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Essays on firm behaviour in the euro area

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the Degree of Doctor of Philosophy

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Abstract

This thesis examines firms' real decisions using a large panel of unquoted euro area firms over the period 2003-2011. To this end, this thesis is composed of five chapters in which three are the main empirical chapters. They assess the dimensions of firm behaviour across different specifications. Each of these chapters provide a detailed discussion on the contribution, theoretical and empirical background as well as the panel data techniques which are implemented.

Chapter 1 describes the introduction and outline of the thesis. Chapter 2 presents an empirical analysis on the link between financial pressure and firms' employment level. In this set-up, it is explored the strength of financial pressure during the financial crisis. It is also tested whether this effect has a different impact for financially constrained and unconstrained firms in the periphery and non-periphery regions. The results of this chapter denote that financial pressure exerts a negative impact on firms' employment decisions and that this effect is stronger during the crisis for financially constrained firms in the periphery.

Chapter 3 analyses the cash policies of private and public firms. Controlling for firm size and other standard variables in the literature of cash holdings, empirical findings suggest that private firms hold higher cash reserves than their public counterparts indicating a greater precautionary demand for cash by the former. The relative difference between these two type of firms decreases (increases) the higher (lower) is the the level of financial pressure. The findings are robust to various model specifications and over different sub-samples. Overall, this chapter shows the relevance of firms' size. Taken together, the findings of Chapter 3 are in line with the early literature on cash holdings and contradict the recent studies, which find that the precautionary motive to hold cash is less pronounced for private firms than for public ones.

Chapter 4 undertakes an investigation on the relation between firms' stocks of inventories and trade credit (i.e. extended and taken) whilst controlling for the firms' size, the characteristics of the goods transacted, the recent financial crisis and the development of the banking system. The main findings provide evidence of a trade-off between trade credit extended and firms' stock of inventories. In other words, firms' prefer to extend credit in the form of stocks to their financially constrained customers to avoid holdings costly inventories and to increase their sales levels. The provision of trade credit by the firms also depends on the characteristics of the goods transacted. This impact is stronger during the crisis. Larger and liquid banking systems reduce the trade-off between the volume of stocks of inventories and the amount sold on credit. Trade credit taken is not affected by firms' stock of inventories. Chapter 5 presents the conclusions of the thesis. It provides the main contributions, implications and future research of each empirical chapter.

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Dedicated to Ju, Fernando and Kika.

"A person who never made mistakes never tried something new."
Albert Einstein

"All is worthwhile if the soul is not small."
Fernando Pessoa

"Knowledge is the eye of desire and can become the pilot of the soul."
Will Durant

Declaration

I declare that, except where explicit reference is made to the contribution of others, that this dissertation is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution.

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1 Chapter 1: Introduction

1.1 General background and motivation

In a world where markets are perfect, the behaviour of the firm does not depend on its financial situation. In reality, though, financial markets are imperfect. Traditional standard issues in finance such as taxes, transaction costs or information asymmetry shape how managers deal with firms' financial activities. Deciding whether or not to invest in new projects is a problem which firms face on a day-to-day basis, especially small firms.

Over the recent decades, the corporate world has witnessed several changes in the international markets. For instance, in Europe one of the most noticeable aspect was the creation of the Economic and Monetary Union (EMU) and the adoption of the common currency by a number of states which formed the euro area. Capital markets were integrated and currency risks were eliminated within the euro area countries (Bris et al., 2009). The euro area experienced a rapid economic development with a decline of the level of unemployment and an increase of the labour force participation (Lin, 2016). The financial system also grew dramatically in size. In fact, the total assets of the banking system corresponded to over 200% of euro area Gross Domestic Product (GDP) in 2007 compared with less than 100% in the U.S. (Shambaugh, 2012). Firms witnessed a decrease of their cost of capital and at the same time were faced with an increase of the range of borrowing.

The outbreak of the global financial crisis in August 2007 and its intensification in September 2008 with the bankruptcy of the Lehman Brothers brought significant changes to the economy. In the the euro area, labour markets were strongly hit. Employment decreased sharply and the government debt-to-GDP ratio increased from 66% to 93% (Economides and Moutos, 2013). At the same time, banks faced liquidity shortages due to their inability to access wholesale funding, and therefore secure assets (Wehinger, 2014) Consequently, non-financial corporations, especially small firms were faced with major problems in obtaining external finance. Between 2008 and 2011, Small and Medium-Sized firms (SMEs) saw their bank loans cut by 47%. During this period, firms applied for alternative sources of finance such as trade credit and other types of informal lending (see amongst others Casey and O'Toole (2014) and McGuinness (2015)). The aforementioned scenario should have an impact on the overall economy of the eurozone. In fact, SMEs are considered to be the backbone of the European Union (EU) economy. They represent 99.8% of the firms and contribute to 55.8% of the value added and 67% of the employment level (Kaya, 2014).

Understanding how firms behave has been a devoted line of research within the financial literature. Scholars have examined how the availability of internal and external finance

can influence firms' financial decisions. Financial corporations use internal and external funds to finance their projects. However, the cost of external finance depends on how much firms are subject to capital market imperfections (see amongst others Stiglitz and Greenwald (1993), Greenwald and Stiglitz (1993) and Jensen (1986)). For example, in a pionner work Fazzari et al. (1988) test the effect of capital market imperfections on firms' behaviour and highlight that firms which face a greater wedge between the cost of internal and external finance need to relay more on their internal funds. Such firms are called financially constrained and their internal funds are fundamental to finance their projects.

Subsequent studies have provided evidence that firms' financial positions have an impact on its fixed investment, employment and R&D decisions (see amongst others Nickell and Nicolitsas (1999) and Benito and Young (2007)). On the other hand, extant research also establishes that monetary policy, credit risk and macroeconomic uncertainty are some of the channels through which the cost and availability of external finance have an impact on firms' financial decisions (see amongst others Almeida et al. (2004), Acharya et al. (2012)). Hence, the imperfection of capital markets along with other linking mechanisms are relevant aspects which can provide valuable information for policy makers in the future.

1.2 Outline and contribution

In light of the motivation which is outlined above, this thesis contributes to the field of financial economics by exploring new aspects of firms' employment decisions, cash holdings and trade credit of firms. These applications are presented in three self-contained chapters (chapters 2-4). These chapters explore a sample of mainly unquoted euro area firms for the period between 2003 and 2011. All chapters employ the system Generalised Method of Moments (GMM) estimator as a estimation methodology.

Overall, Chapter 2 examines the effect of a firm-specific interest rate (i.e. interest burden) on the level of firms' employment with an emphasis on financial constraints and the recent crisis. Chapter 3 investigates the differences in cash holdings of private and public firms taking into account the effect of financial pressure. Chapter 4 tests the extent to which firms' stock of inventories have an impact on trade credit with a focus on firms' product characteristics, credit crunch and financial development.

Through Chapter 2 the literature of financial constraints and employment is extended. The chapter employs an unbalanced panel of 150,258 euro area firms. The value added is threefold. First, it is tested whether the response of employment to financial pressure (measured by interest burden) is stable across crisis and more tranquil years. Previous studies denote that interest burden is a representative measure of firms' level of financial pressure since a higher value of interest burden can be considered as an indicator that a firm is charged with a higher external finance premium (Nickell and Nicolitsas, 1999; Guariglia et al., 2015). Studies within the literature on employment consider the link

between employment and interest burden using only single-country data for U.K., Spain or China (Nickell and Nicolitsas, 1999; Benito and Hernando, 2008; Chen and Guariglia, 2009). However, the role of the crisis is not researched. This is also an important issue since in the presence of structural changes, the effect of interest burden during the crisis and non crisis years should be significantly different. The results of Chapter 2 show that higher levels of interest burden are associated with lower levels of employment, especially during the crisis.

Second, Chapter 2 also considers the country-level heterogeneity since interest burden is unlikely to affect all euro area economies in the same way. The countries are split into periphery and non-periphery economies for crisis and non crisis periods. This permits to draw conclusions for the euro area as a whole and also to compare the interest burden-employment nexus across different economies within the eurozone. Empirical findings suggest that only firms at the periphery of the euro area during the crisis are affected by changes in the interest burden.

Third, in Chapter 2 it is studied how the relation between interest burden and employment unfolds across time for firms which are more or less likely to suffer from financial constraints. Firms are divided into financially constrained and unconstrained based on three dimensions of firm-level heterogeneity. The idea is that firms which face different wedges between internal and external costs of capital might also respond differently to changes in the interest burden. Results show that the impact of interest burden on employment is stronger for firms classified as financially constrained and operating in the periphery countries during the financial crisis.

The focus of the next chapter shifts from employment to cash holdings decisions and the contribution is also threefold. Chapter 3 bridges the gap between the literature of cash holdings and financial constraints highlighting the importance of the precautionary motive for hoarding cash. Several explanations have been provided in the literature for the reasons for firms to hold cash which are mainly related to the precautionary motive. Firms with a restricted access to borrowing are expected to hold more cash as a precaution against potential cash flow shortfall in the future (Ferreira and Vilela, 2004). Private firms are typically smaller and are associated with higher levels of information asymmetry and higher transaction costs (Ferrando and Griesshaber, 2011).

The first contribution of this chapter is that it takes into account a recent puzzling and controversial result in the empirical literature of cash reserves. The few studies which compare the cash holdings of private and public firms demonstrate that the former hold less cash than the latter (Akguc and Choi, 2013; Gao et al., 2013). This goes against the main literature on cash holdings. To unravel the aforementioned issue, Chapter 3 main focus is on the cash holdings' differences among private and public firms. It employs an unbalanced panel of 120,796 firms, over 90% of which are not quoted in the stock market.

This is a crucial characteristic since these firms are more likely to suffer from information asymmetry.

The findings of Chapter 3 provide evidence that private firms hold more cash than their public counterparts. This finding is robust in various model settings. Next, this chapter investigates the role of financial pressure (calculated as coverage ratio) on the cash holdings' differences of private and public firms. This hypothesis is motivated by Acharya et al. (2012) who argue that changes in the level of credit risk affect cash holdings decisions of the firms. In doing so, this chapter provides a systematic analysis of the link between financial pressure and cash holdings at the micro level. Results show that the cash holdings' differential between private and public firms forms a U-shape. In addition, the speed of adjustment to target cash levels is introduced to further understand the behaviour of private and public firms' cash reserves. The results point out that both private and public firms adjust to their target cash levels whilst private firms adjust quicker than their public counterparts.

In Chapter 4 it is proposed an analysis to trade credit, i.e. an alternative source of short-term financing. This chapter builds on the theoretical and empirical literature off trade credit. The chapter tries to empirically link two theoretical explanations for the reasons for firms to extend and take trade credit. It focus on the inventory management motive and the diversion value of traded goods. According to the former, firms prefer to sell their stock on credit to their financially constrained customers rather than accumulate costly stock of inventories (Bougheas et al., 2009). On the other hand, the latter refers to the fact that suppliers of trade credit have an advantage relative to banks in financing their customers. Goods which are repossessed have more value for suppliers than to the banks. Firms in the differentiated industries produce more specific products than those in the standardised ones making the seller-buyer relation closer to the former rather than in the later (Bougheas et al., 2009; Guariglia and Mateut, 2016). This chapter employs an unbalanced panel of 136,489 firms. The contribution is threefold.

The first contribution of Chapter 4 is to empirically test whether the inventory management motive is influenced by the characteristics of the goods transacted and the level of financial constraints firms face. Empirical findings show that financially constrained firms (i.e. small firms), especially those in the differentiated sector offer more trade credit than larger firms. This provides evidence that the inventory management motive is related to the characteristics of the goods sold and the size of the firm. These characteristics have no effect on trade credit taken.

Secondly, Chapter 4 explores the role of the recent financial crisis on the trade-off between trade credit and inventories. The objective is to determine whether the crisis magnifies the inverse relation between the volume of stock of inventories and the amount which is sold on credit. The results point out that during the turmoil period, there is a

significant higher effect of inventories on trade credit extended only.

Thirdly, Chapter 4 also builds on the literature of financial development by taking into account the role of financial development (i.e. bank development) on the trade-off between inventories and trade credit. This chapter tests whether country-level financial development mitigates the impact of the inventory management motive. In this chapter it is argued that firms in a more developed banking system may find it easier to access capital markets and therefore resort less to alternative source of finance such as trade credit. Empirical findings show that large and liquid banking systems reduce the inverse relation between the volume of inventory stocks and the amount sold on credit.

Overall, each chapter presents its specific hypothesis, model specification, empirical results and conclusions. Hence, the reader is able to follow the motivation of each empirical chapter in a straightforward way. Chapter 2 and Chapter 3 have been considered for publication and have been presented to academic peers in conferences. In fact, a working paper which is derived from Chapter 2 is available online in the discussion paper series of the Adam Smith Business School, University of Glasgow. Chapter 2 has been presented at the 2014 Financial Engineering and Banking Society Conference in Surrey. Chapter 3 has also been presented at the 1st Symposium on Quantitative Finance and Risk Analysis (QFRA) in Greece and at the 6th National Conference of Financial Engineering and Banking Society (FEBS) 2015 Conference in Greece. This chapter is currently under review at the *Small Business Economics: An Entrepreneurship Journal.*

The remainder of this thesis is structure as follows. Chapter 2 presents the empirical analysis on the relation between interest burden and employment decisions. Chapter 3 denotes the empirical analysis for cash holdings' differences of private and public firms. Chapter 4 tests empirically how trade credit (i.e. extended and taken) is affected by firms' stock of inventories. Finally, Chapter 5 provides the general conclusions, implications and possible future research.

2 Chapter 2: The impact of financial pressure on euro area firm-level employment

2.1 Introduction

The financial credit crisis that started in August 2007 and reached the peak in September 2008 had a strong impact on the economy of the euro area. The events that unfolded after the Lehman's crash in September 2008 adversely affected the euro area banking sector through sharply increased funding cost and deteriorated liquidity conditions. On the other hand, the cost of bank borrowing for firms and the volatility of the financial markets increased to levels rarely seen before (Ivashina and Scharfstein, 2010). In late 2008, non-standard policies were adopted by the euro area countries in order to provide liquidity to financial and non-financial firms (Reichlin, 2014). However, the sovereign debt crisis initiated in Greece, gradually spread to the EMU countries and particularly to those in the periphery. In effect, Greece, Ireland and Portugal resorted to financial rescue programs in 2010-2011.

According to the Eurostat, the euro area has experienced a fall in the GDP between 2008 and 2009 by 4%. Furthermore, labour markets also suffered. The level of employment in the EU decreased sharply since the first quarter of 2008, with a contraction of 4 million (Hijman, 2009*a*). These events were particularly more severe to the so-called periphery countries. Hijman (2009*b*) refers that since March 2008 Spain and Portugal were the most affected countries. Euro-area economies faced a rise of unemployment at very different points in time. For instance, the unemployment rate for countries such as Spain and Italy increased in May 2007, whereas Greece and Portugal started to experience a rise of unemployment in the second quarter of 2008. Additionally, euro area banks drastically cut credit on loans to non-financial institutions. These events constrained the access of euro area firms and especially SMEs. These firms generally lack of access to capital markets and rely on banks for borrowing. Therefore, the access to external finance is vital to these firms in order to maintain their day-to-day business and obtain long-term investment and growth goals (Ferrando and Griesshaber, 2011).

SMEs are also crucial to the European economy and especially to the so-called periphery countries. Due to the financial stress that the periphery countries face, the cost of borrowing for such firms is higher. The latest European Central Bank (ECB) figures indicate that the access to finance for periphery SMEs is more constrained than for the non-periphery ones.[1] For example, Iyer et al. (2014) show that during the 2007-2009 fi-

[1] In a report for ECB, Wymenga et al. (2012) show the average of SMEs employment and their real value added from 2008 to 2011. The results indicate that countries such as France and Germany performed above the average of the EU-27 for both SMEs employment and SMEs value added. Conversely, Portugal and Spain perform below the average of the two indicators.

nancial crisis period, the supply of credit for Portuguese firms decreased, especially for smaller firms with weaker banking relations. Clearly, it seems that the access to finance during the crisis is more difficult for firms in the periphery. The market instability and discrepancy among the countries, gives the motivation for this chapter.

A limited number of pre-crisis studies show that financial pressure through a firm-specific interest rate (i.e. interest burden) affects firms' labour decisions (Nickell and Nicolitsas, 1999; Benito and Hernando, 2008; Chen and Guariglia, 2009). These studies refer that a higher interest burden indicates that firms are charged with a higher external finance premium (Guariglia et al., 2015). Under this scenario, the financial burden of debt-servicing is expected to affect firms' labour and financial decisions. Notwithstanding, these studies do not expand to the recent financial crisis and they employ single-country datasets which makes it difficult to draw conclusions about the euro area as a whole, or to establish comparisons on the experience of periphery versus non-periphery countries.

To this end, Chapter 2 focuses on the employment behaviour of firms which face changes in their financial conditions associated with tight monetary policy and financial constraints. The present chapter employs a large panel of eleven euro area countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain) during the 2003-2011 period, where the majority of the firms are not quoted on the stock market.

The chapter makes three main contributions to the literature. First, it explores whether the relation between financial pressure and employment has strengthened during the recent financial crisis. The motivation behind this study originates from the financial accelerator theory of Bernanke et al. (1996). The authors show that when financial conditions deteriorate and firms rely heavily on external finance, the cost of borrowing rises. Firms' are financially constrained if their external finance is too costly or their internal finance is insufficient (Von Kalckreuth, 2001). Consequently, when the access to external finance is more expensive, existing interest payments increases. Therefore, all kind of firms' investment, including the hiring of new employees may decrease (Mojon et al., 2002).

Second, motivated by recent developments in the euro area, the sample is divided into periphery and non-periphery economies to test for differences in the exposure of employment to financial pressure. Periphery economies are likely to exhibit higher sensitivities of employment to financial pressure compared with their non-periphery counterparts, since the former economies suffered disproportionately during the crisis.

Third, the chapter explores whether the employment level of different type of firms may be affected differently by financial pressure. There is an establish literature which provides evidence that financial constraints originated by information asymmetry and agency problems have a significant impact on firms activities such as fixed capital investment and inventory investment (Fazzari et al., 1988; Carpenter et al., 1998). The main reason

for this is that firms which face financial constraints have more difficulties in obtaining external finance. Nevertheless, Chapter 2 explores for the first time the role of financial constraints on the relation between financial pressure and employment decisions. To this end, it is tested the effect of financial pressure on employment by distinguishing between more or less financially constrained firms. To ensure robustness of the results this chapter considers three different dimensions of firm heterogeneity (i.e. bank dependence, size and firms' legal status).

The rest of Chapter 2 is organised as follows. Sub-section 2.2 reviews the relevant theory and the extant empirical studies. Sub-section 2.3 summarises the research design while sub-section 2.4 shows the model specification. Sub-section 2.5 discusses the empirical methods and sub-section 2.6 elaborates on the dataset. Finally, sub-section 2.7 provides the results and the main conclusions of this chapter are given in sub-section 2.8.

2.2 Literature review

One of the dominant themes in the finance academic literature is the concept of capital markets' performance. According to the seminal paper of Modigliani and Miller (1958), under the assumption of perfect capital markets, firms' financing policy is irrelevant. The same point is emphasized by Stiglitz (1974), who shows that, in a perfect setting, the market value of a firm is not influenced by its financial decisions. The key aspect in both of these papers is that, in a perfect market, firms can easily obtain external financing at a fair price.

When the assumption of perfect markets is abandoned, financial decisions become important. In such alternative setting, capital market imperfections can influence firms' financial status, especially for those more financial constrained. In the presence of asymmetric information, credit markets can give the balance sheet conditions of borrowers a role to play in the business cycle, through their impact on the cost of external finance (Bernanke and Gertler, 1989).

Gertler and Gilchrist (1994) develop a theoretical framework to explain how financial constraints and investment behaviour work. The first approach is the credit view. This suggests that reserve requirements on bank deposits may regulate the ability of banks to grant loans. As a result, the borrowing and spending decisions of bank dependent firms are affected. The second approach is the financial propagation mechanism. It explores the idea that an initial decrease in the aggregate economic activity initiated by tight money increases the impact on the borrowing and spending decisions of small firms. These firms are more sensitive to credit market frictions. Hence, academic literature, nonetheless, largely suggests that liquidity constraints are even more important to more vulnerable firms (Myers, 1984).

In the following sub-sections it is presented the theoretical background as well as the

key empirical studies on financial constraints and employment decisions.

2.2.1 Theoretical background

Market imperfections play a specific role on firms' ability to raise funds. In an imperfect market setting, there is a wedge between internal and external costs of funds due to asymmetric information and agency costs (Gertler and Gilchrist, 1994). The pecking order theory of Myers (1984) refers that information asymmetry has an impact on firms' availability of internal funds. Firms undertake investment without recurring to external finance. However, in this scenario, it is relatively more expensive to invest due to transaction costs, tax issues and costs associated with problems of asymmetric information (Allen and Santomero, 1997). Firms seeking to finance new investments prefer to use funds according to a hierarchy (i.e. internal funds, debt and equity issuance). This creates a gap between the cost of internal and external funds.

Conflicts between managers and shareholders also influence firms' investment decisions. The free cash flow model of Jensen (1986) suggests that managers have an incentive to build up cash to increase the amount of assets under their control. The implementation of projects which maximises managers' own utility can lead to over-investment problems (Ferreira and Vilela, 2004). In other words, firms with higher free cash flow are more likely to invest in unproductive projects due to agency problems. Managers can spend money on their own projects reducing firms' values. Firms facing financial constraints may undertake optimal investment decisions and be creative in improving capital efficiency (Almeida et al., 2013).

These problems can be particularly severe to SMEs. These firms can suffer from higher information opacity than larger ones. Capital market imperfections also limit the access to bank lending for firms with lower financial health (Hoshi et al., 1991). Bernanke et al. (1996) develop a hypothesis to test the effect of credit market imperfections on firms' cost of borrowing. The authors define this mechanism as the financial accelerator or credit multiplier. In a context of financial pressure, corporate investment' cyclical volatility is strongly concentrated in specific periods which are followed by other periods of sharp decline. Firms depending mainly on external finance, have higher costs of borrowing. Bernanke and Gertler (1989), demonstrate that a tightening monetary policy can also damage firms' creditworthiness. A weak monetary system significantly increases negative shocks and influence the ability of central banks to stabilise the economy. In other words, a deterioration of firms' balance sheet has an impact on firms' financial stability. This leads to an increase of the adverse selection and moral hazard problems (Mishkin, 2001). Consequently, obtaining external funds from financial institutions may be difficult to small and younger firms.

Another strand of the literature links financial constraints with firms' labour decisions.

Stiglitz and Greenwald (1993) and Greenwald and Stiglitz (1993) develop a New Keynesian model which includes financial and labour market imperfections. They explore the effect of adjustment costs and information asymmetry in firms' labour demand and employment fluctuations. According to the authors, financing attitude to risk and the optimal level of output explain firms' corporate behaviour. The existence of information asymmetry makes firms' ability to raise funds in the external capital markets restricted (Stiglitz and Greenwald, 1993). Firms not quoted in the stock market only have access to debt financing. This can increase the probability of bankruptcy for firms. Such bankruptcy aversion influences firms' labour demand. If firms' financial position is weak, labour demand is lower due to the probability of higher risks of financial distress in the future (Arnold, 2002). In fact, the fluctuation in labour demand may influence the level of firms' employment and production.

In a similar model, Arnold (2002) identifies a relation between financial constraints and employment. Following Stiglitz and Greenwald (1993) , the author develops a rational expectation model with financial constraints. The model assumes that managers are strictly bankruptcy averse and workers efforts rely on the real wage rate they are paid. The author concludes that employment decreases for firms which face financial constraints caused by information asymmetry. In other words, labour demand and employment fluctuates due to changes in investment.

Overall, the aforementioned studies provide theoretical evidence that firms' investment decisions and level of employment may vary according to the financial pressure that firms face. The majority of the empirical studies have focused on the extent to which firms' investment decisions are constrained by the availability of finance. Few studies have also questioned the role of financial constraints on firms' employment level and recently, the empirical literature has explored this issue on the financial crisis. The next sub-sections shed light on this debate by revising the main empirical studies on the financial constraints' literature.

2.2.2 Financial constraints and Q investment models

Empirical literature on financial constraints focuses mainly on the effect of cash flow sensitivity on firms' investment. The impact of financial constraints on firms' investment behaviour relies on the seminal paper by Fazzari et al. (1988). The authors extend the neoclassical investment model and consider the effect of Tobin's Q, financing constraints and investment on the basis of firms' retention behaviour. The Tobin's Q approach is employed as the stock market valuation of the firm to measure future returns to capital (Johansen and Juselius, 1994). Fazzari et al. (1988) consider that investment spending depends on the availability of cash flow. In other words, under imperfect capital markets, cash flow has an impact on investment due to a financing hierarchy in which internal

capital has an advantage cost over external capital (Myers, 1984).

Fazzari et al. (1988) use a sample of 421 manufacturing U.S. firms for the period of 1970 to 1984. They estimate two different Q models and classify firms according to differences in Tobin's Q. The authors partition the sample according to firms' level of dividends. In particular they identify firms with lower dividends as "most constrained" (i.e. small and young) and firms with higher dividends as "unconstrained" (i.e. listed and mature). This a priori division allows Fazzari et al. (1988) to investigate the existence of a shadow price differential between internal and external finance (Calormiris and Hubbard, 1995). Firms which have lower internal funds (i.e. short dividend payout ratios) are more sensitive to fluctuation in their cash flow. Fazzari et al. (1988) refers that information problems in the capital markets lead to firms' financial constraints on investment. Especially, for those firms which retain most of their income. In effect, firms use external finance to smooth investment when internal finance fluctuates. The results show that investment-cash flow sensitivities are higher for firms classified as being more financially constrained. The authors conclude that capital market imperfections influence firms' investment behaviour. Particularly, for small and young firms which retain nearly all of their income.

A number of studies support Fazzari et al. (1988) main conclusions. They find a positive relation between cash flow and investment. For instance, Hoshi et al. (1991) investigate the role of banks in corporate investment and internal funds. They use a sample of Japanese firms and split the firms as Fazzari et al. (1988). The sub-sample of firms is divided according to the Keiretsu affiliation (i.e. bank affiliated and unaffiliated firms).[2] For a panel of 145 manufacturing listed firms, the authors employ a regression model which includes measures of liquidity, Tobin's Q and lagged production. The results indicate that strong ties help to alleviate liquidity constraints. Specifically, Japanese banks are considered as a primary source of external finance for bank affiliated firms. Independent firms show more problems to raise capital. Thus, investment is more sensitive for independent firms comparing with the bank affiliated ones. According to the authors, this discrepancy is related to the asymmetric information of capital markets.

Schaller (1993) tests a Q model for liquidity constrained firms. The model employs age, ownership, collateral assets and group affiliation. Using a sample of 212 Canadian firms from 1973-1986, Schaller (1993) divide the sample according to the aforementioned firms' specific characteristics. The empirical findings demonstrate that in contrast with mature firms, younger firms pay a higher price to equity finance and their investment spending is more affected by liquidity. The results are in line with the idea that mature firms are less likely to face information asymmetry. As firms' age increases, lenders get additional information about firms' quality, adjusting the terms of financial constraints. Therefore,

[2]Note that in the Japanese system, a main bank acts as a monitor and firms are members of large industrial groups (i.e. Keiretsu). See Pinkowitz and Williamson (2001) for details.

for mature firms the costs of external capital should be lower (Brito and Mello, 1995). The concentration of ownership is also important for the investment sensitivities of firms' cash flow. Schaller (1993) shows that firms pay more for new equity if the ownership is disperse. The less concentrated the ownership of the firm, the higher is the risk faced by an investment. Thus, the wedge between the cost of internal and external finance increases. The author refers that firms' investment spending without collateral assets shows higher sensitivity to liquidity. The availability of collateral decreases the relevance of information asymmetry between firms and potential lenders. Firms which invest less in standardised assets are most subject to financial constraints. Finally, the authors show that group affiliation has an influence on firms' investment-cash flow sensitivities.[3] The results indicate that equity finance is less costly for firms belonging to the industrial groups and that their investment is less constrained in contrast with independent firms. Overall, Schaller (1993) denote that information asymmetry influences firms' investment behaviour.

Himmelberg and Petersen (1994) investigate whether internal finance has an impact on Research and Development (R&D) investment for a sample of 179 small, high-tech U.S. firms. They test the importance of cash flow on R&D investment for firms between the period of 1983 and 1987. In their study, the authors employ the following specification models: the within-firms Ordinary Least Squares (OLS), the between-firm OLS and the instrumental variable method. Himmelberg and Petersen (1994) refer that the within-firms OLS avoids the possibility of correlation between internal finance (i.e. cash flow) and R&D since the estimator controls for unobservable firm effects. Not using a between-firm OLS estimator can remove most of the sample variance which can lead to biased results.[4] Finally, the instrumental variable regression model controls for the high adjustment cost bias of R&D. The GMM estimator which is proposed by Hansen (1982) is also employed. This technique avoids serious sample-selection, simultaneity and measurement error problems which can occur with a large dataset (Whited and Wu, 2006).[5]

Empirical findings show a statistically significant relation between R&D investment and the use of internal finance for U.S. small firms. This is inconsistent with previous empirical studies on R&D investment (Mueller, 1967; Elliot, 1971). However, these studies investigate the same issue for samples of large firms. Himmelberg and Petersen (1994) interpret their results as evidence that contrary to small firms, large ones have an easier access to debt financing. Large firms generate cash flow in excess of investment needs.

[3]Note that Schaller (1993) employs the classification scheme suggested by Hoshi et al. (1991) The authors classify firms membership as either group or non-group affiliated and consider group affiliated firms as those which have strong stable group ties (i.e. Keiretsu groups).

[4]Himmelberg and Petersen (1994) claim that "these estimates provide evidence on the extent to which the within-firm estimates are biased downward due to the unresponsiveness of R&D to the transitory component of cash flow".

[5]Note that the GMM estimator formalised by Hansen (1982) makes use of the orthogonality conditions to allow for efficient estimation in the presence of heteroskedasticity of unknown form (Baum, 2001).

The authors conclude that the availability of cash flow (i.e. internal finance) is the main determinant of investment for small R&D firms.

2.2.3 Financial constraints and Euler's investment models

A second set of the literature also uses a similar approach to Fazzari et al. (1988). These studies employ a set of Euler equations. Contrary to Tobin's Q, the Euler equation considers the use of the stock market valuation of the firm to measure the marginal cost of capital in the next period (Johansen and Juselius, 1994). Whited (1992) investigates the role of debt markets estimating Euler equations. Using firm-level panel data of 325 manufacturing U.S. firms, the author employs the GMM estimator formalised by Hansen (1982). Different financial ratios are employed to test firms' investment behaviour. Firms are considered financially constrained if they have higher debt-to-assets and interest coverage ratios. Euler equations are estimated for firms which are grouped according to the aforementioned ratios. Whited (1992) finds that financial variables are only significant for constrained firms (i.e. firms with low debt-to-asset and interest coverage ratio). The impact of bond ratings on firms' behaviour is also explored. Whited (1992) refers that firms' information asymmetry between insiders and outsiders decreases if firms' debt is rated. The sample is then divided into firms with and without corporate bond ratings. The results suggest that for both groups, the credit ratio is less significant than for the group of the financial ratio variables.

Bond and Meghir (1994) also investigate the investment-cash flow sensitivity. They estimate an Euler equation for optimal capital accumulation in the presence of adjustment costs. A panel of 626 unquoted U.K. manufacturing firms is employed over the period of 1974-1986. Using a GMM estimator, the authors split the sample into constrained and unconstrained firms. The results demonstrate that cash flow has a negative influence on financial constrained firms and it is not significant for unconstrained firms. These findings are inconsistent with the Euler investment model.

Hubbard et al. (1995) use a sample of 428 manufacturing U.S. firms from 1976-1987 and an Euler equation of investment. The authors employ a GMM estimator on firms' discount factor through the dividend payout and borrowing constraints. The sample of firms is divided a priori according to the following categories: higher and lower payout ratios (i.e. unconstrained and constrained firms). Hubbard et al. (1995) find a significant relation between investment-cash flow sensitivities for financially constrained firms. The results are insignificant for firms with low payout ratios. The authors also explore whether investment for low payout firms is susceptible to capital market frictions. In this scenario, low payout firms are separated in order to isolate the mature ones. The results suggest that fixed investment of mature firms is successfully described by the Euler equation for market imperfections. Finally, an alternative model is estimated. In this model, firms'

cost of funds depends on a measure of tightness off aggregate credit conditions and cash flow. Results suggest that financially constrained firms are affected by credit markets' conditions.

2.2.4 The Kaplan and Zingales critique

Sub-section 2.2.2 shows that a number of studies have supported the argument of Fazzari et al. (1988), i.e. that there is a positive relation between financial variables and firms' activities which is stronger for firms which suffer from higher levels of financial constraints. Fazzari et al. (1988) introduce the cash flow variable to explore whether information asymmetry has an impact on the accumulation of firms' internal funds. The approach of Fazzari et al. (1988) shows that firms with positive investment cash flow sensitivities are characterised as being financially constrained since it is costly for these firms to obtain access to external finance. In other words, the authors show that the sensitivity of investment to cash flow is higher for the group of firms which are classified a priori with a low payout rate. This view is challenged by Kaplan and Zingales (1997). The authors have raised questions regarding the interpretation of investment cash flow sensitivity as a measure of financial constraints. They suggest that positive investment cash flow sensitivities may not reflect financial constraints as it is argued by Fazzari et al. (1988). Kaplan and Zingales (1997) suggest that corporate investment is less sensitive to fluctuations in cash flow for financially constrained firms.

To provide evidence on their argument, Kaplan and Zingales (1997) re-examine the sample of 49 low-dividend payout firms from the work of Fazzari et al. (1988). In other words, the authors test both Euler equation and Q model only on the sample of firms which Fazzari et al. (1988) identify as financially constrained. In contrast with Fazzari et al. (1988) which have identified financial constraints based on the payout policy of firms as a classification criteria, Kaplan and Zingales (1997) have classified firms as financially constrained based on operating performance. They consider public statements of Chief Executive Officer (CEO) regarding the access to credit of firms. Kaplan and Zingales (1997) use a measure based on qualitative information which is gathered from firms' annual report or 10-K for each of the sample year.[6] Contrary to Fazzari et al. (1988), the authors divide manufacturing firms in three different categories (i.e. financially, possible and not financially constrained).[7] Empirical results show that 85% of these firms cannot be classified as financially constraints. They have raised their investment level by using

[6]Note that all U.S. publicly held firms are required to file an annual report or 10-K by the Security Exchange Act (SEC) of 1934. Both form 10-k and the annual shareholders' report include financial statements and other data which denotes firms' accounting personnel and its independent auditors. Firms are also required to disclose whether they have difficulties financing investments.

[7]As it is explained in sub-section 2.2.2 Fazzari et al. (1988) split the sample of firms as follows: firms with low dividends "most constrained " (i.e. small/young) and firms with high dividends "unconstrained" (i.e. listed and mature).

credit lines and internal funds. In other words, less constrained firms actually exhibit greater investment cash flow sensitivities. In this scenario cash flow is capturing investment opportunities not capture by Tobin's Q. Hence, the authors raise some doubts about the rationale and interpreation of the study of Fazzari et al. (1988).

In response to this criticism, Fazzari et al. (2000) provide a set of arguments for the reasons why the results in Kaplan and Zingales (1997) are misleading and not conclusive. For example, they refer that the results in Kaplan and Zingales (1997) are based on a very small sample of firms which makes it difficult to support the magnitude of the results (i.e. the authors only use the low dividend payout sample of firms). Fazzari et al. (2000) also argue that the classification criteria which is used by Kaplan and Zingales (1997) is in fact subjective and not clear. The former employ statements of managers about the firms' liquidity and access to external finance but the weights which are used for the different criteria are not specified. Fazzari et al. (2000) also denote that the classification scheme of Kaplan and Zingales (1997) reflects the degree of financial distress a firm faces rather than the degree of financial constraints. According to the authors financially distressed firms should exhibit lower sensitivity to cash flow since they may face restrictions by creditors when using internal funds for investment. The argument of Fazzari et al. (2000) is that in the work of Kaplan and Zingales (1997), firms which face financial distress are removed from the sample, and as a result very few observations should fall in the aforementioned constrained category which is defined by Kaplan and Zingales (1997). To sum up, Fazzari et al. (2000) refer that the work of Kaplan and Zingales (1997) in not theoretically and empirically accurate.

Overall, these results have led to an intense debate on how to analyse the sensitivity to cash flow and which classification criteria should be used to define financially constrained and unconstrained firms. In the next sub-sections it is discussed the subsequent studies on these issues.

2.2.5 Q and Euler's investment models: Subsequent debate

The following studies try to explain and reconcile the findings of the two abovementioned views. For example, Cleary (1999) uses a larger sample and classify firms according to their ability to raise external finance. The author employs a classification index similar to the Z-score model of Altman (1968) to determine firms' financial status.[8] Using a sample of 1,317 listed U.S. firms, Cleary (1999), classify firms which reduce dividends payments as financially constrained. The author considers that the firms' classification changes every period to account for firms which financial status changes continuously. The findings

[8] In a seminal paper, Altman (1968) develops the Z-score model for predicting bankruptcy. The author combines five different financial ratios. They are defined as follows: X1= working capital/total assets; X2= retained earnings/total assets; X3= earnings before interest and taxes/total assets; X4= total shareholders' equity/total debt; X5= total revenue/total assets.

suggest that more creditworthy firms present higher sensitivity of investment-liquidity. The results provide a strong support for the Kaplan and Zingales (1997) findings.

Gomes (2001) develops a structural model of investment behaviour in order to simulated data with a Q model with asymmetric information. Using 12,323 observations of U.S. firms, the author shows that the existence of financial constraints is not sufficient to establish cash flow as an indicator of financial constraints. In the model, optimal investment is sensitive to cash flow and Tobin's Q. Gomes (2001) demonstrates that cash flow is important only if Tobin's Q is ignored but without any market frictions cash flow is significant. According to the author, the success of previous cash flow augmented regressions are related to the combination of a measurement error in Tobin's Q and identification problems in a linear regression framework.

Consistent with Gomes (2001), Alti (2003) creates a model of investment behaviour exploring the impact of firms' growth and investment using data from the same sample of Fazzari et al. (1988). Younger firms are considered as financially constrained. According to Alti (2003), these firms face higher uncertainty regarding their growth prospects. The results indicate that investment is sensitive to cash flow in environments with no financial frictions. The author report that young and small firms (i.e. with higher growth rates and lower dividend payout ratios) present higher sensitivity to cash flow. Young firms with higher growth rates show higher levels of Tobin's. These findings are inconsistent with Fazzari et al. (1988).

The previous studies suggest that least financially constrained firms present higher investment-cash flow. This is inconsistent with the investment-cash flow sensitivity suggested by Fazzari et al. (1988). As such, investment-cash flow sensitivity cannot be seen as an evidence of corporate financial constraints.

Allayannis and Mozumdar (2004) study the influence of negative cash flow observations on the investment sensitivities of non-financial and non-utility U.S. listed firms. Firstly, based on the work of Kaplan and Zingales (1997), they use a subset of Fazzari et al. (1988)' sample. Allayannis and Mozumdar (2004) perform a model specification which is given by Tobin's Q. Secondly, the authors investigate the empirical findings of Cleary (1999). Specifically, they consider a measure of financial constraints (i.e. Z-score) and a discriminant analysis for the sub-sample of dividend payout ratios.

Allayannis and Mozumdar (2004) attribute the results of Kaplan and Zingales (1997) and Cleary (1999) to the existence of negative cash flow observations from the samples. Allayannis and Mozumdar (2004) show that such negative observations, influence investment cash flow sensitivities of financially constrained firms. After dropping the negative observations, empirical findings suggest a positive relation between financial constraints and cash flow. This is in line with the results of Kaplan and Zingales (1997) and Cleary (1999)).

Other authors demonstrate that the results regarding firms' investment-cash flow sensitivity depend on the choice of the proxy for financial constraints. For instance, Whited and Wu (2006) develop an index of financial constraints. It is based on a GMM estimator of an investment Euler equation. The index avoids the introduction of measurement bias since it does not include Tobin's Q as in Kaplan and Zingales (1997). In each year, firms are classified according to the index of Whited and Wu (2006). Firms with higher levels of financial constraints belong to the higher half of the distribution whereas firms with lower levels of financial constraints are located in the lower half. The authors find that firms with higher levels of financial constraints are associated with higher exposure to external finance. These firms are characterised as being small, under-invest and do not present bond ratings. The results are inconsistent with the findings by Kaplan and Zingales (1997).

In a related study, Almeida and Campello (2007) consider a new theoretical assumption which allows to test empirically the link between financial frictions and firms' investment. The authors assume that tangible assets increase firms' ability to achieve external funding. This helps firms to increase their investment when imperfect access to credit is considered. Almeida and Campello (2007) refer that these assets mitigate contractibility problems, i.e. they increase the value that can be taken by creditors in default states.

Using a sample of 18,304 firm-year observations from manufacturing firms for the period between 1985 and 2000, the authors test the impact of tangibility on investment-cash flow sensitivities on different proxies of financial constraints. The authors use a similar model to Fazzari et al. (1988) but include an interaction term which accounts for the impact of asset tangibility on the investment-cash flow sensitivities.[9] Almeida and Campello (2007) use the switching regression framework instead of dividing firms a priori. In other words, they add the access to credit of financially constrained firms with investment equations.

The results suggest that asset tangibility increases with investment-cash flow but only for financial firms. Interestingly, the switching regression estimator also demonstrates that firms with higher asset tangibility have a higher probability of being financially unconstrained.

Contrary to previous studies, Guariglia (2008) explores the investment-cash flow sensitivity on a panel of unquoted firms. Using an unbalanced panel model of 7,534 unquoted U.K. firms for the period 1993-2003, the author employs an error-correction method instead of a Q investment model. Guariglia (2008) refers that the error-correction specification allows a more flexible specification since it is less likely to suffer from misspecification problems. The author explores the extent to which internal and external financially constrained firms have different sensitivity of investment to cash flow. The impact of investment on

[9] The authors use expected liquidation value of firms' operating assets (i.e. cash, accounts receivables, inventories and fixed capital) based on Berger et al. (1996).

internal financial constrains is tested. The sample of firms is divided according to firms' cash flow-to-capital ratio.

Additionally, the impact on external financial constraints is also explored. The author splits the sample using firms' size. Cash flow is used to investigate the degree of internal and external financial constraints which firms face. A first-difference GMM estimator is employed. This approach is defined by Arellano and Bond (1991). It considers unobserved firm heterogeneity, estimates the equation in first-differences and controls for possible endogeneity problems.

Similarly to Whited and Wu (2006), the results also show that the sensitivity of investment-to-cash flow depends on criteria which is considered. Guariglia (2008) shows that when proxies for external finance constraints are used (i.e. size, dividend payout) the results are consistent with Fazzari et al. (1988). However, if the classification is based on the level of internal funds, the investment-cash flow relation is U-shaped. In terms of internal financial constraints, these findings support those by Kaplan and Zingales (1997). The combination of internal and financial constraints indicates that investment sensitivity is higher for the externally financially constrained firms (i.e. firms with higher level of internal funds).

In a similar study, Spaliara (2009) explores the sensitivity of the capital-labour ratio to financial factors. The author investigates the relation between the capital-labour ratio with cash flow, leverage and collateral for a set of constrained and unconstrained firms. Spaliara (2009) uses a sample of 17,350 manufacturing firms over the period 1994-2004. The sample of firms is split by size, age and bank dependence. As Guariglia (2008), the author employs a first-difference GMM estimator. The results indicate that financially constrained firms show a higher sensitivity of their capital-labour ratio when comparing with their unconstrained counterparts.

Another strand of the literature has also accounted to the effect of an exogenous change in the supply of external finance on firms' behaviour. For example, Von Kalckreuth (2001) explores the impact of interest rates and monetary policy on the fixed investment of German firms. Using an unbalanced panel of 6,408 firms for the period between 1988 to 1997, the author employs an Autoregressive Distributed Lag (ADL) model to capture the effect of the investment-capital ratio. The model also includes the ratio of cash flow-to-capital stock as a proxy for firms' level of financial constraints. Results demonstrate that financially constrained firms present lower user cost sensibility. The results indicate that there is no sensitivity to cash flow for both sub-samples.

Mojon et al. (2002) study the effect of changes in the monetary policy on euro area firms' investment behaviour. The authors use a firm-specific interest rate (i.e. implicit interest rate) and employ a sample of firms from France, Germany, Italy and Spain for the period between 1983 and 1988. The authors estimate the effect of changes in the firm-

specific interest rate on firms' investment using two different estimators, i.e. the within estimator and the instrumental variable estimator.

Empirical findings show that firm-specific characteristics have an impact on the interest rate that firms are charged. In particular, the results suggest that the average interest rate is statistically significant and higher for small firms. The results do not show that small firms' investment is more sensitive to changes in the user cost of capital than investment of large firms. Mojon et al. (2002) conclude that these results provide little evidence that the monetary policy in these euro area countries during this period has an heterogeneous effect on firms.

Arslan et al. (2006) study the relation between financing constraints and investment-cash flow sensitivities. They focus on the level of firms' cash holdings as the main classification variable to distinguish between financially constrained and unconstrained firms. According to the authors, higher cash holdings indicates that firms' are able to obtain profitable investment opportunities.

The authors use a sample of publicly traded Turkish firms for the period between 1998 and 2002. They focus their analysis before and during the financial crisis to test the role of cash reserves in a scenario with higher level of information asymmetry and higher costs of external finance.[10] Arslan et al. (2006) construct a cash model which captures capital market imperfections to explore the target cash level of each firm. Following the investment model of Fazzari et al. (1988), the sample of firms is divided in financially constrained and unconstrained categories based on different proxies, i.e. size, age, dividend payouts and business group affiliation.

The empirical results indicate that the impact of financial constraints on firms' investment is related to the level of cash firms hold. Financially constrained firms have higher investment-cash flow sensitivities than their unconstrained counterparts, especially during the crisis.

Blalock et al. (2008) focus on the financial constraints issue for firms during the emerging market financial crisis in East Asia in 1997.[11] The authors use foreign ownership to test if capital market imperfections limit the level of investment in Indonesia. The authors identify the effect of financial crisis on firms' performance using the value added, investment and employment. Blalock et al. (2008) perform a difference-in-difference approach. The method compares changes in the outcome in the domestic-own exporters and non-exporters groups, before and after the financial intervention. They conclude that capital

[10] According to Akyüz and Boratav (2003) the volatility of the financial markets and banking sector in Turkey lead to a financial crisis. Turkey experienced a financial crisis during the 2000-2001 period.

[11] Baig and Goldfajn (1999) refer that the Asian financial crisis started in July 1997, with the devaluation of Thailand's currency after the bankruptcy of Thailand's largest finance company (i.e. Finance one). A second sub-period of the crisis started in November 1997, after the collapsed of the stock market of Hong Kong. This crisis led to the collapse of economic growth in several East Asian countries. Financial intervention was provided by the Internal Monetary Fund (IMF) and World Bank.

market imperfections reduce exporter' investment and amplify emerging market crisis.

Chava and Purnanandam (2011) investigate the credit contraction in the U.S. in 1998 which originated in Russia. The authors estimate a model which considers firm-specific factors. In particular, the authors use demand shocks proxies (i.e. profitability and growth rates) and a supply shock proxy (i.e. firms' capital). The results reveal that banks which are affected by the crisis reduce their supply of credit.

Görg and Spaliara (2014) study the effects of firms' borrowing ratio, financial health and their export exit from 2000 to 2009. They use an unbalanced panel of 14,533 U.K. firms and employ a log-log hazard model. The model is based on the version of the Cox proportional hazard model. This model assumes that the hazard function for separate samples converges with time (Jenkins, 2005). The authors show that during the crisis period, the impact of firms' interest payments on the risk of export failure is higher in comparison to the tranquil period (2000-2006). They refer that firms with higher borrowing ratio, are likely to exit the export market during the crisis period. Görg and Spaliara (2014) conclude that the deterioration of firms' financial position increases the hazard of export exit of U.K firms.

Recently, Guariglia et al. (2015) investigate the link between interest payments and firms' chances of survival. Using a panel of U.K. firms from the period between 2000 and 2009, the authors employ a complementary log-log model to capture the probability of firms' failure. Guariglia et al. (2015) demonstrate that the debt-servicing costs have a direct effect on firms' survival. The empirical results show that during the recent credit crisis, the relation between firms' interest payments and their change of survival is higher. The authors conclude that changes in the debt-serving costs affect mainly firms which are young, non-exporting and depend mainly on external finance.

Overall, the aforementioned studies provide a promising framework to examine the cash flow-sensitivity of firms, especially in the context of the recent financial crisis. It is clear that the sensitivity of investment-cash flow varies according to the level of financial constraints firms' face. Thus, studying euro area firms' reaction to the financial crisis provides a privileged opportunity to contribute for this on-going debate.

2.2.6 Financial constraints and employment decisions

Empirical research regarding the determinants of employment at a firm level is limited. One of the first contributions in this domain belongs to Nickell and Wadhwani (1991). The authors develop an employment model in the presence of bargaining and wages' efficiency. They explore whether insider and outsider forces are relevant to determine wage (Graafland and Lever, 1996). The authors classify insider forces based on prices and productivity and measure outsider determinants as unemployment and alternative wages. Using a sample of 219 quoted U.K. manufacturing firms over the period 1972-1982, the authors employ a first

difference GMM estimator. Nickell and Wadhwani (1991) demonstrate that employment is negatively related to firms' own wage and that it decreases with the firms' leverage ratio.

Sharpe (1994) investigates firms' financial structure on the cyclicality of their employment policies. The author estimates pooled regressions using 2,192 manufacturing U.S. firms on annual net sales, number of employees, firms' size and leverage. Firstly, to avoid problems of endogeneity, the author employs macroeconomic variables (i.e. consumer price index, inflation rate, ratios of sales and growth). Sharpe (1994) considers that employment growth and sales are interrelated since changes in employment affect the level of sales. As such, the use of macroeconomic variables allows the separation of firms' size and leverage on unexpected shock to firms' demand (Basset et al., 2010). Secondly, Sharpe (1994) groups industries according to the historical covariance between their sales and the Gross National Product Average (GNP). The set of high covariance industries includes all the durable goods industries (Campello, 2003). The empirical findings show a significant relation between firms' leverage and the cyclicality of firms' workforce. The results indicate that although leverage increases firms' employment sensitivity, the influence on sales is higher for firms producing durable goods. Small firms quickly lay off workers during a recession. Sharpe (1994) attributes the results to the existence of hiring and training costs. The costs induce healthy firms to save labour whilst small firms are willing to adjust their workforce more since they face higher opportunity costs of capital.

Nickell and Nicolitsas (1999) investigate the impact of financial pressure on firms' behaviour in the form of employment decisions, wage settlements and productivity growth. Using an unbalanced panel model of 670 manufacturing U.K. listed firms, the authors employ a labour demand equation from a quadratic adjustment cost model.[12] The model follows a standard production function. Firms' output is a function of employment, capital and a multiplicative technological factor. Sharpe (1994) obtain a reduce form of the employment demand equation which stands as the basic equation of their empirical analysis. The impact of financial pressure is measured by the ratio of interest payments to cash flow (i.e. borrowing ratio) and a Treasury Bill yield. In order to avoid endogeneity problems, the authors use a set of instruments for the financial determinants. Specifically, they use the borrowing ratio two or three years lag and the Treasury Bill yield to ensure that both financial variables are uncorrelated with current employment shocks. Exogenous variables (i.e. short term demand, price and cost expectations) are included in the employment equation.[13] The labour demand equation is employed with the first-difference GMM estimator by Arellano and Bond (1991). The empirical results indicate that financial pressure has a negative impact on employment, wages and a positive impact on productivity. Nick-

[12]Note that in the standard quadratic adjustment cost model,Nickell and Nicolitsas (1999) create a log approximation of a standard quadratic model. In their model, the employment of year t depends on the previous employment level. All the future levels of desired employment are adjusted by a discount factor.

[13]Information is collected from the publish data by the Confederation of British Industry (CBI).

ell and Nicolitsas (1999) also divided the sample in two equal size groups (i.e. above and below the median) for the average employment, ratio of dividends to assets and the ratio of debt to capital stock. The results suggest that there is no difference between small and large firms regarding the effect of the borrowing ratio. The same outcome is obtained for higher and lower dividend firms.

After the publication of Nickell and Nicolitsas (1999) a number of studies provide empirical support on how financial pressure affects firms' employment decisions. For instance, Benito and Young (2007) investigate firms' financial pressure through the level of dividend payments, propensity to issue new equity and rates of investment. Their empirical strategy is to examine the role of dividends, investment and the use of new equity finance as functions of firms' financial characteristics. Firstly, to develop a dividend equation, the authors follow Bond et al. (1996). Benito and Young (2007) consider a model in which dividends are normalised by firms' sales and capital stock.[14] Secondly, the investment equation is based on Blundell et al. (1992) and includes a financial pressure (i.e. the borrowing ratio).[15] Benito and Young (2007) use a panel of U.K. listed firms between 1980 and 1998 and employ a dynamic GMM estimator. The authors find a negative relation between dividends and cash flow. Results also show a negatively influence of dividends on investment rates and the level of indebtedness. Firms more likely to issue equity present lower levels of cash and high levels of investment and debt. Benito and Young (2007) refer that the results indicate the influence of debt-servicing costs on dividend payments and investment expenditures.

Drawing on the work by Nickell and Nicolitsas (1999), Benito and Hernando (2008) obtain the same empirical findings as in Nickell and Nicolitsas (1999) but for Spanish firms. The authors use the labour demand equation derived by Nickell and Nicolitsas (1999) also employing financial factors. The model of Benito and Hernando (2008) differs from the one of Nickell and Nicolitsas (1999). Firstly, the authors consider as financial variables not only borrowing ratio but also cash flow, liquidity and net indebtedness. Secondly, they consider a demand shock proxy measured as the growth in log of real sales. Using a panel model over the period 1985-2001, they employ the labour demand equation with a system GMM estimator proposed by Arellano and Bover (1995). This method considers the estimator with the level equations together with Arellano and Bond (1991) usual lag differences (Baum, 2001). Consistent with the previous empirical findings by Nickell and Nicolitsas (1999), the borrowing ratio has a significant and negative influence on employ-

[14] Bond et al. (1996) explore the behaviour of a sample of 1,218 U.K. industrial and commercial firms in order to verify if the presence of surplus advance corporate tax (ACT) influences firms' dividend payments. As such, their regression model relates dividends to profits and firm size and both dividends and profits are divided by total sales in order to compare measures between small and large firms.

[15] Blundell et al. (1992) estimate a Q model of investment. The measurement error in the average Tobin's Q is corrected when it is serial uncorrelated by using lagged values of average Q as instrumental variables.

ment. The results suggest that the borrowing ratio affects firms' financial constraints, and therefore, has an impact on labour demand. Benito and Hernando (2008) do not find a significant influence of liquidity, cash flow and net indebtedness on Spanish firms' employment. Regarding the demand for flexible and rigid labour, the authors show that temporary employment is more volatile for Spanish manufacturing firms and permanent labour contracts are unaffected by financial factors.

In a complementary paper, Caggese and Cuñat (2008) explore how hiring and firing cost are related with financial constraints and influence firms' employment policies. They use a sample of small and medium Italian manufacturing firms for the period 1995-2000. The model considers the impact of financial constraints on employment decisions, fixed-term and permanent employment. The regression model uses a qualitative measure of financial constrains which is based on a survey to firms . The authors use capital and sales as control variables in all regressions. Results indicate that fixed-term contracts are used more intensively by financially constrained firms. Financially constrained firms also present a higher volatility of total employment comparing with the unconstrained ones. Fixed-term contracts are more volatile than permanent contracts. The authors conclude that financial market imperfections denote an increase in expected firing cost which makes permanent contracts implicitly more expensive.

Recently, Chen and Guariglia (2009) investigate whether financial factors have an impact on firms' level of employment. The authors use a sample of 16,000 Chinese manufacturing firms over the period of 2000 to 2005. Chen and Guariglia (2009) follow the model of employment by Nickell and Nicolitsas (1999) and use six financial factors (i.e. cash flow, interest burden, collateral, leverage, interest coverage and borrowing ratios). The system GMM approach is employed. The sample is defined in two ways. First, the authors split firms according to their ownership (i.e. firms owned by the state, foreign investors, collective and private investors). Secondly, firms' are divided by their geographic location (i.e. east, central and west). Chen and Guariglia (2009) refer that different ownerships can be associated with different pension schemes and benefits. This can affect firms' labour costs. Furthermore, firms' location can also have an impact on the level of employment. Labour regulations may be different across the regions. The empirical results indicate that the six financial factors influence firms' level of employment. In particular, Chen and Guariglia (2009) refer that the debt-servicing costs ratios (i.e. interest burden, borrowing and coverage ratio) have a negative impact on the level of employment. This is consistent with the role of economic fluctuations by the monetary policy channel. In terms of firms' ownership, the empirical findings suggest that interest burden is not significant for any of the sample ownership categories. However, the authors show that the level of employment for foreign owned firms is negatively related to cash flow and leverage. Collective firms increase their level of employment with their leverage and private firms show a positive

relation with collateral, cash flow, borrowing and coverage ratio. Eastern firms reduce their level of employment with an increase of the coverage ratio and collateral. Interest burden has also a negative influence on central firms' level of employment. Finally, all the financial factors are not significant for western firms.

2.2.7 Employment level and labour market regulation

Research on labour markets also sheds light on how job creation is affected by credit market frictions. Acemoglu (2001) investigates whether the availability of credit markets to provide loans to new firms affects the level of employment. The author follows Rajan and Zingales (1998) and classifies sectors according to firms' dependence on U.S. credit. The share of European countries employment through data provided from Organisation for Economic Cooperation and Development (OECD) is also considered. Acemoglu (2001) employs a two-sector search model. This approach indicates that in the presence of a technological shock the ability of firms to take advantage of the new technology depends on the status of the credit markets. The author refers that, in a rigid credit market, new firms cannot borrow cash and as a result, unemployment increases. In a flexible credit market, funds may be channel quickly to new firms. In this scenario, firms can create employment and avoid losing their workforce. The results show that since the 1960s the rate of unemployment is always higher for firms in Europe which are more external dependent. The author refers that financial constrains are considered as obstacles to employment. It hinders new investment especially for firms which create jobs.

Another strand of the literature, also demonstrates that financial factors influence employment decisions. Nicoletti and Scarpetta (2005) analyse interaction between product and labour market regulation on employment. A sample of OECD countries between 1980 and 2002 is employed. The authors consider that the employment rate depends on the determinants which affect both demand and supply of labour. Following the work of Layard et al. (1991) the authors use a bargaining model. The model assumes that real wages are the result of a bargaining process between employers and employees with a labour demand schedule (Nicoletti and Scarpetta, 2005).[16] They conclude that product market deregulation is more effective at the margin in highly-regulated markets.

Berger and Danninger (2007) posit that when labour market policies are less restricted, product market deregulation is more efficient. The authors investigate the effect of growth employment. They use aggregate sector employment and regulation data from 1990-2004. Data is collected from a panel of OECD countries. The authors use an unrestricted dynamic model of employment growth with interaction effects between product and labour

[16]Note that Layard et al. (1991) create an employment model which imposes a nominal rigidity in the form of sticky price expectations and includes the variable money. The model permits to trace out the effect of shocks that has its origins outside of the labour market.

market regulation. The results indicate that when labour market policies are less restricted, product market deregulation is more efficient. The effect on employment is higher when deregulation includes both labour and product markets.

Nickell et al. (2005) show that unemployment across OECD countries is explained by shifts in labour market institutions. The authors use a regression equation which considers interactions between institutions and factors. According to the authors, these interactions can explain the deviation of unemployment in the short run (i.e productivity and wage shocks). The results indicate that employment protection, labour taxes and unemployment benefit system increases unemployment. Finally, Fiori et al. (2012) study a dynamic panel model for OECD countries over the period 1980-2002. The empirical findings suggest a negative relation between product and labour market regulation. The authors conclude that employment increases when barriers to entry are reduced.

In a contribution to this area of the literature, Belke and Fehn (2001) examine the impact of venture capital markets on financial constraints. They compare employment behaviour in continental European countries with Anglo-Saxon economies for the period 1986-1999. Belke and Fehn (2001) use a model which includes macroeconomic indicators (i.e. unemployment rate) institutional labour market variables (i.e. employment protection index) and venture capital investment time series (i.e. venture capital investment). They find that employment protection increases unemployment. Results also indicate that venture capital affects employment growth. Belke and Fehn (2001) refer that a less develop venture capital delays the creation of new firms, and penalises the creation of employment.

Recent research explores the influence of financial and labour market factors in a multi-country framework. Rault and Vaubourg (2012) estimate a panel Vector Autoregressive (VAR) model of 18 OECD countries between 1980 and 2004. The authors document that in countries such as Belgium, Italy and Spain, financial factors influence the impact of labour market flexibility or increases unemployment. Empirical findings for Austria, Finland and Portugal show the opposite effect. Moreover, Gatti et al. (2012) estimate a dynamic panel model for twenty OECD countries from 1980 to 2004 and employ a GMM estimator. The results suggest that interactions between labour and financial factors also have an impact on unemployment. An increase in the stock market capitalisation reduces unemployment for weak labour market institutions (i.e. union density and wage bargaining centralisation). Finally, an increase in intermediated credit creates more unemployment with strongly regulated and coordinated labour markets.

Overall previous empirical studies suggest that labour market decisions have an impact on the level of employment. Thus, it is relevant to investigate whether labour markets disparities help explain employment changes of European firms.

2.2.8 The financial crisis

In this sub-section the most recent empirical literature is described which links the effect of the recent financial crisis with firms' financial decisions. Sub-section 2.2.8.1 shows the recent studies based on surveys whereas sub-section 2.2.8.2 refers to studies on firm-level data on this issue.

2.2.8.1 Studies based on surveys

Recent studies have considered the use of surveys to investigate firms' real decisions during the crisis. To begin with, Campello et al. (2010) study the impact of the global credit crisis on listed firms which face credit constraints. They use a survey of 1,050 corporate managers in U.S., Europe and Asia from December of 2008. The authors find evidence that firms forego profitable investment opportunities during the crisis as a result of binding external financing constraint. However, they show that financially constrained firms are forced to use their cash holdings during the crisis and cut their planned dividend distributions. Campello et al. (2010) refer that financially constrained firms cut more on investment, technology and even employment in comparison with unconstrained firms. The authors denote that firms which face financial constraints restrict investment since they are constrained before and during the crisis.

Similar, Campello et al. (2011) survey corporate managers regarding firms' credit lines. They investigate firms' lines of credit during the 2008-2009 financial crisis from 31 countries in North America, Europe and Asia. Results show that firms which are considered small, private, non-investment and unprofitable present higher lines of credit during the crisis period. Moreover, Campello et al. (2011) study whether firms' cash and profitability have an impact on the use of credit lines. First, they employ OLS regression models in which they regress lines of credit on cash flow and firm-specific measures.[17] Results show that firms which have enough internal funds do not use lines of credit. According to the authors, firms appear to substitute cash reserves for investment at lower levels of credit lines.

Campello et al. (2012) explore the relation between access to credit and investment decisions during the financial crisis. They conduct two surveys on a total of 600 managers in 20 countries in Europe and North America. Their aim is to investigate the impact of corporate liquidity on investment for the European sample in the middle of the crisis.[18] Using a two-step GMM the regression assumes the CFO's planned percentage changes in capital expenditures on cash holdings. Line of credits and indicators such as firm

[17] Campello et al. (2011) employs two dependent variables. The first corresponds to the ratio of credit lines to the sum of lines of credit and cash reserves. The second is the ratio of unused credit lines to the sum of unused lines of credit and cash holdings. Firms-specific measures include investment growth, size, credit ratings and the ease of access to credit.

[18] Campello et al. (2012) collect surveys conducted in the first and second quarters of 2009.

size, ownership and financial constraints are also employed. The results show that access to external liquidity significantly affects corporate investments for firms with large cash reserves. The authors refer that internal and external sources of liquidity play an important role in planning investment and employment during the crisis.

Duygan-Bump et al. (2015) study the effect of the recent financial crisis on the transition from employment to unemployment, using firm size and financial needs. They study three different recession periods in the U.S. (i.e. 1990-1991, 2001 and the 2007-2009 recessions). Using the Current Population survey (CPS) to capture unemployment status, the dependence on external finance is defined as the proportion of capital expenditures which is financed with external funds.[19] During the 2008-2009 financial crisis, firm size and external financial dependence are divided into three different categories according to the distribution of external finance dependence. The results show a monotonic relation between the propensity of becoming unemployed and firm size. The empirical findings are only valid for industries with high external finance dependence. Duygan-Bump et al. (2015) also identify a monotonic relation between external finance and changes in unemployment only for small firms. Finally, the findings for the recession of 1990-1991 support the empirical findings. The results indicate that unemployment is found among workers who belong in firms depending more on external finance. Conversely, the 2001 recession has no impact on unemployment. As the authors state the core of the recession is the technological sector and not the banking sector as in the 1990-1991 and 2007-2009 recessions.

Finally, Hetland and Mjøs (2012) examine the relation between credit constraints and firms' investment crisis for a sample of Norwegian private firms. As Campello et al. (2010), the authors employ a survey of 500 Norwegian firms from the autumn of 2010. They investigate to what extend firms that are more or less financially constrained are more likely to reduce investments due to reduced access to credit. Based on Almeida et al. (2004), the authors employ a model which tests whether financial constraints cause a demand for hedging against future cash flow shortfalls.[20] They refer that changes in credit availability affect investment the most for firms which are less financially constrained.

2.2.8.2 Firm-level studies

The recent empirical literature also focused on the role of the financial crisis at a firm-level setting. One set of the studies explore firms' investment decisions during the crisis. For example, Duchin et al. (2010) explore the impact of the crisis on corporate investment, during the first year of the crisis (i.e. July 1, 2007 to June 30, 2008). A sample of

[19] Duchin et al. (2010) define the dependence on external finance as in Cetorelli and Strahan (2006). Cetorelli and Strahan (2006) define the dependence on external finance as the proportion of capital expenditures financed with external funds.

[20] Almeida et al. (2004) use the cash flow sensitivity of cash holdings to test for financial constraints. Please refer to Chapter 2 sub-section 2.3.5 for details on this study.

26,421 quarterly observations for 3,668 U.S. listed firms is used to compare firms' investment policies before and during the crisis. The sample of firms is split in three different groups (i.e. internal financial resources, external financial constraints and dependent on external finance). To measure financial constraints, the authors employ the indicators of Kaplan and Zingales (1997) and Whited and Wu (2006). Firms' size is measured by total assets, payout ratio and bond ratings. The results demonstrate that unconstrained and constrained firms show a decrease in the level of investment after the crisis. This decrease is higher for firms which face financial constraints.

Duchin et al. (2010) also test firms' dependence on external finance based on the method of Rajan and Zingales (1998).[21] The results indicate that the level of investment decreases after the crisis for firms which present higher levels of information asymmetry or belong to industries depending on external finance. The authors also extend the sample period to March 2009. Results are robust to the previous findings, and therefore confirm that corporate investment continues to decrease.

Almeida et al. (2012) investigate the impact of the crisis on U.S. listed firms' investment. The authors use long-term debt maturity to identify the impact of financial contracting on firms' behaviour. A Difference-in-Difference (DID) matching estimator is employed. The results indicate that firms which have their long-term debt maturing after the third quarter of 2007, decrease their investment in comparison to the firms which debt matures over the first three quarters of 2008.

Claessens et al. (2012) explore whether changes in the external financing, domestic demand and international trade have an impact on firms' investment conditions, sales and profits. The authors use 7,722 non-financial firms from 42 countries between 2007 and 2009. Firms' dependence on external finance is defined based on capital investment and working capital.[22]

Empirical findings suggest that the crisis has a higher negative impact for firms with a greater sensitivity to demand and trade. The results show that firms' sales and the availability of working capital decreases during the crisis. However, the authors do not find any significant effect of the crisis on capital investment.

Vermoesen et al. (2013) investigate financial constraints of Belgium SMEs during the crisis. Using a sample of 2,354 firm-year observations between 2006 and 2009, the authors explore the effect of financial constraints on SMEs investments. Vermoesen et al. (2013)

[21] Rajan and Zingales (1998) employ a proxy for external finance dependence at an industry level for a sample of U.S. firms. They define the dependence on external finance as capital expenditures minus cash flow from operations divided by capital expenditures.

[22] Working capital is defined as in Raddatz (2006). Raddatz (2006) defines the index for working capital based on the notion of Cash Conversion Cycle (CCC). According to Gentry et al. (1990), CCC measures the number of days which funds are devoted to inventories and receivables, less the number of days which payments to suppliers is deferred. The external finance dependence on capital investment is based on the methodology develop by Rajan and Zingales (1998).

employ a fixed-effects model and show that SMEs investment in Belgium decreases in 2009. Empirical findings also indicate that a negative credit supply shock affects the behaviour of Belgium SMEs. Vermoesen et al. (2013) refers that these findings show that SMEs invest less when faced with higher proportion of long-term debt which needs to be renewed in the short-run. Long-term debt maturity structure is only significant for SMEs with higher probability of financial constraints.

Other empirical studies consider the role of bank lending on firms' employment and investment decisions during the crisis. Ivashina and Scharfstein (2010) investigate the lending to corporate U.S. firms during 2007 and 2008. The results demonstrate that banks in the U.S reduce lending to the corporate sector during the recent financial crisis. The decrease of lending is related to the shortage of credit supply by the banks. Ivashina and Scharfstein (2010) refer that this decrease occurs despite the large infusion of liquidity by the Federal Reserve System (FED). The authors show that banks with better access to deposit financing decrease their lending. These banks do not provide credit to new firms. In other words, firms which belong to more constrained banks have difficulties in obtaining new credits from less constrained banks.

Liu et al. (2012) study the impact of the global financial crisis on 970 Chinese state-owned enterprises (SOEs). Similar to Ivashina and Scharfstein (2010) they define financial crisis period from August 2007 through December 2008. Tobin's Q is used as a proxy for changes in the firm value. The sample of firms is divided into four different groups (i.e. SOEs with and without bank debt; non-SOEs with and without bank debt). The results indicate that SOEs with bank loans perform better during the global financial crisis. They also experience a poor performance during the pre-crisis period. According to the authors, the positive bank debt effect is similar to the results on corporate diversification found by Kuppuswamy and Villalonga (2015). Firms with poor liquidity suffer more during crisis period. Liu et al. (2012) refer that state ownership mitigates financial constraints during times of financial crisis.

In another financial-crisis relate paper, Kathle and Stulz (2013) explore U.S. firms' bank financing and investment policies. They use quarterly data for the period of 1983 to 2010. Cross-sectional variation in firms' investment and financial policies during the crisis are also employed. The authors estimate matching and regression models. Firms are split into three different types of bank dependence (i.e. bank-dependent, small and high leverage firms without credit rating). The results suggest that bank-dependent firms do not decrease their capital expenditures more severely than matching firms (i.e. bank or credit dependent) before April 2009. Kathle and Stulz (2013) also provide evidence that net debt issuance does not decrease during the first year of the crisis. The debt issuance does not decrease more for matching firms. Bank-dependent firms show higher cash reserves during the crisis when compared with non-leveraged firms.

Garicano and Steinwender (2013) study the effect of the recent financial crisis on corporate investment and use a sample of 1,800 Spanish manufacturing firms from 1990 to 2010. The authors divide firms' investment decisions in two different categories (i.e. short-term and long-term investment). Garicano and Steinwender (2013) employ a difference-in-difference approach to compare the behaviour of credit constraint firms The model predicts that firms which are credit constrained reduce long-term investment by more than short-term in order to secure firms' survival. The results demonstrate that Spanish manufacturing firms affected by credit constraints have a tendency to reduce investment with a medium-to-long term pay-off. In other words, firms prefer investments that pay-off in the near future (i.e. advertising and product innovation) rather than those which pay-off is long or (i.e. process innovation, capital investment and information technology). The authors also explore the effect of the crisis on labour market decisions. The results show that after the crisis, credit constrained firms cut on employment and not wages. As the authors state, the results are in line with previous evidence on the rigidity of wage bargaining in Spain. Garicano and Steinwender (2013) show that firms' increase their prices significantly during the crisis.

Bentolila et al. (2013) explore employment changes from 2006 to 2010 and the effect of banks' credit constraints. The authors use a sample of banking relationship of over 217,000 Spanish firms with approximately 230 banks. A difference-in-difference approach is employed to capture the real effect of the credit crisis. The aim is to compare firms' level of employment before and after the crisis. Firms are split according to their level of exposure to weak banks.[23] Results indicate that weak banks decrease firms level of employment from 8% to 36%. On the other hand, Spanish firms which rely on a single bank are not adversely affected by the weakness of the bank.

Similar, Chodorow-Reich (2014) investigates the effect of bank lending frictions on employment during the 2008-2009 financial crisis. The author uses a dataset which combines information on a sample of 2,000 U.S firms. The results show that smaller firms which have pre-crisis relations with less healthier banks present stronger credit constraints after the crisis. On the other hand, these firms present lower levels of employment comparing with those which have a relation with healthier banks. The author shows that withdrawal of credit can explain between one-third and one-half of job losses at SMEs, especially after the the Lehman's crash in September 2008.

Greenstone et al. (2014) investigate the role of U.S. bank lending to small U.S. firms after the 2008 financial crisis. They construct a measure which predicts the level of lending supply during the crisis. This measure is based on the changes of U.S. bank lending to small firms and the predetermined credit market share. The authors use the Com-

[23] The authors measure exposure to banks as the pre-crisis ratio between firms' loans from weak banks and its asset value.

munity Reinvestment Act (CRA) disclosure data from the Federal Financial Institutions Examination Council (FFIEC) to construct the variable.[24]

Greenstone et al. (2014) develop a modified version of a shift-share model as in Bartik (1991).[25] Specifically, the authors test a model which separates the demand and supply effect to bank lending during the crisis. The results show that the credit supply shock is associated with the a decrease of credit from banks to small firms, especially during the 2008-2010 period. The supply of credit also has an impact on the real economy during the crisis. Greenstone et al. (2014) find that firms' employment level decreases after the hit of the crisis. This decrease corresponds to 20% of the employment decline in firms with less than 20 employees.

McLean and Zhao (2014) explore whether the access to external finance varies over time and if this access has an impact on firms' investment and employment decisions. First, the authors consider whether low investor sentiment and recessions have an impact on the financial constraints that firms face, and therefore, influence firms' real decisions. This is based on previous studies which show that the cost of external finance depends on the investor sentiment and the business cycle.

To test their assumptions McLean and Zhao (2014) employ a sample of U.S firms for the 1965-2010 period and employ a cross-sectional yearly investment model. An OLS with clustered standard errors is implemented. In this model, the authors assume that firms' investment depends on Tobin's q and cash flow. The authors interact different measures of economic conditions and investor sentiment with Tobin's Q and cash flow to account for the business cycle and investor sentiment. McLean and Zhao (2014) use two different proxies for economic conditions (i.e. the economic expansion and the increasing industrial production) and two different measures for investor sentiment (i.e. the sentiment index of Baker and Wurgler (2006) and the consumer sentiment index).[26]

Results show that both the business cycle and investor sentiment have an impact on the cost of external finance. Specifically, McLean and Zhao (2014) find that in period

[24] Greenstone et al. (2014) also note that the CRA obliges banks a determine asset threshold to report small business lending each year as well as Census tract.

[25] Bartik (1991) employs a method of isolating local labour demand. In other words, these shocks are changes in national employment by industry which are weighted by state specific industry weight. This is based on the 1980 state-level industry output shares.

[26] Economic expansion is measured as a yearly indicator. It assumes the value of 1 if at least 6 out of 12 months represent an expansion period according to the National Bureau of Economic Research (NBER), and 0 otherwise. Industrial Production is a dummy variable. It is 1 when industrial production growth is average positive during the previous 12 months and, 0 otherwise.

Regarding the investor sentiment, the authors use the Baker and Wurgler (2006) index which has 6 main components. They are as follows: closed-end fund discount; New York Stock Exchange (NYSE) share turnover; the number of initial public offerings; the average first day's return of initial public offerings; the equity share in new issues; and the dividend premium (i.e. the difference in average market-to-book ratios between dividend payers and non-dividend payers). Finally, the University of Michigan's consumer sentiment index is constructed based on telephone interviews in the U.S..

characterised with low financial costs, investment is less sensitive to Tobin's Q and more sensitive to cash flow.

In addition, the authors also explore the impact of financing costs on firms' employment decisions. They re-estimate the aforementioned model of investment. The dependent variable investment is replaced with an employment variable. Empirical findings also suggest that in periods of recessions and low investor sentiment employment growth is more sensitive to Tobin's Q and less sensitive to cash flow.

Benmelech et al. (2011) explore the effects of financial constraints, maturing debt and bank deregulation on firm employment decisions. They use a sample of 51,608 firm-year observations of U.S. publicly listed firms from 1970-2009. Firstly, based on Fazzari et al. (1988) they estimate different types of regressions to examine the sensitivity of employment decisions to cash flow. Their findings suggest that financial constraints are important in determining firm-level employment decisions. Benmelech et al. (2011) show that the level of employment has a positive relation with cash flow. Secondly, the authors explore whether the effects of financial constraints on employment vary with the financial leverage of the firms. They use the DID approach and classify firms in two different groups based on firms' leverage. The empirical results indicate that the sensitivity of employment to cash flow is higher for firms with higher financial leverage. Finally, the authors focus on the impact of bank deregulation on unemployment. Based on the work by Jayaratne and Strahan (1996), Benmelech et al. (2011) use cross-sectional and time-series variation to analyse the impact of bank deregulation on state-level unemployment rates. They conclude that bank regulation is associated with a reduction of unemployment.

Finally, Carvalho et al. (2015) consider a sample of 1,564 publicly trade firms from 34 countries to investigate the link between firm and bank returns. They divide and classify firms according to their lending relation with banks (i.e. weak, medium and strong). Using a cross-sectional estimation, the authors explore how the cost of bank distress is related to the information asymmetry of the firms. In particular, Carvalho et al. (2015) employ two proxies for borrower information asymmetry (i.e. size and number of analyst following a firm). The authors measure both proxies at the end of 2006 and show that information asymmetry only increase the effect of bank distress for firms with medium or strong lending relations. Similar to Almeida et al. (2012), Carvalho et al. (2015) employ firms' short-term debt at the end of 2007 to capture how firms with large maturity debt react during the crisis period. The results indicate that firms in the high short-term leverage category present a positive relation with bank abnormal stock returns. Thus, firms with higher levels of debt maturity are the most affected by the bank supply shock.

2.3 Research Design

The next sub-sections describe the theoretical framework of the employment model as well as the main empirical variables which are used in this chapter.

2.3.1 Theoretical framework

The starting point for the empirical analysis of this chapter relies on the empirical employment model by Benito and Hernando (2008). The authors follow the model of Nickell and Nicolitsas (1999) which can be derived from a basic production function for a firm i :

$$Y_i = A_i f(N_i, K_i) \tag{2.1}$$

Where Y represents the output, N the number of employees, K firms' capital stock and A production efficiency. Assuming an imperfect capital market and ignoring financial factors, the equilibrium of the level of employment is as follows:

$$Y_i = A_i f(N_i, K_i) = W_i(1+t)/P_i \tag{2.2}$$

Where W_i is the wage cost of firm i, which is presumed to be determined prior to the hiring of employees, t is the payroll tax rate, P_i is the price of the output, and $K_i = (1-\alpha)^{-1}$, where α corresponds to a demand elasticity. The right-hand side of the equation may vary over the cycle as a result of the influence of α , i.e., current or future expected demand. Thus, the equilibrium of employment n_{it} can be express in the following log-linear format:

$$n_{it} = \alpha_0 + \alpha_1 k_{it} + \alpha_2(w_{it} - p_{it}) + \alpha_3 d_{it} + \gamma_i + \gamma_t \tag{2.3}$$

Where n_{it}, k_{it}, w_{it}, p_{it} represent the logarithms of the number of employees, capital stock, wages and price, respectively. d_{it} is the demand effect which is associated with k for firm i at time t. γ_i indicates a firm-specific effect capturing the individual firms' characteristics which are fixed over time, i.e. efficiency. γ_t represents the time effect, controlling for all the factors which are common to all firms, i.e. payroll tax rate and business cycles.

If financial factors are not taken into account by the standard quadratic adjustment cost model then it is expected that the actual employment would be influenced by past employment and the current expectations of future equilibrium employment.[27] To create

[27] The standard partial adjustment or quadratic adjustment models imply the influence of past, actual or desired employment on current employment: $n_t - n_{t-1} = k(n_t^* - n_{t-1})$, with $0 < k < 1$ being the fraction of the gap $n_t^* - n_{t-1}$ that closed in the period. This means that the past, actual or desired employment have an effect on current employment, $n_t = k\, n_t^* + (1-k)\, n_{t-1} = \sum_{j=0}^{\infty}(1-k)^j n_{it}$. Sargent (1978) shows that this adjustment model can also be derived as the solution to firms' dynamic profit maximisation, assuming that there are quadratic costs of adjusting the workforce (King and Thomas, 2006).

an observable model of employment, the stochastic processes of all the variables need to be specified in equation (2.1). As such, the following assumption of an autoregressive model AR (1) process is considered:

$$k_{it}=a_{0it}+k_{i,t-1}+\varepsilon_{1it} \tag{2.4}$$

$$w_{it}-p_{it}=b_{oi}+b_1(w_{i,t-1}-p_{i,t-1})+\varepsilon_{2it} \tag{2.5}$$

$$d_{it}=c_{oi}+c_1 d_{it-1}+\varepsilon_{3it}\ \gamma_t=\gamma_{i,t-1}+\varepsilon_{4it} \tag{2.6}$$

Where ε_{1it}, ε_{2it}, ε_{3it}, ε_{4it} are all iid errors.

The reduced form of the employment equation based on equation (2.1) takes the following form:

$$n_{i,t}=\rho_o+\rho 1 n_{i,t-1}+p_2 k_{it}+p_3(w_{it}-p_{it})+\rho_4 d_{it}+\upsilon_i+\upsilon_t+\varepsilon_{it} \tag{2.7}$$

Where ρ parameters incorporate the parameters set for k,$w-p$,and d processes abovementioned.

Furthermore, the labour demand equation which is derived from a quadratic adjustment cost model can then be augmented with financial factors (f_{it}) into the following equation:

$$n_{i,t}=\rho_0+\rho_1 n_{i,t-1}+\rho_2 k_{it}+\rho_3(w_{it}-p_{it})+\rho_4 d_{it}+f_{it}+\upsilon_i+\upsilon_t+\varepsilon_{it} \tag{2.8}$$

However, a more general model should be considered. The aforementioned equation is a simple AR (1) model, while the processes creating k, $w-p$ and d can be more complex. For instance, it may be necessary to consider more lags in the equations for the variables' set above (Chen and Guariglia, 2009). The parameter w might dependent on changes or levels of demand. As Nickell and Nicolitsas (1999) points out, the quadratic cost model may not hold in reality. Therefore, equation (2.8) may be rewritten as:

$$\begin{aligned} n_{i,t}=\rho_0+\rho_1 n_{i,t-1}+\rho_2 k_{it}+\sum_{j=0}^{1}\delta_{2j}(w_{i,t-j}-p_{i,t-j}) \\ +\rho_2' E_t(w_{i,t+1}-p_{i,t+1})+\sum_{j=0}^{1}{}_{2j}\rho_{3j} d_{i,t-j}+\rho_3' E_t d_{i,t+1}+ \\ +\upsilon_4 f_{it}+\upsilon_i+\upsilon_t+\varepsilon_{it} \end{aligned} \tag{2.9}$$

Where, E_t indicates the expectation at time t.

Equation (2.9) may contain some endogeneity problems (Nickell and Nicolitsas, 1999). In particular, demand shocks, employment, and wages may influence financial factors and firm-specific variables (Chen and Guariglia, 2009). Benito and Hernando (2008) include growth of real sales in their model to control for demand shocks. To avoid potential

endogeneity, the authors also employ deeper lags on the financial variable indicator, as well as, on the dependent variable of employment. Finally, year dummies are also included to control for time effects. The equation takes the following format:

$$n_{i,t} = \rho_0 + \rho_1 n_{i,t-1} + \rho_2 n_{i,t-2} + \rho_3 w_{i,t-1} + \rho_4 \Delta w_{i,t} + \rho_5 k_{i,t} + \rho_6 \delta_{i,t} + X'_{i,t-1}\lambda + \Psi_t + \varepsilon_{it} \quad (2.10)$$

Where i indicates firms $i = 1, 2...T, N_i$ and t represents year $t = 1, 2...T, n$ is the log average firm during the year, w is the log average wage of the firm, Δw is the log average of wage growth, k is the log of capital stock, δ is the demand shock proxy which represents the log of sales growth and , Ψ_t represents a time effect year dummy. ε_{it} is the error term. Finally, $X'_{i,t-1}$ represents the financial factors.

To explore the role of financial factors on labour demand, Benito and Hernando (2008) also include a set of financial variables in their employment model. They consider cash flow, liquidity, interest burden and the flow borrowing ratio of the firms. Hence, the authors investigate how a ceteris paribus increase of the financial pressure variable affects employment, wages and productivity behaviour controlling for other firm-specific characteristics.

2.3.2 Variables Definition

The literature defines the dependent variable of employment as the total number of employees at the balance sheet data of the firms (Benito and Hernando, 2008; Yazdanfar and Salman, 2012; Garicano and Steinwender, 2013). Conversely, the financial variable interest burden is defined as a measure of financial pressure in order to account for the role of firm-specific interest rate on employment. In effect, following previous studies (Nickell and Nicolitsas, 1999; Benito and Hernando, 2008; Görg and Spaliara, 2014), the variable interest burden is measured as the ratio of interest payments to cash-flow. This is thought to be an efficient index since it provides evidence of a direct impact of interest rate on firms' financial position. For example, Benito and Whitley (2003) demonstrate that the average interest rate on financial debt in the U.K. has a negative effect on firms' financial health. Chen and Guariglia (2009) show a significant inverse relation between the level of employment of Chinese firms and the level of interest burden, coverage and borrowing ratio. Spaliara (2009) provides evidence of a direct effect of firm-specific interest rate on the capital-labour. The author shows that interest burden has a higher impact on the capital-labour ratio of firms which are more financial constrained. Recently, Guariglia et al. (2015) show that the ratio of interest payments to total debt affects the survival of U.K. firms. Overall, previous empirical studies suggest a direct impact of interest rate on firms' financial position. Consequently, it is expected that an increase in firms' interest burden (or firm-specific interest rate) should lead to lower levels of employment.

In addition to the financial pressure indicator, other firm-specific characteristics are also considered in the employment literature. The lead variables of wage and sales are included to control for future expectations (Nickell and Nicolitsas, 1999). Following the work of Benito and Hernando (2008) wage is defined as the cost of employment divided by the number of employees and deflated by the GDP deflator whereas sales is defined as total sales deflated by the GDP deflator. Finally capital is defined as the logarithm of fixed assets minus depreciation, working capital less provisions normalised on the Consumer Price Index (CPI). Previous studies find a negative relation between wage, sales and the level of employment while capital is positively related to employment (Nickell and Nicolitsas, 1999; Benito and Hernando, 2008; Chen and Guariglia, 2009).

2.4 Model specification

Sub-section 2.4 presents the empirical models of this chapter which test the effect of a firm-specific interest rate on firms' employment decisions.

2.4.1 Baseline

The baseline model follows a quadratic adjustment cost employment model. The aim is to test for the impact of financial pressure on firms' employment. This model has been augmented to account for financial factors as it is explained in sub-section 2.3.1. The specification model follows the work of Nickell and Nicolitsas (1999) and Benito and Hernando (2008) and takes the following form:

$$n_{it} = \alpha_1 + \beta_1 n_{it-1} + \beta_2 IB_{it-1} + \beta_3 \Delta w_{it} + \beta_4 \delta_{it} + \beta_5 w_{it-1} + \beta_6 k_{it} + \epsilon_{it} \tag{2.11}$$

where $i = 1,2,\ldots, N$ refers to a cross-section of units (firms in this study) and $t = 1,2,\ldots, T$ refers to time period. n is the log average firm employment during the year, w is the log average wage of the firm, Δw is the log average of wage growth, k is the log of capital stock, δ is the demand shock proxy which represents the growth of real sales, capturing demand shocks. IB represents the key explanatory variable interest burden. This variable is a proxy for the role of financial pressure on employment. It is measured as the ratio of interest payments to cash flow.

The error term ϵ_{it} comprises a firm-specific time-invariant component, encompassing all time-invariant firm characteristics likely to influence employment, as well as the time-invariant component of the measurement error affecting any of the regression variables; a time-specific component accounting for possible business cycle effects; and an idiosyncratic component. To control for the firm-specific time-invariant component of the error term the equation is estimated in first-differences. To account for time-specific component time

dummies are included (in addition to the time dummies interacted with industry dummies) in all our specifications. This is a common procedure in the literature (Brown et al., 2009). Finally, country dummies are also included to control for institutional differences between countries.

Following the previous studies (Nickell and Nicolitsas, 1999; Benito and Hernando, 2008), it is expected that financial pressure (in the form of interest burden) to have a negative effect on firms' employment decisions.

2.4.2 Financial crisis

The baseline empirical specification examines whether interest burden has a negative impact on firms' employment decisions over time. However, it does not take into account whether this effect varies with the state of the economy. To do so, a dummy variable $Crisis_t$ is constructed and it takes the value of 1 over the period 2007-2009, and 0 otherwise. To understand whether interest burden differs across crisis and tranquil periods, the variable interest burden (IB) is interacted with the $Crisis_t$ and $(1 - Crisis_t)$ terms. Thus, equation (2.11) is re-formulated as follows:

$$n_{it} = \alpha_1 + \beta_1 n_{it-1} + \beta_2 IB_{it-1} * Crisis_t + \beta_3 IB_{it-1} * (1 - Crisis_t) + \\ + \beta_4 \Delta w_{it} + \beta_5 \delta_{it} + \beta_6 w_{it-1} + \beta_7 k_{it} + \epsilon_{it} \quad (2.12)$$

This test is motivated by the financial accelerator theory according to which deteriorations in economic conditions increase the costs of finance, weakening firms' balance sheet positions (Bernanke et al., 1996). Thus, under this assumption, if firms face higher levels of debt-servicing costs, they may have the need to decrease their workforce. Therefore, it is expected that the interaction terms during the crisis/non-crisis periods to be significantly different and stronger in the former than in the latter ($|\beta_2| > |\beta_3|$).

2.4.3 Periphery versus non-periphery

Next, it is investigated the extent to which an increase in the interest burden may have a different effect across periphery and non-periphery firms, controlling for the crisis. To test this hypothesis, the model in equation (2.12) is augmented with interactive terms which are linked to a periphery dummy ($Periphery_i$). The dummy is equal to 1 if the firm belongs to the periphery countries (i.e. Ireland, Italy, Portugal and Spain), and 0 otherwise. This classification scheme is a common practice in the literature on European countries. For example, Bris et al. (2009) define Italy, Ireland, Spain and Portugal as the weak euro area countries. This classification is based on these countries currency performance

when comparing to the German currency in the pre euro period. Consistent with this view, Arghyrou and Kontonikas (2012) assume these countries as the peripheral countries. According to the authors, these economies have experienced a significant deterioration in the value of fundamentals which is crucial for ensuring long-term EMU membership since the introduction of the euro in 1999. The following specification model is estimated:

$$n_{it} = \alpha_1 + \beta_1 n_{it-1} + \beta_2 IB_{it-1} * Crisis_t * Periphery_i + \beta_3 IB_{it-1} * (1 - Crisis_t) * Periphery_i + \\ + \beta_4 IB_{it-1} * Crisis_t * (1 - Periphery_i) + \beta_5 IB_{it-1} * (1 - Crisis_t) * (1 - Periphery_i) + \\ + \beta_6 \Delta w_{it} + \beta_7 \delta_{it} + \beta_8 w_{it-1} + \beta_9 k_{it} + \epsilon_{it} \quad (2.13)$$

It is expected that an increase in the interest burden to have a more severe impact on the level of employment for periphery firms than for their non-periphery counterparts during the crisis ($|\beta_2| > |\beta_4|$). The argument for this expectation is that during the turmoil period, banks tightened their lending standards and charged firms with higher interest rates, especially in the periphery countries (Lane, 2012; Ferrando et al., 2015). This means that it is likely that periphery firms suffer from higher levels of information asymmetry and they are more responsive to changes in debt servicing costs, especially during the crisis.

2.4.4 Financial constraints

In addition, it is considered the impact of financial constraints on firms' employment decisions during and outside of the crisis. Following the established literature on financial constraints and to ensure the robustness of the results, three different dimensions of firm-level heterogeneity are used: bank dependence, size and firms' legal status. Firms are differentiated into more or less bank dependent; small and large; private and public. This separation scheme is based on quantitative and qualitative information of the firms.

Firstly, the sample of firms is divided according to an indicator of firms' level of bank dependence, called mix. Following the literature (Spaliara, 2009; Guariglia and Mateut, 2010) this indicator is based on the ratio of firms' short-term debt to total liabilities. The higher the mix, the more bank dependent the firm is. A dummy variable $BankDep_{it}$ is employed. It takes the value of 1 if firm i's mix falls in the top 50% of the distribution of the mix's of all firms which belong to the same industry as firm i and year t, and 0 otherwise. Thus, bank dependent firms are considered to be less financially healthier than their less bank dependent counterparts. As banks significantly cut credit towards firms during the financial crisis, it is expected that more bank dependent firms for whom access to external finance is expensive or limited to suffer more.

Secondly, the sample of firms is partitioned into small and large firms, using firms' real assets as a sorting device. Specifically, a dummy variable $Small_{it}$ is constructed. It assumes the value of 1 if firms' real assets are in the bottom 50% distribution of firms operating to the same industry as firm i and year t, and 0 otherwise. Spaliara (2009) refers that smaller firms are associated with higher levels of information asymmetry. Thus, they are more likely to suffer from capital markets imperfections than their larger counterparts.

Finally, firms are sorted every year into public and private based on their legal status. A dummy variable $Private_t$ is employed which assumes the value of 1 if a firm is private within each industry at year t and, and 0 otherwise. Gao et al. (2013) denote that private firms have a more difficult access to external finance and they rely more on their internal funds when comparing with their public counterparts. This indicates that if access to external funds is restricted, private firms should suffer from higher levels of financial constraints in their ability to respond to changes in the external financial conditions. Overall, the resulting dummy variable $Constrained_{it}$ is equal to one if the firm is classified as financially constrained within each industry at year t, and zero otherwise. The model is defined as follows:

$$\begin{aligned} n_{it} = {} & \alpha_1 + \beta_1 n_{it-1} + \beta_2 IB_{it-1} * Crisis_t * Constrained_{it} + \\ & + \beta_3 IB_{it-1} * (1 - Crisis_t) * Constrained_{it} + \beta_4 IB_{it-1} * Crisis_t * (1 - Constrained_{it}) + \\ & + \beta_5 IB_{it-1} * (1 - Crisis_t) * (1 - Constrained_{it}) + \beta_6 \Delta w_{it} + \beta_7 \delta_{it} + \beta_8 w_{it-1} + \beta_9 k_{it} + \epsilon_{it} \end{aligned} \tag{2.14}$$

This specification captures the impact of financial constraints on the response to financial pressure during and outside of the crisis. It is anticipated that changes in the interest burden to exert a stronger impact on employment in the case of financially constrained firms, especially during the turmoil period ($|\beta_2| > |\beta_4|$).

2.4.5 Financial constraints, financial crisis, periphery and non-periphery

Next, it is explored whether during crisis/non-crisis periods, changes in the interest burden affect differently the level of employment across periphery and non-periphery firms which are characterised by different degrees of financing constraints. Equation (2.14) is re-estimated by splitting the sample of firms according to their location, i.e. periphery and non-periphery.

It is expected that the differential response of interest burden would be stronger for financially constrained firms in the periphery area when comparing to the same group of firms in the non-periphery economies, especially during the turmoil period. As it is explained in sub-section 2.4.3, the incremental idea is that firms in the periphery region

should face higher borrowing costs, especially during the turmoil period. As a consequence, they are more likely to be associated with higher degrees of informational asymmetry and are less likely to access external financial markets.

2.4.6 Robustness checks: Additional control variables

To ensure the strength of the main empirical specifications, in Chapter 2 it is considered a set of different robustness. As a first test, equation (2.11) and equation (2.12) are re-estimated with additional controls. To be specific, it is included a set of firm-specific characteristics as well as country-specific macroeconomic indicators. The former controls for firms' overall balance sheet position (Benito and Hernando, 2008). The latter accounts for aggregate pressure. The aim is to test whether the main findings remain unchanged. The models are re-estimated as follows:

$$n_{it} = \alpha_1 + \beta_1 n_{it-1} + \beta_2 IB_{it-1} + \beta_3 X_{it-1} + \beta_4 \Delta w_{it} + \beta_5 \delta_{it} + \beta_6 w_{it-1} + \beta_7 k_{it} + \epsilon_{it} \tag{2.15}$$

$$\begin{aligned} n_{it} = {} & \alpha_1 + \beta_1 n_{it-1} + \beta_2 IB_{it-1} * Crisis_t + \beta_3 IB_{it-1} * (1 - Crisis_t) + \\ & + \beta_4 X_{it-1} * Crisis_t + \beta_5 X_{it-1} * (1 - Crisis_t) + \beta_6 \Delta w_{it} + \beta_7 \delta_{it} + \beta_8 w_{it-1} + \beta_9 k_{it} + \epsilon_{it} \end{aligned} \tag{2.16}$$

Where, X_{it-1} represents the control variables which are implemented. They are as follow: $Cflow$ which is defined as the ratio of cash flow to capital stock. Liq which is measured as cash and equivalents normalised on capital stock. $Netdebt$ which is defined as liabilities plus long term debt normalised on capital stock minus cash and equivalent divided by capital stock. $Bondy$ which is the 10-year sovereign bond yield of the country. $Unem$ which is the annual average unemployment rate of the country. It is expected that the impact of interest burden on firms' employment level to remain negative and statistically significant, especially during the financial crisis.

2.4.7 Robustness checks: Alternative measure/instrument for interest burden

Next, as a further robustness check, equation (2.11) and equation (2.12) are estimated with a different proxy for the variable interest burden (IB_{it-1}). Consistent with the work of Benito and Whitley (2003) an implicit interest rate is used. The ratio is measured taking into account a three year moving average of the data on the total debt variable, centred on the current year and use this as the denominator.

In addition, equation (2.11) and equation (2.12) are also re-formulated but with an alternative instrument. Following the work of Nickell and Nicolitsas (1999) the instrument is calculated as the product of debt-to-capital ratio two or three years lagged and the contemporaneous change in the 10-year government bond yield. This measure enables the use of exogenous shifts in the interest rates which have been influenced by government policy (Nickell and Nicolitsas, 1999). The implementation of deep lags of the debt-to-capital ratio is used to ensure that they are uncorrelated with the contemporaneous shocks in employment.

2.4.8 Robustness checks: Alternative crisis period

So far the financial crisis has been defined for the years between 2007 and 2009. To ensure that the results are not driven from the way the financial crisis is defined, equation (2.12) is re-estimated considering a more narrower definition of the crisis. A new crisis dummy ($Crisis_t^n$) is employed. It assumes the value of 1 for the 2008-2009 period, and 0 otherwise. The equation takes the following form:

$$n = \alpha_1 + \beta_1 n_{it-1} + \beta_2 IB_{it-1} * Crisis_t^n + \beta_3 IB_{it-1} * (1 - Crisis_t^n) + \\ + \beta_4 \Delta w_{it} + \beta_5 \delta_{it} + \beta_6 w_{it-1} + \beta_7 k_{it} + \epsilon_{it} \quad (2.17)$$

It is expected that the negative effect of financial pressure (in the form of interest burden) on employment to remain statistically significant and stronger during this crisis period.

2.4.9 Robustness checks: Two phases of the crisis

In this chapter it is also explored the two phases of the recent financial crisis. They correspond to the earlier credit crisis and the later euro area sovereign debt crisis. The aim is to test the differential impact of financial pressure on employment level for periphery and non-periphery firms during these two phases. Two crisis period dummies are implemented: $Credit_t$ and $Debt_t$. The former takes the value of 1 over the period 2008-2009, and 0 otherwise. Similarly, the latter assumes the value of 1 for 2010-2011, and 0 otherwise. These dummies correspond to the credit and the debt sovereign crisis, respectively. Equation (2.11) is re-formulated as:

$$n_{it} = \alpha_1 + \beta_1 n_{it-1} + \beta_2 IB_{it-1} * Debt_t * Periphery_i + \beta_3 IB_{it-1} * Credit_t * Periphery_i +$$
$$+ \beta_4 IB_{it-1} * Debt_t * (1 - Periphery_i) + \beta_5 IB_{it-1} * Credit_t * (1 - Periphery_i) +$$
$$+ \beta_6 IB_{it-1} * (1 - Debt_t - Credit_t) * Periphery_i + \beta_7 IB_{it-1} * (1 - Debt_t - Credit_t) * (1 - Periphery_i) +$$
$$+ \beta_8 \Delta w_{it} + \beta_9 \delta_{it} + \beta_{10} w_{it-1} + \beta_{11} k_{it} + \epsilon_{it} \quad (2.18)$$

It is expected that during the sovereign debt crisis, the variable interest burden has a higher impact on firms' employment, especially in the periphery. This test is motivated by the euro area sovereign debt crisis which unfolded in 2010. In fact, between 2010-2011 the eurozone entered in a second recession due to the sovereign debt crisis of the peripheral countries. Bank loans to firms decreased sharply and economic confidence hit a new low with the bailout of Greece, Ireland and Portugal (Reichlin, 2014).

2.4.10 Robustness checks: SMEs vs non-SMEs

Thus far, the previous sections have investigated if there is a differential effect of financial pressure on employment of financially constrained and unconstrained firms. As an additional check and to ensure robustness, an alternative classification scheme is used. Specifically, the sample of firms is split into SMEs and non-SMEs. Equation (2.11), equation (2.12) and equation (2.13) are employed for a sample of SMEs and non-SMEs firms.

A dummy variable $SMEs_{it}$ is used. It takes the value of 1 if the firms have less than 250 employees and a total revenue equal of less than €50 million, and 0 otherwise. This definition follows the one by ECB. It is anticipated that SMEs, in the periphery suffer from higher levels of financial pressure especially during the crisis. This is based on the argument that SMEs have more difficulties in obtaining external finance than their larger counterparts (Beck et al., 2006) and that firms in the periphery countries are charged with higher interest rates during the turmoil period (Van der Zwan, 2014).

2.4.11 Robustness checks: Alternative cut-off points

Finally, in the main specification in sub-section 2.4.4, the 50th percentile is used as a cut-off point to define financially constrained and unconstrained firms. To test the robustness of these results, the sample of firms is divided with the 75th percentile as alternative cut-off value. In the same vein, bank dependent (small) firms are classified as those whose bank dependence (total assets) are on the top (below) 75 % of the distribution of all the firms in that particularly industry and year, and zero otherwise. The models from sub-section 2.4.4 and 2.4.5 are employed for this different criteria and it is expected that the results to remain robust to the previous splitting criteria of 50%.

2.5 Model estimation

2.5.1 Dynamic panel model

The key modelling technique which is employed in this chapter is the regression using panel data methods. There are several benefits from using panel data. According to Baltagi (2013), such technique allows us to:

1. Control for individual heterogeneity;
2. Use more data, obtain more variability, reduce collinearity among the variables of interest and increase the number of degrees of freedom;
3. Better study the dynamic behaviour of the variables and the relation between them;
4. Identify and measure effects that are not detectable in pure cross-section or time-series data;
5. Construct and test more complicated models than those allowed by employing purely cross-section or time-series data.

Some panel datasets, especially those employing individuals or firms, usually suffer from missing data. This is more common some combination of cross-sectional unit and time period(s) (Wooldridge, 2006). In this dataset, information is missing for some of the sample firms in certain years. As a result, the panel is unbalanced. The unbalanced panel structure has the benefit of partially mitigating potential selection and survival bias problems (Carpenter and Guariglia, 2008).

Literature on employment commonly uses dynamic panel data models (Arellano and Bover, 1995; Blundell and Bond, 1998). The rationale for estimating the model in a dynamic panel data setting can be attributed to the lagged value of the dependent variable and the lagged values of the explanatory variables (Gujarati and Porter, 2009). Consequently, the models which are defined in sub-section 2.5 include lagged values of the explanatory variables, as well as, the time path of the dependent variable employment in relation to its past value. Next it is discussed the estimation method implemented in this chapter.

2.5.2 Estimation methodology

In this chapter all the equations are estimated using the system GMM estimator by Arellano and Bover (1995) and Blundell and Bond (1998).[28] The specification model which is defined in sub-section 2.4.1 makes the simple OLS estimator upwards biased and inconsistent since the lagged level of employment is correlated with the error term (Verbeek, 2012). The within-groups estimator is also not appropriate due to inconsistency and downward

[28] All the regressions are performed in Stata using the command xtabond2 developed by Roodman (2009).

bias (Nickell and Nicolitsas, 1999). More importantly, the employment model may suffer from endogeneity. Firm-specific variables are likely to be influenced by employment, wage, productivity shocks and the lagged dependent variable is automatically endogeneous due to the presence of the lagged error in the equation (Nickell and Nicolitsas, 1999). For this reason, the most appropriate techique for the abovementioned specification is the GMM estimator.

The implementation of the GMM estimator provides a number of advantages. Firstly, it controls for the endogeneity of the regressors. Secondly, it accounts for unobserved effects and the inclusion of the lagged dependent variable as regressors. The first-difference GMM estimator of Arellano and Bond (1991) uses the first-differences of the explanatory variables to remove the unobserved firm-specific effects, time-invariant, industry-specific and country-specific effects. The first-difference GMM estimator requires that the regressors are used as instruments (i.e. using deep lags of the explanatory variables). The aim is to control for simultaneity bias of the explanatory variables and the correlation between the lag dependent variable and the error term. However, as it is noted by Blundell and Bond (1998), this estimator can create considerable bias. It can suffer from a weak instrument problem if the the lag dependent variable follows a random walk. In a scenario that the time dimension of the sample is small , the first-difference GMM estimator performs poorly since lagged levels of the variables are weak instruments for subsequent first-differences.

The system GMM estimator is a more efficient estimator. It combines in a system the equation in the first-differences with an equation in levels. It makes use of the lagged levels of the regressors as instruments in the differenced equation, and the lagged differences of the regressors as instruments in the levels equation. One of the advantages of the system GMM is that it reduces the potential bias and inaccuracy associated with the use of the first-difference GMM estimator. It improves efficiency and a significant reduction in finite sample bias comparing with the simple first-difference GMM approach (Blundell and Bond, 1998).

In the employment models of Chapter 2 firm-specific variables, including interest burden may suffer from some endogeneity issues since they are likely to be influenced by employment wages and demand shocks (i.e. sales growth). To avoid the bias which is associated with this endogeneity problem, Chapter 2 follows Nickell and Nicolitsas (1999) and takes deeper lags of the explanatory variables as instruments in the equations in first-differences and in levels. In other words, the use of deeper lags of interest burden may overcome for the possibility of simultaneity bias.

The consistency of the system GMM estimator depends on two different criteria. First, the Sargan test (also known as J test), which is a test for overidentifying restrictions. Under the null of instrument validity, it is asymptotically distributed as a chi-square with

degrees of freedom equal to the number of instruments less the number of parameters. Second, the GMM estimator can only be appropriate if there is no serial correlation in the first-differenced residuals. In the presence of serial correlation of order n in the differenced residuals, the instrument set of the equation in the first-differences should be restricted to lags *n+1* and deeper (Roodman, 2009). To check for the existence of n^{th}-order serial correlation in the differenced of the residuals the m(n) test is implemented. The m(n) test is asymptotically distributed as a standard normal under the null of no serial correlation of the differenced residuals. In Chapter 2 it is reported the first-(*m1*) order and the fourth order-(*m4*) test for serial correlation of the differenced residuals in the tables. At the same time it is used four (and deeper) lags of the regressors as instruments. The use of deeper lags is a common procedure in the literature. This enables the research to improve the specification tests of the models (Chen and Guariglia, 2013; Guariglia et al., 2012).[29] Country, industry, time dummies and time dummies interacted with industry dummies are also included in the instrument matrix.

Finally, it should be noted that the system GMM estimator is sometimes weak when it is used on large samples. Blundell et al. (2001) demonstrate using Monte Carlo experiments that this test tends to over-reject the null hypothesis of valid instruments for the system GMM, especially for large samples. Chen and Guariglia (2013) confirm this finding using a large panel of Chinese firms.

2.6 Data

The dataset for this chapter is drawn mainly from Amadeus database, the World Bank and the Statistical Office of the European Union (i.e. Eurostat). These are combined in order to shed light on the effect of interest burden on the level of employment of euro area firms.

This sub-section is divided in four parts. The first part, elaborates on the main source of financial variables. The data collection construction and descriptive statistics are described in the next sub-sections.

2.6.1 Source of firm-level data

The dataset is drawn from the annual accounting reports from the 2012 version of Amadeus (Analyse Major Database from European Sources) database by Bureau Van Dijk (BvD). The database comprises financial information on 19 million public and private firms across European countries. [30] Currently, Amadeus covers 43 European countries (EU-28, Belarus, Albania, Bosnia-Herzegovina, Croatia, Estonia, Iceland, Liechtenstein, Macedonia,

[29] Note that in Chapter 2, I have also tested all baseline specification models restricting the number of instruments to t-4 to t-6 or t-4 to t-7. Unfortunately, the Sargan test does not improve.

[30] See http://amadeus.bvdinfo.com for details.

Moldova, Montenegro, Norway, Serbia, Switzerland, Turkey and Ukraine).

BVD collects and transforms all information into standardised format of annual accounts before the data is inserted on Amadeus. The information is gathered from all register offices of firms' respective countries. [31] Firms' financial statements are issued annually at the end of March. The accounts cover the period from January to December. Employment data are given as in 31 December of each year (Faggio and Konings, 2003). There are multiple advantages to using Amadeus database. Firstly, it allows us to compare information within a country as well as across countries since all variables are consistent with each other.

Secondly, it covers both listed and unlisted firms. However, the very majority of the firms in Amadeus database are unlisted. Thirdly, it also provides up to ten years of detailed information on accounting and ownership data per firm, although information can vary by country (Huyghebaert and Luypaert, 2013). Amadeus database contains information regarding consolidated and unconsolidated accounts in a format of 26 balance sheet and 26 profit and loss account items, as well as 32 standard ratios which cover the major items of profit and loss and balance sheet accounts (i.e. assets, turnover, labour costs). In addition, Amadeus includes detailed ownership information, namely the names and countries of all shareholders (with greater than 5% shareholdings). Supplemental information is also available on subsidiaries.

This database also provides other firm-level information. Particularly, it offers data on both manufacturing and non-manufacturing sectors and allocates firms according to the European industrial classification (NACE rev. 2). Conversely, it also contains information on the year of incorporation, legal status, quoted/unquoted indicator, activity codes and location of the firms. Amadeus also classify firms in different categories. In other words, firms are considered very large, large, medium and small if they match specific criteria. The dataset which is implemented in this thesis includes all the four type of firms. Details on this classification follow in Appendix A.1.

Nevertheless, the Amadeus data set does have some limitations. Firstly, reporting statements differ across countries. Secondly, small and medium firms are allowed to draw up bridged balance sheets and income statements, namely some information might be omitted. For instance, Denmark does not disclose any firms' accounting information for more than 5 years (Bartholdy and Mateus, 2008). The collection of the data can also be affected when firms stop reporting their financial statements. Amadeus places a missing for the 4 years following the last included filing. However, these firms are not removed from the database unless there is no reporting for at least five years, which can create some potential survivorship bias (Klapper et al., 2004).

Information is also not backfilled for new firms entering the database in a given year

[31] For instance, the Kamers van Koophandel in the Netherlands.

and firms only appear in the database if they fulfil the minimum size requirements. Gómez-Salvador et al. (2004) refer that "*it is not possible to distinguish between newly created firms and firms that simply enter the sample at a given period t, but were already operating in the period before*". On the other hand, each release of Amadeus only contains the listing status of a firms' current year (Gómez-Salvador et al., 2004). This indicates that the database does not report past years' information status. Hence, for firms which have changed listing status over the five-year sample period, their information may be misclassified (Klapper et al., 2004).

Overall, the key advantage of Amadeus is that it provides information which is uniform and enables the cross-border analysis. As such, given the unique nature of the financial development and market structure of European countries, this dataset allows the researcher to explore how labour market decisions are formulated across different European firms.

2.6.2 Data collection

The data for this chapter is mainly collected from Amadeus database for all firms from the annual accounting reports. The initial sample covers all firm-year observations from private and public firms. Information is available for a period between 2003 and 2011, corresponding to a nine year period.

Information comprises the following eleven euro area countries: Austria, Belgium, Finland, France, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain and Germany. It should be noted that Greece is dropped from the dataset due to missing data on wages. This is a common procedure in the literature. Firms which do not have complete records on the main variables of interest are dropped from the dataset (Carpenter and Guariglia, 2008).

Firms with only unconsolidated statements are considered to avoid double counting. This is a standard procedure in the literature of financial constraints (Guariglia, 2008; Guariglia et al., 2015). As a result, this approach ensures that the majority of the firms in the sample are small. In fact, approximately 70% of the firms which are included in the dataset are not traded on the stock market. In the dataset the majority of the firms are unlisted, and therefore particularly likely to face financial constraints (Guariglia, 2008). Following Blundell et al. (1992) and based on a two-digital NACE classification, all manufacturing firms are also included in the sample.[32]

In addition, it is also used the category "legal form" from Amadeus database. The aim is to use the information in this category to construct the variable $Private_i$ which is defined in sub-section 2.4.4. To define this variable, two steps are required. Firstly, in this

[32]Note that the authors allocate firms according to one of the following nine industrial sectors: metal and metal goods; other minerals and mineral products; chemical and man made fibres; mechanical engineering; electrical and instrument engineering; Moto vehicles and parts; other transport equipment; food, drink tobacco; textiles, clothing, leather and footwear; and others.

thesis private and public firms are defined under the new standardized legal form category. In Amadeus, since 2012 firms are classified based on nine legal forms.[33] To account for this issue and following the suggestion from the BVD technical support, these new nine categories are considered under the old system classification which only defines firms as public and private. [34]

Secondly, information on the "legal form" category is static. In other words, the dataset only reports contemporaneous information (i.e. the firm' latest status) rather than firm' historical information. Thus, if a firm' legal status is changed, this is updated in Amadeus database but the previous information is removed. Since the separation between public and private firms is crucial (it is used as a scheme to define financial constraints), this chapter follows the work of Akguc and Choi (2013) and classifies firms based on a contemporaneous measure. For each firm it is checked its Initial Public Offering (IPO) date and de-listing from the stock market date during the sample period. Firms are reclassified as public or private based on this information.[35]

Finally, the GDP deflator is collected from the World Bank dataset and the CPI is obtained from the Eurostat. In the dataset, the GDP deflator is used to deflate the variables real sales and wage whereas the CPI is normalised on the capital stock variable. The ten-year bond yield and the unemployment rate which are used in sub-section 2.4.6 are also obtained from Eurostat. After combining the appropriate Amadeus items, the initial sample consists of 1,916,694 firm-year observations. This large panel of financial data on euro area firms is particularly relevant since unquoted firms suffer more of financial constraints (Guariglia, 2008).

2.6.3 Sample selection process

Following normal selection criteria in the literature observations with negative sales and assets are dropped (Tsoukas, 2011). To control for the potential of outliers, observations in the one percent tail for each of the regression variables are also excluded. Firms with less than 3-years of observations are also dropped from the sample. Such procedure is a common practice for dynamic models (Carpenter and Guariglia, 2008; Guariglia, 2008). In the sample, entry and exit (death) of firms are allowed and the use of an unbalanced panel partially mitigates potential selection and survivorship bias (Guariglia and Mateut,

[33] Firms are classified based on the following categories: public limited, private limited, partnerships, sole proprietorships, public authorities, non-profit organisations, branches, foreign and other legal forms.

[34] According to the dataset providers, private limited, sole traders/proprietorships, partnerships, public authorities, non-profit organisations and branches are normally classified as private firms. However, it is not possible to confirm in which public/private categories foreign firms, other legal form and firms with unknown/unrecorded situation fall.

[35] For example, if a firm had an IPO in 2009 and it also has accounting information from 2003 to 2011, Amadeus database classifies the firm as public throughout the sample period. Thus, in this case in this thesis the firm is reclassified as private from 2003 to 2008 and as public from 2009 to 2011. The same methodology is employed for the de-listing case.

2010).

The final panel, which is unbalanced, covers 3,678 firms from Austria (corresponding to 21,347 observations), 3,964 firms from Belgium (corresponding to 32,202), 2,626 firms from Finland (corresponding to 20,024 observations), 22,820 firms from France (corresponding to 176,771 observations), 35,081 firms from Germany (corresponding to 200,373 observations), 830 firms from Ireland (corresponding to 6,123 observations), 49,433 firms from Italy (corresponding to 361,887 observations), 151 firms from Luxembourg (corresponding to 998 observations), 5,343 firms from Netherlands (corresponding to 39,382 observations), 5,617 firms from Portugal (corresponding to 39,965 observations) and 20,715 firms from Spain (corresponding to 148,966 observations) and . Finally, the total number of observations for the sample period is of 1,048,028. [36]

2.6.4 Descriptive statistics

Table 2.1 describes statistics of all the variables which are used in the empirical models for the entire sample. Number of observations, means, standard deviations and percentiles of the firm-specific variables and the financial indicator are presented. Table 2.2 and Table 2.3 show the aforementioned statistics for firms outside and during the crisis and for non-periphery and periphery economies, respectively. Table 2.4 and Table 2.5 describe the number of observations, means and standard deviations for periphery and non-periphery countries before and during the crisis period, respectively. The p-values of a test of equality of means are also reported.

Table 2.1 indicates that there are a total of 434,446 observations remaining in the sample when outliers and firms with missing values are dropped. The main variable of interest in the analysis, interest burden, has a mean of 0.300 and a median of 0.126 with a standard deviation of 0.658. This result is within the boundaries of the literature on employment (Nickell and Nicolitsas, 1999; Benito and Hernando, 2008; Chen and Guariglia, 2009). A similar pattern is observed for the capital stock variable. The employment level in the sample has a mean of 3.244 and a median of about 3.178, and the 75th and 25th percentile values of 3.912 and 2.565. In other words, among all people which are employed during the 2003-2011 period, the table shows that the level of employment grew more at the 75th percentile than those at the 25th and 50th percentiles. Furthermore, the level of wage growth for workers at the median is positive but closer to zero and workers at the 75th percentile see their real earning grow more 4%. Interestingly, the figures in Table 2.1 also illustrate that the average sales growth is 0.046 and at the median is negative and only positive for levels of sales above the median.

[36] See Appendix A.2, A.3, A.4, A.5 and A.6. for the definition of all the variables used in this chapter, number of firms per country, number of observations per country, the number of observations per year and the total structure of the panel, respectively.

Table 2.1: Descriptive statistics: Full sample

	Full sample					
	Obs.	Mean	St. dev	25^{th}	50^{th}	75^{th}
	(1)	(2)	(3)	(4)	(5)	(6)
n (employment)	646,044	3.244	1.074	2.565	3.178	3.912
IB (interest burden)	800,965	0.300	0.658	0.026	0.126	0.394
Δw (wage growth)	434,446	0.016	0.199	-0.053	0.012	0.080
δ (sales growth)	865,118	0.046	0.264	-0.075	0.024	0.143
w (wage)	601,424	3.479	0.388	3.271	3.507	3.728
k (capital stock)	1,037,042	6.256	1.601	5.196	6.343	7.465

Notes: This table presents the number of observations, sample means, standard deviations, the 25th percentile, the median and the 75th percentile for the all sample (column 1 to 6), respectively. See Table A.2 in the Appendix A for the definition of the variables.

Turning to Table 2.2, it is clear that average level of employment is lower during the crisis period when comparing with the tranquil period. However, during the crisis period the workforce level remain the same at the 75th percentile of the distribution whilst the level of employees at the 25th and the median percentiles has decreased significantly. Regarding, the interest burden variable, outside of the crisis, 75% of the firms in the distribution have a lower interest burden than during the crisis period. Similarly, 50% of the firms also have a higher value of interest burden during turmoil period than in the non-crisis period. This may suggest that firms in the distribution may suffer from financial constraints, especially during the crisis. The average wage growth is significantly lower during the crisis than outside of the crisis. The mean of wage growth is 0.027 before the crisis and closer to zero during the turmoil period. This suggests a cut on wages during the 2007-2009. Interestingly, for firms at the 25th percentile of the distribution, the wage growth is negative and below the median and only positive for those firms above the median. In other words, the workforce which earns less (those at the 25th percentile) is faced with a decrease of their wages during the crisis. Similarly, firms which are located at the 25% percentile of the distribution show a decrease of their sales level. This decline is even higher during the crisis. Finally, the average of wage and capital stock decrease during the crisis. The differences between sub-samples are statistically significant in all cases. Overall, these statistics are consistent with those described by the Structural Business Statistics by Eurostat. Specifically, in the manufacturing sector, the average rate of employees decreases from pre-crisis to during crisis and the costs in human capital increase.[37]

[37] See `http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=sts_inlb_a&lang=en` for details.

Table 2.2: Descriptive statistics: Crisis and non-crisis period

	Non-crisis						Crisis						Diff.
	Obs. (1)	Mean (2)	St. dev (3)	25^{th} (4)	50^{th} (5)	75^{th} (6)	Obs. (7)	Mean (8)	St. dev (9)	25^{th} (10)	50^{th} (11)	75^{th} (12)	Means (13)
n (employment)	380,187	3.259	1.064	2.565	3.218	3.912	265,857	3.222	1.088	2.365	3.135	3.912	0.000
IB (interest burden)	497,691	0.286	0.651	0.028	0.125	0.372	303,274	0.314	0.737	0.022	0.132	0.434	0.000
Δw (wage growth)	233,222	0.027	0.194	-0.041	0.018	0.087	201,224	0.002	0.205	-0.068	0.004	0.072	0.000
δ (sales growth)	478,232	0.062	0.251	-0.053	0.038	0.154	386,886	0.027	0.278	-0.102	0.003	0.128	0.000
w (wage)	358,247	3.479	0.379	3.274	3.501	3.722	243,177	3.477	0.402	3.262	3.516	3.736	0.082
k (capital stock)	625,396	6.254	1.599	5.184	6.318	7.423	411,646	6.314	1.634	5.214	6.381	7.518	0.000

Notes: This table presents the number of observations, sample means, standard deviations, the 25th percentile, the median and the 75th percentile for the non-crisis (column 1 to 6) and crisis (column 7 to 12) periods, respectively. The crisis/non-crisis sub-samples are based on a dummy crisis equal to 1 for the 2007-2009 period, and 0 otherwise. Diff. means is the p-value of the test statistic for the equality of means between non-crisis and crisis periods (column 13). See Table A.2 in the Appendix A for the definition of the variables.

Table 2.3 provides statistics when the sample of firms is split into non-periphery and periphery firms. It seems that the average employment level is higher for firms at the non-periphery than at the periphery of the euro area. It is interesting to note that the level of employment follows the same pattern for non-periphery and periphery firms across different percentile but for any level of the distribution non-periphery firms have higher levels of employment. The figures in Table 2.3 also show that the average interest burden for periphery firms is significantly higher than the average interest burden of non-periphery firms. In fact, at the 25th percentile non-periphery firms show an average of 0.015 against the 0.036 for periphery firms. This difference is significantly higher at the 75th percentile (i.e. 0.208 against 0.509). This suggests that firms at the euro area periphery pay significantly more to service their debt than firms in the core. In addition, the average growth of wages is significantly higher for periphery firms than for non-periphery ones. To be specific, the growth of wages for firms at the 25th percentile of the distribution is negative and below the median for both periphery and non-periphery firms with the former presenting higher growth rates than the latter. The sales growth variables follows a similar pattern to the wage growth variable with firms at the periphery having a higher average than the non-periphery ones. Finally, Table 2.3. also shows that capital stock is significantly higher, especially for periphery firms at the 75th percentile of the distribution.

Table 2.3: Descriptive statistics: Non-periphery and periphery firms

	Non-periphery						Periphery						Diff.
	N	Mean	St. dev	25^{th}	50^{th}	75^{th}	N	Mean	St. dev	25^{th}	50^{th}	75^{th}	Means
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
n (employment)	256,188	3.469	1.140	2.708	3.401	4.263	389,856	3.096	1.001	2.485	3.045	3.738	0.000
IB (interest burden)	268,913	0.160	0.489	0.015	0.072	0.208	532,052	0.366	0.756	0.036	0.178	0.509	0.000
Δw (wage growth)	147,139	0.011	0.169	-0.046	0.009	0.066	287,307	0.019	0.213	-0.057	0.013	0.089	0.000
δ (sales growth)	402,779	0.040	0.271	-0.082	0.023	0.143	462,339	0.051	0.258	-0.070	0.024	0.143	0.000
w (wage)	211,956	3.681	0.297	3.497	3.675	3.866	389,468	3.368	0.388	3.169	3.391	3.620	0.000
k (capital stock)	482,625	6.028	1.651	4.873	5.988	7.168	554,417	6.567	1.547	5.53	6.626	7.656	0.000

Notes: This table presents the number of observations, sample means, standard deviations, the 25th percentile, the median and the 75th percentile for the non-periphery (column 1 to 6) and periphery (column 7 to 12) periods, respectively. Firms are split into those operating in periphery economies and those in non-periphery economies across the non-crisis periods. Diff. means is the p-value of the test statistic for the equality of means between non-periphery and periphery periods (column 13). See Table A.2 in the Appendix A for the definition of the variables.

Furthermore, this chapter also takes into account descriptive statistics for periphery and non periphery firms across crisis and non-crisis periods. Comparing the descriptive statistics in Table 2.4 and Table 2.5, it is clear that the average level of employment decreases during the turmoil period only for periphery firms. For instance, during the non-crisis period for periphery economies (Table 2.4) a firm at the 25th percentile has a level of employment of 2.56 comparing with a firm at the 75% percentile which has a workforce of 3.807. During the crisis firms at the 25th percentile and 75th percentile of the distribution show a level of employment of 3.019 and 3.536 (Table 2.5). Conversely, for firms at the non-periphery the figures show that the average employment actually increases with an employment level for firms at the 25th percentile of the distribution positive and below the median but higher when comparing with periphery firms at the same levels of distributions. Similar the average growth of wages is significantly higher for periphery firms than for non-periphery ones during the non-crisis period. Notwithstanding, when considering the crisis the average wage growth is negative for non-periphery firms and closer to zero for periphery ones suggesting that during this period firms cut on wages. In effect, it seems that the growth of wages for firms at the median is broadly negative and only positive above the median for both periphery and non-periphery firms which may indicate a real wage cut during this period. On the other hand, Table 2.4 and Table 2.5 show that the parallel figures of the variable wage are higher for firms belonging to the core. These statistics are in line with the figures of the Employment Protection Legislation (EPL) index which is developed by the OECD. According to this index, adjustments for the periphery countries in the labour market occur almost exclusively on the wage and working time, while core's labour market legislation is less rigid.[38] Holden and Wulfsberg (2008) provide evidence in support of the previous statements.

Moving to the interest burden, it is clear that during both sub-periods, firms in the periphery pay significantly more to service their debt than firms in the core, especially during the crisis. For instance, let us consider the distribution of interest burden across different percentile during the crisis for periphery and non periphery firms. While at the non-periphery economies, 75% of the firms in the distribution have an average interest burden of 0.217, for firms at 75% of the distribution at the periphery show an average of 0.869. This is consistent with the notion that small firms in countries under stress suffer more from asymmetric information problems and therefore have a limited access to the external financial markets (Lopez-Gracia and Aybar-Arias, 2000; Guariglia, 2008). For these firms, access to external finance is limited and prohibitively expensive. Interestingly, for both sub-samples, the variable interest burden is lower during the crisis period. Such results might be related to the measures which are implemented by the ECB during the

[38]The employment outlook of OECD (2013) shows that countries such as Portugal or Spain have a higher EPL.

crisis. In effect, the aims of such non-standard policies rely on the assistance to the banking sector in order to reduce financial distress and boost the bank lending to the private sector. As explained by Ciccarelli et al. (2013), in the EU the fragility of the bank was extremely important in the 2008-2009 crisis. However, until the end of 2011, there is still substantial heterogeneity in bank loan conditions and standards for non-financial borrowers between distressed and other European countries. These differences are even stronger for small firms. Thus, policies which are adopted until the end of 2011 might have fallen short of reducing credit availability problems.

In addition, firms in the periphery have higher average of sales during the crisis period, while the inverse pattern is observed for firms in the core economies. The median firm at the periphery (non periphery) shows an average sales growth of 0.038 (0.058) and 0.192 (0.004) for the non-crisis and crisis periods, respectively. What it is also interesting is that the median firm sales growth is almost zero for both periphery and non-periphery firms and it is negative below the same median which suggest that sales decrease for those firms which sell less, especially at the non-periphery area. This statistic suggests that firms in the periphery might suffer from higher agency costs of debt. As a result, they sell their assets in order to provide funds, when alternative sources of finance are too expensive. These findings are consistent with Campello et al. (2010) according to which the vast majority of financially constrained firms sold their assets in order to fund their operations in 2008.

Table 2.4: Descriptive statistics: Periphery and non-periphery economies for non-crisis periods

	Non-crisis												
	Non-periphery						Periphery						Diff.
	N	Mean	St. dev	25^{th}	50^{th}	75^{th}	N	Mean	St. dev	25^{th}	50^{th}	75^{th}	Means
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
n (employment)	156,193	3.399	1.139	2.639	3.332	4.159	223,994	3.161	0.995	2.565	3.135	3.807	0.000
IB (interest burden)	165,856	0.159	0.473	0.017	0.073	0.202	331,994	0.350	0.715	0.039	0.170	0.477	0.000
Δw (wage growth)	84,944	0.019	0.172	-0.039	0.017	0.076	148,278	0.033	0.205	-0.043	0.020	0.096	0.000
δ (sales growth)	209,130	0.057	0.258	-0.059	0.058	0.155	269,102	0.065	0.246	-0.050	0.038	0.152	0.000
w (wage)	134,556	3.671	0.297	3.488	3.664	3.854	223,691	3.364	0.376	3.179	3.370	3.605	0.000
k (capital stock)	279,747	6.059	1.635	4.859	5.966	7.144	345,649	6.399	1.537	5.493	6.560	7.602	0.000

Notes: This table presents the number of observations, sample means, standard deviations, the 25th percentile, the median and the 75th percentile for periphery and non-periphery firms during the non-crisis period. Firms are split into those operating in periphery economies and those in non-periphery economies across the non-crisis periods. Diff. is the p-value of the test statistic for the equality of the means between non-periphery and periphery economies during the non-crisis period (column 13). See Table A.2 in the Appendix A for the definition of the variables.

Table 2.5: Descriptive statistics: Periphery and non-periphery economies across the crisis

	Crisis												
	Non-periphery						Periphery						Diff.
	N	Mean	St. dev	25^{th}	50^{th}	75^{th}	N	Mean	St. dev	25^{th}	50^{th}	75^{th}	Means
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
n (employment)	99,995	3.578	1.132	2.833	3.555	4.382	165,862	3.019	1.001	2.398	2.944	3.636	0.000
IB (interest burden)	103,057	0.163	0.514	0.013	0.072	0.217	200,217	0.391	0.818	0.031	0.192	0.869	0.000
Δw (wage growth)	62,195	-0.002	0.165	-0.056	0.001	0.053	139,029	0.004	0.221	-0.075	0.006	0.082	0.000
δ (sales growth)	193,649	0.022	0.285	-0.107	0.004	0.129	193,237	0.032	0.274	-0.098	0.003	0.127	0.000
w (wage)	77,400	3.698	0.296	3.513	3.694	3.389	165,777	3.377	0.404	3.155	3.419	3.637	0.000
k (capital stock)	202,878	6.115	1.657	4.894	6.077	7.22	208,768	6.478	1.560	5.584	6.707	7.742	0.000

Notes: This table presents the number of observations, sample means, standard deviations, the 25th percentile, the median and the 75th percentile over the crisis for periphery and non-periphery firms. Firms are split into those operating in periphery economies and those in non-periphery economies across the non-crisis periods. Diff. is the p-value of the test statistic for the equality of the means between non-periphery and periphery economies during the crisis period (column 13). See Table A.2 in the Appendix A for the definition of the variables.

As a robustness check for the preliminary analysis, this chapter includes plots of the main variable of study, interest burden. Specifically, Figure 2.1 shows the average interest burden for the total sample, Figure 2.2 depicts the average 3-month interest rate and the average interest rate for loans to non-financial corporations in the euro area. Figure 2.3 plots the average interest burden for firms in the periphery and non-periphery economies. Finally, the average interest burden for SMEs and non-SMEs is described in Figure 2.4.

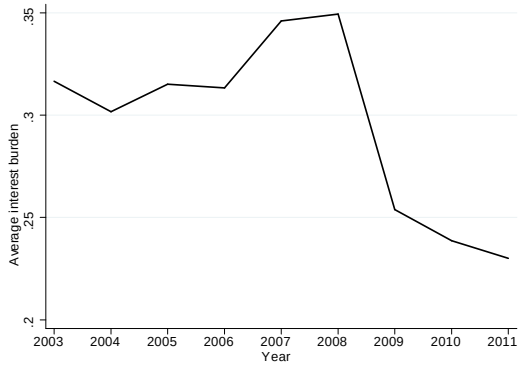

Figure 2.1: Average interest burden for the sample of firms in the euro area.

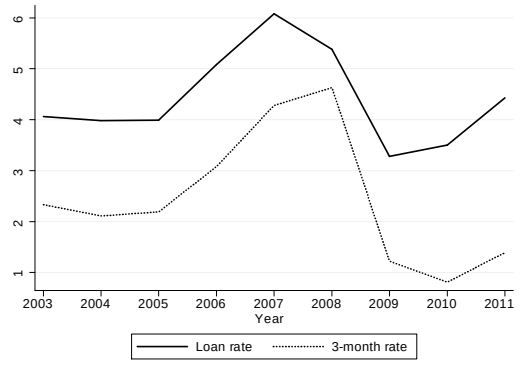

Figure 2.2: Resident monetary and financial institutions average lending rates for non-financial corporations (maturity less than one year).

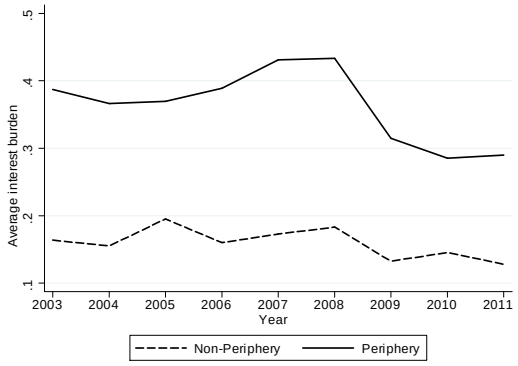

Figure 2.3: Average interest burden across the sample of firms in the periphery and non-periphery economies.

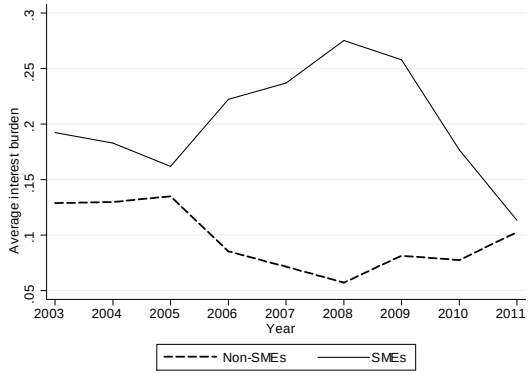

Figure 2.4: Average interest burden across the sample of SMEs and non-SMEs in the euro area.

To begin with, the most noticeable feature between Figure 2.1 and Figure 2.2 is the similar pattern throughout the period of analysis. It is clear that the interest burden of firms peaks in 2008 which marks the most intense phase of the global financial crisis. This is also true for the 3-month interest rate which is at its highest level during this period. It can also be observed that the interest burden of firms along with both the 3-month rate and the loan interest rates to firms gradually decrease during the period that ECB implemented unconventional monetary policy measures (Fawley and Neely, 2013). Such a pattern can be at least partially explained by higher liquidity of the banking sector and increased availability of loans to the private sector (ECB's non-standard measures). Giannone et al. (2011) offer some empirical evidence supporting this view.

Figure 2.3 illustrates the variation in the interest burden over time across firms in the sample, broken down by periphery and non-periphery economies. The variation in the interest burden is substantial and firms in the periphery face much higher interest

payments than those in the non-periphery economies. For the firms in the periphery the interest burden increased by up to 0.13 percent points during the crisis, compared to only 0.05 percent points for firms in the non-periphery countries. This serves to illustrate the heterogeneity in the interest rate payments.

Finally, Figure 2.4 demonstrates that SMEs are exposed to higher levels of financial pressure, especially during the crisis with the interest burden reaching a peak in 2008. This goes in line with Darvas (2013). According to the authors, SMEs are more vulnerable during the crisis since they suffer from higher levels of information asymmetry and face higher costs of borrowing.

Overall, the preliminary statistics suggest that firms' labour decisions are related to financial conditions which are associated with tight monetary policies and the recent financial crisis. Then, the question that arises is if this pattern is confirmed when controlling for a number of factors, which play a role in determining firms' level of employment. In the section that follows, it is provided the empirical analysis which tests whether the sensitivity of employment to the financial variable interest burden is significantly higher. This is investigated in a per-period (i.e. turmoil, tranquil), in a per-region (i.e. periphery and non-periphery) and on different dimensions of firm-level heterogeneity.

2.7 Results

2.7.1 The role of financial pressure on employment and the financial crisis

This sub-section investigates the impact of financial pressure on firms' labour decisions. Specifically, it intends to explore the role of interest burden on the level of employment. Previous evidence denotes that the cost of servicing debt is related to the level of inventory investment, firms' survival and employment decisions (Nickell and Nicolitsas, 1999; Benito and Hernando, 2008; Chen and Guariglia, 2009; Guariglia et al., 2015).

Under tight monetary policies, financial structure of corporations may change affecting the real activities of the firms (Nickell and Nicolitsas, 1999). The recent financial crisis has led to an increase of the cost of borrowing and consequently a reduction of all kinds of investment, including the hiring of new employees. On the other hand, such market conditions might also contribute to a contraction of the workforce in order to avoid potential bankruptcy of the firms (Chen and Guariglia, 2009). Therefore, this section explores whether the response of firms' employment decisions is affected by the level of interest burden for the sample period between 2003 and 2011. Finally, it also assesses if these effects are magnified during the recent financial crisis.

Table 2.6 shows the estimation results for equations 2.11 and 2.12. In column 1, the financial variable interest burden (IB) is included in the estimation model to test for the direct impact of interest payments on firms' employment decisions. In order to

control for existing and expected demand, n, k, Δw, w and are also included in the both estimations. Column 2 includes the financial indicator interest burden interacted with $Crisis_t$ and $(1 - Crisis_t)$. Finally, tests of equality of means between the interacted terms are also presented at the bottom of the table. To begin with, the employment dynamics are captured in the baseline model. For instance, a 10 percent increase of wages (w_{it-1}) reduces the level of employment by 1.01 percent whereas a 10 percent increase in sales growth (δ_{it}) increases firms' employment level by 0.26 percent.[39] These findings are consistent with previous work by Nickell and Nicolitsas (1999) and Benito and Hernando (2008), which show a negative w and a positive δ effect on employment from a panel of U.K. and Spanish manufacturing firms, respectively.

Table 2.6: Employment, financial pressure and the crisis

	Baseline (1)	Crisis (2)
n_{it-1}	0.986***	0.965***
	(106.78)	(94.81)
IB_{it-1}	-0.120**	
	(-2.23)	
IB_{it-1}*Crisis$_t$		-0.204***
		(-2.83)
IB_{it-1}*(1-Crisis$_t$)		-0.058
		(-0.78)
Δw_{it}	-1.342***	-0.869***
	(-10.56)	(-4.72)
δ_{it}	0.799***	0.832***
	(9.45)	(9.02)
w_{it-1}	-0.101**	-0.088*
	(-2.38)	(-1.76)
k_{it}	0.017***	0.020***
	(2.86)	(2.81)
Observations	399,948	399,948
Firms	94,395	94,395
Sargan (p-value)	0.020	0.010
m1 (p-value)	0.000	0.000
m4 (p-value)	0.060	0.080
F-test of equality (p-value)		
IB crisis vs. non-crisis		0.004

All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged four times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 17 in column 1, 7 in column 2. m1 (m4) is a test for first (fourth) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table A.2 in the Appendix A for the definition of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Turning to the analysis of the interest burden, it is clear that firm-specific interest burden exerts a negative and highly significant impact on firms' level of employment. The result is not statistically but also economically important. The coefficient of - 0.120 implies an elasticity of employment with respect to interest burden, evaluated at sample means of

[39] The coefficient of 0.799 indicates an elasticity of employment to sales growth of 0.026 (0.799*0.0328), where 0.0328 is the mean of sales growth.

-0.035. A 10 percent increase of interest burden reduces the level of employment by 0.35 percent. The finding implies that financial pressure in the form of interest burden has a significant impact on euro area firms' employment. This is consistent with the results of Benito and Hernando (2008) according to who financial constraints have an effect on labour demand.

Column 2 of Table 2.6 includes the interactions between interest burden and the crisis terms. The coefficient of interest burden is negative and statistically significant only for the crisis period. The results reinforce the idea that during the crisis, financial pressure is more relevant in determining firms' level of employment. Specifically, when comparing the role of interest burden during and outside the crisis, employment is more sensitive to the changes of firms' servicing debt during the crisis. The economic impact across the two periods is clear: a 10 percent change of the interest burden variable has an impact on the level of employment by only 0.08 percent during the tranquil period and 0.32 percent during the turmoil period. The p-values for the differences between the two coefficients are statistically significant. Finally, in terms of the control variables all the non-financial variables have the expected sign and are highly important determinants of firms' current employment. The Sargan test shows that the model is not misspecified and the $m4$ indicates that the instrument sets are valid.[40]

2.7.2 Periphery and non-periphery

The previous results demonstrate the differential role of interest burden on firms' employment decisions during the crisis and outside of the crisis period. Motivated by the above-mentioned findings, the aim of this sub-section is to verify whether this differential effect remains when splitting firms based on their location, i.e. periphery and non-periphery economies.

Results are presented in Table 2.7. All of the non-financial variables retain their sign and significance regarding firms' level of employment. In terms of the role of interest burden on firms' workforce, the empirical findings suggest that firms in the periphery react differently to the financial pressure of debt-servicing costs during cyclical fluctuations than their non-periphery counterparts.

It is clear that in the periphery area there is a significantly different response of firms' employment to interest burden during the crisis period. Specifically, the interaction between interest burden and the periphery dummy is statistically significant only for the

[40]The literature refers that an unrestricted set of lags may lead to a huge number of instruments with a possible loss of efficiency(Roodman, 2009). To account for this issue, I have limit the number of instruments used in the system GMM in Chapter 2 to t-4 and t-7 and t-4 and t-6. The value of the sargan test does not improve for any of the specifications. Nevertheless, it should be noted that throughout all specifications (i.e. in Chapter 2 and the following empirical chapters) I have employed one instrument per variable instead of one instrument per year. This reduces substancially the number of instruments use and it is a way of dealing with instrument proliferation.

Table 2.7: Periphery, non-periphery and the crisis

n_{it-1}	0.988***
	(63.21)
IB_{it-1}*$Crisis_t$*$Periphery_i$	-0.205***
	(-3.64)
IB_{it-1}*(1-$Crisis_t$)*$Periphery_i$	-0.094
	(-1.52)
IB_{it-1}*$Crisis_t$*(1-$Periphery_i$)	0.197
	(0.83)
IB_{it-1}*(1-$Crisis_t$)*(1-$Periphery_i$)	0.202
	(0.86)
Δw_{it}	-1.270***
	(-8.62)
δ_{it}	0.855***
	(8.46)
w_{it-1}	-0.143***
	(-3.90)
k_{it}	0.017**
	(2.56)
Observations	399,948
Firms	94,395
Sargan (p-value)	0.028
m1 (p-value)	0.000
m4 (p-value)	0.118
F-test of equality (p-value)	
IB crisis periph. vs. non-crisis periph.	0.077
IB crisis non-periph. vs. non-crisis non-periph.	0.969
IB non-crisis periph. vs. non-crisis non-periph.	0.251
IB crisis periph. vs. crisis non-periph.	0.076

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged four times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 15 in column 1. m1 (m4) is a test for first (fourth) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table A.2 in the Appendix A for the definition of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

turmoil period. During tranquil periods firm-specific interest rate is insignificant. This result suggests that firms in the periphery group react differently to debt-servicing costs during cyclical fluctuations. This is a novel result which demonstrate the effect of the interest burden on firms' employment during the recent global financial crisis. More importantly, the results reinforce the economic impact of interest burden on firms' employment: a 10 percent rise in the interest burden decreases firms' workforce by only 0.10 percent during non-crisis times and by 0.27 percent during the crisis period. The p-values for the equality of the coefficients show a statistically significant difference between the two point estimates.

Turning to the remaining interaction terms, results show that for non-periphery firms the interest burden does not seem to exert any significant effect on these firms during the tranquil and turmoil periods. The p-value shows that the coefficients are also not statistically different from each other.

Overall, the findings from Table 2.7 suggest that the impact of financial pressure on

employment is stronger for firms in the euro area periphery and during the crisis. These is consistent with the idea that firms in the periphery are more likely to be affected by the level of financial pressure during the crisis due to their limited access to external finance and tighter credit conditions (Artola and Genre, 2011).

2.7.3 Firm-level heterogeneity

Next, it is provided results on the impact of financial constraints on the interest burden-employment nexus during crisis and tranquil periods for both periphery and non-periphery economies. Three different dimensions of firm-level heterogeneity are considered: bank dependence, size and legal status. Table 2.8 presents the results. The comparison across columns in Table 2.8 permits to explore the specific influence of each dimensions of financial constraints (i.e. based on size, bank dependence, privately held versus public held) on each of the interactions in the rows.[41]

To begin with, the interactions between interest burden and financially constrained firms show that the point estimates are negative and highly statistically significant during the turmoil period. In other words, these findings suggest that firms for whom access to external finance is restricted or expensive are more responsive to changes in the debt servicing costs during adverse economic events. More importantly, these results extend the empirical findings of Nickell and Nicolitsas (1999). The authors show that interest burden has a higher impact in determining the employment level of firms with higher debt than for those with lower debt levels. The results also reinforce the economic effect of the firm-specific interest rate on firms' employment. For instance, let us focus on row 2 of column 1. The coefficient of -0.147 denotes an elasticity of employment with respect to interest burden, evaluated at sample means of -0.0072. A 10 percent rise in the interest burden decreases the employment level of financially constrained firms by -0.072 percent.

In addition, results show that the interest rate burden effect is statistically insignificant for unconstrained firms. This means that for these firms an increase in debt servicing costs has no effect on employment when comparing to their financially constrained counterparts whose employment is significantly more responsive during the crisis period.

As a final test, in Chapter 2 it is also considered the role of financial constraints on firms' employment decisions across periphery and non-periphery economies. Empirical findings are presented in Table 2.9. Results suggest that interest burden effect has a negative and statistically significant impact on employment decisions for financially constraints firms in the periphery during the crisis. Firms which are less bank dependent, large and public remain largely unaffected independently of their location and the crisis/non crisis period.

[41] Note that Finland and Ireland is dropped from the estimation when the criteria private/public is taken into account. Thus, column 3 presents a small number of observations when comparing with the other measures in column 1 and column 2. This is due to the fact that public firms in Finland and Ireland are dropped after the cleaning process.

To sum up, financially constrained firms show greater sensitivity to interest burden, especially in the euro area periphery and during the recent financial crisis. The findings are robust to the inclusion of firms' legal status (i.e. private versus public) as a measure of firm heterogeneity. This indicates that the results are not drive by demand shocks. Previous empirical literature demonstrate that capital market imperfections are important in influencing firms' real activities such as investment, inventory, employment and firm survival (Guariglia, 2008; Carpenter and Guariglia, 2008; Guariglia and Mateut, 2010; Tsoukas, 2011).

Overall, employment consequences of interest rate burden shifts are more important for financially constrained firms during the crisis than for their unconstrained counterparts. The greater sensitivity for the former group of firms firms may result from the greater information asymmetries in the periphery economies when comparing to their non-periphery counterparts. This is a new result which complements the findings of Nickell and Nicolitsas (1999) and Benito and Hernando (2008).

Table 2.8: Financial constraints and the crisis

	Constrained= BankDep (1)	Constrained= Size (2)	Constrained= Private (3)
n_{it-1}	0.961***	0.958***	0.932***
	(82.31)	(51.69)	(37.74)
IB_{it-1}*$Crisis_t$*$Constrainted_{it}$	-0.147***	-0.221***	-0.304***
	(-2.76)	(-3.40)	(-3.76)
IB_{it-1}*(1-$Crisis_t$)*$Constrained_{it}$	-0.088	-0.126**	-0.162
	(-1.46)	(-2.31)	(-1.60)
IB_{it-1}*$Crisis_t$*(1-$Constrained_{it}$)	0.020	-0.009	-0.063
	(1.07)	(-0.16)	(-0.47)
IB_{it-1}*(1-$Crisis_t$)*(1-$Constrained_{it}$)	0.004	0.010	0.191
	(0.16)	(0.34)	(1.27)
Δw_{it}	-1.284***	-1.011***	-0.883***
	(-9.82)	(-9.08)	(-4.67)
δ_{it}	0.687***	0.585***	0.547***
	(7.13)	(5.34)	(8.30)
w_{it-1}	-0.341***	-0.110***	-0.096
	(-3.48)	(-4.29)	(-1.53)
k_{it}	0.007	0.007	0.036***
	(0.78)	(1.48)	(6.86)
Observations	399,948	399,948	321,294
Firms	94,395	94,395	74,010
Sargan (p-value)	0.037	0.001	0.019
m1 (p-value)	0.000	0.000	0.000
m3 (p-value)			0.616
m4 (p-value)	0.118	0.043	
F-test of equality (p-value)			
IB crisis Constrained vs. non-crisis Constrained	0.085	0.010	0.029
IB crisis 1-Constrained vs. non-crisis 1-Constrained	0.361	0.704	0.063
IB non-crisis Constrained vs. non-crisis 1-Constrained	0.202	0.037	0.019
IB crisis Constrained vs. crisis 1-Constrained	0.008	0.003	0.093

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. The variable $constrained_{it}$ indicates in turn Bank Dependent, Small and Private firms. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged four times or more in column 1 and 2. Instruments in column 3 are all regressors lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity. with degrees of freedom for the sargan test equal to 15 in column 1, 18 in column 2, 8 in column 3. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. m4 is a test for fourth order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table A.2 in the Appendix A for the definition of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 2.9: Financial constraints, periphery, non-periphery and the crisis

	Periphery			Non-periphery		
	Constrained= BankDep	Constrained= Size	Constrained= Private	Constrained= BankDep	Constrained= Size	Constrained= Private
	(1)	(2)	(3)	(4)	(5)	(6)
n_{it-1}	0.999***	0.975***	0.914***	0.859***	0.898***	0.915***
	(59.54)	(55.27)	(49.14)	(16.40)	(23.99)	(16.42)
$IB_{it-1}*Crisis_t*Constrained_{it}$	-0.249***	-0.159***	-0.293***	-0.014	-0.243	-0.126
	(-2.73)	(-2.72)	(-4.20)	(-0.21)	(-1.06)	(-0.64)
$IB_{it-1}*(1\text{-}Crisis_t)*Constrained_{it}$	-0.117	-0.110**	-0.173*	-0.063	-0.443	-0.133
	(-0.89)	(-2.38)	(-1.65)	(-0.83)	(-1.37)	(-0.76)
$IB_{it-1}*Crisis_t*(1\text{-}Constrained_{it})$	0.038	-0.041	-0.073	-0.008	0.074	-0.077
	(0.60)	(-0.63)	(-0.66)	(-0.15)	(0.37)	(-0.19)
$IB_{it-1}*(1\text{-}Crisis_t)*(1\text{-}Constrained_{it})$	-0.058	-0.008	0.156	-0.009	0.124	-0.091
	(-0.62)	(-0.36)	(1.35)	(-0.13)	(1.01)	(-0.72)
Δw_{it}	-0.972***	-0.979***	-0.793***	0.081	-0.134	-0.566
	(-5.09)	(-7.79)	(-6.03)	(0.71)	(-0.74)	(0.38)
δ_{it}	1.282***	0.647***	0.412**	0.337***	0.615***	0.540***
	(5.93)	(3.84)	(7.74)	(2.22)	(4.34)	(3.78)
w_{it-1}	-0.048	-0.104***	-0.130***	-0.105	-0.258	-0.101
	(-1.05)	(-4.46)	(-3.00)	(-1.02)	(-1.12)	(-0.98)
k_{it}	0.016	0.003	0.040***	0.023***	0.017**	0.028***
	(1.27)	(0.59)	(8.65)	(3.25)	(1.99)	(3.22)
Observations	278,245	278,245	228,584	121,703	121,703	92,710
Firms	63,124	63,124	50,699	31,271	31,271	23,311
Sargan	0.066	0.000	0.000	0.445	0.252	0.347
m1 (p-value)	0.000	0.000	0.000	0.000	0.000	0.000
m3 (p-value)			0.109			0.156
m4 (p-value)	0.077	0.745		0.164	0.216	
F-test of equality (p-value)						
IB crisis Constrained vs. non-crisis Constrained	0.063	0.187	0.055	0.435	0.423	0.977
IB crisis 1-Constrained vs. non-crisis 1-Constrained	0.017	0.585	0.095	0.992	0.697	0.972
IB non-crisis Constrained vs. non-crisis 1-Constrained	0.741	0.058	0.003	0.590	0.163	0.830
IB crisis Constrained vs. crisis 1-Constrained	0.017	0.062	0.098	0.952	0.277	0.877

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies and time dummies interacted with industry dummies are included. Instruments include all regressors lagged four times or more in column 1 and 2. Instruments in column 3 are all regressors lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 11 in column 1, 18 in column 2, 10 in column 3, 27 in column 4 and 19 in column 5 and 10 in column 6. m1 (m4) is a test for first (fourth) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. m3 is a test for third order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table A.2 in the Appendix A for the definition of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

2.7.4 Additional control variables

So far, Chapter 2 has examined whether interest burden has an effect on firms' employment decisions. Following the work of Benito and Hernando (2008), it is tested whether the main results remain unchanged balance sheet variables are included. A set of macroeconomic variables is also considered.

Table 2.10 and Table 2.11 report the estimates including the control variables for the baseline and crisis models. The results in Table 2.10 and Table 2.11 should be compared with those in column 1 and column 2 of Table 2.6, respectively.

Empirical findings confirm the results which are discussed in sub-section 2.4.6. The addition of firm-specific variables (with the exception of liquidity) have no effect on firm-specific employment whereas the 10-year bond yield and the national unemployment rate have a negative and statistically significant effect on firms' employment decisions. More importantly, firm-specific interest rate still exerts a negative impact on firms' employment decisions.

Results in Table 2.10 demonstrate that the impact of firm-specific interest rate on the level of employment remain negative only during the turmoil period. Overall, the above-mentioned results corroborate the previous findings. The negative relation between interest burden and firms' employment decisions is robust to the addition of a number of firm-specific variables and well as macroeconomic variables.

Table 2.10: Baseline model with additional control variables

	Cflow	Liq	Netdebt	Bondy	Unem
	(1)	(2)	(3)	(4)	(5)
n_{it-1}	0.975***	0.971***	0.975***	0.981***	0.945***
	(84.50)	(93.74)	(84.76)	(110.49)	(64.70)
IB_{it-1}	-0.074*	-0.129***	-0.086*	-0.109**	-0.151*
	(-1.80)	(-2.89)	(-1.66)	(-2.37)	(-1.79)
$Cflow_{it-1}$	0.001				
	(0.06)				
Liq_{it-1}		0.012*			
		(1.74)			
$Netdebt_{it-1}$			-2.162		
			(-1.03)		
$Bondy_{it-1}$				-0.711**	
				(-2.37)	
$Unem_{t}$					-0.516***
					(-6.23)
Δw_{it}	-1.052***	-1.167***	-1.110***	-1.211***	-1.305***
	(-9.91)	(-10.50)	(-7.02)	(-11.65)	(-7.24)
δ_{it}	0.722***	0.710***	0.742***	0.688***	0.748***
	(9.77)	(8.68)	(8.00)	(7.42)	(5.27)
w_{it-1}	-0.090***	-0.162***	-0.115**	-0.114***	-0.135***
	(-3.03)	(-4.31)	(-2.57)	(-3.10)	(-2.73)
k_{it}	0.016**	0.033***	0.001	0.021***	0.031***
	(2.37)	(3.92)	(0.06)	(3.47)	(3.54)
Observations	372,109	367,345	305,761	373,651	373,651
Firms	90,786	90,631	81,461	91,037	91,037
Sargan (p-value)	0.000	0.014	0.000	0.029	0.950
m1 (p-value)	0.000	0.000	0.000	0.000	0.000
m4 (p-value)	0.208	0.067	0.992	0.283	0.264

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged four times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 18 in column 1, 18 in column 2, 15 in column 3, 19 in column 4 and 22 in column 5. m1 (m4) is a test for first (fourth) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table A.2 in the Appendix A for the definition of the variables. *, **, and *** indicate statistical significance at the 10 %, 5%, and 1% level, respectively.

Table 2.11: Crisis model with additional control variables

	Cflow (1)	Liq (2)	Ndebt (3)	Bondy (4)	Unem (5)
n_{it-1}	0.964***	0.955***	0.988***	0.968***	0.973***
	(79.01)	(71.50)	(74.65)	(86.27)	(114.69)
$IB_{it-1} * Crisis_t$	-0.126***	-0.157***	-0.156*	-0.178***	-0.101***
	(-2.81)	(-3.54)	(-1.70)	(-3.67)	(-2.32)
$IB_{it-1} * (1\text{-}Crisis_t)$	-0.031	-0.029	-0.027	-0.030	0.037
	(-1.21)	(-1.11)	(-0.79)	(-1.35)	(0.88)
$Cflow_{it-1} * Crisis_t$	0.012				
	(0.29)				
$Cflow_{it-1} * (1\text{-}Crisis_t)$	0.027				
	(0.86)				
$Liq_{it-1} * Crisis_t$		0.016			
		(1.23)			
$Liq_{it-1} * (1\text{-}Crisis_t)$		0.016			
		(1.32)			
$Ndebt_{it-1} * Crisis_t$			1.789		
			(1.50)		
$Ndebt_{it-1} * (1\text{-}Crisis_t)$			0.870		
			(1.08)		
$Bondy_{i-1} * Crisis_t$				3.000	
				(1.36)	
$Bondy_{t-1} * (1\text{-}Crisis_t)$				0.286	
				(1.00)	
$Unem_t * Crisis_t$					-0.272***
					(-4.72)
$Unem_t * (1\text{-}Crisis_t)$					-0.466***
					(-3.74)
Δw_{it}	-1.061***	-1.086***	-1.075***	-1.095***	-0.983***
	(-9.86)	(-9.61)	(-4.89)	(-8.95)	(-8.84)
δ_{it}	0.570***	0.651***	-0.820***	1.047***	0.813***
	(5.26)	(6.45)	(5.80)	(11.38)	(16.54)
w_{it-1}	-0.103***	-0.123***	-0.116**	-0.075***	-0.071**
	(-3.65)	(-3.81)	(-2.16)	(-2.85)	(-2.32)
k_{it}	0.028***	0.040***	0.022*	0.016***	0.018***
	(3.24)	(3.58)	(1.84)	(3.02)	(3.71)
Observations	372,109	367,345	305,761	373,651	373,651
Firms	90,786	90,631	81,461	91,037	91,037
Sargan	0.005	0.015	0.010	0.000	0.000
m1 (p-value)	0.000	0.000	0.000	0.000	0.000
m4 (p-value)	0.303	0.080	0.123	0.152	0.199
F-test of equality (p-value)					
IB crisis vs. non-crisis	0.009	0.001	0.066	0.001	0.000
Cflow crisis vs. non-crisis	0.352				
Liq crisis vs. non-crisis		0.939			
Ndebt crisis vs. non-crisis			0.149		
Bondy crisis vs. non-crisis				0.226	
Unem crisis vs. non-crisis					0.041

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged four times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 6. m1 (m4) is a test for first (fourth) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table A.2 in the Appendix A for the definition of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

2.7.5 Alternative measure of financial pressure

Next, to verify whether the results are derived from the firm-specific interest rate, a different definition of interest burden is considered. Following the work of Benito and Whitley (2003), an alternative interest burden measure is constructed, the implicit interest rate. Benito and Whitley (2003) find evidence of a statistically significant inverse relation between the firms' financial health and the firm implicit interest rate. To this end, it is employed a moving average of 3-year of the data on the debt variable which is centred on the current year. This is used as the denominator to calculate the implicit interest rate. Results are provided in Table 2.12 and should be compared with those from Table 2.6**.**

Table 2.12: Alternative definition of interest burden

	Baseline (1)	Crisis (2)
n_{it-1}	0.997***	0.981***
	(63.91)	(76.01)
IB^d_{it-1}	-0.073*	
	(-2.19)	
$IB^d_{it-1} * Crisis_t$		-0.061**
		(-2.44)
$IB^d_{it-1} * (1\text{-}Crisis_t)$		-0.011
		(-0.41)
Δw_{it}	-1.036**	-0.791***
	(-6.15)	(-4.85)
δ_{it}	0.488***	0.162
	(2.07)	(0.72)
w_{it-1}	0.006	-0.014
	(0.16)	(-0.46)
k_{it}	-0.013	-0.004
	(-1.28)	(0.52)
Observations	363,932	363,932
Firms	86,636	86,636
Sargan (p-value)	0.744	0.129
m1 (p-value)	0.000	0.000
m4 (p-value)	0.380	0.145
F-test of equality (p-value)		
IB crisis vs. non-crisis		0.021

All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged four times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 10 in column 1 and 10 in column 2. m1 (m4) is a test for first (fourth) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table A.2 in the Appendix A for the definitions of the variables. *, **, and *** indicate statistical significance at the 10 %, 5 %, and 1 % level, respectively.

Empirical findings show that the negative effect of interest burden on the level of employment remains statistically significant even after controlling for the crisis period (column 2). In fact, the alternative measure of interest burden is also negative and statistically significant during the crisis period than in the tranquil period. The p-value for the equality of the coefficients indicate a statistically significant difference between the two

coefficients. Overall, the main results are robust to using an alternative measure of the interest burden.

2.7.6 Different instrument for interest burden

In addition, it is also considered an alternative instrument for the interest burden based on the work of Nickell and Nicolitsas (1999). Table 2.13 presents the results for the baseline and the crisis models.

Empirical findings are robust to the results of Table 2.6. Column 1 provides evidence that the negative relation between interest burden and the level of employment remains negative and statistically significant. This effect continues to be stronger only during the turmoil period. Therefore, it is clear that independently of the instruments set which are used the results support the main empirical findings.

Table 2.13: Alternative instrument for interest burden

	Baseline (1)	Crisis (2)
n_{it-1}	0.986***	0.972***
	(106.85)	(99.93)
IB_{it-1}	-0.109*	
	(-1.91)	
$IB_{it-1} * (Crisis_t)$		-0.183***
		(-3.65)
$IB_{it-1} * (1\text{-}Crisis_t)$		-0.031
		(-0.91)
Δw_{it}	-1.320***	-0.924***
	(-10.64)	(-5.23)
δ_{it}	0.811***	0.866***
	(9.21)	(10.81)
w_{it-1}	-0.092**	-0.085**
	(-2.10)	(-2.38)
k_{it}	0.016**	0.017***
	(2.56)	(4.01)
Observations	399,948	399,948
Firms	94,395	94,395
Sargan (p-value)	0.015	0.010
m1 (p-value)	0.000	0.000
m4 (p-value)	0.047	0.080
F-test of equality (p-value)		
IB crisis vs non-crisis		0.002

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors four times or more with the exception of IB_{it-1}. The instrument for interest burden (IB_{it-1}) is defined as the product of debt-capital ratio two or three years lagged and the contemporaneous change in the 10-year bond yield. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity. m1 (m4) is a test for first (fourth) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation,with degrees of freedom for the sargan test equal to 17 in column 1 and 12 in column 2. See Table A.2 in the Appendix A for the definition of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

2.7.7 Alternative definitions for the crisis period

So far, the main empirical specifications take into consideration the crisis period between 2007 and 2009. As a robustness check of the main analysis, the crisis period is calculated for the period between 2008 and 2009. Equation (2.17) which is defined in sub-section 2.4.8 is used and the results are provided in Table 2.14.

Table 2.14: Alternative crisis period

n_{it-1}	0.976***
	(106.48)
$IB_{it-1} * Crisis_t^n$	-0.139*
	(-1.79)
$IB_{it-1} * (1\text{-}Crisis_t^n)$	-0.038
	(-0.48)
Δw_{it}	-1.111***
	(-8.89)
δ_{it}	0.841***
	(9.13)
w_{it-1}	-0.034
	(-0.59)
k_{it}	0.016**
	(2.16)
Observations	399,948
Firms	94,395
Sargan (p-value)	0.001
m1 (p-value)	0.000
m4 (p-value)	0.124
F-test of equality (p-value)	
IB crisis vs. non-crisis	0.041

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged four times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity. m1 (m4) is a test for first (fourth) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation, with degrees of freedom for the sargan test equal to 6. See Table A.2 in the Appendix A for the definition of the variables. *, **, and *** indicate statistical significance at the 10 %, 5 %, and 1 % level, respectively.

The above empirical findings are consistent with the previous results. Specifically, when comparing the role of interest burden during and outside the crisis, employment remains more sensitive to changes of firms 'interest burden during the crisis. The p-values for the difference between the two coefficients are statistically significant.

Moreover, the crisis period is also split in two phases of the crisis. Both periods correspond to the credit (i.e. 2008-2009) and debt (i.e. 2010-2011) crisis, respectively. Table 2.15 reports the estimates for the model that includes interaction terms between the interest burden, the periphery and non-periphery dummies, and the crisis and non-crisis dummies.

Table 2.15: Two phases of the crisis

n_{it-1}	0.995***
	(54.71)
IB_{it-1}*$Debt_t$*$Periphery_i$	-0.221**
	(-2.55)
IB_{it-1}*$Credit_t$*$Periphery_i$	-0.139**
	(-2.48)
IB_{it-1}*$Debt_t$*(1-$Periphery_i$)	0.416
	(1.38)
IB_{it-1}*$Credit_t$*(1-$Periphery_i$)	0.352
	(1.31)
IB_{it-1}*(1-$Debt_t$-$Credit_t$)*$Periphery_i$	-0.210
	(-1.30)
IB_{it-1}*(1-$Debt_t$-$Credit_t$)*(1-$Periphery_i$)	0.488
	(1.36)
Δw_{it}	-1.374***
	(-7.70)
δ_{it}	0.913***
	(5.87)
w_{it-1}	-0.150**
	(-2.49)
k_{it}	0.015
	(1.47)
Observations	399,948
Firms	94,395
Sargan	0.009
m1 (p-value)	0.000
m4 (p-value)	0.130
F-test of equality (p-value)	
IB debt crisis periph. vs. credit crisis periph.	0.031
IB debt crisis non-periph. vs. credit crisis non-periph.	0.654
IB credit crisis periph. vs. credit crisis non-periph.	0.076
IB debt crisis periph. vs. debt crisis non-periph.	0.049

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged four times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 13. m1 (m4) is a test for first (fourth) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. The latter takes the value of 1 in the years 2010-2011 and 0 otherwise. See Table A.2 in the Appendix A for the definition of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Results indicate that the interest burden is not statistically significant for the non-periphery countries. The debt-servicing cost ratio plays a significant role for the periphery firms during both crisis periods. Particularly, during the debt crisis, interest burden has a higher effect on periphery firms. Such pattern can be partially explained by the European sovereign debt crisis of the periphery countries, which have worse bank lending for firms. This is consistent Reichlin (2014). The author refers that the second recession is characterised by an unusual decrease of bank loans.

Finally, the p-values for the equality of the coefficients for periphery and non-periphery during both sub-periods (i.e. credit and debt) indicate a statistically significant difference between the coefficients. This means that the main results are found robust in the two alternative definitions of the crisis.

2.7.8 Alternative classification scheme

As an alternative classification scheme, the sample of firms is differentiated into SMEs and non-SMEs. Equation (2.11), equation (2.12) and equation (2.13) are re-estimated for the sample of SMEs and non-SMEs and empirical findings are presented in Table 2.16 and Table 2.17.

Starting with Table 2.16, the effect of interest burden is negative and statistically significant only for SMEs even during the crisis period. The differences between crisis and non-crisis period remain statistically significant as before. The results show that SMEs in the periphery area are more vulnerable during the financial crisis period. This is consistent with Darvas (2013). The author argues that SMEs have a higher vulnerability during the turmoil period since they suffer from higher levels of information asymmetry and higher costs of borrowing.

Table 2.17 reports the results for SMEs and non-SMEs at the periphery and non-periphery countries during and outside of the crisis periods. Empirical findings show that the response of employment to interest burden is detectable only for SMEs during the crisis in the periphery countries. This is in line with the argument of Artola and Genre (2011). According to the authors SMEs, especially those in the periphery economies have more serious problems of accessing finance than non-periphery firms.

Table 2.16: Baseline and crisis models for SMEs and non-SMEs

	SMEs		Non-SMEs	
	Baseline (1)	Crisis (2)	Baseline (3)	Crisis (4)
n_{it-1}	0.973***	0.970***	0.974***	0.966***
	(89.84)	(91.01)	(19.82)	(18.69)
IB_{it-1}	-0.241***		0.057	
	(-3.29)		(1.11)	
$IB_{it-1}*Crisis_t$		-0.231***		0.011
		(-3.96)		(0.10)
$IB_{it-1}*(1\text{-}Crisis_t)$		-0.058**		0.064
		(-2.13)		(0.97)
Δw_{it}	-1.449***	-1.054***	-0.153	-0.126
	(-9.87)	(-8.55)	(-1.49)	(-0.40)
δ_{it}	0.797***	0.489***	0.370**	0.398**
	(7.73)	(3.40)	(2.20)	(2.38)
w_{it-1}	-0.168***	-0.107***	-0.153	-0.182
	(-3.04)	(-3.30)	(-1.49)	(-1.61)
k_{it}	0.027***	0.013**	0.006	-0.014
	(3.50)	(2.53)	(-0.22)	(-0.47)
Observations	376,959	376,959	22,989	22,989
Firms	88,872	88,872	8,060	8,060
Sargan (p-value)	0.412	0.035	0.711	0.673
m1 (p-value)	0.000	0.000	0.000	0.000
m4 (p-value)	0.125	0.040	0.298	0.352
F-test of equality (p-value)				
IB crisis vs. non-crisis		0.001		0.685

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged four times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 15 in column 1, 11 in column 2, 16 in column 3 and 16 in column 4. m1 (m4) is a test for first (fourth) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. SMEs are firms that have less than 250 employees and a total revenue equal or less than €50 million. See Table A.2 in the Appendix A for the definition of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 2.17: Periphery, non-periphery, SMEs and non-SMEs

	SMEs (1)	Non-SMEs (2)
n_{it-1}	0.995***	0.954***
	(61.67)	(21.95)
IB_{it-1}*$Crisis_t$*$Periphery_i$	-0.176**	0.329
	(-2.52)	(1.13)
IB_{it-1}*(1-$Crisis_t$)*$Periphery_i$	-0.047	0.165
	(-1.06)	(1.14)
IB_{it-1}*$Crisis_t$*(1-$Periphery_i$)	0.329	0.083
	(1.14)	(0.70)
IB_{it-1}*(1-$Crisis_t$)*(1-$Periphery_i$)	0.143	0.026
	(1.00)	(0.39)
Δw_{it}	-0.961***	-0.245
	(-3.78)	(-0.80)
δ_{it}	0.910***	0.343**
	(4.93)	(2.35)
w_{it-1}	-0.112**	-0.127
	(-2.34)	(-1.26)
k_{it}	-0.011	0.013
	(1.36)	(0.55)
Observations	376,959	22,989
Firms	88,872	8,060
Sargan (p-value)	0.659	0.164
m1 (p-value)	0.000	0.000
m4 (p-value)	0.021	0.631
F-test of equality (p-value)		
IB crisis periph. vs. non-crisis periph.	0.014	0.590
IB crisis non-periph. vs. non-crisis non-periph.	0.339	0.695
IB non-crisis periph. vs. non-crisis non-periph.	0.271	0.339
IB crisis periph. vs. crisis non-periph.	0.085	0.267

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged four times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity , with degrees of freedom for the sargan test equal to 11 in column 1, 18 in column 2. m1 (m4) is a test for first (fourth) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. SMEs are firms that have less than 250 employees and a total revenue equal or less than €50 million. See Table A.2 in the Appendix A for the definition of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

2.7.9 Alternative cut-off value

As a final robustness check for Chapter 2 a different cut-off value for the sample of constrained and unconstrained firms is considered. In the main empirical results, the 50th percentile is used as a cut-off to define financially constrained and unconstrained firms. To ensure that the results are not driven from the way the sample is divided, in Chapter 2 it is considered an alternative benchmark level of 75%. The models from Table 2.8 and Table 2.9 are re-estimated for this new cut-off point. Results are shown in Table 2.18 and Table 2.19.

Table 2.18: Alternative classification scheme for financial constraints

	Constrained= BankDep (1)	Constrained= Size (2)
n_{it-1}	0.983***	0.962***
	(0.012)	(55.33)
$IB_{it-1}*Crisis_t*Constrained_{it}$	-0.165***	-0.165***
	(-2.94)	(-3.07)
$IB_{it-1}*(1\text{-}Crisis_t)*Constrained_{it}$	0.005	-0.085**
	(0.06)	(-2.24)
$IB_{it-1}*Crisis_t*(1\text{-}Constrained_{it})$	0.232	0.030
	(1.27)	(0.37)
$IB_{it-1}*(1\text{-}Crisis_t)*(1\text{-}Constrained_{it})$	0.300	0.031
	(1.61)	(0.79)
Δw_{it}	-1.035***	-1.008***
	(-6.98)	(-8.00)
δ_{it}	0.675***	0.576***
	(5.33)	(4.66)
w_{it-1}	-0.057	-0.119***
	(-1.20)	(-4.40)
k_{it}	0.015	0.009*
	(1.55)	(1.79)
Observations	399,948	399,948
Firms	94,395	94,395
Sargan (p-value)	0.017	0.003
m1 (p-value)	0.000	0.000
m4 (p-value)	0.233	0.114
F-test of equality (p-value)		
IB crisis Dummy vs. non-crisis Dummy	0.023	0.027
IB crisis 1-Dummy vs. non-crisis 1-Dummy	0.320	0.989
IB non-crisis Dummy vs. non-crisis 1-Dummy	0.131	0.050
IB crisis Dummy vs. crisis 1-Dummy	0.024	0.012

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged four times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 8 in column 1, 18 in column 2. m1 (m4) is a test for first (fourth) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. The variable $Constrained_{it}$ indicates in turn Bank dependence and small firms. Classification is based on BankDep (Size) at the top (bottom) 75% of the distribution of all firms operating in the same industry at a given year. See Table A.2 in the Appendix A for the definition of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Comparing the results in Table 2.18 with those of Table 2.8, it seems that financially constrained firms show the same sensitivity to the financial crisis while unconstrained

firms remain largely unaffected. Finally, from Table 2.19 it is clear that the differential effect of interest burden on employment continues to be statistically significant only for constrained firms in the periphery during the crisis. Therefore, the findings are robust to the selection of different cut-off values.

Table 2.19: Financial constraints, periphery, non-periphery and the crisis

	Periphery		Non-periphery	
	Constrained= BankDep	Constrained= Size	Constrained= BankDep	Constrained= Size
	(1)	(2)	(4)	(5)
n_{it-1}	0.995***	0.967***	0.924***	0.898***
	(71.41)	(72.48)	(30.22)	(23.99)
IB_{it-1}*$Crisis_t$*$Constrained_{it}$	-0.130**	-0.093**	0.014	-0.243
	(-2.23)	(-2.11)	(0.24)	(-1.06)
IB_{it-1}*(1-$Crisis_t$)*$Constrained_{it}$	0.006	-0.060**	0.024	-0.443
	(0.10)	(-2.05)	(0.43)	(-1.37)
IB_{it-1}*$Crisis_t$*(1-$Constrained_{it}$)	0.193	-0.087	-0.050	0.074
	(1.40)	(-1.25)	(-0.49)	(0.37)
IB_{it-1}*(1-$Crisis_t$)*(1-$Constrained_{it}$)	0.130	0.002	-0.085	0.124
	(1.00)	0.06	(-0.98)	(1.01)
Δw_{it}	-1.094***	-0.965***	0.046	-0.134
	(-7.66)	(-9.13)	(0.48)	(-0.74)
δ_{it}	0.902***	0.792***	0.586***	0.615***
	(6.36)	(7.32)	(4.95)	(4.34)
w_{it-1}	-0.047	-0.056**	0.034	-0.258
	(-1.36)	(-2.12)	(0.55)	(-1.12)
k_{it}	0.030***	0.016***	0.018**	0.017**
	(3.43)	(2.61)	(2.53)	(1.99)
Observations	278,245	278,245	121,703	121,703
Firms	63,124	63,124	31,271	31,217
Sargan	0.000	0.000	0.065	0.252
m1 (p-value)	0.000	0.000	0.000	0.000
m4 (p-value)	0.637	0.154	0.233	0.323
F-test of equality (p-value)				
IB crisis Dummy vs. non-crisis Dummy	0.057	0.406	0.858	0.424
IB crisis 1-Dummy vs. non-crisis 1-Dummy	0.351	0.137	0.708	0.697
IB non-crisis Dummy vs. non-crisis 1-Dummy	0.398	0.914	0.321	0.163
IB crisis Dummy vs. crisis 1-Dummy	0.012	0.191	0.633	0.277

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged four times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity with degrees of freedom for the sargan test equal to 13 in column 1, 22 in column 2, 31 in column 3 and 19 in column 4. m1 (m4) is a test for first (fourth) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. The variable $Constrained_{it}$ indicates in turn bank dependence and small firms. Classification is based on BankDep (Size) at the top (bottom) 75% of the distribution of all firms operating in the same industry at a given year. See Table A.2 in the Appendix A for the definition of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

2.8 Concluding remarks

The literature on financial constraints and firms' behaviour has mainly considered the impact of financial pressure for firms in the U.K., Spain and China. This chapter goes one step further and investigates how debt-servicing costs measured as interest burden affect firms' behaviour during the recent financial crisis in the euro area.

The empirical findings introduce four main implications. Firstly, it is clear that interest burden affects firms' employment decisions. The debt-servicing costs variable exerts a negative influence on employment. These results are as expected. In other words, since the majority of firms in the sample are unquoted, they rely on external sources to finance debt. Unquoted firms are more likely to suffer from asymmetric information and therefore face problems of financing constraints. Results are in line with previous studies (Nickell and Nicolitsas, 1999; Benito and Hernando, 2008; Chen and Guariglia, 2009). Secondly, the findings also demonstrate that the impact of interest burden on firms' workforce is higher during the 2007-2009 crisis compared to the tranquil period. This is also consistent with the idea that during periods of financial pressure employment behaviour is associated with changes in firms' financial conditions (Görg and Spaliara, 2014; Guariglia et al., 2015).

Thirdlt, when differentiating firms according to the euro area region, the results show that interest burden has no effect on the non-periphery firms. Conversely the debt-servicing cost ratio has a negative and significant impact on periphery firms. The empirical findings suggest that firms in the periphery economies are more vulnerable to tight monetary policies. The result may be explained by the higher dependence on external sources of finance. During an economic downturn, external finance is more costly, affecting firms' financial position. These changes affect firms' labour decisions and their level of employment. Previous empirical evidence shows that debt-servicing costs affect firms' behaviour (Spaliara, 2009; Guariglia et al., 2015). Furthermore, results also demonstrate that for periphery firms during the recession period, the effect of interest burden on the level of employment is intensified.

Finally, the influence of financial constraints on the response to interest burden is only significant during the crisis period. In fact, the impact of financial pressure on employment is only detectable for firms which are classified as financially constrained and operating in the periphery economies. On the other hand, firms which belong to the non-periphery countries show no statistically significant response during periods of crisis and non-crisis. The main empirical findings are also robust to a set of different criteria. Overall the results suggest that financial pressure in the form of interest burden plays a key role on the level of employment for euro area firms, especially for financially constrained ones in the periphery region.

3 Chapter 3: Cash holdings of private and public firms in the euro area

3.1 Introduction

A relevant aspect of firms' financial management is the decision-making in cash holdings. One of the advantages of holding cash is that firms can increase their liquidity (Pelly and Krämer-Eis, 2011). Firms which suffer from more from capital market imperfections should hold more cash since hoarding cash helps firms to increase their ability to undertake investment opportunities (Arslan et al., 2006). Thus, understanding cash holdings decisions is an important element on the analysis of firms' behaviour.

Small firms sector are often considered to be an important engine for the development of the eurozone. For example, in 2007, SMEs generated 58% of the value added and 52% of the total sales in the euro area business economy (Audretsch et al., 2009). Within the SMEs sector, 92% of the firms were micro firms. This clearly shows the key part small firms play in the economy. Nevertheless, the literature on cash holdings has mainly analysed the determinants and implications of holding cash for firms which are listed in stock market (Opler et al., 1999; Almeida et al., 2004). Only recently, a limit number of studies explore the determinants of cash holdings for large public and private firms (Akguc and Choi, 2013; Gao et al., 2013; Farre-Mensa, 2014). Surprisingly, the literature is relatively silent regarding the behaviour of small firms.

Based on the above, Chapter 3 tests the cash holdings behaviour of privately held and publicly traded firms in euro area over the period 2003-2011. This chapter focuses on ten euro area countries (Austria, Belgium, France, Germany, Greece, Italy, Luxembourg, Netherlands, Portugal and Spain). The reason to do so relates to the recent studies which find that public firms hold more cash than their private counterparts in the U.S. and Europe due to agency motives (Akguc and Choi, 2013; Gao et al., 2013). This goes against the earlier literature on cash holdings which denote that firms with greater information asymmetry alleviate costly external finance by retaining higher levels of cash (Opler et al., 1999; Ozkan and Ozkan, 2004). Therefore, private firms which in theory have more difficulties in accessing capital markets, should hold more cash than their public counterparts.

The value added of this chapter is threefold. This chapter makes the first contribution by selecting a large panel of small euro area firms to test whether private firms hold higher cash levels than their public counterparts. While previous studies have used firms which are large, the majority of the firms in this chapter are relatively small when comparing with previous studies.[42] In fact, 90% of the firms in Chapter 3 are not quoted in the stock

[42]Note that Akguc and Choi (2013), Gao et al. (2013) and Farre-Mensa (2014) have used a sample of firms from Capital IQ database. This database only reports information on private and public firms with

market. Investigating the role of capital market imperfections focusing on cash reserves of small firms rather than of large ones is important since it allows me to contribute to the literature on financial constraints and cash holdings (Almeida et al., 2004). Small and unquoted firms face higher levels of information asymmetry comparing with their larger counterparts. As a result the former should hold more cash as a precaution against the possibility of cash flows shortfall in the future.(Keynes, 1936; Baumol, 1952; Miller and Orr, 1966) Firms with greater information asymmetry alleviate costly external finance by retaining higher levels of cash.

Secondly, this chapter tests the impact of financial pressure (in the form of the credit risk) on firms' cash holdings decisions. This is based on one of the most known areas of research in corporate finance, i.e., the literature on financial constraints and firms' real activities. It is well established that both information assymetry and agency costs upon lending are not evenly distributed across firms. As a consequency, firms are more or less likely to suffer from financially constraints on their access to external market. A limited number of studies have only linked cash holdings with the cash flow sensitivity of cash as a measure for financial constraints (Almeida et al., 2004; Han and Qiu, 2007; Pál and Ferrando, 2010). Recently, Acharya et al. (2012) argue that in the presence of financial constraints, firms which suffer from higher levels of financial pressure (i.e. firms with lower expected cash flows and lower credit worthiness) decide to uphold higher levels of cash reserves as a buffer against possible cash flow shortfall in the future. Drawing on the these new insights from the literature on cash holdings and financial constraints (Acharya et al., 2012), this chapter aims at advancing our understanding on the role of financial pressure by exploring whether the relative difference of cash holdings between public and private firms is affected by their level of credit risk.

Finally, it is investigated the extent to which public and private firms follow a target cash level. In particular, it is tested whether there is a difference in the speed of adjustment to target cash levels of private and public firms. The reason to do so is that in an imperfect capital market, the existence of adjustment costs prevents actual cash holdings from adjusting to their target levels instantly (Gao et al., 2013). The argument is simple to follow. If firms which suffer from higher (lower) financial frictions and have a better (worse) access to external markets, as it is argued in the literature on financial constraints, then these firms should adjust their actual cash positions towards their target cash levels quicker (slower). Hence, in Chapter 3 the argument is that private firms (which suffer from higher levels of financial frictions) are able to adjust to their target cash levels slower than their public counterparts. Previous studies explore the speed of adjustment of cash holdings on large publicly traded and private firms using a partial adjustment model

a minimum annual revenue of approximately 5 million euros. Amadeus, which is the database used in this chapter includes information on firms with less than 2 million euros.

(Akguc and Choi, 2013; Gao et al., 2013). This chapter uses a dynamic adjustment model to analyse the cash holding behaviour of euro area public and private firms.

The rest of this chapter is organised as follows. Sub-section 3.2 reviews the theories and empirical literature. Sub-section 3.3 summarises the research design while sub-section 3.4 denotes the model specification. Sub-section 3.5 provides the empirical methodology whereas sub-section 3.6 describes the data which is used. Finally, sub-section 3.7 and sub-section 3.8 provide the empirical results and concluding remarks, respectively.

3.2 Literature review

In a world of perfect markets, holding cash neither creates or destroys value. There is no information asymmetry, transaction costs and taxes. In an imperfect market setting transactions costs and taxes are constraints which firms face. There is no liquid premium and firms have an incentive to hold a substantial portion of their assets in the form of cash and liquidity securities (Denis, 2011).

The availability of external funding, especially the availability and cost of external finance is quite important for firms, especially for SMEs. These conditions may affect firms' corporate behaviour, i.e. firms' investment and the amount of cash reserves. Cash holdings have been studied extensively in the financial literature. Chapter 3 reviews the theoretical and empirical literature on cash holdings decisions.

3.2.1 Theoretical and empirical background

Prior literature has tested the determinants of cash holdings based on different theories and motives. The former is employed to explain the volume of firms' cash reserves. The latter is used under the idea that in a imperfect market setting firms have several motives to hold cash.

Prior research has tested the determinants of cash holdings in light of three main theoretical models: the trade-off theory, the pecking order theory and the cash flow theory. The trade-off model is based on the assumption that firms' have an optimal level of cash. To do so, firms weight the marginal benefits and marginal costs of holding cash (Miller and Orr, 1966). According to Ferreira and Vilela (2004) holding cash has several benefits for the firms. First, it acts as a safety reserve, minimizing the likelihood of financial distress. Cash helps dealing with unexpected losses, creates a buffer that allows managing the operating cycle, and allows firms to deal more efficiently with external fund-raising constraints. Second, having readily available cash minimizes the likelihood of having to forgo new Net Present Value (NPV) projects when access to new debt or equity is difficult. Holding cash has also a higher opportunity cost, which is a direct consequence of the low return one can earn on liquid assets.

The pecking order theory of Myers (1984) refers that firms do not have an optimal debt level. Under an imperfect capital market setting, the presence of information asymmetry leads firms to prefer internal finance to external sources. External finance is costly due to transaction costs, tax issues, costs of financial distress as well as costs associated with problems of information asymmetry (Allen and Santomero, 1997).

This theory proposes that firms only resort to external finance when internal cash flows are not sufficient to meet the financial demands of new positive NPV. Under this theory assumptions, equity is considered to be the most expensive source to obtain finance. According to Benito and Whitley (2003) new equity issues are associated with various costs, i.e. registration fees, taxes, selling and administrative expenses. Therefore, first firms employ their accumulated cash reserves to finance new projects. Only if it is needed they issue debt and then equity.

The free-cash flow theory of Jensen (1986) indicates that there is agency conflicts between managers and shareholders. Managers have an incentive to build up cash to increase the amount of assets under their control (Ferreira and Vilela, 2004). This allows them to gain discretionary power over firms' investment decisions.

This theory is based on the agency cost assumption which is developed by Jensen and Meckling (1976). Agency costs arise when there is a separation between ownership and control, i.e. managers and shareholders have different views regarding the costs and benefits of holdings the cash. Thus, this theory assumes that the availability of free cash flow allows managers to invest in negative NPV projects rather than paying dividends to shareholders (Stulz, 1999). Jensen (1986) defines free cash flow as the cash flow which is left after the firms have invested in all available positive NPV projects. Therefore, the aim of the firms is to increase their size investing in all type of projects.

Furthermore, the literature shows that these main theories that are discussed above may be derived from four main motives of cash holdings: the transaction cost motive, the precautionary cost motive, the agency motive and the tax motive.

The transaction cost motive corresponds to the cost that firms face when converting non-financial assets in cash and the uses of cash for payments. Thus, holding liquid assets avoids the transaction costs of selling illiquid assets and avoids the need for external funds (Baumol, 1952; Miller and Orr, 1966) Under the precautionary motive, firms hold cash as a precaution against possible adverse shocks in the future, especially if external financial cost is costly or unavailable for firms (Pinkowitz and Williamson, 2002).

The agency motive to hold cash is based on the assumption of Jensen and Meckling (1976). The conflicts of interest between managers and shareholders exert an impact on cash holdings decisions. Entrenched managers choose to hoard cash than to increase pay-outs to shareholders in a period when investment prospects are low for the firms (Dittmar and Mahrt-Smith, 2007). Finally, the tax motive is based on the assumption that multina-

tional firms benefit from allocating foreign assets to cash if they are faced with heavy tax expense by repatriating foreign earnings and if they cannot find more profitable investment opportunities abroad (Foley et al., 2007).

3.2.2 Determinants of listed firms cash holdings

The initial empirical literature has mainly focused on the determinants of cash reserves for listed firms. Firms' cash holdings decisions are first studied by Kim et al. (1998). The authors consider an optimal cash reserves model and tests the trade-off between the low return earned on liquid assets and the benefit of minimising costly external finance.

The authors use a panel of 915 industrial U.S. firms between 1975-1994. Two proxies for the cost of external finance are implemented. Size is used as a proxy for the cost of external finance since smaller firms are more likely to face higher costs of borrowing (Fazzari and Petersen, 1993). The variable growth opportunities is also taken into account. A cross-sectional regressions is implemented. It uses the time-series averages for each firms' variable.

Results indicate that firms have an optimal amount of liquidity. Firms which present higher costs of external finance in the form of growth opportunities and size tend to hold higher cash reserves. Cash varies inversely with leverage, probability of bankruptcy, and operating performance.

Following the work of Kim et al. (1998), Opler et al. (1999) create the most known model of cash holdings' decisions. The authors first test whether firms have target cash levels. To do so, the authors use a sample of 1,048 U.S. publicly traded firms during the 1971-1994. Opler et al. (1999) associate firms' actual cash with their target cash reserves. Firm specific characteristics are employed as determinants of cash decisions of a firm (i.e. size, leverage, dividends, financial distress costs and market to book ratio). An adjustment partial model similar to the one in Shyam-Sunder and Myers (1999) is used.[43] Opler et al. (1999) findings support only for the precautionary motive to hold cash and the trade-off theory. Firms in the sample follow a target cash level.

Secondly, to account for the pecking order assumptions, Opler et al. (1999) consider that changes in cash reserves are given by the flow of funds of deficit. The flow of funds of deficit is calculated as cash dividends plus capital expenditures, the change in net working capital less cash, plus the current portion of long term debt due minus the operating cash flow. The same partial adjustment model is used. Empirical findings suggest that the flow of funds deficit explain changes in cash reserves. This is consistent with the pecking order theory.

In addition, the authors regress cash holdings on firms' specific characteristics (i.e.

[43] Shyam-Sunder and Myers (1999) use a target adjustment model which shows that changes in the debt ratio are explained by deviations of the current ratio from the target.

size, leverage, dividends, financial distress costs and market to book ratio). The aim is to measure the level of firms' liquidity. Different methodologies are implemented. Opler et al. (1999) use a cross sectional regression, a fixed effect regression and the method of Fama and MacBeth (1973).[44]

Firms with strong growth opportunities, riskier cash flows and with smaller size hold higher levels of cash when comparing with larger ones. The authors refer that firms hold cash to save transaction costs when raising funds, avoiding liquidating assets to make payments. Opler et al. (1999) conclude that transaction costs and costs associated with asymmetric information are important factors in the trade-off theory assumptions. Finally, the model of cash holdings is re-estimated omitting some of the firm-specific characteristics (i.e. capital expenditures, dividends and leverage). According to the authors, using these specific variables simultaneously can lead to inconsistent estimates. However, results remain robust to the previous findings.

3.2.3 Corporate governance

A second set of the literature refers that the financial structure of the countries and its legal system have an effect on firms' corporate governance structure and consequently its cash holdings' decisions. For example, Dittmar et al. (2003) investigate the role of shareholders protection in a multi-country setting. More specifically, the authors test whether in countries with less developed capital markets, firms may have a limit access the external finance due to the higher transaction costs of raising funds (Ferreira and Vilela, 2004).

A sample of 11,000 listed firms are used from 45 different countries for the year of 1998. Firms' cash holdings are regressed on a set of firm-specific characteristics (i.e. market to book, size, net working capital, cash flow, R&D), common law, private bank credit to GDP, external capital held by minority shareholders and the shareholders' right index. The latter is first developed by La Porta et al. (1997) and it is a measure of corporate governance.[45] A pooled OLS regression is employed.

Results provide evidence of an influence of shareholders' protection on firms' cash reserves decisions. In countries with lower shareholders protection, firms retain more

[44] Fama and MacBeth (1973) approach is an alternative method to estimate the regression coefficients and standard errors when the residuals are not independent. In other words, it is a two-stage approach. It is a method which uses a time series regression to estimate betas and a cross-sectional regression to test the hypothesis derived from the Capital Asset Pricing Model (CAPM).

[45] La Porta et al. (1997) investigate the impact of a country legal system in protecting corporate shareholders rights on a sample of 49 countries. They refer that commercial legal codes of most countries are based in four main traditions: English common law, French or Roman civil law, German civil law and Scandinavian law. La Porta et al. (1997) employ three different index, i.e. anti-director rights index (shareholders protection), creditor rights index (creditor protection) and rule of law index (based on the country risk rating). The results suggest that common law countries provide the most protection to investors. On the other hand, shareholders and creditors suffer from the weakest level of protection when firms are located in countries which are rooted in Roman law.

than twice the amount of cash when comparing to firms in those countries with higher shareholder protection.

Guney et al. (2003) extend the work by Dittmar et al. (2003). The authors explore how legal and institutional characteristics affect firms' cash holdings policies. Guney et al. (2003) assume that higher credit protection and stronger rule of law should increases the probability of financial distress of firms leading firms to accumulate more cash. As a result, their main aim is to test whether target cash levels are different for firms in different countries. A sample of 3,989 publicly traded firms from France, Germany, Japan and U.K. over the period of 1983 to 2000 is employed.

The authors use the same model as Dittmar et al. (2003) but include the a law index, an ownership concentration index and the degree of creditor protection. These indicators account for legal and institutional characteristics. A GMM estimator is used.

Results demonstrate that higher levels of shareholders rights are associated with lower levels of cash reserves. According to the authors, results demonstrate that firms which operate in countries with higher shareholders protection should have a better access to capital markets. Good law enforcement and strong creditor rights are related to higher cash reserves.

Ferreira and Vilela (2004) investigate a sample of listed firms for 12 European countries (i.e. Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain). Contrary to the previous studies (Kim et al., 1998; Opler et al., 1999) the authors explore firms' cash holdings in countries with different corporate governance and financial structure. Using a sample of 400 listed firms for the period 1987-2009, the authors employ the methodology in Fama and MacBeth (1973) and pooled time-series regressions. The results show a positive relation between firms' cash holdings and investment opportunities. Liquid assets, size, leverage and bank debt are negatively related with cash holdings.

Furthermore, Ozkan and Ozkan (2004) explore the empirical determinants of cash holdings for a sample of U.K. firms. More specifically, it is investigated whether managerial ownership has an impact on firms' cash holdings decisions. According to the authors, the U.K. corporate sector lacks of efficient monitoring and external market discipline. This means that managers have an incentive to increase cash to pursue their own interest which may include higher cash reserves. The authors test if firms' corporate governance factors have an effect on cash reserves and serve as incentive for managers to hold cash.

A sample of 839 listed U.K. firms for the period of 1984 to 1999 is employed. The authors construct cash holdings as a function of firm-specific characteristics (i.e. cash flow, liquidity, variability, leverage, bank debt, market-to-book, size, dividends) and a set of corporate governance proxies (i.e. firms' board structure, existence and identity of control shareholders, discrepancy between largest shareholders' control rights and cash

flow rights). To avoid biased estimates, Ozkan and Ozkan (2004) expand the target-adjustment model by Opler et al. (1999) and include unobservable fixed effects, fixed effects and firm-specific factors. A first-difference GMM estimator is employed.

Empirical findings show a non-monotonic relation between managerial ownership and cash reserves. Firms with families as controllers have a tendency to hold more cash comparing with those which controllers are financial institutions. The results show a positive relation between cash flow, growth opportunities and cash reserves. Liquidity has a negative impact on the level of cash holdings, whereas higher cash holdings are related with lower levels of bank debt.

3.2.4 Financial constraints

Another set of the literature has considered that firms suffer from financial frictions from the market to save cash out of cash flow. This is based on the theoretical model which is first defined by Almeida et al. (2004). According to the authors, the discrepancy in the response of cash reserves to operating cash flow (i.e. the cash flow sensitivity of cash) among financially constrained and unconstrained firms is explained by the imperfections of the financial markets.

Almeida et al. (2004) develop a empirical model of the cash flow sensitivity of cash to explain the link between financial constraints and cash reserves. The cash flow sensitivity of cash is defined as the change in cash due to changes in cash flow and should be higher for financially constrained firms. Almeida et al. (2004) argue that financially constrained firms have a tendency to hold higher levels of cash as a buffer to balance the profitability of current and future investments. Unconstrained firms should not display a systematic propensity to hoard cash. These firms face less difficulties in accessing the markets and have a lower propensity to hold cash.

To empirically test their hypothesis, the authors employ a sample of 29,954 firm-year observations from U.S. listed firms over the 1971 to 2000 period. The model captures the effect of cash flow in the change in cash holdings and includes a set of control variables (i.e. Tobin's Q, size, expenditures, acquisitions, net working capital and change in short term debt). Firms are classified as constrained/unconstrained based on several criteria. The payout ratio, size, bonds, commercial paper rating, the Kaplan and Zingales (1997) index are used as a classification scheme. An OLS and IV estimations are used.

Results indicate that constrained firms have a positive sensitivity of cash to cash flow. However, there is no statistically significant effect for unconstrained firms. According to the Almeida et al. (2004) the macroeconomic conditions explain the results. Under a tight credit market, financially constrained firms hold higher levels of cash. They conclude that the precautionary motive for holding cash exists especially for financially constrained firms.

Han and Qiu (2007) expand the model of Almeida et al. (2004) and investigate whether firms' cash holdings change in the presence of cash flow volatility. In their model, Han and Qiu (2007) assume that firms' choice to invest over two periods cannot hedge future cash flow risk directly in the market. To hedge for future cash shortage, firms' rely on their cash holdings. The model explores optimal investment and corporate cash holdings in a setting which allows to capture the precautionary motive of holdings cash.

A sample of publicly trade U.S. firms using quarterly data from 1997-2002 is employed. The sample of firms is also divided apriori into constrained and unconstrained. The following proxies are implemented: dividend payout, size, bond ratings and commercial paper ratings. A first-difference GMM estimator is used.

Results show that the impact of cash flow volatility on cash holdings depends on whether a firm is considered to be constrained. Firms which are classified as financially constrained increase their level of cash holdings in response to a raise in the cash flow volatility. Unconstrained firms show no systematic relation between cash holdings and cash flow volatility. The results demonstrate that financial constraints have an impact on the relation between cash flow volatility, cash reserves and investment.

Lin (2007) examines the impact of operating cash flow in firm cash policies in Taiwan. The author extends the model of Almeida et al. (2004) and includes debt and equity issuances. The author argues that operating cash flow is a relevant determinant of corporate debt/equity policies. This is due to the fact that new debt/equity are hold as cash before they are spent.

A sample of publicly traded firms in Taiwan are used from 1990 to 2004. Changes in cash holdings is a function of operating cash flow, sum of net debt/equity issuances, changes in the interest rate and other control variables (i.e. change in net working capital, market-to-book ratio, size, R&D). The author considers that external finance and changes in cash reserves are jointly determined which means that net debt/equity issuances and innovations in changes in cash reserves may be correlated. To account for this the author uses a fixed effects two least square (FE-2SLS) and a fixed effects three least square (FE-3SLS).[46]

Contrary to previous studies Lin (2007) uses a new method to define financially constrained/ unconstrained firms, i.e. the investment-dividend correlation method of Moyen (2004). According to the author there is a correlation between investment and dividends. This investment-dividend correlation is positive (negative) for financially constrained (unconstrained) firms.

Lin (2007) classifies the sample of firms based on the above methodology and on common measures from the literature of financial constraints (i.e. age, bank debt to total debt

[46] According to Greene (2012), while the FE-2SLS control for possible endogeneity of the regressors and unobserved heterogeneity it does not take into account the simultaneity problem among regressors. Contrary to the FE-2SLS, the FE-3SLS approach is considered to be asymptotically efficient.

ratio, issuance of public debt). Results show that only both constrained/unconstrained firms have a positive cash flow sensitivity of cash. This effect is stronger to financially constrained firms. Firms with access to the bond market hold more cash out of cash flow than firms which do not issued any public debt.

Recently, Pál and Ferrando (2010) challenge the work by Almeida et al. (2004). They refer that the model of Almeida et al. (2004) is not able to test the degree of financial constraints firms face. To account for this issue, they identify a priori groups of firms which experience different financial conditions. They first identify those firms with the better financial conditions. Then, the authors determine whether the liquidity demand test is able to differentiate these firms from the rest of the sample.

Using a sample of 2,190 listed and unlisted euro area firms during the 1994-2003 period, it is tested whether small and unlisted firms are more affected by worse financial conditions when comparing to their large counterparts. The authors use the empirical model by Almeida et al. (2004). They divide the sample of firms a priori using asset size, number of employees and quotation. An OLS regression is employed controlling unobserved individual heterogeneity by firms.

Secondly, Pál and Ferrando (2010) employ a new a priori classification scheme for firms. They rank them in three different groups: absolutely constrained, constrained in the relative sense and unconstrained firms. Pál and Ferrando (2010) follow the work by Vermeulen (2002). They define absolutely constrained firms as those which cannot obtain new debt and financing through external sources. Constrained firms are those which access to capital market is costly whereas unconstrained firms are those with no difficulties in obtaining external finance.

In other words, the authors explore whether the presence of financing constraints is based on the relation of the financial variables (i.e. asset size, number of employees and quotation) within three different scenarios. A dynamic model of cash is also developed and includes all types of debt (i.e. trade credit, short and long term debt). A two-step system GMM estimator is applied. Results show that find absolutely constrained and constrained Euro area firms invest at a lower rate, grow slower and hold higher levels of cash which increases during periods of financial turmoil. On the other hand, unconstrained firms save more cash with an increasing long-term debt.

3.2.5 Macroeconomic uncertainty

Prior research has mainly considered the effect of financial constraints on firms' cash decisions. However, these studies have not focused exactly on the influence of macroeconomic uncertainty on firms' demand for liquid assets. Baum et al. (2006) are the first to link macroeconomic uncertainty with firms' cash decisions. The authors argue that firms define their level of cash holdings based on the level of macroeconomic uncertainty they face.

Baum et al. (2006) employ a sample of 4,125 non-financial U.S. firms between the period of 1970 and 2000. The cross-sectional distribution of firms' cash to total assets ratios is a function of several measures of macroeconomic uncertainty. The following proxies are used: overall macroeconomic activity (i.e. a monthly measure of real GDP), monthly index of industrial production variable, uncertainty related to nominal magnitudes variable (i.e. a monthly rate of consumer price inflation) and the financial market uncertainty variable (i.e. monthly returns on the Standard and Poor's 500 share index). The authors use an IV estimator where the macroeconomic volatility proxies are weighted averages of lagged effects.

Baum et al. (2006) classify the sample of firms based on two different criteria. First, they define high-growth/low-growth firms based on their growth in real total assets. High-growth (low-growth) firms are defined as those above (below) the 75th (25th) percentile of the annual distribution of growth in real total assets. Second, Baum et al. (2006) distinguish between financially constrained and unconstrained firms based on the level of dividends. Financially constrained (unconstrained) firms are those which their dividend payout ratio is below (above) the 25th percentile or corresponds to those firms not paying dividends. Empirical findings suggest that macroeconomic uncertainty affects negatively firms' cash reserves. High-growth, constrained and capital intensive firms are quite sensitive to macroeconomic conditions.

Baum et al. (2010) explore the effect of leverage on firms' capital investment behaviour under capital market uncertainty. The authors employ a sample of 7,769 firm-year observations from U.S. manufacturing firms during the 1988-2005 period. The authors use a standard investment model which uses as explanatory variables the lag of the dependent variable, cash flow, leverage and the lagged value of intrinsic uncertainty. A system-GMM estimator is employed. Results show that the impact of leverage on capital investment depends on the effect of uncertainty. To be specific, leverage exerts a stimulative role in investment at lower levels of uncertainty. However, from the moment market uncertainty crosses a certain threshold, leverage decreases firms' investment.

Chen and Mahajan (2010) also test the impact of macroeconomic conditions on cash holdings on a sample of non-financial firms from 45 countries from 1994 to 2005. The authors use cash holdings as a function of macroeconomic measures (i.e. GDP growth,inflation, short term rate, the government deficit/surplus as a fraction of GDP) and control variables (i.e. profits, net working capital, capital expenditures, leverage, dividend payout). A fixed effect model and a first-difference GMM estimator is employed. Their work suggests that GDP growth, inflation, short term rate and government deficit have a statistically significant effect on corporate liquidity. In other words, firms hold more cash when the economy is in an expansion phase and decrease their level of cash reserves when inflation is high.

Baum et al. (2011) explore how the structure of the financial system and level of development have an impact on firms' need to save cash out of cash flows. To be specific, the authors test whether small (large) firms or firms with low (high) payout ratios, which in theory suffer from higher (lower) levels of financial constraints, show a higher (lower) sensitivity of cash to cash flow when the impact of the financial system is considered.

As Almeida et al. (2004), the authors consider that a firm is financially constrained if it builds up its stock of cash out of cash flow. To explore the abovementioned issue, they extend the model of Almeida et al. (2004) and include country level attributes of financial markets. Specifically, change in cash holdings is used as a function of cash flow, structure of the financial system, an interaction term between the former and the latter and a set of control variables (i.e. lead investment, size, payout, change in net working capital, change in short debt). Financial structure is calculated based on two proxies. Following Levine (2002), the first indicator is the activity of stock markets relative to banks. The second indicator proxies for the relative size of the stock markets. Using a sample of 5,500 manufacturing firms from 1989 through 2006 for 35 countries, the authors employ an IV-GMM estimator. Empirical findings suggest that firms in a market based economy have a higher sensitivity of cash holdings to their cash flows.

Baum et al. (2012) investigate the impact of uncertainty and corporate governance on firms' demand for liquidity. To do so, the authors extend the model of Baum et al. (2008) by including indicators for corporate governance and an interaction of an uncertainty measure and corporate governance index.[47] Baum et al. (2012) use a GARCH model to proxy for macroeconomic uncertainty. They consider a volatility measure which is obtained from the CPI index as a proxy for the macro-level uncertainty that firms may face. To capture firm-level uncertainty the authors compute a standard deviation of the firm's excess returns over the market return. Firms' return is obtained by using monthly equities prices. Firm-specific variables for U.S. firms are obtained annually for the 1990-2007 period. To calculate the quality of corporate governance the authors construct an Annual Governance Index (Gindex) following the work of Gompers et al. (2003). The specification model is as follows: firms' liquidity is a function of the lag cash holdings, capital investment, the value of sales in the next period, the last period's values of the index of leading indicators, the treasury bill rate, the previous cash flow shock and macroeconomic uncertainty. Results show that firms' cash holdings depend on the quality of governance and the level of uncertainty they face.

In addition, Song and Lee (2012) examine the effect of the Asian financial crisis on

[47] According to Baum et al. (2012), Baum et al. (2008) develop a two-period cash buffer-stock model. In the model, the manager of the firm is able to vary the optimal level of liquid assets in response to macroeconomic and/or firm-level uncertainty.

firms' cash holdings. They study cash reserves of firms before and after the Asian crisis. The authors use a sample of Asia firms for the following countries: Hong Kong, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan and Thailand. The total sample corresponds to 5,059 Asian firms over the period of 1990-2006. Their aim is to investigate the increase of firms cash reserves after the Asian Crisis.

They follow the model of Opler et al. (1999) and estimate a system of cash holdings and investment models to determine the impact of investment on cash holdings and the effect of cash reserves on investment. The authors employ the Fama and MacBeth (1973) procedure and then re-estimate the modified model of Opler et al. (1999) for the pre-crisis period. Empirical results indicate that macroeconomic conditions have an impact on firms' cash policies. Cash holdings increase in all sample countries except Indonesia.

In a similar study, Baum et al. (2013) test the role of future fixed capital and R&D investment expenditures on firms' cash reserves while considering the role of market imperfections. To do so, the authors use a sample of 32,000 manufacturing firm-year observations for the U.S., U.K. and Germany for the period between 1989 and 2007. A system-GMM estimator is employed. First, the authors model change in cash holdings as a function of a change of the following variables: lagged cash reserves, cash flow, R&D, fixed investment, short term debt and net working capital. Secondly, they interact the explanatory variables with a dummy variable. The aim is to capture the categorisations of the firms which are more/less likely to be financial constraints (i.e. this is based on small/large nexus; higher/lower dividend payout nexus). Empirical findings suggest that firms increase their level of cash holdings more in a scenario when future R&D expenditures increase than in a situation where future fixed capital investment raises. This result is more prominent for firms which face financial constraints (i.e. small/ low dividend payout firms).

Recently, Baum and Chakraborty (2016) explore the impact of firm-specific and macroeconomic uncertainty on shareholders' valuation of firms' cash holdings decisions. To explore this issue, the authors test whether the marginal effect of cash holdings on excess stock returns is sensitive to uncertainty. The authors extend the model of excess stock returns of Faulkender and Wang (2006) and include two proxies of uncertainty: economy uncertainty and firm-specific uncertainty.[48] These two proxies are interacted with scaled measures of change in cash holdings. Macroeconomic uncertainty is measured using the CPI and an index of leading indicators as in Baum et al. (2012). Three different firm-specific uncertainty measures are used: stock price volatility, volatility of sales and volatility of the number of employees. A sample of 210,632 firm-year observations over the 1971-2006 period is used. Results show that the type of uncertainty affects differ-

[48] Faulkender and Wang (2006) regress excess stock returns on the unexpected change in cash holdings, scaled by the prior period's market value of the firm and a set of control variables.

ently the shareholders' valuation of firms' cash holdings. Specifically, higher firm-specific (macroeconomic) uncertainty increases (decreases) the value of cash.

3.2.6 Small firms

Recently, the literature has focused on the determinants of cash holdings for small firms. These studies rely on the argument that financial frictions are higher for smaller firms then their larger counterparts (Faulkender, 2002). The former suffer from higher levels of information asymmetry and higher transaction costs.

For instance, García-Teruel and Martínez-Solano (2008) explore the determinants of cash reserves of Spanish SMEs. Specifically, they test whether changes in the firms' cash ratios follow a partial adjustment model. Using a sample of 860 Spanish SMEs for the period between 1997 and 2001, the authors use a 2-stage GMM estimator.

Results show that cash holdings of Spanish SMEs follow a partial adjustment model. The target level of firms' cash holdings is higher if firms have more growth opportunities and larger cash flows. Conversely, firms' cash reserves are lower if firms' have access to bank debt or other substitutes for cash. SMEs' Spanish firms tend to achieve an optimal cash level more quickly than large firms studied by Guney et al. (2003). This can be explained by the relatively higher cost for small firms of being off target, since SMEs suffer more severe information asymmetries than financial constraints and have a greater likelihood of suffering financial distress.

Bigelli and Sánchez-Vidal (2012) examine cash reserves' determinants of private Italian firms during the 1996-2005 period. They use three different measures of cash holdings, i.e. pure cash, cash equivalents and total cash. The authors define pure cash as the ratio of cash, cheques and bank deposits to total assets. Cash equivalents are measured as other short term marketable securities divided by total assets while total cash as in defined as in Opler et al. (1999). In addition, the authors use the common explanatory variables of the literature on cash holdings as controls (i.e. size, cash flow volatility, effective tax rate, growth opportunities and financing deficit).[49] The authors follow the target-adjustment model by Ozkan and Ozkan (2004) and use a GMM estimator. Smaller firms which are younger, riskier and reasonably more financially constrained hold more cash compared with big firms. Results are consistent with the trade-off theory. On the other hand, Bigelli and Sánchez-Vidal (2012) also find evidence which support the pecking order theory. Firms retain cash in the presence of longer cash conversion cycles and when they report financial surpluses or lower effective tax rates. Private firms which pay dividends tend to have more

[49]The financing deficit is based on the model by Shyam-Sunder and Myers (1999). In their model, the authors test the relation between financial deficit and variations in debt. The authors refer that firms' financial behaviour is based on the difference between firms' investment needs and the internal resources which is generated. The difference is known as the financial deficit. If this difference is positive, firms will seek more debt and the opposite occurs if it is negative.

cash reserves.

Finally, Pastor and Gama (2012) study cash holdings' decisions for a sample of Portuguese SMEs for the period 2001 to 2007. They use a linear regression of cash holdings on exogenous variables which are based on the work by García-Teruel and Martínez-Solano (2008). Results are consistent with the previous studies. The authors find that size, growth opportunities, relation with banks, cash flow uncertainty, debt structure, liquidity and leverage significantly affect SMEs' level of cash holdings.

3.2.7 Public and private firms

A new strand of the literature tests the differences between public and private firms' cash holdings. Gao et al. (2013) are the first to test cash holdings' differences among public and private firms. Specifically, they test whether public firms hold less cash then their private counterparts. This is based on the assumption that public firms have lower cost of accessing external capital and therefore, the precautionary motive should be lower for public firms. However, Gao et al. (2013) argue that public firms can have lower cash reserves than their private counterparts. This is based on the idea that public firms suffer from higher agency costs. Private firms have less shareholders and are managed by normally owners with greater control.

To test the above-mentioned hypothesis, each private firm in the sample is matched with a public firm in the same industry and closest in size. A matching with replacement procedure is used. In the end, their final sample include 7,879 unique public firms, 2,624 matched public firms, 3,604 private firms for the period 1995-2011.

Following the previous literature (Opler et al., 1999; Dittmar and Mahrt-Smith, 2007), the authors use cash holdings as a function of a set of firm-specific characteristics (i.e. size, cash flow, cash flow volatility, sales growth, leverage, public debt,net working capital, capital expenditures, acquisition, R&D, dividend, age, dividends, number of segments) and a dummy variable public which assumes the value of 1 for public firms, and 0 otherwise.

Empirical findings suggest that public firms hold more cash than their private counterparts which is in line with the agency cost motive. Furthermore, Gao et al. (2013) investigate the speed of adjustment of firms to their target cash levels and how firms react to excess cash. Gao et al. (2013) employ a partial adjustment model. They conclude that public firms adjust their cash holdings much faster towards their target levels than do private firms when holdings less cash. Finally, they also test whether the speed of public firms adjustment is affected by corporate governance using the insider ownership and the E-index.[50] Results indicate that well-governed public firms are slower in adjusting down to target cash levels comparing with governed public firms.

In a similar setting, Farre-Mensa (2014) explores the cash differences between U.S.

[50]Note that E-index corresponds to the entrenchment index developed by Bebchuk et al. (2009).

public and private firms. The author employs a sample of 66,092 firm-year observations for private firms and 26,751 firm-year observations for public firms from 2002 to 2011. Farre-Mensa (2014) follow the cash model of Bates et al. (2009) and uses an OLS regression. Results show that the cash-to-assets ratio of public firms is higher than their private counterparts and that the cash difference between public and private firms is decreasing with size.

Similar to Gao et al. (2013) the author applies a matching procedure (i.e. calliper-based nearest-neighbour with replacement) to account for differences in size and industry distribution of public and private firms. Results are robust to their previous findings. Public firms hold more cash than private firms. Farre-Mensa (2014) concludes that the precautionary motive leads public firms with worse access to external finance to accumulate more cash than those with better access. Results demonstrate that the differences in cash between public and private firms is larger in industries with riskier cash flows.

Finally, Hall et al. (2014) explore the behaviour of public and private firms in a cash holding setting. The authors study cash reserves for public and private firms from 20 emerging markets. Firstly, they test whether private firms hold more cash than private firms. Secondly, the authors explore whether firms specific-characteristics and the national level of institutions have a different impact among private and public firms.

The sample consists of 18,167 firms from 18 Central and Eastern European countries from 2001 to 2010. Hall et al. (2014) use a cash holding model based on previous literature (Kim et al., 1998). They employ a pooled OLS regression in order to include the listing status of the firms (i.e. private firms versus public firms) and transition indicators (i.e. transition to capitalism and markets development).

The empirical evidence demonstrates that public firms hold less cash than their private counterparts. Firms which are located in more developed countries with better institutions tend to choose a more conservative policy increasing their cash reserves.

In addition, the authors employ three distinguish fixed effects models to examine if firm and country-specific determinants have a different effect on private and public firms. Firstly, they test the existence of a U-shaped form between short term debt and cash holdings for both type of firms. They confirm that the relation is U-shaped for both public and private firms. Finally, they employ two models which take into account the following independent variables: maturity, return on assets, size, unemployment working capital and bankruptcy prediction variable (i.e. Z-Score). Evidence shows that the determinants of cash holdings are similar to both private and public firms independently of the stage in the transition to capitalism. Overall the authors find evidence in line with the precautionary motive to hold cash.

3.2.8 Credit risk

Some studies have also focused on the role of credit risk on firms' cash reserves. The crucial assumption in this strand of the literature is that cash is positively related with credit risk. This is based on the work of Acharya et al. (2012). Contrary to previous studies, the authors suggest that cash holdings should be obtained endogeneously as part of an optimization process. They argue that an increase in cash reserves should be interpreted as a negative signal by the markets since the firms should be increasing their cash levels for a precautionary motive. In this scenario, there should be a positive relation between cash and firms' credit risk and default probability.

To test the assumption that cash holdings are positively related to credit spreads and default risk, the authors employ monthly credit spreads combined with quarterly balance sheet data for U.S. listed firms from 1996 to 2010. This sample includes 9,932 firm-quarter observations for 2,247 bond issuers at risk of default and 341,954 firm-year observations for 24,825 firms.

As a preliminary analysis, the authors summarise cash holdings by firms' credit risk (i.e. coverage ratio and credit ratings). They find that there exists an U-shaped relation between firms' cash and credit risk. Safer firms have higher cash reserves and low debt levels. According to the authors, their higher levels of liquidity and low debt levels make agencies to rate them at higher categories. For these firms, the risk of default is unlikely to explicate these firms higher cash levels. Conversely, riskier firms (i.e. those that are rate at low categories) are also characterised by higher cash holdings due to leveraged firms' precautionary motive to hold cash. To confirm these preliminary findings, the authors use an OLS regression of bond spreads and an IV regression of credit spreads.

Empirical findings show that the relation between credit spreads and liquidity is positive. Riskier firms have more cash and higher credit spreads (or credit risk). Liquidity is also positively related to the probability of default. Overall, the results confirm that cash reserves are driven by the precautionary motive to hold.

Palazzo (2012) investigates the link between firms' precautionary motive to hold cash and firms' risk premia. The author tests whether changes in cash holdings can be explained by firms' expected return. The author extends the model of Kim et al. (1998) and includes a source of aggregate risk. Specifically, Palazzo (2012) considers that investors are not risk-neutral (i.e. shareholders value future cash flows). The author assumes that riskier firms are those with a higher correlation between cash flow and the aggregate risk. These firms have a higher probability of using costly external funds to fund their growth option exercises and obtain higher savings.

Contrary to previous studies on cash holdings which employ cash flow volatility as a measure of firm risk, Palazzo (2012) considers an accounting based measure for expected

equity returns.[51] Using a sample of U.S. public firms for the sample period between 1975 and 2009, the author uses pooled OLS, fixed effects and Fama and MacBeth regressions. The empirical evidence provides evidence of a positive relation between changes in cash holdings and expected equity returns. Results are in line with the precautionary motive to hold cash.

3.2.9 Recent financial crisis

Finally, empirical studies on cash holdings study the importance of the recent turmoil period on firms' cash decisions. For example, Pinkowitz et al. (2012) investigate whether U.S. firms' cash reserves are abnormally high after the crisis. Based on Bates et al. (2009), the authors estimate a model of normal cash holdings. The model tests how abnormal cash holdings evolve across countries and different types of firms. According to the authors, all the models which explain firms' cash holdings are prior to the 2000s. Thus, Pinkowitz et al. (2012) compare the evolution of U.S. firms' cash reserves to the evolution of firms in other countries estimating how much cash firms would have each year from 2000 until 2010.

The results show that U.S. firms hold more cash than foreign firms. When comparing the U.S. cash reserves with those of U.K. and Japan. In addition, they estimate the model comparing actual cash holdings in the 2000s to the cash holdings predicted by the model, i.e. the abnormal cash reserves.[52] The results indicate that only U.S. firms experience an increase in cash holdings from the late 1990s to before the crisis. The increase of cash after the crisis is higher for more profitable firms.

Akguc and Choi (2013) test the impact of the recent crisis in a sample of listed and unlisted firms in Europe. They use a sample of 76,587 firms from 33 European countries during 2002-2011. Firstly, they employ a similar model as in Opler et al. (1999) and Bates et al. (2009). The aim is to verify whether private firms hold less cash than public firms. Results indicate that public firms hold on average more cash than private firms in Europe. As Opler et al. (1999), the authors re-estimate a reduce form regression to avoid inconsistent estimates. Results confirm that public firms still hold more cash comparing with private firms.

Akguc and Choi (2013) also follow the work by Ferreira and Vilela (2004). They employ a country level investor protection index and a ownership concentration index based on the work of La Porta et al. (1997). Results indicate that countries with better shareholder

[51] Palazzo (2012) follows the method which is used by Gebhardt and Swaminathan (2001) and modified by Tang et al. (2013). The methodology is based on a residual income model. It permits to " evaluate an implied rate of return (the proxy for expected equity returns) which equates the stock price of a firm to the present discounted value of future dividends".

[52] It should be noted that abnormal cash holdings are defined as actual cash holdings minus predicted cash holdings. In other words, abnormal cash holdings are cash reserves relative to what firms would hold if they held cash as in the base period.

protection hold less cash. This result is consistent with Ferreira and Vilela (2004) for a sample of listed European firms and with the free cash flow theory.

In addition, the authors employ a dynamic target adjustment model. They follow the work of Dittmar and Duchin (2011). They investigate if and how firms manage cash holdings toward a target cash ratio using publicly traded firms for the period between 1965 and 2006. They find that firms adjust their cash holdings back to a predicted target level but the adjustment speed is relatively slow.

Both public and private firms adjust to target cash levels. Empirical findings suggest that there is no statistically difference between public and private firms. Finally, the authors test whether cash holdings are sensitive to operational cash flow (Almeida et al., 2004). They employ the model defined by Almeida et al. (2004) to test for cash flow sensitivity of cash. Results demonstrate that cash flow is significant showing that cash reserves are sensitive to both public and private firms. Cash flow sensitivity is higher for public firms.

Stone and Gup (2015) study whether firms increase their cash reserves during recession periods. They use the National Bureau of Economic Analysis (NBER) recession dates and announcement dates of recessions. They test five different recessions periods. Recession dates and announcement dates are also included. The aim is to investigate how firms' cash reserves react during recessionary periods. The authors also employ a random effect double-censored Tobit model similar to Loudermilk (2012).[53] They use three different datasets (i.e. non-missing observations dataset, a mature firms dataset and a growth firms dataset). Stone and Gup (2015) conclude that firms tend to respond to announcement of recessions and increase their cash reserves. The authors conclude that these findings are not consistent with the precautionary motive to hold cash. Firms do not hold large amount of cash in their balance sheets. They only hold large amounts of cash once they know the economy is in a recession.

3.3 Research design

The following sub-sections define the theoretical framework and variables definition which are implemented in this chapter.

3.3.1 Theoretical framework

Chapter 3 follows the empirical model of cash holdings which is defined in Gao et al. (2013). The model which is a static linear model considers that cash reserves adjust immediately

[53] According to the authors, this model allows one to bound predicted values between zero and one while also controlling for unobserved heterogeneity. Thus, the dependent variable presents a value between 0 and 1.

to changes in the explanatory variables. The model assumes that cash holdings can be taken as a function of several firm-specific characteristics X , of firm i at time t and a disturbance error term. The static linear model takes the following general form:

$$Cash_{it} = \alpha_0 + \sum_{k=1}^{k} \beta_{1,k} X_{it} + \varepsilon_{it} \tag{3.1}$$

Where, firms are represented by subscript $i = 1, ..., N$, t represents time by $t = 1, 2, ...T$. $Cash_{it}$ is the ratio of cash holdings, X_{it} is the vector of the explanatory variables. ε_{it} is the error term which is composed by five components: α_i as a firm-specific effect, α_t which is a time-specific effect, α_j is an industry-specific effect, α_k is an country-specific effect and lastly ε_{it} is an idiosyncratic component. It is also assumed that α_i are unobservable but have a significant effect on cash reserves and that α_t varies through time but is the same for all firms in a given year. It captures the economic factors like prices which are outside the control of firms.

It should be noted, however, that in equation (3.1) there is no adjustment process. In reality, though, markets are imperfect and transaction and adjustment costs exist. Following previous literature (Ozkan and Ozkan, 2004; Bigelli and Sánchez-Vidal, 2012), this chapter also takes into account this issue. The adjustment process involves a lag in adjusting to changes in the target cash structure (Ozkan and Ozkan, 2004). In this scenario, cash reserves do not instantly adjust to changes in the explanatory variables. It is assumed that firms pursue a target level when making their cash reserves' decisions. The level of cash which is achieved at time t is also explained by the decisions which are taken at time $t-1$. The model is determined as follows:

$$Cash^*_{it} = \alpha_0 + \sum_{k=1}^{k} \beta_{1,k} X_{it} + \varepsilon_{it} \tag{3.2}$$

Where, firms are represented by subscript $i = 1, ..., N$, t represents time by $t = 1, 2, ...T$. α_i. $Cash^*_{it}$ is the optimal cash ratio, X_{it} is the vector of the explanatory variables. ε_{it} is the error term. In this scenario, firms adjust their cash holdings to be closer to their target cash ratio. This leads to a partial adjustment cash level. The equation takes the following format:

$$Cash_{it} - Cash_{it-1} = \gamma(Cash^*_{it} - Cash_{it-1}) \tag{3.3}$$

Where $Cash_{it}$ is the actual cash ratio. The coefficient γ measures the rate of adjustment to the target cash holdings and it is expected to lie between 0 and 1. If $\gamma = 1$, firms adjust their cash levels to the optimal level immediately. In a scenario of $\gamma = 0$, firms' cost of adjustments are so high that they are not able to modify their investment in liquid assets (García-Teruel and Martínez-Solano, 2008). A higher value of γ indicates a fast adjustment

from the actual to the target level of cash. The reduced form of the cash holdings' equation is obtained by replacing equation 3.2 into equation 3.3. The final model is defined below:

$$Cash_{it} = \alpha_1 + \delta_0 Cash_{it-1} + \sum_{k=1}^{k} \delta_k X_{it} + \varepsilon_{it} \tag{3.4}$$

where, $\alpha_1 = \alpha_0 \gamma$; $\delta_0 = (1-\gamma)$; $\delta_k = \gamma \beta_{1,k}$; ε_{it} is the error term. Since the adjustment speed is determined by $1 - \delta_0$, a higher value of δ_0 indicates a lower adjustment speed.

3.3.2 Variables definition

Following the literature (Akguc and Choi, 2013; Gao et al., 2013), the dependent variable cash holdings is defined as the ratio of cash and equivalents to total assets. The main variable of interest in this chapter is the private dummy. It assumes the value of 1 if firms are private and , 0 otherwise. It is expected that private firms hold higher levels of cash than their public counterparts. The former suffer from higher levels of information asymmetry and have a more restricted access to external markets (Akguc and Choi, 2013). Please refer to Chapter 2, sub-section 2.6.2 for details on the construction of this variable.

A set of control variables are also included in the regression model based on the previous literature (Akguc and Choi, 2013; Gao et al., 2013; Hall et al., 2014). They are as follows: cash flow, leverage, net working capital, capital expenditures, firms' size, cash flow volatility, sales growth and firms' age. The definition of these variables are provided in the next paragraphs.

The variable cash flow is measure based on the cash flow of the firms. The majority of the previous studies find a positive relation with cash reserves (Opler et al., 1999; Ozkan and Ozkan, 2004; Gao et al., 2013). This is consistent with the idea behind the pecking order theory. Firms' prefer to obtain finance through internal sources before accessing external markets. In other words, if operating cash flows exceed investment needs, firms repay debt and/or accumulate cash (Opler et al., 1999).

The variable leverage is calculated as firms' total debt. Previous studies show a negative relation between leverage and cash holdings (Opler et al., 1999; Akguc and Choi, 2013). Brav (2009) provides evidence that Private firms are highly leveraged and have a higher proportion of short-term debt to total debt when comparing with their public counterparts. This negative relation is explained under the pecking order theory. When investment exceeds retained earnings debt grows, and therefore, cash reserves decrease (Pastor and Gama, 2012).

Net working capital is obtained as the difference between current assets and current liabilities excluding cash. This variable is a proxy for cash' substitute (Opler et al., 1999). Previous studies find a negative relation with cash holdings (Bates et al., 2009; Bigelli and Sánchez-Vidal, 2012). In addition, Chapter 3 follows the work of Erel et al. (2015)

to define capital expenditures since Amadeus database does not provide information on this variable. Thus, capital expenditures variable is measured as the change in fixed assets plus depreciation. Kim et al. (1998) and Dittmar et al. (2003) refer that cash balances are the outcome of investment decisions (i.e. capital expenditures) which are made by the firm. Investment improves collateral and borrowing capacity leading to a reduction of the costs associated with external markets. As a result, a negative relation between cash and capital expenditures is expected.

Moreover, firms' size is measured as the logarithm of total assets. Previous studies find that the variable size has a negative effect on firms' cash holdings (Opler et al., 1999; Gao et al., 2013) which is in line with the trade-off theory. Since there are economies of scale in cash management, larger firms are expected to be able to obtain finance easier. Thus, the trade-off theory may predict lower cash reserves for private firms.

Cash flow volatility is calculated as the standard deviation of industry-median-adjusted yearly cash flow over the previous three years. It is included to control for the firms' risk. Previous studies find a positive relation with cash reserves (Bates et al., 2009; Bigelli and Sánchez-Vidal, 2012). Firms which are in industries associated with a large increase in the idiosyncratic risk hoard more cash.

The variable sales growth is calculated as the change in total sales. It accounts for the growth opportunities of the firms. Previous empirical studies find a positive relation between cash and firms' growth opportunities (Bigelli and Sánchez-Vidal, 2012; Gao et al., 2013). According to Myers (1984), firms which are largely determined by their growth opportunities suffer from higher levels of information asymmetry. This indicates that these firms are also characterised by higher external financing costs. Finally, firms' age is calculated as the difference between the present year and firms' date of incorporation. The relation between cash and age should be a negative one. Younger firms tend to have weaker associations with corporate stakeholders (Almazan et al., 2009).

Finally, with the exception of size, cash flow volatility and sales growth all variables are divided by total assets. All Euro variables are also adjusted using the CPI at the 2005 price level.

3.4 Model specification

The empirical models which are used in this chapter are defined in the next sub-sections.

3.4.1 Baseline

The main aim of this chapter is to test whether private firms hold more cash than their public counterparts. To do so, Chapter 3 follows the recent literature on private and public firms' cash holdings (Gao et al., 2013). It employs the following baseline model:

$$Ln(cash_{it}) = \alpha + \beta_1 Private_t + \beta_2 Cflow_{it} + \beta_3 Lev_{it} + \beta_4 Nwc_{it} + \beta_5 Capex_{it} + \beta_6 Ln(Size)_{it} + \\ + \beta_7 Cfv_{it} + \beta_8 Sgrowth_{it} + \beta_9 Ln(Age)_{it} + \varepsilon_{it} \quad (3.5)$$

where $i = 1, 2, .., N$ indexes firms and $t = 1, 2, ..., T$ indexes years. $Ln(cash_{it})$ is the log cash ratio of firms. $Private_t$ is the main variable of interest and it accounts for the percentage of cash holdings for private firms when comparing with their public counterparts. It is based on a dummy variable equal to 1 for private firms, and 0 otherwise. $Cflow_{it}$ indicates the cash flow to total assets ratio. Lev_{it} indicates total debt scaled by total assets. Nwc_{it} is measured as the difference between current assets and current liabilities excluding cash scaled by total assets. $Capex_{it}$ is defined as the change in fixed assets plus depreciation divided by total assets. $Ln(Size_{it})$ corresponds to the natural logarithm of total assets while Cfv_{it} denotes the cash flow volatility which is measured as the standard deviation of industry-adjusted yearly cash flow over the previous three years. $Sgrowth_{it}$ corresponds to the growth rate. Lev_{it} indicates total debt scaled by total assets. Finally, $Ln(Age)_{it}$ corresponds to the natural logarithm of firms' age which is calculated as the difference between the present year and firms' date of incorporation.[54]

The error term ε_{it} includes a firm-specific time-invariant component, including all time-invariant firm characteristics likely to have an impact on the cash holdings variable and it also accounts for the time-invariant component of the measurement error affecting any of the regression variables: a time specific component accounting for possible business cycle effects and an idiosyncratic component. As in Chapter 2, to account for the firm-specific time-invariant component of the error term, the equation is estimated in first-differences. Time-specific component is considered as well by including time dummies (in addition to the time dummies interacted with industry dummies) in all specifications (Brown et al., 2009). Country dummies are also used to control for institutional differences between countries.

If the coefficient (β_1) on the variable $Private_t$ is positive and statistically significant that means that private firms hold more cash than their public counterparts. More importantly, it indicates that the precautionary demand motive drives the results and not the agency-based explanation as in Akguc and Choi (2013) and Gao et al. (2013). In other words, the argument is that due to higher levels of financial constraints and information asymmetry, private firms hoard more cash as a precaution against future cash flow shortfalls.

[54] See Table B.1 in the Appendix B for the definition of the variables in the data-set.

3.4.2 The effect of financial pressure

Next, it is considered the extent to which financial pressure exerts an effect on the difference of cash holdings for private and public firms. To explore this hypothesis, equation (3.5) is re-estimated for three different levels of financial pressure. Financial pressure is measured as the coverage ratio following previous literature (Görg and Spaliara, 2014). It measures firms' level of credit worthiness. The higher the credit worthiness the better is the balance sheet of the firms (Görg and Spaliara, 2014). Three different categories of financial pressure are implemented: higher (1^{st} decile), medium (5^{th} decile) and lower (10^{th} decile).

It is anticipated that the coefficient on the private variable (β_1) to remain positive and statistically significant across the three levels of financial pressure. More importantly, it is expected that there is a U-shaped relation between the cash holdings' differences of private and public firms. This is based on the rationale of Acharya et al. (2012) for listed firms. According to the author, safer firms have higher cash reserves and low levels of debt. Their risk of default most probably does not explain their higher cash holdings levels. However, riskier firms also present higher cash holdings. This pattern is obtained due to leveraged firms precautionary motive to hold cash. In Chapter 3 it is hypothesised that at higher levels of financial pressure, access to external market is more restricted to all the firms. This means that private and public firms should hoard more cash as a precaution against possible decrease of cash flow in the future. However, it is also possible that safer firms to hold higher levels of cash. Firms which suffer from higher levels of information asymmetry always prefer internal over external finance holding more cash as a buffer.

3.4.3 Speed of adjustment

Finally, it is investigated the speed of adjustment of private and public firms' cash levels. It is tested whether private firms adjust slower to their target cash levels than their public counterparts. The reason to explore this hypothesis is based on the assumption that capital market imperfections may prevent firms from quickly adapt to new circumstances (Ozkan and Ozkan, 2004). This means that private firms which face more financial frictions and have lower access to external finance should adjust their cash reserves slower than their public counterparts (Akguc and Choi, 2013).

To explore this issue, the variable $Private_t$ is interacted with the lagged of the dependent variable ($cash_{it-1}$). Equation (3.5) is augmented with a lagged variable of the log of cash ($cash_{it-1}$) and an interaction term ($cash_{it-1} * Private_t$).

Previous studies on private and public firms cash holdings' decisions use a partial target-adjustment model (Akguc and Choi, 2013; Gao et al., 2013). They consider only the difference between actual cash holdings and target cash holdings of public and private firms. Contrary to their analysis, the model which is implemented includes unobservable fixed and time effects as well as the firm-specific characteristics. By accounting for these

effects, it is ensured that the target cash model which is estimated does not provide biased estimates (Ozkan and Ozkan, 2004). The model takes the following form:

$$\begin{aligned} Ln(cash_{it}) = & \alpha + \beta_1 Private_t + \beta_2 Private_t * Cash_{it-1} + \beta_3 Cash_{it-1} + \\ & + \beta_4 Cflow_{it} + \beta_5 Lev_{it} + \beta_6 Nwc_{it} + \beta_7 Capex_{it} + \beta_8 Ln(Size)_{it} + \\ & + \beta_9 Cfv_{it} + \beta_{10} Sgrowth_{it} + \beta_{11} Ln(Age)_{it} + \varepsilon_{it} \end{aligned} \quad (3.6)$$

The coefficient of interaction term (β_2) captures the difference in the speed of adjustment between public and private firms. β_3 can be interpreted as an inverse measure of the adjustment speed. Firms' ability to reach their target cash level is obtained by $(1 - \beta_3)$. If $\beta_3 = 0$, the speed of adjustment equals 1. Firms adjust instantaneously towards the optimal cash target level. Conversely, a low speed of adjustment ($\beta_3 = 1$) indicates that the cash level modification is extremely costly for the firms (Ozkan and Ozkan, 2004).

It is expected that the coefficient on the interaction term (β_2) to be positive which denotes that private firms adjust slower to their target cash levels. This is consistent with the idea that private firms suffer from higher levels of information asymmetry and have a higher cost of external finance (Gao et al., 2013).

3.4.4 Robustness check: Dynamic models

As a first robustness check it is considered a dynamic cash model. The aim is to explore whether the hypothesis which are defined subsection 3.4.1 and 3.4.2 are robust to the addition of the lagged dependent variable. The motivation to do so, is that in a dynamic model is is possible to explore whether the current behaviour of firms depends on their past behaviour. Similar to the model which is defined for the speed of adjustment in subsection 3.4.3, the dependent variable $Ln(cash_{it})$ is regressed on the past cash $Ln(cash_{it-1})$ and a set of control variables. The equation takes the following form:

$$\begin{aligned} Ln(cash_{it}) = & \alpha + \beta_1 Private_t + \beta_2 Cash_{it-1} + \beta_3 Cflow_{it} + \beta_4 Lev_{it} + \beta_5 Nwc_{it} + \beta_6 Capex_{it} + \\ & + \beta_7 Ln(Size)_{it} + \beta_8 Cfv_{it} + \beta_9 Sgrowth_{it} + \beta_{10} Ln(Age)_{it} + \varepsilon_{it} \end{aligned} \quad (3.7)$$

The coefficient in the lagged cash holdings variable (β_2) corresponds to the adjustment speed. It should be interpreted as $1 - \beta_2$. A low speed of adjustment indicates that cash level is very costly for firms (Ozkan and Ozkan, 2004). If β_2 is positive and statistically significant that means that firms cannot adjust immediately towards their target cash level following changes in firm-specific determinants. It is expected that private firms continue to hold more cash than public firms. Finally, the cash holdings' different of private and

public firms should remain U-shaped based on their level of financial pressure.

3.4.5 Robustness check: Alternative measure of financial pressure

So far financial pressure is defined based on the credit risk measured as in Acharya et al. (2012). To ensure robustness of the empirical findings, it is also considered an alternative measure of financial pressure. In particular, Chapter 3 employs the change in the borrowing ratio as in Chapter 2. Following Nickell and Nicolitsas (1999) it is used the product of the debt capital ratio three years lagged and the contemporaneous change in the bond yield.

Equation 3.5 is re-estimated with a new measure of financial pressure. Similar to section 3.4.2, firms are also split into deciles of the new financial pressure variable. It is anticipated that the cash holdings' difference between private and public firms remains unchanged to the new measure of financial pressure.

3.4.6 Robustness check: Jointly determined coefficients

Further, Chapter 3 employs a robustness check which is based on the work of Opler et al. (1999). According to the author, firm-specific variables such as leverage and capital expenditures can be jointly determined with cash reserves. This means that the baseline regression which is defined in sub-section 3.4.1 can lead to inconsistent estimates. To account for this issue, equation (3.5) is re-formulated without these jointly determined variables. The new equation is defined as follows:

$$Ln(cash_{it}) = \alpha + \beta_1 Private_t + \beta_2 Cflow_{it} + \beta_3 Nwc_{it} + \beta_4 Ln(Size)_{it} + \\ + \beta_5 Cfv_{it} + \beta_6 Sgrowth_{it} + \beta_7 Ln(Age)_{it} + \varepsilon_{it} \quad (3.8)$$

Once more, if the coefficient on the variable $Private_t$ (β_1) is positive and statistically significant, that means that private firms hold more cash than their public counterparts.

3.4.7 Robustness check: Cash flow sensitivity of cash

To check for the robustness of the main findings, it is also considered if firms' have a different propensity to save cash out of cash flows. In particular, it is tested whether private firms have a higher cash flow sensitivity of cash than their public counterparts. To test this assumption, equation (3.5) is re-formulated as in Almeida et al. (2004). The following specification is estimated:

$$\Delta cash_{it} = \alpha + \beta_1 Private_t + \beta_2 Private_t * Cflow_{it} + \beta_3 Cflow_{it} + \beta_4 \Delta Nwc_{it} + \\ + \beta_5 Capex_{it} + \beta_6 Ln(Size)_{it} + \beta_7 Sgrowth_{it} + \beta_8 \Delta STdebt_{it} + \varepsilon_{it} \quad (3.9)$$

Where, $\Delta cash_{it}$ represents the change in log of cash and equivalents to total assets. ΔNWC_{it} denotes the change in net working capital while $\Delta STdebt$ is change in the ratio of short-term debt to total assets.

This is based on the argument of Almeida et al. (2004). Firms which face a higher degree of information asymmetry are less likely to access external capital markets, and therefore, have a tendency to save higher levels of their operating cash flow as cash. Almeida et al. (2004), classify these firms as financially constraints. For the author firms which suffer from higher levels of financial constraints have a positive cash flow sensitivity of cash. Thus, based on the assumption of sub-section 3.4.1, it is anticipated that private firms save more cash out of cash flow than their public counterparts (i.e. a higher cash flow sensitivity of cash).

3.4.8 Robustness check: The financial crisis

This sub-section takes into account the effect of the global financial crisis on private and public firms' cash holdings. The aim is to explore whether private firms hold more cash than their public counterparts during the crisis. To account for this scenario, equation (3.5) is augmented with a financial crisis dummy ($Crisis_t$) and an interaction term between the crisis and the private variable ($Private_t$). The crisis dummy assumes the value of 1 for the period between 2007-2009, and 0 otherwise. The equation is as follows:

$$Ln(cash_{it}) = \alpha + \beta_1 Private_t + \beta_2 Private_t * Crisis_t + \beta_3 Crisis_t + \beta_4 Cflow_{it} + \beta_5 Lev_{it} + \beta_6 Nwc_{it} + \\ + \beta_7 Capex_{it} + + \beta_8 Ln(Size)_{it} + \beta_9 Cfv_{it} + \beta_{10} Sgrowth_{it} + \beta_{11} Ln(Age)_{it} + \varepsilon_{it} \quad (3.10)$$

This hypothesis is based on the financial-accelerator theory. It refers that firms' have higher costs of external finance in a period of uncertainty. For example, Duchin et al. (2010) demonstrate the recent financial crisis exerted a negative impact on the supply of external finance for non-financial firms.

It is anticipated that private firms hold more cash than their public counterparts during the turmoil period. In an uncertainty period, the former may increase their cash balances in response to more difficult access to external finance. Finally, the financial crisis dummy should have a positive effect on cash holding of firms. They should build up more cash reserves during and/or right after the turmoil period (Akguc and Choi, 2013).

3.4.9 Robustness check: Alternative cut-off point

As a final robustness check, the sample of firms is split according to their size. Previous studies have explored cash holdings of large private and public firms and find that the latter hold more cash than the former (Akguc and Choi, 2013; Gao et al., 2013). In this sub-section it is argued that the differences in the results between this chapter and the previous studies is the size of the firms in the sample.

To ensure that the results are driven by the size of the firms in the sample, in this sub-section firms are divided into large and small using a dummy variable $Dummy_{it}$ as a sorting device. Once more this variable assumes the value of 1 if firms' real total assets belong to the bottom 75% distribution of firms operating to the same industry as firm i and year t, and 0 otherwise. In other words, large (small) firms are defined as those in the top (bottom) 75% of the size distribution.

To explore this issue, equation (3.5) is re-estimated only for large firms. If private firms at the top size of the distribution hold less cash than their public counterparts that means that the relative size of firms in the sample drives the empirical findings.

3.5 Model estimation

Unlike Akguc and Choi (2013) which use a fixed effect methodology to explore the cash holdings of public and private firms in Europe, this chapter employs a system GMM. The main drawback of the fixed effect estimator is that it assumes that the regressors are strictly exogenous with respect to the error term. Firm-specific variables (cash flow or leverage for example) are likely to be influenced by cash holdings. More importantly, cash holdings and firm-specific characteristics may also be affected by unobservable shocks (Ozkan and Ozkan, 2004). This means that firm-specific variables may suffer from endogeneity issues.

In this chapter, the model of cash holdings considers all regressors as endogeneous with the exception of the variable private and log of age which are treated as exogenous. The Sargan and $m(n)$ test are implemented to test whether the instruments are valid and the specification models are also correctly specified. In Chapter 3, two (and deeper) lags of the regressors are used as instruments. It is also presented the $m2$ and $m3$ tests for second and third order serial correlation of the differenced residuals in the tables.

3.6 Data

This section is divided in 3 parts. The first describes the main sources for the database which is used to test the differences in cash holdings of public and private firms. The construction of the data and the description statistics are shown in the last sections.

3.6.1 Data collection

The dataset which is employed in this chapter is obtained from Amadeus database as in Chapter 2. Once more, firm-level data is provided over the period 2003-2011. Information corresponds to a nine year period and it comprises the following ten euro area countries: Austria, Belgium, France, Germany, Greece, Italy, Luxembourg, Netherlands, Portugal and Spain. It should be noted that due to the lack of information on public and private firms in Finland and Ireland these countries are dropped from the dataset.

Similar to Chapter 2, only firms with unconsolidated accounts are considered. The vast majority of the firms in the dataset are also not trade in the stock market (i.e. approximately 90.0%). Chapter 3 also follows the work of Blundell and Bond (1998) and takes into account all manufacturing firms following the 2-digital NACE rev. classification. Finally, the CPI is collected from the Eurostat as it is explained in Chapter 2. Private and public firms are defined as in the sub-section 2.6.2.

3.6.2 Sample selection process

Consistent with Chapter 2, negative sales and assets are dropped from the initial sample. To control for the potential influence of outliers, observations in the 1% tails for each of the regression variables are dropped.

The final panel which is unbalanced covers 120,796 firms (Corresponding to 829,178 observations) which belong to the manufacturing sector. In particular, the panel includes 2,693 firms from Austria (corresponding to 14,277 observations), 3,078 firms from Belgium (corresponding to 23,696 observations), 19,185 firms from France (corresponding to 144,812 observations), 28,405 firms from Germany (corresponding to 154,367 observations), 1,582 from Greece (corresponding to 12,289 observations), 40,790 firms from Italy (corresponding to 300,085 observations), 123 firms from Luxembourg (corresponding to 769 observations), 5,223 firms from Netherlands (corresponding to 37,352 observations), 4,646 firms from Portugal (corresponding to 33,882 observations) and 15,071 firms from Spain (corresponding to 107,649 observations).[55]

3.6.3 Descriptive statistics

Table 3.1 presents descriptive statistics (i.e., number of observations, mean, standard deviation, 25th percentile, median and 75th percentile) for the firm-specific variables which are used in the analysis for Chapter 3 for the sample period (2003-2011). Table 3.2 describes the abovementioned statistics across private and public firms. The P-values of a test for the equality of means is also provided in Table 3.2.

[55] In Appendix B, see B.2, B.3, B.4 and B.5 for the number of firms per country, number of observations per country, the number of observations per year and the total structure of the panel, respectively.

Table 3.1: Descriptive statistics for the all sample

	Total sample					
	Obs. (1)	Mean (2)	St. dev (3)	25^{th} (4)	50^{th} (5)	75^{th} (6)
Cash (cash holdings)	806,782	0.102	0.123	0.020	0.048	0.150
Cflow (cash flow)	538,729	0.070	0.073	0.002	0.050	0.109
Lev (leverage)	562,604	0.261	0.162	0.065	0.170	0.334
Nwc (net working capital)	794,665	0.129	0.224	0.016	0.119	0.268
Capex (capital expenditures)	582,719	0.053	0.069	0.009	0.029	0.071
Size (log of size)	674,217	7.952	1.190	5.361	6.301	7.122
Cfv (cash flow volatility)	292,616	0.043	0.028	0.022	0.037	0.057
Sgrowth (sales growth)	576,047	0.370	0.701	-0.113	0.259	0.713
Age	816,450	28.337	20.521	16.000	24.000	35.000

Notes: This table presents the number of observations, sample means, standard deviations, the 25th percentile, the median and the 75th percentile for the all sample (column 1 to 6), respectively. See Table B.1 in the Appendix B for the definition of the variables.

Row 1 of Table 3.1 indicates that the average total cash holdings is approximately 10.2% which is similar to previous studies on Italian and Spanish SMEs (García-Teruel and Martínez-Solano, 2008; Bigelli and Sánchez-Vidal, 2012). As it can be seen, the distribution for the cash holding ratio seems to be strongly positively skewed and firms at the 75th of the distribution hold an average cash holdings of 0.150. In terms of cash flow, the distribution remains rather skewed, with firms at the 75th percentile presenting an average cash flow level which is large than of the median firm. The leverage in the sample has a mean and a median of 0.170 and 0.065, and the 75th percentile and a 25th percentile of 0.334 and 0.065, respectively. A similar pattern is observed for the net working capital and capital expenditures ratios. The figures in Table 3.1 also show that during the 2003-2011 period, firms have a mean (median) size of 7.950 (6.301). These results are similar to those which are presented by Bigelli and Sánchez-Vidal (2012) for small firms. Table 3.1 also shows the industry cash flow risk across percentiles. It is clear that during the 2003-2011 period, cash flow volatility is higher for firms at the 75th percentile of the distribution then at the 25th and 50th percentiles. It is important to mention that the sample size is further reduced when the variable cash flow volatility is considered. In chapter 2 the variable cash flow volatility measures the industry cash flow risk and it is calculated as the standard deviation of industry average cash flow to assets ratio for the previous three years. In other words, it means that 3 out of the 9 years are lost to calculate this variable. Finally, the level of sales growth for firms at the 25th percentile is negative whereas at the median is positive. Firms at the 75th percentile of the distribution see their earnings increasing five decimal points more than at the median of the distribution. Finally, the average firm is 28 years old and 75% of the firms in the distribution are approximately 35 years old.

Table 3.2. shows that the majority of the observations in the sample belong to the

private firms.[56] When comparing private and public firms (Table 3.2), it is clear that the former hold substantially more cash than the latter. In fact, across the different percentiles distribution of cash, private firms hoard more than their public counterparts. This is consistent with the notion of the precautionary motive. Firms which suffer from higher levels of information asymmetry and have a restricted access to capital markets should hoard more cash as a precaution. These findings contradict the recent studies on private and public firms' cash reserves (Akguc and Choi, 2013; Gao et al., 2013) but are in line with those which focus on small firms (Bigelli and Sánchez-Vidal, 2012; Hall et al., 2014). However, the difference between sub-samples is not statistically significant (column 4). A similar pattern is observed when considering cash flow. The mean of cash flow for private firms is higher than for their public counterparts. More important, for private (public) firms at the 25th percentile of distribution, the cash flow is negative (closer to zero). In other words, these may indicate that private firms at the low end of the distribution are not able to hold cash inflows from their operations and may need to raise external finance more. Private firms are on average smaller and highly leveraged when compared with public firms. Looking at the percentiles of the distribution of both variables, the statistics indicate that the leverage (size) for firms at the 25th percentile of the distribution is positive and below the median for both private and public firms although the latter present lower levels than the former. This seems to be consistent with the argument that private firms depend more on internal debt and/or equity whilst public firms obtain finance through the public equity market (Brav, 2009).

Moving to the net working capital, it seems that this variable takes the average value of 10.0% for private firms while it equals 13.0% for public firms. Firms at the low end of the distribution hold a lower proportion of net working capital, with private firms showing a net working capital closer to zero at the 25th and 50th percentile. The literature of cash holdings denotes that net working capital is a substitute for cash (Opler et al., 1999). In fact, these results are consistent with the assumption of Gao et al. (2013). The authors refer that a higher value of net working capital for public firms should be explained by a decrease in cash reserves for public firms.

Another important difference which is documented in Table 3.2 is that public firms have higher cash flow volatility (i.e. Chapter 2 measure of risk) than private firms. However, when considering the percentiles distribution of this variable for private and public firms, the statistics show that private firms experience highest cash flow variability at the median and 75th percentile when comparing with public firms at the 50th and 75th percentile. Hence, the statistics suggest that private firms at the top of the distribution have a higher variability of cash flow. It should be taken into account once more that to calculate this

[56] This is in line with the expectations since the data which is implemented includes mainly unquoted firms (approximately 90%).

variable I have required a minimum of 3 years which decreases the sample size of this variable for both private and public firms.

In terms of sales growth both private and public firms have similar patterns. The average sales growth is higher for the former than for the latter. The median growth on sales is below the average but also negative at lower levels of sales growth (25th percentile) for both type of firms. Private firms are younger when comparing with public firms across the different percentiles of the distribution. Overall, private firms are on average highly leveraged, smaller and younger when comparing with their public counterparts.

Table 3.2: Descriptive statistics across public and private firms

	Private						Public						Diff.
	Obs. (1)	Mean (2)	St. dev (3)	25^{th} (4)	50^{th} (5)	75^{th} (6)	Obs. (7)	Mean (8)	St. dev (9)	25^{th} (10)	50^{th} (11)	75^{th} (12)	Means (13)
Cash (cash holdings)	571,388	0.106	0.127	0.008	0.047	0.151	235,394	0.095	0.116	0.002	0.012	0.139	0.276
Cflow (cash flow)	304,094	0.071	0.072	-0.062	0.062	0.102	234635	0.081	0.079	0.001	0.079	0.106	0.000
Lev (leverage)	359,447	0.275	0.168	0.065	0.154	0.335	203,157	0.233	0.162	0.045	0.137	0.291	0.000
Nwc (net working capital)	559,512	0.102	0.224	0.016	0.091	0.268	235,153	0.134	0.193	0.011	0.133	0.259	0.000
Capex (capital expenditures)	379,412	0.059	0.069	0.010	0.029	0.071	203,294	0.041	0.062	0.009	0.025	0.068	0.000
Size (log of size)	439,428	7.701	1.092	5.012	6.201	7.123	234,789	8.556	1.243	4.201	5.107	6.123	0.000
Cfv (cash flow volatility)	155,642	0.044	0.028	0.021	0.035	0.056	136,974	0.050	0.031	0.020	0.030	0.045	0.000
Sgrowth (sales growth)	388,935	0.406	0.738	-0.100	0.276	0.749	187,112	0.296	0.610	-0.139	0.224	0.648	0.000
Age	577,653	27.018	21.592	15.000	23.000	33.000	238,797	31.600	17.251	20.000	28.000	39.000	0.000

Notes: This table presents the number of observations, sample means, standard deviations, the 25th percentile, the median and the 75th percentile for private firms (column 1 to 6) and public firms (column 7 to 12), respectively. This is based on a dummy variable equal to 1 for firms considered as private, and 0 otherwise. Diff. means is the p-value of the test statistic for the equality of means between private and public firms (column 13). See Table B.1 in the Appendix B for the definition of the variables.

As a further story for the preliminary analysis, Figure 3.1 shows the average cash holdings for the sample period between 2003 and 2011. Figure 3.2 describes the average cash holdings by public and private firms for the overall sample period. Figure 3.3 denotes the average cash holdings for public and private firms according to their level of financial pressure.

The most noticeable feature of Figure 3.1 is that since 2003 the overall cash ratio for euro area firms has fluctuated increasing again in 2008 in the context of the financial crisis. This is a period characterised by a high uncertainty for firms. In line with this argument, Forster et al. (2011) refer that during the financial crisis firms sold other assets to raise cash since their net borrowing decreased.

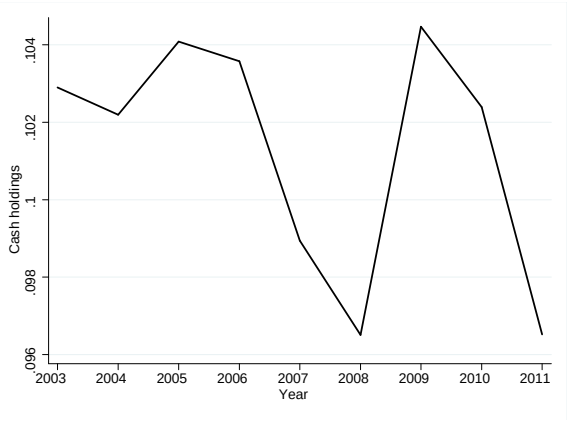

Figure 3.1: Average cash holdings for the sample of firms in the euro area.

Figure 3.2 shows that private firms have constantly kept higher cash levels than their public counterparts. The average cash holdings for both type of firms converges at the end of 2011. In fact, private firms' cash holdings have decreased since 2009 and public firms have raised their cash level since 2010. Two factors may explain this behaviour during the crisis period. First, in the euro area since 2009 there has been a tightening of the business credit standards together with a decrease of the availability of external financing. This may enable public firms to increase their level of cash reserves as a precautionary measure. Ferrando and Mulier (2013) argue that firms which normally hold lower cash reserves attempt to raise it during crisis periods. Secondly, private firms may face a deterioration of their financial situation during the crisis which explains their decrease in cash levels at the end of the sample period.

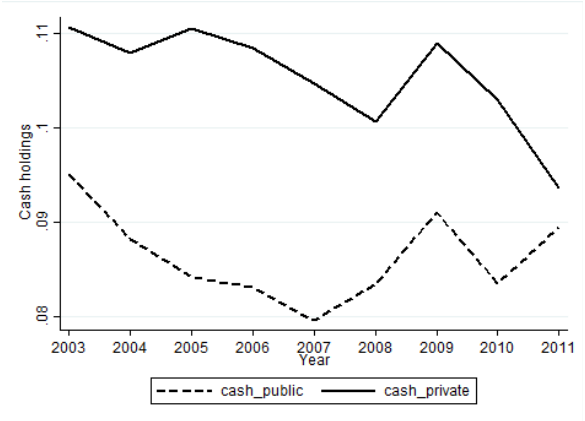

Figure 3.2: Average cash holdings for the sample of private and public firms in the euro area.

Finally, Figure 3.3 shows the average cash holdings of public and private firms by deciles of financial pressure, i.e. coverage ratio. Coverage ratio measures firms' credit worthiness. The higher the coverage ratio, the better is the firms' balance sheet of the firms(Spaliara, 2009). The figure shows a right hand side of a U-shaped relation between cash holdings and credit risk. Figure 3.3 indicates that for higher levels of financial pressure private firms hold more cash than their public counterparts. Once more the way the sample of firms behave may be an indicator that the precautionary motive leads private firms to hold more cash than their public counterparts.

To sum up, the descriptive statistics show that there is an important heterogeneity in cash holdings for public and private firms. The following sub-section shows the econometric analysis on the links between these variables.

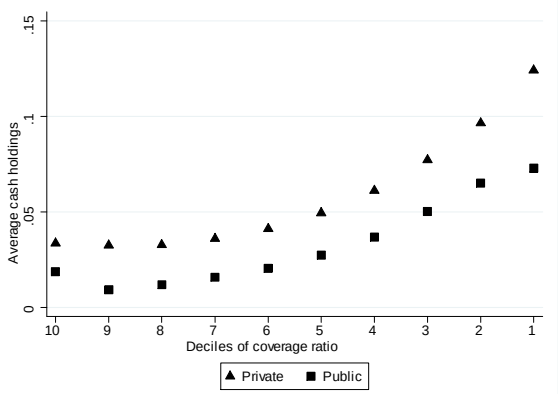

Figure 3.3: Average cash holdings for the sample of private and public firms in the euro area across deciles of financial pressure.

3.7 Results

3.7.1 Cash holdings of private and public firms

This section explores whether private firms hold higher levels of cash than their public counterparts. While previous evidence explores this issue for relatively large firms (Akguc and Choi, 2013; Gao et al., 2013; Farre-Mensa, 2014), this chapter takes one step forward and explores cash reserves for a sample of relatively small and unquoted firms. Table 3.3 shows the estimates for equation (3.5).

To begin with the coefficient on the variable $Private_{t}$ is positive and statistically significant which confirms the summary statistics from Table 3.1. In other words, private firms hold more cash than their public counterparts when controlling for firm-specific characteristics. It is also clear the economic effect of this variable. Private firms hold approximately 35.8% more cash than their public counterparts.[57] This result can be explained under the precautionary motive. Private firms have a higher need to hold more cash than their public counterparts to counter the impact of financial frictions. The former suffer from higher levels of information asymmetry than the latter and as a result they hoard more cash (Akguc and Choi, 2013). This is inconsistent with the previous literature which shows that public firms hold more cash than their private counterparts (Akguc and Choi, 2013; Gao et al., 2013).

Turning to the coefficients of the control variables, it is clear that they have the expected sign. For instance, $Capex_{it}$ and Lev_{it} have a negative and significant effect whereas $Sgrowth_{it}$ and Cfv_{it} present a positive relation with the cash variable. The negative sign on the coefficient of Nwc_{it} demonstrates that working capital is a substitute for cash. Overall, firms with greater cash flow, cash flow volatility and sales growth hoard more

[57] Following Gao et al. (2013) the percentage of cash holdings is calculated as follows: exp(0.306)=1.358; (1.358-1)*100=35.8%

Table 3.3: Public and private firms' cash holdings

	Baseline (1)
Private_t	0.306**
	(2.09)
Cflow_{it}	0.312***
	(3.11)
Lev_{it}	-2.996***
	(-4.27)
Nwc_{it}	-1.824***
	(-4.03)
Capex_{it}	-0.358***
	(-2.99)
$\text{Ln(Size}_{it}\text{)}$	-0.150*
	(-1.72)
Cfv_{it}	0.850***
	(3.25)
Sgrowth_{it}	1.627***
	(3.39)
$\text{Ln(Age}_{it}\text{)}$	-0.144*
	(-1.80)
Observations	329,706
Firms	72,008
Sargan (p-value)	0.158
m1 (p-value)	0.000
m3 (p-value)	0.090

All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry and time dummies are included in the specification. Instruments include all regressors (except Private_t and $\ln(\text{Age}_{it})$) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 18. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table B.1 in the Appendix B for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

cash. Larger and highly leveraged firms hold less cash. These findings are in line with previous empirical literature (Gao et al., 2013; Akguc and Choi, 2013).

The diagnostic tests demonstrate that neither the Sargan test (J statistic) nor the $m3$ indicate any problems with the choice of instruments or the general specification of the model.

3.7.2 The impact of financial pressure

In this section it is explored the effect of financial pressure (measured as the coverage ratio) on the relative cash holdings differences among private and public firms.

Table 3.4 shows the results for the private firm dummy across three different levels of financial pressure. Empirical findings suggest that the difference between private and public firms' cash holdings is of a U-shaped pattern. At higher (lower) level of financial pressure private firms hold 64.70% (70.02%) more cash as a percentage of assets than their public counterparts.[58] This result suggest that the difference in cash holdings between

[58]In column 1, this is calculated as follows: exp(0.532)=1.702; (1.702-1)*100=70.02. In column 3, the

Table 3.4: Cash holdings and financial pressure

	Financial pressure		
	Low	Med.	High
	(1)	(2)	(3)
Private_t	0.532**	0.270***	0.499**
	(2.43)	(2.71)	(2.32)
Cflow_{it}	0.414***	0.342***	0.157
	(2.72)	(3.56)	(0.68)
Lev_{it}	-4.733***	-3.941***	-6.255**
	(-4.45)	(-2.68)	(-2.51)
Nwc_{it}	0.785	-4.205***	-4.748***
	(1.16)	(-3.57)	(-6.11)
Capex_{it}	-1.702	-0.182	-7.947*
	(-0.99)	(-0.10)	(-1.72)
$\text{Ln(Size}_{it})$	-0.758	-0.053*	1.719
	(-0.96)	(0.02)	(0.88)
Cfv_{it}	0.049	0.195**	0.617***
	(0.10)	(2.54)	(2.69)
Sgrowth_{it}	0.834	0.808***	1.818**
	(1.63)	(5.96)	(2.00)
$\text{Ln(Age}_{it})$	-0.339***	-0.359	-0.076
	(-2.79)	(-1.00)	(-0.68)
Observations	29,004	27,540	21,855
Firms	18,302	19,496	11,138
Sargan (p-value)	0.430	0.454	0.020
m1 (p-value)	0.000	0.000	0.000
m2 (p-value)	0.040	0.345	0.094

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Firms are split according to each decile of the financial pressure (coverage ratio). Low indicates the the 10^{th} decile. Med denotes the 5^{th} decile . High corresponds to the the 1^{th} decile. Country, industry and time dummies are included in the specification. Instruments include all regressors (except Private_{it} and $\ln(\text{Age}_{it})$) lagged two times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 27 in column 1, 31 in column 2 and 26 in column 3. m1 (m2) is a test for first (second) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table B.1 in the Appendix B for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

private and public firms is smaller (higher) at higher (lower) levels of financial pressure. This is a novel and significant result which extends the argument of Acharya et al. (2012). The smaller gap between private and public firms at higher levels of financial pressure (column 3) can be attributed to the precautionary motive. At higher levels of financial pressure firms hoard cash as a precaution.

Similarly, private firms hold even more cash than their public counterparts at lower level of financial pressure (column 1). This difference may be explained under the assumption that firms which are faced with more financial frictions always prefer internal to external funds for financing. Private firms are normally characterised as those with a more costly access to external finance. Thus, it is likely that the way these firms obtain finance explain their cash levels.

Finally, firm-specific variables continue to be important in explaining cash decisions.

coefficient is calculated as: exp(0.499)=1.647; (1.647-1)*100=64.70.

For instance, it is clear that cash flow volatility is higher in the higher level of financial pressure category. The Sargan and $m2$ tests do not indicate any problems with the specification of the model and the choice of the instruments.

3.7.3 Target cash levels

Next, it is explored whether firms' status has a differential effect on the speed of adjustment of firms to their target cash levels. Empirical findings for equation (3.6) are provided in Table 3.5.

Results show that private firms continue to hold more cash than public firms. They show that private firms hold approximately 27.1% more than private counterparts.[59] The coefficient on the Cash_{it-1} variable is positive and statistically significant. It indicates that firms try to achieve their optimal cash level. The coefficient on the interaction term (Private_i*Cash_{it-1}) is also positive and statistically significant. This suggests that private (public) firms adjust slower (quicker) to their target cash levels. This finding is in line with the idea that private firms have higher transaction costs as well as a restricted access to capital markets than their public counterparts. As a result, the former adjust their actual cash positions towards their target cash levels slower than the latter (Gao et al., 2013).[60]

Consistent with the results of the baseline model in sub-section 3.7.1, the control variables are also statistically significant and present the expected signs. Finally, the Sargan test is statistically significant and the m3 does not indicate problems with the instruments.

[59] In column 2, this is calculated as follows: exp(0.243)=1.271; (1.271-1)*100=27.1%

[60] In Chapter 3 it is also employed a partial adjustment model to estimate the speed of adjustment of cash holdings of private and public firms following the literature on cash holdings (Akguc and Choi, 2013; Gao et al., 2013). Results are robust to the empirical findings provided in Table 3.4. Please see sub-section B.6 in Appendix B for details.

Table 3.5: Cash holdings and target cash levels

	(1)
Private_t	0.243**
	(2.97)
Cash_{it-1}	0.612***
	(5.41)
Private_t*Cash_{it-1}	0.275**
	(2.05)
Cflow_{it}	0.254***
	(2.70)
Lev_{it}	-2.485***
	(-3.47)
Nwc_{it}	-2.962***
	(-5.39)
Capex_{it}	-3.008***
	(-2.01)
$\text{Ln(Size}_{it}\text{)}$	-0.086***
	(-2.59)
Cfv_{it}	0.651**
	(2.53)
Sgrowth_{it}	1.539***
	(4.78)
$\text{Ln(Age}_{it}\text{)}$	-0.900***
	(-3.26)
Observations	327,688
Firms	71,761
Sargan (p-value)	0.030
m1 (p-value)	0.000
m3 (p-value)	0.300

All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry and time dummies are included in the specification. Instruments include all regressors (except Private_t and $\ln(\text{Age}_{it})$) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 32. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table B.1 in the Appendix B for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

3.7.4 Dynamic specification

Until now a static model has been used which means that adjustment costs have not been considered. Since markets are imperfect and adjustment and/or transaction costs exist, a dynamic estimation is implemented. Results for equation (3.7) and equation (3.8) are presented in Table 3.6 and Table 3.7.

Starting with Table 365, it is observed that private firms continue to hold more cash than their public counterparts. All control variables retain their significance.

The coefficient of the lagged cash variable (Cash_{it-1}) indicates a speed of adjustment of 0.116.[61] This implies that firms follow a target cash level while maintaining a low adjustment speed. This adjustment may be explained by the existence of transaction and other adjustment costs. Finally, results in Table 3.7 show that the difference in cash

[61] As it is noted in sub-section 3.4.4, the adjustment speed is calculated as 1-β. In this case 1-0.884=0.116.

holdings of private and public firms are of a U-shaped when considering the effect of financial pressure.

Table 3.6: Cash holdings of public and private firms: Dynamic specification

	Baseline
Private_t	0.191*
	(1.94)
Cash_{it-1}	0.884***
	(28.43)
Cflow_{it}	0.172***
	(2.44)
Lev_{it}	0.126
	(0.25)
Nwc_{it}	-0.175
	(-0.75)
Capex_{it}	-4.735**
	(-2.33)
$\text{Ln(Size}_{it}\text{)}$	0.978
	(0.61)
Cfv_{it}	-0.086
	(-0.45)
Sgrowth_{it}	0.703*
	(1.84)
$\text{Ln(Age}_{it}\text{)}$	-0.055
	(-0.91)
Observations	327,688
Firms	71,761
Sargan (p-value)	0.085
m1 (p-value)	0.000
m3 (p-value)	0.117

All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry and time dummies are included in the specification. Instruments include all regressors (except Private_t and $\ln(\text{Age}_{it})$) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 21. m1 (m3) is a test for first (fourth) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table B.1 in the Appendix B for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 3.7: Cash holdings and financial pressure: Dynamic specification

	Financial pressure		
	Low	Med.	High
	(3)	(2)	(1)
$Private_t$	0.394***	0.205*	0.375**
	(4.31)	(1.87)	(2.37)
$Cash_{it-1}$	0.582***	0.557***	0.617***
	(6.99)	(6.45)	(9.68)
$Cflow_{it}$	0.303**	0.019	0.244**
	(2.93)	(0.16)	(2.55)
Lev_{it}	-1.518	-0.450	-1.973**
	(-1.24)	(-0.26)	(-2.20)
Nwc_{it}	0.378	-1.415**	0.640
	(0.39)	(-2.29)	(1.29)
$Capex_{it}$	-1.829	-2.419	-4.818**
	(-1.10)	(-0.78)	(-2.52)
$Ln(Size_{it})$	-0.157	-0.965	-0.210
	(-0.18)	(-0.71)	(-0.34)
Cfv_{it}	7.039	0.352**	-0.325
	(0.93)	(2.45)	(-0.80)
$Sgrowth_{it}$	0.821**	0.220	0.245
	(2.07)	(1.07)	(0.56)
$Ln(Age_{it})$	0.031	-0.044	0.062
	(0.08)	(-0.69)	(0.41)
Observations	25,756	28,805	21,777
Firms	17,233	18,174	11,097
Sargan (p-value)	0.101	0.747	0.935
m1 (p-value)	0.000	0.000	0.000
m2 (p-value)	0.022	0.136	0.012

Notes: All specifications are estimated using a system GMM estimator.The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Firms are split according to each decile of the financial pressure (coverage ratio). Low indicates the the 10^{th} decile. Med denotes the 5^{th} decile . High corresponds to the the 1^{th} decile. Country, industry and time dummies are included in the specification. Instruments include all regressors (except $Private_t$ and $ln(Age_{it})$) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 34 in column 1, 38 in column 2 and 38 in column 3. m1 (m2) is a test for first (second) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table B.1 in the Appendix B for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

3.7.5 Alternative definition of financial pressure

In the main empirical results, financial pressure is defined using the coverage ratio. To ensure the robustness of the results, Chapter 3 also includes an alternative measure of financial pressure, i.e. the debt-capital ratio. Results are presented in Table 3.8.

Empirical findings are robust to the results of Table 3.4. Private firms hold more cash than their public counterparts. The U-shaped relation between the differential in cash holdings of public and private firms persists. Firms which suffer from higher levels (3 column) and lower levels (column 1) of financial pressure hold also higher levels of cash reserves.

Table 3.8: Alternative measure of financial pressure

	Financial pressure		
	Low	Med.	High
	(1)	(2)	(3)
Private_t	0.516***	0.167**	0.399***
	(2.91)	(6.50)	(3.00)
Cflow_{it}	0.476***	0.170**	0.390*
	(3.79)	(2.53)	(4.03)
Lev_{it}	0.898	-0.635	-5.987***
	(0.56)	(-0.74)	(-9.44)
Nwc_{it}	-0.028	1.616***	-1.275
	(-0.02)	(1.99)	(-1.40)
Capex_{it}	2.576	-1.633	-2.485
	(1.13)	(-0.87)	(-1.19)
$\text{Ln(Size}_{it})$	-0.269**	-0.211*	-0.152
	(-2.16)	(-1.69)	(-1.33)
Cfv_{it}	0.338**	0.234***	0.164**
	(2.47)	(3.54)	(2.13)
Sgrowth_{it}	1.229**	0.973***	0.512
	(2.42)	(3.88)	(1.30)
$\text{Ln(Age}_{it})$	-0.219	-0.266	-0.581
	(-0.40)	(-0.83)	(-1.16)
Observations	25,314	32,304	29,057
Firms	17,749	21,514	22,641
Sargan (p-value)	0.147	0.004	0.000
m1 (p-value)	0.000	0.000	0.000
m3 (p-value)	0.720	0.015	0.052

Notes: This table shows the impact of financial pressure on public and private firms cash holdings. In this case, financial pressure is defined as the debt-capital ratio. Firms are split according to each decile of the debt-capital ratio, i.e. from the 1^{th} decile (lower financial pressure) to the 10^{th} decile (higher financial pressure). Debt-capital ratio is the product of debt-capital ratio three years lagged and the contemporaneous change in the 10-year bond yield. Specifications are estimated using a system GMM estimator.The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry and time dummies are included. Instruments include all regressors (except Private_t and $\ln(\text{Age}_{it})$) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 18 in column 1, 22 in column 2 and 26 in column 3. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table B.1 in the Appendix B for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

3.7.6 Jointly determined variables

The baseline regression model which is obtained in sub-section 3.7.1 employs as control variables firm-specific characteristics which are normally implemented in the cash literature. However, Opler et al. (1999) refer that variables such as leverage and capital expenditures may be determined jointly with cash reserves. This means that the coefficients which are presented for the baseline model can be inconsistent.

To account for this issue, equation (3.5) is re-estimated without the aforementioned variables. Table 3.9 provides the empirical findings.

Results are robust to the previous empirical findings when considering the exclusion of the jointly determined variables. In other words, private firms continue to hold more cash than their public counterparts.

All control variables have the expected signs and are statistically significant. Overall, the empirical findings continue to suggest that private firms retain more cash holdings comparing with public firms due to a precautionary demand for cash.

Table 3.9: Omission of jointly determined variables

	Baseline (1)
Private_t	0.638***
	(4.07)
Cflow_{it}	0.505***
	(4.35)
Nwc_{it}	-2.163***
	(-5.42)
$\text{Ln(Size}_{it}\text{)}$	0.612
	(0.51)
Cfv_{it}	0.642***
	(2.62)
Sgrowth_{it}	1.598***
	(3.93)
$\text{Ln(Age}_{it}\text{)}$	0.124
	(1.35)
Observations	381,106
Firms	77,077
Sargan (p-value)	0.060
m1 (p-value)	0.000
m3 (p-value)	0.006

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry and time dummies are included in the specification. Instruments include all regressors (except Private_t and $\ln(\text{Age}_{it})$) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 12. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table B.1 in the Appendix B for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

3.7.7 Cash flow sensitivity of cash

Chapter 3 also takes into account the argument of Almeida et al. (2004) according to who the cash flow sensitivity of cash is greater for financially constrained firms than for their unconstrained counterparts. Table 3.10 provides the empirical findings for equation 3.9.

The coefficient on the cash flow variable is positive and statistically significant. It denotes that private and public firms have a cash flow sensitivity of cash. When considering the interaction term (Private_t*Cflow_{it}), it is clear that the coefficient also captures the indirect effect of cash flow on cash holdings. In fact, it provides evidence that private firms save more cash out of cash flow than their public counterparts.

The aforementioned findings contradict the recent studies on U.S. and European private and public firms(Farre-Mensa, 2014; Gao et al., 2013). However, they are in line with the argument of Almeida et al. (2004). Cash flow sensitivity of cash is positive for financially constrained firms. These firms have a more restricted access to external markets and suffer

from higher levels of information asymmetry. Hence, in Table 3.10 the empirical findings suggest that private firms may suffer from higher levels of financial constraints than their public counterparts (Akguc and Choi, 2013).

Table 3.10: Cash flow sensitivity of cash

	(1)
Private_t	0.528*
	(1.79)
Private_t*Cflow_{it}	0.047**
	(2.19)
Cflow_{it}	0.008***
	(3.79)
ΔNwc_{it}	-0.405***
	(-9.96)
Capex_{it}	-0.033
	(-0.31)
$\text{Ln(Size}_{it}\text{)}$	-0.900***
	(-7.51)
Sgrowth_{it}	0.254***
	(10.41)
ΔSTdebt_{it}	-0.360***
	(-10.96)
Observations	329,706
Firms	73,551
Sargan (p-value)	0.016
m1 (p-value)	0.000
m3 (p-value)	0.582

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry and time dummies are included in the specification. Instruments include all regressors (except Private_t) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 18. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table B.1 in the Appendix B for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

3.7.8 Private firms' cash holdings during the crisis

This sub-section takes into account the effect of the crisis in the cash holdings' differences among private and public firms. Table 3.11 presents the results for equation 3.10.

Table 3.11: The impact of the financial crisis

$Private_t$	0.173***
	(4.84)
$Private_t$*$Crisis_t$	0.321***
	(2.13)
$Crisis_t$	0.440***
	(7.86)
$Cflow_{ti}$	0.283***
	(2.67)
Lev_{ti}	-0.115
	(-1.36)
Nwc_{ti}	-1.841***
	(-4.16)
$Capex_{ti}$	-0.159
	(-0.08)
$Ln(Size_{it})$	-0.246
	(-0.16)
Cfv_{ti}	0.974***
	(3.71)
$Sgrowth_{ti}$	1.824***
	(4.85)
$Ln(Age_{ti})$	0.126
	(1.40)
Observations	329,706
Firms	72,008
Sargan (p-value)	0.095
m1 (p-value)	0.000
m3 (p-value)	0.008

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry and time dummies are included. Instruments include all regressors (except $Private_t$, $Private_t$*$Crisis_t$, $Crisis_t$and $\ln(Age_{it})$) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 19. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table B.1 in the Appendix B for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

The coefficient on the variable $Private_t$ is positive and statistically significant. That means that private firms hold more cash than their public counterparts, especially during the financial crisis. This contradits Akguc and Choi (2013). They provide evidence that public firms hoard more cash than their public counterparts during the crisis in Europe. However, the empirical findings are in line with other recent evidence by Campello et al. (2010). The authors show that in Europe and Asia firms which suffer from credit constraints decrease their investment levels and increase their cash holdings than their unconstrained counterparts, especially during the turmoil period. More importantly, the results are consistent with the idea that an increase in cash reserves is related to a precautionary motive against unexpected credit supply shock (Almeida et al., 2004). Finally,

the financial crisis (Crisis_t) exerts a positive effect on the cash level of the firms.

3.7.9 Private and public firms' cut-off point

As a final robustness check, the sample of firms is split according to their size. The motivation to do so is to ensure that the results are driven by the large share of small firms in the sample. A 75th percentile is used as a cut-off point to distinguish between large and small firms. In fact, large firms are classified as those whose total assets are above the 75th percentile of the distribution of the assets of all the firms in a particular country, year and industry, and 0 otherwise. Equation (3.5) is re-estimated only for firms above the 75th percentile. Empirical findings are shown in Table 3.12.

Table 3.12: Cash holdings for the largest firms in the sample

Private_t	-0.345***
	(-5.23)
Cflow_{it}	-0.143
	(-1.56)
Lev_{it}	-4.822***
	(-6.52)
Nwc_{it}	-1.162**
	(-1.70)
Capex_{it}	-1.124
	(-0.96)
$\text{Ln(Size}_{it})$	0.535
	(0.32)
Cfv_{it}	-0.702
	(-1.04)
Sgrowth_{it}	-1.046***
	(-3.47)
$\text{Ln(Age}_{it})$	-1.504***
	(-4.59)
Observations	115,322
Firms	28,939
Sargan (p-value)	0.014
m1 (p-value)	0.000
m2 (p-value)	0.379

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. High size firms correspond to the upper 25 percentile of firms' size. Country, industry and time dummies are included. Instruments include all regressors (except Private_t and $\ln(\text{Age}_{it})$) lagged two times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 12. m1 (m2) is a test for first (second) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table B.1 in the Appendix B for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Results provide evidence that only large private firms hold less cash than their public counterparts. This indicates that for large private firms the agency motive is more pronounced than the precautionary one. More importantly, the negative and statistically significant coefficient on the private variable implies that all the previous results are driven by the very small size of the firms which are used in Chapter 3.

3.8 Concluding remarks

Recently, private and public firms' cash holdings have been subject of attention (Akguc and Choi, 2013; Gao et al., 2013). The few empirical studies which test cash reserves among private and public firms show that public firms hold more cash than their private counterparts. However, in these studies private firms are able to issue debt. In other words, both private and public firms are relatively large firms. Having this caveat in mind, this chapter offers new insights on the behaviour of public and private firms. It investigates the cash holdings' differences of private and public firms for a sample in which the vast majority are relatively small.

The contribution of this chapter is threefold. Firstly, private firms hold more cash than their public counterparts. These results reconcile with the main literature of cash holdings decisions (Opler et al., 1999; Ozkan and Ozkan, 2004; Bates et al., 2009). The precautionary motive to hold cash is more pronounced than the agency cost motive. Private firms have less access to external finance and therefore are expected to have a stronger precautionary motive to financial frictions (Gao et al., 2013). Results contradict the recent diverging studies on cash holdings for private and public firms (Akguc and Choi, 2013; Gao et al., 2013).

Secondly, when differentiating firms according to three different levels of financial pressure (i.e. lower, medium and higher levels), it is clear that private firms still hold more cash than their public counterparts. The difference between private and public firms cash reserves decreases the higher is the level of financial pressure of the firms. There is also a U-shaped relation between firms' cash holdings and financial pressure. This is consistent with the work by Acharya et al. (2012).

Thirdly, the results suggest that both private and public firms adjust to their target cash levels and that private firms are slower in adjusting to their targets. Finally, the results are robust to a set of distinct criteria. When the dynamic component is implemented, results show that private firms still hold more cash.[62] Private firms also have a higher cash flow sensitivity of cash than their public counterparts. During the crisis the former also hoard higher cash levels than the latter emphasising the role of the precautionary motive. Overall, the results suggest that in the euro area small private firms hold more cash than public counterparts.

[62] Empirical findings are also robust when considering an adjustment cash model based on the literature on cash holdings (Akguc and Choi, 2013; Gao et al., 2013). Empirical findings are provided in Appendix B, sub-section B.6.

4 Chapter 4: Trade credit and inventories: Evidence from a panel of euro area firms

4.1 Introduction

Trade credit is considered to be one of most important sources of short-term financing. According to Demirgüç-Kunt and Maksimovic (2002), trade credit is behind bank lending the most important source of external finance, especially for SMEs. Trade credit is defined as an agreement between the buyer and the supplier. The buyer of goods and/or services is not required to pay immediately since the seller offers credit terms to the buyer.

The literature suggests that trade credit should be considered from a demand and a supply point of view (Petersen and Rajan, 1997). Both sides should contribute to the final impact of trade credit on the firms' balance sheets. A firm can be seen as a supplier and its accounts receivables are a proxy for how much the firm is willing to lend (Petersen and Rajan, 1997). However, a firm is also a customer and its accounts payables correspond to the borrowing from suppliers (Ferrando and Mulier, 2013).

In the euro area, trade credit is associated with the economic cycle. For instance, Ferrando and Mulier (2013) provide evidence that between 2000 and 2005, trade credit declined due to an easier access to bank financing. The situation is reversed during the crisis period. More importantly, recent evidence suggests trade creditors play an important role on SMEs financing. The former act as an alternative important source of short-term financing to the latter and this role is magnified during the turmoil period (Casey and O'Toole, 2014; Carbó-Valverde et al., 2016).

The main focus of the empirical literature on trade credit is on whether trade credit and bank loans act as complements or substitutes of one another depending on the phase of the business cycle. Other studies have focused on the relation between trade credit and inventories and argue that suppliers are only willing to provide credit to their buyers as a way of shifting their inventory stocks to their buyers (Bougheas et al., 2009; Guariglia and Mateut, 2016). This approach is based on the inventory management motive of Bougheas et al. (2009). According to the authors, firms have an advantage to extend trade credit to their financially constrained customers. Since producers face an uncertain demand for their products, they prefer to obtain sales rather than to accumulate costly inventories of finish goods. The literature on trade credit and inventories is surprisingly limited. The only studies which explore this link are based on a sample of U.K. and Chinese firms (Bougheas et al., 2009; Guariglia and Mateut, 2016). What is less explored, however, is the role of financial constraints and the characteristics of the goods transacted on trade credit.

The present chapter seeks to fill this gap by connecting the literatures on trade credit,

financial constraints and financial development. More specifically, the aim is to provide for the first time an empirical analysis on the trade-off between inventories and trade credit (i.e. extended and taken) by testing whether firm-specific dimensions and different channels are important in explaining the trade credit process. Hence, Chapter 4 uses a sample of twelve euro area countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain) for the period between 2003 and 2011. The chapter makes three main contributions to the literature of trade credit and inventories. First, it determines whether the trade-off between stock of inventories and trade credit (i.e. extended and taken) depends on the characteristics of the goods which are sold and firms' access to external finance. The former is based on the diversion value hypothesis of Giannetti et al. (2011) according to which firms which produce differentiated goods have a closer buyer-seller relation when comparing with the one in the standardized industries. The latter is based on the well known literature on financial constraints which refers that firms with a restriced access to credit suffer from higher levels of financial constraints. The motivation to explore the role of financial constraints on inventory management motive stems from the fact that changes in the costs of storing goods (especially higher costs) can force firms to sell their products on credit to reduce their storage costs and facilitate external funding. These effects should be stronger for financially constrained firms since they suffer from higher levels of information assymetry and are more vulnerable to capital market imperfections.

Second, Chapter 4 contribution is related to the recent financial crisis. In this chapter the effect of stock of inventories on trade credit is differentiated over a crisis and a non-crisis period. To this end, it is hypothesised that during the turmoil period, firms should have a higher incentive to sell their stock on credit as a way to improve their sales and decrease their costs of holding stock. This is based on the financial accelerator theory according to which deteriorations in the economic conditions increase firms' costs of finance, and therefore, weakens firms' balance sheet positions (Bernanke et al., 1996). Recent literature only explores whether trade credit acts as a substitute and/or complement to bank lending during the crisis and do not take into account the role of inventories on trade credit (Garcia-Appendini and Montoriol-Garriga, 2013; Kabir and Zubair, 2015; Carbó-Valverde et al., 2016). This is an important contribution since it may help us understand the channels through which the financial crisis led firms to extend and take trade credit.

The final contribution of this chapter is to determine for the first time whether financial development has an indirect role on firms' willingness to offer and receive trade credit. To be specific, the aim is to test the extend to which the development of the banking system affects firms' decisions to extend and take trade credit. It is well established that the euro area is characterised by a more bank-based system. The banks have a more influential role than markets in channelling funds from investors to non-financial corporations (Boot and

Thakor, 2008; Bijlsma and Zwart, 2013). Thus, Chapter 4 contributes to the literature on trade credit by investigating whether financial development is an important channel in the inventory management process. This approach complements the existing empirical literature which focuses on the direct effect of bank development on trade credit (Demirgüç-Kunt and Maksimovic, 2002; Fisman and Love, 2003; Cassia and Vismara, 2009; Deloof and La Rocca, 2015).

The rest of this chapter is organised as follows. Sub-section 4.2 reviews the theories and empirical literature. Sub-section 4.3 summarises the research design whereas sub-section 4.4 provides the model specification. Sub-section 4.5 and sub-section 4.6 denote the estimation method and the data which is used. Finally, sub-section 4.7 and sub-section 4.8 show the results and final conclusions of the chapter.

4.2 Literature review

Trade credit is an agreement in which the suppliers offer credit terms that allow the customers of a business to delay payment of goods and services. Usually, transactions of trade credit involve short-term delay of payment (30 to 60 days) of purchases of intermediate goods and services (Cuñat, 2007).

Under the assumption of perfect markets trade credit does not exist. Firms sell their goods and services for cash rather than use trade credit (Lewellen et al., 1980). All credit terms that are acceptable to both the seller and the buyer are the present value equivalent of cash terms (Emery, 1984). However, capital markets are imperfect and research on trade credit has focused on several financial market imperfections to explain the use of trade credit by the firms (Lewellen et al., 1980).

Many theories have been put forward to explain the existence of trade credit. The following sub-sections describe the main theoretical and empirical studies on trade credit.

4.2.1 Theoretical and empirical background

The literature provides different theories to describe the use of trade credit. They are based on advantages that suppliers (customers) have to provide (receive) trade credit from a commercial, an operational and a financial point of view. In the next paragraphs it is described the most prominent theories.

- Information asymmetry

  Trade credit can alleviate the information asymmetry between banks and firms (Biais and Gollier, 1997). Suppliers have private information about their customers at lower costs than banks due to the business between the two parties. This means that suppliers are able to choose creditworthy firms for trade credit alleviating an information asymmetry which would prevent the financing of positive NPV projects.

- Price discrimination

  Suppliers which extend trade credit can also use it as a mechanism for price discrimination. This is known as the price discrimination theory of trade credit. If the firm decides to extend the period of credit supplied or raise a discount for an "on time payment", this leads to a price reduction (Brennan et al., 1988). In other words, firms can sell the same product but at different prices to different customers.

- Product quality

  For the supplier, trade credit can serve as a guarantee of product quality (Emery, 1984). The supplier is willing to provide trade credit allowing the customer sufficient time to test the product (Long et al., 1993). Under this scenario, trade credit is seen as a guarantee of product quality. According to Mian and Smith (1992) monitoring of credit quality is possible if a manufacturer sales representative visits the borrower regularly.

- Bankruptcy and comparative liquidity advantage

  It is on the interest of suppliers to provide trade credit to their customers. Since trade credit is based on a long-term relation and it is likely to involve sunk costs, trade creditors have an incentive to keep their customers in business (Wilner, 2000; Cuñat, 2007). However, suppliers provide trade credit only if there is a higher probability of reselling the product being sold. In a scenario of default, the seller is able to seize and resell the products (Mian and Smith, 1992; Frank and Maksimovic, 1998).

- Opportunistic behaviour

  The amount of credit which the firm needs depends on its financial wealth. Less wealthier firms need higher levels of financing and they prefer to resort to trade credit since they are more constrained on bank loans. The advantage of trade credit is that it increases efficiency. Opportunistic borrowers prefer to buy inputs on credit. It may be more profitable for them to invest in their own projects than to divert due to the lower liquidity of inputs relative to cash (Burkart and Ellingsen, 2004).

- Inventory transaction costs

  The theoretical literature also considers the inventory transactions costs as a motive to offer trade credit. The main assumption is that suppliers offer trade credit to their buyers as an incentive to the latter to hold higher stock of inventories. In other words, there is a shift from the sellers to the buyers (Emery, 1987; Bougheas et al., 2009; Daripa and Nilsen, 2011).[63]

[63]It should be noted that the theories which are defined in Bougheas et al. (2009) and Daripa and Nilsen (2011) are different. The former study is based on a storage cost model in which the supplier

- Transaction motive

  According to this motive the use of trade credit also reduces the transaction costs of paying bills (Ferris, 1981). Both the seller and the buyer are able to separate the payment cycle from the delivery schedule. This process allows the firms to optimise their inventories and cash flows.

To sum up, the above-mentioned theories denote the importance of trade credit from the supplier and buyer points of view. The majority of the empirical evidence on trade credit focuses on these theories and provide evidence from a demand and a supply view of trade credit.

Core empirical studies focus on two main issues. They examine the link between trade credit and firm-specific characteristics and the use of trade credit relative to bank loans during and/or outside periods of tight monetary policy. In the next sub-sections, it is described the main relevant papers.

4.2.2 Trade credit and bank credit: The redistribution role of trade credit

A key strand of the literature explores the link between trade credit and bank lending. Meltzer (1960) is the first to theoretically propose a relation between trade credit and bank loans. According to the author, there is a redistribution view of trade credit. Firms which receive financing from banks can redistribute these funds through trade credit (in the form of accounts receivables) to their financially constrained customers. For Meltzer (1960), trade credit can be seen as a channel to redistribute bank credit from creditworthy suppliers to less creditworthy customers. For the redistribution view to take place, firms (i.e. the lenders) need to be able to raise external finance to distribute credit to less privileged firms (Love et al., 2007).

Nevertheless, there is another set of the literature which considers that trade credit and bank lending are complements. This is based on the theoretical model of Biais and Gollier (1997). Firms which receive trade credit can use it as a way to improve their credit standing. The complementary view of trade credit occurs if the sellers have enough expected future cash flow as a guarantee of collateral. The next paragraphs describe the main empirical studies which give emphasis to the redistribution and complementary views of trade credit.

Petersen and Rajan (1997) are the first to empirical test the assumptions of Meltzer (1960). The authors explore the determinants of trade credit based on the suppliers and customers' trade credit allocation. They define accounts receivables as a proxy for

faces a stochastic demand. The supplier has the need to extend trade credit only to meet their financial obligations. In the latter model, it is the downstream customer who faces a stochastic demand. The buyer has to decide whether to hold inventories to meet their sales or to order inputs when the final demand materialises (Mateut et al., 2015).

trade credit extend. Firms' accounts payables are defined as trade credit taken which corresponds to the firms' borrowing from their suppliers.

The authors use a sample of U.S. SMEs from the National Survey of Small Business Finance (NSSBF) during the period 1988-1989. A simultaneous equation model is employed to estimate the demand and supply of trade credit.

To test the determinants of accounts receivables, Petersen and Rajan (1997) regress firms' trade credit extended on their size and age. In their model the uptake of trade credit depends on firms' level of creditworthiness (i.e. size and profitability), factors that allow the suppliers a great advantage in financing the firms (i.e. better information about the firms than financial institutions, better control and better ability to liquidate goods) and demand for funding (i.e. the amount of accounts payable is determined by suppliers' demand for credit).

Results show that firms which are smaller and without long-term relations with banks extend less trade credit to their customers. These firms take more trade credit from their suppliers. The authors interpret the results as an evidence that trade credit falls below bank credit. Trade credit is used as a source of financing of last resort by small and constrained firms. This is consistent with the redistribution view of trade credit of Meltzer (1960).

Ono (2001) investigates which factors determine trade credit and tests whether trade credit can act as a complement to bank loans. Aggregate quarterly data is used for a sample of Japanese manufacturing firms between 1979 and 1996. The sample of firms is split into 4 groups based on the size of capital stock. Firms are divided in the following categories: 10-49 million; 50-99 million; 100-999 million; 1000 and above. A two-stage least square (2SLS) is implemented. In the model, trade credit (i.e. trade payables to trade receivables) is regressed on firm specific characteristics (i.e. cash flow) and credit terms offered by the banks. This allows to test the relation between credit terms offered by the banks and trade credit.

Results demonstrate that both trade credit receivable and payable are influenced by firm-specific characteristics and transactional activities. For small firms increase in cash flow allow them to reduce trade payables. Cash flow has no impact on the trade payables of large firms. Interestingly, the author finds that the ratio of trade payables to trade receivables increase when banks ease their lending attitude. This means that trade credit can act as a complement to bank loans.

Nilsen (2002) investigates the receipt of trade credit (i.e. accounts payables to sales) for U.S. firms. The author regresses trade credit taken on a set of firm-specific characteristics (i.e. inventories and cash reserves) and a set of macroeconomic variables (i.e. GDP, price level and the spread between the Fed funds and long-term treasury bond rates as an indicator of monetary policy). Following the work of Gertler and Gilchrist (1994)

the sample of firms is split into large and small based on firms' assets.[64] Nilsen (2002) employs a sample of U.S. firms for the period 1972-1982 and a Vector Auto Regressive (VAR) model. To investigate trade credit of small and large firms, a system of equations is implemented.

Results show that small and large firms use higher levels of trade credit during a period of contractionary monetary policy which supports the redistribution view of trade credit. However, large firms increase their level of trade credit more than small firms. For Nilsen (2002) this is a puzzling finding. Large firms are expected to be more established and to suffer from lower levels of information asymmetry than smaller firms.

To explain the aforementioned results the author divides the sample of large firms using a direct indicator of market access. This indicator is based on bond ratings and it is first introduced in Whited (1992).[65] Empirical findings suggest that only non-rated firms increase trade credit. Rated firms use more loans. Overall, the author concludes that only small and large firms without bond ratings increase their reliance on trade credit during monetary contractions.

4.2.3 Trade credit, bank credit and financial crises: Conflicting view

A second set of the literature relates trade credit with tight monetary policy. Meltzer (1960) also argues that the use of trade credit can weaken the traditional credit channel hypothesis. Monetary policy is distributed to the real economy through its effect on bank loans and firms' balance sheet variables (Choi and Kim, 2005). Under this scenario, banks are expected to be more restricted in lending money to their financially constrained customers. As a result, firms should resort to other sources of finance such as trade credit. This is known as the substitution effect.

Empirical studies find a conflicting evidence regarding the relation between bank loans and trade credit during financial crises. For instance, Choi and Kim (2005) explore the impact of macro-financial shocks on trade credit from both sides of trade credit (extended and taken). The net position of these variables determines whether a firm is a customer or a supplier. The authors argue that during a period of tight monetary policy, stronger firms most likely increase their accounts receivables and decrease accounts payables. If markers are constrained, larger firms may not be able to provide liquidity to smaller firms.

Two different quarterly panel data sets are used for the period between 1975 to 1997. Data is collected for S&P 500 U.S. listed firms and a comparison group of 689 non-S&P 500 U.S. firms. Both accounts payables and receivables are regressed separately in two different equations. Specifically, the authors define that trade credit depends on macro-

[64] As it is mentioned in sub-section 2.2 of Chapter 2, Gertler and Gilchrist (1994) refer that small firms behave differently than their larger counterparts over the business cycle. During periods of monetary contraction the credit flows to small firms decrease when comparing with large firms.

[65] Please refer to sub-section 2.2.3 in Chapter 2 for more details on this indicator.

economic variables and firm-specific characteristics (i.e. cost change, firm size, inventory stock, retained earnings for accounts payables and sales change, size, inventory stock, retained earnings, short term debt for accounts receivables). Regarding the macroeconomic variables the authors employ two different measures of market interest rate (i.e. 3-month treasury bill rate and the change in the FED funds rate) and macro-financial shocks (i.e. the change in the FED funds rate and a dummy for the dates corresponding to the period in which the Fed policy happen to be disinflationary). The methodology which is implemented is the OLS method.

Empirical findings demonstrate that accounts receivables and accounts payables relative to their assets increase with a tighter monetary policy. This supports the idea that trade credit is a substitute for bank lending.

Love et al. (2007) investigate the impact of a financial crisis on firms' trade credit. Trade credit is proxied by 3 different measures. Firstly, firms are considered as borrowers and the ratio of accounts payables to sales is used as a form of non-bank debt (i.e. trade credit taken). Secondly, the ratio of accounts receivables to sales is employed (trade credit extended). The authors have also implemented the net trade credit (i.e. the difference between receivables and payables to total sales).

Love et al. (2007) argue that the ratio of receivables should indicate the percentage of sales that it is acquired on credit. Trade credit has a shorter maturity and should be interpreted as the percentage of goods sold on credit and the time it takes for credit to be repaid. Therefore, the authors multiply the ratios of credit extended and received by 360. All the ratios are interpreted in terms of number of days.

Love et al. (2007) use a sample of 890 large publicly trade firms from Indonesia, South Korea, Malaysia, the Philippines and Thailand and the devaluation of the 1994 peso on Mexican firms. A fixed effect estimation is used. To test the behaviour of firms during and after the crisis, trade credit is regressed on a set of control variables (i.e. cash flow, cash balances and the lagged of sales growth) and the depreciation of the exchange rate. The set of the control variables are interacted with two different dummy variables to account for the impact of the crisis and post-crisis years, respectively.

Results demonstrate that trade credit extended increases immediately after the crisis. However, it decreases sharply in the post crisis period. This is inconsistent with the redistribution view of Meltzer (1960), according to who trade credit extended should increase during periods of monetary contraction. Love et al. (2007) argue that the results provide evidence that the redistribution view of trade credit shuts down if all sources of external financing dry up, especially during a financial crisis. The monetary contraction which has an impact on financial lenders also has an effect on non-financial lenders of trade credit. Regarding accounts payables, findings show that they do not decline significantly during the crisis when comparing with the pre-crisis period. After the peak of the crisis,

the ratio of accounts payables increases.

Love et al. (2007) also account for the important dimension of firm heterogeneity during the crisis period. The model is extended and includes a set of firms' vulnerability measures (i.e. short-term debt to assets, short-term debt foreign currency, cash flow and cash stock to assets). The assumption of the author is that more vulnerable firms have a higher probability of being affected by the crisis. They are more likely to cut the extension of trade credit to their customers and increase their use of credit from suppliers. To explore whether firm-level heterogeneity affects firms' response to trade credit differently during the crisis, an interaction of pre-crisis financing variables with crisis and post crisis dummies is implemented. Results show that before the crisis firms with a higher level of vulnerability extend more trade credit. After the crisis, there is a sharp decline on this provision.

Finally, the authors investigate the impact of bank credit growth on trade credit before, during and after the crisis. Trade credit is regressed on the same set of control variables and an interaction between a crisis dummy and the private credit to GDP ratio, which measures the overall credit growth in the banking sector. There is a positive relation between bank credit growth and trade credit extended during the crisis. After the crisis, there is a sharp decline of the provision of trade credit especially for countries which have experienced a higher contraction in bank credit.

Love and Zaidi (2010) extend the work of Love et al. (2007) for a sample of SMEs during the Asian crisis. In particular, the authors test the heterogeneous response of financially constrained firms to alternative sources of finance during and after the crisis.

Data is provided for Thailand, Korea, Philippines and Indonesia from a survey of 3,160 manufacturing firms between November 1998 and February 1999. All firms are surveyed about the impact of the crisis, prospects of recovery and sources of finance prior and after the crisis. The survey includes detailed information on trade credit terms, i.e. the length of accounts payables, accounts receivables and early payments discounts. Financially constrained firms are classified based on two measures. Firms' application for a bank loan and a subjective perception. The former measure classifies firms as constrained if there is a rejection for a loan before and after the crisis. The latter is based on a survey response regarding the restriction of firms to bank loans during the crisis. An OLS estimation is used.

Results demonstrate that the use of trade credit declines after the crisis. Financially constrained firms extend less trade credit to their customers and use less trade credit after the turmoil period. The length of time to repay the credit to the supplier is shorter for financially constrained firms. These firms also buy a smaller amount of inputs on credit and pay a higher cost for trade credit. Love and Zaidi (2010), conclude that the existence of the substitution effect is not clear. During the crisis financially constrained firms are

not able to obtain bank loans and cannot meet the excess demand for funds with trade credit.

4.2.4 Trade credit and inventories

Empirical research relates trade credit also with suppliers' stock of inventories. This is based on the inventory transaction cost motive which is defined in sub-section 4.2.1. The most prominent empirical study in this area is the one of Bougheas et al. (2009). The authors build on a theoretical two-period stochastic demand model of firms' behaviour. The rationale behind the model is that firms produce products for sale. In the first period the firm chooses its level of production in an environment where the final demand for its product is uncertain. In the second period if demand is uncertain, the firm can hold stock of inventories which are not sold but at a cost. Hence, the firm has an incentive to sell on credit its products to reduce inventories and increase its sales. In other words, producers which face uncertain demand for their products, are motivated to extend credit to their financially constrained customers. The incentive to provide credit is only limited by the need to obtain liquidity to meet its own financial obligations. This is known as the inventory management motive. Since its potential buyers are financially constrained, the firm faces a trade-off by extending trade credit to its customers and avoiding holding costly stocks of inventories. As a result, Bougheas et al. (2009) predicts a negative relation between the volume of trade credit extended and stock of inventories as firms attempt to minimize the inventory storage costs.

Bougheas et al. (2009) empirically test whether trade debit (i.e. trade credit extended) and trade credit (i.e. trade credit taken) are influenced by changes in the cost of inventories, profitability, risk, liquidity and a proxy for the access to bank credit. A sample of U.K. firms is used for the period between 1993 and 2003 and the system GMM estimator is implemented. Results demonstrate that inventories have a negative and statistically significant effect only on accounts receivables. The stock of inventories variable has an insignificant impact on firms' trade credit taken.

The authors also consider the impact of firm-level heterogeneity on the trade-off between trade credit and inventories. They examine the role of inventories on the account receivables and payables of larger and small firms. In the model, size is interacted with firms' stocks. Firms which are characterised as large provide and receive more trade credit from their business partners. The authors conclude that the bigger the size of the firm the smaller is the role of inventories on firms' decisions to extend credit.

Giannetti et al. (2011) link the use of trade credit (i.e. extended and taken) to the characteristics of the transacted good. The authors follow the diversion vulnerability theory of Burkart and Ellingsen (2004). This theory assumes that suppliers of credit have an advantage comparing to the banks in financing their customers. Goods which are

reacquired are worth more to suppliers than to banks. Thus, trade credit decreases the risk of moral hazard. The buyer is more likely to repay the supplier rather than the bank.

Giannetti et al. (2011) explore whether the trade credit a firm extends depends on the nature of the product which is transacted. According to the author, providers of trade credit have an advantage relative to banks in financing their customers since repossessed goods are worth more to suppliers than to the banks. This advantage is stronger for firms in the differentiated sector than for firms in the standardised industries. Firms in the former industries produce more specific products and the seller-buyer relation is also closer than in the latter industries (Guariglia and Mateut, 2016).

To account for this hypothesis, firms are divided based on their product characteristics. Following the work of Rauch (1999), firms are split based on standardized and differentiated products. A sample of U.S. SMEs from the NSSBF survey is used during the period between 1999-2001. The sample is matched with the industry-specific information, i.e. based on a product classification (i.e. differentiated and standardized goods). Two proxies for trade credit are implemented. The ratio of receivables to sales and the percentage of purchases on account by a firm. An OLS methodology is used. Results show that firms which produce differentiated products are willing to extend more trade credit to their customers. Firms which buy differentiated products present more purchases on account.

Furthermore, Mateut et al. (2015) explore the relation between trade credit and the type of inventory a firm hold. The authors assumption is that the composition of inventories affects firms' trade credit (i.e. extended and taken). Firstly, they explore the inventory management motive of Bougheas et al. (2009) and account for the diversion hypothesis in Giannetti et al. (2011).

A sample of French firms for the period between 2000 and 2007 is used and the models are estimated with the Hausman–Taylor (HT) estimator. The HT estimator combines the consistency and efficiency of a fixed effects model with a random-effect estimator. In other words, the regressors are correlated with the individual effects and includes time-invariant controls (Hausman and Taylor, 1981; Baltagi et al., 2003).

To explore the inventory management motive and the diversion hypothesis, Mateut et al. (2015) define trade credit extended as a function of sector specific effects (i.e. differentiated, services, retail and wholesale), a set of control variables (i.e. bank loans, profits, liquidity, size, age and a measure of likelihood of failure) and the proportion of raw materials in total inventories which is the main variable of interest. Results demonstrate that firms with higher inventories in raw material extend more trade credit. Provision of trade credit is also higher for producers of differentiated goods.

In addition, trade credit taken is considered as a function of the same control variables, lag of inventories, sector specific effects (i.e. differentiated and services) and the share of

processed inventories in total inventories. Empirical findings demonstrate that firms which buy more differentiated inputs have higher levels of trade credit taken.

Finally, Guariglia et al. (2015) test differences in trade credit extension across politically affiliated and non-affiliated firms.[66] The authors extend the work of Bougheas et al. (2009) and include in their model a measure of short-term financing. This measure accounts for firms' level of financial constraints. Following the work of Giannetti et al. (2011), the authors also separate the sample of firms based on differentiated and standardized products. Firms are also classified in 4 different categories. They are as follows: state-owned, private, foreign and collective. A sample of 65,706 Chinese firms is used over the period 2000-2007 and a first-difference GMM estimator is employed.

Empirical findings suggest that independently of the ownership type there is a positive relation between short-term liabilities and trade credit (i.e. accounts receivables). Firms use short-term financing to fund their accounts receivables and to allocate long-term liabilities to long-term investments. The trade credit extension is higher for firms operating in differentiated sectors than for those firms with standardized goods.

4.2.5 Trade credit and financial development

Another set of the literature on trade credit focuses on the role of financial development. Demirgüç-Kunt and Maksimovic (2002) are the first to link trade credit with financial development. The authors investigate whether the use of trade credit between firms is a substitute or a complement for borrowing from the financial intermediaries. Specifically, they test whether the use of trade credit is linked to the development of the banking system of a country and its legal infrastructure.

To account for financial development, the authors define three different measures. They consider the overall development of the banking system (i.e. the ratio of private bank credit to GDP), bank efficiency (i.e. the extent of public ownership of a country's banking system) and an indicator of concentration. The latter indicator measures the assets of the three largest banks in the financial system. Based on the work of De Silanes et al. (1998) they employ different proxies for the efficiency of the legal system (law and order, creditors' rights, legal origin).

The authors use a sample of publicly trade firms in 40 countries for the period between 1989 and 1996. Trade credit is defined as receivables turnover (i.e. sales to accounts receivables ratio) and payables turnover (i.e. costs of goods sold to accounts payables ratio). Trade credit is tested as a function of the aforementioned financial development proxies and firm-specific characteristics (i.e. size, return on assets, net sales, inflation,

[66] Political affiliated firms are those not owned by the government. These firms are controlled by or subordinated to the government.

GDP per capita and GDP growth rate). A pooled OLS methodology is implemented.

Empirical findings suggest that firms which are located in a large banking system obtain more credit from their suppliers and lend more to their customers. If a country's legal system is efficient firms rely less on trade credit. These firms have a small advantage on providing trade credit to their buyers. Demirgüç-Kunt and Maksimovic (2002) conclude that there is a complementary effect between firms' trade credit and the development of the banking system, especially in countries which legal system is not efficient.

Fisman and Love (2003) investigate the relation between trade credit and financial development at a industry level. They argue that firms with easier access to trade credit should face less difficulties in countries where the quality of financial intermediation is low. The authors refer that financial market development should matter disproportionately more for firms which do not have access to trade credit financing.

The main aim is to test whether industries that are more dependent on trade credit are relatively better off in countries with lower development of financial institutions. To do so, the authors use data at an industry level from 1970 to 1998 from a panel of 37 industries and 44 countries. Industry growth is a function of an interaction between a measure of financial development of a country and trade credit taken (i.e. accounts payables to total assets ratio). An OLS estimation is implemented.

Results show that industries which are more dependent on trade credit financing grow quicker in countries with less developed financial intermediaries. Firms in countries with less developed financial markets substitute credit which is provided by their suppliers to finance their growth.

Ge and Qiu (2007) study how firms in a country with poorly developed financial institutions fund their growth opportunities. They test the difference in the level of trade credit between state and non-state owned firms in China. According to the authors, China is the largest developed country with a poor developed financial system. State (non-state) firms have a lower (higher) access to bank loans.

Using firm-level data on 442 state owned and 358 non-state owned firms from 1994 to 1999, the authors use four different measures of trade credit. They are as follows: the trade credit extended (i.e. accounts receivables to total assets or sales ratio); the trade credit taken (i.e. accounts payables to total assets or sales ratio); net trade credit (i.e. accounts payables minus accounts receivables to total assets or total sales). Ge and Qiu (2007) link trade credit to firms' ownership and a set of control variables (i.e. size, age, capital to labour ratio, cash flow, sales growth, fixed investment to total investment, industry, location). The model is estimated using random effects. Results show that non-state firms use more trade credit than state firms.

Finally, Cassia and Vismara (2009) link firms' trade credit with the local development of the banking system. Their aim is to test whether different degrees of trade credit (i.e.

extended, taken and net trade credit) are affected by the characteristics of the local banking system. To do so, the authors use 6 different measures of local banking development.[67]

A sample of 24,479 euro-area firms is used over the period of 2002-2006. Trade credit extended (taken) is a function of trade credit taken (extended), local banking development indicators, inflation and a set of firm-specific variables variables (i.e. size, leverage and sales to total assets). Net trade credit is regressed on the same variables with the exception of trade credit extended and taken. An OLS estimation is implemented.

Results show that independently of the proxies which are used, the direct impact of financial development on trade credit is negative and statistically significant. This indicates that firms which belong to a more developed banking system rely less on trade credit. According to the authors the empirical findings show that there is a substitution effect. Trade credit is considered as an alternative to bank credit.

4.2.6 Trade credit and firms' performance

Subsequent studies relate firms' value and its performance with trade credit. The underlying assumption behind these studies is that trade credit mitigates firms' performance, i.e. firms support their profitability through credit sales.

To begin with, Martínez-Sola et al. (2013) study the impact of trade credit on the value of Spanish SMEs. They argue that investing in trade credit in the form of accounts receivables is important for the sellers' balance sheets. To do so, firms weight the benefits and costs of extending trade credit. Martínez-Sola et al. (2013) argue that at lower levels of accounts receivables, firms have financial and commercial benefits.[68] Conversely, at higher levels of accounts receivables firms obtain credit risk, opportunity and financial costs.[69]

A sample of Spanish listed firms is used from 2001 to 2007 and a first-difference GMM estimation is employed. Firm value is defined as Tobin's Q and it depends on trade credit (i.e. accounts receivables), trade credit squared and firm-specific characteristics (i.e. firms' growth, size and leverage).

Results show that there is a positive relation between firm value and trade credit at lower level of accounts receivables. A negative relation between firm value and trade credit is found at higher level of receivables.

[67] The following indicators are considered by Cassia and Vismara (2009): Counters-the number of counters which are opened in the province where each individual firm is located; Counters to the population ratio-number of bank counters to the number of inhabitants; private bank to GDP ratio; private bank credit; number of Automatic Teller Machines (ATMs) in the province where each firm is located; ratio of number of ATMs over population.

[68] These financial and operational benefits are related to the supplier theories of trade credit. These benefits are as follows: reduction of transaction costs, mitigating customers financial frictions, stimulation of sales, reduction in information asymmetry between buyer and seller, price discrimination.

[69] Trade credit is costly and involves an opportunity cost. On the other hand, providing trade credit also involves bearing the credit risk due to the exposure to payment default.

Empirical findings show that there is a positive relation between suppliers financing and SMEs' value. Firms with better access to alternative financing have lower value of supplier financing. Conversely, firms with a worst access to external finance have a greater supplier financing value. This is in line with the redistribution view of trade credit. The credit which is provided by suppliers is more relevant for SMEs with less borrowing capacity and which produce lower levels of cash flow.

Ferrando and Mulier (2013) explore whether firms resort to trade credit to manage their growth. For the authors, it is the combination of both aspects of trade credit (i.e. receivables and payables) that affect firms' performance. The firm can be considered a lender but also as a customer. The combination of both aspects of trade credit permits to optimise firms' performance.

The authors follow the work of Coluzzi et al. (2015) and implement a dynamic growth model. The aim is to estimate the impact of trade credit on firms' performance. Coluzzi et al. (2015) use a model of firms' growth, i.e. a version of the Law of Proportionate Effect (LPE) to determine the impact of financial obstacles on firms performance.[70]

A sample of 600,000 euro area firms from 8 euro-area countries between 1993 and 2009 is used.[71] For each country, the authors regress firms performance (measured as the growth of value added) on a set of firm-specific characteristics (i.e. bank loans, sales growth and age) and on the trade credit channel. The latter is calculated as the sum of accounts payables with accounts receivables. A first-difference GMM estimator is employed.

Results show that there is a positive relation between trade credit and firms' performance for all the countries. This is consistent with the hypothesis of Ferrando and Mulier (2013) that firms use trade credit to grow.

Furthermore, the authors also test the impact of firm-level heterogeneity on the relation between firms' performance and trade credit. They focus on two different dimensions of firm-level heterogeneity: size and age. The behaviour of firms with different size (age) is explored by interacting trade credit with a size (age) dummy. Empirical findings suggest that trade credit is more important for younger and smaller firms

Ferrando and Mulier (2013) also explore whether the development of financial markets have an impact on the trade credit relation with firms' performance. They refer that euro area countries are considered to have developed financial markets but these countries continue to be heterogeneous. To investigate this issue, all the firm-level information is merged into one single panel. Trade credit is interacted with two different measures of financial market development (i.e. bank loans to GDP and deb securities to GDP). They

[70] Coluzzi et al. (2015) employ an augment version of the original Law of Proportionate Effect determined by Goddard et al. (2002). The original LPE model refers that firms' growth does not depend on the initial size and past growth rates. However, Coluzzi et al. (2015) indicate that the existence of information asymmetry makes firms dynamics dependent on firm-specific characteristics (i.e. size and age).

[71] Belgium, Germany, Spain, Finland, France, Italy, Netherlands and Portugal are the 8 euro area countries which are used in this study.

conclude that the use of trade credit is more relevant in years and countries where firms issue less debt securities and is less important in years/countries where there is a higher supply of bank loans.

In a similar vein, Martínez-Sola et al. (2015) explore the effect of trade credit in the form of accounts payables on the value of Spanish SMEs. The authors modify the Fama and MacBeth (1973) valuation regression to test whether changes in trade credit have an impact on firms' value. Specifically, firm value is regressed on accounts payables, a set of control variables (i.e. total assets, earnings, intangible assets and interest expenses) and an interaction term between changes in accounts payables and a dummy variable for the availability of financial resources (i.e. long-term leverage ratio, short-term bank debt and financial costs). The interaction term accounts for the difference in the value of supplier financing between groups of firms.[72] Using a sample of 7,952 Spanish SMEs firms between 1998 and 2007, the authors employ the Fama and MacBeth (1973) method and an OLS estimator.

4.2.7 The recent financial crisis

Few studies have looked at trade credit during the recent turmoil period. Once more, the central focus is on the link between trade credit and bank loans. The most prominent studies are presented in the next sub-sections.

4.2.7.1 Trade credit and access to finance

Recent studies on the impact of the recent credit crunch have provided mixed findings on whether trade credit can be considered as a complement or a substitute to bank loans. For instance, Garcia-Appendini and Montoriol-Garriga (2013) test whether U.S. suppliers with liquidity provision prior to the turmoil period provide trade credit to their liquidity constrained customers. The authors employ a sample of quarterly data of 2,250 U.S. firms between the 3^{rd} quarter of 2005 and the 4^{th} quarter of 2010. Information is included on a matched sample of 9,368 client-supplier quarter-pairs. Information on firms' key customers is also collected. They manually match it to the original data. The matched sample allows the authors to control for the demand and the supply factors of trade credit. Following the work of Duchin et al. (2010), firms' financial position is measured one year prior to the crisis. Trade credit is used as a function of firms' liquidity provision (i.e. cash reserves) and a set of control variables (i.e. size, age, net profit margin, sales growth, total debt, net worth, Tobins' Q, tangible assets and long term ratings measures). A DID approach is implemented. Results show that liquid firms increase the trade credit extend more than

[72] Firm value is measured as the book value of assets minus the book value of equity plus a proxy for the market value of equity. Since the authors deal with unlisted firms, they substitute the value of equity with net profit plus depreciation over the average return on equity of the industry.

less liquid firms. Specifically, cash-rich firms provide more credit to their customers during the first stage of the crisis (2007-2008).

In addition, Garcia-Appendini and Montoriol-Garriga (2013) examine the impact of the crisis on financially constrained firms. The authors use the Kaplan and Zingales (1997) index, the Whited and Wu (2006) index and the dividend payout ratio to measure firms' level of financial constraints. Empirical findings demonstrate that financially constrained firms resort more to trade credit than their unconstrained counterparts during the crisis.

Finally, the impact of liquidity provision on suppliers and clients' performance is also examined. According to the authors, liquidity provision is only possible for suppliers of trade credit. These firms have the possibility to expand their market positions. Garcia-Appendini and Montoriol-Garriga (2013) find that liquid firms which receive more trade credit (accounts receivables) have a better performance during and after the crisis. This is consistent with the redistribution view of trade credit and the substitution effect.

Casey and O'Toole (2014) investigate the extent to which SMEs with restricted access to bank loans are more likely to apply for alternative sources of external finance (i.e. trade credit, informal lending, loans from other firms and state grants). The authors employ survey data of SMEs from the ECB Survey on Access to Finance of Enterprises (SAFE) during the 2009 and 2011 period across 11 euro area countries.[73]

The dependent variable is defined as a binary variable. It corresponds to different alternative sources of finance. This variable is regressed on a set of control variables. They capture the degree of risk, level of creditworthiness, firms' quality, firms' outlook perspective and profit growth. A probit model is implemented.

Empirical findings provide evidence of a positive relation between trade credit and bank constraints. Credit rationed SMEs have a higher probability of applying and use trade credit during the crisis. These findings suggest that there is a substitution effect between bank lending and other sources of finance and that there is a redistribution effect from liquidity provider firms.

Next, the authors determine how firms' firms' age, ownership and country-specific heterogeneity have an impact on SMEs financing during the crisis. The sample is divided into different levels of financial constraints, i.e. credit rationed firms and self-rationed borrowers.[74] Casey and O'Toole (2014) observe that larger and older SMEs with a higher level of debt and better outlooks are more likely to request trade credit when bank lending is rejected.

Abdulla et al. (2015) shed light on the role played by private and public firms on trade credit taken. The authors argue that public (private) firms have easier (harder) access to

[73] Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, the Netherlands and Portugal are the countries which are used in this study.

[74] Credit rationed firms are those which apply for loans and are rejected. Self-rationing borrowers are those which do not apply to allow due to high lending costs.

external finance and suffer from lower (higher) levels of information asymmetry. Abdulla et al. (2015) test whether the level of financial vulnerability of firms prior to the crisis has an impact on trade credit taken.

A sample of 27,300 private firms and 3,340 public firms is employed for the period 1995-2012. Trade credit (calculated as accounts payables to total assets) is regressed on a dummy public, a set of control variables (i.e. age, cash flow, cash holdings, current assets, sales growth, short term debt and firm size) and an interaction between a crisis dummy and firms' level of financial vulnerability. The latter is measured on short-term debt and cash flow. A matching procedure is used. Each public firm-year observation is matched to a private firm-year observation in the same industry, year and closest size.

Empirical findings demonstrate that public firms rely more on trade credit as a substitute during the credit crunch. Private firms which are vulnerable prior to the crisis period have more difficulties in obtaining trade credit after the crisis. This is in line with argument of Love et al. (2007). Large suppliers transfer funds through trade credit to their less liquid customers. It occurs until the point in which bank loans and trade credit are not accessible, i.e. when the redistribution view shuts down.

In a similar study, Kabir and Zubair (2015) study the uptake and extension of trade credit for Dutch SMEs. 368 firms are used for the period between 2003 and 2012. Trade credit extended (i.e. accounts receivables to total assets) and trade credit taken (i.e. accounts payables to total assets) are a function of bank loans, an interaction term capturing bank loans during the crisis and a set of control variables (i.e. cash flow, size, liquidity, firms' growth, inventories). A fixed effect model is estimated.

The coefficient on the bank loans variable determines whether trade payable has a substitution/compliment role and trade receivable has a redistribution one. A negative (positive) coefficient on the bank loan is associated with a substitution (complementary) effect.

Empirical findings show that during the financial crisis, both trade credit extended and taken decreases. Kabir and Zubair (2015) show that during the crisis there is a positive relation between bank loans and trade credit. This indicates that there is a complimentary role of trade credit with bank credit during the crisis.

Muñoz et al. (2015) investigate the use of trade credit and bank loans for a sample of 1,186 SMEs from 5 European countries (i.e. France, Germany, Italy, Spain and U.K) for the period between 2006 and 2011. Contrary to the previous studies, the authors use a binary variable as the main dependent variable. It assumes the value of 1 if firms are not able to substitute bank loans with trade credit, and 0 otherwise. The dependent variable is regressed on lagged firm-specific controls (size, tangible fixed assets, return on assets, investment, cash reserves), a crisis dummy and a lagged credit quality measure which is defined as the Z-score of Altman (1968). A logit model is implemented. Results

show that there is a monotonic relation between credit quality and the probability of substitution. Credit quality has a positive effect on the probability of substitution and that the probability of substitution decreases during the crisis.

Muñoz et al. (2015) also test the impact of firm-level heterogeneity on the probability of substitution. The authors consider as a measure of financial constraints the index of Kaplan and Zingales (1997) and interact it with the credit quality measure.[75] The sample of firms is separated by each quintile of the index. Empirical findings show that there is an inverse U-shaped relation between the probability of substitution and the interaction term. Intermediate financially constrained firms with high credit have a higher probability of substitution. For firms with lower levels of financial constraints the quality of credit is less relevant for the probability of substitution. The authors conclude that the substitution effect is not as straightforward as earlier literature suggests (Meltzer, 1960; Petersen and Rajan, 1997).

Furthermore, different than the previous empirical studies, Carbó-Valverde et al. (2016), explore how trade credit affects the investment (i.e. capital expenditures) of Spain SMEs during the turmoil period. A sample of 40,000 firms over the period 1994-2010 is used.

Contrary to previous studies, the authors employ a disequilibrium model to identify financially constrained and unconstrained firms. The model follows the one of Maddala and Nelson (1974). It is estimated by including three different equations. They correspond to the demand, supply and the quantity which is observed as the minimum quantity which is supplied and demanded. The demand equation is used for bank loans. The supply regression is implemented for the maximum amount of loans that banks are willing to lend. The last is a transaction equation which restricts the value of loans as a minimum equation of desired demand and loan supply. To be more specific, from a demand point of view, the bank loans variable is regressed on sales, cash flow, loan interest spread and GDP growth. In the supply side, bank loans are a function of tangible assets, bank market power, default risk and GDP growth.

Using the aforementioned classifications from the disequilibrium model, the authors then test the sensitivity of investment (in the form of capital expenditures) to the two key sources of SMEs external finance (i.e. bank loans and trade credit). The empirical specification follows a panel causality test as in Holtz-Eakin et al. (1988). This method first-differences the data to remove the fixed effects and then estimates the models using instruments. Holtz-Eakin et al. (1988) suggest to use a time-varying set of instruments that includes differences and levels.

Empirical findings suggest that financially constrained SMEs depend only on trade credit to finance their capital expenditures. This effect is stronger during the financial

[75] See Chapter 2, sub-section 2.2.4 for details on the Kaplan and Zingales (1997) index of financial constraints.

crisis. Conversely, unconstrained SMEs are only dependent on bank loans.

Finally, McGuinness and Hogan (2016) explore whether unconstrained SMEs extend trade credit to their financially constrained counterparts during the recent financial crisis. To this end, the authors use a sample of 7,618 Irish SMEs over the period 2003-2011.

In the model, McGuinness and Hogan (2016) regress trade credit (i.e. accounts payables, accounts receivables and net trade credit) on a set of control variables (i.e. age, sales growth, cash reserves, size and the level of economic activity) and on the financial position of the firm (i.e. bank loans) calculated one year prior to the crisis. A fixed effect estimator is used. Results show that SMEs with a better financial position extend higher levels of trade credit to more vulnerable SMEs after the crisis. This is consistent with the redistribution view of Meltzer (1960).

4.2.7.2 Trade credit and financial development

Finally, studies on the link between trade credit and financial development during the recent crisis are limited. In fact, Deloof and La Rocca (2015) is the only study which links the provision of trade credit with local financial development. The authors test the relation between local financial development and trade credit, for a sample of Italian SMEs. In particular, it is examined whether the development of local banking system has a positive relation with trade credit extended (i.e. accounts receivables to total assets ratio). Deloof and La Rocca (2015) follow the work of Alessandrini et al. (2009) and consider the role of providences on trade credit.[76]

A sample of 14,662 SMEs during the period between 2003 and 2009 is employed. Trade credit (i.e. extended, taken and net trade) is tested as a function of economic indicators (i.e. GDP growth, bank credit standards), province characteristics (i.e. north, south, social capital, extortion crimes, industrial district density), branch/coop density and firm-specific characteristics (i.e. size, age, cash flow, sales growth, sales, gross profit margin, costs of goods sold over total assets, short-term debt over total assets). An OLS methodology with standard errors clustered at the firm level is used.

Results show that trade credit enforces the positive effect of local banking development on the availability of external finance for Italian SMEs. SMEs which are located in a more developed banking system, extend and take more trade credit. Deloof and La Rocca (2015) argue that trade credit acts as a complement to bank loans in line with Demirgüç-Kunt and Maksimovic (2002).

Moreover, Deloof and La Rocca (2015) test the effect of banking development on SMEs during the crisis. The authors interact the proxies of financial development with year dummies for 2008 and 2009. Empirical findings suggest that during 2008 trade credit

[76] Alessandrini et al. (2009) consider that in providences with a better banking developed system, borrower firms have a better access to bank loans. As a result, these firms have a lower demand for trade credit taken (i.e. accounts payables to total assets ratio).

extended and taken has experienced a small declined for firms in a more development banking system. In 2009 there is no statistically significant effect. According to the authors, the results suggest that local bank development reduces the impact of the crisis on trade credit. However, this only occurs in the start of the turmoil period.

4.3 Research design

The main aim of Chapter 4 is to explore the interaction between trade credit and inventories for optimal control. Next, it is presented the theoretical framework and the main variables used in Chapter 4.

4.3.1 Theoretical framework

The starting point of the empirical analysis is the trade credit model of Giannetti et al. (2011). The model which is implemented in Chapter 4 extends the one of Giannetti et al. (2011) to account for the inventory management motive of Bougheas et al. (2009).[77]

The model assumes that trade credit extended and trade credit taken can be captured by the same set of independent variables. These variables correspond to the characteristics of a firm i at time t and a disturbance error term. The models take the following general form:

$$Y_{it} = \alpha_0 + \sum_{k=1}^{k} \beta_{1,k} X_{it} + \varepsilon_{it} \tag{4.1}$$

Where, firms are represented by subscript $i = 1, ..., N$, t represents time by $t = 1, 2, ..., T$. Y_{it} represents trade credit extended or trade credit taken. X_{it} is the vector of the explanatory variables. ε_{it} is the error term. Overall, trade credit (extended and taken) is explained as a function of stock of inventories, profits, liquidity, collateral, size, bank loans and age. These variables are defined in the next sub-section.

4.3.2 Variables definition

Following the literature (Bougheas et al., 2009), the dependent variable trade credit is defined from a supply and a demand side. Trade credit extended (or trade debit) is calculated as the ratio of accounts receivables to total sales. This variable is a proxy for the suppliers willingness to extend trade credit to all customers. Trade credit taken (or trade credit) is measured as accounts payables to sales ratio. This variable captures the supply of trade credit to a given firm from all suppliers (Giannetti et al., 2011).

[77] Guariglia et al. (2015) also follows Giannetti et al. (2011) and include stock of inventories to test the impact of stock of inventories on trade credit extended.

In terms of the explanatory variables, the main variable of interest is the stock of inventories. It is calculated as firms' total stock of inventories. Previous studies find a negative relation between the stock of inventories and trade credit extended (Giannetti et al., 2011; Guariglia and Mateut, 2016). This is consistent with the inventory management motive of Bougheas et al. (2009). Producers which face an uncertainty for the demand of their products prefer to extend trade credit to their financially constrained customers to increase their sales instead of accumulating costly inventories. Conversely, Bougheas et al. (2009) find that the cost of holding inventories does not have an impact on trade credit taken.

In addition to the stock of inventories variable, Chapter 4 also includes a set of controls. In particular, it is used firms' profit which is defined as firms' profit (or loss) for the period. It is calculated as the firms' operating profit (or loss). Previous studies show a positive relation with trade credit (extended and received). An increase in profitability has a positive effect on both accounts. Suppliers are more likely to offer trade credit since this situation represents an opportunity for potential future cash sales. Extra profit represents a channel towards accounts receivables (Guariglia and Mateut, 2016). Firms' with a creditworthiness balance sheet are also more likely to receive credit from their suppliers.

In addition, a liquidity variable is considered. It is determined as firms' cash and equivalents. In line with the previous literature (Petersen and Rajan, 1997; Bougheas et al., 2009), the expectation is that liquidity exerts a negative effect on trade credit. According to Guariglia et al. (2015), less liquid firms extend trade credit to boost its credit sales. It is preferable to lend credit rather than not selling firms' products.

The variable loans is also implemented as a control. It is calculated as short-term liabilities. Previous literature finds a positive impact of loans on trade credit extended and a negative effect on trade credit taken (Bougheas et al., 2009). The availability of bank loans allows firms as suppliers to extend trade credit, and therefore increase their volume of sales on credit. Conversely, the negative relation between trade credit taken and bank loans is associated with a credit rationing. If the access to bank loans is constrained, firms look for other sources of external finance such as trade credit (Petersen and Rajan, 1997).

Furthermore, collateral is calculated as tangible assets. Following the work of Giannetti et al. (2011) this chapter calculates collateral as tangible assets in total assets. The variable collateral is used as a proxy for firms' borrowing capacity. Previous studies find a negative relation between firms' collateral and the trade credit (Giannetti et al., 2011). Firms with higher asset tangibility have a higher borrowing capacity and a higher probability of operating in a less dynamic industry with lower growth potential (Guariglia and Mateut, 2016).

It should be noted that all the variables which are described above are scaled by total sales with the exception of collateral. Moreover, size corresponds to the logarithm of firms'

real assets. Previous studies suggest that larger firms have the ability to extend and receive more trade credit and have lower inventory holding costs (Bougheas et al., 2009; Guariglia and Mateut, 2016). Thus, a positive relation between size and trade credit (accounts payables and accounts receivables) is expected. Finally, firms' age is calculated as the difference between the present year and the firms' date of incorporation. The literature is not clear regarding the impact on firms' age on trade credit (extended and taken). Giannetti et al. (2011) find no effect of age on trade credit extended and a negative effect on trade credit taken. According to Guariglia et al. (2015), the negative effect may be explained by the lack of financial flexibility which is a characterist of old firms. However, younger firms tend to have weaker balance sheets and they should not be able to extend credit to their customers. All Euro variables are adjusted using the GDP deflator at the 2005 price level.[78]

4.4 Model specification

The empirical models are defined in the next sub-sections.

4.4.1 Baseline

The baseline specification extends the model of Giannetti et al. (2011) to account for the inventory management motive of Bougheas et al. (2009). The aim is to test whether firms substitute holding costly inventories with higher accounts receivables and accounts payables. The equations which are estimated take the following form:

$$TD_{it} = \alpha_i + \beta_1 Stock_{it} + \beta_2 Profit_{it} + \beta_3 Liq_{it} + \\ + \beta_4 Loans_{it} + \beta_5 Coll_{it} + \beta_6 Size_{it} + \beta_7 Age_{it} + \epsilon_{it} \quad (4.2)$$

$$TC_{it} = \alpha_i + \beta_1 Stock_{it} + \beta_2 Profit_{it} + \beta_3 Liq_{it} + \\ + \beta_4 Loans_{it} + \beta_5 Coll_{it} + \beta_6 Size_{it} + \beta_7 Age_{it} + \epsilon_{it} \quad (4.3)$$

Where, α_i is the idiosyncratic error component, i = 1,2,..., N indexes firms and t = 1,2,..., T indexes years. TD_{it} and TC_{it} correspond to the dependent variable Trade debit (trade credit extended) and trade credit (trade credit taken), respectively. $Stock_{it}$is the total stock of inventories and accounts for the incentives firms face to increase sales. $Profit_{it}$represents firms' profits (or loss) for the period while Liq_{it} denotes firms' gross

[78] See Table C1 in the Appendix for the summarised data items.

liquid assets. These two variables capture the financial condition of the firms. $Loans_{it}$ represents short-term liabilities of the firms and it controls for alternative sources of finance which may enable firms to extend trade credit while continuing production. $Coll_{it}$ represents tangible assets in total assets and captures firms' borrowing capacity. $Size_{it}$ is the logarithm of firms' total assets which controls for size effects whereas Age_{it} represents the log of firms' age. All these variables are scaled by total sales with the exception of firms' collateral and size.

The error term ϵ_{it} comprises a firm-specific time-invariant component, encompassing all time-invariant firm characteristics likely to influence trade credit and the time-invariant component of the measurement error affecting any of the regression variables. As in Chapter 2, to control for firm-specific time-invariant component of the error term the equation is estimated in first-differences. Time specific component is controlled by including time dummies (in addition to the time dummies interacted with industry dummies) in all specification. Country dummies are also included to control for institutional differences between countries

A negative coefficient (β_1) on the variable $Stock_{it}$ in equation (4.2) denotes the inventory management motive of Bougheas et al. (2009). Firms prefer to sell their stock on credit to their customers rather than accumulate costly stock of inventories. In other words, the expectation is a trade-off between stock of inventories and trade credit extended. Consistent with the work of Bougheas et al. (2009) it is anticipated that the variable $Stock_{it}$ exerts an insignificant effect on trade credit taken.

4.4.2 Firms' product characteristics

Next, it is examined whether the inventory management motive is related with firms' product characteristics. This is based on the work of Giannetti et al. (2011) who follow the classification of Rauch (1999).[79] A dummy variable $Diff_i$ is used. It takes the value of 1 if firms are in the differentiated sector, and 0 otherwise. To test whether the inventory management motive differs across firms' producing differentiated and standardised products, the variable stock of inventories ($Stock_{it}$) is interacted with $Diff_i$ and $(1 - Diff_i)$ terms. Equation (4.2) and equation (4.3) are re-formulated as follows:

$$TD_{it}=\alpha_i+\beta_1 Stock_{it} * Diff_i+\beta_2 Stock_{it} * (1 - Diff_i) + \beta_3 Profit_{it}+ \\ +\beta_4 Liq_{it}+\beta_5 Loans_{it}+\beta_6 Coll_{it} + \beta_7 Size_{it}+\beta_8 Age_{it} + \epsilon_{it} \quad (4.4)$$

[79] See Table C2 in the Appendix C for the assigning of the US 2003 SIC codes for the two sectors.

$$TC_{it}=\alpha_i+\beta_1 Stock_{it}*Diff_{it}+\beta_2 Stock_{it}*(1-Diff_i)+\beta_3 Profit_{it}+ \\ +\beta_4 Liq_{it}+\beta_5 Loans_{it}+\beta_6 Coll_{it}+\beta_7 Size_{it}+\beta_8 Age_{it}+\epsilon_{it} \quad (4.5)$$

This test is motivated by the diversion value hypothesis in Giannetti et al. (2011). Suppliers of trade credit have an advantage relative to banks in financing their customers since repossessed goods are worth more to suppliers rather than to banks. This advantage is stronger for firms in the differentiated industries than for those in the standardised sector. Firms in the former industries produce more specific products and the seller-buyer relation is closer than in the latter (Guariglia and Mateut, 2016). Hence, it is expected that the trade-off between inventories and trade credit extended to be negative and significantly higher for firms in the differentiated sector than for those in the standardised one ($|\beta_1| > |\beta_2|$). Finally, trade credit taken should remain unaffected as in Bougheas et al. (2009).

4.4.3 The differentiated effect of firm size

In addition, Chapter 4 also explores whether the trade-off between stock of inventories and trade credit is different across all type of firms. To do so, firms' size is used as a sorting device. This is based on the financial constraints literature (Guariglia, 2008; Spaliara, 2009). Small firms are normally associated with a higher degree of information asymmetry and are more vulnerable to capital markets imperfections. This means that they are more likely to be financially constraints. Therefore, small firms should have higher costs of storing goods and should sell more on credit when their stock of inventories are high (Bougheas et al., 2009).

Using the same criteria as in Chapter 2, sub-section 2.4.4, a dummy variable $Small_{it}$ is employed. It takes the value of 1, if firms' real assets are in the bottom 50% distribution of firms. Equation (4.2) and equation (4.3) are re-estimated as follows:

$$TD_{it}=\alpha_i+\beta_1 Stock_{it}*Small_{it}+\beta_2 Stock_{it}*(1-Small_{it})+\beta_3 Profit_{it}+ \\ +\beta_4 Liq_{it}+\beta_5 Loans_{it}+\beta_6 Coll_{it}+\beta_7 Size_{it}+\beta_8 Age_{it}+\epsilon_{it} \quad (4.6)$$

$$TC_{it}=\alpha_i+\beta_1 Stock_{it}*Small_{it}+\beta_2 Stock_{it}*(1-Small_{it})+\beta_3 Profit_{it}+ \\ +\beta_4 Liq_{it}+\beta_5 Loans_{it}+\beta_6 Coll_{it}+\beta_7 Size_{it}+\beta_8 Age_{it}+\epsilon_{it} \quad (4.7)$$

Both specifications capture the effect of firms' size on the inverse relation between

stock of inventories and trade credit (extended and taken). It is expected that changes in inventories exert a higher impact on trade credit extended for smaller firms than for their larger counterparts ($|\beta_1| > |\beta_2|$). This means that smaller firms are more likely to have higher costs of storing goods. If so, they sell more of their stock on credit to increase their sales and meet their financial obligations. Once more it is anticipated that the trade-off between inventories and trade credit taken remains statistically insignificant.

4.4.4 Trade credit, firm size and product characteristics

It is also investigated the extent to which the inventory management motive differs across small and large firms, controlling for the characteristics of the goods which are traded. To explore this hypothesis, equation (4.4) and equation (4.5) are augmented with interaction terms of the $Diff_i$ dummy. The equations take the following form:

$$\begin{aligned} TD_{it} = \alpha_i + \beta_1 Stock_{it} * Small_{it} * Diff_i + \beta_2 Stock_{it} * Small_{it} * (1 - Diff_i) + \\ + \beta_3 Stock_{it} * (1 - Small_{it}) * Diff_i + \beta_4 Stock_{it} * (1 - Small_{it}) * Diff_i + \beta_3 Profit_{it} \\ + \beta_4 Liq_{it} + \beta_5 Loans_{it} + \beta_6 Coll_{it} + \beta_7 Size_{it} + \beta_8 Age_{it} + \epsilon_{it} \end{aligned} \quad (4.8)$$

$$\begin{aligned} TC_{it} = \alpha_i + \beta_1 Stock_{it} * Small_{it} * Diff_i + \beta_2 Stock_{it} * Small_{it} * (1 - Diff_i) + \\ + \beta_3 Stock_{it} * (1 - Small_{it}) * Diff_i + \beta_4 Stock_{it} * (1 - Small_{it}) * Diff_i + \beta_3 Profit_{it} \\ + \beta_4 Liq_{it} + \beta_5 Loans_{it} + \beta_6 Coll_{it} + \beta_7 Size_{it} + \beta_8 Age_{it} + \epsilon_{it} \end{aligned} \quad (4.9)$$

It is expected that smaller firms in the differentiated industries to extend more trade credit than smaller firms in the standardized sectors. This is based on the argument that smaller firms are more likely to have higher storing costs of holding stocks than their larger counterparts (Bougheas et al., 2009) and that firms with larger proportions of differentiated goods inputs extend more trade credit (Giannetti et al., 2011).

4.4.5 Financial crisis

Until now the trade-off between stock of inventories and trade credit is considered for the whole sample. To account for the effect of the recent financial crisis, a crisis dummy ($Crisis_t$) is considered. It takes the value of 1 over the period 2007-2009, and 0 otherwise. The aim is to investigate whether the crisis magnifies the inverse relation between the volume of stock of inventories and the amount sold on credit. Equation (4.2) and Equation (4.3) are re-estimated with the stock of inventories variable interacted with the $Crisis_t$

and the $(1 - Crisis_t)$ terms. The models take the following form:

$$TD_{it}=\alpha_i+\beta_1 Stock_{it} * Crisis_t + \beta_2 Stock_{it}*(1 - Crisis_t) + \beta_3 Profit_{it}+ \\ +\beta_4 Liq_{it}+\beta_5 Loans_{it}+\beta_6 Coll_{it} + \beta_7 Size_{it}+\beta_8 Age_{it} + \epsilon_{it} \quad (4.10)$$

$$TC_{it}=\alpha_i+\beta_1 Stock_{it} * Crisis_t + \beta_2 Stock_{it}*(1 - Crisis_t) + \beta_3 Profit_{it}+ \\ +\beta_4 Liq_{it}+\beta_5 Loans_{it}+\beta_6 Coll_{it} + \beta_7 Size_{it}+\beta_8 Age_{it} + \epsilon_{it} \quad (4.11)$$

This test is motivated by the financial-accelerator theory according to which periods of monetary contraction increase the costs of finance, weakening firms' balance sheet positions (Bernanke et al., 1996). Previous literature on trade credit also refers that deteriorations in economic conditions lead to an increase of both accounts payables and receivables of firms (Choi and Kim, 2005; Love et al., 2007). Thus, in Chapter 4 it is argued that during this period, producers face a much higher uncertain demand for their products and have a higher need to obtain liquidity. The magnitude of the inventory management motive is expected to be higher during the turmoil period than in the non-crisis period ($|\beta_1| > |\beta_2|$).

4.4.6 Financial development

Finally, it is considered the effect of financial development on the inventory management motive. The aim is to test whether country-level financial development mitigates the impact of the inventory management motive. To test this hypothesis, the models in equation (4.2) and equation (4.3) are augmented with a financial development term (FD_t) and an interaction term between financial development and stock of inventories variable ($Stock_{it} * FD_t$). The financial development term denotes the vector of financial development measures.

To ensure the robustness of the results, three different indicators of financial intermediary development are used. Following the literature (Demirgüç-Kunt and Levine, 2009; Beck et al., 2010a), the overall development of the banking system is first considered. It measures the extent to which new firms have opportunities to acquire bank financing (Baltagi, 2013). The overall development of the banking system is defined in two ways: the first is based on the ratio of private bank credit to GDP, and the second is the ratio of private bank credit and other institutions to GDP. Finally, the ratio of deposit-money bank assets to GDP (i.e. bank assets to GDP) is implemented. It measures the overall size of the banking sector (King and Levine, 1993). The following specification models are estimated:

$$TD_{it}=\alpha_i+\beta_1 Stock_{_{it}}+\beta_2 Stock_{_{it}} * FD_{_t} + \beta_3 FD_{_t} + \beta_4 Profit_{_{it}} + +\beta_5 Liq_{_{it}}+\beta_6 Loans_{_{it}}+ \\ +\beta_7 Coll_{_{it}} + \beta_8 Size_{_{it}}+\beta_9 Age_{_{it}} + \epsilon_{it} \quad (4.12)$$

$$TC_{it}=\alpha_i+\beta_1 Stock_{_{it}}+\beta_2 Stock_{_{it}} * FD_{_t} + \beta_3 FD_{_t} + \beta_4 Profit_{_{it}} + +\beta_5 Liq_{_{it}}+\beta_6 Loans_{_{it}}+ \\ +\beta_7 Coll_{_{it}} + \beta_8 Size_{_{it}}+\beta_9 Age_{_{it}} + \epsilon_{it} \quad (4.13)$$

The motivation for this specification stems from two important considerations. First, it is argued that financial development helps improve firms' access to lower cost of external finance (Rajan and Zingales, 1998). This means that a bank-based system is superior in financing transactions which would otherwise finance through trade credit (Demirgüç-Kunt and Maksimovic, 2002). Secondly, in the euro area banks have dominated the financial markets (Bijlsma and Zwart, 2013). Hence, a large and efficient banking system should mitigate the need of firms to sell their stock on credit. Firms in a financial development system face lower levels of uncertainty since they are able to obtain more credit through banks.

The estimation results should be interpreted as follows: the coefficient on the stock of inventories variable (β_1) refers to the trade-off between inventories and trade credit when financial development is not taken into account. The indirect effect of financial development on the inventory management motive is given by the coefficient on the interaction variable (β_2). The overall effect of financial development is given by $\beta_1+\beta_2$. It is expected that the inverse relation between inventories and trade credit to would be lower for firms in a development banking system than for their non-development counterparts.

Finally, the coefficient of the financial development variable (β_3) should be positive and statistically significant in line with the complementary view of trade credit. The use of trade credit by firms is higher in countries characterised with a larger banking sector (Deloof and La Rocca, 2015).

4.4.7 Robustness check: Financial development and product characteristics

In addition, it is explored whether the impact of financial development on the inventory management motive is linked with the characteristics of the inputs which are purchased. To do so, the sample of firms is divided into those producing differentiated and standardized products based on the dummy variable $Diff_i$ which is defined in sub-section 4.4.2. Equation (4.12) and equation (4.13) are re-estimated.

It is expected that the relation between stock of inventories and the amount sold on

credit to be higher for firms in the differentiated sector than in the standardised industries. This is once more based on the assumption that firms from sectors producing differentiating products have a higher advantage in financing their customers as a repossessed good is worth more to suppliers than to banks (Giannetti et al., 2011).

4.4.8 Robustness check: SMEs and non-SMEs

Previous studies have shown that trade credit is an important source of external finance for SMEs (Casey and O'Toole, 2014; Carbó-Valverde et al., 2016). However, this literature is silence on the role of stock of inventories on trade credit. To test for this hypothesis, a dummy SME_{it} is interacted with the variable stock of inventories ($Stock_{it}$).[80] Equation (4.2) and equation (4.3) are extended as follows:

$$TD_{it}=\alpha_i+\beta_1 Stock_{it} * SME_{it}+\beta_2 Stock_{it} * (1-SME_{it}) + \beta_3 Profit_{it}+ \\ +\beta_4 Liq_{it}+\beta_5 Loans_{it}+\beta_6 Coll_{it} + \beta_7 Size_{it}+\beta_8 Age_{it} + \epsilon_{it} \quad (4.14)$$

$$TC_{it}=\alpha_i+\beta_1 Stock_{it} * SME_{it} + \beta_2 Stock_{it} * (1-SME_{it}) + \beta_3 Profit_{it}+ \\ +\beta_4 Liq_{it}+\beta_5 Loans_{it}+\beta_6 Coll_{it} + \beta_7 Size_{it}+\beta_8 Age_{it} + \epsilon_{it} \quad (4.15)$$

This hypothesis is motivated by the argument that SMEs are considered to suffer from higher levels of information asymmetry and higher costs of borrowing than non-SMEs (Darvas, 2013). It is expected that the trade-off between inventories and trade credit extended to have a higher impact on SMEs than for non-SMEs. The former are considered to be more vulnerable to capital market imperfections, and therefore, their costs of holding inventories should be higher. Once more the relation between trade credit taken and inventories should not be statistically significant.

Finally, this section also relates SMEs/non-SMEs to product characteristics. Equation (4.14) and (4.15) are re-estimated by considering the characteristics of traded products. The equations are modified as follows:

$$TD_{it}=\alpha_i+\beta_1 Stock_{it} * SME_{it} * Diff_i+\beta_2 Stock_{it} * SME_{it} * (1-Diff_i)+ \\ + \beta_3 Stock_{it} * (1-SME_{it}) * Diff_i+\beta_4 Stock_{it} * (1-SME_{it}) * Diff_i+\beta_3 Profit_{it} \\ +\beta_4 Liq_{it}+\beta_5 Loans_{it}+\beta_6 Coll_{it} + \beta_7 Size_{it}+\beta_8 Age_{it} + \epsilon_{it} \quad (4.16)$$

[80] See sub-section 2.4.10 for details on the definition of variable SME_{it}.

$$TC_{it}=\alpha_i+\beta_1 Stock_{_{it}} * SME_{it} * Diff_i+\beta_2 Stock_{_{it}} * SME_{it} * (1-Diff_i)+$$
$$+\beta_3 Stock_{_{it}} * (1-SME_{it}) * Diff_i+\beta_4 Stock_{_{it}} * (1-SME_{it}) * Diff_i+\beta_3 Profit_{_{it}}$$
$$+\beta_4 Liq_{_{it}}+\beta_5 Loans_{_{it}}+\beta_6 Coll_{_{it}}+\beta_7 Size_{_{it}}+\beta_8 Age_{_{it}}+\epsilon_{it} \quad (4.17)$$

Following the argument in sub-section 4.4.2, it is expected that SMEs in the differentiated sector extend more credit than SMEs in the standardized sector. The interaction terms should also have no effect on the ratio of accounts payables to sales ratio.

4.4.9 Robustness checks: Alternative cut-off point

In the main specification models the 50th percentile is employed as a cut-off point to define small and large firms. To ensure that the results are not driven from the way the sample is split, the 75% percentile is used as an alternative cut-off point. In this case, small firms are classified as those with total assets below the 75% of the distribution of the assets of all the firms in that particular industry and year, and 0 otherwise. Equation (4.6) and equation (4.7) are re-estimated. The expectation is that the empirical findings remain robust to the previous splitting criteria.

4.5 Estimation methodology

To control for both endogeneity of the regressors as well as unobserved heterogeneity problems, this chapter implements the system GMM estimator. In line with the previous studies (Chen and Guariglia, 2013), all regressors (with the exception of age) are treated as endogenous. In order to evaluate whether the instruments are valid and the specification models are correctly specified the Sargan and m(n) test are used. In summary, in this chapter three (and deeper) lags of the regressors are used as instruments. It is also reported the $m3$ test for third order serial correlation of the differenced residuals in tables.

4.6 Data

This section is divided in 3 parts. The first describes the main sources for the database which is used to test the relation between trade credit and inventories. Data construction and the description statistics are provided in last sub-sections.

4.6.1 Data collection

The main dataset which is used is the Amadeus database as in Chapter 2. Firm-level accounting data continues to cover the period between 2003 and 2011. However, in Chapter

4 information on annual accounting reports comprises the following 12 euro area countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain. Following the steps of Chapter 2, firms with unconsolidated accounts are eliminated ensuring that the majority of the firms in the dataset are small. In fact, the vast majority (95%) of the firms included in the dataset are not traded in the stock market. Consistent with the previous chapters, Chapter 4 follows the work of Blundell and Bond (1998) and considers all manufacturing firms based on a 2-digital NACE rev. classification.[81]

To account for the characteristics of the transacted goods, this chapter follows the work of Giannetti et al. (2011). The author use the product classiffication of Rauch (1999) to distinguish between standardized goods and differentiated goods. Table C.2 in the Appendix C provides information on the assignment of U.S. SIC codes to the inputs characteristics. This information is also taken from Amadeus database.

Data on financial development is obtained from the World Development Indicators (WDI, November 2013) as it is described in Beck et al. (2003). Finally, the GDP deflator is collected from the World Bank dataset.

4.6.2 Sample selection process

Following the same criteria as in the previous chapters, negative sales and assets are dropped. To control for outliers observations are excluded in the 1% tail for each of the regression variables. Firms with less than 3-years of observations are also dropped from the sample. The final panel which is unbalanced covers 136,489 firms (corresponding to 822,488 observations) which operate in the manufacturing sector. Specifically, it includes 3,499 firms from Austria (corresponding to 18,741 observations), 3,604 firms from Belgium (corresponding to 24,416), 2,267 firms from Finland (corresponding to 14,398 observations), 20,874 firms from France (corresponding to 137,176 observations), 33,036 from Germany (corresponding to 175,977), 1,819 from Greece (corresponding to 11,204 observations), 755 firms from Ireland (corresponding to 4,847 observations), 41,495 firms from Italy (corresponding to 250,272 observations), 138 firms from Luxembourg (corresponding to 758 observations), 5,190 firms from Netherlands (corresponding to 36,947 observations), 5,056 firms from Portugal (corresponding to 32,010 observations), 18,756 firms from Spain (corresponding to 115,724 observations).[82]

[81] See sub-section 2.6.2 for details on the assigning of firms based on the industrial sectors.

[82] In Appendix C, see C.3, C.4, C.5 and C.6 for the number of firms per country, number of observations per country, the number of observations per year and the total structure of the panel, respectively.

4.6.3 Descriptive statistics

Table 4.1 provides statistics for the sample during the 2003-2011 period. It includes information on number of observations, means, standard deviations and percentiles (i.e. 25th percentile, 50th percentile and 75th percentile). Table 4.2 and Table 4.3 show the aforementioned statistics for firms producing differentiated/standardised products and crisis/non-crisis periods, respectively. The P-values of a test for the equality of means is also provided in both tables. Figure 4-1 and Figure 4-2 illustrate the average provision and receipt of trade credit for the overall sample.

Column 1 of Table 4.1 indicates that the information that it is possible to make the most use of is on the age and collateral variables. In fact, Chapter 4 provides 911,404 and 901,645 firm-level observations for age and collateral during the 2003-2011 period, respectively. Conversely, for loans and size the number of observations is smaller than for any other variables (i.e. 464,483 and 348,823 respectively).

Table 4.1 shows that the average accounts receivable to sales ratio for firms in the sample is 26.7%. The ratio for a median firm is approximately 24.5%, with substantial variation across the distribution; a firm at the 25th percentile has an average trade credit extended of 15.1% comparing with a firm at the 75th percentile which has an average of 34.3%. This is similar to the ratio for a sample of French manufacturing firms (21.2%) in Mateut et al. (2015) but much higher when comparing with the previous studies on U.K. and China. (Bougheas et al., 2009; Guariglia and Mateut, 2016).[83] On average, the trade credit taken for the sample of firms is approximately 17.8% with a median of 15.6%. These figures are consistent with those from the earlier study of Bougheas et al. (2009). The main variable of interest in the analysis, stock of inventories, has a mean (median) of 14.0% (10.6%) with a standard deviation of 13.3%. The 25th and 75th percentile of this variable indicate that there is some variability in the distribution of this variable across the sample period. Turning to the control variables both profit and liquidity have similar patterns. The average firm presents a profit (liquidity) level of 3.6% (7.9%) with the 25th percentile below the median and closer to zero. Loans account for 11.0% (mean) or 6.2% (median). The fact that the mean is much larger than the median may suggest that there a small number of firms which have a large number of laons when comparing with other firms. The size variable suggest that firms' size is skewed to the left. Finally, collateral (age) is skewed to the right (left).

Table 4.2 indicates that the number of observations in the dataset is higher for firms in the standardised industry than in the differentiated one. Table 4.2 also shows a striking difference in the ratio of accounts receivables to sales (TD). Firms producing differentiated

[83]Bougheas et al. (2009) and Guariglia and Mateut (2016) found an average accounts receivables to sales ratio of 17.0% and 17.2%. This discrepancy is probably explained by the different sample period which is used. These studies employ data for the 1993-2003 period and the 2000-2007 period, respectively. Chapter 4 uses a sample of firms for the period between 2003 and 2011.

Table 4.1: Descriptive statistics: Full sample

	Full sample					
	Obs.	Mean	St. dev	25^{th}	50^{th}	75^{th}
	(1)	(2)	(3)	(4)	(5)	(6)
TD (Trade debit)	644,250	0.267	0.178	0.151	0.245	0.343
TC (Trade credit)	551,830	0.178	0.117	0.094	0.156	0.228
Stock (Inv. stock)	792,464	0.140	0.133	0.052	0.106	0.188
Profit (Profits)	693,310	0.036	0.040	0.006	0.021	0.049
Liq (liquidity)	804,495	0.079	0.106	0.007	0.036	0.106
Loans (loans)	464,483	0.110	0.127	0.017	0.062	0.169
Coll (collateral)	901,645	0.273	0.137	0.073	0.171	0.325
Size (size)	348,823	7.088	1.206	6.955	7.683	8.521
Age (log age)	911,404	3.148	0.602	2.708	3.178	3.526

Notes: This table presents the number of observations, sample means, standard deviations, the 25th percentile, the median and the 75th percentile for the all sample (column 1 to 6), respectively. See Table C.1 in the Appendix C for the definition of the variables.

products on average sell more on credit than firms in the standardized sector (i.e. 31.2% against 18.2%). The ratio for a median firm in the differentiated (standardised) sector is 23.3% (16.2%). However, firms at the 75th percentile of the distribution of trade credit extended have an average of 35.5% in the differentiated sector and 33.3% in the standardised industry. Once more it should be taken into account that the number of observations for firms in the standardised sector are higher than for those in the differentiated one. These findings are consistent with Giannetti et al. (2011) and Guariglia and Mateut (2016).

By contrast, trade credit taken (TC) does not differ much across differentiated and standardized sectors. In effect, the ratio for a median firm in the differentiated (standardised) sector is approximately 22.1% (11.8%), with a small variation across the distribution. At the 25th percentile a firm in a differentiated (standardised) industry shows an average trade credit taken of 9.6% (9.5%) whereas a firm at the 75th percentile displays an average of 23.6% (23.2%). This is an expected result since the uptake of trade credit depends on the characteristics of the products which are used such as the proportion of differentiated products versus standardized products (Mateut et al., 2015).

Another important difference which is documented in Table 4.2 is that differentiated goods manufacturers have higher levels of inventories (relative to sales). In fact, when considering the percentiles distribution of this variable it is clear that differentiated firms have experienced highest levels of stock of inventories at the median and 75th percentile when comparing with firms in the standardised industries at the 50th and 75th percentile. Hence, the statistics suggest that firms which produce differentiated products at the top of the distribution have a higher stock of inventories.

Moreover, differentiated goods manufacturers are younger and make a higher use of bank loans relative to sales with the distribution of the being skewed to the right for both differentiated and standardised samples. This is in line with previous studies (Giannetti

et al., 2011). The profit in the sample is higher (lower) for firms in the standardised (differentiated) industry with a mean and a median of 3.1% (4.6%), and the 25th and the 75th percentile of 0.7% (0.8%) and 4.9% (5.1%), respectively. A similar pattern is observed for liquidity and collateral. Finally, firms in the differentiated sector are larger than those in the standardised one with a small variation across the distribution of firm size. The differences between sub-samples are statistically significant in all cases (column 13).

Moving to Table 4.3, it is also clear that when the sample is split into crisis and non-crisis period that the number of observations is much higher outside of the crisis period thant during the turmoil. Starting with row 1 and row 2, the statistics show that the average trade credit extended and trade credit taken is lower during the crisis. Although the difference in the trade credit extended between the two periods is statistically significant, it is not actually large. The ratio for a median firm in the crisis (non-crisis) period is approximately 23.9% (25.3%), with a small variation across the distribution; a firm at the 25th percentile in the crisis (non-crisis) has an average trade credit extended of 14.9% (15.8%) comparing with a firm at the 75th percentile which has an average of 33.8% (35.4%). A similar pattern is observed for the trade credit taken.

Furthermore, the average firm during the crisis has 13.8% of inventories (relative to sales) and 13.2% outside of the crisis. Once more the discrepancy between the two sub-samples is not relatively large. When considering the percentiles distribution across the two sub-periods, it seems that during the crisis firms present a higher levels of stocks at the median, 25th and 75th percentile of the distribution of this variable. This results may indicate that during the crisis firms' reduce their inventory stock levels which may be related to their need to obtain liquidity. The average loans and profit is higher for the crisis period than outside. It is also clear that across the different percentiles distribution of loans and profits the mean values are always higher during the crisis period. However, the difference between the means is not statistically significant for loans and for profit at 1% level.

Turning to the other control variables, it seems that liquidity and collateral have similar patterns. The average firm presents a higher profit (liquidity) outside of the crisis than during the turmoil period, with the 25th percentile below the median and closer to zero. The mean average of size is not different between crisis and non crisis period and this is also observed when considering the different percentiles distribution of the variable size. Finally, the distribution of the age variable may suggests that age is skewed to the left since the median age of the firm is higher than the mean and it is younger during the crisis period.

Figure 4.1 and Figure 4.2 show that all trade credit ratios exhibit very similar patterns to the abovementioned descriptive statistics on the trade credit extended and taken. A

slight increase at the beginning of the crisis followed by a sharp decline in subsequent crisis years. Both statistics are in line with the figures provided by Ferrando and Mulier (2013). To sum up, these preliminary results suggest that firms' provision and receipt of trade credit may be related to the level of inventories, the characteristics of the goods produced and the financial crisis. In the next sub-section, it is provided an empirical analysis on the relation between these variables.

Table 4.2: Descriptive statistics: Differentiated and standardised sectors

	Differentiated						Standardised						Diff.
	Obs.	Mean	St. dev	25^{th}	50^{th}	75^{th}	Obs.	Mean	St. dev	25^{th}	50^{th}	75^{th}	Means
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
TD (Trade debit)	266,642	0.312	0.164	0.141	0.233	0.355	377,608	0.182	0.111	0.089	0.162	0.333	0.000
TC (Trade credit)	243,137	0.221	0.121	0.096	0.163	0.236	308,693	0.118	0.077	0.095	0.157	0.232	0.000
Stock (Inv. stock)	336,913	0.154	0.143	0.063	0.121	0.206	455,551	0.123	0.113	0.045	0.097	0.176	0.000
Profit (Profits)	285,312	0.031	0.039	0.007	0.022	0.049	407,998	0.046	0.042	0.008	0.023	0.051	0.000
Liq (liquidity)	340,482	0.073	0.100	0.008	0.038	0.108	464,013	0.087	0.110	0.009	0.038	0.107	0.176
Loans (loans)	205,907	0.150	0.138	0.016	0.068	0.180	258,576	0.045	0.066	0.009	0.037	0.107	0.000
Coll (collateral)	368,906	0.222	0.172	0.061	0.146	0.293	532,739	0.204	0.174	0.078	0.177	0.329	0.000
Size (size)	146,392	7.922	1.172	6.981	7.735	8.594	202,431	7.691	1.249	6.940	7.657	8.481	0.000
Age (log age)	368,977	3.067	0.533	2.773	3.178	3.526	542,427	3.223	0.654	2.773	3.178	3.526	0.000

Notes: This table presents the number of observations, sample means, standard deviations, the 25th percentile, the median and the 75th percentile for firms in the differentiated sector (column 1 to 6) and firms in the standardised sector (column 7 to 12) , respectively. This is based on a dummy variable equal to 1 for firms in the differentiated sector, and 0 otherwise. Diff. means is the p-value of the test statistic for the equality of means between firms in the differentiated and standardised sectors (column 13). See Table C.1 in the Appendix C for the definition of the variables.

Table 4.3: Descriptive statistics: Crisis and non-crisis periods

	Crisis						Non-crisis						Diff.
	Obs.	Mean	St. dev	25^{th}	50^{th}	75^{th}	Obs.	Mean	St. dev	25^{th}	50^{th}	75^{th}	Means
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
TD (Trade debit)	211,387	0.260	0.159	0.149	0.239	0.338	351,237	0.272	0.161	0.158	0.253	0.354	0.000
TC (Trade credit)	175,902	0.142	0.114	0.048	0.092	0.153	287,425	0.182	0.117	0.099	0.163	0.238	0.000
Stock (Inv. stock)	266,963	0.138	0.133	0.047	0.101	0.183	418,843	0.142	0.132	0.052	0.107	0.189	0.000
Profit (Profits)	221,090	0.037	0.041	0.008	0.022	0.051	387,777	0.036	0.040	0.007	0.021	0.050	0.010
Liq (liquidity)	271,509	0.076	0.102	0.008	0.036	0.102	425,272	0.081	0.107	0.009	0.039	0.111	0.000
Loans (loans)	151,159	0.111	0.127	0.017	0.061	0.166	233,664	0.110	0.127	0.016	0.060	0.164	0.157
Coll (collateral)	317,125	0.212	0.174	0.069	0.163	0.317	488,256	0.215	0.173	0.073	0.168	0.319	0.000
Size (size)	324,068	7.808	1.200	6.960	7.688	8.516	497,664	7.808	1.200	6.952	7.679	8.524	0.825
Age (log age)	324,252	3.122	0.631	2.708	3.135	3.526	496,068	3.165	0.581	2.773	3.178	3.526	0.000

Notes: This table presents the number of observations, sample means, standard deviations, the 25th percentile, the median and the 75th percentile for firms in the crisis (column 1 to 6) and non-crisis (column 7 to 12) periods, respectively. This is based on a dummy variable equal to 1 for the 2007-2009 period, and 0 otherwise. Diff. means is the p-value of the test statistic for the equality of means for crisis and non-crisis periods (column 13). See Table C.1 in the Appendix C for the definition of the variables.

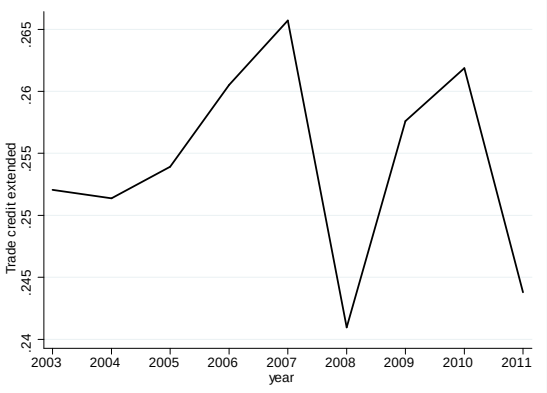

Figure 4.1: Average trade receivables to total sales ratio for the sample of firms in the euro area.

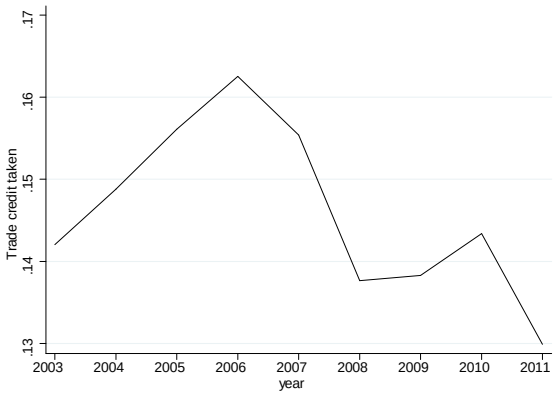

Figure 4.2: Average trade payables to total sales ratio for the sample of firms in the euro area.

4.7 Results

4.7.1 The inventory management motive

To begin with, this section sheds light on the role of inventories on trade credit. Few papers have considered the trade-off between inventories and trade credit (Bougheas et al., 2009; Giannetti et al., 2011; Guariglia and Mateut, 2016). Chapter 4 takes one step further and tests whether there is an inventory management motive using a comparable multi-country data on euro-area firms. Table 4.4 presents the estimates for equation (4.2) and (4.3).

Starting with column 1, it is clear that stock of inventories ($Stock_{it}$) has a large, negative and statistically significant effect on the trade credit extended (TD_{it}). This relation is not only statistically significant but also economically important. The magnitude of change in trade credit extended is of -0.039 when the variable stock takes its average value for the overall sample period.[84] This can be explained under the assumption of the inventory management motive of Bougheas et al. (2009). In a scenario where demand is uncertain and the production exceeds sales firms' the level of inventories increases. Thus, they prefer to extend more trade credit to obtain more sales and decrease their level of inventories. In line with this argument, Bougheas et al. (2009) and Guariglia and Mateut (2016) find a negative relation between stock of inventories and the provision of trade credit for U.K. and China, respectively.

Focusing on the other regressors, I find that all control variables are statistically significant (with the exception of age) and have the expected sign. For instance, the coefficient on the profit variable ($Profit_{it}$) is positive indicating that profitable firms are more likely to extend trade credit to their financially constrained customers. As more external funding is available, firms extend trade credit to their buyers as it can be seen by the positive sign on the bank loans variable ($Loans_{it}$). On the other hand, collateral ($Coll_{it}$) and liquidity (liq_{it}) have a negative and significant effect on trade credit extended. Firms with a higher level of asset tangibility are more likely to extend less trade credit since they operate in a less dynamic industry with a lower growth potential (Hovakimian, 2009).

Results in column 2 suggest that there is no trade-off between inventories and trade credit taken. The coefficient on the stock of inventories is statistically insignificant. This is consistent with the previous work of Bougheas et al. (2009). Finally, the diagnostic tests do not indicate significant problems with the choice of the instruments and the specification of the model.

[84] The magnitude of the change in the accounts receivables to sales ratio is given by the coefficient associated with the stock variable multiplied by the mean value of stock during the 2003-2011 period. This is calculated as follows: -0.283*0.140=-0.039.

Table 4.4: Trade credit extended and taken

	TD (1)	TC (2)
Stock_{it}	-0.283***	0.041
	(-3.89)	(0.65)
Profit_{it}	0.426*	-0.126
	(1.94)	(-0.78)
Liq_{it}	-0.283*	-0.053
	(-2.06)	(-1.42)
Loans_{it}	0.574***	0.120
	(9.04)	(1.00)
Coll_{it}	-0.369***	0.009
	(-4.78)	(0.21)
Size_{it}	0.021***	-0.001
	(3.87)	(-0.16)
Age_{it}	0.003	-0.024***
	(0.70)	(-5.23)
Observations	364,868	348,138
Firms	83,700	75,891
Sargan	0.020	0.862
m1(p-value)	0.000	0.000
m3 (p-value)	0.043	0.437

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors (except age) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 14 in column 1 and 12 in column 2. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

4.7.2 The nature of the transacted good

Next, it is investigated whether firms with different product characteristics exhibit different effects of stock of inventories on their trade credit (extended and taken). Table 4.5 presents the estimates for equation (4.4) and equation (4.5) as well as the test for equality of the coefficients.

Starting with column 1, it is clear that the strength of the relation between trade credit extended and the stock of inventories varies with the characteristics of the traded products. The empirical findings suggest that the inverse relation between the volume of stocks of inventories and the amount sold on credit is stronger for firms producing differentiated goods than for their standardized counterparts. This can be explained under the diversion theory in Giannetti et al. (2011). Firms in the differentiated sector produce products which are more specific to the needs of the their customers. Thus, the seller-buyer relation is closer than in the standardized industries. The P-value for the equality of the coefficients indicates a statistically significant difference between the two coefficients. The results also reinforce the economic importance of the inventory management motive: the magnitude of the change in trade credit extended when stock of inventories takes its average value

Table 4.5: Firms' product characteristics

	TD	TC
	(1)	(2)
$Stock_{it}$*$Diff_i$	-0.407***	-0.849
	(-3.66)	(-0.98)
$Stock_{it}$*(1-$Diff_i$)	-0.149*	-0.006
	(-1.66)	(-0.02)
$Profit_{it}$	0.045	0.213
	(0.19)	(0.55)
Liq_{it}	-0.036	0.488*
	(-0.30)	(1.74)
$Loans_{it}$	0.528***	-0.287**
	(8.32)	(-1.96)
$Coll_{it}$	-0.280***	-0.113
	(-5.07)	(-1.16)
$Size_{it}$	0.016***	0.003
	(3.31)	(0.41)
Age_{it}	0.001	-0.014*
	(0.23)	(-1.89)
Observations	364,868	348,138
Firms	83,700	75,891
Sargan	0.503	0.182
m1(p-value)	0.000	0.000
m3 (p-value)	0.064	0.425
F-test of equality (p-value)		
Stock diff vs non-diff	0.073	0.455

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation, with degrees of freedom for the sargan test equal to 17 in column 1 and 9 in column 2. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

for differentiated and standardized products is -0.063 and -0.018, respectively.[85] This is consistent with Guariglia and Mateut (2016) for a sample of Chinese firms.

Moving to column 2 of Table 4.5, empirical findings suggest that independently of the characteristics of the goods which are transacted, the trade-off between stock of inventories and trade credit taken remains statistically insignificant. Finally, the Sargan test shows once more that the model is not misspecified and the m3 indicates that the instruments are valid.

4.7.3 The impact of firms' size

It is tested also whether all type of firms are equally affected by the trade-off between stock of inventories and the provision/uptake of trade credit. Following previous literature (Bougheas et al., 2009), the focus is on the effect of firms' size. Empirical findings for

[85] In row 1, the magnitude of the change is measured as the coefficient associated with the stock variable multiplied by the mean value of stock in the differentiated sector (-0.407*0.154=-0.063)

In row 2, the magnitude of the change is obtained by multiplying the coefficient of the stock variable with the mean value of stock in the standardized sector (-0.149*0.123=-0.018).

equation (4.6) and equation (4.7) are shown in Table 4.6.

Column 1 of Table 4.6 show the interactions between stock of inventories and the size terms. The inventory management motive is higher for smaller firms than for their larger counterparts. Stock of inventories play a greater (lesser) role on trade credit extended for smaller (larger) firms. This is consistent with the literature on financial constraints (Guariglia, 2008; Spaliara, 2009) according to which small firms suffer from higher levels of information asymmetry and find it more difficult to access external capital markets.

More importantly, empirical findings provide evidence that smaller firms have higher costs of storing goods and provide credit to decrease their storage goods. Once more, for both interactions the coefficients are significantly different from each other. To see the economic magnitude, both coefficients on the interaction terms should be consider. The magnitude of the change in the provision of trade credit when stock of inventories takes its average value for small and large firms is -0.081 and -0.022, respectively.[86] Clearly, the inventory management motive is much higher for smaller firms than for their larger counterparts. Results are consistent with the findings of Bougheas et al. (2009) for a sample of U.K. firms.

In column 2 of Table 4.6, results remain largely unaffected for all type of firms. There is no trade-off between stock of inventories and trade credit taken. This is in line with the work of Bougheas et al. (2009) for a sample of U.K. firms.

[86] In row 1, the magnitude of the change is calculated as the coefficient of the stock variable multiplied by the mean value of stock for small firms (-0.689*0.118=-0.081).

In row 2, the magnitude of the change is obtained by multiplying the coefficient of the stock variable with the mean value of stock of large firms(1-$Small_{it}$). This value is obtained as:-0.139*0.163=-0.022.

Table 4.6: The effect of firms' size

	TD (1)	TC (2)
$Stock_{it}$*$Small_{it}$	-0.689***	-0.119
	(-3.88)	(-0.94)
$Stock_{it}$*(1-$Small_{it}$)	-0.139**	0.053
	(-2.04)	(0.78)
$Profit_{it}$	0.529**	-0.110
	(2.34)	(-0.66)
Liq_{it}	-0.399***	-0.009
	(-2.70)	(-0.09)
$Loans_{it}$	0.527***	0.219
	(8.11)	(1.61)
$Coll_{it}$	-0.415***	0.014
	(-5.13)	(0.81)
$Size_{it}$	-0.005	-0.010
	(-0.54)	(-1.22)
Age_{it}	0.006	-0.023***
	(1.46)	(-5.68)
Observations	364,868	348,138
Firms	83,700	75,891
Sargan	0.077	0.932
m1(p-value)	0.000	0.000
m3 (p-value)	0.063	0.248
F-test of equality (p-value)		
Stock small vs. non-small	0.003	0.181

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 16 in column 1 and 12 in column 2. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

4.7.4 The effect of size and product characteristics

Results for equation (4.8) and equation (4.9) are shown in Table 4.7. In it, it is explored whether changes in the stock of inventories have a different impact on trade credit (extended and taken) of small/large firms in the differentiated and standardized sectors. Focusing on column 1 rows 1 and 2, empirical findings show that the variable stock of inventories exhibits a much larger coefficient for smaller firms which produce differentiated products. The differences in the coefficients on the stock of inventories for small firms in the differentiated/standardised sectors are statistically significant.

When comparing rows 3 and 4, results indicate that the estimate coefficient on the stock of inventories variable is negative and only significant for larger firms in the differentiated sector.

Overall results show that firms which are in the differentiated sector, especially small firms sell more on credit when stock of inventories are high. For instance, the economic impact of stock of inventories across small and large firms in the differentiated sector is clear: in the differentiated sector, the magnitude of the change in trade credit when stock

Table 4.7: Firms' size and product characteristics

	TD (1)	TC (2)
$Stock_{it}$*$Small_{it}$*$Diff_i$	-0.691***	-0.656
	(-3.28)	(-1.42)
$Stock_{it}$*$Small_{it}$*(1-$Diff_i$)	-0.209*	0.080
	(-1.79)	(0.28)
$Stock_{it}$*(1- $Small_{it}$)*$Diff_i$	-0.277**	0.267
	(-2.31)	(0.95)
$Stock_{it}$*(1- $Small_{it}$)*(1-$Diff_i$)	-0.160	0.090
	(-1.45)	(0.81)
$Profit_{it}$	-0.536	0.171
	(-1.08)	(0.44)
Liq_{it}	-0.762***	0.135***
	(-4.62)	(2.26)
$Loans_{it}$	0.366***	-0.527***
	(4.60)	(-3.50)
$Coll_{it}$	-0.469***	-0.099*
	(-6.39)	(-1.66)
$Size_{it}$	0.005	-0.014
	(0.32)	(-0.82)
Age_{it}	0.014**	-0.020***
	(2.12)	(-3.86)
Observations	364,868	348,138
Firms	83,700	75,891
Sargan	0.029	0.179
m1(p-value)	0.000	0.000
m3 (p-value)	0.343	0.304
F-test of equality (p-value)		
Stock small diff vs non-small diff	0.031	0.160
Stock small diff vs small non-diff	0.032	0.115
Stock small non-diff vs stock non-small non-diff	0.691	0.973
Stock non-small diff vs stock non-small non-diff	0.247	0.571

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 24 in column 1 and 9 in column 2.. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

of inventories has its average value for small (large) firms is -0.094 (-0.049).[87] The P-values of the test of the differences in the coefficients are once again statistically significant.

Finally, column 2 of Table 4.7 shows that trade credit taken is once more not influenced by the inventory management cost theory. Overall, empirical findings suggest that the effect of inventories on the trade credit extended depends on the size and the characteristics of the goods which are transacted.

[87] In row 1, the magnitude of the change is calculated as the coefficient of the stock variable multiplied by the mean value of stock for small firms in the differentiated sector (-0.691*0.135=-0.094).

In row 3, the magnitude of the change is obtained by multiplying the coefficient of the stock variable with the mean value of stock of large firms(1-$Small_{it}$) in the differentiated sector. This value is obtained as:-0.277*0.178=-0.049.

4.7.5 The impact of the crisis

Having established that the variable stock of inventories has a direct negative effect on trade credit extended, the next focus is on the implications of the crisis. Table 4.8 presents the estimates for equation (4.10) and equation (4.11), respectively. In the first two rows, it is reported the impact of stock of inventories on trade credit extended during and outside of the crisis periods.

Table 4.8: The financial crisis

	TD (1)	TC (2)
$Stock_{it}$*$Crisis_t$	-0.405***	0.032
	(-6.41)	(0.18)
$Stock_{it}$*(1-$Crisis_t$)	-0.285***	0.042
	(-4.92)	(0.60)
$Profit_{it}$	-0.711	-0.126
	(-1.29)	(-0.79)
Liq_{it}	-0.260	-0.126
	(-1.49)	(-0.79)
$Loans_{it}$	-0.186	0.120
	(-0.37)	(1.00)
$Coll_{it}$	-0.250	0.009
	(-0.70)	(0.21)
$Size_{it}$	0.075***	-0.001
	(3.60)	(-0.15)
Age_{it}	-0.014	-0.024***
	(-1.29)	(-5.19)
Observations	364,868	348,138
Firms	83,700	75,891
Sargan	0.012	0.809
m1(p-value)	0.000	0.000
m3 (p-value)	0.176	0.480
F-test of equality (p-value)		
Stock Crisis vs non-Crisis	0.000	0.958

Notes: All specifications are estimated using a system GMM estimator. $Crisis_t$ refers to the Crisis period between 2007 and 2009.The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors (except age and crisis) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 5 in column 1 and 11 in column 2. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Starting with column 1 of Table 4.8, results show that the inverse relation between stock of inventories and trade credit extended increases significantly during periods of tight monetary policy when comparing with the trade-off outside of the crisis. This finding reinforces the idea that during the crisis, firms face a higher demand uncertainty and therefore, they prefer to sell their stock on credit to boost their sales and decrease their costs of holding stock. This can be explained in the light of the financial accelerator theory. Bad economic conditions increase the cost of finance of firms, deteriorating its balance sheet positions (Vermeulen, 2002).

To assess the economic importance of the financial crisis let us focus on the coefficients

on the interaction terms ($Stock_{it} * Crisis_t$ and $Stock_{it}*(1 - Crisis_t)$). The magnitude of the change in trade credit when stock of inventories takes its average value for crisis and non-crisis period is -0.056 and -0.040, respectively.[88] In other words, the overall trade-off between inventories and trade credit extended is much higher during the turmoil period than outside. The magnitude of the response is greatly different. The p-value for the differences between the two coefficients is statistically significant. Finally, column 2 of Table 4.6 shows that there is no trade-off between stock of inventories and trade credit taken even when the financial crisis is considered.

4.7.6 The effect of financial development

Finally, it is tested whether the link between stock of inventories and trade credit (extended and taken) is influenced by the development of the banking system in terms of liquidity and size. Empirical findings for equation (4.12) and equation (4.13) are provided in Table 4.9 and Table 4.10, respectively.

Results in Table 4.9 show that the inverse relation between trade credit extended and stock of inventories remains negative and statistically significant. When considering the interaction term ($Stock_{it} * FD_t$), it is clear that the coefficient also captures the indirect effect of financial development on the inventory management motive. More importantly, the stock of inventory-financial development interaction has a lower impact on the trade credit extended.

To ascertain the overall economic effect, I consider for example the coefficients on the stock variable ($Stock_{it}$) and the interaction term ($Stock_{it} * FD_t$), as shown in row 1 and 2 of column 1. Moving from the 25th percentile of the distribution of private bank credit to the 50th percentile and given the mean value of inventories, the trade credit extended fall more for firms which are located in a more developed banking system.[89] Results are robust to other measures of financial development (column 2 and column 3).

[88] In row 1, the magnitude of the change in the trade credit extended during the crisis is given by the coefficient associated with the stock variable multiplied by the mean value of the stock variable during the crisis (-0.405*0.138=0.056).

In row 2, the magnitude of the change is provided by the coefficient associated with the stock variable multiplied by the mean value of stock outside of the turmoil period (-0.285*0.142=-0.040).

[89] The full magnitude of the change of financial development on the inventory management motive is given by the sum of the coefficients associated with the stock variable and the interaction term multiplied by the overall mean value of stock. To compute the total effect of financial development, the 25th and 50th percentile are evaluated. This is calculated as follows: (-0.203*0.140)+(-0.101*0.14)*0.936=-0.039; (-0.203*0.140)+(-0.101*0.140)*1.071=-0.046, where -0.203 and -0.101 are the coefficient on the stock of inventories variable and the interacted term.

Table 4.9: Trade credit extended and financial development

	FD= Private bank (1)	FD= Bank assets (2)	FD= Private bank & other (3)
$Stock_{it}$	-0.203*	-0.142*	-0.418***
	(-1.69)	(-1.81)	(-4.44)
$Stock_{it}$*FD_t	-0.101**	-0.079***	-0.053**
	(-1.96)	(-3.79)	(-1.97)
FD_t	0.020*	0.115***	0.076***
	(1.68)	(7.48)	(7.09)
$Profit_{it}$	0.929***	-0.706	-0.398
	(3.21)	(-1.18)	(-0.79)
Liq_{it}	-0.458***	-0.415***	-0.353**
	(-3.29)	(-2.97)	(-2.41)
$Loans_{it}$	0.841***	0.877***	0.821***
	(3.61)	(5.66)	(5.26)
$Coll_{it}$	-0.615***	-0.588***	-0.580***
	(-7.42)	(-7.28)	(-8.28)
$Size_{it}$	0.004	0.033***	0.026***
	(0.49)	(3.92)	(2.74)
Age_{it}	0.021**	0.001	0.010*
	(2.56)	(0.21)	(1.68)
Observations	364,868	364,868	364,868
Firms	83,700	83,700	83,700
Sargan	0.044	0.010	0.017
m1(p-value)	0.000	0.000	0.000
m3 (p-value)	0.002	0.018	0.072

Notes: All specifications are estimated using a system GMM estimator. The variable FD_t indicates in turn private bank to GDP (column 1), deposit money bank assets to GDP (column 2) and private bank credit by deposit money banks and other financial institutions to GDP (column 3). The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors (except age) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 12 in column 1, 19 in column 2 and 12 in column 3. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Overall, these empirical findings suggest that a more developed and liquid banking system mitigates the need of firms to sell their stock on credit. This offers support to the conjecture which is developed in sub-section 4.4.6. In a more developed banking system firms prefer not to sell as much of their stock on credit since they are able to cover the costs of storing goods through external finance. A more developed banking system stimulates new firm formation and helps small firms to expand by giving them access to external finance (Beck et al., 2010a). This is a novel result which expands the finding of Bougheas et al. (2009) and highlights the role of financial institutions in the euro area.

It is worth emphasizing that the coefficient of the financial development variable is positive and statistically significant across the three different columns. These findings are in line with the previous literature which shows that trade credit extended is a complement to a country's financial institutional development (Demirgüç-Kunt and Maksimovic, 2002; Cassia and Vismara, 2009).

Finally, Table 4.10 shows that financial development has no impact on the trade-off

between inventories and trade credit taken. Once more there is no inventory management motive when trade credit taken is considered.

Table 4.10: Trade credit taken and financial development

	FD= Private bank (1)	FD= Bank assets (2)	FD= Private bank & other (3)
$Stock_{it}$	-0.961	0.757	-0.147
	(-1.28)	(0.94)	(-0.54)
$Stock_{it}$*FD_t	0.659	-0.777	0.144
	(1.11)	(-0.90)	(0.65)
FD_t	-0.043	0.062	0.057
	(-0.40)	(0.29)	(0.73)
$Profit_{it}$	0.203	-0.115	0.317
	(0.88)	(-0.43)	(1.27)
Liq_{it}	0.454*	-0.180	0.166***
	(1.83)	(-1.11)	(2.66)
$Loans_{it}$	-0.215	0.089	-0.310***
	(-1.62)	(1.26)	(-4.04)
$Coll_{it}$	-0.132	-0.125	-0.062
	(-0.90)	(-1.27)	(-0.82)
$Size_{it}$	-0.001	-0.001	-0.001
	(-0.08)	(-0.20)	(-0.17)
Age_{it}	-0.010	-0.023***	-0.020***
	(-1.12)	(-4.63)	(-5.25)
Observations	348,138	348,138	348,138
Firms	75,891	75,891	75,891
Sargan	0.275	0.141	0.074
m1(p-value)	0.000	0.000	0.000
m3 (p-value)	0.066	0.302	0.720

Notes: All specifications are estimated using a system GMM estimator. The variable FD_t indicates in turn private bank to GDP (column 1), deposit money bank assets to GDP (column 2) and private bank credit by deposit money banks and other financial institutions to GDP (column 3). The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors (except age) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 9 in column 1, 9 in column 2 and 8 in column 3. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

4.7.7 Trade credit and financial development by sector

As a first robustness check, in Chapter 4 it is tested whether the effect of financial development on the inventory management motive is linked with the characteristics of the inputs purchased. Equation (4.2) and equation (4.3) are re-estimated and the sample of firms is split into those producing differentiated and standardized products. Table 4.11 and Table 4.12 show the results.

Table 4.11 demonstrates that once the sample of firms is divided into differentiated and standardized industries, the inverse relation between the volume of stock of inventories and the amount sold on credit remains only significant for firms producing differentiated goods. More importantly, when considering the impact of financial development, the

trade-off between inventories and trade-credit extended is smaller and only significant in the differentiated sector. These results provide evidence that the characteristics of the goods not only affect the extension of trade credit as it is provided by Giannetti et al. (2011) but also the sensitivity of trade credit extension to financial development.

Finally, empirical findings in Table 4.12 demonstrate once more that the trade-off between inventories and trade credit taken is not significant even when considering the natured of the transacted good.

Table 4.11: Trade credit extended, financial development and product characteristic

	FD= Private bank (1)		FD= Bank assets (2)		FD= Private bank &other (3)	
	Diff.	Stand.	Diff.	Stand.	Diff.	Stand.
$Stock_{it}$	-0.603**	-0.194*	-0.192**	-0.289***	-0.175*	-0.430***
	(-2.27)	(-1.65)	(-2.00)	(-2.90)	(-1.90)	(-3.37)
$Stock_{it}$*FD_t	-0.170*	-0.068	-0.086***	-0.041**	-0.071**	0.030
	(-1.68)	(-1.59)	(-2.62)	(-2.11)	(-2.27)	(0.73)
FD_t	0.044**	0.048***	0.077***	0.061**	0.029*	0.107***
	(2.22)	(5.85)	(3.19)	(2.05)	(1.77)	(7.49)
$Profit_{it}$	-0.086	-0.595	0.434	0.549	0.653	0.335
	(-0.21)	(-1.24)	(0.60)	(0.92)	(1.09)	(0.62)
Liq_{it}	0.120	0.321**	-0.535**	-0.502**	-0.253	-0.340**
	(0.54)	(2.20)	(-2.28)	(-2.58)	(-1.12)	(-2.39)
$Loans_{it}$	0.005	0.759***	0.740***	0.929***	0.766***	0.050***
	(0.98)	(3.30)	(3.23)	(3.79)	(3.43)	(8.05)
$Coll_{it}$	-0.299*	-0.042	-0.457***	-0.756***	-0.436***	-0.641***
	(-1.71)	(-0.50)	(-3.64)	(-3.93)	(-4.03)	(-7.19)
$Size_{it}$	-0.030	0.002	0.020*	0.043***	0.009	0.023***
	(-1.38)	(0.14)	(1.81)	(5.14)	(0.72)	(2.61)
Age_{it}	0.049**	0.004	0.011	-0.001	0.014	0.010
	(2.23)	(0.41)	(1.24)	(-0.09)	(1.63)	(1.46)
Observations	120,102	244,766	120,102	244,766	120,102	244,766
Firms	27,891	56,038	27,891	56,038	27,891	56,038
Sargan	0.376	0.087	0.139	0.014	0.122	0.322
m1(p-value)	0.000	0.000	0.000	0.000	0.000	0.000
m3 (p-value)	0.377	0.087	0.431	0.004	0.220	0.005

Notes: All specifications are estimated using a system GMM estimator. Diff. denotes firms in the differentiated sectors while Stand. represents firms in the standardized sector. The variable FD_t indicates in turn private bank to GDP (column 1), deposit money bank assets to GDP (column 2) and private bank credit by deposit money banks and other financial institutions to GDP (column 3). The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors (except age) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 11 in column 1, 14 in column 2, 13 in column 3, 12 in column 4, 15 in column 5 and 14 in column 6. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 4.12: Trade credit taken, financial development and product characteristic

	FD= Private bank		FD= Bank assets		FD= Private bank &other	
	Diff.	Stand.	Diff.	Stand.	Diff.	Stand.
	(1)	(2)	(3)	(4)	(5)	(6)
$Stock_{it}$	0.157	-0.095	0.130	0.356	-0.343	-0.518
	(1.46)	(-0.50)	(0.56)	(1.37)	(-1.02)	(-1.41)
$Stock_{it}$*FD_t	-0.016	-0.131	-0.099	-0.259	0.274	0.390
	(-0.19)	(-0.94)	(-0.37)	(-0.74)	(1.04)	(1.31)
FD_t	-0.006	-0.002	0.024	0.100	-0.026	0.074
	(-0.38)	(-0.09)	(0.34)	(1.24)	(-0.26)	(0.94)
$Profit_{it}$	-0.381	-0.558	-0.071	-0.963	0.421	-0.212
	(-0.81)	(-1.09)	(-0.38)	(-1.56)	(1.07)	(-0.73)
Liq_{it}	0.444***	0.713***	0.122	0.268	0.292***	0.277***
	(2.66)	(2.67)	(1.47)	(1.25)	(4.63)	(3.84)
$Loans_{it}$	0.001	-0.384**	0.126*	0.436	-0.045	-0.186**
	(0.01)	(-2.50)	(1.68)	(1.55)	(-0.36)	(-2.04)
$Coll_{it}$	0.057	-0.399***	0.027	0.027	-0.030	-0.020
	(0.40)	(-3.19)	(1.05)	(0.56)	(-0.28)	(-0.24)
$Size_{it}$	-0.008	0.012	0.006	0.002	0.004	0.014**
	(-0.80)	(1.14)	(1.00)	(0.10)	(0.45)	(2.46)
Age_{it}	-0.029***	-0.012	-0.032***	-0.031***	-0.024***	-0.027***
	(-3.17)	(-1.46)	(-7.86)	(-2.78)	(-3.70)	(-8.58)
Observations	115,146	232,992	115,146	232,992	115,146	232,992
Firms	25,550	50,566	25,550	50,566	25,550	50,566
Sargan	0.017	0.266	0.076	0.011	0.037	0.092
m1(p-value)	0.000	0.000	0.000	0.000	0.000	0.000
m3 (p-value)	0.415	0.027	0.855	0.034	0.942	0.843

Notes: All specifications are estimated using a system GMM estimator. Diff. denotes firms in the differentiated sectors while stand. represents firms in the standardized sector. The variable FD_t indicates in turn private bank to GDP, deposit money bank assets to GDP and private bank credit by deposit money banks and other financial institutions to GDP. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors (except age) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 15 in column 1, 9 in column 2, 14 in column 3, 4 in column 4, 12 in column 5 and 14 in column 6. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation.See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

4.7.8 SMEs vs non-SMEs

Chapter 4 takes into account also whether SMEs and non-SMEs respond differently to the trade-off between inventories and trade credit. The estimates for trade credit extended and taken are reported in Table 4.13 Table 4.14. provides the results for trade credit separating the sample of firms by differentiated and standardized sectors.

In table 4.13, the relation between trade credit extended and inventories is negative and statistically significant for SMEs and non-SMEs. The effect is stronger for SMEs. The findings suggest that SMEs suffer from higher levels of information asymmetry and have higher holding costs of storing goods than non-SMEs.

Once more that there is no statistically significant effect of stock of inventories on trade credit taken when the sample is split into SMEs and non-SMEs (column 2).

Finally, column 1 of Table 4.14 provides evidence that the trade-off between stock of

inventories and trade credit extended is only significant for SMEs and non-SMEs in the differentiated sector. The effect is found to be higher for SMEs. This finding is robust to the theoretical assumption that in a differentiated sector products are more specific and the seller-buyer relation is closer(Cuñat, 2007; Giannetti et al., 2011). The inverse relation between trade credit taken and inventories remains statistically insignificant which is in line with the expectations (column 2).

Table 4.13: Baseline models for SMEs and non-SMEs

	TD	TC
	(1)	(2)
$Stock_{it}$*$SMEs_{it}$	-0.506***	-0.027
	(-3.76)	(-0.33)
$Stock_{it}$* (1-$SMEs_{it}$)	-0.293***	-0.067
	(-3.16)	(-0.80)
$Profit_{it}$	-0.068	0.242
	(-0.23)	(1.44)
Liq_{it}	-0.015	0.307
	(-0.08)	(1.60)
$Loans_{it}$	0.562***	-0.193**
	(8.42)	(-2.25)
$Coll_{it}$	-0.341***	-0.060
	(-4.79)	(-1.10)
$Size_{it}$	0.019***	-0.007
	(3.14)	(-1.10)
Age_{it}	0.008	-0.016***
	(1.58)	(-2.76)
Observations	364,868	348,138
Firms	83,700	75,891
Sargan	0.595	0.136
m1(p-value)	0.000	0.000
m3 (p-value)	0.166	0.169
F-test of equality (p-value)		
Investment SMEs vs non SMEs	0.001	0.325

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 12 in column 1 and 11 in column 2.. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 4.14: SMEs and non-SMEs and product characteristics

	TD (1)	TC (2)
$Stock_{it}$*$SMEs_{it}$*$Diff_i$	-0.379***	-0.084
	(-2.63)	(-0.80)
$Stock_{it}$*$SMEs_{it}$*(1-$Diff_i$)	-0.047	-0.041
	(-0.30)	(-0.48)
$Stock_{it}$*(1-$SMEs_{it}$)*$Diff_i$	-0.196**	-0.101
	(-2.35)	(-1.21)
$Stock_{it}$*(1-$SMEs_{it}$)*(1-$Diff_i$)	-0.063	-0.091
	(-0.84)	(-1.01)
$Profit_{it}$	0.216	0.169
	(0.80)	(1.02)
Liq_{it}	-0.119	0.369*
	(-0.88)	(1.93)
$Loans_{it}$	0.405***	-0.120
	(5.34)	(-1.35)
$Coll_{it}$	-0.306***	-0.054
	(-5.10)	(-0.98)
$Size_{it}$	-0.008	-0.008
	(-0.62)	(-1.22)
Age_{it}	0.015**	-0.015***
	(2.17)	(-2.63)
Observations	364,868	348,138
Firms	83,700	75,891
Sargan	0.461	0.071
m1(p-value)	0.000	0.000
m3 (p-value)	0.129	0.132
F-test of equality (p-value)		
Stock SMEs Diff vs non-SMEs Diff	0.066	0.760
Stock SMEs Non-Diff vs non-SMEs non-diff	0.075	0.592
Stock non-SMEs Diff vs non-SMEs non-diff	0.021	0.922
Stock SMEs Diff vs SMEs non-diff	0.070	0.807

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 13 in column 1 and 15 in column 2.. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

4.7.9 Alternative cut-off points

In the main empirical results, the 50th percentile is used as a cut-off value for small and large firms. To ensure that the results are not driven by the way the sample is divided , in Chapter 4 it is also employed the 75th percentile as an alternative cut-off point. Small firms are classified as those whose total assets are below the median of the distribution of the assets of all the firms in a particular country, year and industry, and 0 otherwise. The models which are defined in sub-section 4.4.3 and sub-section 4.4.4 are re-estimated based on this criteria. Results are reported in Table 4.15 and 4.16.

Empirical findings are robust to the the previous results. Starting with Table 4.15, it is clear that smaller firms have a higher sensitivity to the stock of inventories than their larger counterparts. The inverse relation between stock of inventories and the amount sold on credit is higher for smaller firms. The coefficient on the stock of inventories variable

remains insignificant when trade credit taken is considered.

Table 4.15: The effec of firm size (alternative cut-off point)

	TD (1)	TC (2)
$Stock_{it}$*$Small_{it}$	-0.213***	-0.016
	(-3.51)	(-0.19)
$Stock_{it}$*(1-$Small_{it}$)	-0.112*	0.025
	(-1.69)	(0.29)
$Profit_{it}$	0.641	-0.095
	(1.03)	(-0.52)
Liq_{it}	-0.585***	-0.006
	(-4.14)	(-0.06)
$Loans_{it}$	0.446***	0.250
	(5.38)	(1.43)
$Coll_{it}$	-0.416***	-0.011
	(-6.67)	(-0.21)
$Size_{it}$	-0.003	-0.003
	(-0.24)	(-0.43)
Age_{it}	0.015***	-0.022***
	(2.68)	(-4.03)
Observations	364,868	348,138
Firms	83,700	75,891
Sargan	0.031	0.846
m1(p-value)	0.000	0.000
m3 (p-value)	0.061	0.237
F-test of equality (p-value)		
Stock inventories large vs small	0.077	0.846

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 15 in column 1 and 14 in column 2. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Turning to Table 4.16, column 1 demonstrates that the inventory management motive remains statistically significant for firms in the differentiated sector and for smaller firms in the standardized industries. The trade-off effect is higher for smaller firms which produce differentiated products. Finally, for all type of firms the inverse relation between stocks of inventories and trade credit taken remains statistically insignificant. Overall, the results provide evidence that the main empirical findings are robust to different cut-off values.

Table 4.16: Firm size and product characteristics (alternative cut-off point)

	TD (1)	TC (2)
$Stock_{it}$*$Small_{it}$*$Diff_i$	-0.732***	-0.237
	(-3.37)	(-1.07)
$Stock_{it}$*$Small_{it}$*(1-$Diff_i$)	-0.209*	0.108
	(-1.76)	(1.01)
$Stock_{it}$*(1- $Small_{it}$)*$Diff_i$	-0.300**	-0.152
	(-2.41)	(-1.09)
$Stock_{it}$*(1- $Small_i$)*(1-$Diff_i$)	-0.174	0.025
	(-1.52)	(0.12)
$Profit_{it}$	0.298	-0.150
	(0.41)	(-0.46)
Liq_{it}	-0.944***	0.142***
	(-5.14)	(2.59)
$Loans_{it}$	0.439***	-0.433***
	(4.63)	(-4.23)
$Coll_{it}$	-0.496***	-0.080
	(-6.56)	(-1.47)
$Size_{it}$	0.003	0.009
	(0.17)	(0.72)
Age_{it}	0.018**	-0.023***
	(2.48)	(-4.98)
Observations	364,868	348,138
Firms	83,700	75,891
Sargan	0.277	
m1(p-value)	0.000	0.000
m3 (p-value)	0.195	0.712
F-test of equality (p-value)		
Stock small diff vs non-small diff	0.029	0.711
Stock small diff vs small non-diff	0.023	0.138
Stock small non-diff vs stock non-small non-diff	0.778	0.635
Stock non-small diff vs stock non-small non-diff	0.227	0.403

Notes: All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 14 in column 1 and 6 in column 2.. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

4.8 Concluding remarks

The literature on trade credit and inventories has mainly considered the response of accounts receivables and accounts payables to changes in the cost of inventories and other firms' balance sheet variables. Trade credit can be considered as a substitute and/or a complement to other sources of external finance (Love and Zaidi, 2010; Casey and O'Toole, 2014). Bougheas et al. (2009) also refer that there is an inventory management motive for suppliers to extend trade credit to their financially constrained customers. The former prefers to increase their sales rather than accumulate costly inventories stocks. Recently, Giannetti et al. (2011) also link the relation between trade credit and bank loans to the characteristics of the goods transacted.

In Chapter 4 it is examined for the first time the trade-off between inventories and trade credit (extended and taken) for a sample of 12 euro area countries in the differentiated and

standardized sectors. In other words, this chapter accounts toghether for the assumptions of Bougheas et al. (2009) and Giannetti et al. (2011). Furthermore, the investigation in Chapter 4 also takes a different approach. It tests for the first time, the role of the financial crisis and banking development on the inventory management motive for a comparable multi-country data.

The empirical findings are based on firm-level data over the period 2003-2011. They provide evidence of a trade-off between inventories and trade credit extended. The inverse relation between the volume of stocks of inventories and the amount sold on credit is higher for smaller firms which produce differentiated products. This is in line with the previous literature (Giannetti et al., 2011; Guariglia and Mateut, 2016). Furthermore, the inventory management motive is found to be stronger during the recent turmoil period when comparing with the more tranquil periods. During this period, firms' face higher uncertain demand for their products. They are more likely to provide credit to their customers to increase their sales and to avoid holding costly stock of inventories. When considering the effect of banking development, empirical findings demonstrate that larger and liquid banking systems reduce the inverse relation between the volume of stocks of inventories and the amount sold on credit. These abovementioned empirical findings remain the same when the lag of the dependent variable is included in the main specification models.[90]

In line with the study of Bougheas et al. (2009) results show no trade-off between inventories and trade credit taken. Overall, the findings of Chapter 4 show that to fully explain the extension of trade credit, the inventory management motive needs to be complemented by the monetary policy transmission and the financial development theories.

[90] Appendix C, sub-section C.7 provide the results for the main empirical models of Chapter 4 when considering a dynamic specification.

5 Chapter 5: Conclusion

5.1 Contribution

The scope of this thesis is to investigate the firm-level behaviour in the euro area economy during the 2003-2011 period. The main focus is on three aspects of firms' financial behaviour: firm-level employment and financial pressure (Chapter 2), cash holdings' differences among private and public firms (Chapter 3) and the relation between trade credit and firms' stock of inventories (Chapter 4). All the aforementioned chapters use a system GMM estimator. This chapter (Chapter 5) provides the overall conclusion of the thesis with an emphasis on the main contributions to the literature, potential limitations and future research extensions.

The first empirical chapter (Chapter 2) is motivated by the literature on financial constraints, employment level and the financial crisis. The chapter makes three main contributions. Firstly, it explores empirically the relation between financial pressure on firms' employment decisions by differentiating the impact of interest burden on employment for non-crisis and crisis periods. The empirical findings provide evidence that employment is more sensitive to the changes of firms' servicing debt during the turmoil period. This is also a significant result which demonstrates the role of debt-servicing costs on the workforce level of firms in the euro area, especially during the recent financial crisis.

Moreover, Chapter 2 also explores the differential effect of interest burden on employment for periphery and non-periphery countries during and outside crisis periods. Countries at the periphery of the eurozone are considered as weaker countries (Arghyrou and Kontonikas, 2012). The results show that financial pressure exerts a more significant impact on employment decisions in the periphery of the euro area during the crisis. Furthermore, this chapter exploits firm-level heterogeneity and classifies firms into financially constrained and unconstrained using three different criteria. Empirical findings show that only within the periphery group, the sensitivity of employment to financial pressure is stronger for financially fragile firms.

The second empirical chapter (Chapter 3) links the literature on cash holdings with financial constraints. Specifically, the purpose of this chapter is to provide for the first time a systematic analysis on the cash holdings differences of private and public firms in which 90% are not listed in the stock market. This allows me to contribute to the on-going debate on the role of financial constraints on firms' real activities. Contrary to previous studies, this chapter shows that private firms hold more cash than their public counterparts. This is in line with the precautionary motive and the notion that firms which suffer from higher levels of financial constraints (i.e. restricted access to external markets) should hoard more cash. This is an important result which highlights the role of

small firms in the euro area.

In addition, Chapter 3 adds value to the literature by considering the role of financial pressure (in form of the coverage ratio). Specifically, it is explored the extent to which financial pressure has an impact on the relative cash holdings' differences across private and public firms. Acharya et al. (2012) highlights the role of financial pressure on cash holdings. This chapter goes one step further and explores this relation for the cash holdings' differences across private and public firms. After taking into account the financial pressure measure, empirical findings show that the differences in cash holdings of private and public firms is of a U-shaped. Finally, the third contribution of this chapter is to test if both type of firms follow a target cash levels and if so whether they achieve it at the same speed. The findings denote that both firms follow a target cash level and that private firms are slower to achieve it than their public counterparts. Overall, these results extend those of private and public firms. They demonstrate the behaviour of relatively small firms' cash holdings.

The third and last empirical chapter of this thesis (Chapter 4) is mainly concentrated on the literature of trade credit and inventories. The first contribution of Chapter 4 is to explore the role of stock of inventories on trade credit extended and taken taking into account the type of goods which are transacted and the role of financial constraints. The results indicate that firms reduce their stock of inventories by selling on credit, especially in the differentiated industries and for financially constrained (i.e. small) firms.

Furthermore, Chapter 4 evaluates for the first time the effect of the recent financial crisis on the trade-off between inventories and trade credit. This chapter investigates the differences in the inventory management motive for crisis and non-crisis periods. Empirical findings indicate that the inverse relation between stock of inventories and trade credit extended is higher during the turmoil period than outside. Chapter 4 also contributes the literature on trade credit, inventories and financial development. It is also tested the impact of financial development (i.e. banking development) on the trade-off between inventories and trade credit extended. The results show that financial development reduces the inverse relation between the volume of stock of inventories and the amount which is sold on credit. This is an important result which highlights that a more developed and liquid banking system mitigates the need of firms to sell their stock on credit. Finally, inventory stocks do not exert any significant effect on trade credit taken for any of the consider aforementioned hypothesis.

5.2 Implications of research

This sub-section accounts for possible policy implications of each of the aforementioned empirical chapters. The first empirical chapter (Chapter 2) considers the role of firm-specific interest payments (i.e. interest burden) in determining firms' employment. The

results show that there is a strong negative link between interest burden and firms' employment, especially for financially constrained firms in the periphery region during the crisis. To be specific, the results suggest that higher levels of interest payments, especially during the turmoil period exert a crucial role in the propagation of the crisis. The chapter also shows that financially constrained firms are those with more difficulties in accessing external markets due to the higher cost of finance, especially during the turmoil period. Hence, policy initiatives should be developed with the aim of increasing credit availability and relaxing the financial constraints which smaller firms at the periphery face. This should help the euro area authorities to recover the economy of the euro area while improving the shortage of credit and avoid job cuts for financially constrained firms.

The second empirical chapter (Chapter 3) first investigates the cash holdings' differences of private and public firms. The results confirm that private firms hold more cash than their public counterparts which contradict the recent studies on this issue (Akguc and Choi, 2013; Gao et al., 2013). One important aspect is that for the previous studies private and public firms are relatively large, since the former can actually issue public debt. Thus, the argument behind this chapter is that the relatively small size of firms in the sample explain the differences in the results. Next, Chapter 3 focuses on the cash holdings' differences of private and public firms for different levels of financial pressure. When considering this effect, results indicate that the cash holdings' differential decreases (increases) for higher (lower) levels of financial pressure. Finally, private firms adjust slower to their target cash levels than their public counterparts. From a policy perspective, the results suggest that the cash build-up is a pervasive issue across all firms, especially small ones. However, it also highlights the difficulties in accessing external markets for small firms. Since small firms are the drivers of the euro area economy that means that policymakers, economists and business experts should take the behaviour of relatively small firms into account.

The last empirical chapter (Chapter 4) explores the role of stock of inventories on trade credit (extended and taken). The results provide evidence that firms prefer to sell their stock on credit rather than accumulate them. In other words, there is an inverse relation between firms' stock of inventories and trade credit which is consistent with the inventory management motive of Bougheas et al. (2009). Further, it is tested whether the nature of the transacted goods and firms' size have an effect on the trade-off between inventories and trade credit. Empirical findings emphasis that the provision of trade credit is higher for small firms in the differentiated sectors. The results imply that to fully comprehend the use of trade credit as an alternative source of finance, policy makers need to be informed about firms' inventories, size and industry location. On the other hand, in the last empirical chapter it is also considered the impact of the financial crisis and the financial development on the trade-off between inventories and trade credit. The inventory management motive

is more pronounced during the financial crisis and the effect is reduced when development of the banking system is considered. The results imply that the existence of the trade credit channel through the inventory management motive weakens the influence of adverse shocks (such as the crisis). This type of short-term financing is mainly provided when the banking system is not able to do so. Hence, this is of particular importance for policy makers since this type of finance can help financially constrained firms to avoid shortage of credit and perform their day-to-day business operations.

5.3 Prospects of future research

This thesis sheds light on the behaviour of firms in the euro area by presenting novel empirical findings on firms' employment, cash holdings and trade credit. However, it is still possible to further strengthen the empirical evidence following this thesis.

The second chapter studies the relation between firm-specific interest burden and the level of employment focusing on the recent financial crisis and periphery/non-periphery countries. For possible future extension of this research it would be interesting to increase the time span of the dataset by including firm-level information until 2014. This corresponds to the total period of the sovereign debt crisis (2010-2012) and the implementation of non-conventional monetary policy, i.e. the Outright Monetary Transactions (OMT) program (2012-2014).

The third chapter analysis the cash holdings' differences of private and public firms in the euro area. Future work could test whether these results hold for private and public firms in transition economies in Europe. Nevertheless, it would also be interesting to further examine the role of financial development on private and public firms' cash holdings decisions. Finally, the fourth chapter tests the relation between stock of inventories and trade credit extended, while controlling for the goods transacted, the recent financial crisis and the development of the banking system. Future studies could explore how the trade-off between inventories and trade credit (extended and taken) is affected by the characteristics of the traded goods across crisis and non-crisis periods. In addition, this chapter also accounts for the role of financial constraints in the form of firm size. It would also be enlightening to consider other measures of firm-level heterogeneity distinguishing for example between private and public firms, young and old. Finally, this thesis has mainly explored the behaviour of manufacturing firms. It would be also worthwhile to extend the analysis to other sectors of the economy.

Appendices

A Appendix A Chapter 2

A.1 Firms' definition according to Amadeus database

Table A.1: Definition of firms' according to Amadeus

Firms size categories	Conditions
Very large size	Operating revenue >= 100€ million; Total assets >= 200€ million Employees >= 1000 Listed
Large size	Operating revenue >= 10€ million Total assets >= 20€ million Employees >= 150 Not very large
Medium size	Operating revenue >= 1€ million Total assets >= 2€ million Employees >= 15 Not very large or Large
Small size	All the firms which are not included in the abovementioned categories are considered small

Notes: Table A.1 describes the criteria which is used in Amadeus database to define firms' size. All the firms should match at least one of the conditions which are described above.

A.2 Definition of the variables

Table A.2: Variables definition

Variable	Definition
n_{it}	Logarithm of number of employees.
IB_{it}	Ratio of interest payments to cash flow.
w_{it}	Employment costs divided by number of employees and deflated by the GDP deflator.
Δw_{it}	Log difference of wage.
δ_{it}	Log difference of real sales (total sales divided by the GDP deflator).
k_{it}	Logarithm of fixed assets minus depreciation and working capital less provisions.
$Crisis_t$	Dummy variable equal to 1 over the period 2007-2009, and 0 otherwise.
$Periphery_i$	Dummy variable equal to 1 if the firm is operating in periphery economies (i.e. Ireland, Italy, Portugal and Spain) and 0 otherwise.
$Constrained_{it}$	Dummy variable equal to 1 if the firm is private and exhibits BankDep (size) at the top (bottom 50% of the distribution of all firms, 0 otherwise.
$Cflow_{it}$	Ratio of cash-flow to capital stock.
Liq_{it}	Ratio of cash and equivalent to capital stock.
$Netdebt_{it}$	Ratio of liabilities plus long-term debt minus cash and equivalent to capital stock.
$Bondy_{it}$	10-year government bond yield.
$Unem_t$	Ratio of total sales to number of employees.
$Credit_t$	Dummy variable equal to 1 over the period 2008-2009, and 0 otherwise.
$Debt_t$	Dummy variable equal to 1 over the period 2010-2011, and 0 otherwise.
$Crisis_t^n$	Dummy variable equal to 1 over the period 2008-2009, and 0 otherwise.
IB_{it}^d	Ratio of interest payments to 3-year moving average of total debt.

Notes: Table A.2 provides the definitions for all the variables which are employed in this chapter.

A.3 Number of firms per country

Table A.3: Number of firms (per country)

Countres	Number of firms
Austria	3,678
Belgium	3,964
Finland	2,626
France	22,820
Germany	35,081
Ireland	830
Italy	49,433
Luxembourg	151
Netherlands	5,343
Portugal	5,617
Spain	20,715
Total	150,258

Notes: Table A.3 presents the number of firms per country during the sample period.

A.4 Structure of the unbalanced panel by country

Table A.4: Number of observations (per country)

Number of observations	Countries										
	Austria (1)	Belgium (2)	Finland (3)	France (4)	Germany (11)	Ireland (5)	Italy (6)	Luxembourg (7)	Netherlands (8)	Portugal (9)	Spain (10)
3	630	363	423	2,349	6,585	78	7,935	15	711	894	2,184
4	1,420	448	584	3,640	11,556	140	12,020	40	1,108	1,340	3,484
5	4,075	615	750	5,130	48,380	150	15,660	140	1,665	2,060	6,020
6	6,708	858	954	8,964	73,962	426	24,036	144	2,628	3,828	13,278
7	6,587	1,463	1,666	20,006	33,376	1,141	49,336	168	4,739	9,331	27,160
8	1,792	67,92	3,848	40,472	20,160	2,856	108,504	472	15,184	7,176	76,248
9	135	21,663	11,799	96,210	6,354	1,332	144,396	9	13,347	15,336	20,592
Total	21,347	32,202	20,024	176,771	200,373	6,123	36,1887	988	39,382	39,965	148,966

Notes: Table A.4 contains the number of observations per country for the sample period between 2003 and 2011.

A.5 Structure of the unbalanced panel per year

Table A.5: Structure of the panel (per year)

Year	Freq.	Percent	Cumulative
2003	82,765	7.90	7.90
2004	96,091	9.17	17.07
2005	114,803	10.95	28.02
2006	130,650	12.47	40.49
2007	136,143	12.99	53.48
2008	139,905	13.35	66.83
2009	140,158	13.37	80.20
2010	135,715	12.95	93.15
2011	71,798	6.85	100.00
Total	1,048,028	100.00	

Notes: Table A.5 reports the number of observations, percentage and cumulative values per year.

A.6 Structure of the unbalanced panel according to the number of observations

Table A.6: Structure of the panel (number of observations)

Observations	Frequencies	Percent	Cumulative
3	22,167	2.12	2.12
4	35,780	3.41	5.53
5	84,645	8.08	13.61
6	135,973	12.96	26.56
7	154,973	14.79	41.35
8	283,504	27.05	68.40
9	331,173	31.60	100.00
Total	1,048,028	100.00	

Notes: Table A.6 describes the number of observations in the sample.

B Appendix B Chapter 3

B.1 Definition of the variables

Table B.1: Variables definition

Variables	Definition
Cash_{it}	Ratio of cash and equivalents to total assets.
Size_{it}	Log of total assets.
Cflow_{it}	Ratio of cash flow to total assets.
CFV_{it}	Standard deviation of industry-median adjusted yearly cash flow. over the previous 3 years.
Sgrowth_{it}	Change in total sales.
Lev_{it}	Total debt scaled by total assets.
NWC_{it}	Difference between current assets and current liabilities. excluding cash scaled by total assets.
CAPEX_{it}	Change in fixed assets plus depreciation normalised by total assets.
Age_{it}	The difference between the present year and firms' date of incorporation.
Private_{t}	1 if firm is private, 0 otherwise.
$\text{Coverage ratio}_{it}$	Cash flow divided by interest payments.
ΔNWC_{it}	Change in the difference between current assets and current liabilities. excluding cash scaled by total assets.
ΔCash_{it}	Change in the log of cash and equivalents to total assets
ΔStdebt_{it}	Change in short-term debt to total assets
Crisis_{t}	Dummy variable equal to 1 over the period 2007-2009, and 0 otherwise.
Dummy_{it}	Dummy variable equal to 1 if the firm' total assets are at the bottom 75% of the distribution of all firms, and 0 otherwise.

Notes: Table B.1 presents a summary of the main variables which are implemented in Chapter 3.

B.2 Number of firms per country

Table B.2: Number of firms (per country)

Countries	Number of firms
Austria	2,693
Belgium	3,078
France	19,185
Germany	28,405
Greece	1,582
Italy	40,790
Luxembourg	123
Netherlands	5,223
Portugal	4,646
Spain	15,071
Total	120,796

Table B.2 describes the total number of firms per country during the 2003-2011 period.

B.3 Structure of the unbalanced panel by country

Table B.3: Number of observations (per country)

Number of observations	Austria	Belgium	France	Germany	Greece	Italy	Luxembourg	Netherlands	Portugal	Spain
(1)	(2)	(3)	(4)	(6)	(5)	(7)	(8)	(9)	(10)	(11)
3	804	330	2,211	6,933	192	6,363	15	867	486	1,629
4	1,760	528	3,540	14,516	316	9,212	64	1,311	828	2,648
5	3,735	780	5,725	45,255	385	12,510	80	1,780	1,475	4,780
6	4,632	1,242	9,642	50,412	540	19,128	156	3,117	3,222	9,534
7	2,702	2,541	17,899	22,519	896	40,299	189	5,430	8,022	21,819
8	608	5,720	35,928	11,384	2,688	93,584	256	13,785	6,736	52,776
9	36	12,555	69,867	3,348	7,272	118,989	9	11,062	13,113	14,463
Total	14,277	23,696	144,812	154,367	12,289	300,085	769	37,352	33,882	107,649

Notes: Table B.3 describes the number of observations per country.

B.4 Structure of the unbalanced panel by year

Table B.4: Structure of the panel (per year)

year	Frequencies	Percent	Cumulative
(1)	(2)	(3)	(4)
2003	66,725	8.05	8.05
2004	75,597	9.12	17.16
2005	87,131	10.51	27.67
2006	102,677	12.38	40.06
2007	106,780	12.38	52.93
2008	109,228	13.17	66.11
2009	110,501	13.33	79.43
2010	109,776	13.24	92.67
2011	60,763	7.33	100.00
Total	829,178	100.00	

Table B.4 indicates the number of observations, percentage and cumulative values per year.

B.5 Structure of the unbalanced panel according to the number of observations

Table B.5: Structure of the panel (number of observations)

Observations	Frequencies	Percent	Cumulative
(1)	(2)	(3)	(4)
3	19,830	2.39	2.39
4	34,423	4.19	6.58
5	76,505	9.23	15.81
6	101,625	12.26	28.06
7	122,316	14.75	42.81
8	223,316	26.95	69.76
9	250,714	30.24	100.00
Total	829,178	100.00	

Table B.5 shows the minimum and maximum number of observations in the sample, percentage and cumulative values.

B.6 Alternative specification for firms' target cash levels

This subsection of Appendix B considers an alternative specification to the target cash model which is defined in sub-section 3.4.3 of Chapter 3. Following the literature on cash holdings (Gao et al., 2013), a partial adjustment model for firms' target cash level is used. Table B.6 presents the results. Empirical findings are robust to those of Table 3.4. To be specific, The coefficient on the (Cash^*_{it}-Cash_{it-1}) is positive and statistically significant which indicates that both private and public firms adjust to target cash levels. Conversely, the coefficient on the interaction term (Private_t*(Cash^*_{it}-Cash_{it-1})) is negative which denotes that private firms adjust slower to their cash target than their public counterparts.

Table B.6: Alternative specification for target cash levels

	(1)
Private_t	0.015***
	(16.59)
Private_t*(Cash^*_{it}-Cash_{it-1})	-0.020***
	(-6.13)
(Cash^*_{it}-Cash_{it-1})	0.010*
	(1.80)
Observations	327,688
Firms	71,761
Sargan (p-value)	0.467
m1 (p-value)	0.000
m3 (p-value)	0.373

The dependent variable is the change in the cash ratio ($\triangle\text{Cash}_{it}$), Cash^*_{it} is the predicted cash ratio based on column 1 of Table 3.3. All specifications are estimated using a system GMM estimator. The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry and time dummies are included in the specification. Instruments include all regressors (except Private_t and $\ln(\text{Age}_{it})$) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 2. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table B.1 in the Appendix B for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

C Appendix C Chapter 4

C.1 Definition of the variables

Table C.1: Variables definition

Variables	Definition
TD_{it}	Accounts receivables to total sales.
TC_{it}	Accounts payables to total sales.
$Stock_{it}$	Stock of total inventories to total sales.
$Profit_{it}$	Firms operating profits (or loss) divided by total sales.
Liq_{it}	Cash and equivalents to total sales.
$Loans_{it}$	Short-term debt to total sales.
$Coll_{it}$	Tangible assets to total assets.
$Size_{it}$	logarithm of total assets.
Age_{it}	The log difference between the present year and the firms' date of incorporation.
$Diff_i$	Dummy variable equal to 1 if the firm belongs to the differentiated sector, 0 otherwise.
$Small_{it}$	Dummy variable equal to 1 if the firm exhibit size at the bottom 50% of the distribution of all firms, 0 otherwise.
$Crisis_t$	Dummy variable which assumes the value of 1 for the 2007-09 periods and, 0 otherwise.
FD_t	Vector of financial development measures of size and liquidity (private bank credit to GDP; bank assets to GDP; Private bank credit & other institutions to GDP).
$SMEs_{it}$	Dummy variable equal to 1 if the firm is a SME, and 0 otherwise.

Notes: Table C1 presents a summary of the main variables which are implemented in this study.

C.2 Definition of firms' categories-characteristics of the goods

Table C.2: Classification of the goods (SIC codes)

U.S. SIC code	Sectors	Diff
10	Metal mining	0
20	Food and kindred products	0
22	Textile mill products	0
23	Apparel and other finished products made from fabrics and other similar materials	0
24	Lumber and wood products, except furniture	0
25	Furniture and fixtures	1
26	Paper and allied products	0
27	Printing, publishing and allied industries	1
28	Chemicals and allied products	0
29	Petroleum refining and related industries	0
30	Rubber and miscellaneous plastics products	1
31	Leather and leather products	0
32	Stone,clay, glass and concrete products	1
33	Primary metal industries	0
34	Fabricated metal products, except machinery and transportation equipment	1
35	Industrial and commercial machinery and computer equipment	1
36	Electronic and other electrical equipment and components, except computer equipment	1
37	Transportation equipment	1
38	Instruments;photographic, metal and optical goods; watches and clocks	1
39	Miscellaneous manufacturing industries	1

Notes: Table C2 corresponds to the classification of industry groups, distinguishing between differentiated and standardized products in the manufacturing sector based on Amadeus database. This classification follows Giannetti et al. (2011) and it is based on Rauch (1999). Finally, in column 3, the number 1 denotes firms in the differentiated sector whereas 0 indicates firms belonging to the standardized sector.

C.3 Number of firms per country

Table C.3: Number of firms (per country)

Countries	Number of firms
Austria	3,499
Belgium	3,604
Finland	2,267
France	20,874
Germany	33,036
Greece	1,819
Ireland	755
Italy	41,495
Luxembourg	138
Netherlands	5,190
Portugal	5,056
Spain	18,756
Total	136,489

Notes: Table C3 describes the total number of firms per country during the 2003-2011 period.

C.4 Structure of the unbalanced panel per country

Table C.4: Number of observationsl (per country)

Num. of observations (1)	Austria (2)	Belgium (3)	Finland (4)	France (5)	Germany (6)	Greece (7)	Ireland (8)	Italy (9)	Luxembourg (10)	Netherlands (11)	Portugal (12)	Spain (13)
3	999	804	690	5,004	9,573	585	114	15,813	54	885	1,461	4,797
4	2,288	1,288	1,116	7,976	18,020	1,036	272	22,836	104	1,284	2,248	8,180
5	4,645	2,020	1,420	13,120	52,075	1,310	555	30,205	150	2,080	3,270	14,415
6	5,868	2,802	2,010	18,510	59,682	1,566	852	38,316	126	3,042	4,866	20,394
7	3,927	3,801	2,590	24,374	24,157	2,086	1,232	45,605	147	5,320	6,958	24,878
8	960	5,592	2,952	31,976	10,184	2,200	1,264	53,280	168	13,464	5,800	35,248
9	54	8,109	3,690	36,216	2,286	2,421	558	44,217	9	10,872	7,407	7,830
Total	18,741	24,416	14,398	137,176	175,977	11,204	4,847	250,272	758	36,947	32,010	115,724

Table C4 describes the number of observations per country.

C.5 Structure of the unbalanced panel per year

Table C.5: Structure of the panel (per year)

year (1)	Frequencies (2)	Percent (3)	Cumulative (4)
2003	64,779	7.88	7.88
2004	77,094	9.37	17.25
2005	91,042	11.07	28.32
2006	108,519	13.19	41.51
2007	114,343	13.90	55.41
2008	111,208	13.52	68.94
2009	98,761	12.01	80.94
2010	102,358	12.44	93.39
2011	54,384	6.61	100.00
Total	822,488	100.00	

Table C5 indicates the number of observations, percentage and cumulative values per year.

C.6 Structure of the unbalanced panel according to the number of observations

Table C.6: Structure of the panel (number of observations)

Observations (1)	Frequencies (2)	Percent (3)	Cumulative (4)
3	40,799	4.96	4.96
4	66,648	8.10	13.06
5	125,265	15.23	28.29
6	158,034	19.21	47.51
7	145,005	17.63	65.14
8	163,088	19.83	84.96
9	123,669	15.04	100.00
Total	822,488	100.00	

Table C6 shows the minimum and maximum number of observations in the sample, percentage and cumulative values.

C.7 Dynamic models of the main specification models

As a robustness check of the main empirical specifications, it is tested whether by including the lag of the dependent variable trade credit (extended and taken), the results remain robust to the empirical findings which are discussed in subsection 4.7 of Chapter 4. The results sugges that the inverse relation between stock of inventories and trade credit extended remain statistically significant and it is higher for firms which are smaller and produce differentiated products. More importantly, it is clear that the inventory management motive is higher during the turmoil period than outside of it and that the development of the banking system decreases the trade-off between inventories and trade credit extended. Finally, there is no relation between inventories and trade credit taken. Empirical results are provided in the below tables.

Table C.7: Trade credit extended and taken

	TD (1)	TC (2)
Stock_{it}	-0.181***	0.063
	(-2.94)	(1.40)
TD_{it-1}	0.573***	
	(4.05)	
TC_{it-1}		0.782***
		(7.90)
Profit_{it}	0.409*	0.001
	(1.72)	(0.48)
Liq_{it}	-0.291*	0.034*
	(-1.89)	(1.84)
Loans_{it}	0.255***	-0.209**
	(2.76)	(-2.23)
Coll_{it}	-0.178**	-0.009
	(-2.36)	(-0.30)
Size_{it}	0.016***	-0.006
	(3.45)	(-1.32)
Age_{it}	0.002	0.001
	(0.77)	(0.13)
Observations	265,464	246,252
Firms	75,916	67,995
Sargan	0.010	0.207
m1(p-value)	0.000	0.000
m3 (p-value)	0.802	0.248

Notes: All specifications are estimated using a system GMM estimator. $\text{TD}_{it-1}(\text{TC}_{it-1})$ indicates the lag of the trade credit extended (taken).The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors (except age) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 7 in column 1 and 16 in column 2. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table C.8: Firms' product characteristics

	TD	TC
	(1)	(2)
$Stock_{it}$*$Diff_i$	-0.967***	0.137
	(-2.68)	(0.40)
$Stock_{it}$*(1-$Diff_i$)	-0.177	-0.008
	(-0.71)	(-0.05)
TD_{it-1}	0.389*	
	(1.68)	
TC_{it-1}		0.763***
		(6.38)
$Profit_{it}$	-0.385	0.521***
	(-1.22)	(2.59)
Liq_{it}	0.032	-0.218***
	(0.22)	(-2.96)
$Loans_{it}$	0.271**	0.252**
	(2.14)	(2.06)
$Coll_{it}$	-0.162*	-0.040
	(-1.90)	(-0.74)
$Size_{it}$	0.012**	0.002
	(2.16)	(0.52)
Age_{it}	0.007	0.001
	(1.166)	(0.06)
Observations	265,464	246,252
Firms	75,916	67,995
Sargan	0.581	0.002
m1(p-value)	0.000	0.000
m3 (p-value)	0.768	0.685
F-test of equality (p-value)		
Stock diff vs non-diff	0.099	0.747

Notes: All specifications are estimated using a system GMM estimator. TD_{it-1}(TC_{it-1}) indicates the lag of the trade credit extended (taken).The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation, with degrees of freedom for the sargan test equal to 10 in column 1 and 13 in column 2. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table C.9: The effect of firms' size

	TD (1)	TC (2)
$Stock_{it}$*$Small_{it}$	-0.459***	0.023
	(-3.11)	(0.28)
$Stock_{it}$*(1-$Small_{it}$)	-0.116***	0.028
	(-2.24)	(0.66)
TD_{it-1}	0.513***	
	(3.73)	
TC_{it-1}		0.778***
		(8.06)
$Profit_{it}$	0.489***	-0.188
	(2.00)	(-1.52)
Liq_{it}	-0.376**	0.023
	(-2.28)	(0.31)
$Loans_{it}$	0.261***	-0.106
	(2.95)	(-1.20)
$Coll_{it}$	-0.231***	-0.020
	(-2.95)	(-1.52)
$Size_{it}$	0.001	0.008***
	(0.12)	(3.12)
Age_{it}	0.005	0.003
	(1.44)	(0.88)
Observations	265,464	246,252
Firms	75,916	67,995
Sargan	0.020	0.019
m1(p-value)	0.000	0.000
m3 (p-value)	0.827	0.119
F-test of equality (p-value)		
Stock small vs. non-small	0.011	0.937

Notes: All specifications are estimated using a system GMM estimator. TD_{it-1}(TC_{it-1}) indicates the lag of the trade credit extended (taken). The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 15 in column 1 and 16 in column 2. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table C.10: The financial crisis

	TD (1)	TC (2)
$Stock_{it}$*$Crisis_t$	-0.262***	-0.178
	(-3.78)	(-1.59)
$Stock_{it}$*(1-$Crisis_t$)	-0.194***	0.042
	(-2.79)	(0.52)
TD_{it-1}	0.896***	
	(10.04)	
TC_{it-1}		0.773***
		(8.57)
$Profit_{it}$	0.046***	0.018
	(4.26)	(1.58)
Liq_{it}	-0.268	-0.026
	(-1.21)	(-0.93)
$Loans_{it}$	-0.722	-0.226**
	(-1.41)	(-2.42)
$Coll_{it}$	-0.683**	-0.009
	(-2.05)	(-0.29)
$Size_{it}$	0.102***	-0.004
	(5.42)	(-1.01)
Age_{it}	-0.011	0.002
	(-1.62)	(0.66)
Observations	265,464	246,252
Firms	75,916	67,995
Sargan	0.010	0.546
m1(p-value)	0.000	0.000
m3 (p-value)	0.488	0.645
F-test of equality (p-value)		
Stock Crisis vs non-Crisis	0.000	0.004

Notes: All specifications are estimated using a system GMM estimator. TD_{it-1}(TC_{it-1}) indicates the lag of the trade credit extended (taken). $Crisis_t$ refers to the Crisis period between 2007 and 2009.The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors (except age and crisis) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 11 in column 1 and 13 in column 2. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table C.11: Trade credit extended and financial development

	FD= Private bank (1)	FD= Bank assets (2)	FD= Private bank & other (3)
$Stock_{it}$	-0.343*	-0.156***	-0.238***
	(-1.95)	(-5.68)	(-5.07)
TD_{it-1}	0.689***	0.718***	0.726***
	(9.61)	(4.93)	(8.09)
$Stock_{it}$*FD_t	-0.058*	-0.097***	-0.125***
	(-1.69)	(-3.49)	(-8.84)
FD_t	0.029*	0.442***	0.385***
	(1.94)	(8.27)	(3.82)
$Profit_{it}$	-0.043	0.308	0.012*
	(-0.65)	(0.59)	(1.88)
Liq_{it}	0.240**	0.114	-0.114
	(2.49)	(0.54)	(-0.95)
$Loans_{it}$	0.434***	0.571***	0.405***
	(3.98)	(2.96)	(3.57)
$Coll_{it}$	-0.149**	0.011	-0.204***
	(-2.24)	(0.09)	(-2.73)
$Size_{it}$	-0.004	-0.009	0.001
	(-0.91)	(-1.56)	(0.007)
Age_{it}	0.008*	0.006	0.008**
	(2.55)	(0.95)	(2.22)
Observations	265,464	265,464	265,464
Firms	75,916	75,916	75,916
Sargan	0.005	0.359	0.001
m1(p-value)	0.000	0.000	0.000
m3 (p-value)	0.478	0.215	0.417

Notes: All specifications are estimated using a system GMM estimator. TD_{it-1}indicates the lag of the trade credit extended. The variable FD_t indicates in turn private bank to GDP (column 1), deposit money bank assets to GDP (column 2) and private bank credit by deposit money banks and other financial institutions to GDP (column 3). The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors (except age) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 15 in column 1, 9 in column 2 and 18 in column 3. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table C.12: Trade credit extended and financial development

	FD= Private bank (1)	FD= Bank assets (2)	FD= Private bank & other (3)
$Stock_{it}$	0.732	0.105	0.306
	(1.33)	(0.20)	(1.06)
TC_{it-1}	0.736***	0.680***	0.798***
	(7.07)	(6.10)	(9.81)
$Stock_{it}$*FD_t	-0.536	-0.092	-0.234
	(-1.29)	(-0.17)	(-1.02)
FD_t	0.134	-0.068	0.068
	(1.62)	(-0.51)	(1.11)
$Profit_{it}$	-0.135	-0.413*	-0.026
	(-0.54)	(-1.71)	(-0.15)
Liq_{it}	-0.042	-0.030	-0.141
	(-0.34)	(-0.24)	(-1.63)
$Loans_{it}$	-0.095	-0.111*	-0.073
	(-1.42)	(-1.90)	(-1.30)
$Coll_{it}$	-0.002	-0.053	-0.039
	(-1.00)	(-1.00)	(-0.78)
$Size_{it}$	-0.012*	-0.004	-0.007
	(-1.88)	(-0.70)	(-1.54)
Age_{it}	0.002	-0.001	-0.011
	(0.62)	(-0.13)	(-0.62)
Observations	246,252	246,252	246,252
Firms	67,995	67,995	67,995
Sargan	0.291	0.093	0.274
m1(p-value)	0.000	0.000	0.000
m3 (p-value)	0.649	0.571	0.561

Notes: All specifications are estimated using a system GMM estimator. TC_{it-1} indicates the lag of the trade credit taken. The variable FD_t indicates in turn private bank to GDP (column 1), deposit money bank assets to GDP (column 2) and private bank credit by deposit money banks and other financial institutions to GDP (column 3). The figures in parentheses report t-statistics that are asymptotically robust to heteroskedasticity. Country, industry, time dummies, and time dummies interacted with industry dummies are included. Instruments include all regressors (except age) lagged three times or more. Sargan is a test of over-identifying restrictions, distributed as chi-square under the null of instrument validity, with degrees of freedom for the sargan test equal to 11 in column 1, 9 in column 2 and 12 in column 3. m1 (m3) is a test for first (third) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. See Table C.1 in the Appendix C for the definitions of the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectivel

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