, using either GDP growth or GVA growth as a proxy for the wider economic conditions in a country, the findings of this study demonstrate that the economic conditions are significant determinants of all firms' transition to failure. On the other hand, the significance of the economic conditions does vary between the alternative firm failure processes depending on the granularity of the proxy that is used (in this case the country-level GDP growth or the region-level GVA growth). Such results confirm evidence from the qualitative firm failure process literature which suggested that economic conditions may lead firms to failure. However, effects may vary in alternative firm failure processes as firm-specific characteristics, (which also determine the classification of firm failure process) may exacerbate or reduce the impact of external factors in firms' propensity to fail (Argenti, 1976).

Considering credit availability (as a percentage of GDP growth) as a determinant of firms' transition to failure, the results suggest that it is a significant determinant in the full sample of UK firms as well as in all firm failure processes (with directors). The metric has a negative coefficient implying that (in line with expectations arising from the literature) that reduced credit availability could lead firms to fail (Ma and Lin, 2010). This applies in all the processes with the exception of the second failure process for the reasons discussed in the previous section and which were related with the deterioration of the GDP in 2009-2010. However, even in that situation the underlying results still imply that a reduction in credit is associated with an increased propensity for firms to transition failure. This is in line with evidence from the literature that states that a reduction in credit availability can lead small firms to financial distress and eventually failure (Acosta-González et al., 2017; Kelly et al., 2015).

iv. Directors' characteristics

Two of the most significant contributions of this study is the use of directors' characteristics in identifying firm failure processes in a quantitative firm failure process study and the consideration of the directors' characteristics as determinants of firms' transition to failure in these firm failure processes. Directors' characteristics have been identified as key drivers of firm failure in the academic literature in both firm failure process studies as well as in the wider firm failure literature. In the qualitative firm failure process studies, Ooghe and DePrijcker (2008) argued that managerial inexperience was a key driver of management errors and problems in all failure processes and especially in the firm failure process that involves the failure of new firms. In the wider firm failure literature, the number of directors that a firm has been usually used as a proxy for the management's ability to direct and to control effectively the firm (Bennett and Robson, 2004; Daily et al., 2002). Zahra et al., (2009) suggested that director experience in new SMEs are particularly important since they develop and provide human and social capital in the early stages of the business development.

The usage of directors' characteristics in the clustering method enables the factor/cluster analysis to capture further latent characteristics from the firms and therefore the firm failure processes that result from this procedure are quite different. Lack of experience and contacts in directors may be determinants of firm failure. Additionally, older directors can bring greater stability to the board and can preserve founding values (Anderson et al, 2011), something observed in the third and fourth firm failure processes (with directors) when using the *average directors' age* variable.

In the firm failure processes that include directors' characteristics, one can observe that the total number of directors was an additional significant determinant of firms' transition towards liquidation only in the third firm failure process. More directors generally bring more social contacts and experience on the board which are important determinants of small firms' performance (Cope et al., 2007). However, in the case of the third firm failure process, the opposite appears to be suggested by the regression results. Other studies support this finding. Arosa et al., (2013) provided evidence that overly large boards can be counter-productive in SMEs because of poor coordination, limited flexibility and communication in such structures. Indeed, the third firm failure process has one of the highest average number of directors in any firm failure process and is a process which is otherwise characterized from relatively mature firms with weak financials. In these circumstances it is possible that a polyphony in the management may be problematic. The results support prior studies (De Andrés et al., 2005; Eisenberg et al., 1998; Yermack, 1996) and confirm that small boards of directors are more effective. Nevertheless, the results contrast with the earlier work of García-Olalla and García-Ramos (2010), Nicholson and Kiel (2007) and Van den Berghe and Levrau (2004) who find that increasing the number of directors improve firm performance.

A further determinant of firm failure has been the heterogeneity in the board of directors. This heterogeneity has been frequently expressed by the presence of gender heterogeneity and therefore by the presence of female directors. Management groups with gender diversity have been considered as more able in problem solving (Jehn et al. 1999). It has been shown that the presence of women on the board of directors is associated with reduced risk of insolvency (Adams and Ferreira, 2009; Wilson et al., 2013). In firm failure clusters with directors characteristics two of the failure processes (first and third) have the number of female directors as a negative and significant determinant in the transition towards failure. This means that increased gender diversity in the board is associated with decreased propensity to transition to failure.

Given the focus of this chapter on firms in the UK regions, one observes that not all regions are significant determinants of firms' transition to failure. The significance of UK regions as determinants of failure is partly associated with London being the reference variable. As such the significance of the regions as a determinant of firms' transition to failure should be compared with London. A number of reasons can be associated with the difference in the regions as determinants of firms' transition to failure in the alternative firm failure processes. First, credit availability and banks proximity to firms in a given area have been identified as one such determinant in the UK regions, especially during and after the financial crisis (Degryse et al., 2018). Second, the UK has been associated with discrepancy in its regions' economic performance and governance (McCann, 2016). However, further unobserved factors, associated with firms' spatial location, may also contribute to firms' transition to failure. This is discussed in chapter 7.

6.8 Conclusion and Chapter Summary

This chapter is has three objectives. First, to investigate the alternative firm failure processes in UK regions by considering financial ratios and the age of the firm . Second, to investigate the impact of firms' management characteristics in the identification of failure processes and their transition to failure between firms in the UK regions. Third, to investigate the influence of business environment factors, management characteristics and excessive growth in firms' transition to failure in the alternative failure processes in the UK regions.

The results show that there are 4 different failure processes for UK SMEs. When directors' characteristics are used to determine the failure processes, these differ between regions (at Sig. <0.10). These processes are affected by directors' characteristics but there is no standalone failure process that is solely defined by the directors' characteristics. Instead, different directors' characteristics are associated with each of the alternative firm failure processes. Moreover, the financial ratios and the age of the firm differ between the alternative firm failure processes. That is in line with evidence from the quantitative and qualitative firm failure process literature (Argenti, 1976, Laitinen, 1991, Laitinen et al., 2014). In addition, evidence for the UK firms confirms the evidence from the EU firms (chapter 5) and shows that whilst non firm-specific characteristics were not used in the identification of the alternative firm failure processed, they did differ between them. This implies that the alternative firm failure processes include firms whose business and economic environments differ. Such evidence was implied in the qualitative firm failure process literature (see for example Argenti, 1976) but there has been little such evidence in the quantitative failure process literature. On the other hand, firms' transition to failure depends on the firm failure process they belong to. Financial ratios, directors' characteristics, the economic and business environment can also be determinants of firms' transition to failure but they generally differ between the alternative firm failure processes. As such, even at an intra-country or regional level, the identification of the alternative firm failure process to which a firm belongs is important in order to understand the determinants of failure. In addition to the above, the location of the firm (certain regions) appeared to be significant determinants of firms' transition to failure in some firm failure processes. One could argue that this is down to the economic and business environment conditions in these regions as well as due to the agglomeration of economic activity in certain UK regions (including London) (Henderson, 1997). Chapter 7 investigates the importance of spatial location in more detail.

CHAPTER 7: SPATIAL ANALYSIS OF EU AND UK SMEs' TRANSITION TO FAILURE

7.1 Introduction

One of the objectives of this research is to investigate the influence of location at firm level and aggregate firm transitions towards failure in the alternative failure processes between EU countries and within the UK. To that end, Chapters 5 and 6 investigated the influence of location at firm-level, and controlled for it by means of dummy variables. This chapter extends the investigation on the importance of geographical (spatial) location and considers aggregate firm transitions to financial distress and to liquidation, separately. Therefore, the aggregated number of firms in financial distress is calculated first for each firm failure process and for all the processes collectively. Subsequently, the aggregated number of firms in liquidation is calculated for each firm failure process and for all the processes collectively. In that way, one can asses the importance of spatial location for the two stages of firms' failure, separately. In doing so, this chapter applies spatial data analysis, for first time in the quantitative firm failure process literature, and tests the hypotheses introduced in chapter 3.

Wang et al. (2012) argued that spatial data are particularly relevant for economic-related studies, especially when considering different geographical locations. In an increasingly inter-connected economy the cross-sectional independence assumption between a sample's observations (eg. firms) is becoming difficult to identify (Wang et al., 2012). For SMEs this argument may be stronger as they tend to do much of their business relatively locally and the experience in related geographic markets may affect not only the probability of exit from the market but also the mode of exit (including failure) (Dunee et al., 2005). Therefore, any spatial interactions may be due to competition between firms in given geographies, network issues, spill-overs, externalities, and regional issues (Kapoor et al., 2007). Likewise, Longhi et al., (2014) provided evidence that regional specialization is emerging in Europe pointing also that there are spatial patterns of agglomeration of the economic activity. In particular, some metropolitan areas appear to be more specialized in financial services while others appear to be more specialized in "other services". It is worth noting that in the sense of Longhi et al (2014) the term “regional” was used to denote areas in Europe constituted of countries or even larger geographical parts of Europe. For the purpose of this chapter, spatial effects will be tested against the European countries in an inter-country comparison and also within the UK countries/regions. Therefore there are two hypotheses to be tested in this chapter (as introduced in chapter 3):

- *Hypothesis 13a: There are statistically significant spatial effects associated with EU firm failures.*
- *Hypothesis 13b: Spatial effects are the same between alternative firm failure processes in EU firms, in terms of statistical significance.*

- *Hypothesis 14a: There are statistically significant spatial effects associated with the UK firm failures.*
- *Hypothesis 14b: Spatial effects are the same between alternative firm failure processes in UK firms, in terms of statistical significance.*

In previous empirical chapters, the research question(s) of whether there is any association between the firm failure processes and the countries and regions has been assessed by means of statistical significance, using firm-level information, information for the economic and business environment and dummy variables for the EU countries or the UK regions. The results of the previous empirical chapters indicated that there is a statistically significant difference in firm failure processes across EU countries. In these countries, the non-firm-specific characteristics (related to the countries’ business and economic environment) provided evidence of wider differences between the alternative firm failure processes.

On the other hand, in relation to UK geographical regions and whether firm failure processes differ between regions, the evidence is somewhat different. In that context, firm failure processes do differ significantly between regions when directors’ characteristics are used to determine the failure processes. In such cases, differences between regions are significant at the 10% level. As a result, in the firms’ transition to failure, the dummy variables controlling for the firms’ region were rarely significant determinants whilst the dummy variables controlling for the firms’ countries were more frequently significant determinants of the transition to failure in the alternative firm failure processes. Moreover, findings in previous chapters indicated that a number of EU country-specific characteristics (legal tradition and economic environment) and UK region specific characteristics (economic environment and percentage of new firms in a region) are significant determinants of the transition towards failure in most firm failure processes.

This chapter approaches the theme of firm failure process and particularly the transition towards liquidation from a different angle; it aims to test whether there is association between aggregated firm failures (financial distress and liquidations, separately) and their geography. In other words, this chapter investigates the effect of spatial (geographical) proximity on the alternative firm failure processes for a sample of EU countries and UK regions. As a result, the contribution of this chapter to the wider thesis is both from a purely technical perspective, that of introducing spatial econometrics in firm failure studies, and also conceptual, that of understanding the importance of geographical location as a potential determinant of the two stages of firm failure (financial distress and liquidation, separately) in alternative firm failure processes.

The theoretical advantage of spatial panel data is that this specification considers disturbances that are correlated spatially (across European countries and UK countries/regions in this case) in addition to the normal time wise correlation (Arnold and Wied, 2014). The usage of spatial econometric techniques has seen growing interest within economic studies because these models take a different angle in the analysis of relationships between agents. In fact, the focus is shifted from the individual agent (in this case the firm) where decisions are made in isolation to an approach where the interaction between agents matters (Anselin, 1999; Diggle, 2013). At present there is no evidence of the application of spatial analysis to the area of firm failure process analysis.

Using the same sample of SMEs, countries and regions, the attention will now switch to the geography (EU countries and UK regions) as opposed to the individual firms. To do so, this chapter emphasizes the spatial, as opposed to the firm-specific effects in previous chapters. The economic and business environment factors are still controlled variables. Investigating the importance of location has been one of the objectives of this study. The use of spatial data is one way to do so by focusing on the location of the firms. As a result, one can better understand the importance of geographical location and geographical proximity to the firms' failure and more specifically to the transition towards failure that the alternative firm failure processes have. The potential existence of spatial effects at country or regional level would imply that firms' financial distress and liquidation (both stages of failure) are determined from a further non-observable non-firm specific influential element: the geographical location and, in particular, the geographical proximity. Geographical proximity could therefore be an influential determinant of firms' failure. The results of this analysis suggest that there is evidence of spatial effects both at both EU country and UK region levels.

The rest of the chapter is structured as follows. Section 7.2 describes the methodological tools and assumptions for the spatial analysis; Section 7.3 contains the analysis of the spatial effects in the firm failure processes of the EU countries in the sample. Section 7.4 presents the analysis for the spatial effects in the firm failure processes within the UK countries and regions; Section 7.5 explains the limitations and the robustness test results; Section 7.6 discusses the results; Section 7.7 concludes the chapter.

7.2 Methodological Tools and Data

7.2.1 Data Structure and Definition of Variables

Testing for spatial effects at country and regional level requires a reorganized dataset. In this chapter, the focus shifts from the individual firms towards the countries and the regions. The new data structure for this chapter aggregates the firms at EU country and at UK regional level. For the EU country analysis, the data in this chapter is based on the initial sample of 5,195 firms. In this case, there are 8 EU countries in the sample observed every year from 2004-2013, which gives a balanced panel of 80 country-year observations.

For the UK regional analysis, the data in this chapter are based on the 979 firms that were used in Chapter 6. The 12 regions of the UK are observed each year from 2004 and to 2013, therefore producing a balanced panel of 120 UK region-year observations.

The total number of firms in financial distress and the total number of firms in liquidation are aggregated to create the number of firms that enter financial distress or enter liquidation each year for each country or region. In addition to the total aggregation at country or region per year, a further aggregation subset takes place for each firm failure process. That is, for each country or region, for each year, the total number of firms, the total number of firms in financial distress and the total number of firms into liquidation are calculated for each of the firm failure processes (as they are developed in chapters 5 & 6). This chapter uses the firm failure processes with directors' characteristics both for the EU countries and for the UK regions' analysis. This is because utilizing the directors' characteristics creates a more complete profile of the firm-specific characteristics in the failure process formation. In addition, the results without directors' characteristics are reported in the appendix (Tables C.1-C.14).

The analysis in this chapter looks at the potential impact of spatial effects both for firms in financial distress (event_failure=1) and for firms in liquidation (event_failure=2). First, to investigate the potential influence of spatial weights on firms' financial distress in EU countries and in UK regions, the dependent variable is the number of firms in financial distress (event_failure=1) in a given year for each EU country (EU countries' level of analysis) or for each UK region (UK regions' level of analysis). An additional dimension that aggregates the number of firms in financial distress and liquidation for each EU country/UK region and for each firm failure process also takes place. Second, the dependent variable that is used to investigate the potential influence of spatial weights on firms' liquidation, is the number of firms in liquidation (event_failure=2) for each country (or UK region) per year and additionally in each firm failure process. This data structure gives the opportunity to use linear regression techniques, as opposed to ordered logit structures that have been used previously. Additionally, this econometric approach where the EU country or the UK region is the unit of reference, gives the opportunity to account for the unobserved heterogeneity on the EU countries and UK regions, as opposed to the individual firms in the previous chapters. Therefore, this chapter is established based on the developments of the previous chapters, while approaching the topic of location from a different perspective. Although the same firm failure processes are utilized and the same macroeconomic and business environment information is used, this chapter uses a different approach by utilizing an alternative methodology for the first time in a firm failure process context. Instead of looking at the firm, it looks at the location, be it a country (EU) or a region (UK).

The independent variables that are of interest in this chapter are the spatial weights associated with the dependent variable (W dependent variable) and the spatial weights associated with the error terms (W error term). Details about the spatial weights are given in section 7.2.2. In addition, a number of control variables are also used as independent variables, in order to control for the effects of the economic and business environment.

For the part of the analysis that focuses on the EU countries, the control variables are the GDP growth and the credit availability as a percentage of the GDP of a country. Additionally the legal tradition (Leg_trad) dummy variable takes the value of 1 for countries associated to common law and 0 for countries associated to legal traditions of civil law tradition (French, Scandinavian or German law).

For the part of the analysis that focuses on the UK regions, the control variables are the regional GVA growth (the GDP growth is also tested in section 7.5), the credit availability as a percentage of the GDP of a country and the percentage of new firms' formation (New_Firms_perc.) in a region (per year). Table 7.1 summarizes the independent variables that are used in this chapter.

Table 7.1: List of Independent Variables.

	Variable Symbol	Variable meaning	Usage
Main Variables	W_Dpd	Spatial effects (weights) applied on the dependent variable	EU Countries & UK Regions
	W_error	Spatial effects (weights) applied on the dependent variable	EU Countries & UK Regions
Control Variables	GDP_gr	GDP_growth for each country per year	EU Countries & UK Regions
	GVA_gr	GDP_growth for each region per year	UK Regions
	Credit	Credit availability as a % of GDP	EU Countries & UK Regions
	Leg_Trad	Dummy variable=1 for common law countries; 0 otherwise	EU Countries
	New_Firms_perc	Percentage of new firms in a region (% of total firms)	UK Regions

The use of the same independent control variables as in Chapters 5 and 6 is down to consistency reasons as well as the availability of the particular data. These independent variables have been used in other studies (see for example Jones, 2013) and have been identified as potential determinants of firms' failure. It is possible that additional control variables can be determinants of firms' failure at EU and UK basis in aggregated studies. GDP growth (GDP_gr), the credit availability (Credit), the new firms' formation (used in the UK regions part) and the legal origins (Leg_trad) have been identified (together or separately) as key determinants of firm liquidations (including corporates and SMEs) in a number of aggregate firms and firm-specific failure studies, at country level (see for example Jones, 2013; Liu, 2004; Berger and Udell, 2006; Wehinger, 2014; LaPorta et al., 2008). In any case, the focus of this chapter is on the two independent variables that are concerning the spatial weights and are included in the analysis of this chapter.

As mentioned above, the data structure has been amended in order to match the requirements of this chapter. Table 7.2 shows the distribution of firms entering financial distress and liquidation, respectively, each year for all the EU countries in the sample. The tables demonstrate that the percentage of firms in financial distress peaks in 2009 and then it reduces. At the same time the number of firms in liquidation starts increasing and peaks in 2012. The distribution of firms in financial distress in Table 7.2 shows relatively small differences in the timing of the peak of financial distress rates in the alternative firm failure processes. The first and second firm failure process financial distress rates peaked in 2008. The third and the fourth firm failure process peak in year 2009. The differences in timing can reflect the distribution of firms in the alternative countries (and their associated economic environments). The first firm failure process is characterized by a majority of Irish and UK firms; the second by a majority of French and Italian firms. On the other hand, the third firm failure process is dominated by German, Spanish and Swedish firms and the fourth by Dutch firms. The timing of the peak in firms' liquidations is more consistent across the alternative firm failure processes. The peak of liquidation rates in all firm failure processes is during 2012.

Table 7.2: Percentage of EU Firms in Financial Distress (left) and Liquidation (right): Total and by Firm Failure Process

Firms in all countries: % in Financial Distress per year					
Year	All firms	1st Process	2nd Process	3rd Process	4th Process
2004	7.80%	5.03%	8.16%	9.87%	7.32%
2005	8.17%	6.23%	8.74%	9.69%	7.93%
2006	8.93%	8.74%	10.72%	11.80%	7.88%
2007	10.63%	13.19%	11.21%	15.80%	9.43%
2008	13.01%	13.45%	11.62%	18.74%	11.99%
2009	14.18%	12.64%	10.83%	19.07%	15.11%
2010	9.13%	12.91%	6.28%	14.04%	8.91%
2011	6.74%	7.89%	4.70%	10.22%	6.49%
2012	1.14%	1.23%	0.80%	3.09%	1.32%
2013	0.00%	0.00%	0.00%	0.00%	0.00%

Firms in all countries: % in liquidaiton per year					
Year	All firms	1st Process	2nd Process	3rd Process	4th Process
2004	0.05%	0.18%	0.00%	0.08%	0.10%
2005	0.09%	0.17%	0.03%	0.08%	0.09%
2006	0.08%	0.17%	0.02%	0.07%	0.09%
2007	0.10%	0.18%	0.02%	0.11%	0.09%
2008	1.17%	1.77%	1.30%	0.44%	1.01%
2009	10.22%	7.91%	8.81%	12.31%	9.94%
2010	37.67%	31.52%	34.13%	42.18%	38.31%
2011	63.23%	64.24%	62.31%	66.41%	65.44%
2012	93.54%	80.54%	94.23%	93.06%	94.23%
2013	75.00%	50.00%	62.50%	75.00%	50.00%

Similarly, Table 7.3 shows the distribution of firms entering financial distress and liquidation, respectively, each year for all the UK regions in the sample. The table demonstrates that the percentage of firms in financial distress peaks in 2010 and then it reduces. The percentage of firms in financial distress peak in 2012 for the first firm failure process that is a collection of a majority of London, Yorkshire and Midlands' firms. The percentage of firms in financial distress for the second firm failure process peaks in 2010. That process is not dominated by any particular region but London and North West do have significant concentrations there. The financial distress rates for the third firm failure process peak in 2011 and for the fourth in 2008. The third firm failure process is dominated by N. Irish, Scottish and Welsh firms whilst the fourth failure process is not dominated by any region specifically but it is the process characterized by new firms. These appear to get into financial distress first, in this case. At the same time the percentage of UK firms in Liquidation starts increasing and peaks in 2013 for all firm failure processes, apart from the fourth failure process.

Table 7.3: Percentage of UK Firms in Financial Distress (left) and Liquidation (right): Total and by Firm Failure Process

Firms in UK Regions: % in Financial Distress per year					
Year	All firms	1st Process	2nd Process	3rd Process	4th Process
2004	11.78%	4.01%	7.92%	7.54%	66.17%
2005	12.13%	6.37%	7.20%	6.55%	78.34%
2006	11.81%	5.40%	10.43%	7.87%	66.34%
2007	11.38%	7.57%	7.49%	16.79%	43.49%
2008	14.27%	13.23%	12.84%	17.36%	49.52%
2009	14.89%	16.20%	12.16%	15.66%	42.70%
2010	19.34%	20.25%	23.65%	18.08%	32.84%
2011	16.75%	18.83%	17.50%	18.37%	27.39%
2012	18.17%	22.18%	21.67%	9.21%	7.87%
2013	0.00%	0.00%	0.00%	0.00%	0.00%

Firms in UK Regions: % in liquidation per year					
Year	All firms	1st Process	2nd Process	3rd Process	4th Process
2004	0.00%	0.00%	0.00%	0.00%	0.00%
2005	0.00%	0.00%	0.00%	0.00%	0.00%
2006	0.00%	0.00%	0.00%	0.00%	0.00%
2007	0.00%	0.00%	0.00%	0.00%	0.00%
2008	0.00%	0.00%	0.00%	0.00%	0.00%
2009	0.45%	0.05%	1.08%	0.56%	0.00%
2010	2.78%	3.22%	2.62%	1.31%	11.55%
2011	11.52%	9.94%	0.00%	10.45%	20.04%
2012	26.78%	25.63%	0.00%	23.35%	47.22%
2013	83.33%	58.33%	16.67%	75.00%	25.00%

Once the data were amended as described above, the normality assumptions of the key variables (dependent variables and control variables) were tested again, using the same techniques employed in the previous chapters (Skewness/Kurtosis; Shapiro-Wilk). The results are shown in the Appendix, Tables C.5 and C.6. The null hypothesis that each of the explanatory variables is normally distributed at the Sig.<0.05 or Sig.<0.10 level is rejected for most variables. Nevertheless, deviations from normality are frequent in firm failure studies due to the nature of their data. In addition, robustness checks using robust and bootstrapped errors will be used to confirm the confidence intervals of the initial regressions. These are considered as options in occasions where the standard errors are of interest (Li et al., 2012).

7.2.2 Spatial Weights

The computation of the metrics for spatial association are based on values of spatial location. Spatial data analysis requires some form of spatial proximity in a metric. One way to do this is by constructing a spatial weights matrix W (Pisati, 2012; Anselin, 2002; Anselin and Bera, 1998; LeSage, 1999). The spatial weights matrix is an n-by-n matrix capturing for each location i (rows) the other locations j (columns) that belong to its neighborhood set (Anselin & Bera, 1998). Each location in the matrix will therefore have a location W_{ij}, expressing the degree of spatial proximity between i and j (Pisati, 2012). Spatial proximity is measured by the inverse distance. The diagonal elements of the matrix (W) are zero because a given location cannot be a neighbor of itself and the matrix is spectral – normalised. In this case each entry in the matrix is divided by the largest eigenvalue in the matrix. This approach has the advantage of preserving symmetry without altering the model specification (Drukker et al., 2013; Plummer, 2010). Whilst there is no formal way to specify the spatial weights matrix (Anselin, 2002; Anselin & Bera, 1998), Pisati (2001; 2012) proposed using geographical coordinates (longitude and latitude) to do so and he has developed a STATA command that has been introduced in current STATA packages to support the construction of the weighting matrix based on geographical co-ordinates. LeSage and Pace (2014) provided evidence that although not all spatial weight matrices are performing equally, there is little evidence that over-specification of the spatial weights matrix or broadly similar matrix constructions materially affect the spatial results. For these reasons, the Pisati (2001; 2012) approach of constructing the weights matrix with geographical coordinates based on the STATA software is used in this chapter.

In order to compute the metrics discussed above the location of the countries and regions within the sample is required. To obtain this, data from the LatLong.net database were collected. LatLong.net is an online geographic database that provides the latitude and longitude of any country and/or city and region in the world. The data are based on GPS coordinates and comply with the World Geodetic System (WGS) standard and the data collected were verified on Google Maps.

The location of each European country has been used in order to create the spatial weights matrix (Table 7.4). Similarly, the location of each UK region has been used for the creation of the spatial weights matrix (Table 7.5).

Tables 7.4 and 7.5 present the Latitude and the Longitude of each country (EU) and region (UK), respectively. Based on these co-ordinates the spatial weights matrix is created. The matrixes are based on centroid (mid-point) distances between each pair of spatial units (countries or regions). Each weight that appears in the matrix expresses the weighted average of neighboring areas to a given country (Kondo, 2017). Table 7.4 presents the initial spatial weights for the EU countries. Table 7.5 presents the initial spatial weights matrix for the UK regions.

Table 7.4: Spatial Weights Matrix for EU countries.

Nr.	Country	LATITUDE	LONGITUDE	W1	W2	W3	W4	W5	W6	W7	W8
1	FRANCE	46.228	2.214	0.000	0.104	0.083	0.089	0.150	0.121	0.046	0.093
2	GERMANY	51.166	10.452	0.104	0.000	0.055	0.105	0.190	0.056	0.082	0.069
3	IRELAND	53.142	-7.692	0.083	0.055	0.000	0.043	0.077	0.075	0.037	0.208
4	ITALY	41.872	12.567	0.089	0.105	0.043	0.000	0.079	0.061	0.052	0.048
5	NETHERLANDS	52.133	5.291	0.150	0.190	0.077	0.079	0.000	0.068	0.064	0.107
6	SPAIN	40.464	-3.749	0.121	0.056	0.075	0.061	0.068	0.000	0.034	0.067
7	SWEDEN	60.128	18.644	0.046	0.082	0.037	0.052	0.064	0.034	0.000	0.044
8	U.K.	55.378	-3.436	0.093	0.069	0.208	0.048	0.107	0.067	0.044	0.000

Table 7.5: Spatial Weights Matrix for UK Regions

Nr.	Region	LATITUDE	LONGITUDE	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12
1	Yorkshire & H.	53.992	-1.541	0.000	0.596	0.674	0.350	0.199	1.010	0.884	0.274	0.293	0.247	0.343	0.648
2	East Anglia	52.356	-1.174	0.596	0.000	0.963	0.742	0.171	0.376	0.485	0.195	0.498	0.309	0.382	1.501
3	East Midlands	53.045	-0.398	0.674	0.963	0.000	0.640	0.158	0.438	0.421	0.195	0.502	0.235	0.285	0.649
4	London	51.507	-0.128	0.350	0.742	0.640	0.000	0.140	0.265	0.294	0.155	1.452	0.254	0.270	0.511
5	N.Ireland	54.788	-6.492	0.199	0.171	0.158	0.140	0.000	0.205	0.252	0.350	0.128	0.212	0.264	0.192
6	North East	54.978	-1.618	1.010	0.376	0.438	0.265	0.205	0.000	0.634	0.334	0.234	0.207	0.280	0.398
7	North West	53.790	-2.654	0.884	0.485	0.421	0.294	0.252	0.634	0.000	0.321	0.247	0.303	0.498	0.644
8	Scotland	56.491	-4.203	0.274	0.195	0.195	0.155	0.350	0.334	0.321	0.000	0.142	0.175	0.228	0.214
9	South East	51.279	0.522	0.293	0.498	0.502	1.452	0.128	0.234	0.247	0.142	0.000	0.220	0.228	0.379
10	South West	50.777	-3.999	0.247	0.309	0.235	0.254	0.212	0.207	0.303	0.175	0.220	0.000	0.730	0.363
11	Wales	52.131	-3.784	0.343	0.382	0.285	0.270	0.264	0.280	0.498	0.228	0.228	0.730	0.000	0.504
12	West Midlands	52.475	-1.830	0.648	1.501	0.649	0.511	0.192	0.398	0.644	0.214	0.379	0.363	0.504	0.000

The spatial weight matrices in Tables 7.4 and 7.5 present the spatial weights for each country and region. These weights effectively measure the intensity of the relationship between two countries or regions, in terms of distance. Higher weight is placed in closer locations and lower weights are associated with more distant locations.

For example, considering Table 7.4, we can observe that for France the country with the lowest weight (and therefore the highest distance) is Sweden. Equally the country with the highest weight (and therefore the smallest distance) is the Netherlands, closely followed by Spain and Germany. Similarly in UK regions South East has the highest weight (lowest distance) to London whilst N. Ireland has the lowest weight (and the highest distance). Therefore, these matrices define the countries or the regions that are considered (according to the weights) to be the closest neighbors.

Both matrices in Tables 7.4 and 7.5 are normalized prior to enter the panel regressions using the spectral normalization. Normalization is important in order for the maximum Eigenvalue of the matrix to be equal to 1 and the spectral normalization guarantees non singularity without changing the model specification (LeSage and Pace, 2009). In order to do so, all the entries in the matrix are divided by the absolute value of the largest eigenvalue of the matrix.

7.2.3 Econometric Methodology

Spatial econometrics are defined as "*a subfield of econometrics that deals with the treatment of spatial interaction (spatial autocorrelation) and spatial structure (spatial heterogeneity) in regression models for cross-sectional and panel data"* (Anselin, 1999, p.1). There are alternative ways to introduce spatial effects in a regression model (panel or not). The most commonly used specifications in spatial econometrics are the Spatial Error Model (SEM), the spatial Durbin model (SDM) and the Spatial Autoregressive model (SAR) (LeSage and Pace, 2009; Cravo et al., 2015). The chosen econometric specification for this part of the study is a SAR model (a more detailed discussion of Spatial Panel Regressions is given in section 3.4.5). LeSage and Pace (2009) argue that SAR is the "*hallmark of spatial econometrics*" (Cravo et al., 2015, pp.13) whilst Elhorst (2014) argues that SAR and SEM as presented by Anselin (1988) and Anselin et al.,(1996) can be regarded as the main pillars in spatial econometric thinking. Given the above, and considering the fact that the SAR model has the advantage of having a fully supported and documented process within STATA 15, this analysis will utilize the SAR modelling methodology. However, as the structure of the dataset is different from those used in the regressions analyses of Chapters 5 and 6, we need to test again whether a fixed or random effects panel regression is appropriate for the current data structure.

Given the processes applied in Chapters 5 and 6, the random effects model should in principle be the preferred specification. This is due to the inclusion of time invariant independent variables in the model specification (eg. legal origins and the spatial matrix itself). Nevertheless, the approach that this research undertakes, considers the likelihood ratio test as described in Chapters 5 and 6 (following Greene and Hensher, 2010).

7.2.4 Model Specification and Panel Effects[16]

The modelling approach first specifies a simple (non-spatial) panel model to be used as a benchmark against the results from the spatial panel model. This model uses the control variables that were introduced in section 7.2.1.

Subsequently, a spatial panel model is employed with the same control variables as the non-spatial model, and the additional spatial weights. Therefore, there will be a spatial panel model at country (or UK region/countries) level and a traditional panel (non-spatial) model as well for robustness checks.

The simple (non-spatial) model will have the following general specification (ignoring panel effects) for the EU countries:

$$DV = c + \beta_1 GDP_{gr} + \beta_2 CR + \beta_3 Leg\_trad + \ error \qquad (7.1a)$$

And the following general specification (ignoring panel effects) for the UK regions:

$$DV = c + \beta_1 GVA + \beta_2 CR + \beta_3 New\_Firms\_perc + \ error \qquad (7.1b)$$

DV is the number of event_failure=1 or event_failure=2 (depending on whether it is applied on firms in financial distress or in liquidation) companies for each year in each country or regions and c is the constant.

GDP_gr is the GDP growth rate in each country (each year); GVA is used for the UK regions. CR is the credit availability in each country, each year as a percentage of GDP. Leg_trad is a dummy variable that takes the value of 1 for countries that are associated to common law and 0 for firms associated to legal traditions of civil law tradition. New_Firms_perc is used for the UK regions' analysis to measure the percentage of new firms in a given region in a given year.

In addition to model (7.1) above, generic forms of two spatial model are specified in models (7.2a) and (7.2b) (ignoring panel effects in the representation) for the EU countries and the UK regions:

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[16] Panel models in this chapter do not consider unit root tests, in line with previous chapters, due to the large N compared to T structure of the dataset. Maddala and Wu (1999) questioned the validity of unit root tests in panel data applications and a sufficient body of the panel data literature (see for example Arellano and Bond, 1991) do not propose them in the panel model applications. Likewise, Barreira and Rodrigues (2005) point that unit root tests for panel data such as the IPS and Chang's tests can be distorted under small samples, influencing the panel data results. As such this study is not using them as the academic debate in that area remains separate and outside the scope of this study.

$$DV_{nt} = c + \beta_1 GDP_{gr_{nt}} + \beta_2 CR_{nt} + \beta_3 Leg_{trad_n} + \beta_4 W\_DV_{nt} + error_{nt} \quad (7.2a)$$

$$DV_{nt} = c + \beta_1 GVA_{nt} + \beta_2 CR_{nt} + \beta_3 New\_firms\_perc_{nt} + \beta_4 W\_DV_{nt} + error_{nt} \quad (7.2b)$$

In all cases:

$$error_{nt} = \rho W\_error_{nt} + v_{nt}$$

Where: DV_{nt}=*(DV1t;DV2t….DVnt)* is a vector (*n*1*) vector of observations for the dependent variable with a time period of *t* and with *n* number of panels. $error_{nt}$ is the spatially lagged error, v is a vector of disturbances that are independent and identically distributed between panels and with variance σ^2. W is the spatial matrix and c is the constant. The remaining variables are the independent variables for each part of the analysis as described above. Models also account for panel effects. Spatial dependence can be incorporated in at least two ways in a spatial model. The first is in the form of an additional independent variable that represents a spatially lagged dependent variable (Anselin, 1999). This specification is called the spatial lag model. The second approach is to incorporate the spatial effects in the error structure (combinations also can exist) in what is known as the spatial error model. The former specification deals with testing for the existence and strength of spatial interaction in the dependent variable. The latter deals with the identification of spatial correlation in the error terms and is appropriate when the concern is in correcting the potentially biasing effects of spatial autocorrelation (Anselin, 1999). In both cases a maximum likelihood estimator is utilised.

Models (7.2a and 7.2b) test for spatial effects in the lag dependent variable as well as the error terms. The spatial lag in the dependent variable is referred to, in the text as W_DV and implies a spatially lagged dependent variable. The spatial lag in the error term is referred in the text as W_error and implies a spatially lagged error term. W_DV is introduced in models (7.2a and 7.2b) to denote the assumption that the number of companies that fail in each country each year is experiencing spillovers from other countries. W represents the spatial Weight matrix. In models (7.2a and 7.2b) the spatial Weights are both on the spatially lagged dependent variable and on the error term. This variable is effectively testing for the potential existence of spatial effects in firms' liquidations between countries (EU) and regions (UK). The logic of this test is that in an open economy where businesses are free to trade with each other and SMEs are known to operate in a relatively local manner, it is possible that financial hardship and liquidation in firms that operate in an area may be related to financial hardship and liquidations for firms that operate in nearby areas (Love, 1996). The exact definition of locality can be concluded when the spatial effects are tested in both EU countries level as well as UK country/regional level. Additionally, for similar reasons, the spatial Weights matrix is also introduced in the residuals. ρ is the autocorrelation parameter and can take values between -1 and 1. It shares some characteristics with a correlation coefficient but in contrast to that, it is not restricted to the (+/-) 1 range (LeSage and Fischer, 2008). The idea is to capture spatially correlated errors that provide evidence of spatial effects.

A two step approach will be used in this part of the analysis. First, regressions will be used in the general specification of model (7.1a and 7.1b) both for the number of firms in financial distress and subsequently for the number of firms in liquidation (representing the two stages of failure that were considered in he previous chapters). A test for the existence of fixed or random effects when the time invariant variables are excluded from the model will be used. This primarily affects the (non-spatial) panel models. For consistency with Chapters 5 and 6 the test that will be used is the one proposed by Greene and Hensher (2010). This is based on a likelihood ratio test and can be used in the place of the Hausman test, when ordered logistic regressions are considered (Greene and Hensher, 2010) but can also be applicable to linear cases. However, the Hausman test is also applied.

It is assumed that random effects will be the preferable option due to the existence of non-time varying variables such as the legal tradition for the EU firms. For the spatial panel models in particular, Elhorst (2014) observed that random spatial effects is generally the point of departure in spatial panel models because models with spatial fixed effects only utilize the time series component of the data whereas random effects are actually using both the time series and the cross sectional elements. Additionally, as already mentioned, the random effects specification avoids the problem that the coefficients of time-invariant variables or variables that only vary a little cannot be estimated (Elhorst, 2014).

The results of the above regressions will be then used as reference point for the spatial effects model. The second step uses the model (7.2a and 7.2b) which is the full representation of the SAR model (LeSage and Pace, 2008) that includes spatial error terms as well[17]. The spatial panel models will be tested in the full firms' sample and the alternative firm failure processes that were identified in Chapters 5 and 6 for EU and UK firms, respectively.

7.3 Spatial Effects in European Countries' Firm Failure Processes

7.3.1 Fixed or Random Effects

This section will first examine the EU countries in a full sample and then at firm failure process (cluster) level. The first step, as described in the previous section, is to run non-spatial models, check for random or fixed effects when only the time varying covariates are used and then report the results of the selected specification. To do so we first check a fixed and a random effects model based on the general model (7.1a) (for firms in financial distress and firms in liquidation separately). Given the linear nature of these regressions both the Hausman test and the likelihood ratio-based methodology that was adopted in Chapters 5 and 6 (from Greene and Hensher, 2010) can be applicable. For consistency reasons with the previous chapters the Likelihood Ratio approach has been undertaken as the primary methodology.

Under the Likelihood Ratio Test, a random effects model with the time varying independent variables has been used to which we add the group means of the variables. The purpose of the means is to control for correlation between the individual effects and the independent variables. Therefore, the group mean of variables should account for the correlation between the individual effect and the regressors (Greene and Hensher, 2010). If this correlation is confirmed then the fixed effect approach should be undertaken. If such a correlation does not exist then the random effects model should be appropriate (Greene and Hensher, 2010). The model's estimates (for each regression were financial distress or liquidation

[17] Some parts of the literature may use different names for that model. For example Golgher and Voss, (2016) use the name Spatial Durbin Error Model in a similar specification; Belotti et al., (2017) use the term SAC (Spatial Autocorrelation Model) for a similar specification.

was considered) were then stored and a similar random effects model without the means was also run (and its estimates were also stored). Consequently, a likelihood ratio test is carried out as a variable addition test for joint significance of the group means. Specifically, the estimates of the two models with and without the group means of the time-varying variables were compared with the likelihood ratio, on the null hypothesis that the coefficients on the means are all zero, following Greene and Hensher (2010).

The results did not reject the null hypothesis (at p=0.01 with 2 degrees of freedom) that the coefficients on the means are all zero. Therefore we conclude that this is a further reason why the random effects specification should be used. A Hausman test was also performed and confirmed the same results (Appendix C, Tables C.15 and C.16). In that case the null hypothesis that the random effects estimator is consistent is not rejected. The same process was then applied to the individual failure clusters which are essentially smaller subsets of the main dataset with no difference in the results.

7.3.2 Analysis on EU Countries

7.3.2.1 Non-Spatial Panel

The next step after accepting the random effects specification is the panel regression that follows the general specification shown in model (7.1a) above. This panel regression aims to create a benchmark against which to compare the spatial panel results.

Table 7.6 shows the result of the panel model regression where the dependent variable is the number of firms in financial distress (as the first stage of failure). In this aggregated data structure, the results suggest that (in the full firms' sample) GDP growth and the credit availability are both significant determinants of the number of firms that enter financial distress each year. The signs of the coefficients are in line with what we observed in Chapter 5. The GDP growth has a negative sign implying that a reduction in the GDP growth is associates with an increase in the number of financially distressed firms. Credit availability has also a positive sign due to the reasons that were explained in Chapter 5. That is, it is measured as a percentage of GDP and therefore the credit availability declines in absolute terms but its proportion as a percentage of GDP can still be positive, because GDP reduces more during the financial crisis years. Therefore, due to its specification being a percentage of GDP, the positive coefficient is possible because it is based on a decreasing GDP. Nevertheless, the point remains that credit availability (decreased in absolute levels) is a determinant of firms' financial distress in the EU countries of this sample. The legal tradition dummy variable was not significant determinant of firms' financial distress in this aggregation of the data.

As shown in Table 7.6, the results for the alternative firm failure processes indicate a more significant reliance on credit availability than on GDP growth as the latter is not significant in all firm failure processes. In addition, in this specification of the model (without panel or spatial effects), the legal tradition is not a significant determinant of firms' transition to financial distress.

Table 7.6: Non-Spatial Panel regression on EU countries' financially distressed firms

Firm Failure Process		1	2	3	4
Independent Variables	All Firms	Clusters with Directors char.			
Coeff. Pr>|z|					
c	-0.058*	-0.011	-0.118**	-0.248**	-0.021
GDP_gr	-0.008**	-0.002	-0.005*	0.001	-0.002
Credit	0.002**	0.001**	0.002**	0.003**	0.001**
Leg_trad	-0.022	-0.036	-0.044	-0.044	-0.012
/sigma_u/STD error sigma_u	0.089 / 0.009	0.029 / 0.015	0.068 / 0.020	0.081 / 0.024	0.037 / 0.012
/sigma_e/ STD error sigma_e	0.099 / 0.004	0.089 / 0.007	0.059 / 0.005	0.071 / 0.006	0.049 / 0.004
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10					
Glossary					
Credit	Credit availability (% GDP)				
GDP_gr	GDP Growth (%)				
Leg_trad.	Legal Tradition				

Considering firms from EU countries that entered liquidation procedures (the terminal stage of failure) each year, a simple (non-spatial) panel is also run. The results are presented in Table 7.7. The results suggest that in contrast with the financial distress situation, the key business environment determinants of the firms' liquidation is the GDP growth and not the credit availability. GDP growth has the expected sign and it is significant in all firm failure processes with the exception of the fourth, where the legal tradition dummy variable is instead significant (at Sig<0.10). Decreased GDP growth is associated with increasing propensity for liquidation in the all firms sample and in the first, second and third firm failure process. These failure processes are associated with young firms, negative growth firms and firms with few directors and liquidity problems. In addition, the negative sign of the coefficient for the legal tradition dummy variable in the fourth firm failure process suggests that firms in countries under the common law system are less likely to enter liquidation. The fourth firm failure process has been associated with firms that have negative or low growth and increased usage of trade credit.

Table 7.7: Non-Spatial Panel regression on EU countries' liquidated firms

Firm Failure Process:		1	3	4	5
Independent Variables	All Firms	Clusters with Directors char.			
		Coeff. Pr>|z|			
c	0.250**	0.359**	0.374**	0.386**	0.342**
GDP_gr	-0.029**	-0.021*	-0.024**	-0.029**	-0.018
Credit	-0.001	-0.001	-0.001	-0.001	-0.001
Leg_trad	-0.036	0.018	-0.410	-0.029	-0.083*
/sigma_u/STD error sigma_	0.001 / 0.543	0.001 / 0.054	0.001 / 0.053	0.001 / 0.063	0.001 / 0.054
/sigma_e/ STD error sigma_	0.380 / 0.300	0.363 / 0.028	0.373 / 0.029	0.389 / 0.030	0.370 / 0.029
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10					
		Glossary			
Credit		Credit availability (% GDP)			
GDP_gr		GDP Growth (%)			
Leg_trad.		Legal Tradition			

The results above provide an indication of the significance of the variables that will be used as control variables in the spatial panel regressions and are meant to be used as the reference point for the spatial models.

7.3.2.2 Spatial Panel

After having a broad understanding of the expectations from the independent variables, the next step is to test spatial autocorrelation. There are 8 countries participating in the analysis: France, Germany, Ireland, Spain, Italy, Netherlands, Sweden and the United Kingdom (UK). France and Germany share borders and as such are neighbors to each other. Netherlands shares borders with Germany and Spain and Italy share borders with France making them neighbors. The UK also shares (sea) borders with France, Netherlands and Ireland. Sweden on the other hand appears to be the most distanced country from the sample, sharing (sea) borders with Germany.

First, the spatial panel regression is run with the number of firms entering financial distress as the dependent variable. The results are shown in Table 7.8. For the number of firms in financial distress in all EU countries, there is statistical evidence of spatial effects in the (spatial) lag of the dependent variable in the full firms' sample and in all the firm failure processes. The W_DV variable is significant at Sig<0.10 in the full sample and Sig.< 0.05 in the individual firm failure processes.

The interpretation of the coefficients in spatially lagged dependent variables is complicated because spatial models expand the information set to include information from neighboring areas (LeSage and Pace, 2009). As such a change in an independent variable in a country could affect the dependent variable in another country (LeSage and Pace, 2009). In this context, directionally, the sign of the W_DV coefficient in the full sample of EU countries is negative, implying that a decrease in the spatial weights of countries whose firms enter financial distress is associated with increased levels of firms in financial distress. Considering the properties of the weighting matrix, a decreased weight in the matrix is associated with increased distance between countries. As such the interpretation of the coefficient is that firms entering financial distress in a given country can be associated with increased levels of firms entering financial distress in countries that are not neighboring. This interpretation holds for the full sample and all the firm failure processes with the exception of the third. In the third firm failure process, increases in the levels of firms entering distress in a country is associated with increases in nearby countries. This is potentially due to the construction of the third firm failure process which is concentrated from German, Italian and Spanish firms, which are all close to each other.

In addition, there is evidence of spatial effects in the error term in the full sample and in the majority of the firm failure processes because the W_error variable is significant at Sig<0.05 in the full sample of EU firms and in the individual firm failure processes (with the exception of the third firm failure process). The fact that the spatial patterns in the error term are statistically significant implies that a model that did not control for these effects would probably have spatial autocorrelation in its residuals, making that model mis-specified from a statistical perspective (LeSage and Peace, 2009).

Table 7.8: Spatial panel Regression results on EU countries' firms' financial distress

Firm Failure Process:	1	2	3	4
Independent Variables	All Firms	Clusters with Directors char.		
	Coeff. Pr>|z|			
W_DV	-0.322*	-1.878***	-1.692**	0.633**	-1.162***
W_error	0.329***	0.881***	0.901***	-0.257	0.916**
c	0.081*	0.163**	0.026	-0.235**	0 .083*
GDP_gr	-0.018*	-0.013*	-0.003	0.001	-0.001
Credit	0.002**	0.001	0.001**	0.002**	0.004
Leg_trad	-0.032	-0.009	-0.028	-0.021	0.004
/sigma_u/STD error sigma_u	0.061/0.020	0.059/0.018	0.066/0.018	0.059/0.018	0.049/0.015
/sigma_e/ STD error sigma_e	0.049/0.004	0.048/0.006	0.032/0.004	0.058/0.005	0.023/0.003
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10					
Glossary					
W_DV	Spatially lagged Dependent Variable		GDP_gr	GDP Growth (%)	
W_error	Spattially lagged error term		Leg_trad.	Legal Tradition	
Credit	Credit availability (% GDP)				

The rest of the control variables exhibit a similar behavior to the one that was presented in the models without spatial effects. GDP growth and credit availability are both significant (at Sig.< 0.10 and Sig.<0.05 levels accordingly) in the full sample. Their significance differs across the alternative firm failure processes. Similar variations have been observed in the standard panel models at country level as well as in the firm level ordered logistic regression panels employed in Chapter 5. We can, however, observe that when including the spatial effects in the spatially lagged dependent variable and in the error term that the overall significance of GDP growth reduces from being significant at Sig.<0.05 in the panel regressions to being significant at Sig.<0.10 level in spatial panels, potentially due to the inclusion of the spatial weights in the error terms and in the spatially lagged dependent variable. Overall, one can conclude that the geographical location is a significant determinant that should be considered in financial distress studies across EU countries. Spatial effects and the importance of location also applies to the alternative firm failure processes.

Second, the spatial panel regression is run with the number of liquidations as the dependent variable. The results are presented in Table 7.9. In contrast with the financial distress rates, in the case of the firms that are entering liquidation in the EU countries, there is limited evidence of statistically significant spatial effects in the dependent variable (with spatial lag) as the significance levels of the W_DV variable in Table 7.9 shows. That means for all the firms and for most firm failure processes, with the exception of the third firm failure process, the spatial location and the distance between countries is not directly related with liquidation rates in another country. The third firm failure process differs (some evidence of significant (Sig.< 0.10) spatial lags in the dependent variable) from the others in the significance of the W_DV variable. The results for the third firm failure process indicate, as in the case of financial distress, that decreased spatial weights (and therefore increasing distance between countries) is associated with increases in the levels of firms entering liquidation. However, some caution should be taken in the interpretation of the results in this firm failure process because it is characterized by a concentration of firms from countries that are relatively close to each other.

On the other hand, there is evidence of spatial effects in the error term in the full sample and in all of the firm failure processes separately. This is evidenced by the significance levels (Sig.< 0.05) for all firm failure processes and in the all firms sample. The sign of the coefficient on the W_error variable, denoting spatial effects in the error term, is difficult to be interpreted directionally. However, the positive sign is associated with increased spatial weights and therefore with decreased distance. As in the case of the regressions above, which considered financial distress rates in EU countries, the presence of statistically significant spatial effects in the error term implies that the non-spatial model could be mis-specified. More importantly, the practical implication is that the spatial model provides information on some unobserved spatially correlated effects that are not observable to this research (this can be down to limited data availability or due to some effects that cannot be measured).

Table 7.9: Spatial panel Regression results on EU countries' firms liquidations

Firm Failure Process:		1	2	3	4
Independent Variables	All Firms	Clusters with Directors char.			
		Coeff. Pr>|z|			
W_DV	-0.269	-0.246	-0.451	-0.486*	-0.251
W_error	0.819***	0.734***	0.832***	0.841**	0.804***
c	0.453**	0.312**	0.402**	0.486**	0.332**
GDP_gr	-0.013*	-0.010*	-0.001	-0.013*	0.008
Credit	0.001	-0.001	0.001	0.001	0.001
Leg_trad	-0.032	0.022	-0.039	-0.024	-0.068*
/sigma_u/STD error sigma_u	0.001/0.049	-0.005/0.332	0.001/0.049	0.001/0.108	0.001/0.079
/sigma_e/ STD error sigma_e	0.219/0.020	0.294/0.029	0.221/0.023	0.225/0.022	0.223/0.022
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10					
		Glossary			
W_DV	Spatially lagged Dependent Variable			GDP_gr	GDP Growth (%)
W_error	Spattially lagged error term			Leg_trad.	Legal Tradition
Credit	Credit availability (% GDP)				

The rest of the control variables exhibit a similar behavior to the one that was presented in the models without spatial effects (although with reduced levels of significance: Sig< 0.10). Comparing the panel regressions on liquidation rates across countries, one can observe that reducing GDP growth is a determinant of liquidation rates in both cases. However, consistent with the financial distress observations, it is significant at Sig.< 0.10 level when spatial effects are included in the model. Credit availability is not a key driver in any of the regressions when liquidation rates are concerned. Legal tradition is not a key determinant in the overall sample but it is a determinant in the fourth firm failure processes in both regressions. The sign of the coefficient suggests that firms in common law countries are less associated with entering the liquidation stage than firms in civil law countries. Overall, one can conclude that the geographical location is again a significant determinant that should be considered in financial distress studies across EU countries.

7.3.3 Conclusion on Spatial Effects in EU Countries

The results from the above spatial panel regressions provided evidence of statistically significant spatial effects in the error terms (W_error) for both options of the dependent variable. However, evidence of statistically significant spatial effects in the spatially lagged dependent variable (W_DV) were only evidenced in the regressions against financial distress (and in the third firm failure process in the regression against liquidations).

Therefore Hypothesis 13a is accepted. There is statistically significant evidence of spatial effects in EU firm failures, both in the case of firms' financial distress and firms' liquidations. What differs between firms in financial distress and firms in liquidation, is the type of the spatial effects that are identified, that is, the effect is found either in the spatially lagged dependent variable or in the error term. Hypothesis 13b, is rejected though. The spatial effects are not the same in terms of statistical significance across the alternative firm failure processes because the third firm failure process in the financially distressed EU firms has not significant spatial effects in the error terms. Likewise for firms in liquidation, only the third firm failure process has got statistically significant effects in the spatially lagged dependent variable. The existence of spatial effects in the error term implies spatial autocorrelation in the error term, possibly due to the usage of spatial data (Anselin, 1999). Therefore the model residuals are experiencing a correlation which is directly associated with the geography of the countries. The neighbouring countries (for example Germany and France; France and Spain and Italy; Germany and Netherlands) have essentially spatially correlated residuals. In other words, as it has been explained in the previous section, the spatial patterns in the error term suggest that there are random determinants that influence the dependent variable that are not present in the model and that they exhibit spatial correlation. In other words, the statistically significant presence of spatial errors may be down to omitted random factors (Anselin, 2013). Table 7.10 provides a summary of the outcomes of the hypotheses tested in this section.

Table 7.10: Summary table for Chapter 7 Hypotheses on EU firms

Table of Hypotheses for Spatial Effects in EU Countries		
Nr.	**Hypothesis Statement**	**Accepted?**
H13a	There are statistically significant spatial effects associated with EU firm failures.	Yes
H13b	Spatial effects are the same between alternative firm failure processes in EU firms, in terms of statistical significance.	No

There are two conclusions that may be drawn from these findings. First, it is possible that additional, potentially observable, independent variables could be added in models to reduce or control for these spatial errors. Second, it is possible that these spatial error patterns are down to unobservable effects that cannot be measured and therefore the researcher or the policy maker should be aware that such effects exist between failed firms in the EU countries. For example, Buehler et al., (2012) suggests that culture affects firms' bankruptcy rates but culture cannot be measured directly. Therefore, accounting for spatially correlated unobservable effects is a primary reason to use models that account for such effects, because the researcher cannot obtain the necessary variables to account for these effects and therefore a non-spatial error model would be misspecified. Glass et al., (2012) makes the economic case for spatial error models, noting that they should be used (when necessary) because they are able to capture spatial dependence beyond what non-spatial models can capture. In this case, such effects are applicable to financial distress and to liquidation rates of firms in the EU countries under consideration.

In addition, the evidence from the previous section suggests that the spatial lag on the dependent variable (W_DV) is statistically significant determinant for financial distress rates (and in the case of the third firm failure process for liquidation rates too). The spatial lag on the dependent variable (also known as spatial autoregression) element shows the existence and the strength of spatial autocorrelation (Anselin, 1999). The significance of that variable can be interpreted as substantive spatial dependence (Anselin, 1999). In other words, there is an association in the dependent variable (number of firms in financial distress in all firms and number of firms in liquidation for the third firm failure process) between neighboring countries. Therefore, the number of financially distressed firms in one country affects the number of firms' financial distress in another nearby country (a negative coefficient implies that financially distress rates increase as the distance decreases).

7.4 Spatial Effects in UK Countries and Regions Firm Failure Processes

7.4.1 Fixed or Random Effects

Looking at the UK country-region level, the same principles of the research methodology are applied. The first step is to run the non-spatial panel models, and determine whether a random or fixed effects specification is more appropriate. Similar to the EU countries' firms' sample, the existence of time-invariant variables (in this case the spatial weights matrix) would suggest that the spatial panel model is better suited with a random effects specification. Nevertheless, adopting the same principles as in the EU countries' firms, this section tests for fixed or random effects using only the time varying variables. This is additionally helpful due to the fact that initially a non-spatial panel model is considered as a benchmark to compare the spatial panel models against.

Consistent with the EU sample, the first step is to check a fixed and a random effects model based on the general model (7.1b). Given the linear nature of these regressions both the Hausman test and the likelihood ratio-based methodology that was applied in Chapters 5 and 6 (Greene and Hensher, 2010) can be applicable. For consistency with the previous chapters, the Likelihood Ratio approach has been undertaken as a primary methodology. The results did not reject the null hypothesis (at p=0.01 with 3 degrees of freedom) that the coefficient of the means of the (time varying) independent variables are all zero and therefore the conclusion is the random effects specification should be used. A Hausman test was also performed and confirmed the same results (Appendix C tables C.17 and C.18). The same process was also applied to the individual failure clusters which are essentially smaller subsets of the main dataset, the results indicate that again, random effects specification should be used.

7.4.2 Analysis on UK Regions

7.4.2.1 Non-Spatial Panel

The first step after accepting the random effects specification is the panel regression that follows the general specification shown in model 7.1b. This panel regression aims to create a benchmark against which to compare the spatial panel results.

Table 7.11 shows the result of the panel model regression when the dependent variable is the number of UK firms in financial distress. In this aggregated data structure, the results suggest that, in the all UK firms sample, regional GVA growth is not a significant determinant of UK firms' financial distress at aggregated UK level. This is also the case with most firm failure processes, with the exception of the fourth. In the fourth firm failure process, GVA growth is a significant determinant of UK firms' financial distress. The negative sign of the coefficient suggests that a decrease in regional GVA is associated with an increase in the number of firms entering financial distress.

On the other hand, the credit availability is a significant (Sig.< 0.05) determinant of the number of firms that enter financial distress each year. The sign of the credit coefficient is positive and consistent with what has been reported in the previous section and chapters. The credit availability is expressed as a percentage of GDP. Therefore, despite the positive sign of the credit coefficient which could be associated with increasing credit, credit availability is actually decreasing. Therefore, the relationship implies that a decline in credit availability is associated with increasing numbers of financially distressed UK firms. This relationship is also significant for the third firm failure process.

The percentage of new firms in a region is also a significant determinant of firms' financial distress (Sig.< 0.05). This evidence applies to the full sample and the first firm failure process. The sign of the coefficient supports the argument that the higher the percentage of new firms entering a region, the higher the number of firms entering financial distress, possibly down to increased competition at regional level.

The differences in the significance of the economic and business environment variables in the alternative firm failure processes are associated with the characteristics of the firms' in these processes. The first firm failure process in UK firms (with directors) is associated with deteriorating growth and high trade credit firms; the second with firms that have strong sales but weak cash conversion; the third with old firms that have deteriorating cash conversion ability and the fourth with young firms that are highly indebted. Therefore, one can conclude that, in terms of the number of firms' entering financial distress in the UK regions, those who are young are more affected by the economic environment, as in the case of the fourth firm failure process. On the other hand, firms that are unable to generate sufficient cash (third failure process) are more affected by a deterioration in credit availability and those that experience deteriorating growth (first failure process), are more affected by increased competition, caused from new businesses in the area. The second firm failure process did not have any statistically significant variables for financial distress in this occasion.

Table 7.11: Non-Spatial Panel regression on UK regions' financially distressed firms

Firm Failure Process:		1	2	3	4
Independent Variables	All Firms	Clusters with Directors char.			
		Coeff. Pr>|z|			
c	0.168	0.235	-0.080	-0.323	-0.694
GVA	0 .005	-0.005	0.005	-0.002	-0.039**
Credit	0.001**	0.001	0.002	0.002**	0.003
New_firms_perc.	0.018**	0.022**	-0.010	0.002	0.034
/sigma_u/STD error sigma_u	0.035/0.018	0.037/0.001	0.072/0.028	0.109/0.027	0.096/0.049
/sigma_e/ STD error sigma_e	0.061/0.004	0.086/0.006	0.186/0.012	0.162/0.011	0.367/0.024
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10					
		Glossary			
Credit		Credit availability (% GDP)			
GVA		GVA Growth (%)			
New_firms_perc.		Percentage of New firms in a region			

Considering firms from the UK regions that entered liquidation procedures each year, a simple (non-spatial) panel is also run. The results are presented in Table 7.12. The results suggest that the key business environment determinants of the firms' liquidation is the GVA growth (Sig. <0.05); the credit availability (Sig. <0.05) and the percentage of new firms in a region (Sig. <0.05).

Table 7.12: Non-Spatial Panel regression on UK regions' firms that enter liquidation.

Firm Failure Process:	1	2	3	4	
Independent Variables	All Firms	Clusters with Directors char.			
	Coeff. Pr>|z|				
c	1.015**	0.734**	0.181	0.954**	0.822*
GVA	-0.044**	-0.035**	-0.009	-0.041**	-0.015
Credit	-0.007**	-0.005**	-0.002	-0.006**	-0.003*
New_firms_perc.	0.036**	0.029**	0.006	0.032**	-0.010
/sigma_u/STD error sigma_u	0.223/0.035	0.326/0.035	0.123/0.041	0.133/0.038	0.020/0.001
/sigma_e/ STD error sigma_e	0.253/0.016	0.023/0.013	0.127/0.008	0.247/0.159	0.279/0.017
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10					
Glossary					
Credit	Credit availability (% GDP)				
GVA	GVA Growth (%)				
New_firms_perc.	Percentage of New firms in a region				

The sign of the coefficient of the GVA is negative, implying that a decline in the regional GVA growth is associated with an increased number of firms entering liquidation in the UK. The coefficient of credit availability is negative when UK firms' liquidation is considered, in contrast to the coefficient that was observed in the financial distress section. This negative credit availability coefficient was also observed in Chapter 6 and is associated with the timing of UK firms' entering liquidation. UK firms mostly entered liquidation at a time when the UK GDP was growing (but the credit availability was still not recovering as credit started increasing after the UK GDP started increasing). In contrast with the EU countries average, where the decrease of the credit provision was less than the decrease in GDP growth (resulting in a positive coefficient for the credit availability independent variable), in the UK the credit availability as percentage of GDP decreased even further than the GDP. In addition the credit availability reduction continue happening even when GDP was increasing, resulting in the negative coefficient. In addition, the percentage of new firms entering a region has a positive sign, confirming that increased competition is associated with higher liquidation rates.

7.4.2.2 Spatial Panel

Following the same approach as the EU countries' analysis, and after having a broad understanding of the expectations from the independent variables, the next step is to test spatial autocorrelation. In order to be consistent with the selection of the generic model that applied for the EU countries' firms' analysis, UK regions' also use the full general specification of the model 7.2b that considered potential spatial effects in the residuals and in the (spatial) lags of the dependent variable.

The spatial panel regression is run with the number of firms entering financial distress being the dependent variable. The results are shown in Table 7.13. For the number of firms in financial distress in all UK regions, there is statistical evidence of spatial effects in the (spatial) lag of the dependent variable in the full firms' sample and in all firm failure processes, with the exception of the third firm failure process. The W_DV variable is significant at Sig<0.05 in the full sample as well as in the second and fourth firm failure process. Likewise the W_DV is significant at Sig.< 0.10 in the first firm failure process.

Table 7.13: Spatial panel Regression results on UK country regions firms' financial distress

Firm Failure Process:		1	2	3	4
Independent Variables	All Firms		Clusters with Directors char.		
		Coeff. Pr>|z|			
W_DV	0.587***	0.290*	1.389***	-0.328	-0.813***
W_error	-0.228	0.243	-1.658**	0.071	0.788**
c	0.123*	0.110	-0.547**	-0.422	-0.574
GVA	0.003	-0.005	-0.001	-0.001	0.020
Credit	0.001*	0.001	0.001*	0.003**	0.003
New_firms_perc.	0.012**	-0.012*	0.034**	0.002	0.066**
/sigma_u/STD error sigma_u	0.038/0.011	0.030/0.012	0.108/0.026	0.107/0.026	0.129/0.040
/sigma_e/ STD error sigma_e	0.052/0.005	0.082/0.005	0.153/0.012	0.160/0.011	0.292/0.026
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10					
		Glossary			
W_DV	Spatially lagged Dependent Variable		GVA	GVA Growth (%)	
W_error	Spattially lagged error term				
Credit	Credit availability (% GDP)				
New_firms_perc.	Percentage of new firms in a region				

Overall, the existence of spatial effects in the dependent variable implies that the number of firms that are entering financial distress in a given UK country region is affected by, and affects, the number of firms entering financial distress in neighboring regions. This is called the simultaneous feedback effect (LeSage and Fischer, 2008). Spatial effects in the spatially lagged dependent variable can be observed in some of the firm failure processes. There are two potential interpretations of that. One is that certain firm failure processes have a significant number of firms from other UK regions that experience simultaneous feedback in their financial distress. The second interpretation is that certain firm failure processes are more open to the influence of other firms' financial performance.

The sign of the W_DV coefficient is positive in most firm failure processes (negative in the fourth), implying an increase in spatial weights (and therefore a decrease in distance) is positively associated with increased numbers of firms entering financial distress in a region. In other words, increases of firms entering financial distress in a region positively affect the number of firms entering financial distress in a close-by (neighbouring) region. The negative sign of the coefficient of the W_DV variable in the fourth firm failure process differs though and suggests that increases in firms entering financial distress in a region are affecting firms in regions that more distanced. A closer look at the composition of the fourth firm failure process, reveals that whilst no particular region has got high concentrations in this process, it has a relatively higher presence of London firms and of firms in Northern regions. Therefore one possible explanation for this firm failure process is that younger firms in Northern UK regions are affected from the business environment (in terms of financial distress) in London where they may have their first business interactions with. In order to further investigate the impact of London, the same spatial panel regression is applied to all UK regions' firms but this time the firms in London are excluded from the analysis. The result suggested that, by excluding London, the W_DV becomes not significant. Therefore, a tentative conclusion can be drawn that London firms have an additional weight in influencing financial distress in firms across the UK regions. This is reflected in the spatial effects positive sign that suggests that the distance from other firms in London is effectively a determinant of increased numbers of financially distressed firms across the UK regions.

Finally, considering the spatial effects in the error terms (W_error), there is only significant statistical association with financially distressed firms in the second and fourth firm failure processes (Sig.< 0.05). As noted in the EU countries' firms section, the sign of the coefficient on the W_error variable, denoting spatial effects in the error term, is difficult to interpret directionally. However, the fact that the spatial patterns in the error term are statistically significant, implies that a model that did not control for these effects would probably have spatial autocorrelation in its residuals, making that model mis-specified from a statistical perspective (LeSage and Peace, 2009).

The rest of the control variables exhibit a similar behavior to the one that was presented in the models without spatial effects in the full UK sample. Credit availability and the percentage of new firms in a UK region are both significant (at Sig.< 0.10 and Sig.< 0.05 levels respectively) in the full sample. Their significance differs across the alternative firm failure processes. Similar variations have been observed in the standard panel models at country level as well as ordered logistic regression panels at firm level which were employed in Chapter 5. It can be observed that when including the spatial effects in the spatially lagged dependent variable and in the error term, the overall significance of credit availability falls from being statistically significant at Sig.<0.05 in the panel regressions to being significant at Sig.<0.10 level in spatial panels. This may be potentially due to the inclusion of the spatial weights in the error terms and in the spatially lagged dependent variable. Overall, one can conclude that the geographical location is a significant determinant that should be considered in financial distress studies across UK regions. Spatial effects and the importance of location also applies to the alternative firm failure processes.

In order to consider the number of UK firms entering liquidation, the spatial panel regression is run with the number of liquidations as the dependent variable. The results are presented in Table 7.14. In contrast with the firms entering financial distress, for firms that are entering liquidation in the UK regions, there is limited evidence of statistically significant spatial effects in the dependent variable (with spatial lag). The exception is the first and the fourth firm failure process where some evidence of significant (Sig.< 0.01 and Sig.< 0.10 respectively) spatial lags in the depended variable (W_DV) exists. It indicates that for the full sample and for two of the firm failure processes, the spatial location and the distance between countries is not directly related with liquidation rates in another region. In addition, the observation related to the sign of the coefficient of the W_DV variable in the fourth firm failure process is consistent with what has been observed in the case of the financial distress; the sign is affected by the representation of regions and especially the presence of London within each firm failure process. On the other hand, the sign of the coefficient in the first firm failure process indicates that the number of firms entering liquidation in a region affects, is affected by, the number of firms entering liquidation in neighboring regions.

Table 7.14: Spatial panel Regression results on UK regions firms' liquidation

Firm Failure Process:		1	2	3	4
Independent Variables	All Firms	Clusters with Directors char.			
		Coeff. Pr>|z|			
W_DV	-0.263	0.658***	0.155	-0.375	-0.549*
W_error	0.854***	0.125	-0.157	0.817***	0.626**
c	0.839*	0.202	0.154	0.959*	0.584
GVA	-0.016*	-0.016	-0.008*	-0.019*	-0.010*
Credit	-0.005**	-0.001	-0.001	-0.006**	-0.003
New_firms_perc.	0.021**	0.015	0.006	0.021*	0.009
/sigma_u/STD error sigma_u	0.010/0.002	0.059/0.018	4.070/0.038	0.059/0.018	2.570/0.062
/sigma_e/ STD error sigma_e	0.143/0.011	0.048/0.006	0.127/0.008	0.058/0.005	0.257/0.019
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10					
		Glossary			
W_DV	Spatially lagged Dependent Variable		GVA	GVA Growth (%)	
W_error	Spattially lagged error term				
Credit	Credit availability (% GDP)				
New_firms_perc.	Percentage of new firms in a region				

On the other hand, there is evidence of spatial effects in the error term in the full sample and the third and fourth firm failure processes. As for the regressions above (considering financial distress rates in UK regions' firms) the presence of statistically significant spatial effects in the error term implies that models applied in aggregate (as opposed to firm-specific) firm failure studies (for example studies analysing the macroconomic determinants of aggregate firm failures in a country) at the wider firm failure literature, should also test for the potential existence of spatial dependencies in the error terms. Failure to do so could lead to models being mis-specified, if there is spatial correlation in their error terms. More importantly, the practical implication is that the spatial model is able to provide information about some unobserved spatially correlated effects that are not observable to this research.

The remaining control variables experienced a similar behavior to that observed in the non-spatial panel regressions of the full sample, with a small variation in the levels of significance of the GVA variable (Sig.<0.10 in the spatial panel; Sig.<0.05 in the non-spatial panel). The significance of the control variables in the alternative firm failure processes has changed. The most significant change is observed in the first firm failure process where none of the control variables remains significant when the W_DV effects are included in the spatial panel regression, potentially implying that the W_DV is in fact a key driver for firms' liquidations in this failure process.

7.4.3 Conclusion on Spatial Effects in UK Regions

The results from the above spatial panel regressions provide evidence of statistically significant spatial effects in the error terms (W_error) for the number of firms entering liquidation procedures in the UK as well as significant spatial effects in the spatially lagged dependent variable (W_DV) for the number of firms in financial distress in the UK regions. Therefore, Hypothesis 14a is accepted. There is statistically significant evidence of spatial effects in UK firms' firm failures. This holds for both UK firms in financial distress and for firms in liquidation. The difference between the failure stages (of financial distress and liquidation) exist in the type of spatial effects that are exhibited (being in the error term or the spatially lagged dependent variable). Typically, for the first stage of failure (that is, the financial distress), the spatial effects in the spatially lagged dependent variable were significant for all the firms and for the first and second firm failure processes, where firms entering financial distress were positively correlated with firms entering financial distress in a neighboring region. In addition, these effects were significant in the fourth firm failure processes. Spatial effects in the error terms of firms entering into financial distress were significant in the second and fourth firm failure process.

On the other hand, for firms entering the second stage of failure (that is, liquidation), the spatial effects in the error term were significant for all firms, the third and the fourth firm failure processes. Meanwhile the spatial effects in the lagged dependent variable were not significant in the full sample, the second and third firm failure processes.

Hypothesis 14b, is rejected. The spatial effects are not the same in terms of statistical significance across the alternative firm failure processes because the first and the third firm failure process in the financially distressed UK firms do not have significant spatial effects in the error terms. Likewise the third firm failure process is the only one without statistically significant effects in the spatially lagged dependent variable for UK firms in financial distress. In addition, for firms in liquidation, only the third and fourth firm failure process got statistically significant effects in the error term, while only the first and fourth firm failure processes got statistically significant spatial effects in the spatially lagged dependent variable. Table 7.15 provides a summary of the hypotheses acceptance for this section.

Table 7.15: Summary table for Chapter 7 Hypotheses on UK firms

Table of Hypotheses for Spatial Effects in UK regions		
Nr.	**Hypothesis Statement**	**Accepted?**
H14a	There are statistically significant spatial effects associated with the UK firm failures.	Yes
H14b	Spatial effects are the same between alternative firm failure processes in UK firms, in terms of statistical significance.	No

The results are broadly in line with the behavior that was observed in the EU firms and therefore similar conclusions apply. The existence of spatial patterns in the error term suggest that there are effects that influence the dependent variable, that are not present in the model, which are exhibiting spatial correlation. Failure to include them in an aggregate regression such as the one used in this chapter, may result in spatial autocorrelation in the residuals and therefore biased estimates. This result does not affect earlier chapters in this thesis where the analysis was based on firm-level data (and the location was captured with dummy variables). However, other studies for policy making that aim to investigate aggregated firm failures between multiple locations may be prone to this bias. Practically, there appears to be regional factors that may determine firms' financial distress and liquidation that cannot be otherwise measured or observed, therefore the inclusion of spatial effects in the error term provides a further tool for analysis.

Likewise, the existence of a statistically significant spatial lag on the dependent variable (W_DV) demonstrates that there is a statistically significant spatial association in the dependent variable between UK regions. On that point, it appears that the presence of London does affect the spatial results, probably due to the significance of London in the UK economy and the concentration of firms (including financially distressed firms) there. Nevertheless, the point remains that the number of financially distressed firms in a region affects the number of firms' financial distress in another region for a number of firm failure processes, and for all the firms collectively. The direction of the effect is mostly related to the interactions between businesses in different regions. However, the results of the UK regions are broadly similar to those observed in the EU countries analysis were the spatial effects on the dependent variable affected the financial distress numbers and those in the error term affected the liquidations.

7.5 Alternative Specifications and Limitations

7.5.1 Limitations of the Control Variables and Alternative Definitions

A number of alternative specifications for the above regressions could have been performed for both the EU countries and the UK regions.

First, slightly different definitions of the control variables have been used. In line with specifications that have been used or tested in Chapters 5 and 6, the control variables that were used in this chapter are GDP growth; GVA and credit availability; legal tradition and new firms in a region. Choices of control variables were due to three main reasons. The first is that these variables have been widely referenced as determinants of aggregate firms' liquidations. The second is that, it was practically necessary to keep the same variables that were used in Chapters 5 and 6. In order to be consistent with Chapters 5 and 6, the same macroeconomic variables were used. Thirdly, the emphasis of this section is on the spatial effects, not so much on the control variables. However, this also represents a limitation of this analysis; there may be further metrics from the economic and business environment that could provide a more accurate estimation on the number of firms that are entering financial distress and/or liquidation.

To address the above issue, some slightly different definitions of these control variables have been used in the analysis, in line with what has been also tested in Chapters 5 and 6. Starting with the EU countries, an alternative specification of the panel models was also tested, using lag of one year for the control variables. This was motivated by evidence that the aggregate (time series) firm failure literature suggesting some time lag effects between macroeconomic effects and aggregate firm failure exist (see for example Jones, 2013; Liu, 2008). As this specification did not provide statistically different results in terms of the statistical significance of the control variables, the results are not reported.

Second, in line with Chapter 5, the legal tradition control variable was used with a different specification. Instead of leg_trad taking the value of 1 for countries associated with the common law and 0 for countries associated to the legal traditions of the civil law, a further dummy variable for French, Scandinavian and German law origins was created. These dummy variables represent all the main legal traditions that have been recorded (for a discussion of legal traditions, see Chapter 2). With it the regression would account for further sub-divisions of the legal traditions, which are more detailed than the civil and common law split. However the results were statistically similar confirming a similar observation that was made in Chapter 5. The UK firms were tested with their control variables lagged for one year, in line with what was tried in the EU firms. Again, there are no statistically different results. As such, the results are not reported in this section.

Third, the UK firms' regressions were run using the UK GDP growth instead of the regional GVA. This approach is similar to the one adopted in Chapter 6. The results were marginally different due to the UK GDP being a more generic variable at regional level compared to the regional GVA. Nevertheless, this did not change the direction or the significance of the spatial weight variables. The results are discussed in section 7.5.2.

Fourth, robustness checks on the regressions have been performed. These are discussed in the following sections. Moreover, checks for the direct and indirect impacts of the spatial effects are performed in Section 7.5.4. Finally, a further regression was run excluding year 2013, given that in 2013 there were no firms in financial distress as they had entered liquidation by then. This is also discussed the next sections.

7.5.2 Controlling for Alternative Definitions of the Independent Variable for UK firms

As discussed in the previous section, the UK firms' have been tested by also using the GDP_growth as an alternative control variable to the GVA growth already discussed. Table 7.15 summarizes the results for the total UK firms' sample for financial distress and liquidations. One can see that there is no significant difference in the signs or the statistical significance of the spatial effects. However, GDP growth fails to be a significant determinant in UK firms' financial distress, whereas the GVA growth was (Sig.< 0.10).

Table 7.15: All UK firms' spatial panel regression with GDP growth instead of GVA growth.

All UK Firms Clusters with Directors characteristics		
Independent Variables	Liquidation	Financial Distress
Coeff. Pr>|z|		
W_DV	-0.226	0.307***
W_error	0.850***	-0.729
c	0.857*	-0.255*
GDP_gr	-0.023	0.009
Credit	-0.005*	0.002**
New_firms_perc.	0.018**	0.015**
/sigma_u/STD error sigma_u	0.001/0.003	0.022/0.003
/sigma_e/ STD error sigma_e	0.145/0.011	0.128/0.008
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10		

7.5.3 Bootstrapping for coefficients significance

As observed in earlier parts of the chapter, the distribution of the independent variables has had a small deviation from normality. For this reason a bootstrapping approach has been used in order to check whether there is any material change in the signs of the coefficients or of their significance.

The bootstrapping approach preserved the panel structure of the data and used the standard number of replications that STATA is using (100) with replacement. Tables 7.16 and 7.17 present the results. Whilst there have been some small scale changes from the coefficient reported in the previous sections, there was no difference in the significance of the spatial errors in the EU or UK firms full samples. Additionally there was minimal difference in the significance of the control variables. Table 7.16 shows that the key conclusion that, in the full firms' sample for EU firms, W_error is significant for firms' entering liquidation and W_error and W_DV are significant for firms entering financial distress, still holds. Likewise, Table 7.17 shows that W_error is significant for UK firms entering liquidation and W_DV and W_error are significant for those entering financial distress. The significance of the control variables remains directionally similar to the main analysis. There are only some variations in the levels of significance. For example, the GVA in UK firms entering liquidation is significant at Sig.<0.05 in the bootstrapped errors, compared to Sig.<0.10 when the standard errors were used. Therefore, one can conclude that the results reported in the previous sections hold.

Table 7.16: Bootstrapping results in the full EU firms' sample

Bootstrap All EU Firms Clusters with Directors characteristics		
Independent Variables	Liquidation	Financial Distress
	Coeff. Pr>|z|	
W_DV	-0.226	-0.319*
W_error	0.830***	0.333***
c	0.857**	-0.081**
GVA	-0.029**	-0.014
Credit	-0.001	0.002**
leg_trad	-0.036	-0.020
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10		

Table 7.17: Bootstrapping results in the full UK firms' sample

Bootstrap All UK Firms Clusters with Directors characteristics		
Independent Variables	Liquidation	Financial Distress
	Coeff. Pr>|z|	
W_DV	-0.234	0.555**
W_error	0.844**	-0.229
c	1.015**	0.069
GVA	-0.043**	0.005*
Credit	-0.007**	0.001**
new_firms_perc	0.035*	-0.013**
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10		

7.5.4 Controlling for the Direct and Indirect Impact of the Spatial Effects

The inclusion of spatial effects in the spatially lagged dependent variable and in the error term has added value to the spatial panel regressions. One can compare estimations for the standard deviations of the panel effects in the two types of regressions (sigma u is the standard deviation of the panel effects; sigma e is the standard deviation of the errors) which are broadly similar between the two types of regressions both for the financially distressed firms and the liquidated firms and both for the EU and UK firms. However, the coefficient estimates are not directly comparable because the inclusion of the spatially lagged dependent variable introduces direct and indirect effects in the covariates (Kondo, 2017). The estimation of these effects for the independent variables controlling for the economic and business environment is provided in this section. Tables 7.18-7.19 show the direct and indirect effects of the control variables for financial distress and liquidations in the EU countries as well as the UK regions.

Table 7.18: EU Firms in Financial Distress and Liquidation: Control Variable Effects

EU Firms in Liquidation: Control Variable effects					
		Firm Failure Processes			
dy/dx	Full San	1	2	3	4
direct					
GDP_gr	-0.013	-0.010	-0.001	-0.014	0.008
credit	0.001	0.000	0.000	0.000	0.000
leg_trad	-0.032	0.022	-0.040	-0.025	-0.069
indirect					
GDP_gr	0.003	0.002	0.000	0.005	-0.002
credit	0.000	0.000	0.000	0.000	0.000
leg_trad	0.007	-0.004	0.013	0.008	0.014
total					
GDP_gr	-0.011	-0.008	0.000	-0.009	0.007
credit	0.000	0.000	0.000	0.000	0.000
leg_trad	-0.025	0.017	-0.028	-0.016	-0.055

EU Firms in Financial Distress: Control Variable effects					
		Firm Failure Processes			
dy/dx	Full Sample	1	2	3	4
direct					
GDP_gr	-0.004*	0.352	-0.075	-0.271	-0.002
credit	0.001**	0.330**	-0.004	0.112	0.061
leg_trad	-0.012	3.101	-1.019	-7.811	-6.234
indirect					
GDP_gr	0.002*	0.287	0.015	-0.396	-0.004
credit	-0.001**	0.270**	0.001	0.164	0.148
leg_trad	0.007	2.533	0.199	-11.428	-15.238
total					
GDP_gr	-0.002**	0.639	-0.060	-0.667	-0.006
credit	0.001**	0.600**	-0.003	0.277	0.209
leg_trad	-0.005	5.635	-0.821	-19.238	-21.473

Table 7.19: UK Firms in Financial Distress and Liquidation: Control Variable Effects

UK Firms in Liquidation: Control Variable effects					
		Firm Failure Processes			
dy/dx	Full Sample	1	2	3	4
direct					
GVA	-0.016*	-0.018*	-0.008	-0.019*	-0.010
credit	-0.005**	-0.002	-0.001	-0.006**	-0.003
new_firms_perc	0.021**	0.0175	0.006	0.021*	0.009
indirect					
GVA	0.003	-0.027	-0.001	0.005	0.004
credit	0.001	-0.003	0.000	0.002	0.001
new_firms_perc	-0.004	0.026	0.001	-0.005	-0.003
total					
GVA	-0.0127	-0.044	-0.01	-0.014	-0.007
credit	-0.004*	-0.005	-0.001	-0.004*	-0.002
new_firms_perc	0.017*	0.044	0.007	0.015*	0.006

UK Firms in Financial Distress: Control Variable effects					
		Firm Failure Processes			
dy/dx	Full Sample	1	2	3	4
direct					
GVA	0.003	-0.005	-0.001	-0.001	0.021
credit	0.000	0.001	0.000	0.003*	0.003
new_firms_perc	-0.012**	-0.012	0.022**	0.002	0.069**
indirect					
GVA	0.004	-0.002	0.004	0.000	-0.009
credit	0.000	0.000	-0.002	-0.001	-0.001
new_firms_perc	-0.014	-0.004	-0.099**	-0.001	-0.031*
total					
GVA	0.007	-0.007	0.003	-0.001	0.012
credit	0.001	0.001	-0.002	0.002**	0.001
new_firms_perc	-0.026	-0.017	-0.077**	0.002	0.038**

*** Sig<0.01; **Sig<0.05; *Sig<0.10

The above tables show the impact that is implied in the spatial panel regressions when there are no (spatially) lagged dependent variables. These effects do not indicate spillover effects. From the above one can observe that there is significant variation from the impact that the control variables have across the alternative firm failure processes in both the EU firms as well as the UK.

Considering the EU countries first, one can observe (Tables 7.18 and 7.19) that the independent variables controlling for the business and economic environment are only significant for the case of financial distress. In that case GDP growth has statistically significant direct and indirect effects (of opposite directions) in the full sample of firms. A decrease in GDP growth (and credit availability, which in EU countries is presented as a percentage of GDP and therefore is affected by opposite signs despite a reduction in credit) is directly associated with an increase in the number of firms entering financial distress. However, there is also an indirect effect, suggesting that increases in GDP growth (and credit availability) in neighboring countries may result in increases in firms entering financial distress in one country. One possible explanation for that can be related to the sample of this research. Some countries experienced more pronounced GDP growth when neighboring countries were still suffering from the results of the financial crisis with increasing number of firms entering financial distress. Germany and Italy are two examples of that.

Considering the UK regions, one can observe that there are very little indirect effects in any of the business and economic environment explanatory variables for firms entering liquidation. The results are mainly driven by direct effects. In these cases a reduction in GVA growth and credit availability, an increase in new firms in a region are directly associated with increased number of firms in liquidation in the full sample and in the third firm failure process. On the other hand the first firm failure process is only affected by direct effects in GVA growth. However, in the case of firms entering financial distress, the percentage of new firms in a region as a proportion of the business population in that region has both direct and indirect effects for the second and fourth firm failure process. For these firm failure processes, an increase in the percentage of new firms in a given region is associated with increased numbers of firms entering financial distress in these regions. In addition a reduction of new firms in neighboring regions is associated with increases in firms entering financial distress in a region. One possible explanation is that new firms in neighboring regions may not be direct competitors but instead may increase business transactions with firms in a region. As such a reduction of new firms in neighboring regions is not necessarily a positive development for firms in nearby areas.

7.5.5 Excluding 2013 from the Regression of Financial Distress

As discussed in Section 7.2.1, there are no firms in financial distress in 2013. That is because any firms under financial distress in the previous years, has eventually failed in the final year of the data. Given that the number of firms in financial distress in 2013 is zero by construction and not by random, one can argue that the inclusion of 2013 could affect the results of the regression analysis, both for the EU countries and the UK regions.

In order to check if any such bias could affect the results, additional spatial panel regressions were performed but excluding data for 2013 when testing for financial distress. The results are shown in Tables 7.20 (EU countries) and 7.21 (UK regions).

Table 7.20: Spatial Panel Regression on EU countries' firms in Financial Distress (Excluding 2013).

Firm Failure Process:		1	2	3	4
Independent Variables	All Firms	Clusters with Directors char.			
	Coeff. Pr>|z|				
W_DV	-0.222*	-1.977***	-1.700**	0.666**	-1.149**
W_error	0.340***	0.805***	0.899***	-0.266	0.991**
c	0.084**	0.143**	0.022	-0.333**	0 .056**
GDP_gr	-0.020*	-0.033*	-0.001	0.001	-0.001
Credit	0.002**	0.001	0.002**	0.002**	0.001
Leg_trad	-0.016	-0.009	-0.008	-0.021	0.001
/sigma_u/STD error sigma_u	0.066/0.020	0.068/0.018	0.088/0.021	0.039/0.012	0.048/0.009
/sigma_e/ STD error sigma_e	0.064/0.007	0.052/0.008	0.033/0.004	0.055/0.005	0.033/0.003
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10					
Glossary					
W_DV	Spatially lagged Dependent Variable			GDP_gr	GDP Growth (%)
W_error	Spattially lagged error term			Leg_trad.	Legal Tradition
Credit	Credit availability (% GDP)				

Table 7.21: Spatial Panel Regression on UK regions' firms in Financial Distress (Excluding 2013).

Firm Failure Process:		1	2	3	4
Independent Variables	All Firms	Clusters with Directors char.			
	Coeff. Pr>|z|				
W_DV	0.544***	0.338*	1.219***	-0.147	-0.833***
W_error	-0.121	0.031	-1.118**	0.046	0.763**
c	0.241**	0.117	-0.412**	-0.156	-0.420
GVA	0.003	-0.009	-0.001	-0.004	0.027
Credit	0.001*	0.001	0.001*	0.002**	0.005
New_firms_perc.	0.015**	-0.010*	0.214**	0.003	0.077**
/sigma_u/STD error sigma_u	0.045/0.012	0.035/0.012	0.132/0.033	0.108/0.027	0.133/0.041
/sigma_e/ STD error sigma_e	0.067/0.004	0.088/0.004	0.158/0.014	0.172/0.015	0.293/0.028
*** Sig.<0.01; ** Sig. <0.05; *Sig.<0.10					
Glossary					
W_DV	Spatially lagged Dependent Variable		GVA	GVA Growth (%)	
W_error	Spattially lagged error term				
Credit	Credit availability (% GDP)				
New_firms_perc.	Percentage of new firms in a region				

The results for both the EU countries and the UK firms remain practically the same as those in Section 7.3 and 7.4. There is a marginal change in the values of the coefficients. However, all the variables remain quantitatively similar both in terms of significance and the signs of their coefficients. As such one can conclude that the results reported in Sections 7.3 and 7.4 remain valid.

7.6 Discussion on Spatial Effects

7.6.1 Discussion on Spatial Effects

Both the EU countries sample and the UK country regions sample provide evidence for the existence of spatial effects in the spatially lagged dependent variable be it liquidation rates or financial distress rates. Whilst there is no evidence of the application of spatial econometric models in the firm failure literature, there is some implied evidence from the wider literature that underlying business conditions have some spatial characteristics. Therefore, the conclusion of this section is that these spatial characteristics actually affect firm failure as well. For example, the existence of spatial patterns of agglomeration of economic activity (Longhi et al., 2014) suggests that economic activity for services in metropolitan cities and manufacturing in medium sized cities could imply that shocks in the financial supply chain are transmitted in nearby areas. Likewise, considering local industries in Italy, Cainelli et al., (2013) stated that firms' failure (as well as mergers and acquisitions) experience time (temporal) effects that are territorially bounded.

Additionally, there is evidence shows that region-specific characteristics may be different and start-up costs may vary considerably between regions in a country (Gries and Naude, 2008). Therefore, neighbouring regions can be expected to experience spatial correlation that affects firms' financial distress and/or liquidation in a given geographic area. This can be extended to the local competition between neighbouring areas. SMEs are firms that generally serve the local population (of other firms or individual customers) (Love, 1996). Buenstorf and Klepper (2009) and Fotopoulos (2001) found evidence that firms located in regions with more concentrated economies have lower probabilities of exiting because most of the productive firms located in these regions are less vulnerable to economic shocks. However, the opposite can also be the case when a given region experiences a localized economic shock due to a decline in a major sector in the local economy (Keeble and Wever, 2016). Buehler et al (2012) also noted that culture could vary across regions or countries and that can affect the attitude towards failure rates. Glauben et al. (2006) found differences in firm exits in various regions of Germany. However, firm exits and their underlying reasons may be quite different from firm failures. They may not necessarily happen due to failure but for a variety of reasons that may include for example the retirement of the owner(s).

The above provided some initial evidence that spatial effects are indeed significant enough that they should not be neglected in the firm failure literature in general and in firm failure process studies in particular. Focusing on the latter and reorganizing the data at EU country and UK regions' level, the results reported in this chapter support Hypotheses 13a and 14a. In other words, they showed that there is indeed significant statistical evidence of spatial effects in firms' financial distress in EU countries and UK regions. In addition, the results rejected hypotheses 13b and 14b concluding that the spatial effects (although they exist) are not the same across different firm failure processes. Therefore, the concept of the alternative firm failure processes remains relevant in the context of (aggregated) spatial analysis.

7.6.2 Discussion on EU Countries

As discussed in the previous sections Hypothesis 13a was accepted whilst hypothesis 13b was rejected. Whilst there is statistically significant evidence of spatial effects in EU firms' financial distress and liquidations, these effects are not the same across all firm failure processes.

Considering the results of Section 7.3 from an EU firm failure process perspective, one can see that when the firms in financial distress across the EU countries was considered as the outcome of the model (dependent variable), the spatial effects in the spatially lagged dependent variable (W_DV) are significant at Sig.< 0.10 for the full sample and Sig.<0.05 or Sig.<0.01 for the firm failure processes. As it was already mentioned in Section 7.3, this indicates that firm financial distress in one country is associated with firms' financial distress in other countries but, with the exception of the third firm failure process, those are not the closest neighbouring countries. Likewise there is statistically significant evidence of spatial effects in the error terms (W_error) variable, in the full sample and in the majority of the firm failure processes. It is significant at Sig<0.01 in the full sample of EU firms and in the individual firm failure processes (with the exception of the third firm failure process). The presence of the statistically significant spatially auto correlated W_error variable in the SAR model specification, implies that a (non-spatial) model that would not control for these effects would probably have spatial autocorrelation in its residuals, making that model mis-specified from a statistical perspective (LeSage and Peace, 2009).

On the other hand when the firms' liquidation rates in the EU countries were considered, there was evidence of spatial effects in the error term (W_error) variable in the full sample and all the firm failure processes (Sig.<0.01). From an econometric perspective, the presence of statistically significant spatial effects in the error term implies that the non-spatial model could be mis-specified whilst from a practical perspective, the spatial model demonstrates that some unobserved spatially correlated effects are affecting the EU countries liquidation of firms.

From a practical perspective, these results are in line with theoretical expectations from the firm demography literature that looks at the location of firms and which speculates on the behavior of firms as agents (Arbia et al, 2014; Lazear, 2005). The spatial effects in the spatially lagged depended variable of the third firm failure process, imply that SMEs' financial distress in the EU countries affect each other. This is also a function of the distance. As such, increasing distances result in firms from countries in the EU periphery to be affected (by greater distance and as such) from firms in Northern Europe, when financial distress is considered. This pattern can be associated with structural considerations related to North versus South Europe that lead in an increase of SME formation and performance in the former (Wever and Keeble, 2016). Whilst there is no evidence in the literature using spatial regression methodologies in SMEs' financial distress and liquidation across the EU countries, the findings of this chapter add to the wider literature by considering SMEs and SME failures in different geographical contexts. Soares and Pina (2017) and Serrano-Cinca et al., (2005) showed that clusters related to firm geography exist in Europe.

With regards to EU countries' firms entering financial distress, the alternative firm failure processes that have been identified exhibit different (although in most cases statistically significant) spatial patterns. The third firm failure process has different signs for the coefficient of the spatially lagged dependent variable when financial distress is considered. This result for the third firm failure process appears possible. Neighbouring firms' characteristics have been identified as significant determinants of firms' operations. This can be due to firms forming business clusters in geographically close areas where firms are connected with buyer/supplier relationships (Porter, 1990). Therefore, it sensible to assume that these relationships and the similarities remain relevant when firms' financial distress and liquidations are concerned. On the other hand, firm failure processes in the EU countries experiencing negative coefficient in the spatially lagged dependent variable can be linked with the interactions between Northern and Southern European SMEs in this case. Whilst spatial effects have been associated with firms' operations and firm creation (Arbia et al., 2014), the evidence directly associated with firms' failure is less clear. Arbia et al. (2014) for example did not find any evidence of spatial effects in a sample of Italian retail stores' growth and survival. On the other hand, Weterings and Marsili (2015) showed that spatial effects, and spatial concentration in particular decreases the propensity of firms to close down operations but pointed that these effects are industry specific. For these reasons, Weterings and Marsili (2015) argued that economic geography should be considered when researching the survival of new firms.

Considering the alternative firm failure processes from a financial distress perspective and liquidation perspective they all have spatial autocorrelation in the error terms with the exception of the third firm failure process (in the case of the financial distress). As it has already been discussed, the existence of significant spatial effects in the error terms highlights the importance of allowing for spatial autocorrelation in the residuals of the econometric models to avoid model mis-specification and also to account for unobservable effects for which the researcher or the policy maker cannot obtain information. For such occasions, the usage of spatial techniques is particularly relevant as controlling for the location, one can effectively control for a number of unobserved variables.

Looking at the spatial effects on the spatially lagged dependent variable for financially distressed firms, all firm failure processes show evidence of statistically significant effects when financial distress is considered. However, the main difference appears to be with the sign of the coefficient. In the third firm failure process, the coefficient is positive, unlike the other failure processes. The sign of the coefficient implies that an increase in the distance is associated with firms' financial distress in this firm failure process. This is slightly counter-intuitive, given that this firm failure process is associated with firms that have the opposite (and statistical significant) sign when liquidation rates are considered, and includes primarily firms from Germany, France and Spain. Therefore, it can be concluded that this sign is associated with temporal associations between firms' financial distress that are located in more distant countries.

Looking at the spatial effects on the spatially lagged dependent variable for liquidated firms, the third firm failure process was associated with firms that have few and relatively young directors and severe liquidity problems and is dominated by firms in Germany and France, which are largely neighboring each other, and Spain. Therefore, the significance in the spatially lagged dependent variable maybe related to neighboring effects of the firms in this cluster, given that the statistical significance is associated with a reduction in the distance between the firms in this cluster. In other words, firms that are located closer are more likely to have a statistically significant association with increased liquidation rates.

7.6.3 Discussion on UK Regions level

Considering firms' financial distress in the UK regions, the evidence of statistically significant effects in the error terms (W_error) of the second and fourth firm failure process shows that, as in the case of EU firms, spatial effects should be accounted for when one studies firms' failure at regional level. The same principle applies to the third and fourth firm failure process when firms' liquidations are concerned in the UK and its regions. Adding further explanatory variables could lead to a reduction of the need of controlling for spatial effects in the error terms, but that may not always be feasible and it may not be sufficient, either. In addition, it is clear from the results that these effects tend to be firm failure process specific, as not all firm failure processes have the same statistical behavior.

For firms' insolvency the first firm failure process experiences spatial effects on the spatially lagged dependent variable. The sign of the coefficient suggest that the liquidations are affected by shorter distances and therefore the association is between neighboring firms. This firm failure process is dominated by firms with low growth rates that are based in London and Yorkshire with some firms also in the South East/West of England. Therefore, there may be some impact from the distance between London and the Yorkshire regions is reflected in the sign of the coefficient.

The second firm failure process does not show statistically significant spatial effects on either the spatially lagged dependent variable or the error term when firm liquidations are considered. These are firms whose transition towards liquidation was influenced by the credit availability and the formation of new firms in a region and are almost equally spread between London, Yorkshire, South East and the Midlands.

The third firm failure process shows spatial effects only in the error term for liquidation. These were mature firms with deteriorating financials mainly in the North of England and Scotland whose transition to liquidation was driven by low GDP (or GVA) growth, a lack of credit availability and the new firms' formation in a region.

Finally, the fourth firm failure process in UK country regions has significant spatial effects when liquidation (and financial distress) was considered, both at the spatial lag (Sig.<0.10) of the dependent variable and in the error terms (Sig.<0.05). These are firms whose transition to liquidation were affected form all the macroeconomic variables.

Critically evaluating the results in the context of the (limited) literature that considers firm failures in a regional context, there is evidence of regional factors can determine firm aggregated firm failures. For instance, Moss and Hume (1983) states that there are local determinants which can affect firm failure at least at the aggregate level in Scotland. However, the determinants of firm failure and their inter-regional variations remained time-persistent (Fotopoulos, 2013).

These determinants included the local business population; potential overtrading; the local availability or lack of financing and the concentration of certain industries in certain cities. This study has accounted for some of the above drivers, but there is clearly little prospect that a model will accommodate every potential macroeconomic or social effect factors among regions or countries. In that context, the results of the previous section are line with evidence from the literature and add an alternative way of accounting for determinants of failure by using the spatial effects.

7.7 Conclusions

The aim of this chapter was to investigate whether there are statistically significant spatial effects that affect the firms which enter financial distress or liquidation in the EU countries and the UK regions. In order to perform this investigation, the data were re-structured and aggregated at EU country and UK region level. Two spatial weights matrices were produced, one for the EU countries and one for the UK regions. These were then incorporated in a spatial autoregressive model that included, and controlled for, both spatial lag effects (in the dependent variable) and spatial error effects (in the error term).

In addition, the country and region-specific macroeconomic and business environment variables that were used in Chapters 5 and 6 are again used to control for the economic and business environment. However, the main focus of this chapter is to investigate whether spatial effects exist. This was tested both at full sample level as well as at firm failure process level, using aggregated firm liquidations and financial distress from the firms that participated in the alternative firm failure processes as established in Chapters 5 and 6.

For the first time in the firm failure literature, the results suggest that there is evidence of spatial effects for both EU countries and UK regions. Whilst different firm failure processes generate different results at the total level, there seems to be evidence that spatial effects for firms in financial distress are directly affected by the firms in financial distress in neighboring EU countries and UK regions. In other words, the geographical location of the firm does matter when it comes to financial distress. At country (EU) level, the geographical location appears to be more related to the proximity between (neighboring) countries. However, within the UK the spatial effects appear to be significant but not necessarily on a close proximity perspective.

On the other hand, for firms' liquidation rates, spatial effects mostly affect the error terms, implying that random omitted variables from the models are spatially correlated. Therefore, there are unobserved effects that are spatially correlated and are significant determinants of firms' liquidations at both EU country level and UK regional level. It also implies that simple regressions that do not explicitly account for spatial effects may produce inconsistent results because they will not account for the spatial autocorrelation on their residuals.

For these reasons the Hypothesis 13a which stated that *there are statistically significant spatial effects associated with EU firm failures* is accepted and Hypothesis 13b stating that *spatial effects are the same between alternative firm failure processes in EU firms, in terms of statistical significance is rejected. On the other hand, for UK firms, hypothesis 14a stating that there are statistically significant spatial effects associated with the UK firm failures* is accepted and hypothesis 14b stating that *spatial effects are the same between alternative firm failure processes in UK firms, in terms of statistical significance* is rejected.

CHAPTER 8: CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

8.1 Introduction

As set out in Chapter one, the aim of this thesis is *to enhance the quantitative firm failure process literature on SMEs, by incorporating elements from the qualitative failure process and the wider firm failure literature.* Chapter 2 critically reviewed the literature and developed most of the hypotheses to enable this thesis to fulfil its aims. Chapter 3 presented the methodology that this thesis has used and introduced some further hypotheses, related to the (econometric) aspect of the spatial location of the firms' transition to failure. Chapter 4 presented the data that this thesis has used. Chapters 5, 6 and 7 analysed the data and critically discussed the results and the relevant hypotheses. This final chapter summarises the above and concludes the thesis.

This chapter proceeds as follows. Section 8.2 presents an overview of the findings and discussions of the three empirical chapters. It also presents the answer to the research aims and objectives and explains the contribution of this research to theory, practice and policy. Section 8.3 discusses the limitation of the research. Section 8.4 provides recommendations for further research. Section 8.5 concludes the thesis.

8.2 Summary of Findings and Discussion

In order for this thesis to achieve its aim, it explores four objectives:

- To investigate the alternative firm failure processes between EU countries and within one country's regions- the UK- by considering financial ratios and the age of the firm.
- To investigate the impact of firms' management characteristics, in addition to the financial ratios and the age of the firm, in the identification of failure processes and their transition to failure between EU countries and within one country's regions- the UK.
- To investigate the influence of business environment factors, management characteristics and excessive growth, in firms' transition towards failure in

the alternative failure processes in EU countries and within one country's regions - the UK.

- To investigate the influence of location at firm level and aggregate firm transitions towards failure in the alternative failure processes between EU countries and within the UK.

8.2.1 Alternative Firm Failure Processes

The results indicate that there are four firm failure processes experienced by SMEs in 8 EU countries: Germany, Italy, France, Spain, Netherlands, Ireland, Sweden and the United Kingdom. Similarly, the results of firms within the UK regions indicate that there are also four failure processes for the UK firms of the sample.

This evidence from both the EU countries and the UK regions, is broadly in line with evidence from the literature where between 3 and 6 firm failure processes have been identified (see for example Argenti, 1976; Laitinen, 1991; Laitinen et al., 2014). Whilst the total number of firm failure processes is the same, the addition of directors' characteristics offers a further differentiating characteristic between firm failure processes. For example, in EU countries, the first firm failure process with directors' characteristics includes firms that have female directors on the board, unlike the rest of the failure processes. Similarly, the number of female directors, as well as the total number and age of directors, differs between the alternative firm failure processes in UK firms. This supports, for the first time in the quantitative firm failure process literature, the evidence of qualitative studies which were supporting that the characteristics of a firms' directors are particularly important characteristics of alternative failure processes in the SMEs (Argenti, 1976; Richardson et al., 1994) and in business generally (Ooghe and De Prijcker, 2008). For this reason, the discussion sections focus more on the firm failure processes with directors' characteristics.

In addition, the findings of this thesis support evidence from the qualitative firm failure process literature that the age of the firm, which is another non-financial firm–specific characteristic, differs between alternative firm failure processes in EU countries. As such the qualitative observation of Argenti (1976) and Richardson et al., (1994) that young firms have a different firm failure process is confirmed in the quantitative context as well both for firms in the EU countries and for those within the UK.

However, one should be wary of the alterative firm failure processes. For firms from the EU countries, the research found that there is a statistically significant difference in firm failure processes across countries regardless of whether or not directors' characteristics were included in the identification of the failure processes. In contrast with the findings for the EU countries, the failure processes in UK firms differ significantly between regions when directors' characteristics are used to determine the failure processes. In such cases, the differences between firm failure processes in UK regions are significant at the 10% level. This evidence further supports the argument that considering directors' characteristics in the formulation of firm failure process provides an additional dimension that one should consider. This result is in line with evidence from the qualitative failure process studies that were mentioned above (see for example Argenti, 1976; Richardson et al., 1994; Ooghe and De Prijcker, 2008).

Critically evaluating these results, which are related with the first two objectives (excluding the transition to failure part of the second objective), it can be stated that directors' characteristics add an additional dimension in the quantitative analysis of firm failure processes across (EU) and within (UK) countries, which has been indicated from the qualitative literature (Argenti, 1976; Argenti, 1976b; Richardson et al., 1994; Ooghe and De Prijcker, 2008). Whilst directors' characteristics do not alter the number of firm failure processes, they do differ between the alternative processes and some processes are associated with certain characteristics in the board structure. For example, only the first firm failure process in EU firms is associated with gender diversity on the board, being the only process with female directors. This is related to the fact that the countries most associated with this firm failure processes (UK and Ireland) have got more gender diversity in their firms' boards.

The other firm-specific characteristics, driven mainly by the financial ratios, are still relevant in the identification of firm failure processes. Some key differentiating factors such as the rapid growth in assets, firms with liquidity constraints and negative cash flows are characteristics that were observed among different firm failure processes both in the EU countries' and the UK regions' firms, which is in line with the literature (Laitinen, 1991; Laitinen and Lukason, 2014; Lukason et al., 2016; Lukason and Vissak, 2017).

In addition, the age of the firm, a non-financial firm-specific characteristic is also different in the alternative failure processes. Young firms have separate firm failure processes, in both the firms in EU countries and the UK regions as do much older firms. Such findings are in line with qualitative firm failure process studies which mentioned that young firms and old firms form different firm failure processes (Argenti, 1976; Ooghe and DePrijcker, 2008). It is also relevant to evidence from the wider failure literature which generally considers young firms as a separate and vulnerable business group (Wilson et al., 2014).

Overall, the identified firm failure processes in both EU and UK firms, were shown to differ between each other. Certain firm failure processes were associated with young firms (EU: first process; UK: fourth process) whilst the remaining processes were associated with firms that faced particular financial (EU: fourth process; UK: first process), managerial and growth problems (EU third process; UK: first process). In this thesis' view, such results confirm evidence from the qualitative firm failure process literature and, in addition, relate the wider firm failure literature with the firm failure process one. The failure processes of this analysis are in line with evidence from the qualitative and existing quantitative firm failure process literature (Laitinen, 1991; Argenti, 1976; Richardson et al., 1994; Ooghe and De Prijcker, 2008; Laitinen and Lukason, 2014; Laitinen et al., 2014; Lukason and Laitinen, 2018). As such, the former is broadly confirmed and extended on a quantitative, multi country and intra country analysis and the latter is extended with inclusion of the directors' characteristics in addition to the multi and intra-country elements.

8.2.2 Firms' Transition to Failure

Considering the firms' transition to failure among the different firm failure processes, the objectives were to identify the impact of firms' management characteristics, in addition to the role of financial ratios and of the influence of business environment factors.

One can see that the alternative firm failure processes have different determinants given the different statistically significant variables. Starting from the financial variables, the statistically significant ratios differ between the alternative firm failure processes and also differ from the full sample. This holds true for firms in both the EU countries and in the UK regions.

In relation to the EU failure processes, all the financial ratios are significant determinants of firms' transition to failure in the full sample. There is a variation in the significant financial determinants of the alternative failure processes[18]. For example, the quick assets to current assets, a measure of working capital for the firms, is the only financial ratio that is not significant in the first firm failure process, which is characterized by young firms with gender diversity on the board. In the context of firm failure processes, this implies that young firms' failure does not depend so much on liquidity and working capital characteristics, possibly due to the existence of the honeymoon period that young firms enjoy in their early years (Fichman and Levithal, 1991).

On the other hand, the second firm failure process which is characterized by firms that on average have negative total asset growth and which are older, has as significant determinants the ratios measuring the total assets' growth, the quick ratio, quick assets to total assets and the trade credit to total liabilities. Likewise the third firm failure process, which is characterized with firms that have very few directors (3 on average) and low returns on equity, have all the financial ratios as significant determinants, with the exception of the net sales to total assets (NSTA) and the quick assets to current assets (QACA). Finally, the fourth failure process which is characterized by firms with very high and increasing net sales to total assets but with deteriorating cash flows have all the financial ratios significant with the exception of trade credit to total liabilities (TCTL). As a result, one can argue that the financial ratios are generally significant determinants of firms' transition to failure but they do differ across the alternative firm failure processes. Therefore attention should be given to an understanding of the failure process that an individual firm belongs to.

[18] In this part, results with Directors' Characteristics are considered.

The results for UK firms' transition to failure are broadly similar with respect to the variability in the significance of financial ratios as determinants of firms' transition to failure, in the alternative failure processes of EU firms. However, not all the financial ratios are identified as significant determinants in the full UK firms' sample. Cash flow to total sales (CFTS), total assets growth (growth_rate), quick assets to total assets (QACA) and trade credit to total liabilities (TCTL) are significant determinants of transition to failure for all the UK firms. Looking at the separate failure processes, one can observe that in the first process, which is associated with firms that have deteriorating growth and high usage of trade credit, the ROI, CFTS, quick ratio, TLTA, QACA and TCTL are all significant. A critical evaluation to this combination would suggest that firms' transition to failure in this failure process of firms with small boards of directors is actually affected by declining returns on investment, cash flow from sales that are growing at unsustainable levels, liquidity and trade credit usage compared to total liabilities which are, however, increasing. These determinants are in addition to increased competition from new firms and decreased credit availability. This is different from the second failure process which is associated with firms that have weak cash flows, despite strong sales and in which ROI, NSTA, quick ratio, growth rate and TLTA are significant determinants of transition to failure.

On the other hand the third firm failure process, associated with firms that have deteriorating cash flows, ROI and low usage of trade credit, have the CFTS, QACA and growth rate as the significant financial ratio determinants in the transition to failure. This means that reduced working capital and cash flow generation are prime reasons of failure and financial distress for these firms. Finally, the fourth failure process included firms that were associated with weak growth and liquidity and also young age, has only ROI, growth rate, TLTA, QACA and TCTL as determinants of the transition to failure. Critically evaluating these characteristics, it can be argued that younger UK firms' (in the fourth failure process) transition to failure is impacted by increased indebtedness and the potential inability to further finance themselves since credit availability is also a significant but negative determinant, of failure. Combined with increasing growth (in total assets), potentially financed with credit, this leads these firms into financial difficulties.

In addition to the above, the age of the firm, which is a further firm-specific non-financial characteristic, has been identified as a determinant of firms' transition towards failure in the full EU and UK firm samples. The significance of the firms' age for the transition to failure differs across the alternative firm failure processes in both the EU and the UK areas. This implies that once the alternative firm failure processes have been identified and the firms are allocated to the alternative processes, the determinants are becoming less associated with the characteristics of the firm failure processes. In other words, some of the characteristics of the alternative firm failure processes are not necessarily determinants of firms' transition to failure. In some failure processes (third for EU firms and third and fourth for UK firms) age is a characteristic of the failure process but not a determinant of the transition to failure. Therefore, firms in these failure processes appear to have solved the foundation difficulties associated with very young (Finchman and Levithal, 1991) or very old (Argenti, 1976) firms and their behavior with regards to failure is associated with the rest of the determinants.

The directors' characteristics as determinants of firms' transition to failure are a further significant set of impact factors. Evidence from the wider failure studies' literature suggests that directors' characteristics are significant drivers of failure between failed and non-failed firms (see for example, Finkelstein and D'Aveni, 1994; Watson, 2003; Wilson et al., 2014). The presence of more directors indicates extensive social capital and networks and is negatively associated with failure. In addition the age of directors' is used as a proxy for the experience of directors and as such it is also negatively associated with failure. On the other hand, part of the literature suggests that gender diversity is negatively associated with firm failure because the presence of women on the board adds a different perspective to decision-making due to additional human capital and women's reasoning methods (Adams and Ferreira, 2009; Bart and McQueen, 2013). In addition increased diversity is associated with higher independence in the boards' decision-making in the context of the agency theory (Carter et al., 2010). However, the dynamics on the board may be negatively affected too; women may be tougher when monitoring decision-making and that may in some cases reduce their role in the actual decision-making (Appiah, 2013).

In this analysis, directors' characteristics are significant determinants of firms' transition to failure in some failure processes both for EU countries and for UK regions with the expected negative signs of association with failure. One exception is the third firm failure process in UK firms were the number of directors is positively associated with firms' transition to failure. However, this failure process has the highest number of directors, and as such, beyond a certain point, there is also evidence that too many directors are counter-productive for the firm's decision making (Judge and Zeithaml, 1992). As such, extending the current literature, this thesis provides further evidence that directors' characteristics are significant determinants of firms' transition to failure, even when only bankrupt firms are researched.

Lukason and Hoffman (2015), argued that internal and/or external factors generally explain firms' failures. Yet there is little evidence of the consideration of external factors in the context of the alternative firm failure processes in the firm failure process literature. This thesis examines the economic and business environment, the results indicate that these elements are significant both when firms from a variety of EU countries are analyzed and also when a country-specific analysis is taking place. At the level of both EU countries and UK regions' firms, GDP growth and credit availability are significant determinants of firms' transition to failure in some failure processes. A reduction in GDP growth and credit availability is a significant determinant of firms' transition to failure for a number of failure processes. The key point is that there are variations of significance in the different processes. Based on the Lukason and Hoffman (2015) argument that firm failures in general, can be driven by external or internal factors or from a combination of both, this finding is intuitive. The external economic conditions affect differently the alternative firm failure processes depending on the firms' financial and management characteristics in these processes.

Likewise, the business and country-specific environment appeared to be significant determinants of firms' transition to failure in a number of firm failure processes in the EU and UK firms. For example, the legal tradition of EU countries was identified as a key determinant of firms' transition to failure in all firm failure processes. Firms in common law countries had a negative association with transition to failure, due to the legal framework in these countries being more credit friendly (La Porta et al., 1998). In relation to the UK, firms operating in UK regions with increasing competition from new firm entrants were more likely to transition to failure. These results are in line with evidence from the wider firm failure literature (Wang 2012; Keeble and Walker, 1994) and are analyzed for the first time within the context of a quantitative firm failure process analysis.

Such evidence is conceptually in line with evidence from the wider failure studies literature where the economic environment (proxied by GDP growth) and the credit availability have been found to be negatively associated with firms' propensity to failure. This evidence appears both in firm-level and in aggregate studies in the SME and corporate world (see for example, Jones, 2013; Liu, 2009; Succurro, 2010; Ma and Lin, 2010). This thesis not only adds that the economic environment remains particularly important in firm failure process studies, it also adds to the qualitative firm failure process literature that has made similar references (Argenti, 1976). Likewise, the business environment at country level includes element of its legal tradition and the competition in the market within a country's region from newly incorporated firms. Both elements have been discussed as influential to the wider firm failure context. Common law countries have been identified as more forgiving to entrepreneurs and increased competition from firms has been associated with increased firms' failures (see for example Venkataraman et al., 1990; Hope, 2003; LaPorta et al., 1998; Wang, 2012). This is driven by common law countries having more efficient judicial systems which may result in more successful reorganization processes compared to countries with civil law origins (Wang, 2012). This thesis identifies and highlights for first time, their significance in the context of firm failure process and transition to failure.

8.2.3 Location and Spatial Effects

The final objective of this thesis is to analyse the influence of location at firm level and aggregate firm transitions towards failure in the alternative failure processes between EU countries and within the UK.

Evidence from the firm-level analysis of the EU firms and the UK regions indicate that, in a number of firm failure processes, certain locations (countries or regions) can be an important determinant of firms' transition to failure. For example, Spain, Sweden and Ireland were significant determinants of firms' transition to failure for all processes with directors' characteristics. Spanish and Irish firms' propensity for transition to failure was higher than those in the full UK sample. In contrast, Swedish firms' propensity for transition to failure was lower that the UK firms. Other countries, like Germany, Italy and the Netherlands were not determinants of firms' transition to failure in the full sample. In addition, Italy has a different relationship with the transition to failure in the alternative firm failure processes, negative in the first and positive in the second and third firm failure processes. This implies that firm characteristics, associated with the firm failure processes do also affect the relationship with the transition to failure.

Likewise, in UK regions, certain regions (North West, South West, East Anglia, Wales) were not significant determinants for the firms' transition to failure in any firm failure process; whilst others (Scotland, West Midlands) were significant in all firm failure processes and the remaining (Yorkshire, East Midlands, N. Ireland, North East, South East) were significant only in some of the firm failure processes. Such result implies that some locations within the UK are associated with a "disadvantage" when the transition to failure is concerned for firms that have certain characteristics (as implied by the failure processes).

Critical evaluation leads to a number of possible reasons for the influence of country and regional differences on a firm's transition to failure. For example, Gries and Naude, 2008; Loghi et al., 2014; Bosma and Schutjens, 2009; Stulz and Williamson, 2003, find that cultural factors, proximity to banks, the presence of business networks within a particular area and the specialization of business districts affect business performance and hence by implication, business failure.

For that reason and in addition to the firm-level analysis of location, using spatial data analysis, for first time in a firm failure process analysis, this thesis investigated the significance of location at the aggregate level for these firms, both for the firms in the EU countries and also for those in the UK (regions). Whilst there is no evidence of spatial data analysis in firm failure process studies, the evidence from the literature that firms' location may affect their failure due to supplier-customer relationships and due to specialization of certain geographical areas in specific type of businesses (Henderson, 2007) suggest that the tools of economic geography, by means of spatial analysis, are useful.

The analysis results confirm that spatial location is important for firms in EU countries and for firms in the UK regions in their transition to failure (both for financial distress and for liquidation). In addition, the significance of spatial location is not (statistically) the same among the alternative firm failure processes. From a spatial analysis perspective, distance and by extension the effect of neighboring regions (or countries) can be important. In some firm failure processes increasing distance between firms was positively associated with failure whilst in others the opposite was true. To that end, at country (EU) level the geographical location appears to be more related to the proximity between (neighboring) countries. However, within the UK the spatial effects appear to be significant but not necessarily on a close proximity (distance-based) perspective but rather in association to key regions such as London. This is associated with London being a significant business centre of agglomeration of economic activity (Longhi et al., 2014).

Therefore, the importance of geographical location, as analyzed in the context of spatial analysis can be an area that needs further attention from policy and decision-makers where country level aggregate firm failures are analysed. This is because, this thesis shows that neighboring countries and firm relationships between regions affect each other’s firms’ failure. Such effects are usually unobserved and therefore are not accounted for, due to the lack of data, unless spatial analysis is undertaken.

8.3 Contribution of the Research

Given the above results, this thesis contributes to the academic literature in a number of ways.

First, it investigates the existence of firm failure processes in 8 EU countries and, in addition, in regions of the UK. Second, it further develops the qualitative firm failure process literature by incorporating evidence from the qualitative firm failure process literature and from wider firm failure studies. In doing so, it demonstrates that directors' characteristics add further value when they are included in the identification of firm failure processes, across the EU countries and within the UK regions.

Third, it investigates the determinants of firms' transition to failure both in a cross country (EU countries) context and in an intra-country (the UK regions) context. In doing so, it examines firm-specific characteristics (those which were used to define the failure processes) together with a number of economic and business environment factors. The results indicate that these factors can be significant determinants of firms' transition to failure; they also differ between the alternative firm failure processes. In addition, the transition to failure includes two steps: first, financial distress and second, liquidation. Bringing all these elements together, this thesis further links the limited firm failure process literature with the wider firm failure literature. Moreover, this thesis provides evidence that excessive growth in firms can be associated with failure. Firms' growth is regarded as a positive development because firms that are growing are seen as successful, they are employing more people and generating more income which is associated with contribution to taxes (Parker, 2004; Valliere, 2006). However, this thesis finds that excessive growth in sales is associated with failure if this growth is not accompanied by investment in assets. As such, this thesis extends the findings from Higgins (1977) Platt and Platt (1995) and Argenti (1976b) by confirming an association between excessive growth and failure in the context of a quantitative firm failure process analysis.

Fourth, in relation to the business and economic environment as determinant of firms' transition to failure, this study provides evidence, for first time in a quantitative firm failure process study, that the legal tradition of a country, and the competition that firms face from new businesses in a region can be significant determinants of firms' transition to failure.

Fifth, the thesis examines the importance of firm location not only by using firm-level information for the country or the region where a firm belong to but also by utilizing spatial panel data techniques on aggregated firm failure results in the alternative firm failure processes. By doing so, the thesis concludes that the location and the distance between firms can be a significant determinant of firms' failure in the alternative firm failure processes both in an EU countries context and in the context of the UK regions.

Overall , the results support the theory (Section 1.2.2) that firm failure is a process that builds up over a period of time rather than being the result of a specific event. It also provides evidence that firm failure processes differ due to changing of significance level in some determinants.

Given the above, a number of implications arise from the results of this thesis which might be useful for policy makers, lending professionals and institutions, rating agencies and firm managers.

First, policy makers should perhaps consider some key characteristics of the failure processes when planning support mechanisms to prevent SME failure. Such mechanisms and policies should be relevant to the failure process to which firms belong as it is unlikely that generic approaches will equally benefit firms that belong to different firm failure processes and as such share different characteristics. In addition, policy makers should also consider the location and the management of the firm as both contribute significantly to the firms' propensity to fail. A firm's location should be still considered within the context of the alternative firm failure processes where a firm belongs to. Likewise, management characteristics, including diversity and experience of the board, should be carefully considered. Policy interventions should focus not only on providing firms with financial support but also providing better education to firms' stakeholders about the benefits of having an experienced and diversified board, depending on the firm failure process that a firm is associated with. At EU country level, policy makers need also to tailor SME's support by considering the legal tradition of the country where the firms operate. At country/regional level, policy makers should consider diversifying policies to encourage new business growth and combine that with assistance for existing firms that are in a deteriorating trajectory. This is an important note, given that increased competition from new firms can result in failures of firms, in most firm failure processes. Finally, any policies at country or regional level should consider the geographical location of firms. This is important because increasing firm failures in regions or countries can be associated with firm failures in neighboring countries and regions. As such, policies that target a specific area without considering the neighboring areas could be insufficient to reduce firm failures at aggregate level. Likewise, an identification of the firm failure process of a firm, and therefore the identification of the underlying causes of failure, can assist in designing more targeted solutions to support SMEs.

Second, bank lending and restructuring professionals' decisions can be influenced from the results of the study. Firms' failure trajectories can be identified based on the underlying firm-specific characteristics that this thesis discussed. As such, any lending or restructuring decisions can be influenced depending on the firm failure process a firm is associated with and depending on the conditions of the economic and business environment. Certain firm failure processes are less dependent on the economic environment whilst others are more dependent on it. It is therefore unlikely that generic approaches and assessments of the likelihood of failure are equally applicable to all firms when the failure processes are not considered. In addition care should be taken in the interpretation of sales growth in firms. Evidence from this thesis shows that excessive levels of growth should be treated with caution.

Third, agencies that analyse SME data for credit reports and risk assessments may need to consider the elements that this thesis has highlighted. It is unlikely that creditworthiness and risk of failure between firms that are associated with different firm failure processes can be assessed in the same way since the determinants of firms' transition to failure differ among these processes.

Fourth, firm managers can identify the firm failure process of their firms when things start deteriorating and before firms transition to failure. Depending on the firm failure process, a number of actions can be taken to increase the board's experience, social capital and diversity as this can be associated with reduced propensity to transition towards failure.

8.4 Limitations of the Study

This thesis has a three types of limitations. The first is related to the data sample. The second is related to the inclusion of certain variables. The third is related to the limitations of software.

First, the data sample includes a number of firms from 8 EU countries (the UK regional data is included in these) covering a certain period of time. As a result inclusion of further EU countries or the inclusion of further years or a general increase in the number of firms could lead to bigger samples. These would lend further weight to the results and would enable enhanced generalization of these results at EU level. Nevertheless, a number of robustness checks and weightings to reflect the business population in the countries have been made returning consistent results.

Second, the selection of financial ratios was based in a combination of literature review and a comparison with data availability in the sample. It is well documented that the wider firm failure literature is criticized for the arbitrary nature of the ratio selection (see for example Balcaen and Ooghe, 2006). Nevertheless, the selected ratios reflect both the literature and also cover the basic dimension of a firm’s financial management (Berk and DeMarzo, 2011) and as such the results should be robust in this respect.

Third, some additional quantitative techniques could have been employed to provide further insight- perhaps in the context of future research. However, limitations of the currently used statistical software prohibit usage of (for example) spatial panel data at firm-level.

8.5 Recommendations for Future Research

This thesis can be developed in a number of ways. First, independent analysis on the transition to financial distress or on the transition to liquidation can be made outside the context of the order panel model. Therefore, one can assess financial distress or liquidation independently in each occasion.

Second, the results of the alternative firm failure processes can be applied to the context of firm failure prediction for alternative failure processes. Whilst additional data from non-failed firms would be required, it would be an area of interest to evaluate failure prediction techniques in alternative failure processes.

Third, further research can be made on the area of sustainable growth for SMEs. The particular metric has been proven to be a particularly strong determinant of firms' transition to failure in a number of firm failure processes. As such further work can be made to link this metric with SMEs failure across the European countries.

Fourth, the introduction of spatial data analysis for first time in the context of firm failure process and generally in the context of firm failure, opens significant opportunities to utilize such techniques to further research firms' propensity to fail at a more granular (within country) or more aggregate (between countries) level.

Fifth, one can extend the analysis of this thesis should further data become available. For example, data related to further directors' characteristics and the ownership of the firm can add further dimensions to this area of research. Likewise, larger samples with additional countries could provide further insight into the quantitative aspect of firm failure processes.

8.6 Conclusion

This thesis has highlighted that the consideration of firm failure as a process is significant due to the differences that persist the determinants of firms' transition to failure in the alternative firm failure processes.

The analysis confirms the broader firm failure process literature that there are between 3-6 firm failure processes in any given country, by identifying 4 in a sample of EU countries and confirming this number within the UK. It also adds to the literature that the consideration of directors' characteristics is important both for the identification of the failure processes and the analysis of the firms' determinants for their transition towards failure. In addition, this quantitative analysis confirms a number of observations from qualitative studies. It confirms that firms' management is an important determinant of firms' failure processes, and adds that management characteristics, together with the financial ratios, are generally significant determinants of transition to liquidation, across a number of different failure processes.

Additionally, this thesis critically evaluated a number of wider characteristics (economic environment, legal tradition, new firms' creation, sustainable growth level) that are significant determinants of firms' transition to failure in a number of failure processes for EU and UK firms. As such it extends the firm failure process literature to this direction.

Finally, this thesis provides a methodological contribution to the investigation and measurement of the importance of location for firms' transition to failure in different failure processes.

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APPENDIX A

Table A.1: Descriptive statistics of main continuous variables for firms that eventually failed per country

	France		Germany		Ireland		Italy		Netherlands		Spain		Sweden		United Kingdom	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
roi	-0.05	0.85	-0.46	1.96	-0.38	1.62	-0.06	0.40	-0.56	1.81	-0.04	2.07	-0.03	0.25	-0.23	13.11
growth_rate	1.82	13.37	1.05	23.60	28.28	27.55	0.18	1.82	1.26	29.12	0.27	4.78	0.15	1.46	6.30	172.68
nsta	2.27	2.21	4.35	10.82	2.08	1.29	1.56	2.41	2.85	3.20	1.44	3.09	2.74	2.73	3.00	26.03
cfts	0.02	33.07	-0.43	5.45	-0.71	1.43	-0.33	11.57	-0.37	0.88	-1.13	21.81	-0.08	0.53	-0.51	9.81
quick_ratio	2.12	8.65	21.70	202.94	11.08	74.99	1.22	10.74	1.40	4.20	2.58	36.26	2.15	9.32	12.08	179.71
tlta	1.02	5.47	1.02	3.38	2.21	19.73	0.91	0.41	1.64	14.43	0.84	1.69	0.76	0.25	1.12	18.19
qaca	0.88	0.29	0.95	0.44	0.95	0.40	0.75	0.34	0.94	0.68	0.69	0.42	0.90	0.41	0.96	0.30
tctl	0.39	0.21	0.17	0.17	0.18	0.19	0.32	0.24	0.28	0.15	0.20	0.23	0.27	0.20	0.23	0.21
firmage	19.42	14.11	23.78	31.25	19.52	8.66	19.43	16.64	22.11	26.29	16.89	13.55	18.48	16.44	13.08	51.78
avg_dir_age	40.28	13.81	47.06	12.27	50.37	8.47	55.63	9.57	42.96	11.58	45.06	8.75	40.52	11.98	50.85	8.74
Nr_Female_Dir	0.86	1.35	0.19	0.45	2.64	2.86	0.64	1.28	0.28	0.78	0.68	1.12	0.46	0.91	2.50	2.15
Total_Dir_Nr	5.37	4.50	2.33	1.82	13.31	8.91	4.81	4.28	3.90	2.69	5.57	4.03	3.99	3.36	14.16	9.93
credit	89.76	7.09	95.59	6.58	134.42	23.79	83.67	9.12	115.37	1.99	157.42	18.49	115.55	12.10	171.83	19.34
GDP_gr	1.13	1.76	1.36	3.28	1.92	3.79	-0.12	2.46	1.35	2.30	1.24	2.70	1.91	3.46	1.30	2.05
Liq.Firms per country	774		736		114		1,245		185		1,042		120		979	

Table A.2: Results of the Skewness/Kurtosis test of Normality

Skewness/Kurtosis tests for Normality

Variable	Pr (Skewness)	Pr (Kurtosis)	chi2(2)	Prob>chi2
ROI	0.0000	0.0000	17360.85	0.0000
Growth Rate	0.0000	0.0000	16782.03	0.0000
NSTA	0.0000	0.0000	11030.79	0.0000
CFtS	0.0000	0.0000	11824.42	0.0000
Quick Ratio	0.0000	0.0000	12500.20	0.0000
TLTA	0.0000	0.0000	17317.06	0.0000
QACA	0.0000	0.0000	3804.50	0.0000
TCTL	0.0000	0.0000	924.54	0.0000
Firm Age	0.0000	0.0000	837.45	0.0000
Average Director Age	0.0000	0.0000	347.98	0.0000
Female Director Nr.	0.0000	0.0000	3586.48	0.0000
Number of Directors	0.0000	0.0000	3450.24	0.0000
Credit	0.0000	0.0000	189.22	0.0000
GDP growth	0.0000	0.0000	559.55	0.0000

Table A.3 Results of the Shapiro-Wilk test of Normality

Shapiro-Wilk W test for normal data				
Variable	W	V	z	Prob>z
ROI	0.04053	2693.432	20.750	0.0000
Growth Rate	0.00702	2787.504	20.841	0.0000
NSTA	0.2053	2230.899	20.255	0.0000
CFtS	0.05308	2658.200	20.716	0.0000
Quick Ratio	0.06854	2614.804	20.672	0.0000
TLTA	0.02065	2749.237	20.804	0.0000
QACA	0.8647	379.814	15.604	0.0000
TCTL	0.92105	221.626	14.189	0.0000
Firm Age	0.78121	613.777	16.865	0.0000
Average Director Age	0.94446	155.916	13.265	0.0000
Female Director Nr.	0.85582	404.736	15.771	0.0000
Number of Directors	0.76962	646.728	17.002	0.0000
Credit	0.81699	513.740	16.398	0.0000
GDP growth	0.96231	105.807	12.247	0.0000

Table A.4: Results of the Shapiro-Francia test of Normality

Shapiro-Francia W' test for normal data				
Variable	W'	V'	z	Prob>z
ROI	0.03919	2912.401	20.254	0.0000
Growth Rate	0.00656	3011.317	20.339	0.0000
NSTA	0.20393	2413.064	19.777	0.0000
CFtS	0.05184	2874.064	20.220	0.0000
Quick Ratio	0.06763	2826.219	20.178	0.0000
TLTA	0.01984	2971.052	20.305	0.0000
QACA	0.86264	416.377	15.315	0.0000
TCTL	0.92280	234.011	13.852	0.0000
Firm Age	0.78132	662.394	16.493	0.0000
Average Director Age	0.94480	167.329	13.000	0.0000
Female Director Nr.	0.86012	424.015	15.361	0.0000
Number of Directors	0.77146	692.754	16.608	0.0000
Credit	0.81877	549.354	16.019	0.0000
GDP growth	0.96254	113.540	12.016	0.0000

Table A.5: Correlation matrix of variables without lags.

	ROI	Growth Rate	NSTA	CFtS	Quick Ratio	TLTA	QACA	TCTL	Firm Age	Average Director Age	Female Director Nr.	Number of Directors	Credit	GDP growth
ROI	1.0000													
Growth Rate	-0.0022	1.0000												
NSTA	-0.4073	0.0302	1.0000											
CFtS	0.0099	0.0002	0.0178	1.0000										
Quick Ratio	0.0038	-0.0015	0.0024	-0.0351	1.0000									
TLTA	-0.1459	0.0005	0.2475	-0.0003	-0.0067	1.0000								
QACA	0.0100	0.0654	0.0834	-0.0029	0.0567	0.0176	1.0000							
TCTL	0.0214	0.0171	0.0272	0.0742	-0.0674	-0.0310	0.0978	1.0000						
Firm Age	0.0033	0.0011	-0.0145	0.0007	-0.0040	0.0003	-0.0507	-0.0011	1.0000					
Average Director Age	-0.0018	-0.0092	-0.0102	-0.0019	-0.0002	0.0071	-0.0720	0.0032	-0.0695	1.0000				
Female Director Nr.	0.0034	0.0872	-0.0219	-0.0026	-0.0034	0.0243	0.0372	-0.0177	-0.3598	-0.0211	1.0000			
Number of Directors	-0.0058	0.0168	-0.0465	-0.0381	-0.0091	0.0557	0.0276	-0.0170	-0.4018	0.0379	0.6124	1.0000		
Credit	-0.0120	-0.0069	-0.0822	-0.0235	-0.0395	-0.0128	-0.1545	-0.1390	-0.4512	-0.0604	0.2440	0.3253	1.0000	
GDP growth	0.0408	0.0104	0.1148	0.0016	0.0680	0.0115	0.1651	-0.0110	-0.3027	-0.0922	0.0845	0.0707	-0.1378	1.0000

Table A.6: Partial Correlation matrix of variables without lags.

	ROI	Growth_Rate	NSTA	CFTS	Quick Ratio	TLTA	QACA	TCTL	Firm Age	Average Director Age	Female Director Nr.	Number of Directors
ROI		-0.196	0.058	0.040	0.006	0.001	-0.017	0.018	-0.017	0.012	0.006	0.004
Growth_Rate	-0.196		0.312	0.008	0.002	0.003	-0.016	-0.074	-0.058	-0.001	0.046	-0.015
NSTA	0.058	0.312		0.012	0.007	0.004	0.113	0.218	-0.010	-0.019	0.020	-0.084
CFTS	0.040	0.008	0.012		-0.009	0.000	-0.010	0.025	0.036	0.005	0.004	-0.004
Quick Ratio	0.006	0.002	0.007	-0.009		0.000	0.034	-0.037	0.045	-0.001	-0.001	-0.013
TLTA	0.001	0.003	0.004	0.000	0.000		-0.004	-0.005	-0.054	0.003	0.007	0.018
QACA	-0.017	-0.016	0.113	-0.010	0.034	-0.004		0.060	0.079	-0.085	0.013	0.014
TCTL	0.018	-0.074	0.218	0.025	-0.037	-0.005	0.060		-0.007	-0.015	-0.006	0.009
Firm Age	-0.017	-0.058	-0.010	0.036	0.045	-0.054	0.079	-0.007		0.039	-0.010	0.096
Average Director Age	0.012	-0.001	-0.019	0.005	-0.001	0.003	-0.085	-0.015	0.039		-0.076	0.093
Female Director Nr.	0.006	0.046	0.020	0.004	-0.001	0.007	0.013	-0.006	-0.010	-0.076		0.615
Number of Directors	0.004	-0.015	-0.084	-0.004	-0.013	0.018	0.014	0.009	0.096	0.093	0.615	

Table A.7: Correlation matrix of variables with lags.

	ROI	ROI t-1	ROI t-2	ROI t-3	ROI t-4	ROI t-5	ROI t-6	ROI t-7	Growth Rate	Growth Rate t-1	Growth Rate t-2	Growth Rate t-3	Growth Rate t-4	Growth Rate t-5	Growth Rate t-6	Growth Rate t-7	NSTA	NSTA t-1	NSTA t-2	NSTA t-3	NSTA t-4	NSTA t-5	NSTA t-6	NSTA t-7	CFtS	CFtS t-1	CFtS t-2	CFtS t-3	CFtS t-4	CFtS t-5	CFtS t-6	CFtS t-7	Quick Ratio	Quick Ratio t-1	Quick Ratio t-2	Quick Ratio t-3	Quick Ratio t-4	Quick Ratio t-5	Quick Ratio t-6	Quick Ratio t-7	TLTA	TLTA t-1	TLTA t-2	TLTA t-3	TLTA t-4	TLTA t-5	TLTA t-6	TLTA t-7	QACA	QACA t-1	QACA t-2	QACA t-3	QACA t-4	QACA t-5	QACA t-6	QACA t-7	TCTL	TCTL t-1	TCTL t-2	TCTL t-3	TCTL t-4	TCTL t-5	TCTL t-6	TCTL t-7	Firm Age	Average Director Age	Female Director Nr.	Number of Directors	Credit	Credit t-1	Credit t-2	Credit t-3	Credit t-4	Credit t-5	Credit t-6	Credit t-7	GDP growth	GDP growth t-1	GDP growth t-2	GDP growth t-3	GDP growth t-4	GDP growth t-5	GDP growth t-6	GDP growth t-7
ROI	1.000
ROI t-1	-0.024	1.000
ROI t-2	-0.003	0.378	1.000
ROI t-3	-0.001	0.021	0.028	1.000
ROI t-4	-0.013	0.193	0.349	0.105	1.000
ROI t-5	-0.006	0.163	0.227	0.075	0.294	1.000
ROI t-6	-0.003	0.102	0.167	0.142	0.277	0.372	1.000
ROI t-7	0.000	0.051	0.090	0.146	0.144	0.187	0.415	1.000
Growth Rate	-0.002	0.003	0.003	0.000	0.003	0.003	0.005	0.005	1.000
Growth Rate t-1	0.000	0.090	0.004	-0.001	-0.001	0.000	0.001	0.012	0.000	1.000
Growth Rate t-2	0.002	-0.007	0.074	0.001	-0.005	-0.005	-0.009	-0.011	0.000	0.003	1.000
Growth Rate t-3	0.002	0.002	-0.026	-0.017	-0.035	-0.018	-0.044	-0.031	0.001	0.001	0.022	1.000
Growth Rate t-4	0.001	0.003	0.001	-0.004	-0.020	0.002	-0.004	-0.003	0.000	0.000	0.003	0.006	1.000
Growth Rate t-5	0.000	-0.005	-0.010	-0.007	-0.013	-0.059	-0.003	0.000	0.001	0.000	0.000	0.002	0.001	1.000
Growth Rate t-6	0.002	-0.047	-0.073	-0.091	-0.128	-0.143	-0.436	-0.062	0.008	-0.003	0.001	0.029	0.000	0.001	1.000
Growth Rate t-7	0.008	0.002	-0.014	-0.099	-0.044	-0.038	-0.142	-0.323	0.009	0.008	0.015	0.025	-0.001	0.010	0.061	1.000
NSTA	-0.407	-0.166	-0.104	-0.005	-0.066	-0.050	-0.057	-0.047	0.030	0.000	0.002	0.008	0.002	0.001	0.003	0.023	1.000
NSTA t-1	0.001	0.000	-0.109	-0.002	-0.027	-0.015	-0.006	0.004	-0.007	0.217	0.003	0.006	0.004	0.004	0.004	-0.009	0.186	1.000
NSTA t-2	0.003	-0.022	-0.094	-0.003	-0.036	-0.029	-0.038	-0.035	-0.006	-0.002	0.207	0.003	0.002	0.004	0.003	0.013	0.190	0.304	1.000
NSTA t-3	0.001	-0.001	-0.006	-0.008	-0.005	-0.005	-0.005	-0.001	-0.001	-0.001	0.000	0.910	0.000	0.000	-0.002	-0.007	0.029	0.040	0.044	1.000
NSTA t-4	0.004	-0.016	-0.096	-0.003	-0.037	-0.039	-0.052	-0.007	-0.003	-0.001	-0.001	-0.006	0.004	0.004	0.034	0.052	0.146	0.660	0.245	0.078	1.000
NSTA t-5	0.003	-0.016	-0.056	-0.005	-0.054	-0.032	-0.028	-0.003	0.005	0.000	-0.002	0.000	0.005	0.009	0.038	0.114	0.093	0.155	0.188	0.096	0.570	1.000
NSTA t-6	-0.002	0.007	0.011	-0.003	0.002	-0.006	-0.027	-0.015	0.007	0.001	0.003	0.004	-0.011	0.001	0.045	0.151	0.065	0.100	0.125	0.093	0.490	0.813	1.000
NSTA t-7	0.000	0.020	0.019	-0.004	0.011	0.008	0.004	-0.018	0.010	0.005	0.009	0.013	-0.008	0.004	-0.054	0.202	0.021	0.025	0.053	0.088	0.443	0.722	0.849	1.000
CFtS	0.010	0.003	0.002	0.000	0.004	-0.001	0.001	-0.001	0.000	0.000	0.001	-0.001	-0.004	0.001	0.004	0.011	0.018	0.014	0.011	0.002	0.010	0.017	0.016	0.011	1.000
CFtS t-1	0.001	0.095	0.011	0.001	0.002	0.000	0.000	0.000	0.000	0.001	0.000	-0.006	0.002	0.000	0.007	0.008	0.015	0.017	0.015	0.003	0.013	0.018	0.015	0.012	0.133	1.000
CFtS t-2	-0.001	0.011	0.046	0.002	0.025	0.005	0.005	0.002	0.001	0.001	-0.001	-0.003	0.001	0.001	0.005	0.001	0.010	0.009	0.010	0.002	0.007	0.011	0.007	0.007	0.014	0.030	1.000
CFtS t-3	-0.001	0.003	0.007	0.008	0.011	0.003	0.004	0.003	0.000	0.000	0.000	-0.001	-0.001	0.000	-0.009	-0.019	-0.010	-0.005	-0.009	0.000	-0.003	-0.003	-0.001	-0.001	-0.226	-0.007	0.006	1.000
CFtS t-4	0.002	0.005	0.008	0.003	0.026	0.020	0.009	0.005	0.001	0.000	0.001	-0.002	0.000	-0.001	-0.012	-0.002	-0.001	-0.002	0.000	0.000	0.005	0.004	-0.004	0.005	-0.016	-0.013	0.000	0.013	1.000
CFtS t-5	0.019	0.006	0.009	0.003	0.014	0.028	0.016	0.008	0.000	0.000	0.000	-0.002	0.001	-0.001	-0.012	-0.005	-0.033	-0.001	0.000	0.000	0.007	0.004	-0.005	0.001	0.021	-0.012	-0.005	-0.302	0.632	1.000
CFtS t-6	-0.001	0.005	0.007	0.007	0.013	0.017	0.053	0.026	0.001	-0.001	0.001	-0.002	0.000	0.001	-0.026	-0.005	-0.001	0.002	0.000	0.001	-0.002	-0.003	0.006	-0.004	-0.004	0.004	-0.001	0.112	0.003	-0.021	1.000
CFtS t-7	-0.002	0.006	0.013	0.014	0.015	0.015	0.043	0.246	0.002	0.002	-0.001	-0.003	-0.001	0.001	-0.008	-0.080	-0.006	0.000	-0.005	0.001	-0.003	-0.005	-0.003	0.000	-0.154	-0.004	0.004	0.537	0.001	-0.191	0.233	1.000
Quick Ratio	0.004	-0.003	-0.004	-0.002	-0.067	-0.032	-0.054	-0.063	-0.002	0.000	0.000	0.003	0.000	0.002	0.021	0.032	0.002	0.006	0.003	0.001	0.032	0.058	-0.004	-0.003	-0.035	-0.001	-0.003	-0.002	-0.001	0.001	-0.001	-0.004	1.000
Quick Ratio t-1	0.002	0.018	0.011	0.001	0.003	0.002	0.007	0.003	-0.002	-0.001	0.002	0.004	-0.001	0.001	-0.007	-0.013	0.003	0.023	0.023	0.009	0.005	0.005	-0.008	-0.004	-0.008	0.001	0.003	0.000	0.002	0.002	0.005	0.004	0.204	1.000
Quick Ratio t-2	0.001	0.002	0.007	-0.001	0.004	-0.031	0.008	0.006	-0.001	0.000	0.000	0.001	-0.001	0.004	-0.007	-0.012	0.006	0.008	0.006	0.003	0.006	0.015	-0.004	0.000	0.000	0.002	0.004	0.002	0.003	0.001	0.003	0.004	0.104	0.078	1.000
Quick Ratio t-3	0.002	0.001	0.005	0.001	0.006	0.002	0.006	0.005	-0.001	0.000	-0.001	-0.001	-0.002	0.000	-0.008	-0.008	0.001	0.005	0.005	0.002	0.001	0.001	-0.008	-0.005	0.002	-0.001	0.002	0.001	0.002	0.002	0.002	0.002	0.024	0.054	0.238	1.000
Quick Ratio t-4	0.001	-0.020	-0.031	0.000	0.009	-0.003	0.010	0.005	0.001	0.000	-0.002	-0.004	-0.002	0.000	-0.004	-0.004	-0.001	0.006	0.003	0.000	0.008	0.006	0.000	0.000	0.001	-0.004	0.002	0.000	-0.014	-0.011	0.002	0.001	0.017	0.101	0.070	0.672	1.000
Quick Ratio t-5	-0.002	-0.010	-0.007	0.004	-0.005	-0.006	0.014	0.006	0.006	0.001	0.008	-0.004	0.008	0.001	0.006	-0.004	0.001	0.026	0.008	0.001	0.026	0.019	0.007	-0.001	-0.001	-0.003	0.000	0.000	-0.029	-0.019	0.002	0.003	0.011	0.045	0.032	0.331	0.390	1.000
Quick Ratio t-6	0.003	0.005	0.006	0.001	0.004	0.001	0.007	0.004	0.004	-0.001	-0.002	-0.002	-0.002	-0.001	0.010	0.004	-0.002	-0.003	-0.001	-0.001	0.000	0.010	0.015	0.005	0.001	-0.001	-0.001	0.002	-0.012	-0.007	0.002	0.001	0.013	0.020	0.016	0.026	0.017	0.141	1.000
Quick Ratio t-7	0.000	0.007	-0.003	0.001	-0.006	-0.004	-0.009	0.007	0.009	0.001	0.003	0.004	-0.001	0.000	0.009	0.039	-0.005	-0.006	-0.003	-0.001	-0.001	0.005	0.013	0.031	-0.025	-0.006	-0.003	-0.001	-0.002	0.001	0.002	0.004	0.007	0.018	0.017	0.017	0.028	0.031	0.388	1.000
TLTA	-0.146	-0.127	-0.029	-0.002	-0.088	-0.014	-0.022	0.000	0.001	0.000	0.014	0.001	0.003	0.000	0.005	0.007	0.248	-0.003	0.000	0.000	0.003	0.004	0.005	-0.005	0.000	-0.001	-0.005	-0.002	-0.001	-0.003	-0.006	-0.013	-0.007	-0.005	-0.004	-0.001	-0.002	0.000	-0.003	-0.001	1.000
TLTA t-1	0.043	-0.384	-0.126	-0.008	-0.092	-0.103	-0.017	-0.013	0.000	-0.005	0.074	0.006	0.004	0.007	0.011	0.075	0.116	0.002	0.005	0.000	0.009	0.015	0.006	0.002	0.007	-0.007	-0.015	-0.006	0.005	-0.005	-0.005	-0.008	-0.014	-0.020	-0.016	-0.006	-0.004	-0.004	-0.002	0.004	0.407	1.000
TLTA t-2	0.028	-0.148	-0.062	-0.026	-0.061	-0.073	-0.019	-0.025	0.001	-0.003	0.056	0.013	0.003	0.004	0.011	0.139	0.060	0.003	0.027	0.001	0.006	0.002	-0.003	0.003	0.004	0.001	-0.011	-0.113	0.003	-0.003	-0.003	-0.007	-0.010	-0.012	-0.015	-0.006	-0.005	-0.009	-0.002	0.004	0.252	0.592	1.000
TLTA t-3	0.001	-0.003	-0.001	-0.996	-0.080	-0.065	-0.127	-0.143	0.000	0.001	-0.001	0.017	0.005	0.007	0.088	0.099	0.001	0.000	0.002	0.008	0.002	0.005	0.004	0.006	0.001	-0.001	0.001	-0.006	-0.002	-0.003	-0.007	-0.014	0.000	-0.001	0.002	-0.001	-0.001	-0.001	-0.001	0.001	0.014	0.009	0.025	1.000
TLTA t-4	0.002	-0.002	-0.033	-0.037	-0.150	-0.073	-0.175	-0.187	0.000	-0.002	0.005	0.022	0.005	0.009	0.053	0.146	0.001	-0.001	0.183	0.001	0.006	0.021	0.013	0.015	0.000	0.003	0.002	-0.002	-0.004	-0.006	-0.013	-0.023	0.001	0.001	-0.006	-0.004	-0.004	-0.004	-0.002	0.001	0.045	0.016	0.017	0.040	1.000
TLTA t-5	-0.002	0.001	0.000	-0.033	0.001	0.171	-0.010	0.022	-0.001	-0.001	0.001	0.013	0.006	0.008	0.090	0.138	0.002	-0.001	0.003	0.001	0.008	0.094	0.028	0.027	0.003	0.003	0.002	-0.001	-0.001	-0.005	-0.012	-0.021	0.002	-0.005	-0.005	-0.005	-0.004	-0.004	-0.002	-0.001	0.005	0.006	0.010	0.040	0.225	1.000
TLTA t-6	0.001	0.005	-0.021	-0.040	-0.090	-0.023	-0.176	-0.179	0.000	-0.001	0.003	0.021	-0.002	0.007	0.076	0.175	-0.003	-0.004	0.172	0.001	0.005	0.039	0.030	0.028	0.002	0.004	0.002	0.000	-0.002	-0.004	-0.015	-0.025	0.005	-0.002	-0.007	-0.006	-0.007	-0.007	-0.002	-0.001	0.005	-0.001	0.007	0.043	0.970	0.400	1.000
TLTA t-7	0.000	0.005	-0.027	-0.042	-0.095	-0.067	-0.168	-0.245	0.001	0.001	0.005	0.022	-0.002	0.007	0.021	0.189	-0.004	-0.005	0.179	0.002	0.001	0.017	0.022	0.043	0.003	0.003	0.002	0.000	-0.002	-0.004	-0.013	-0.027	0.007	0.000	-0.005	-0.004	-0.006	-0.007	-0.004	-0.001	0.001	-0.001	0.021	0.044	0.972	0.200	0.961	1.000
QACA	0.010	-0.058	-0.077	-0.004	-0.045	-0.020	-0.015	-0.007	0.065	0.002	0.006	0.010	0.005	0.011	0.023	0.000	0.083	0.100	0.066	0.013	0.064	0.045	0.033	0.018	-0.003	0.005	0.001	-0.022	-0.014	0.004	0.016	0.004	0.057	0.027	0.034	0.025	0.031	0.008	0.017	-0.005	0.018	0.026	0.014	0.001	-0.003	0.003	-0.006	-0.002	1.000
QACA t-1	0.035	-0.034	-0.081	-0.004	-0.073	-0.022	-0.008	0.003	0.015	0.047	0.015	0.021	0.030	0.012	0.029	-0.003	0.047	0.116	0.075	0.020	0.064	0.053	0.037	0.027	-0.028	-0.020	-0.010	0.017	-0.005	0.010	0.023	0.028	0.063	0.059	0.055	0.024	0.028	0.013	0.024	0.012	-0.030	0.012	0.012	0.001	0.004	0.003	-0.001	0.002	0.799	1.000
QACA t-2	0.031	-0.050	-0.077	-0.010	-0.065	-0.038	-0.031	-0.001	0.015	0.041	0.012	0.024	0.021	0.013	0.046	0.012	0.058	0.118	0.084	0.019	0.070	0.062	0.043	0.038	-0.031	0.001	-0.003	0.010	-0.009	0.004	0.020	0.028	0.084	0.053	0.057	0.027	0.036	0.015	0.029	0.016	-0.030	0.017	0.015	0.006	0.031	0.003	0.027	0.032	0.678	0.811	1.000
QACA t-3	0.028	-0.062	-0.078	-0.011	-0.060	-0.026	-0.013	0.014	0.016	0.008	0.011	0.018	0.017	0.011	0.0452	-0.0050	0.054	0.084	0.064	0.016	0.065	0.059	0.037	0.036	-0.012	-0.022	-0.006	0.002	-0.009	-0.001	0.020	0.030	0.096	0.063	0.053	0.035	0.041	0.034	0.018	0.013	-0.029	0.008	0.002	0.007	0.002	0.023	0.002	0.002	0.606	0.716	0.811	1.000
QACA t-4	0.015	-0.048	-0.052	-0.008	-0.069	-0.042	-0.030	-0.001	0.013	0.040	0.022	-0.024	0.019	0.014	0.064	0.032	0.022	0.068	0.052	0.014	0.098	0.095	0.083	0.065	-0.020	0.005	0.029	0.003	-0.028	-0.005	0.012	0.029	0.070	0.042	0.049	0.004	0.041	0.042	0.026	0.020	0.004	0.022	0.009	0.007	0.059	0.021	0.045	0.045	0.434	0.524	0.590	0.642	1.000
QACA t-5	0.008	0.012	-0.002	-0.006	-0.036	-0.034	-0.011	0.000	0.010	0.030	0.019	-0.018	0.007	0.014	0.076	0.061	-0.015	0.027	0.015	0.012	0.079	0.148	0.128	0.105	-0.013	0.012	0.018	0.008	-0.024	-0.011	-0.012	0.019	0.024	0.014	0.020	-0.001	0.013	0.038	0.025	0.027	-0.017	-0.006	0.001	0.007	0.027	0.039	0.031	0.326	0.273	0.346	0.390	0.415	0.692	1.000
QACA t-6	0.009	0.037	0.0345	-0.007	0.004	-0.009	-0.026	-0.007	0.014	0.040	0.032	-0.003	-0.036	-0.001	0.123	0.117	-0.040	-0.022	-0.009	0.011	0.026	0.121	0.215	0.179	-0.004	0.030	0.021	0.009	-0.034	-0.021	-0.015	0.013	0.015	0.002	-0.006	-0.012	0.002	0.019	0.049	0.045	0.003	-0.008	0.005	0.009	0.052	0.039	0.089	0.082	0.201	0.270	0.320	0.323	0.496	0.654	1.000
QACA t-7	0.002	0.058	0.054	-0.010	0.031	0.022	0.022	-0.032	0.020	0.042	0.047	0.026	-0.023	0.009	-0.173	0.204	-0.043	-0.026	-0.015	0.011	0.005	0.068	0.150	0.283	-0.005	0.014	0.003	0.018	0.012	0.003	-0.010	0.017	-0.001	0.002	-0.002	-0.009	0.005	-0.005	0.012	0.076	-0.016	-0.006	0.011	0.013	0.055	0.047	0.083	0.120	0.112	0.172	0.215	0.222	0.314	0.409	0.646	1.000
TCTL	0.021	0.038	0.068	0.004	0.052	0.010	0.020	0.005	0.017	0.000	-0.004	-0.009	-0.032	-0.020	-0.002	-0.013	0.027	0.039	0.018	0.007	0.031	0.052	0.069	0.066	0.074	0.041	0.031	-0.014	-0.002	0.013	0.010	-0.006	-0.067	-0.042	-0.037	-0.026	-0.019	-0.035	-0.013	-0.019	-0.031	-0.025	-0.016	-0.001	-0.001	-0.008	0.002	0.004	0.098	0.082	0.075	0.070	0.059	0.059	0.085	0.071	1.000
TCTL t-1	0.015	0.079	0.098	0.005	0.062	0.041	0.024	0.018	-0.023	-0.001	-0.016	-0.008	-0.030	-0.020	-0.0157	-0.015	0.042	0.050	0.036	0.011	0.038	0.050	0.067	0.063	0.064	0.053	0.035	-0.008	0.001	0.007	0.012	-0.004	-0.057	-0.060	-0.041	-0.033	-0.037	-0.046	-0.028	-0.036	-0.028	-0.049	-0.031	-0.002	0.003	0.014	0.013	0.007	0.085	0.056	0.065	0.067	0.046	0.040	0.061	0.050	0.742	1.000
TCTL t-2	-0.008	0.066	0.129	0.003	0.062	0.058	0.041	0.030	-0.022	0.012	-0.017	-0.017	-0.018	-0.022	-0.033	-0.041	0.038	0.056	0.048	0.011	0.035	0.058	0.063	0.057	0.061	0.048	0.036	-0.005	0.017	0.026	0.025	-0.003	-0.046	-0.052	-0.063	-0.035	-0.041	-0.051	-0.027	-0.040	-0.023	-0.040	-0.043	0.000	-0.004	0.015	0.005	-0.003	0.079	0.049	0.037	0.047	0.024	0.020	0.041	0.030	0.617	0.763	1.000
TCTL t-3	0.008	0.067	0.108	0.015	0.075	0.056	0.068	0.045	-0.022	0.006	-0.027	-0.021	-0.029	-0.020	-0.043	-0.037	0.018	0.044	0.029	0.010	0.038	0.040	0.053	0.042	0.041	0.052	0.023	-0.003	0.002	0.007	0.026	0.005	-0.031	-0.033	-0.035	-0.053	-0.046	-0.053	-0.026	-0.043	-0.020	-0.027	-0.034	-0.011	-0.014	-0.022	-0.007	-0.007	0.064	0.039	0.029	0.029	0.022	0.017	0.039	0.012	0.536	0.650	0.753	1.000
TCTL t-4	0.004	0.049	0.094	0.020	0.097	0.063	0.074	0.046	-0.011	-0.015	-0.017	-0.055	-0.029	-0.019	-0.032	-0.026	-0.002	0.024	0.009	-0.009	0.059	0.074	0.074	0.062	0.048	0.037	0.028	-0.005	0.018	0.015	0.024	-0.007	-0.032	-0.035	-0.036	-0.042	-0.045	-0.042	-0.021	-0.042	-0.018	-0.004	-0.021	-0.017	-0.013	-0.012	-0.006	-0.009	0.051	0.024	0.007	-0.005	0.144	0.117	0.115	0.061	0.462	0.539	0.602	0.724	1.000
TCTL t-5	-0.001	0.053	0.894	0.256	0.854	0.246	0.525	0.342	-0.204	-0.032	-0.216	-0.241	-0.221	-0.225	-0.451	-0.231	-0.016	-0.012	-0.006	-0.012	0.041	0.111	0.110	0.101	0.049	0.043	0.031	-0.007	0.020	0.012	0.024	-0.001	-0.031	-0.034	-0.027	-0.042	-0.034	-0.046	-0.021	-0.034	-0.020	-0.023	-0.022	-0.008	-0.009	-0.003	0.006	0.005	0.013	-0.014	-0.027	-0.034	0.086	0.220	0.210	0.153	0.387	0.444	0.506	0.584	0.731	1.000
TCTL t-6	-0.001	0.064	0.088	0.010	0.063	0.032	0.064	0.022	0.007	-0.011	0.001	-0.033	-0.025	-0.022	-0.019	0.031	-0.033	-0.024	-0.009	-0.012	0.020	0.084	0.153	0.135	0.040	0.032	0.026	-0.005	0.016	0.010	0.018	-0.001	-0.030	-0.040	-0.037	-0.040	-0.032	-0.031	-0.033	-0.023	-0.018	-0.023	-0.020	-0.007	0.012	0.015	0.041	0.039	-0.002	-0.023	-0.035	-0.047	0.060	0.167	0.344	0.277	0.322	0.372	0.424	0.486	0.601	0.745	1.000
TCTL t-7	0.000	0.056	0.079	0.006	0.051	0.018	0.035	0.024	0.012	-0.001	0.009	-0.009	-0.018	-0.015	-0.121	0.077	-0.032	-0.019	-0.010	-0.010	0.018	0.077	0.138	0.228	0.024	0.023	0.019	-0.002	0.011	0.009	0.011	0.005	-0.033	-0.033	-0.031	-0.033	-0.025	-0.030	-0.019	-0.002	-0.012	-0.012	-0.012	-0.004	0.018	0.022	0.041	0.063	-0.010	-0.029	-0.031	-0.036	0.035	0.120	0.263	0.478	0.236	0.282	0.330	0.335	0.426	0.541	0.687	1.000
Firm Age	0.003	-0.016	0.004	0.031	0.008	0.020	0.017	0.032	0.001	-0.046	-0.065	-0.027	0.002	0.000	0.004	-0.012	-0.015	-0.021	-0.026	-0.037	-0.022	-0.077	-0.107	-0.173	0.001	0.007	0.003	0.014	0.007	0.004	0.026	-0.009	-0.004	-0.039	-0.027	-0.001	-0.013	-0.021	-0.021	-0.074	0.000	-0.009	-0.028	-0.033	0.006	0.005	-0.002	-0.023	-0.051	-0.157	-0.193	-0.189	-0.182	-0.187	-0.239	-0.353	-0.001	0.024	0.037	0.056	0.090	0.077	0.021	-0.064	1.000
Average Director Age	-0.002	0.027	0.024	0.004	0.011	0.005	0.011	0.003	-0.009	-0.002	0.008	-0.002	0.039	-0.001	-0.031	-0.024	-0.010	0.000	-0.014	-0.008	0.011	0.015	0.006	0.020	-0.002	0.015	0.001	0.003	0.007	0.001	0.017	0.008	0.000	-0.002	-0.019	0.012	-0.014	0.014	0.020	0.006	0.007	-0.020	-0.013	-0.003	-0.002	0.003	0.002	0.009	-0.072	-0.081	-0.078	-0.064	-0.035	-0.003	0.018	0.060	0.003	-0.007	0.012	0.003	0.012	0.023	0.035	0.066	-0.070	1.000
Female Director Nr.	0.003	0.035	0.003	-0.005	0.004	0.020	0.011	-0.001	0.087	0.107	0.069	0.048	-0.010	-0.006	-0.001	0.031	-0.022	0.023	-0.008	0.025	-0.006	0.021	0.050	0.091	-0.003	0.007	0.013	0.003	-0.005	-0.006	-0.062	0.020	-0.003	0.023	0.034	0.008	0.006	0.014	0.013	0.049	0.024	0.014	0.011	0.009	0.019	0.004	0.017	0.032	0.037	0.095	0.113	0.100	0.123	0.141	0.203	0.280	-0.018	-0.035	-0.046	-0.059	-0.057	-0.017	0.025	0.082	-0.360	-0.021	1.000
Number of Directors	-0.006	0.032	0.016	-0.002	0.028	0.030	0.019	0.019	0.017	0.087	0.070	0.034	-0.014	-0.006	-0.031	0.004	-0.047	-0.016	-0.022	0.005	-0.033	0.001	0.038	0.096	-0.038	0.003	0.005	-0.004	0.001	0.001	-0.018	0.026	-0.009	0.030	0.027	0.006	0.002	0.029	0.037	0.055	0.056	0.017	0.018	0.007	0.003	-0.006	0.005	0.027	0.028	0.094	0.124	0.114	0.144	0.170	0.256	0.342	-0.017	-0.037	-0.040	-0.041	-0.036	0.002	0.056	0.118	-0.402	0.038	0.612	1.000
Credit	-0.012	0.064	0.071	-0.009	0.056	0.028	0.029	-0.001	-0.007	0.022	0.029	-0.005	-0.030	-0.004	-0.030	0.034	-0.082	-0.072	-0.047	0.007	-0.038	-0.001	0.049	0.096	-0.024	-0.020	-0.034	-0.018	-0.018	0.001	-0.023	-0.002	-0.040	-0.011	-0.014	-0.015	-0.006	0.006	-0.001	0.049	-0.013	-0.028	-0.006	0.013	-0.005	-0.007	0.004	0.013	-0.155	-0.101	-0.085	-0.082	0.015	0.091	0.191	0.223	-0.139	-0.158	-0.145	-0.125	-0.105	-0.101	-0.036	-0.001	-0.451	-0.060	0.244	0.325	1.000
Credit t-1	-0.012	0.051	0.053	-0.012	0.043	0.019	0.021	-0.006	-0.004	0.025	0.035	0.002	-0.026	-0.005	-0.026	0.034	-0.067	-0.055	-0.032	0.011	-0.025	0.012	0.058	0.106	-0.023	-0.021	-0.034	-0.018	-0.020	-0.003	-0.026	-0.002	-0.031	0.005	-0.004	-0.006	0.003	0.015	0.007	0.056	-0.010	-0.022	-0.001	0.015	-0.005	-0.006	0.003	0.015	-0.140	-0.071	-0.054	-0.049	0.043	0.108	0.206	0.250	-0.156	-0.174	-0.161	-0.144	-0.124	-0.116	-0.046	0.003	-0.498	-0.054	0.269	0.353	0.984	1.000
Credit t-2	-0.011	0.044	0.039	-0.014	0.034	0.010	0.013	-0.013	-0.002	0.028	0.041	0.007	-0.019	-0.004	-0.023	0.041	-0.054	-0.041	-0.020	0.015	-0.011	0.029	0.071	0.121	-0.022	-0.021	-0.033	-0.018	-0.020	-0.004	-0.028	-0.001	-0.024	0.018	0.004	0.000	0.008	0.021	0.013	0.062	-0.008	-0.017	0.004	0.017	-0.002	-0.005	0.006	0.020	-0.122	-0.049	-0.022	-0.016	0.072	0.132	0.231	0.284	-0.164	-0.185	-0.171	-0.157	-0.137	-0.124	-0.047	0.015	-0.548	-0.049	0.291	0.377	0.961	0.986	1.000
Credit t-3	-0.010	0.040	0.026	-0.018	0.019	-0.001	0.000	-0.022	0.008	0.033	0.053	0.022	-0.015	-0.001	-0.009	0.052	-0.041	-0.026	-0.007	0.021	0.004	0.050	0.093	0.147	-0.022	-0.020	-0.030	-0.018	-0.020	-0.006	-0.030	0.000	-0.014	0.026	0.013	0.006	0.017	0.027	0.020	0.073	0.000	-0.010	0.010	0.020	0.002	0.000	0.010	0.025	-0.089	-0.006	0.022	0.045	0.126	0.177	0.282	0.345	-0.154	-0.179	-0.171	-0.151	-0.133	-0.114	-0.032	0.039	-0.620	-0.032	0.335	0.426	0.905	0.943	0.970	1.000
Credit t-4	-0.013	0.033	0.029	-0.017	-0.012	-0.018	-0.018	-0.031	0.022	0.034	0.062	0.005	-0.005	0.002	0.026	0.090	-0.045	-0.020	-0.011	0.021	0.050	0.103	0.137	0.179	-0.018	0.002	0.012	-0.016	-0.019	-0.008	-0.028	0.001	0.000	0.034	0.022	-0.004	0.028	0.037	0.029	0.076	0.013	0.004	0.017	0.021	0.028	0.020	0.031	0.043	-0.080	0.000	0.018	0.024	0.328	0.324	0.410	0.443	-0.117	-0.151	-0.147	-0.134	-0.006	0.008	0.074	0.129	-0.580	0.011	0.353	0.437	0.746	0.793	0.827	0.877	1.000
Credit t-5	-0.018	0.048	0.038	-0.016	-0.008	-0.032	-0.031	-0.034	0.022	0.034	0.062	0.016	-0.005	0.006	0.049	0.107	-0.044	-0.020	-0.007	0.022	0.048	0.151	0.175	0.205	-0.014	0.004	0.010	-0.005	-0.020	-0.011	-0.028	0.002	-0.005	0.014	0.017	0.000	0.019	0.047	0.037	0.080	0.011	-0.002	0.016	0.020	0.027	0.034	0.045	0.055	-0.083	-0.009	0.007	0.007	0.239	0.450	0.518	0.520	-0.083	-0.120	-0.120	-0.114	-0.015	0.109	0.160	0.201	-0.573	0.049	0.355	0.439	0.658	0.704	0.745	0.804	0.904	1.000
Credit t-6	0.012	0.056	0.059	-0.015	0.010	-0.008	-0.047	-0.039	0.025	0.033	0.062	0.025	-0.035	-0.003	0.088	0.136	-0.064	-0.045	-0.020	0.019	0.014	0.117	0.225	0.233	-0.011	0.014	0.007	-0.002	-0.017	-0.010	-0.028	0.002	-0.007	-0.002	-0.004	-0.014	0.004	0.016	0.046	0.082	0.007	-0.004	0.016	0.019	0.029	0.033	0.068	0.071	-0.073	-0.011	0.013	0.002	0.187	0.357	0.668	0.608	-0.043	-0.071	-0.076	-0.077	0.001	0.103	0.277	0.285	-0.533	0.053	0.349	0.432	0.576	0.616	0.657	0.722	0.809	0.889	1.000
Credit t-7	0.007	0.063	0.058	-0.016	0.027	0.009	0.004	-0.048	0.029	0.035	0.069	0.038	-0.022	0.009	-0.153	0.191	-0.050	-0.034	-0.015	0.019	0.001	0.077	0.161	0.300	-0.005	0.006	0.002	0.006	0.010	-0.002	-0.027	0.004	-0.009	0.008	0.007	-0.004	0.009	0.003	0.017	0.093	0.011	0.000	0.021	0.021	0.030	0.029	0.056	0.098	-0.046	0.015	0.037	0.030	0.145	0.259	0.480	0.801	-0.012	-0.038	-0.047	-0.063	-0.012	0.081	0.222	0.444	-0.577	0.084	0.381	0.460	0.467	0.514	0.563	0.638	0.708	0.768	0.828	1.000
GDP growth	0.041	-0.097	-0.129	-0.016	-0.085	-0.068	-0.048	-0.027	0.010	0.018	0.032	0.022	0.043	0.002	0.124	0.040	0.115	0.151	0.126	0.032	0.113	0.106	0.055	0.001	0.002	0.027	0.020	-0.008	0.017	0.015	0.004	0.009	0.068	0.082	0.063	0.060	0.057	0.067	0.044	0.016	0.012	0.040	0.027	0.012	0.006	-0.007	-0.008	-0.014	0.165	0.246	0.257	0.242	0.165	0.071	-0.021	-0.116	-0.011	-0.055	-0.043	-0.043	-0.072	-0.100	-0.135	-0.192	-0.303	-0.092	0.085	0.071	-0.138	-0.087	-0.035	0.041	0.074	0.066	0.015	-0.034	1.000
GDP growth t-1	-0.002	0.027	0.002	-0.006	-0.006	-0.008	-0.020	-0.020	0.001	0.008	0.023	0.013	0.034	0.005	-0.085	0.117	0.001	0.022	-0.004	0.009	0.028	0.056	0.060	0.137	0.015	0.016	0.004	0.013	0.008	-0.009	0.000	0.011	-0.008	-0.013	-0.008	-0.016	-0.021	-0.015	0.007	0.025	-0.001	0.021	0.021	0.006	0.010	0.018	0.023	0.045	0.073	0.072	0.091	0.081	0.087	0.114	0.181	0.348	0.053	0.055	0.040	0.012	0.014	0.050	0.117	0.259	-0.152	-0.011	0.091	0.101	-0.124	-0.123	-0.050	-0.009	0.036	0.105	0.170	0.323	-0.033	1.000
GDP growth t-2	-0.003	0.014	0.024	-0.008	-0.012	-0.001	-0.017	-0.013	0.021	0.018	0.037	0.045	-0.038	0.011	0.021	-0.126	0.001	-0.008	0.016	0.010	0.003	0.021	0.053	0.085	-0.006	-0.011	0.013	0.005	-0.012	-0.008	-0.011	0.009	0.029	0.007	0.003	0.001	0.029	0.021	0.005	0.035	0.011	-0.013	-0.002	0.010	-0.004	0.015	-0.001	0.004	0.038	0.068	0.075	0.089	0.108	0.100	0.137	0.193	-0.010	0.011	0.003	-0.021	-0.020	0.004	0.034	0.090	-0.278	-0.002	0.208	0.251	0.176	0.203	0.196	0.249	0.263	0.248	0.237	0.259	-0.165	-0.220	1.000
GDP growth t-3	0.035	-0.054	-0.063	-0.010	-0.032	-0.034	-0.017	-0.005	0.006	0.015	0.025	0.005	0.016	-0.007	0.135	0.029	0.028	0.058	0.056	0.018	0.045	0.045	0.016	-0.051	-0.011	0.014	-0.003	-0.022	0.015	0.024	-0.001	0.001	0.014	0.036	0.041	0.035	0.030	0.048	0.018	0.005	0.002	0.018	0.011	0.008	0.005	-0.017	-0.011	-0.025	0.005	0.080	0.092	0.080	0.066	0.023	-0.054	-0.222	-0.078	-0.117	-0.084	-0.049	-0.068	-0.115	-0.156	-0.277	-0.256	-0.117	0.087	0.101	0.367	0.379	0.370	0.358	0.279	0.201	0.090	-0.086	0.684	-0.405	-0.173	1.000
GDP growth t-4	0.009	-0.050	-0.030	0.019	-0.003	-0.002	0.002	0.032	-0.046	-0.039	-0.080	-0.088	0.011	0.002	0.064	-0.012	0.013	0.006	-0.012	-0.022	0.016	-0.034	-0.093	-0.206	0.006	0.003	0.001	-0.002	0.006	0.014	0.022	-0.009	0.003	-0.008	-0.017	-0.009	-0.011	-0.005	-0.011	-0.073	-0.029	-0.008	-0.025	-0.023	-0.001	-0.013	-0.014	-0.046	-0.065	-0.128	-0.152	-0.156	-0.091	-0.145	-0.272	-0.523	-0.068	-0.057	-0.034	0.005	0.052	-0.013	-0.103	-0.267	0.661	-0.176	-0.399	-0.475	-0.151	-0.204	-0.256	-0.363	-0.370	-0.446	-0.498	-0.678	-0.030	-0.284	-0.501	0.175	1.000
GDP growth t-5	-0.011	0.016	0.035	0.018	0.027	0.007	-0.007	0.020	-0.047	-0.031	-0.068	-0.092	0.011	0.009	0.023	0.043	-0.035	-0.044	-0.054	-0.022	0.010	0.029	-0.005	-0.067	0.003	-0.002	0.005	0.013	-0.008	-0.001	0.008	-0.007	-0.023	-0.055	-0.041	-0.033	-0.035	-0.014	-0.006	-0.038	-0.035	-0.026	-0.025	-0.019	0.008	0.018	0.020	-0.002	-0.125	-0.191	-0.210	-0.218	-0.054	0.111	0.066	-0.131	-0.072	-0.065	-0.049	-0.020	0.079	0.133	0.086	-0.005	0.526	-0.145	-0.273	-0.310	0.079	0.027	0.027	-0.003	-0.096	0.000	-0.056	-0.242	-0.349	0.054	-0.375	-0.155	0.730	1.000
GDP growth t-6	0.013	0.067	0.075	-0.002	0.010	0.006	-0.047	-0.043	0.051	0.014	0.043	0.046	-0.028	0.005	0.094	0.126	-0.090	-0.080	-0.059	-0.002	-0.015	0.059	0.163	0.171	-0.009	0.005	0.001	0.006	-0.024	-0.013	-0.022	-0.007	-0.016	-0.025	-0.019	-0.031	-0.013	-0.021	0.013	0.056	0.019	-0.014	0.000	0.006	0.035	0.034	0.068	0.063	-0.109	-0.097	-0.086	-0.089	0.105	0.285	0.585	0.490	-0.054	-0.061	-0.069	-0.065	0.031	0.133	0.283	0.260	-0.144	-0.031	0.212	0.265	0.482	0.488	0.493	0.523	0.608	0.674	0.800	0.614	-0.279	0.053	0.275	-0.116	-0.245	0.212	1.000
GDP growth t-7	0.011	0.058	0.057	-0.008	0.011	0.010	-0.007	-0.049	0.069	0.024	0.074	0.076	-0.010	0.006	-0.120	0.247	-0.054	-0.044	-0.032	0.007	-0.015	0.048	0.125	0.255	-0.001	-0.001	-0.006	0.007	0.009	-0.003	-0.026	-0.009	-0.023	-0.002	0.007	-0.013	-0.005	-0.009	0.005	0.077	0.038	0.016	0.025	0.013	0.041	0.044	0.060	0.094	-0.071	-0.032	-0.015	-0.020	0.098	0.211	0.421	0.719	-0.023	-0.047	-0.057	-0.065	-0.003	0.082	0.204	0.411	-0.330	0.013	0.301	0.360	0.410	0.443	0.472	0.530	0.610	0.656	0.723	0.875	-0.087	0.256	0.127	-0.073	-0.499	-0.114	0.700	1.000

Table A.8: Bartlett test of sphericity and KMO measure of sampling adequacy (incl. lags)

Determinant of the correlation matrix		
Det	=	0.000

Bartlett test of sphericity	
Chi-square	189000.0
p-value	0
H0: variables are not intercorrelated	

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	
KMO	0.687

Table A.9: Eigenvalues of un-rotated factors; financial ratios and firm age as variables.

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	5.04401	0.93065	0.1625	0.1625
Factor2	4.11335	0.83197	0.1325	0.2950
Factor3	3.28139	0.54104	0.1057	0.4007
Factor4	2.74034	0.60618	0.0883	0.4890
Factor5	2.13416	0.17829	0.0688	0.5578
Factor6	1.95587	0.21289	0.0630	0.6208
Factor7	1.74298	0.11450	0.0562	0.6769
Factor8	1.62849	0.21350	0.0525	0.7294
Factor9	1.41498	0.05286	0.0456	0.7750
Factor10	1.36213	0.15498	0.0439	0.8189
Factor11	1.20715	0.18584	0.0389	0.8578
Factor12	1.02132	0.10988	0.0329	0.8907
Factor13	0.91144	0.10220	0.0294	0.9200
Factor14	0.80923	0.07090	0.0261	0.9461
Factor15	0.73834	0.06822	0.0238	0.9699
Factor16	0.67012	0.02917	0.0216	0.9915
Factor17	0.64094	0.08611	0.0206	1.0121
Factor18	0.55483	0.00813	0.0179	1.0300
Factor19	0.54670	0.16020	0.0176	1.0476
Factor20	0.38650	0.06080	0.0125	1.0601
Factor21	0.32570	0.03464	0.0105	1.0706
Factor22	0.29106	0.08385	0.0094	1.0799
Factor23	0.20721	0.01274	0.0067	1.0866
Factor24	0.19447	0.03366	0.0063	1.0929
Factor25	0.16081	0.02039	0.0052	1.0981
Factor26	0.14042	0.02423	0.0045	1.1026
Factor27	0.11619	0.00884	0.0037	1.1063
Factor28	0.10735	0.02624	0.0035	1.1098
Factor29	0.08111	0.01104	0.0026	1.1124
Factor30	0.07007	0.02092	0.0023	1.1147
Factor31	0.04915	0.00705	0.0016	1.1162
Factor32	0.04210	0.01441	0.0014	1.1176
Factor33	0.02769	0.01058	0.0009	1.1185
Factor34	0.01712	0.00924	0.0006	1.1190
Factor35	0.00788	0.00372	0.0003	1.1193
Factor36	0.00416	0.00842	0.0001	1.1194
Factor37	-0.00425	0.00262	-0.0001	1.1193
Factor38	-0.00687	0.00586	-0.0002	1.1191
Factor39	-0.01273	0.00772	-0.0004	1.1187
Factor40	-0.02045	0.00982	-0.0007	1.1180
Factor41	-0.03027	0.00543	-0.0010	1.1170
Factor42	-0.03570	0.00226	-0.0012	1.1159
Factor43	-0.03796	0.01582	-0.0012	1.1147
Factor44	-0.05378	0.01815	-0.0017	1.1129
Factor45	-0.07193	0.00233	-0.0023	1.1106
Factor46	-0.07425	0.00447	-0.0024	1.1082
Factor47	-0.07872	0.01002	-0.0025	1.1057
Factor48	-0.08874	0.00495	-0.0029	1.1028
Factor49	-0.09369	0.01633	-0.0030	1.0998
Factor50	-0.11002	0.00752	-0.0035	1.0963
Factor51	-0.11754	0.01326	-0.0038	1.0925
Factor52	-0.13080	0.00378	-0.0042	1.0883
Factor53	-0.13458	0.00448	-0.0043	1.0839
Factor54	-0.13906	0.01651	-0.0045	1.0794
Factor55	-0.15557	0.01267	-0.0050	1.0744
Factor56	-0.16824	0.00653	-0.0054	1.0690
Factor57	-0.17477	0.00979	-0.0056	1.0634
Factor58	-0.18456	0.03000	-0.0059	1.0574
Factor59	-0.21457	0.01657	-0.0069	1.0505
Factor60	-0.23114	0.00389	-0.0074	1.0431
Factor61	-0.23503	0.02214	-0.0076	1.0355
Factor62	-0.25717	0.01257	-0.0083	1.0272
Factor63	-0.26974	0.01313	-0.0087	1.0185
Factor64	-0.28287	0.00927	-0.0091	1.0094
Factor65	-0.29214	-0.00021	-0.0094	1.0000

LR test: independent vs. saturated: chi2(2080)= 1.9e+05 Prob>chi2 = 0.0000

Table A.10: Eigenvalues of VARIMAX- rotated factors (with Eigenvalues >1); financial ratios and firm age as variables.

Factor	Variance	Difference	Proportion	Cumulative
Factor1	4.40438	0.58136	0.1419	0.1419
Factor2	3.82302	0.64764	0.1232	0.2651
Factor3	3.17538	0.41230	0.1023	0.3674
Factor4	2.76308	0.45013	0.0890	0.4564
Factor5	2.31296	0.26588	0.0745	0.5309
Factor6	2.04707	0.28097	0.0660	0.5968
Factor7	1.76611	0.19531	0.0569	0.6537
Factor8	1.57080	0.00841	0.0506	0.7044
Factor9	1.56239	0.12202	0.0503	0.7547
Factor10	1.44037	0.02939	0.0464	0.8011
Factor11	1.41098	0.04135	0.0455	0.8465
Factor12	1.36963	0.45819	0.0441	0.8907

LR test: independent vs. saturated: chi2(2080) = 1.9e+05 Prob>chi2 = 0.0000

Table A.11: Factor Loadings for factor analysis without directors' characteristics (post VARIMAX rotation).

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Factor11	Factor
roi	0.0025	0.0353	-0.0010	0.0202	-0.0053	0.0018	-0.0015	-0.0850	-0.0236	0.0000	-0.1097	0.0268
roiL1	0.0651	-0.0647	0.0160	0.0086	0.0659	-0.0104	0.0061	-0.4341	0.2338	-0.0103	-0.0305	0.0293
roiL2	0.1176	-0.0890	-0.0160	0.0021	0.0622	-0.0091	-0.0090	-0.2188	0.3521	-0.0046	-0.1510	0.0267
roiL3	0.0066	-0.0047	-0.0183	0.0010	-0.0014	0.9931	-0.0053	-0.0065	0.0456	0.0005	-0.0045	0.0004
roiL4	0.0825	-0.0748	-0.0954	-0.0006	0.0297	0.0675	-0.0150	-0.1597	0.4375	0.0114	-0.0572	0.0327
roiL5	0.0499	-0.0263	-0.0241	0.0026	-0.0076	0.0479	-0.0089	-0.1044	0.4875	-0.0044	-0.0438	0.0309
roiL6	0.0537	-0.0163	-0.1694	-0.0279	0.0202	0.1254	-0.0210	0.0114	0.6540	0.0188	0.0047	-0.0036
roiL7	0.0348	0.0213	-0.2096	-0.0303	-0.0215	0.1425	-0.0151	0.0105	0.4505	0.0034	0.0418	-0.1158
growth_rate	-0.0106	0.0253	-0.0009	0.0077	0.0139	0.0000	-0.0011	0.0071	0.0073	0.0004	-0.0065	0.0013
growth_rateL1	-0.0129	0.0293	0.0011	-0.0255	0.0503	-0.0082	0.0029	-0.0416	0.0283	-0.0068	0.1462	0.0069
growth_rateL2	-0.0228	0.0127	0.0174	0.0014	0.0465	-0.0038	0.0145	0.0627	0.0256	-0.0008	0.0427	0.0078
growth_rateL3	-0.0245	0.0071	0.0184	-0.0144	0.0025	-0.0117	0.9388	0.0048	-0.0265	-0.0039	-0.0182	0.0014
growth_rateL4	-0.0284	0.0209	0.0014	-0.0051	-0.0183	-0.0047	0.0019	0.0020	0.0010	-0.0025	0.0074	0.0017
growth_rateL5	-0.0264	0.0146	0.0068	0.0046	0.0027	-0.0054	0.0002	0.0072	-0.0195	-0.0016	0.0042	-0.0028
growth_rateL6	-0.0288	0.0641	0.0528	0.0209	-0.0455	-0.0839	0.0053	-0.0374	-0.3911	-0.0143	-0.0185	-0.0231
growth_rateL7	-0.0373	-0.0171	0.1906	0.1858	0.1389	-0.1092	0.0045	0.0816	-0.1416	-0.0089	-0.0800	0.0667
nsta	0.0241	0.0576	0.0073	0.0383	-0.0781	-0.0035	0.0181	0.2687	-0.0553	0.0016	0.2903	-0.0255
nsta_L1	0.0267	0.0987	0.0057	0.0814	-0.0482	-0.0083	0.0168	-0.0193	0.0080	0.0025	0.7851	0.0096
nsta_L2	0.0226	0.0745	0.1782	0.1024	-0.0545	0.0042	0.0208	0.0382	-0.0145	0.0062	0.3654	0.0037
nsta_L3	0.0050	0.0122	-0.0056	0.0734	-0.0011	-0.0009	0.9347	-0.0027	0.0142	0.0031	0.0355	-0.0020
nsta_L4	0.0229	0.0544	-0.0027	0.5236	-0.0387	-0.0018	0.0137	-0.0144	-0.0394	0.0047	0.6567	0.0059
nsta_L5	0.0436	0.0520	0.0176	0.8428	-0.0028	0.0027	0.0181	0.0138	-0.0338	0.0095	0.1675	-0.0041
nsta_L6	0.0573	0.0206	0.0042	0.9166	0.0742	0.0017	0.0211	-0.0025	-0.0156	-0.0041	0.0500	-0.0076
nsta_L7	0.0440	0.0000	0.0121	0.8837	0.1400	-0.0043	0.0297	0.0051	0.0377	-0.0028	-0.0346	0.0084
cfts	0.0755	-0.0229	-0.0006	0.0166	-0.0137	0.0042	0.0011	0.0070	-0.0337	0.0129	0.0039	0.1699
cfts_L1	0.0582	-0.0100	0.0055	0.0140	0.0137	-0.0009	-0.0004	-0.0272	-0.0017	0.0014	0.0175	0.0106
cfts_L2	0.0377	-0.0005	0.0030	0.0059	0.0149	-0.0008	-0.0011	-0.0207	0.0123	0.0048	0.0096	-0.0043
cfts_L3	-0.0134	0.0027	0.0084	-0.0055	0.0107	-0.0060	0.0010	-0.0437	0.0677	-0.0173	0.0130	-0.5762
cfts_L4	0.0043	-0.0086	-0.0013	-0.0126	-0.0026	-0.0064	0.0004	0.0100	0.1115	-0.0286	0.0431	0.4594
cfts_L5	0.0087	0.0109	-0.0082	-0.0123	-0.0064	0.0004	-0.0008	-0.0031	0.0834	-0.0177	0.0292	0.6724
cfts_L6	0.0272	0.0204	-0.0115	-0.0045	-0.0166	0.0014	-0.0003	0.0062	0.0753	-0.0007	0.0109	-0.1554
cfts_L7	-0.0078	0.0341	-0.0276	-0.0136	0.0089	0.0069	0.0005	0.0035	0.1673	-0.0161	0.0302	-0.5385
quick_ratio	-0.0602	0.0867	0.0059	0.0183	0.0006	-0.0010	-0.0015	-0.0304	-0.0713	0.0489	0.0133	0.0044
quick_ratioL1	-0.0595	0.0621	-0.0010	-0.0041	0.0018	0.0015	0.0054	-0.0334	0.0120	0.1126	0.0246	0.0036
quick_ratioL2	-0.0516	0.0595	-0.0075	0.0025	-0.0043	-0.0006	0.0008	-0.0232	0.0036	0.1907	0.0096	0.0030
quick_ratioL3	-0.0355	0.0227	-0.0014	-0.0020	-0.0199	-0.0011	0.0012	-0.0074	0.0132	0.7614	-0.0019	0.0056
quick_ratioL4	-0.0350	0.0314	-0.0037	0.0023	-0.0002	0.0004	-0.0020	0.0027	0.0012	0.7625	0.0028	-0.0065
quick_ratioL5	-0.0535	0.0204	-0.0062	0.0093	0.0195	0.0031	-0.0035	-0.0059	-0.0013	0.4566	0.0261	-0.0199
quick_ratioL6	-0.0443	0.0281	-0.0054	0.0160	0.0376	0.0013	-0.0022	-0.0115	0.0030	0.0953	-0.0130	-0.0102
quick_ratioL7	-0.0622	0.0130	-0.0019	0.0257	0.0728	-0.0019	0.0022	-0.0030	-0.0008	0.0637	-0.0207	-0.0035
tlta	-0.0204	-0.0212	0.0150	-0.0075	-0.0038	-0.0084	0.0005	0.4865	0.0189	0.0007	0.0388	-0.0096
tltaL1	-0.0283	0.0169	-0.0008	0.0120	-0.0038	-0.0058	0.0005	0.7661	-0.0241	-0.0049	-0.0234	0.0011
tltaL2	-0.0316	0.0097	0.0164	0.0139	0.0154	-0.0295	0.0065	0.6011	0.0037	-0.0076	-0.0366	0.0546
tltaL3	-0.0031	0.0010	0.0223	0.0013	0.0050	-0.9950	0.0054	0.0034	-0.0183	0.0005	0.0000	0.0010
tltaL4	-0.0039	0.0099	0.9716	-0.0081	-0.0017	-0.0071	0.0038	0.0166	-0.0517	0.0013	0.0195	-0.0073
tltaL5	-0.0110	0.0324	0.3700	0.0959	-0.0199	-0.0627	-0.0011	0.0435	0.2068	-0.0158	-0.0865	0.0122
tltaL6	0.0047	0.0070	0.9943	0.0209	0.0201	-0.0192	0.0025	-0.0055	0.0025	-0.0042	-0.0084	0.0003
tltaL7	0.0021	-0.0015	0.9667	0.0050	0.0525	-0.0147	0.0058	-0.0073	-0.0482	0.0004	0.0057	0.0065
qaca	0.0720	0.7656	-0.0080	0.0096	-0.0403	-0.0001	0.0037	0.0426	0.0010	0.0070	0.0248	0.0203
qacaL1	0.0257	0.8757	-0.0049	0.0124	0.0149	-0.0011	0.0130	0.0033	0.0117	0.0020	0.0266	0.0024
qacaL2	0.0047	0.8826	0.0208	0.0189	0.0717	-0.0050	0.0142	0.0016	-0.0087	0.0088	0.0321	-0.0021
qacaL3	-0.0033	0.8431	-0.0051	0.0183	0.0961	-0.0052	0.0093	-0.0030	-0.0049	0.0237	0.0136	-0.0054
qacaL4	0.0189	0.6758	0.0305	0.0346	0.3723	0.0032	-0.0215	0.0030	-0.0591	0.0191	0.0602	-0.0269
qacaL5	0.0323	0.4628	0.0151	0.0800	0.5597	0.0026	-0.0184	-0.0338	-0.0588	0.0036	0.0295	-0.0265
qacaL6	0.0630	0.3298	0.0557	0.1316	0.7224	-0.0034	-0.0027	-0.0284	-0.0497	-0.0091	-0.0535	-0.0251
qacaL7	0.0356	0.1741	0.0813	0.1459	0.7287	-0.0186	0.0260	0.0072	0.0928	-0.0087	-0.0745	0.0196
tctl	0.6850	0.1130	0.0042	0.0509	-0.0761	-0.0046	0.0112	-0.0216	-0.0249	-0.0035	-0.0385	0.0115
tctlL1	0.7977	0.0991	0.0161	0.0470	-0.1102	-0.0071	0.0156	-0.0426	-0.0019	-0.0150	-0.0262	0.0042
tctlL2	0.8297	0.0640	0.0073	0.0328	-0.0922	-0.0090	0.0097	-0.0303	0.0285	-0.0194	0.0044	0.0115
tctlL3	0.8323	0.0312	-0.0103	0.0064	-0.0416	0.0071	0.0022	-0.0142	0.0316	-0.0234	0.0216	-0.0106
tctlL4	0.7989	-0.0051	-0.0180	0.0144	0.1397	0.0189	-0.0340	0.0144	0.0252	-0.0120	0.0444	0.0018
tctlL5	0.7314	-0.0780	-0.0130	0.0424	0.3284	0.0133	-0.0325	0.0106	0.0080	-0.0063	0.0303	0.0005
tctlL6	0.6444	-0.1202	0.0174	0.0609	0.4744	0.0116	-0.0240	0.0159	0.0076	-0.0068	0.0076	0.0030
tctlL7	0.4758	-0.1279	0.0332	0.1028	0.5123	0.0027	-0.0040	0.0345	0.0531	-0.0083	-0.0141	0.0101
firmage	0.0966	-0.1775	0.0002	-0.1172	-0.2488	0.0346	-0.0382	-0.0033	-0.0133	-0.0075	0.0184	-0.0132

Table A.12: Failed Firm Clusters (without Directors' Characteristics).

	Cluster 1		Cluster 2		Cluster 3		Cluster 4	
Variable	Median	St. Dev	Median	St. Dev	Median	St. Dev	Median	St. Dev
roi	-0.077	1.496	-0.054	5.803	-0.148	0.945	-0.198	0.498
roiL1	0.001	1.606	-0.017	0.690	0.000	1.494	-0.012	1.036
roiL2	0.008	1.474	-0.004	0.816	0.003	0.623	0.004	1.318
roiL3	0.011	1.469	0.000	0.838	0.005	0.611	0.008	33.395
roiL4	0.002	1.756	0.001	0.865	0.007	0.673	0.010	1.148
roiL5	0.001	1.175	0.002	0.888	0.010	1.670	0.016	1.308
roiL6	0.001	0.494	0.000	0.740	0.011	0.830	0.025	0.596
roiL7	0.001	0.216	0.001	0.527	0.005	0.655	0.016	0.788
growth_rate	0.066	15.166	0.099	14.122	0.218	11.690	0.817	190.067
growth_rateL1	0.051	26.397	0.059	4.433	0.050	8.077	0.088	43.995
growth_rateL2	-0.118	2.669	0.020	2.974	0.005	6.002	0.030	44.076
growth_rateL3	-0.063	2.218	-0.079	2.543	-0.073	10.389	-0.036	3.162
growth_rateL4	-0.021	46.643	-0.149	1.500	-0.161	1.891	-0.077	2.461
growth_rateL5	-0.001	1.347	-0.057	1.150	-0.106	1.547	-0.057	27.194
growth_rateL6	0.014	0.949	-0.037	1.167	-0.005	1.165	0.054	1.214
growth_rateL7	0.001	0.437	-0.005	0.896	0.000	1.023	0.014	1.352
nsta	2.435	7.538	0.829	7.103	2.241	5.607	2.147	3.138
nsta_L1	2.243	5.437	0.655	1.802	1.958	8.621	3.213	4.486
nsta_L2	2.114	7.867	0.688	1.716	1.913	4.977	1.717	10.440
nsta_L3	2.178	4.815	0.692	1.733	1.918	61.415	1.603	6.183
nsta_L4	1.510	5.041	0.673	1.629	1.995	8.351	1.665	6.029
nsta_L5	1.212	5.027	0.611	1.500	2.039	1.663	1.912	6.018
nsta_L6	1.114	3.416	0.507	1.517	2.006	1.817	2.014	6.141
nsta_L7	0.953	0.597	0.000	1.202	1.667	1.945	1.604	6.314
cfts	-0.174	18.015	-0.305	16.393	-0.088	12.494	-1.624	32.153
cfts_L1	0.011	31.434	-0.006	18.924	0.008	0.604	0.004	7.202
cfts_L2	0.025	23.118	0.011	10.406	0.014	0.552	0.038	5.119
cfts_L3	0.035	5.650	0.022	7.788	0.014	1.000	0.040	11.700
cfts_L4	0.019	3.789	0.026	4.799	0.017	18.425	0.053	7.307
cfts_L5	0.016	1.250	0.026	10.119	0.019	12.243	0.087	10.929
cfts_L6	0.018	0.219	0.019	5.438	0.021	0.315	0.102	6.925
cfts_L7	0.013	0.236	0.001	4.305	0.015	0.609	0.074	1.687
quick_ratio	0.936	35.417	0.368	14.429	0.832	7.446	3.469	21.453
quick_ratioL1	0.983	48.149	0.404	75.054	0.822	14.251	1.309	36.074
quick_ratioL2	1.001	12.402	0.405	9.642	0.813	18.983	1.071	97.589
quick_ratioL3	0.986	17.093	0.413	14.660	0.819	20.775	1.023	108.733
quick_ratioL4	0.798	59.923	0.429	11.059	0.822	14.853	1.031	48.720
quick_ratioL5	0.068	28.900	0.430	81.961	0.846	41.051	1.080	51.611
quick_ratioL6	0.077	3.342	0.373	47.133	0.850	6.285	1.084	164.970
quick_ratioL7	0.035	1.138	0.046	53.287	0.746	5.429	1.013	65.533
tlta	0.944	4.169	0.958	4.706	1.015	14.978	1.270	0.828
tltaL1	0.889	1.435	0.911	0.360	0.884	3.536	0.897	0.854
tltaL2	0.873	0.697	0.886	0.290	0.846	3.102	0.826	3.667
tltaL3	0.859	1.661	0.881	0.554	0.839	0.703	0.808	46.309
tltaL4	0.758	1.263	0.859	0.556	0.838	8.459	0.799	1.192
tltaL5	0.009	10.672	0.842	0.551	0.841	2.714	0.785	0.879
tltaL6	0.001	2.732	0.785	0.596	0.830	7.563	0.758	0.734
tltaL7	0.001	0.762	0.153	0.457	0.758	7.473	0.632	1.500
qaca	0.968	0.338	0.353	0.384	0.807	0.221	0.807	0.231
qacaL1	0.984	0.311	0.302	0.289	0.807	0.239	0.970	0.257
qacaL2	0.998	0.328	0.316	0.248	0.807	0.245	1.000	0.270
qacaL3	1.000	0.381	0.316	0.258	0.810	0.265	1.003	0.278
qacaL4	0.941	0.540	0.320	0.295	0.823	0.278	1.009	0.341
qacaL5	0.154	0.539	0.326	0.309	0.834	0.293	1.010	0.550
qacaL6	0.123	0.368	0.306	0.342	0.860	0.301	1.010	0.335
qacaL7	0.087	0.134	0.038	0.332	0.746	0.431	0.970	0.474
tctl	0.244	0.232	0.091	0.122	0.293	0.184	0.244	0.111
tctlL1	0.274	0.243	0.082	0.112	0.361	0.187	0.171	0.128
tctlL2	0.291	0.248	0.090	0.117	0.394	0.196	0.117	0.134
tlL3	0.268	0.249	0.097	0.127	0.433	0.199	0.096	0.132
tctlL4	0.125	0.242	0.078	0.143	0.459	0.201	0.094	0.134
tctlL5	0.113	0.192	0.073	0.146	0.474	0.205	0.107	0.143
tctlL6	0.095	0.084	0.027	0.148	0.460	0.223	0.120	0.151
tctlL7	0.053	0.023	0.001	0.134	0.369	0.274	0.070	0.152
finalfirmage	8.000	23.522	18.000	30.614	18.000	46.124	10.000	59.220

Table A.13: Eigenvalues of un-rotated factors; factor analysis with directors' characteristics.

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	5.08467	0.89634	0.1585	0.1585
Factor2	4.18833	0.90248	0.1306	0.2891
Factor3	3.28585	0.54284	0.1024	0.3915
Factor4	2.74300	0.50483	0.0855	0.4770
Factor5	2.23818	0.17330	0.0698	0.5468
Factor6	2.06488	0.31448	0.0644	0.6112
Factor7	1.75041	0.10228	0.0546	0.6657
Factor8	1.64812	0.23123	0.0514	0.7171
Factor9	1.41690	0.05409	0.0442	0.7613
Factor10	1.36281	0.13526	0.0425	0.8038
Factor11	1.22755	0.11450	0.0383	0.8420
Factor12	1.11304	0.13006	0.0347	0.8767
Factor13	0.98298	0.08045	0.0306	0.9074
Factor14	0.90253	0.11449	0.0281	0.9355
Factor15	0.78804	0.11520	0.0246	0.9601
Factor16	0.67284	0.01251	0.0210	0.9810
Factor17	0.66033	0.06594	0.0206	1.0016
Factor18	0.59439	0.04346	0.0185	1.0202
Factor19	0.55094	0.02104	0.0172	1.0373
Factor20	0.52990	0.15424	0.0165	1.0538
Factor21	0.37566	0.07043	0.0117	1.0656
Factor22	0.30523	0.01571	0.0095	1.0751
Factor23	0.28952	0.08181	0.0090	1.0841
Factor24	0.20771	0.02475	0.0065	1.0906
Factor25	0.18296	0.01768	0.0057	1.0963
Factor26	0.16528	0.02275	0.0052	1.1014
Factor27	0.14253	0.02013	0.0044	1.1059
Factor28	0.12240	0.01707	0.0038	1.1097
Factor29	0.10533	0.01997	0.0033	1.1130
Factor30	0.08536	0.00950	0.0027	1.1156
Factor31	0.07585	0.00798	0.0024	1.1180
Factor32	0.06788	0.01917	0.0021	1.1201
Factor33	0.04871	0.02177	0.0015	1.1216
Factor34	0.02695	0.00298	0.0008	1.1225
Factor35	0.02396	0.01147	0.0007	1.1232
Factor36	0.01250	0.00757	0.0004	1.1236
Factor37	0.00493	0.00885	0.0002	1.1238
Factor38	-0.00392	0.00592	-0.0001	1.1236
Factor39	-0.00984	0.00260	-0.0003	1.1233
Factor40	-0.01244	0.00581	-0.0004	1.1229
Factor41	-0.01825	0.00847	-0.0006	1.1224
Factor42	-0.02671	0.00353	-0.0008	1.1215
Factor43	-0.03025	0.00663	-0.0009	1.1206
Factor44	-0.03688	0.00869	-0.0011	1.1195
Factor45	-0.04557	0.01685	-0.0014	1.1180
Factor46	-0.06242	0.00770	-0.0019	1.1161
Factor47	-0.07012	0.00464	-0.0022	1.1139
Factor48	-0.07475	0.00550	-0.0023	1.1116
Factor49	-0.08026	0.00736	-0.0025	1.1091
Factor50	-0.08762	0.01404	-0.0027	1.1063
Factor51	-0.10166	0.01001	-0.0032	1.1032
Factor52	-0.11167	0.00408	-0.0035	1.0997
Factor53	-0.11575	0.01532	-0.0036	1.0961
Factor54	-0.13107	0.00376	-0.0041	1.0920
Factor55	-0.13483	0.00272	-0.0042	1.0878
Factor56	-0.13755	0.01837	-0.0043	1.0835
Factor57	-0.15592	0.01412	-0.0049	1.0786
Factor58	-0.17004	0.00280	-0.0053	1.0733
Factor59	-0.17284	0.01204	-0.0054	1.0680
Factor60	-0.18489	0.02422	-0.0058	1.0622
Factor61	-0.20910	0.00413	-0.0065	1.0557
Factor62	-0.21323	0.01807	-0.0066	1.0490
Factor63	-0.23130	0.00996	-0.0072	1.0418
Factor64	-0.24126	0.01501	-0.0075	1.0343
Factor65	-0.25627	0.01234	-0.0080	1.0263
Factor66	-0.26861	0.01500	-0.0084	1.0179
Factor67	-0.28361	0.00784	-0.0088	1.0091
Factor68	-0.29145	.	-0.0091	1.0000

LR test: independent vs. saturated: chi2(2278)= 1.9e+05 Prob>chi2 = 0.0000

Table A.14: Eigenvalues of VARIMAX- rotated factors (with Eigenvalues >1); factor analysis with directors' characteristics.

Factor	Variance	Difference	Proportion	Cumulative
Factor1	4.52604	0.60516	0.1411	0.1411
Factor2	3.92088	0.74195	0.1222	0.2633
Factor3	3.17893	0.26806	0.0991	0.3624
Factor4	2.91087	0.48134	0.0907	0.4532
Factor5	2.42952	0.38039	0.0757	0.5289
Factor6	2.04913	0.27927	0.0639	0.5928
Factor7	1.76987	0.19490	0.0552	0.6480
Factor8	1.57496	0.01262	0.0491	0.6970
Factor9	1.56234	0.12115	0.0487	0.7458
Factor10	1.44119	0.05266	0.0449	0.7907
Factor11	1.38853	0.01706	0.0433	0.8340
Factor12	1.37146	.	0.0428	0.8767
LR test: independent vs. saturated: chi2(2278)= 1.9e+05 Prob>chi2 = 0.0000				

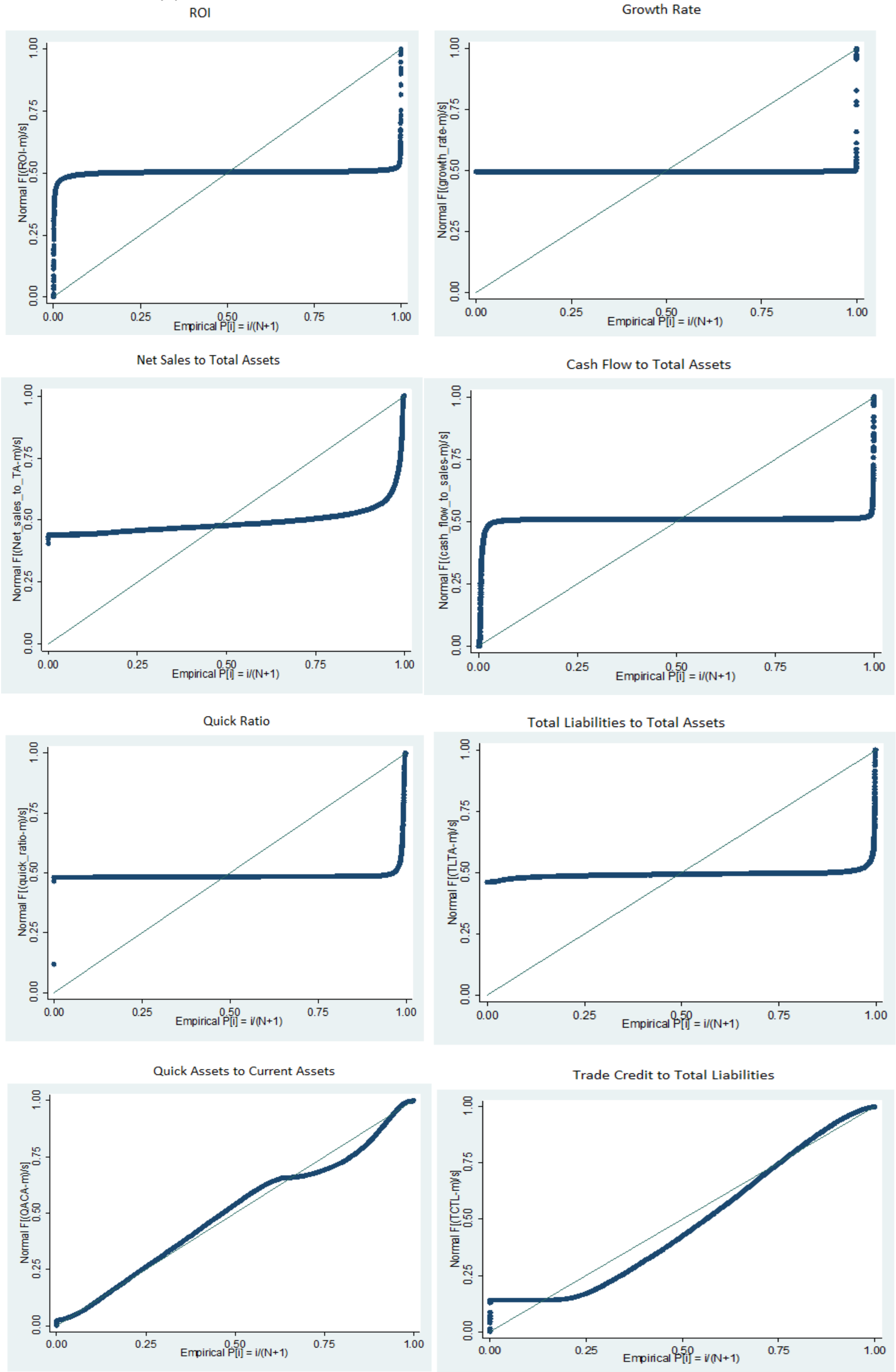
Table A.15: Factor Loadings for factor analysis with directors' characteristics (post VARIMAX rotation).

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Factor11	Factor12
roi	-0.0027	0.0337	-0.0009	0.0041	-0.0116	-0.0018	0.0037	-0.0851	-0.0146	-0.0004	-0.0987	0.0305
roiL1	0.0713	-0.0691	0.0154	-0.0010	0.0926	-0.0086	0.0028	-0.4369	0.2272	-0.0112	-0.0019	0.0281
roiL2	0.1227	-0.0944	-0.0164	-0.0227	0.0766	-0.0096	-0.0094	-0.2236	0.3501	-0.0059	-0.1115	0.0281
roiL3	0.0062	-0.0062	-0.0185	-0.0034	-0.0009	0.9921	-0.0042	-0.0070	0.0452	0.0002	0.0013	0.0010
roiL4	0.0871	-0.0771	-0.0961	-0.0078	0.0469	0.0694	-0.0175	-0.1622	0.4326	0.0112	-0.0419	0.0318
roiL5	0.0497	-0.0283	-0.0249	-0.0005	0.0116	0.0493	-0.0095	-0.1046	0.4873	-0.0039	-0.0381	0.0306
roiL6	0.0607	-0.0123	-0.1699	-0.0135	0.0224	0.1302	-0.0262	0.0110	0.6443	0.0203	-0.0218	-0.0079
roiL7	0.0351	0.0272	-0.2100	-0.0102	-0.0271	0.1454	-0.0167	0.0148	0.4489	0.0056	-0.0003	-0.1188
growth_rate	-0.0119	0.0225	-0.0011	0.0015	0.0366	-0.0007	0.0004	0.0075	0.0092	-0.0001	0.0092	0.0024
growth_rateL1	-0.0073	0.0229	0.0000	-0.0184	0.1114	-0.0045	-0.0026	-0.0405	0.0193	-0.0076	0.1742	0.0038
growth_rateL2	-0.0187	0.0065	0.0167	-0.0031	0.0897	-0.0025	0.0120	0.0625	0.0215	-0.0016	0.0704	0.0070
growth_rateL3	-0.0251	0.0054	0.0182	-0.0155	0.0207	-0.0110	0.9382	0.0051	-0.0261	-0.0039	-0.0102	0.0015
growth_rateL4	-0.0297	0.0209	0.0015	-0.0011	-0.0236	-0.0046	0.0020	0.0022	0.0018	-0.0018	-0.0012	0.0014
growth_rateL5	-0.0257	0.0162	0.0070	0.0075	-0.0043	-0.0051	-0.0002	0.0072	-0.0203	-0.0014	-0.0043	-0.0033
growth_rateL6	-0.0388	0.0682	0.0535	0.0198	-0.0719	-0.0882	0.0122	-0.0338	-0.3788	-0.0143	-0.0352	-0.0196
growth_rateL7	-0.0245	-0.0109	0.1921	0.1773	0.1095	-0.1097	0.0033	0.0771	-0.1489	-0.0102	-0.1006	0.0663
nsta	0.0243	0.0570	0.0068	0.0716	-0.0701	0.0017	0.0110	0.2695	-0.0658	0.0024	0.2752	-0.0300
nsta_L1	0.0413	0.1128	0.0051	0.1965	-0.0382	0.0104	-0.0071	-0.0123	-0.0314	0.0064	0.6704	-0.0100
nsta_L2	0.0253	0.0777	0.1778	0.1487	-0.0478	0.0113	0.0115	0.0406	-0.0286	0.0075	0.3263	-0.0032
nsta_L3	0.0060	0.0158	-0.0054	0.0849	-0.0057	0.0011	0.9329	-0.0022	0.0117	0.0038	0.0115	-0.0034
nsta_L4	0.0325	0.0731	-0.0022	0.6217	-0.0718	0.0103	-0.0010	-0.0082	-0.0649	0.0085	0.4977	-0.0084
nsta_L5	0.0390	0.0566	0.0184	0.8531	-0.0310	-0.0010	0.0239	0.0148	-0.0253	0.0099	0.0828	-0.0018
nsta_L6	0.0571	0.0213	0.0051	0.9028	0.0582	-0.0042	0.0286	-0.0045	-0.0063	-0.0053	-0.0056	-0.0029
nsta_L7	0.0483	-0.0075	0.0125	0.8481	0.1604	-0.0111	0.0367	0.0006	0.0458	0.0054	-0.0431	0.0145
cfts	0.0748	-0.0255	-0.0007	0.0119	-0.0121	0.0041	0.0009	0.0044	-0.0348	0.0123	0.0208	0.1709
cfts_L1	0.0596	-0.0108	0.0055	0.0137	0.0163	-0.0005	-0.0013	-0.0282	-0.0038	0.0012	0.0229	0.0102
cfts_L2	0.0390	0.0004	0.0030	0.0073	0.0140	-0.0004	-0.0015	-0.0209	0.0110	0.0048	0.0076	-0.0048
cfts_L3	-0.0129	0.0076	0.0088	0.0017	-0.0070	-0.0065	0.0021	-0.0408	0.0692	-0.0164	-0.0114	-0.5770
cfts_L4	0.0063	-0.0004	-0.0011	0.0115	-0.0182	-0.0039	-0.0016	0.0162	0.1108	-0.0264	-0.0123	0.4556
cfts_L5	0.0100	0.0170	-0.0081	0.0072	-0.0165	0.0028	-0.0028	0.0016	0.0828	-0.0159	-0.0142	0.6691
cfts_L6	0.0272	0.0258	-0.0111	0.0061	-0.0473	0.0018	-0.0007	0.0074	0.0756	0.0005	-0.0191	-0.1572
cfts_L7	-0.0078	0.0386	-0.0276	-0.0028	0.0009	0.0070	0.0013	0.0080	0.1692	-0.0147	0.0018	-0.5400
quick_ratio	-0.0608	0.0905	0.0063	0.0255	-0.0177	-0.0010	-0.0011	-0.0295	-0.0707	0.0494	-0.0094	0.0039
quick_ratioL1	-0.0600	0.0609	-0.0012	-0.0021	0.0144	0.0019	0.0050	-0.0323	0.0120	0.1127	0.0259	0.0034
quick_ratioL2	-0.0537	0.0578	-0.0078	0.0007	0.0104	-0.0011	0.0018	-0.0221	0.0056	0.1906	0.0162	0.0038
quick_ratioL3	-0.0379	0.0206	-0.0015	-0.0048	-0.0114	-0.0020	0.0023	-0.0075	0.0149	0.7616	0.0051	0.0067
quick_ratioL4	-0.0349	0.0326	-0.0036	0.0032	-0.0026	0.0001	-0.0017	0.0026	0.0006	0.7626	-0.0017	-0.0061
quick_ratioL5	-0.0510	0.0212	-0.0062	0.0137	0.0248	0.0040	-0.0048	-0.0058	-0.0042	0.4569	0.0185	-0.0210
quick_ratioL6	-0.0409	0.0237	-0.0056	0.0078	0.0554	0.0015	-0.0036	-0.0133	0.0005	0.0947	0.0071	-0.0102
quick_ratioL7	-0.0558	0.0067	-0.0022	0.0127	0.1055	-0.0016	0.0001	-0.0052	-0.0053	0.0625	0.0110	-0.0035
tlta	-0.0191	-0.0262	0.0145	-0.0092	0.0276	-0.0078	-0.0006	0.4876	0.0182	0.0007	0.0552	-0.0098
tltaL1	-0.0275	0.0141	-0.0007	0.0049	0.0049	-0.0071	0.0019	0.7653	-0.0220	-0.0051	-0.0147	0.0028
tltaL2	-0.0287	0.0056	0.0164	0.0035	0.0282	-0.0301	0.0066	0.5986	0.0032	-0.0082	-0.0183	0.0559
tltaL3	-0.0024	0.0019	0.0223	0.0044	0.0079	-0.9940	0.0042	0.0036	-0.0182	0.0007	-0.0027	0.0005
tltaL4	-0.0053	0.0100	0.9716	-0.0075	-0.0029	-0.0073	0.0042	0.0169	-0.0494	0.0013	0.0226	-0.0069
tltaL5	-0.0163	0.0387	0.3704	0.0970	-0.0482	-0.0650	0.0043	0.0463	0.2169	-0.0143	-0.1285	0.0142
tltaL6	0.0051	0.0105	0.9946	0.0233	0.0057	-0.0194	0.0032	-0.0049	0.0048	-0.0039	-0.0227	0.0004
tltaL7	0.0063	-0.0015	0.9668	0.0028	0.0549	-0.0141	0.0043	-0.0085	-0.0502	-0.0000	0.0128	0.0059
qaca	0.0566	0.7640	-0.0082	0.0036	-0.0728	-0.0040	0.0100	0.0423	0.0149	0.0066	0.0404	0.0259
qacaL1	0.0128	0.8706	-0.0056	0.0002	0.0074	-0.0050	0.0186	0.0034	0.0246	0.0009	0.0598	0.0081
qacaL2	-0.0023	0.8786	0.0204	0.0080	0.0665	-0.0077	0.0175	0.0012	-0.0006	0.0075	0.0618	0.0021
qacaL3	-0.0066	0.8429	-0.0052	0.0117	0.0756	-0.0073	0.0116	-0.0037	0.0004	0.0228	0.0252	-0.0025
qacaL4	0.0503	0.7103	0.0333	0.0822	0.2539	0.0102	-0.0310	0.0041	-0.0840	0.0211	-0.0854	-0.0381
qacaL5	0.0866	0.5141	0.0195	0.1471	0.3993	0.0143	-0.0348	-0.0333	-0.1018	0.0066	-0.1895	-0.0451
qacaL6	0.1323	0.3773	0.0601	0.1792	0.5924	0.0089	-0.0222	-0.0312	-0.1016	-0.0079	-0.2431	-0.0449
qacaL7	0.1049	0.1960	0.0837	0.1557	0.7162	-0.0073	0.0053	0.0006	0.0414	-0.0103	-0.1476	0.0032
tctl	0.6667	0.0875	0.0024	-0.0067	-0.0336	-0.0129	0.0202	-0.0286	-0.0063	-0.0078	0.1169	0.0231
tctlL1	0.7757	0.0720	0.0140	-0.0133	-0.0684	-0.0160	0.0257	-0.0499	0.0193	-0.0196	0.1418	0.0169
tctlL2	0.8112	0.0452	0.0057	-0.0096	-0.0757	-0.0160	0.0182	-0.0354	0.0462	-0.0225	0.1279	0.0212
tlL3	0.8209	0.0279	-0.0109	-0.0109	-0.0722	0.0027	0.0085	-0.0164	0.0431	-0.0247	0.0732	-0.0054
tctlL4	0.8104	0.0251	-0.0160	0.0493	0.0040	0.0211	-0.0348	0.0158	0.0174	-0.0098	-0.0625	-0.0039
tctlL5	0.7646	-0.0267	-0.0091	0.1060	0.1376	0.0203	-0.0396	0.0133	-0.0169	-0.0024	-0.1740	-0.0133
tctlL6	0.6938	-0.0631	0.0220	0.1298	0.2796	0.0217	-0.0365	0.0175	-0.0301	-0.0030	-0.2210	-0.0150
tctlL7	0.5290	-0.0873	0.0368	0.1472	0.3892	0.0127	-0.0188	0.0325	0.0126	-0.0064	-0.1734	-0.0064
finalfirmage	0.0899	-0.1435	0.0041	-0.0576	-0.4685	0.0379	-0.0388	-0.0019	-0.0141	-0.0023	-0.1468	-0.0183
avg_dir_age	0.0170	-0.0854	0.0017	0.0172	0.0767	0.0042	-0.0067	-0.0176	0.0152	0.0071	0.0013	-0.0069
Nr_Female_Dir	-0.0767	0.0553	0.0115	-0.0311	0.5647	-0.0172	0.0477	0.0088	0.0522	0.0015	0.2171	0.0137
Total_Dir_Nr	-0.0611	0.0604	-0.0019	-0.0437	0.6234	-0.0138	0.0309	0.0230	0.0767	0.0046	0.1786	0.0083

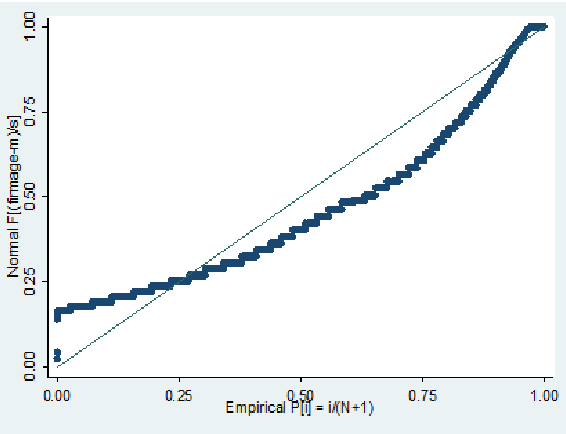
Table A.16: Failed Firm Clusters (Financial Ratios and Directors' Characteristics).

	Cluster 1		Cluster 2		Cluster 3		Cluster 4	
Variable	Median	St. Dev	Median	St. Dev	Median	St. Dev	Median	St. Dev
roi	-0.198	0.502	-0.104	0.758	-0.056	4.795	-0.126	1.000
roiL1	-0.036	1.623	0.000	0.670	-0.006	0.947	-0.003	1.777
roiL2	0.003	1.455	0.003	0.613	0.002	1.101	0.004	1.233
roiL3	0.008	2.884	0.004	33.593	0.002	1.701	0.010	1.459
roiL4	0.008	0.803	0.007	0.593	0.002	0.909	0.013	1.861
roiL5	0.011	0.993	0.010	1.645	0.001	0.882	0.017	1.599
roiL6	0.018	0.741	0.010	0.763	0.001	0.741	0.008	0.449
roiL7	0.021	1.014	0.004	0.408	0.002	0.477	0.000	0.537
growth_rate	6.615	12.591	0.161	10.397	0.086	2.995	0.089	10.228
growth_rateL1	0.356	50.829	0.042	6.692	0.048	3.724	0.053	6.928
growth_rateL2	0.041	54.986	0.019	5.764	-0.016	3.098	-0.013	4.110
growth_rateL3	-0.005	3.593	-0.087	1.854	-0.028	2.643	-0.116	11.434
growth_rateL4	0.022	2.616	-0.172	1.878	0.032	1.778	-0.140	43.590
growth_rateL5	0.007	1.184	-0.106	1.778	0.074	1.125	-0.037	28.559
growth_rateL6	0.004	1.107	-0.057	1.325	0.056	1.058	-0.102	1.008
growth_rateL7	0.121	1.215	-0.042	0.899	0.033	0.794	-0.154	1.215
nsta	2.430	1.389	1.935	3.027	1.650	8.141	2.358	7.072
nsta_L1	2.430	4.616	1.782	8.691	1.380	4.109	1.971	5.124
nsta_L2	2.160	12.349	1.760	3.349	1.345	6.054	1.785	6.828
nsta_L3	1.859	7.085	1.778	2.645	1.246	3.161	1.802	67.888
nsta_L4	1.881	7.238	1.905	8.850	0.622	2.942	1.893	4.189
nsta_L5	2.123	8.000	1.938	1.714	0.085	1.694	1.876	3.808
nsta_L6	2.128	7.554	1.914	1.916	0.086	1.239	1.261	3.402
nsta_L7	2.116	7.690	1.512	1.885	0.077	1.202	0.046	1.861
cfts	-1.624	26.840	-0.063	13.296	-0.215	13.620	-0.895	30.009
cfts_L1	-0.016	10.758	0.008	8.496	0.006	20.029	0.011	23.808
cfts_L2	0.029	2.412	0.013	1.666	0.016	21.781	0.031	5.237
cfts_L3	0.030	3.089	0.013	4.921	0.025	63.409	0.043	3.023
cfts_L4	0.033	1.283	0.016	19.553	0.016	3.234	0.057	8.660
cfts_L5	0.048	1.056	0.019	13.016	0.008	8.108	0.066	11.480
cfts_L6	0.054	8.599	0.019	0.297	0.005	4.361	0.046	0.891
cfts_L7	0.067	1.969	0.013	0.607	0.002	2.768	0.141	2.304
quick_ratio	3.469	2.747	0.791	3.706	0.560	28.921	1.017	29.196
quick_ratioL1	3.308	28.080	0.818	4.534	0.606	72.478	1.022	35.675
quick_ratioL2	1.002	116.663	0.823	45.591	0.620	48.341	1.010	95.939
quick_ratioL3	0.946	130.710	0.813	212.772	0.603	152.605	1.024	61.380
quick_ratioL4	0.953	65.942	0.809	140.265	0.402	77.547	1.050	39.175
quick_ratioL5	0.989	61.113	0.834	37.422	0.174	66.186	1.067	38.717
quick_ratioL6	0.957	111.655	0.831	4.295	0.172	37.444	0.944	146.217
quick_ratioL7	0.922	80.971	0.699	4.047	0.162	42.342	0.260	13.401
tlta	1.270	19.116	0.982	2.107	0.961	5.236	0.951	3.442
tltaL1	0.919	1.685	0.881	2.520	0.910	1.952	0.877	2.175
tltaL2	0.807	1.836	0.850	2.957	0.893	3.465	0.849	1.243
tltaL3	0.799	1.300	0.845	46.720	0.881	1.434	0.826	1.453
tltaL4	0.796	1.075	0.843	2.980	0.811	0.674	0.814	8.915
tltaL5	0.754	0.676	0.845	2.859	0.666	0.758	0.799	9.971
tltaL6	0.697	0.696	0.833	2.909	0.562	0.767	0.724	8.190
tltaL7	0.627	1.751	0.748	2.675	0.557	0.537	0.287	7.824
qaca	0.807	0.191	0.807	0.251	0.605	0.460	0.973	0.315
qacaL1	0.874	0.260	0.807	0.257	0.557	0.425	1.000	0.306
qacaL2	0.976	0.293	0.807	0.266	0.550	0.416	1.003	0.315
qacaL3	0.561	0.320	0.804	0.282	0.547	0.441	1.011	0.323
qacaL4	0.976	0.311	0.805	0.277	0.337	0.420	1.029	0.379
qacaL5	0.563	0.346	0.812	0.283	0.114	0.300	1.024	0.602
qacaL6	0.800	0.393	0.825	0.307	0.174	0.288	1.003	0.528
qacaL7	0.970	0.438	0.694	0.432	0.146	0.282	0.763	0.605
tctl	0.243	0.122	0.289	0.197	0.171	0.197	0.228	0.173
tctlL1	0.244	0.169	0.340	0.204	0.154	0.209	0.153	0.183
tctlL2	0.221	0.200	0.362	0.212	0.150	0.217	0.125	0.184
tlL3	0.213	0.213	0.409	0.216	0.144	0.218	0.125	0.181
tctlL4	0.194	0.209	0.457	0.207	0.052	0.197	0.118	0.174
tctlL5	0.201	0.202	0.489	0.196	0.012	0.139	0.088	0.159
tctlL6	0.181	0.190	0.483	0.208	0.234	0.100	0.024	0.133
tctlL7	0.141	0.180	0.396	0.277	0.074	0.094	0.065	0.114
finalfirmage	8.000	5.216	20.000	37.429	11.000	26.613	13.000	42.917
avg_dir_age	49.513	10.292	48.134	13.161	48.134	11.484	48.134	11.431
Nr_Female_Dir	3.000	2.256	0.000	0.913	0.000	0.679	0.000	0.687
Total_Dir_Nr	14.000	9.810	5.000	3.475	3.000	2.988	3.000	3.239

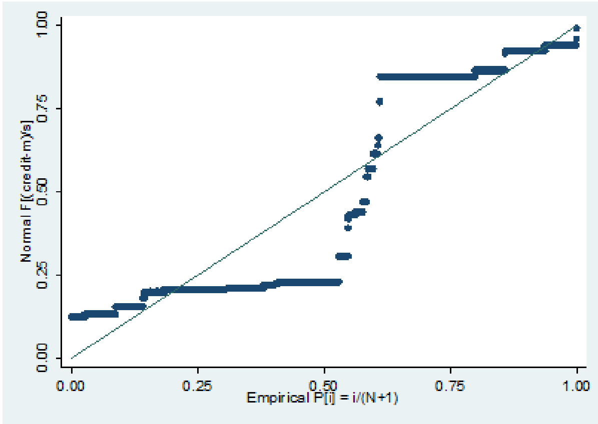
Chart A.1: Normality plots - Firms in EU Countries



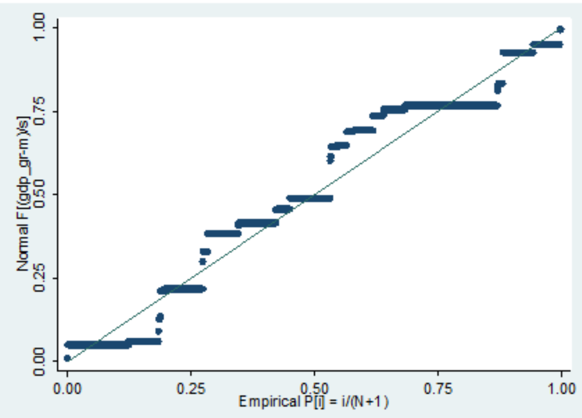
Firm Age



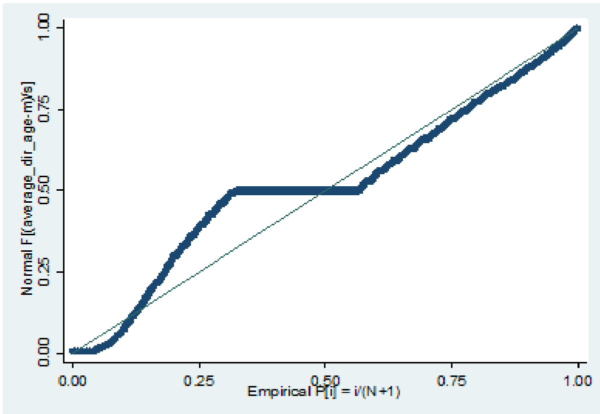
Credit



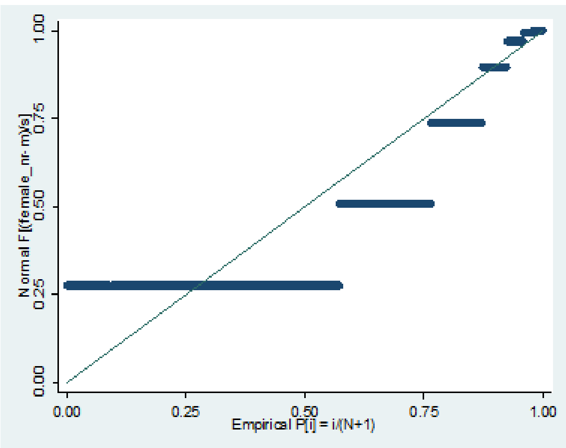
GDP Growth



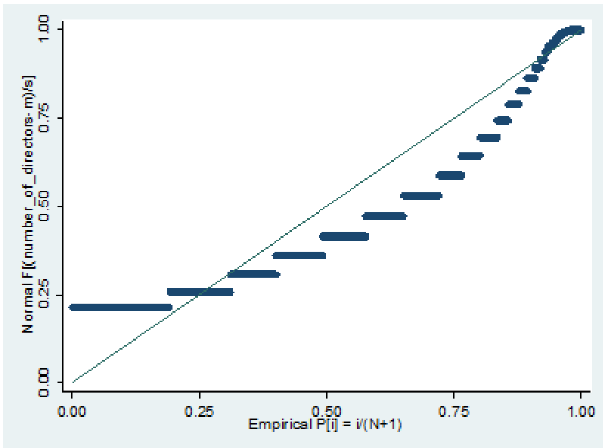
Average Directors' Age



Female Directors Number



Number of Directors



APPENDIX B

Table B.1: UK Firms- Correlation matrix of variables without lags.

	roi	Growth rate	nsta	cfts	quick ratio	tlta	qaca	tctl	firmage	avg dir age	Nr Female Dir	Total dir_nr	credit	GDP_gr
roi	1													
Growth Rate	0.0079	1												
nsta	-0.0069	0.0645	1.0000											
cfts	0.0025	0.0021	0.0036	1.0000										
quick ratio	0.0037	-0.0018	0.0110	-0.0287	1.0000									
tlta	-0.9961	-0.0016	0.0071	-0.0010	-0.0055	1.0000								
qaca	-0.0013	0.0947	0.0049	0.0094	0.1279	0.0037	1.0000							
tctl	0.0182	0.0005	0.0139	0.0467	-0.1137	-0.0196	-0.1458	1.0000						
firmage	0.0311	-0.0010	-0.0218	-0.0089	-0.0013	-0.0334	-0.1394	0.1247	1.0000					
avg_dir_age	0.0162	-0.0167	-0.0240	-0.0237	-0.0325	-0.0194	-0.0808	0.1071	0.3881	1.0000				
Nr_Female_Dir	0.0095	0.1480	0.0249	0.0152	0.0194	-0.0103	0.1112	-0.1207	-0.0097	-0.2000	1.0000			
Total_dir_nr	0.0133	0.0924	-0.0079	-0.0845	0.0166	-0.0152	0.0963	-0.1161	0.2503	0.2102	0.4760	1.0000		
credit	-0.0585	-0.0193	0.0624	0.0630	-0.0034	0.0585	-0.0305	0.1073	0.0515	0.0516	-0.0374	0.0018	1.0000	
GDP_gr	0.0008	-0.0273	0.0007	-0.0365	-0.0484	-0.0006	-0.0346	0.0646	0.0151	0.0179	-0.0503	-0.0158	0.0007	1.0000

Table B.2: Partial Correlation matrix of variables without lags.

	ROI	Growth Rate	NSTA	CFTS	quick ratio	TLTA	QACA	TCTL	Firm age	Average Director Age	Female Director Nr.	Number of Dir.
ROI		0.057	-0.322	0.049	0.035	-0.201	0.020	0.221	0.039	-0.044	0.015	0.012
Growth Rate	0.057		0.163	0.030	-0.089	-0.035	-0.436	0.060	-0.042	0.019	-0.031	0.016
NSTA	-0.322	0.163		0.016	-0.045	0.062	0.106	0.305	0.028	-0.017	0.005	-0.018
CFTS	0.049	0.030	0.016		-0.533	-0.069	0.047	-0.011	0.002	-0.026	0.049	-0.067
quick ratio	0.035	-0.089	-0.045	-0.533		-0.197	0.038	-0.131	-0.047	-0.029	-0.025	0.039
TLTA	-0.201	-0.035	0.062	-0.069	-0.197		-0.044	-0.188	-0.031	-0.075	-0.041	0.019
QACA	0.020	-0.436	0.106	0.047	0.038	-0.044		0.152	-0.031	0.008	0.016	-0.003
TCTL	0.221	0.060	0.305	-0.011	-0.131	-0.188	0.152		-0.055	0.093	-0.001	-0.033
Firm age	-0.042	-0.042	0.028	0.002	0.002	-0.031	-0.031	-0.055		0.323	-0.066	0.218
Average Director Age	0.019	0.019	-0.017	-0.026	-0.029	-0.075	0.008	0.093	0.323		-0.306	0.262
Female Director Nr.	-0.031	-0.031	0.005	0.049	-0.025	-0.041	0.016	-0.001	-0.066	-0.306		0.550
Number of Dir.	0.016	0.016	-0.018	-0.067	0.039	0.019	-0.003	-0.033	0.218	0.262	0.550	

Table B.3: Correlation matrix of variables with lags (UK Firms).

	ROI	ROI t-1	ROI t-2	ROI t-3	ROI t-4	ROI t-5	ROI t-6	ROI t-7	Growth Rate	Growth Rate t-1	Growth Rate t-2	Growth Rate t-3	Growth Rate t-4	Growth Rate t-5	Growth Rate t-6	Growth Rate t-7	NSTA	NSTA t-1	NSTA t-2	NSTA t-3	NSTA t-4	NSTA t-5	NSTA t-6	NSTA t-7	CFtS	CFtS t-1	CFtS t-2	CFtS t-3	CFtS t-4	CFtS t-5	CFtS t-6	CFtS t-7	Quick Ratio	Quick Ratio t-1	Quick Ratio t-2	Quick Ratio t-3	Quick Ratio t-4	Quick Ratio t-5	Quick Ratio t-6	Quick Ratio t-7	TLTA	TLTA t-1	TLTA t-2	TLTA t-3	TLTA t-4	TLTA t-5	TLTA t-6	TLTA t-7	QACA	QACA t-1	QACA t-2	QACA t-3	QACA t-4	QACA t-5	QACA t-6	QACA t-7	TCTL	TCTL t-1	TCTL t-2	TCTL t-3	TCTL t-4	TCTL t-5	TCTL t-6	TCTL t-7	Firm Age	Average Director Age	Female Director Nr.	Number of Directors
ROI	1.000
ROI t-1	0.063	1.000
ROI t-2	0.141	0.184	1.000
ROI t-3	0.121	0.057	0.257	1.000
ROI t-4	0.205	0.180	0.333	0.360	1.000
ROI t-5	-0.003	0.034	0.139	0.123	0.263	1.000
ROI t-6	-0.001	0.068	0.187	0.166	0.330	0.401	1.000
ROI t-7	0.001	0.017	0.046	0.038	0.067	-0.104	0.146	1.000
Growth Rate	0.008	0.016	0.006	0.007	0.006	0.004	0.006	-0.002	1.000
Growth Rate t-1	-0.006	0.000	0.004	0.004	0.004	0.000	0.002	0.000	-0.002	1.000
Growth Rate t-2	-0.107	-0.042	0.174	-0.007	-0.013	0.020	0.022	-0.013	-0.008	0.009	1.000
Growth Rate t-3	-0.126	-0.024	-0.037	-0.517	0.000	0.040	0.015	-0.006	-0.010	-0.007	0.217	1.000
Growth Rate t-4	-0.174	0.000	-0.076	-0.065	-0.148	-0.062	0.027	0.184	-0.020	-0.008	-0.012	0.046	1.000
Growth Rate t-5	-0.009	-0.065	0.023	-0.023	-0.011	-0.283	-0.012	0.163	-0.010	-0.005	-0.019	0.003	0.165	1.000
Growth Rate t-6	-0.012	-0.084	-0.101	-0.058	-0.124	-0.035	-0.273	-0.030	-0.017	-0.009	0.024	0.007	0.088	0.126	1.000
Growth Rate t-7	0.010	-0.030	-0.097	-0.056	-0.104	-0.076	-0.136	0.044	-0.010	-0.018	-0.032	-0.015	-0.020	0.008	-0.080	1.000
NSTA	-0.007	-0.002	0.002	0.000	0.002	0.002	0.002	-0.002	0.246	-0.002	-0.003	-0.007	-0.035	0.008	0.011	-0.017	1.000
NSTA t-1	-0.001	0.010	-0.010	-0.002	0.001	-0.020	-0.045	-0.010	-0.008	-0.009	0.015	-0.005	-0.032	0.174	0.004	-0.022	0.029	1.000
NSTA t-2	0.000	0.007	0.069	0.000	0.008	0.006	-0.002	-0.010	-0.006	0.001	0.054	-0.003	-0.027	0.168	-0.018	-0.021	0.023	0.953	1.000
NSTA t-3	-0.001	0.009	0.000	0.007	0.009	0.006	0.006	-0.003	-0.007	-0.012	-0.009	-0.013	-0.030	0.169	-0.011	-0.011	0.020	0.895	0.916	1.000
NSTA t-4	-0.001	0.008	0.006	0.002	0.007	0.002	0.001	-0.004	-0.006	0.000	-0.008	-0.008	-0.023	0.198	-0.008	-0.018	0.018	0.913	0.939	0.958	1.000
NSTA t-5	0.000	0.010	0.006	0.002	0.015	-0.003	-0.002	0.000	-0.008	0.000	-0.011	-0.010	-0.005	0.214	-0.015	-0.009	0.008	0.895	0.893	0.892	0.954	1.000
NSTA t-6	-0.004	0.004	0.001	-0.033	-0.002	-0.041	-0.020	0.009	-0.026	0.005	-0.019	0.001	0.016	0.085	0.027	-0.054	0.031	0.602	0.550	0.461	0.433	0.457	1.000
NSTA t-7	0.041	0.004	-0.004	-0.023	0.055	-0.024	0.023	0.010	-0.019	0.012	-0.003	0.020	0.014	0.080	-0.171	0.025	-0.022	0.506	0.482	0.421	0.402	0.422	0.709	1.000
CFtS	0.003	0.030	0.032	-0.001	0.000	-0.001	-0.004	0.001	0.004	0.001	-0.001	0.002	-0.024	0.002	-0.008	0.010	0.004	0.014	0.012	0.011	0.011	0.011	0.034	0.025	1.000
CFtS t-1	0.004	0.513	0.062	0.003	0.004	0.003	-0.002	0.002	0.003	0.002	-0.005	0.013	0.004	-0.163	-0.043	-0.008	-0.005	0.017	0.014	0.014	0.013	0.013	-0.003	-0.016	0.019	1.000
CFtS t-2	0.008	0.009	0.035	0.020	0.030	0.018	0.022	0.012	0.005	0.003	0.001	0.006	0.015	-0.011	-0.015	-0.027	0.004	0.014	0.017	0.017	0.018	0.013	-0.003	-0.018	0.005	0.028	1.000
CFtS t-3	0.042	0.029	0.072	0.214	0.157	0.054	0.061	-0.015	0.015	0.009	-0.029	-0.031	-0.033	-0.052	0.023	-0.105	0.011	0.040	0.029	0.041	0.026	0.017	0.015	-0.021	0.006	0.042	0.422	1.000
CFtS t-4	0.006	0.002	0.007	0.013	0.043	0.012	0.011	-0.002	0.004	0.003	0.002	0.009	0.001	0.006	0.021	-0.142	0.003	0.007	0.003	0.004	0.017	0.003	0.046	0.042	0.001	0.002	0.128	0.125	1.000
CFtS t-5	-0.002	0.006	0.102	0.091	0.169	0.550	0.242	-0.011	0.002	0.002	0.008	0.032	0.010	-0.070	-0.144	0.070	-0.009	-0.052	-0.003	-0.003	-0.004	0.003	-0.021	0.005	0.000	0.001	0.048	0.067	0.049	1.000
CFtS t-6	-0.002	0.004	0.011	0.008	0.021	0.057	0.110	-0.005	0.004	0.003	0.009	0.019	0.031	0.025	-0.071	-0.027	0.004	0.012	0.013	0.013	0.012	0.016	0.056	0.041	-0.002	-0.001	0.006	0.037	0.017	0.060	1.000
CFtS t-7	0.005	0.040	0.112	0.068	0.150	0.232	0.292	0.004	0.010	0.013	0.025	0.048	0.065	0.005	0.060	-0.544	0.002	0.028	0.033	0.030	0.031	0.023	0.038	0.091	-0.006	-0.003	0.037	0.229	0.095	0.029	0.079	1.000
Quick Ratio	0.004	0.064	0.057	0.043	0.026	0.025	0.025	0.005	0.011	0.005	0.036	0.004	0.006	-0.035	-0.015	0.023	0.011	-0.007	-0.008	-0.009	-0.006	-0.005	-0.001	-0.016	-0.029	0.007	0.015	0.035	0.010	0.036	0.012	0.040	1.000
Quick Ratio t-1	0.003	0.012	0.011	0.006	0.008	0.009	0.011	0.002	-0.002	-0.002	0.000	-0.010	-0.001	-0.017	-0.020	0.008	-0.004	0.002	0.001	-0.003	0.001	0.000	0.013	0.029	0.001	0.006	0.007	0.031	0.006	0.009	0.006	0.027	0.152	1.000
Quick Ratio t-2	0.003	0.040	0.015	0.007	0.015	0.009	0.013	0.001	-0.004	-0.001	0.000	-0.012	-0.002	-0.017	-0.027	0.022	-0.005	0.002	-0.003	-0.008	-0.002	0.001	0.002	0.040	0.004	0.007	0.009	0.035	0.007	0.008	0.008	0.037	0.263	0.888	1.000
Quick Ratio t-3	0.003	0.065	-0.002	0.008	0.020	0.011	0.015	0.002	-0.002	-0.001	-0.001	-0.011	-0.002	-0.010	-0.013	0.119	-0.005	-0.005	-0.004	-0.004	-0.001	-0.001	0.000	0.021	0.000	0.005	0.005	0.015	0.002	0.002	0.005	0.008	0.369	0.291	0.465	1.000
Quick Ratio t-4	0.003	0.036	0.001	-0.001	0.023	0.012	0.017	0.000	0.000	0.044	-0.007	0.025	0.001	0.015	-0.016	0.030	-0.007	-0.006	-0.004	-0.019	-0.002	-0.002	0.001	0.021	0.004	0.006	0.005	0.009	0.006	-0.001	0.006	0.000	0.170	0.107	0.120	0.181	1.000
Quick Ratio t-5	-0.002	0.012	0.004	-0.002	0.006	0.007	0.011	-0.001	-0.002	-0.003	-0.005	0.020	0.014	0.012	0.006	0.008	0.001	-0.002	-0.011	-0.007	0.000	0.000	0.011	0.025	0.001	-0.001	-0.008	-0.036	0.004	0.000	0.006	0.012	0.056	0.048	0.041	0.044	0.484	1.000
Quick Ratio t-6	0.001	0.001	0.004	0.003	0.003	0.002	0.006	0.000	-0.003	-0.001	-0.003	-0.001	-0.003	-0.004	-0.008	0.001	-0.002	-0.013	-0.001	0.001	0.001	0.000	0.007	0.017	0.002	0.001	0.000	0.002	0.003	0.002	0.003	0.015	-0.003	0.008	0.007	0.011	0.063	0.161	1.000
Quick Ratio t-7	0.006	-0.006	0.003	-0.003	-0.001	0.005	0.017	0.000	0.000	-0.001	0.001	0.011	0.023	0.026	0.012	0.054	-0.008	-0.020	-0.015	-0.013	0.000	-0.004	0.010	0.058	0.002	-0.008	-0.009	0.003	0.005	0.000	0.007	0.045	0.113	0.096	0.084	0.107	0.049	0.034	0.041	1.000
TLTA	-0.996	-0.094	-0.130	-0.121	-0.203	0.003	0.004	-0.001	0.000	0.006	0.111	0.124	0.173	0.023	0.013	-0.011	0.007	0.000	0.000	0.000	-0.001	-0.001	0.007	-0.039	-0.001	-0.076	-0.008	-0.043	-0.006	0.001	0.002	-0.003	-0.005	-0.003	-0.004	-0.003	-0.004	0.003	-0.001	-0.006	1.000
TLTA t-1	-0.198	-0.426	0.146	-0.058	-0.087	-0.042	-0.036	-0.007	-0.016	-0.009	0.200	0.041	0.036	0.164	0.068	0.091	0.009	-0.025	0.035	-0.022	-0.023	-0.015	0.021	-0.001	0.000	-0.771	-0.017	-0.095	-0.014	-0.032	-0.004	-0.030	-0.057	-0.030	-0.039	-0.009	-0.027	0.008	-0.011	-0.007	0.265	1.000
TLTA t-2	-0.447	-0.095	0.045	-0.139	-0.194	-0.074	-0.079	-0.012	-0.028	-0.020	0.244	0.094	0.129	0.067	0.115	0.171	0.010	-0.019	0.040	-0.023	-0.027	-0.013	0.031	-0.030	0.003	-0.026	-0.034	-0.193	-0.032	-0.087	-0.020	-0.085	-0.106	-0.054	-0.075	-0.013	-0.045	0.024	-0.022	-0.031	0.460	0.584	1.000
TLTA t-3	-0.378	-0.054	-0.075	-0.278	-0.184	-0.066	-0.065	-0.004	-0.026	-0.020	0.044	0.146	0.114	0.066	0.090	0.096	0.009	-0.010	-0.007	-0.019	-0.021	-0.005	0.037	-0.006	0.010	-0.010	-0.003	-0.285	-0.023	-0.061	-0.015	-0.036	-0.073	-0.044	-0.058	-0.044	-0.044	0.014	-0.019	-0.028	0.385	0.264	0.526	1.000
TLTA t-4	-0.414	-0.055	-0.075	-0.083	-0.372	-0.234	-0.158	0.015	-0.027	-0.023	0.024	-0.011	0.365	0.206	0.157	0.093	0.011	-0.010	-0.010	-0.011	-0.013	-0.001	0.029	-0.030	0.006	-0.013	-0.006	-0.095	-0.030	-0.074	-0.024	-0.047	-0.080	-0.054	-0.066	-0.052	-0.061	-0.026	-0.028	-0.036	0.419	0.227	0.433	0.420	1.000
TLTA t-5	0.002	-0.021	-0.039	-0.042	-0.104	-0.347	-0.196	0.212	-0.018	-0.011	-0.023	-0.034	0.101	0.197	0.104	0.175	-0.001	0.024	-0.011	-0.007	-0.006	0.032	0.117	0.039	0.005	-0.005	0.004	-0.037	-0.011	-0.086	-0.017	-0.079	-0.044	-0.032	-0.039	-0.030	-0.037	-0.022	-0.017	-0.025	0.009	0.208	0.316	0.285	0.503	1.000
TLTA t-6	0.001	-0.013	-0.021	-0.023	-0.055	0.282	-0.201	0.018	-0.013	-0.009	-0.015	-0.023	0.002	0.035	0.142	0.227	-0.003	0.015	-0.009	-0.007	-0.006	0.023	0.059	0.000	0.005	0.004	0.003	-0.012	-0.005	0.480	-0.004	-0.058	-0.023	-0.023	-0.029	-0.024	-0.028	-0.020	-0.015	-0.027	0.005	0.127	0.195	0.182	0.260	0.571	1.000
TLTA t-7	0.009	-0.016	-0.025	-0.020	-0.025	0.149	-0.047	0.668	-0.010	-0.010	-0.023	-0.016	0.103	0.115	-0.049	0.283	-0.011	-0.013	-0.013	-0.005	-0.008	0.009	0.020	0.063	0.002	0.002	0.003	-0.047	-0.010	0.374	-0.005	-0.190	-0.017	-0.016	-0.022	-0.018	-0.021	-0.011	-0.011	-0.020	-0.006	0.051	0.085	0.081	0.102	0.371	0.622	1.000
QACA	-0.002	-0.009	0.085	-0.077	-0.001	0.050	0.073	0.022	-0.009	0.013	0.060	0.060	0.056	-0.021	0.019	-0.012	0.002	0.002	0.029	0.011	0.009	0.004	0.043	0.043	0.009	-0.025	0.010	-0.027	0.018	0.022	-0.056	0.043	0.129	0.035	0.025	0.002	0.003	0.009	0.097	0.008	0.004	0.043	0.027	0.032	0.002	0.012	0.006	0.017	1.000
QACA t-1	-0.006	-0.010	0.084	-0.007	0.042	0.056	0.077	0.026	-0.011	0.003	0.048	0.006	0.075	-0.004	0.061	-0.004	-0.002	0.002	0.024	0.016	0.016	0.008	0.023	0.038	-0.021	-0.031	-0.087	-0.047	0.008	-0.011	-0.056	0.058	0.075	0.038	0.033	0.044	0.018	0.016	0.103	0.017	0.004	0.039	0.033	0.022	0.021	0.016	0.006	0.010	0.786	1.000
QACA t-2	-0.004	0.012	0.073	-0.044	0.021	0.046	0.063	0.020	-0.002	0.001	0.001	0.052	0.032	-0.008	0.029	0.000	-0.002	-0.019	-0.013	-0.010	-0.003	-0.001	0.003	0.008	-0.007	-0.010	-0.068	-0.012	-0.011	-0.022	-0.050	0.042	0.092	0.035	0.024	0.033	0.012	0.014	0.088	0.008	0.002	-0.011	-0.032	-0.018	-0.026	0.003	0.003	-0.003	0.692	0.814	1.000
QACA t-3	-0.005	0.003	0.029	-0.048	0.041	0.063	0.088	0.019	-0.006	-0.003	-0.024	0.055	0.031	-0.052	0.012	0.019	-0.005	0.002	0.006	0.009	0.009	0.006	0.028	0.025	-0.014	-0.019	-0.005	0.009	-0.097	0.008	-0.060	0.019	0.097	0.023	0.014	0.006	0.018	0.013	0.100	0.004	0.002	-0.008	-0.029	-0.001	0.023	0.019	0.007	0.015	0.648	0.732	0.786	1.000
QACA t-4	-0.005	0.009	0.024	-0.065	0.049	0.063	0.042	0.048	0.007	-0.002	-0.017	0.053	0.027	-0.006	0.060	0.032	-0.005	0.011	0.015	0.015	0.015	0.003	0.029	0.054	-0.015	-0.011	-0.032	-0.038	-0.090	-0.022	-0.070	0.031	0.078	0.008	0.005	0.006	0.021	0.013	0.098	0.015	0.003	-0.005	-0.017	0.006	0.014	0.053	0.034	0.047	0.582	0.654	0.706	0.801	1.000
QACA t-5	-0.002	-0.007	0.006	0.013	0.036	0.052	0.082	0.016	-0.004	-0.003	-0.008	0.003	0.008	-0.034	-0.026	0.012	-0.004	0.002	0.003	-0.024	-0.010	-0.004	0.027	0.039	-0.012	-0.015	-0.087	-0.034	-0.070	-0.002	0.000	-0.001	0.114	0.012	0.006	0.002	0.018	0.012	0.102	0.006	-0.001	-0.011	-0.031	-0.012	-0.021	0.018	0.017	0.016	0.557	0.600	0.641	0.708	0.742	1.000
QACA t-6	-0.003	0.010	0.008	0.005	0.027	0.047	0.063	0.084	-0.002	-0.002	0.006	0.011	0.002	-0.022	0.012	-0.002	-0.002	0.009	0.008	0.021	0.004	0.011	0.040	0.049	-0.009	0.000	-0.024	-0.029	-0.036	0.002	-0.088	-0.002	0.049	0.006	0.001	-0.002	0.004	0.007	0.083	0.006	-0.001	-0.011	-0.014	0.003	0.000	0.041	0.027	0.066	0.508	0.539	0.594	0.642	0.651	0.774	1.000
QACA t-7	0.056	0.010	-0.008	0.012	0.078	0.040	0.071	0.017	0.006	0.007	0.023	0.045	-0.031	-0.019	-0.293	0.147	-0.060	-0.009	0.003	0.005	0.000	0.002	0.010	0.415	-0.022	-0.015	-0.025	-0.063	-0.087	0.049	0.056	0.001	-0.019	0.030	0.033	0.027	0.033	0.025	0.085	0.063	-0.058	-0.009	-0.042	-0.036	-0.071	-0.020	-0.016	0.097	0.243	0.262	0.277	0.311	0.348	0.410	0.453	1.000
TCTL	0.018	0.017	0.062	0.083	0.109	-0.008	-0.007	-0.023	0.006	-0.032	-0.066	-0.063	-0.094	-0.059	-0.028	-0.121	0.014	0.067	0.054	0.064	0.036	0.004	0.128	0.074	0.047	0.035	0.044	0.157	0.051	0.039	-0.031	0.078	-0.114	-0.035	-0.048	-0.075	-0.081	-0.066	-0.040	-0.064	-0.019	-0.081	-0.098	-0.083	-0.019	-0.001	0.008	-0.034	-0.146	-0.113	-0.120	-0.123	-0.133	-0.097	-0.082	-0.127	1.000
TCTL t-1	0.033	0.033	0.040	0.076	0.111	0.026	0.007	-0.015	-0.021	-0.031	-0.059	-0.054	-0.100	-0.076	-0.013	-0.135	-0.029	0.061	0.047	0.041	0.030	0.005	0.114	0.052	0.036	0.050	0.040	0.133	0.049	0.036	-0.019	0.084	-0.115	-0.073	-0.078	-0.073	-0.084	-0.064	-0.040	-0.064	-0.036	-0.095	-0.106	-0.083	-0.036	-0.019	0.001	-0.046	-0.153	-0.145	-0.136	-0.129	-0.153	-0.123	-0.111	-0.134	0.820	1.000
TCTL t-2	0.015	0.027	0.062	0.103	0.123	0.035	-0.002	-0.015	-0.009	-0.029	-0.014	-0.069	-0.092	-0.086	0.007	-0.150	-0.030	0.057	0.045	0.034	0.025	0.003	0.104	0.052	0.034	0.048	0.042	0.139	0.047	0.011	-0.026	0.091	-0.079	-0.069	-0.086	-0.077	-0.080	-0.063	-0.039	-0.060	-0.018	-0.088	-0.113	-0.088	-0.041	-0.018	-0.008	-0.063	-0.170	-0.155	-0.162	-0.156	-0.147	-0.101	-0.075	-0.132	0.718	0.787	1.000
TCTL t-3	0.014	0.007	0.030	0.107	0.124	0.028	0.011	0.004	0.000	-0.027	-0.017	-0.066	-0.083	-0.064	0.037	-0.139	-0.029	0.050	0.038	0.039	0.025	0.004	0.118	0.036	0.032	0.023	-0.014	0.122	0.039	0.009	-0.028	0.096	-0.080	-0.053	-0.053	-0.072	-0.062	-0.058	-0.038	-0.062	-0.016	-0.063	-0.091	-0.094	-0.017	0.011	0.000	-0.056	-0.144	-0.119	-0.135	-0.149	-0.141	-0.093	-0.081	-0.176	0.663	0.730	0.829	1.000
TCTL t-4	0.015	0.014	0.033	0.044	0.103	0.057	0.068	-0.013	0.010	-0.031	-0.014	0.029	-0.105	-0.084	-0.015	-0.113	-0.027	0.026	0.033	0.032	0.030	0.006	0.142	0.083	0.040	0.047	-0.005	0.107	0.036	0.020	0.000	0.084	-0.063	-0.056	-0.066	-0.042	-0.063	-0.059	-0.039	-0.013	-0.018	-0.077	-0.079	-0.060	-0.094	-0.049	-0.047	-0.060	-0.143	-0.112	-0.119	-0.136	-0.137	-0.068	-0.063	-0.111	0.618	0.638	0.719	0.802	1.000
TCTL t-5	-0.007	0.006	0.041	0.024	0.050	0.088	0.114	-0.019	0.006	-0.033	-0.002	0.022	0.023	-0.076	0.019	-0.139	0.014	0.038	0.057	0.034	0.043	0.052	0.145	0.092	0.031	0.037	-0.010	0.065	0.028	0.010	0.026	0.105	-0.078	-0.058	-0.072	-0.043	-0.068	-0.058	-0.040	-0.008	0.005	-0.050	-0.045	-0.029	-0.059	-0.072	-0.048	-0.068	-0.095	-0.073	-0.094	-0.104	-0.097	-0.087	-0.096	-0.121	0.496	0.524	0.582	0.657	0.766	1.000
TCTL t-6	-0.007	-0.015	0.031	0.031	0.027	0.039	0.125	-0.016	-0.001	-0.036	0.021	0.039	0.041	0.027	0.081	-0.142	0.012	0.001	0.001	-0.003	0.003	0.002	0.162	0.074	0.031	-0.007	0.025	0.082	0.033	0.009	0.059	0.110	-0.076	-0.063	-0.073	-0.048	-0.035	-0.037	-0.042	-0.001	0.008	-0.011	-0.029	-0.037	-0.024	-0.049	-0.073	-0.090	-0.130	-0.118	-0.112	-0.127	-0.133	-0.122	-0.123	-0.153	0.483	0.532	0.525	0.613	0.682	0.748	1.000
TCTL t-7	0.033	-0.017	0.037	0.016	0.039	0.042	0.085	-0.003	0.001	-0.033	0.051	0.048	0.028	0.023	-0.078	-0.038	-0.028	0.006	0.006	0.014	0.009	0.000	0.142	0.391	0.023	-0.018	-0.007	0.038	0.014	0.002	0.037	0.174	-0.027	-0.043	-0.049	-0.020	-0.008	0.018	-0.028	0.159	-0.031	-0.010	-0.056	-0.048	-0.053	-0.029	-0.058	-0.030	-0.061	-0.051	-0.040	-0.082	-0.041	-0.059	-0.074	0.256	0.303	0.323	0.343	0.382	0.453	0.477	0.587	1.000
Firm Age	0.031	0.049	0.048	0.085	0.063	0.090	0.057	0.015	0.018	-0.001	0.005	-0.047	-0.164	-0.169	-0.124	-0.101	-0.022	-0.018	-0.023	-0.024	-0.027	-0.026	-0.026	-0.056	-0.009	0.043	0.040	0.098	0.015	0.055	0.024	0.064	-0.001	0.059	0.035	-0.014	0.041	-0.002	-0.030	-0.057	-0.033	-0.088	-0.114	-0.107	-0.085	-0.046	0.004	0.005	-0.140	-0.119	-0.112	-0.110	-0.130	-0.109	-0.093	-0.068	0.124	0.138	0.169	0.193	0.172	0.177	0.178	0.141	1.000
Average Director Age	0.016	0.014	-0.002	0.062	0.019	0.060	0.047	-0.017	0.006	-0.007	-0.032	-0.036	-0.094	-0.086	-0.079	-0.174	-0.023	0.007	-0.010	0.003	-0.002	0.001	0.034	-0.001	-0.024	0.015	0.010	0.081	0.067	0.050	0.033	0.106	-0.033	0.019	0.024	-0.027	0.001	0.006	-0.063	-0.041	-0.019	-0.102	-0.158	-0.096	-0.067	-0.031	0.018	0.001	-0.080	-0.078	-0.052	-0.110	-0.110	-0.065	-0.067	-0.062	0.107	0.124	0.173	0.192	0.177	0.207	0.182	0.077	0.386	1.000
Female Director Nr.	0.009	0.041	0.031	0.019	0.023	0.022	0.032	0.038	0.053	0.086	0.085	-0.039	0.026	0.025	-0.019	0.064	0.020	-0.031	-0.020	-0.035	-0.026	-0.015	-0.064	-0.062	0.015	0.040	0.024	0.020	-0.107	0.036	-0.024	-0.051	0.021	0.041	0.040	-0.011	0.022	0.012	0.054	0.039	-0.010	0.001	0.030	0.003	-0.013	0.002	0.005	0.035	0.099	0.079	0.057	0.055	0.054	0.070	0.020	0.035	-0.122	-0.117	-0.149	-0.148	-0.122	-0.145	-0.135	-0.075	-0.008	-0.199	1.000
Number of Directors	0.013	0.054	0.056	0.043	0.061	0.057	0.050	0.015	0.017	0.049	0.031	-0.053	-0.043	-0.028	-0.018	0.015	-0.011	-0.068	-0.061	-0.057	-0.044	-0.033	-0.083	-0.099	-0.085	0.025	0.020	0.040	0.003	0.057	-0.032	0.013	0.017	0.029	0.035	-0.020	0.084	0.050	0.011	0.003	-0.015	-0.041	-0.047	-0.039	-0.024	0.023	0.054	0.043	0.088	0.096	0.089	0.075	0.076	0.100	0.098	0.045	-0.117	-0.056	-0.081	-0.054	-0.063	-0.058	-0.039	-0.042	0.252	0.213	0.470	1.000

Table B.4: Eigenvalues of un-rotated factors for UK firms; financial ratios and firm age as variables.

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	6.194	0.876	0.164	0.164
Factor2	5.318	0.893	0.141	0.306
Factor3	4.425	0.803	0.118	0.423
Factor4	3.622	1.208	0.096	0.519
Factor5	2.414	0.297	0.064	0.583
Factor6	2.117	0.160	0.056	0.639
Factor7	1.957	0.113	0.052	0.691
Factor8	1.845	0.357	0.049	0.740
Factor9	1.487	0.162	0.040	0.780
Factor10	1.325	0.180	0.035	0.815
Factor11	1.145	0.049	0.030	0.845
Factor12	1.096	0.112	0.029	0.874
Factor13	0.984	0.175	0.026	0.901
Factor14	0.809	0.065	0.022	0.922
Factor15	0.743	0.091	0.020	0.942
Factor16	0.653	0.054	0.017	0.959
Factor17	0.598	0.100	0.016	0.975
Factor18	0.498	0.050	0.013	0.988
Factor19	0.448	0.014	0.012	1.000
Factor20	0.434	0.028	0.012	1.012
Factor21	0.407	0.039	0.011	1.022
Factor22	0.368	0.028	0.010	1.032
Factor23	0.340	0.039	0.009	1.041
Factor24	0.301	0.065	0.008	1.049
Factor25	0.236	0.062	0.006	1.055
Factor26	0.174	0.007	0.005	1.060
Factor27	0.167	0.052	0.004	1.064
Factor28	0.116	0.012	0.003	1.068
Factor29	0.104	0.038	0.003	1.070
Factor30	0.065	0.006	0.002	1.072
Factor31	0.059	0.006	0.002	1.074
Factor32	0.053	0.011	0.001	1.075
Factor33	0.042	0.001	0.001	1.076
Factor34	0.041	0.009	0.001	1.077
Factor35	0.032	0.008	0.001	1.078
Factor36	0.025	0.007	0.001	1.079
Factor37	0.017	0.011	0.001	1.079
Factor38	0.006	0.005	0.000	1.079
Factor39	0.001	0.003	0.000	1.079
Factor40	-0.001	0.015	0.000	1.079
Factor41	-0.016	0.007	0.000	1.079
Factor42	-0.023	0.001	-0.001	1.078
Factor43	-0.024	0.009	-0.001	1.078
Factor44	-0.033	0.015	-0.001	1.077
Factor45	-0.048	0.005	-0.001	1.076
Factor46	-0.053	0.008	-0.001	1.074
Factor47	-0.061	0.011	-0.002	1.073
Factor48	-0.072	0.007	-0.002	1.071
Factor49	-0.079	0.008	-0.002	1.069
Factor50	-0.087	0.007	-0.002	1.066
Factor51	-0.095	0.001	-0.003	1.064
Factor52	-0.096	0.012	-0.003	1.061
Factor53	-0.107	0.009	-0.003	1.058
Factor54	-0.116	0.004	-0.003	1.055
Factor55	-0.120	0.018	-0.003	1.052
Factor56	-0.139	0.005	-0.004	1.048
Factor57	-0.144	0.013	-0.004	1.045
Factor58	-0.157	0.005	-0.004	1.040
Factor59	-0.162	0.004	-0.004	1.036
Factor60	-0.167	0.031	-0.004	1.032
Factor61	-0.198	0.016	-0.005	1.026
Factor62	-0.214	0.034	-0.006	1.021
Factor63	-0.248	0.011	-0.007	1.014
Factor64	-0.260	0.012	-0.007	1.007
Factor65	-0.272	.	-0.007	1.000

LR test: independent vs. saturated: chi2(2080)= 4.6e+04 Prob>chi2 = 0.0000

Table B.5: Failed UK Firm Clusters (without Directors' Characteristics).

	Cluster 1		Cluster 2		Cluster 3		Cluster 4	
Variable	Median	St.Dev	Median	St.Dev	Median	St.Dev	Median	St.Dev
roi	-0.006	2.012	0.006	74.190	0.006	2.221	0.012	1.271
roiL1	0.002	0.944	0.017	0.421	0.019	4.748	0.016	4.545
roiL2	0.000	2.383	0.023	0.557	0.021	0.972	0.021	2.095
roiL3	0.000	3.060	0.030	0.541	0.026	1.097	0.022	0.964
roiL4	0.019	1.070	0.040	1.033	0.030	0.756	0.038	1.073
roiL5	0.125	0.768	0.050	0.745	0.035	1.456	0.044	0.735
roiL6	0.125	0.092	0.064	0.597	0.037	1.089	0.050	1.077
roiL7	0.125	7.534	0.078	0.656	0.036	1.301	0.000	0.025
growth_rate	0.026	1.587	0.012	84.965	0.002	77.403	0.009	31.852
growth_rateL1	0.002	0.734	0.000	2.340	-0.001	55.321	0.015	2.582
growth_rateL2	0.007	3.650	0.000	1.703	-0.120	0.840	-0.007	0.898
growth_rateL3	0.091	3.631	0.000	0.590	-0.003	0.824	-0.042	0.681
growth_rateL4	2.654	2.229	-0.035	0.628	-0.016	0.405	-0.006	1.334
growth_rateL5	4.245	1.966	-0.004	1.012	-0.043	0.788	0.028	1.571
growth_rateL6	1.985	0.911	-0.009	0.592	-0.058	0.551	0.203	1.964
growth_rateL7	1.214	0.608	-0.014	1.240	0.720	2.425	0.000	0.154
nsta	2.161	8.500	2.678	3.734	2.067	20.706	2.430	19.744
nsta_L1	1.950	7.709	2.625	1.931	2.117	1.503	2.430	13.823
nsta_L2	2.397	7.241	2.709	2.351	2.262	1.642	2.850	14.896
nsta_L3	3.364	4.982	2.701	1.530	2.216	4.456	2.732	16.222
nsta_L4	4.321	3.861	2.234	1.378	2.635	1.660	2.742	17.532
nsta_L5	4.037	3.796	2.003	1.328	2.742	1.447	2.098	17.504
nsta_L6	2.988	2.893	3.513	1.551	2.954	1.443	2.299	1.674
nsta_L7	2.554	2.065	2.214	1.242	3.042	1.242	0.234	1.389
cfts	0.006	4.932	0.013	0.416	0.020	44.615	0.013	5.344
cfts_L1	0.024	3.757	0.022	0.390	0.110	0.803	0.024	30.265
cfts_L2	0.031	5.448	0.023	10.826	0.145	1.850	0.051	0.456
cfts_L3	0.020	1.393	0.035	1.019	0.141	1.974	0.085	0.486
cfts_L4	0.220	0.744	0.053	2.044	0.231	14.893	0.108	0.665
cfts_L5	0.189	0.627	0.091	0.502	0.324	3.363	0.101	3.871
cfts_L6	0.141	2.200	0.165	0.299	0.203	0.825	0.210	9.993
cfts_L7	0.166	0.165	0.190	0.341	0.149	0.733	0.054	0.086
quick_ratio	0.856	43.755	0.990	7.668	1.104	37.683	0.930	77.749
quick_ratioL1	0.943	73.569	1.046	19.290	1.053	43.910	0.969	6.004
quick_ratioL2	0.871	78.754	1.073	19.195	1.092	14.926	0.957	6.110
quick_ratioL3	0.869	111.053	1.054	47.236	1.061	16.259	0.995	9.339
quick_ratioL4	1.116	100.702	1.082	10.218	1.077	29.792	1.006	8.741
quick_ratioL5	1.779	237.042	1.063	10.965	1.008	23.498	1.081	8.694
quick_ratioL6	2.178	169.874	1.168	10.981	1.013	82.815	1.074	8.981
quick_ratioL7	1.931	120.269	1.260	12.911	1.008	16.249	0.000	4.108
tlta	0.968	0.970	0.789	10.188	0.815	1.336	0.871	10.150
tltaL1	0.917	2.123	0.750	1.145	0.773	0.891	0.812	3.811
tltaL2	0.906	1.120	0.722	1.044	0.746	0.821	0.826	0.442
tltaL3	0.923	1.895	0.726	0.967	0.754	0.458	0.794	0.623
tltaL4	0.747	1.335	0.722	0.941	0.748	0.387	0.762	1.331
tltaL5	0.672	1.586	0.722	2.633	0.723	0.361	0.735	1.100
tltaL6	0.623	0.334	0.668	2.450	0.758	3.036	0.686	1.451
tltaL7	0.620	4.156	0.627	1.096	0.769	3.002	0.000	0.394
qaca	1.006	0.384	0.977	0.254	0.998	0.357	0.838	0.369
qacaL1	1.001	0.385	0.962	0.253	0.971	0.320	0.830	0.360
qacaL2	1.002	0.363	0.984	0.273	0.996	0.330	0.847	0.377
qacaL3	1.000	0.304	0.917	0.287	1.001	0.340	0.834	0.364
qacaL4	0.767	0.315	0.763	0.282	1.000	0.355	0.842	0.373
qacaL5	0.662	0.231	0.697	0.268	1.000	0.369	0.828	0.358
qacaL6	0.817	0.200	0.995	0.255	1.000	0.362	0.833	0.363
qacaL7	0.868	0.186	0.968	0.279	1.002	0.360	0.000	0.258
tctl	0.039	0.140	0.428	0.226	0.030	0.177	0.230	0.257
tctlL1	0.022	0.133	0.412	0.218	0.014	0.157	0.194	0.246
tctlL2	0.028	0.109	0.409	0.217	0.013	0.117	0.229	0.244
tlL3	0.018	0.126	0.378	0.216	0.005	0.099	0.234	0.251
tctlL4	0.172	0.152	0.371	0.215	0.005	0.097	0.249	0.230
tctlL5	0.246	0.155	0.346	0.216	0.001	0.111	0.289	0.219
tctlL6	0.291	0.119	0.307	0.216	0.004	0.091	0.291	0.228
tctlL7	0.275	0.108	0.291	0.209	0.015	0.100	0.000	0.046
firmage	7.000	13.237	17.000	15.912	14.000	13.146	13.000	15.877

Table B.6: Eigenvalues of un-rotated factors for UK firms; factor analysis with directors' characteristics.

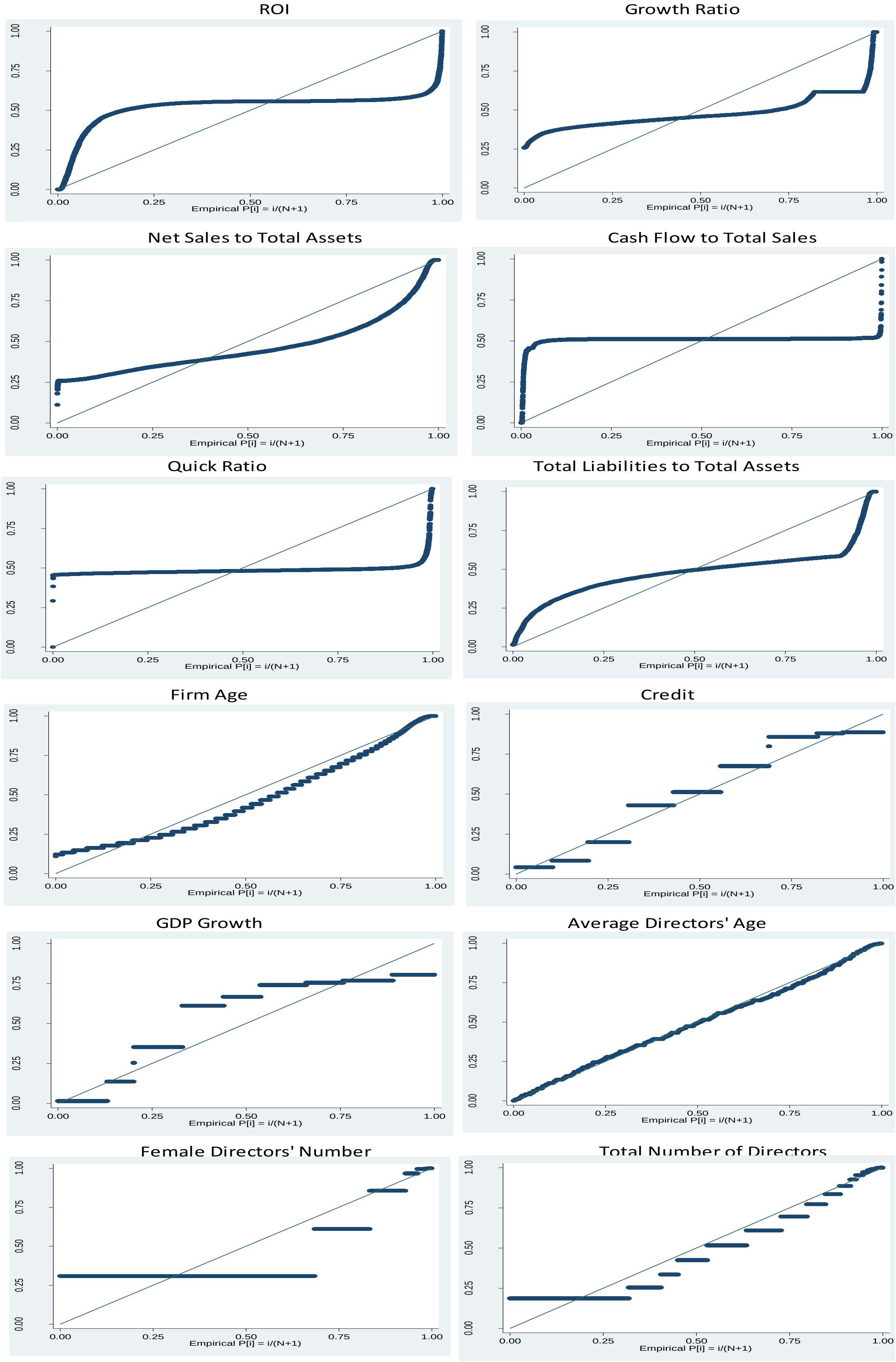
Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	6.296	0.974	0.161	0.161
Factor2	5.321	0.872	0.136	0.298
Factor3	4.450	0.816	0.114	0.412
Factor4	3.634	1.211	0.093	0.505
Factor5	2.423	0.287	0.062	0.567
Factor6	2.136	0.177	0.055	0.622
Factor7	1.959	0.107	0.050	0.672
Factor8	1.853	0.352	0.048	0.720
Factor9	1.500	0.171	0.039	0.758
Factor10	1.329	0.181	0.034	0.792
Factor11	1.148	0.024	0.029	0.822
Factor12	1.124	0.114	0.029	0.850
Factor13	1.010	0.033	0.026	0.876
Factor14	0.977	0.172	0.025	0.901
Factor15	0.805	0.057	0.021	0.922
Factor16	0.748	0.041	0.019	0.941
Factor17	0.707	0.098	0.018	0.959
Factor18	0.609	0.016	0.016	0.975
Factor19	0.593	0.116	0.015	0.990
Factor20	0.478	0.035	0.012	1.002
Factor21	0.442	0.007	0.011	1.014
Factor22	0.435	0.068	0.011	1.025
Factor23	0.367	0.014	0.009	1.034
Factor24	0.354	0.042	0.009	1.043
Factor25	0.312	0.068	0.008	1.051
Factor26	0.244	0.036	0.006	1.057
Factor27	0.208	0.039	0.005	1.063
Factor28	0.169	0.013	0.004	1.067
Factor29	0.156	0.041	0.004	1.071
Factor30	0.116	0.043	0.003	1.074
Factor31	0.072	0.006	0.002	1.076
Factor32	0.066	0.008	0.002	1.078
Factor33	0.058	0.003	0.002	1.079
Factor34	0.055	0.011	0.001	1.081
Factor35	0.045	0.009	0.001	1.082
Factor36	0.036	0.007	0.001	1.083
Factor37	0.029	0.008	0.001	1.083
Factor38	0.021	0.012	0.001	1.084
Factor39	0.009	0.004	0.000	1.084
Factor40	0.005	0.003	0.000	1.084
Factor41	0.002	0.003	0.000	1.084
Factor42	-0.001	0.016	0.000	1.084
Factor43	-0.017	0.005	0.000	1.084
Factor44	-0.021	0.004	-0.001	1.083
Factor45	-0.026	0.010	-0.001	1.083
Factor46	-0.036	0.014	-0.001	1.082
Factor47	-0.049	0.007	-0.001	1.080
Factor48	-0.056	0.008	-0.001	1.079
Factor49	-0.064	0.005	-0.002	1.077
Factor50	-0.069	0.017	-0.002	1.076
Factor51	-0.086	0.003	-0.002	1.073
Factor52	-0.089	0.002	-0.002	1.071
Factor53	-0.091	0.003	-0.002	1.069
Factor54	-0.094	0.015	-0.002	1.066
Factor55	-0.108	0.005	-0.003	1.064
Factor56	-0.114	0.014	-0.003	1.061
Factor57	-0.128	0.010	-0.003	1.057
Factor58	-0.138	0.002	-0.004	1.054
Factor59	-0.140	0.015	-0.004	1.050
Factor60	-0.155	0.010	-0.004	1.046
Factor61	-0.165	0.005	-0.004	1.042
Factor62	-0.169	0.027	-0.004	1.038
Factor63	-0.196	0.013	-0.005	1.033
Factor64	-0.209	0.037	-0.005	1.027
Factor65	-0.246	0.010	-0.006	1.021
Factor66	-0.256	0.011	-0.007	1.014
Factor67	-0.267	0.028	-0.007	1.008
Factor68	-0.295	.	-0.008	1.000

LR test: independent vs. saturated: chi2(2278)= 4.7e+04
Prob>chi2 = 0.0000

Table B.7: UK Failed Firm Clusters (Financial Ratios and Directors' Characteristics).

	Cluster 1		Cluster 2		Cluster 3		Cluster 4	
Variable	Median	St.Dev	Median	St.Dev	Median	St.Dev	Median	St.Dev
roi	0.003	1.732	0.011	0.872	0.008	72.600	-0.029	5.011
roiL1	0.010	1.653	0.018	0.964	0.022	5.453	-0.034	1.802
roiL2	0.015	1.379	0.021	1.559	0.035	0.795	-0.040	3.885
roiL3	0.019	2.099	0.020	0.953	0.034	0.922	0.002	1.803
roiL4	0.038	0.611	0.035	1.065	0.040	1.098	-0.006	1.796
roiL5	0.081	0.447	0.040	0.727	0.045	1.378	-0.002	2.094
roiL6	0.125	0.123	0.050	1.065	0.058	0.612	-0.014	2.340
roiL7	0.125	5.107	0.000	0.025	0.072	0.371	-0.058	2.801
growth_rate	0.014	9.453	0.012	31.479	6.829	77.645	0.000	5.793
growth_rateL1	0.000	1.924	0.015	2.553	3.368	55.501	-0.002	0.365
growth_rateL2	0.008	2.014	-0.007	0.859	0.277	2.268	0.000	2.859
growth_rateL3	0.018	2.506	-0.041	0.871	0.061	0.827	-0.126	0.588
growth_rateL4	0.034	1.545	-0.123	1.322	0.058	0.872	-0.026	0.334
growth_rateL5	0.056	1.400	0.028	1.460	0.162	1.211	-0.057	1.456
growth_rateL6	0.188	0.796	0.720	1.840	0.039	0.708	-0.168	1.098
growth_rateL7	0.720	0.875	0.000	0.147	0.529	1.274	7.239	3.320
nsta	3.344	6.360	1.553	18.503	3.635	20.799	1.994	2.080
nsta_L1	2.700	5.355	3.798	13.660	2.128	1.849	1.673	1.659
nsta_L2	2.732	5.041	3.769	14.725	2.132	1.827	2.391	4.069
nsta_L3	2.651	3.534	4.287	16.981	2.070	1.411	1.706	1.478
nsta_L4	2.775	2.795	4.175	17.382	2.083	1.267	1.695	1.377
nsta_L5	2.934	2.697	3.850	17.306	2.222	1.613	1.836	1.337
nsta_L6	3.000	2.278	2.477	1.692	2.191	1.482	1.942	1.385
nsta_L7	3.005	1.671	0.157	1.341	2.216	1.224	1.838	1.399
cfts	0.012	4.695	-0.125	0.546	-2.787	44.765	-0.579	1.109
cfts_L1	0.022	3.913	-0.041	0.651	-1.294	22.060	-0.267	1.440
cfts_L2	0.025	4.166	-0.008	0.450	-0.033	0.932	-0.390	24.737
cfts_L3	0.033	1.005	-0.007	0.509	0.036	0.506	-0.272	4.703
cfts_L4	0.133	0.613	-0.040	0.655	0.026	1.027	-0.169	35.620
cfts_L5	0.219	0.510	-0.278	3.826	0.201	3.219	-0.107	2.501
cfts_L6	0.399	0.256	-0.725	9.876	0.011	1.794	-1.790	1.548
cfts_L7	0.329	0.139	0.022	0.088	0.127	0.185	-1.994	1.038
quick_ratio	0.929	27.441	0.930	76.839	1.146	27.244	0.713	73.558
quick_ratioL1	0.995	170.045	0.969	6.120	1.087	23.187	0.841	93.230
quick_ratioL2	1.006	171.029	0.969	6.372	1.129	103.348	0.791	236.073
quick_ratioL3	1.004	84.486	1.000	9.436	1.033	20.363	0.876	391.232
quick_ratioL4	1.094	11.641	1.012	8.931	1.061	85.181	0.896	37.185
quick_ratioL5	1.303	139.659	1.081	8.625	1.037	99.677	0.873	28.625
quick_ratioL6	1.725	115.722	1.074	8.834	1.093	85.644	0.884	17.599
quick_ratioL7	21.779	82.430	0.000	3.728	1.138	16.402	0.715	10.690
tlta	0.843	0.759	0.871	0.783	0.759	11.235	1.171	2.828
tltaL1	0.817	0.678	0.811	0.583	0.734	2.993	1.023	4.099
tltaL2	0.807	0.453	0.824	0.430	0.711	0.965	1.011	2.612
tltaL3	0.784	1.311	0.795	0.618	0.730	0.980	1.040	0.693
tltaL4	0.711	0.335	0.762	1.316	0.729	1.404	1.011	0.473
tltaL5	0.627	0.675	0.749	1.088	0.686	2.783	1.001	0.393
tltaL6	0.627	0.304	0.693	1.434	0.693	3.788	1.022	1.808
tltaL7	0.627	2.822	0.541	0.405	0.664	2.846	1.038	3.327
qaca	0.684	0.315	0.598	0.371	0.999	0.356	0.906	0.350
qacaL1	0.678	0.308	0.893	0.351	0.817	0.327	1.000	0.366
qacaL2	0.683	0.308	0.982	0.373	0.990	0.337	1.015	0.330
qacaL3	0.662	0.292	0.616	0.354	1.000	0.337	1.015	0.367
qacaL4	0.666	0.296	0.604	0.365	1.000	0.342	1.015	0.397
qacaL5	0.611	0.240	0.665	0.353	1.000	0.368	1.011	0.362
qacaL6	0.588	0.219	0.687	0.361	0.970	0.352	1.015	0.395
qacaL7	0.562	0.227	0.874	0.284	0.982	0.353	1.015	0.391
tctl	0.653	0.255	0.230	0.258	0.054	0.190	0.004	0.201
tctlL1	0.648	0.247	0.194	0.249	0.045	0.178	0.001	0.183
tctlL2	0.621	0.247	0.245	0.245	0.026	0.151	0.011	0.174
tlL3	0.642	0.240	0.243	0.253	0.016	0.117	0.001	0.180
tctlL4	0.582	0.218	0.254	0.233	0.009	0.095	0.002	0.206
tctlL5	0.741	0.200	0.284	0.225	0.005	0.118	0.038	0.170
tctlL6	0.396	0.186	0.291	0.235	0.021	0.109	0.045	0.146
tctlL7	0.596	0.176	0.000	0.034	0.050	0.119	0.100	0.086
firmage	12.000	15.199	13.000	15.688	15.000	14.647	9.000	5.953
avg_dir_age	51.215	8.738	50.625	9.028	51.400	8.111	47.250	10.996
Nr_Female_Dir	1.000	0.734	2.000	2.182	2.000	2.263	2.000	3.163
Total_Dir_Nr	10.000	7.870	11.000	9.150	13.000	11.904	10.000	9.747

Chart B.1: Normality plots – Firms in UK Regions



APPENDIX C

Table C.1: Distribution of firms in liquidation: All countries; firm failure processes without directors' characteristics.

Firms in all countries: % in liquidation per year					
Year	All firms	1st Process	2nd Process	3rd Process	4th Process
2004	0.05%	0.00%	0.03%	0.04%	0.01%
2005	0.09%	0.00%	0.03%	0.05%	0.01%
2006	0.08%	0.00%	0.03%	0.05%	0.01%
2007	0.10%	0.00%	0.04%	0.04%	0.01%
2008	1.17%	0.15%	0.12%	0.64%	0.26%
2009	10.22%	2.27%	2.08%	2.33%	3.54%
2010	37.67%	12.21%	7.87%	8.20%	9.40%
2011	63.23%	14.94%	11.16%	16.89%	20.24%
2012	93.54%	14.16%	17.92%	28.33%	33.12%
2013	75.00%	5.37%	21.25%	24.26%	24.13%

Table C.2: Distribution of firms in Financial Distress: All countries; firm failure processes without directors' characteristics.

Firms in all countries: % in Financial Distress per year					
Year	All firms	1st Process	2nd Process	3rd Process	4th Process
2004	7.80%	7.07%	8.67%	8.02%	8.05%
2005	8.17%	8.45%	8.60%	9.49%	7.63%
2006	8.93%	9.40%	10.14%	11.22%	7.78%
2007	10.63%	12.59%	14.50%	10.62%	10.12%
2008	13.01%	18.63%	17.86%	10.25%	11.74%
2009	14.18%	17.65%	17.52%	9.56%	15.26%
2010	9.13%	11.97%	14.14%	6.30%	11.66%
2011	6.74%	7.73%	13.21%	4.45%	7.04%
2012	1.14%	2.08%	2.12%	0.50%	1.32%
2013	0.00%	0.00%	0.00%	0.00%	0.00%

Table C.3: Distribution of firms in Liquidation: UK Regions; firm failure processes without directors' characteristics.

Firms in UK Regions: % in liquidation per year					
Year	All firms	1st Process	2nd Process	3rd Process	4th Process
2004	0.00%	0.00%	0.00%	0.00%	0.00%
2005	0.00%	0.00%	0.00%	0.00%	0.00%
2006	0.00%	0.00%	0.00%	0.00%	0.00%
2007	0.00%	0.00%	0.00%	0.00%	0.00%
2008	0.00%	0.00%	0.00%	0.00%	0.00%
2009	0.45%	0.86%	0.00%	0.00%	1.09%
2010	2.78%	6.70%	0.83%	2.58%	2.59%
2011	11.52%	11.96%	7.89%	14.63%	2.78%
2012	26.78%	30.97%	25.39%	25.60%	0.00%
2013	83.33%	66.67%	66.67%	75.00%	8.33%

Table C.4: Distribution of firms in Financial Distress: UK Regions; firm failure processes without directors' characteristics.

Firms in UK Regions: % in Financial Distress per year					
Year	All firms	1st Process	2nd Process	3rd Process	4th Process
2004	11.78%	6.59%	3.53%	19.52%	8.12%
2005	12.13%	11.27%	5.19%	19.73%	8.20%
2006	11.81%	12.25%	5.11%	18.10%	11.14%
2007	11.38%	17.06%	5.12%	15.38%	8.14%
2008	14.27%	26.07%	5.57%	15.44%	13.66%
2009	14.89%	29.93%	6.12%	15.42%	11.55%
2010	19.34%	30.59%	10.34%	19.07%	22.83%
2011	16.75%	26.02%	10.80%	15.85%	17.36%
2012	18.17%	34.09%	9.07%	13.24%	11.90%
2013	0.00%	0.00%	0.00%	0.00%	0.00%

Table C.5: Normality Tests for firms in EU Countries

	Skewness/Kurtosis Test				Shapiro-Wilk				Shapiro-Francia			
Variable	Pr (Skewness)	Pr (Kurtosis)	Chi2(2)	Prob>chi2	W	V	z	Prob>z	W'	V'	z	Prob>z
Liquidated_Firms_Nr.	0.001	0.001	44.730	0.000	0.628	25.536	7.099	0.000	0.675	24.676	6.245	0.001
Liquidated_Firms %	0.001	0.071	11.900	0.003	0.803	13.498	5.702	0.000	0.823	13.451	5.063	0.000
Fin_Distress_firms_N	0.001	0.002	23.514	0.000	0.778	5.623	5.087	0.000	0.877	2.632	1.010	0.000
Fin_Distress_Firms %	0.026	0.368	5.540	0.063	0.942	3.969	3.021	0.001	0.979	1.557	0.863	0.104
GDP_gr	0.017	0.421	5.990	0.050	0.957	2.971	2.386	0.009	0.960	3.055	2.176	0.015
Credit	0.018	0.266	6.350	0.042	0.935	4.471	3.282	0.001	0.940	4.554	2.953	0.002

Table C.6: Normality Tests for firms in UK Regions

	Skewness/Kurtosis Test				Shapiro-Wilk				Shapiro-Francia			
Variable	Pr (Skewness)	Pr (Kurtosis)	Chi2(2)	Prob>chi2	W	V	z	Prob>z	W'	V'	z	Prob>z
Liquidated_Firms_Nr.	0.001	0.001	25.200	0.000	0.635	35.159	7.976	0.000	0.696	32.159	6.942	0.002
Liquidated Firms %	0.001	0.001	54.760	0.000	0.658	32.892	7.826	0.000	0.692	32.591	6.968	0.000
Fin_Distress_firms_N	0.001	0.001	67.480	0.000	0.609	37.626	8.128	0.000	0.626	39.605	7.358	0.002
Fin_Distress_Firms %	0.037	0.009	9.680	0.008	0.954	4.436	3.338	0.000	0.959	4.302	2.918	0.002
GDP_gr	0.000	0.002	35.350	0.000	0.723	26.650	7.355	0.000	0.722	29.431	6.764	0.000
GVA	0.009	0.330	7.130	0.028	0.968	3.084	2.523	0.006	0.970	3.219	2.338	0.010
Credit	0.315	0.000	54.670	0.000	0.946	5.172	3.682	0.000	0.949	5.425	3.382	0.000
New_Firms_perc	0.300	0.075	4.340	0.114	0.985	1.473	0.868	0.092	0.981	1.981	1.367	0.186

Table C.7: Panel regression on EU countries' financially distressed firms (without directors' characteristics)

Firm Failure Process		1	2	3	4
Independent Variables	All Firms	Clusters w/out Directors char.			
	Coeff. Pr>|z|				
c	-0.058*	-0.046	-0.179**	-0.138**	-0.044
GDP_gr	-0.008**	-0.007**	-0.001	0.007**	-0.001
Credit	0.002**	0.001**	0.003**	0.002**	0.001**
Leg_trad	-0.022	-0.018	-0.051	-0.029	-0.020
/sigma_u/STD error sigma_u	0.089 / 0.009	0.046 / 0.016	0.071 / 0.021	0.072 / 0.020	0.042 / 0.013
/sigma_e/ STD error sigma_e	0.099 / 0.004	0.075 / 0.006	0.066 / 0.005	0.056 / 0.004	0.051 / 0.004

**Sig<0.05; *Sig<0.10

Table C.8: Panel regression on EU countries' liquidated firms (without directors' characteristics)

Firm Failure Process:		1	2	3	4
Independent Variables	All Firms	Clusters w/out Directors char.			
	Coeff. Pr>|z|				
c	0.250**	0.102***	0.071	0.146**	0.130
GDP_gr	-0.285**	-0.001	-0.12**	-0.009**	-0.001
Credit	-0.001	-0.001	-0.001	-0.001	-0.001
Leg_trad	-0.036	-0.571**	0.033	-0.19	0.024
/sigma_u/STD error sigma_u	0.001 / 0.543	0.001 / 0.010	0.021 / 0.029	0.021 / 0.051	0.001 / 0.031
/sigma_e/ STD error sigma_e	0.380 / 0.300	0.079 / 0.006	0.135 / 0.011	0.134 / 0.011	0.152 / 0.013

**Sig<0.05; *Sig<0.10

Table C.9: Spatial Panel regression on EU countries' financially distressed firms (without directors' characteristics)

Firm Failure Process:		1	2	3	4
Independent Variables	All Firms	Clusters w/out Directors char.			
	Coeff. Pr>|z|				
W_DV	-0.322*	-0.466	0.091	-1.523**	0.892**
W_error	0.329**	0.768**	0.658**	0.895**	-1.281**
c	0.081*	0.065*	-0.102	-0.013	-0.049**
GDP_gr	-0.018*	-0.015**	-0.008*	0.001	0.001
Credit	0.002**	0.001*	0.002**	0.002*	0.001**
Leg_trad	-0.032	0.002	-0.029	-0.016	-0.001
/sigma_u/STD error sigma_u	0.061/0.020	0.054/0.017	0.062/0.018	0.071/0.019	0.025/0.007
/sigma_e/ STD error sigma_e	0.049/0.004	0.054/0.007	0.048/0.005	0.031/0.004	0.025/0.003

**Sig<0.05; *Sig<0.10

Table C.10: Spatial Panel regression on EU countries' liquidated firms (without directors' characteristics)

		1	2	3	4
Independent Variables	All Firms		Clusters w/out Directors char.		
		Coeff. Pr>|z|			
W_DV	-0.269	0.444**	-0.104	-0.775*	0.408
W_error	0.819**	0.459**	0.473**	0.825**	0.446
c	0.453**	0.089**	0.087	0.096*	0.135*
GDP_gr	-0.013*	0.001	-0.018**	-0.002	-0.004
Credit	0.001	-0.001	-0.001	0.001	-0.008*
Leg_trad	-0.032	-0.057**	0.028	-0.043*	0.037
/sigma_u/STD error sigma_u	0.001/0.049	0.001/0.009	0.030/0.020	0.038/0.025	0.069/0.025
/sigma_e/ STD error sigma_e	0.219/0.020	0.057/0.004	0.124/0.011	0.087/0.012	0.110/0.009

**Sig<0.05; *Sig<0.10

Table C.11: Panel regression on UK Country regions' financially distressed firms (without directors' characteristics)

Firm Failure Process:		1	2	3	4
Independent Variables	All Firms		Clusters w/out Directors char.		
		Coeff. Pr>|z|			
c	0.168	-0.070	0.299**	0.111	-0.137
GVA	0 .005	0.001	0.002	-0.009*	0.007
Credit	0.001**	0.003**	-0.001	0.001	0.001**
New_firms_perc.	0.018**	0.024*	0.021**	-0.010	-0.009
/sigma_u/STD error sigma_u	0.035/0.018	0.088/0.024	0.040/0.011	0.092/0.021	0.070/0.023
/sigma_e/ STD error sigma_e	0.061/0.004	0.157/0.010	0.611/0.004	0.106/0.007	0.162/0.011

**Sig<0.05; *Sig<0.10

Table C.12: Panel regression on UK Country regions' liquidated firms (without directors' characteristics)

Firm Failure Process:		1	2	3	4
Independent Variables	All Firms	Clusters w/out Directors char.			
	Coeff. Pr>|z|				
c	1.015**	-13.439	17.345	-19.538	-20.482
GVA	-0.044**	0.414	-1.347**	-3.243**	-1.243**
Credit	-0.007**	0.211**	0.179**	0.853**	0.197**
New_firms_perc.	0.036**	-1.196*	-2.903**	4.364**	-0.680
/sigma_u/STD error sigma_u	0.223/0.035	14.320/3.109	21.847/4.592	23.847/7.971	9.794/2.265
/sigma_e/ STD error sigma_e	0.253/0.016	7.655/0.522	7.910/0.539	13.769/1.012	7.772/0.532

**Sig<0.05; *Sig<0.10

Table C.13: Spatial Panel regression on UK Country regions' financially distressed firms (without directors' characteristics)

Firm Failure Process:		1	2	3	4
Independent Variables	All Firms	Clusters w/out Directors char.			
	Coeff. Pr>|z|				
W_DV	0.587**	-0.306	0.266*	0.579**	0.556**
W_error	-0.228	0.547**	-0.192	-0.451	-1.145**
c	0.123*	-0.766*	0.268**	0.081*	0.142
GVA	0.003	0.002	0.002	0.006	0.006
Credit	0.001*	0.006**	-0.001	0.001	0.001
New_firms_perc.	0.012**	0.001	0.018**	-0.007	0.017**
/sigma_u/STD error sigma_u	0.038/0.011	0.080/0.022	0.037/0.010	0.097/0.022	0.089/0.023
/sigma_e/ STD error sigma_e	0.052/0.005	0.151/0.011	0.060/0.004	0.098/0.009	0.142/0.012

**Sig<0.05; *Sig<0.10

Table C.14: Spatial Panel regression on UK Country regions' liquidated firms (without directors' characteristics)

Firm Failure Process:		1	2	3	4
Independent Variables	All Firms	Clusters w/out Directors char.			
	Coeff. Pr>|z|				
W_DV	-0.263	0.252	0.519**	-0.587*	-0.099
W_error	0.854**	0.718**	0.539**	0.843**	-0.056
c	0.839*	-0.283	0.385	0.974**	0.136*
GVA	-0.016*	-0.008	-0.016*	-0.015	-0.006*
Credit	-0.005**	-0.001	-0.002	-0.006**	-0.001
New_firms_perc.	0.021**	0.036**	0.016	0.018	0.001
/sigma_u/STD error sigma_u	0.010/0.002	0.054/0.017	0.327/0.024	2.009/0.024	3.500/0.020
/sigma_e/ STD error sigma_e	0.143/0.011	0.054/0.007	0.158/0.010	0.170/0.014	0.096/0.006

**Sig<0.05; *Sig<0.10

Table C.15: Hausman Test results for the EU firms spatial regressions (financially distress)

	(b) fixed	(B) .	(b-B) Difference	ŧ(diag(V_b-V_B)) S.E.
GDP_gr	-0.007	-0.008	0.001	0.001
credit	0.002	0.002	0.000	0.000

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 3.86
Prob>chi2 = 0.1452

Table C.16: Hausman Test results for the EU firms spatial regressions (liquidation)

	(b) fixed	(B) .	(b-B) Difference	ŧ(diag(V_b-V_B)) S.E.
GDP_gr	-0.037	-0.029	-0.009	0.008
credit	-0.003	-0.001	-0.002	0.003

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 1.40
Prob>chi2 = 0.4978

Table C.17: Hausman Test results for the UK firms spatial regressions (financially distress)

	(b) fixed	(B) .	(b-B) Difference	ŧ(diag(V_b-V_B)) S.E.
GVA	-0.005	-0.005	0.000	0.001
credit	0.001	0.001	0.000	0.000
new_firm:	0.015	0.018	-0.003	0.007

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 0.65
Prob>chi2 = 0.7214

Table C.18: Hausman Test results for the UK firms spatial regressions (liquidation)

	(b) fixed	(B) .	(b-B) Difference	t(diag(V_b-V_B)) S.E.
GVA	-0.045	-0.044	-0.001	0.002
credit	-0.006	-0.007	0.001	0.001
new_firm:	0.063	0.036	0.027	0.017

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 2.58
Prob>chi2 = 0.2759