LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

MASTER IN
FINANCE

MASTER FINAL WORK
DISSERTATION

TANGIBLE AND INTANGIBLE INVESTMENT OF PORTUGUESE FIRMS IN TRADITIONAL SECTORS (2004-2011)

DIANA FILIPA CARREIRA SOUSA

OCTOBER - 2015

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SUPERVISION:

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ABSTRACT

This investigation studies the investment in tangible and intangible assets in Portuguese firms of traditional manufacturing sectors. The empirical analysis uses accounting firm-level panel data covering the period 2004-2011. Several specifications for investment behavior equations are tested and different estimation methodologies are applied (pooled OLS, FE - Fixed Effects and RE - Random Effects). Key results emerge: the recent crisis has a strong and decisive negative influence on tangible and intangible investment; sales expectations, return on assets, gross operating profits and investment/cash flow sensitivities contribute positively to total investment; capital stock and wages show weak effects on total investment; and exports, rather than the total sales, have a positive impact on intangible investment. The analysis by size categories (small, medium and large firms) and subsectors (Food Products, Textiles, Wearing, Footwear, Wood and Furniture) reveal heterogeneous dynamics and explanations for investment behavior.

Key words: *tangible investment, intangible investment, business cycle, real capital, traditional sectors, Portugal*

JEL codes: *E22*; *G31*; *D92*; *L67*

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Acronyms and Abbreviations List

AMECO	Annual Macro-Economic Database [European Commission]
BdP	*Banco de Portugal* [Bank of Portugal]
CAE-Rev.3.	*Classificação Portuguesa das Atividades Económicas, Revisão 3*
CBSD	Central Balance-Sheet Database
CF	Cash Flow
EC	European Commission
ECB	European Central Bank
EU	European Union
Eurostat	Statistical Office of the European Communities
FDI	Foreign Direct Investment
FE	Fixed Effects
GAV_{fc}	Gross Added Value at factor costs
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GMM	Generalized Method of Models
GPO	Gross Profit Operation [*Excedente Bruto de Exploração]*
IAS	International Accounting Standards *[Norma Internacional de Contabilidade]*
ICI	*Inquérito Qualitativo de Conjuntura ao Investimento* [Statistics Portugal]
IES	*Informação Empresarial Simplificada* [Simplified Business Information]
IFRS	International Financial Reporting Standards
IMF	International Monetary Fund
INE	*Instituto Nacional de Estatística* [Statistics Portugal]

IS	Investment Survey [Eurostat]
NACE	Nomenclature generale des Activites economiques dans les Communautes Europeennes [Eurostat]
NCRF	*Norma Contabilística e de Relato Financeiro*
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
p.p	percentage point
POC	*Plano Oficial de Contabilidade*
POLS	Pooled OLS
R&D	Research and Development *[I&D: Investigação e Desenvolvimento]*
RE	Random Effects
ROA	Return On Assets
SAFE	Survey on the Access to Finance of Enterprises
SCIE	*Sistema de Contas Integradas das Empresas* [Integrated Business Accounts System]
SME	Small and Medium Enterprises
SNA	System Nacional Accounts
SNC	*Sistema de Normalização Contabilística*
UK	United Kingdom
UN	United Nations
US	United States
VAB_{cf}	*Valor Acrescentado Bruto a custo de fatores*
WEO	World Economic Outlook

Introduction

For its pro-cyclical aggregate demand, low levels of business investment spoil the future growth of the economies in terms of production and employment (Banerjee, Kearns & Lombardi, 2015). The uncertainty from the instability of the Portuguese economy, the restrictions in financing conditions associated with the indebtedness of companies and the limitations imposed on the foreign demand determine the weak position of investment in Portugal in recent years (BdP, 2012). The real investment of Portuguese companies from 2008 to 2009 had a deep decrease: 9.2% in Gross Fixed Capital Formation (GFCF); and 3.6% in investment in non-financial firms (Eurostat, 2015c). For an understanding of the evolution of investment in recent years, it is relevant to grasp the factors that drive private investment.

This research aims to analyze the factors that explain the investment in tangible and intangible fixed assets in Portuguese companies of the traditional manufacturing sector from 2004 to 2011. It takes advantage of a very rich accounting firm-level database *Sistema de Contas Integradas das Empresas* (SCIE) which includes yearly, about 43,000 observations. The choice of six sectors (Food Products, Textiles Wearing, Footwear, Wood and Furniture[1]) is motivated by their economic relevance and performance. They correspond to a large share in the national production (INE, 2015), more than one third of the turnover in manufacture (37.98% in 2004 and 34.24% in 2011) and about half of the employment in manufacture (52.36% in 2004 and 49.87% in 2011)[2]. Additionally, the six sectors represent about one third of the sales in foreign market (INE, 2015) and despite being classified as "Low-technology" sectors (Eurostat,

[1]Nomenclature general des Activites economiques dans les Communautes Europeennes (NACE), Section C: Manufacturing (10, 13-15, 16, 31). Adapted from *Classificação Portuguesa das Actividades Económicas* (CAE).
The original CAE name are: manufacture of Food Products; manufacture of Textiles; manufacture of Wearing apparel; manufacture of Leather and related products; manufacture of Wood and Cork and manufacture of Furniture.
[2] Own calculations based on microdata SCIE.

2015b) they presented, in Portugal, improved recovery after the crisis shock compared to other European countries (Eurostat, 2013).

In the present dissertation, the focus is on the real investment[3] and the investment in intangible assets receives particular attention in order to shed some light on the innovation in the traditional manufacturing sectors.

Existing models of investment behavior follow diverse economic schools (e.g. Keynesian or Neoclassical) that adopt different types of approach (e.g. macroeconomic or microeconomic; dynamic or static) and the empirical applications use various data sources (e.g. survey data or accounting data). In this dissertation, following the empirical work done in the field, is rooted in the mains theories about the behavior of business investment: the *accelerator model*; the *neoclassical model*; the *Q-Tobin*; and the *Euler Equation*. Two surveys of reference published in the Journal of Economic Literature are Chirinko (1993) and Jorgenson (1971).

The *Keynesian accelerator model* establishes a linear relation between the current net investment and the expected changes in output based on demand evolution (Barkbu, Berkmen, Lukyantsau, Saksonovs & Schoelermann, 2015; Clark, Greenspan, Goldfeld & Clark, 1979; Fazzari, Hubbard & Petersen, 1988; Jorgenson, 1971; Oliner, Rudebusch & Sichel, 1995; Von Kalckreuth, 2001)

The *Neoclassical model* focuses on the response of firms to change in relative prices of the productive factors based on a production function that establishes the relation between the capital stock and the output (Barkbu et al., 2015; Bond & Van Reenen, 2007; Chirinko, 1993; Clark et al., 1979; Fazzari et al., 1988; Jorgenson, 1967; Jorgenson & Handel, 1971; Oliner et al., 1995).

[3] Given the study focus and the data availability, two specific steam of the investment literature: the investment on financial assets (Chen, 1991) and the Foreign Direct Investment (FDI) (Barbosa, Guimarães & Woodward, 2004; Blonigen, 1997) are beyond the scope of this research.

The *Q-Tobin* theory (Barkbu et al., 2015; Bond & Van Reenen, 2007; Chirinko, 1993; Clark et al., 1979; Fazzari et al., 1988; Oliner et al., 1995) and the *Euler Equation* (Barkbu et al., 2015; Bond & Van Reenen, 2007; Bond, Elston, Mairesse & Mulkay, 2003; Chirinko, 1993; Clark et al., 1979; Janz, 1997; Oliner et al., 1995) relate to the volatility and the instability that the investment has over time in financial markets. These two theories are not subject to specific empirical analysis in this dissertation because the main database used (SCIE) does not include any information on the cost of capital and the value of the company in the financial market.

The previous studies about the explanatory factors for real investment in Portugal indicate that they are: the size of the company; the growth of sales company; the macroeconomic context; the share of sales in the external market; and the financial situation of the company (Barbosa, Lacerda & Ribeiro, 2007; Barkbu et al., 2015; Farinha & Prego, 2013; Pina & Abreu, 2012).

This dissertation, using panel data analysis, tests several financial and economic variables to explain global business real investment and also by categories of investment (tangible and intangible), by sectors of activity and by firm size[4]. The Return On Assets (ROA), the Cash Flow (CF), the stock of capital, sales expectations, sales in the external markets, Research & Development (R&D) intensity and the crisis are some of the successfully tested explanatory variables.

Explaining the business investment behavior deserves the researcher attention and is also a challenging task because, among other reasons, it is one of the most volatile economic variables (Kohli & Ryan, 1986). This dissertation tries to contribute to that task in multiple domains: (i) applying panel data analysis and using firm-level accounting data empirically tests the combination of explanatory factors from diverse

[4] See Table AII, AIII and AIV in Appendix.

theoretical approaches; (ii) studying independently the investment in intangible assets filling one gap identified in the literature about intangibles (Haskel, Jona-Lasinio & Iommi, 2012; Marrocu, Paci & Pontis, 2012); (iii) analyzing the impact on firm investment caused by the economic and financial crisis and the sovereign debt; and (iv) investigating in detail the differences among the investment behavior by sector and firm size categories .

This dissertation is organized into four sections. In *section 1*, it is carried out the literature review, which is divided in three subsections: conceptual aspects; explanatory theories of investment; and a survey of previous studies for Portugal. The *section 2* presents the database, the sample, and the methodologies adopted. *Section 3* shows and discusses the results. Finally, in *section 4* the conclusions and suggestions for future researches are listed.

1. Literature Review

1.1. Concepts and Measurement: Tangible and Intangible Investment

The investment discussed in this research is the *real investment* that involves some sort of asset, is related to the company's activity and is creator of productive capacity. The real investment includes tangible and intangible assets, that can be used "repeatedly or continuously in production for more than one year" (Eurostat, 1996). In the Portuguese, European and International Accounting Classification, investment is defined as the amount spent to acquire or upgrade productive assets like plant and equipment, vehicles, buildings and also other expenditure including innovation, software, hardware, goodwill, R&D and industrial property (IFRS, 2015; INE, 2012; Rodrigues, 2014).

The International Financial Reporting Standards (IFRS, 2015, p. 1), define *tangible assets* (property, plant and equipment) as "tangible items that are held for use in the production or supply of goods or services, for rental to others, or for administrative purposes (Table BI); and are expected to be used during more than one period"[5]. Tangible assets are also defined as assets with physical investment of company property (Haskel et al., 2012, p. 2) and investment in nonresidential structures (Oliner et al., 1995, p. 807).

There is a strong debate on the definition and categories of *intangible assets*. In contrast to tangible assets, for the intangible assets it is difficult to establish a relationship between the quantity of tangible and physical investment (Young, 1998). Intangible assets are "an identifiable non-monetary asset without physical substance" (IFRS, 2015) (Table BII). Different categories and typologies are proposed to define this type of investment. Following Young (1998), the intangible investment includes six categories: computer-linked (e.g. software); technology and production (e.g. R&D); human sources (e.g. learning by doing and in activities to improve health and motivation of the employees); organization of the firm; marketing and sales; and industry-specific (e.g. mineral exploration). Recently, Haskel et al. (2012) adopts another typology considering that the intangible investment includes: computerized information (e.g. software); innovation property (e.g. mineral exploration and R&D); and economic competencies (e.g. advertising).

The analysis of intangible investment behavior has an increasing role for understanding the total of investment (Marrocu et al., 2012). Corrado, Hulten and Sichel (2005) concluded that, recently, in United Kingdom (UK) and United States (US), the

[5] This definition corresponds to definitions of Portuguese Accounting System (SNC *Sistema de Normalização Contabilística)* (Rodrigues, 2014), that has connection with International Accounting Standards (IAS) and IFRS: Property, plant and equipment have the code IAS 16 (in Portuguese system *Norma Contabilística e de Relato Financeiro* (NCRF) 7 based on it).

investment in intangible assets overtakes the investment in tangible assets. Nevertheless, although theoretically relevant to business growth, Gross Domestic Product (GDP) and employment, the empirical analysis about intangible assets is still insufficient (Corrado et al., 2005 and 2009; EC, 2011; Haskel, et al., 2012; Marrocu et al., 2012). Timmer (EC, 2011) states that "if we want to understand the effects of intangibles on economic growth, perhaps a new approach is needed to replace the traditional growth accounting" (p. 17) and Corrado (EC, 2011) agrees with him claiming that "there is 'a big hole' with respect to intangibles accounting" (p. 25).

There are different lines to study the intangible assets: (i) the inclusion in the accounting (national and firm level) and in firms' behavior (e.g. EC, 2011 and Bond & Van Reenen, 2007), as it is done in the present research; (ii) the effect of intangible on economic growth (Corrado et al., 2009; Solow, 1957); (iii) the impact on productivity (Bontempi & Mairesse, 2015; Marrocu et al., 2012; Haskel et al., 2012); and (iv) the effect on competition (Cañibano, Garcia-Ayuso & Sánchez, 2000).

1.2. Determinants of Investment Behavior

Since the complete surveys of investment literature done by Chirinko (1993), Pindyck (1990) and Jorgenson (1967 and 1971) there is a lack of recent reviews of real investment literature. In this section, a brief review of literature is present: first, a description of the explanatory theories which will be used in the empirical section (the Keynesian accelerator model and neoclassical model) are presented; next, and with less detail, the theories based on financial markets (Q-Tobin and Euler Equation) are described.

Accelerator Models – simple and flexible

The *accelerator theories* are related to the demand, to the optimal stock of capital and to the cost of capital (Barkbu et al., 2015; Clark et al., 1979; Fazzari et al., 1988; Jorgenson, 1971; Oliner et al., 1995; Von Kalckreuth, 2001). The *accelerator models* assume a relationship between the net investment and the expected change in the output or sales that are made through an adjustment process of the net investment and how the expectations about the output are formed (Clark et al., 1979). Variations in the desired output will involve variations in desired stock of capital and, consequently, changes in the net investment (i.e. investment excluding the replacement of capital). Investment depends on the adjustment process of the capital stock to the desired capital stock and, in this model, it can be assumed that the desired stock of capital is proportional to the output (Clark et al., 1979; Oliner et al., 1995).

In the *flexible accelerator model*, the investment in each period contributes partially to attain the desired stock of capital. The aggregate investment is explained using a "distributed lag function, relating the actual level of capital to past desired levels of capital" (Jorgenson, 1971, p. 1111). In this model, the output, the internal funds, and the costs of external funds have also effect on investment (Jorgenson, 1971).

Neoclassic theory of optimal capital accumulation

The *neoclassical model* is related to output dynamics and is based on production function, costs and prices (Barkbu et al., 2015; Bond & Van Reenen 2007; Chirinko, 1993; Clark et al., 1979; Fazzari et al., 1988; Jorgenson, 1967; Jorgenson & Handel, 1971; Oliner et al., 1995). The *neoclassic theory of optimal capital accumulation*, 'the typical model to explain the investment' (Jorgenson, 1967), has several versions. Following Jorgenson (1967) the firm's objective is to maximize the present value of the

project/firm by maximizing profits and, according Bond and Van Reenven (2007, p. 6) the firm's goal is to "maximize the value of the equity owned by its shareholders". The level of investment depends on the relation between capital and output, relation which is done by a production function, which allows to determine the optimum value for the rental cost of capital (Jorgenson, 1971). A higher real cost of capital implies a lower level of desired capital stock and, consequently, a lower level of desired investment (Barkbu et al., 2015). In this model, the desired change in capital is related to the function of the real cost of capital assumed to be equal to the marginal productivity (Jorgenson, 1971; Oliner et al., 1995). The approach to investment done by a production function relates the marginal productivity of factors to the factor's earnings. For example, if a Cobb-Douglas function is adopted, assuming implicitly perfect competition, in the optimum, the wages are equal to the marginal productivity of labor and the rental cost of capital must be equal to the marginal productivity of capital stock. If the relative price of the factors (capital and labor) changes, it is expected that the relative intensity of use of each factor also change. Bond & Van Reenen (2007) studying in separate the investment and the employment incorporates the average wage, computed by the ratio between the wage bill of each firm and the number of workers in the firm. To Chirinko (1993, p. 1876) "prices (taxes, interest rates), quantities (output and liquidity) and autonomous shocks ("animal spirits" and technology)" are determinants of investment. This theory was empirical tested for the manufacture and in aggregate level by Jorgenson and Handel (1971).

Combining the simple Keynesian accelerator approach and the neoclassical approach is possible. For example, the following equation (Oliner et al., 1995; p.811) represents the investment (*I*) in a given moment *t*:

$$I_t = \alpha + \sum_{s=0}^{N} w_s \Delta K_{t-s}^{*} + \delta K_{t-1} \quad (1)$$

where K_{t-1} is the capital stock at *t-1* ; ΔK_t^* is the firm's variation of the desired capital stock; and δ is the depreciation rate of the stock of capital.

Q-Tobin Theory and Euler Equation

Substantial part of the investment literature uses financial market data (Bond & Van Reenen, 2007) to study the volatility, the non-symmetric, and the instability of investment. Two theories used almost exclusively financial data: the *Q-Tobin* (Barkbu et al., 2015; Bond & Van Reenen, 2007; Chirinko, 1993; Clark et al., 1979; Fazzari et al., 1988; Oliner et al., 1995) and the *Euler Equation* (Barkbu et al., 2015; Bond & Van Reenen, 2007; Bond et al., 2003; Chirinko, 1993; Clark et al., 1979; Janz, 1997; Oliner et al., 1995).

The *Q-Tobin theory* establishes a link between the investment rate and the *Q* variable that is "the ratio of the discounted future revenues from an additional unit of capital to its purchase price" (Chirinko, 1993, p. 1988). This model allows to measure, at market prices the investment opportunities (Fazzari et al., 1988) and uses the real cost of capital to measure the investment (Bond & Van Reenen, 2007). However, Q-Tobin theory is considered by some authors as an insufficient model to explain reality due to inconclusive empirical results (for example, "the statistical significance of q_t [the Q-Tobin ratio] and the fit of the equation" (Chirinko, 1993, p. 1891) are weak and also because there are "data measurement issues at aggregate level" (Barkbu et al., 2015, p. 14)).

The *Euler equation* establishes a relation between the maximization of the present value of the dividend flows and the expectations of firms' output, gross investment in fixed capital, amount of hired labor and prices of output goods (Janz,

1997). The adjustment of real investment to desired investment follows a model with lags. For example, the Euler equation model proposed by Bond et al. (2003, p.156) is:

$$\max E_t \quad \sum_{j=0}^{\infty} \beta_{t+j}^{i} R\ K_{i,t+j}, L_{i,t+j,}, I_{i,t+j} \qquad (2)$$
$$\text{s.t .}\ K_{it} = \ 1-\delta\ K_{i,t-1} + I_{i,t}$$

where $E_t(\cdot)$ is the expectation operator conditional to information available in period *t*; β_{t+j}^{i} is the nominal discount factor between period *t* and *t+j*; $R_{it} = p_{it}F\ K_{it}, L_{it}\ - p_{it}G\ I_{it}, K_{it}\ - \omega_{it}L_{it} - p_{it}^{I}I_{it}$ where L_{it} is variable factor input; p_{it} is the price of the output; $F\ K_{it}, L_{it}$ the production function gross of adjustment cost; $G\ I_{it}, K_{it}$ the adjustment cost function and δ the depreciation rate. The opinions regarding this theory are controversial. Bond et al. (2003) consider it a useful model because it captures the influence of expectations on the profitability of the investment and controls the influence of financial variables on the expectations on future profitability. On the contrary, other authors consider the Euler Equation unsuitable (Chirinko, 1993; Oliner et al., 1995). Chirinko (1993) states that the Euler equation "is based on a limited amount of information from the firm's optimization problem. This limitation may prove beneficial if the information contained in the other equations is suspect or more sensitive to certain types of misspecification." (p.1894). Oliner et al. (1995) also argue against the Euler equations because they "produce extremely poor forecasts of investment for both equipment and nonresidential structures" (p. 807).

Expectations and uncertainty

The expectations and the uncertainty are included directly or indirectly in most of the theories of investment and have a key role in the theories about investment behavior (Barbku et al., 2015; Chirinko, 1993; Farla, 2013; Pindyck, 1990). For example, in the accelerator model, the past level of output and sales are determinant to

the creation of future *expectations* about output and sales (Chirinko, 1993) and expectations about future rentability are based on past and current CF (Clark et al., 1979).

The uncertainty about the profitability and economic conditions affects the returns, the rentability, the funding resources and the funding cost expectations (Banerjee et al., 2015). These authors, covering the period of 1990-2014 for Germany, Canada, Japan, Italy, UK and US, conclude that the main reasons for investment to be weak is the uncertainty in relation the future economic situations of the each country, the profitability of the investment opportunities and the return to the application of new capital. The level of uncertainty perceived by the investor differs across investors because it depends on several factors (e.g. type of project, technology and firm's market power). The risk perception can be incorporated into investment decisions by several forms (e.g. though the required rate of return) (Farla, 2013; Pindyck, 1990). Probably, expectations and uncertainty are the main reasons why it is so difficult to find suitable models to explain the investment behavior.

Tight monetary policies, imposing difficult access and reducing granting of bank loans are also factors that may restrict the investment (Kothari, Lewellen & Warner, 2014) since it makes more expensive the investment by using external funds (Fazzari et al., 1988). The empirical results about this issue are mixed. For example, Von Kalckreuth (2001) demonstrates that even companies without financial constraints do not invest if there are in risky situations.

The investment is also analyzed by business surveys (e.g. *Inquérito Qualitativo de Conjuntura ao Investimento* (ICI) is the business investment survey (INE, 2014a) in Portugal which follows the Eurostat guidelines for business survey) which collect

information from the business responsible the expectations of entrepreneurs about future sales, the objectives and main obstacles to investment (Farla, 2013; Jorgenson & Handel, 1971; Maria & Serra, 2008).

Summarizing, there are diverse theories that try to explain investment behavior and consequently, the empirical approaches are also diverse concerning model specifications, databases and methodologies. The empirical studies are being improved as more detailed and representative databases become available from administrative, accounting, and survey sources. However, the difficulties to explain and to forecast private investment remain. The statement of Caballero, Engel, Haltiwanger, Woodford and Hall (1995) about the obstacles faced by investors is still valid and also explain the difficulties of the researchers about investment behavior: "there are serious theoretical obstacles, stemming mostly from the richness of the cross-sectional and time-series scenarios faced by actual investors, from the complexity of the investment technologies available to them, and from the myriad incentive problems that these economic agents face. There are at least as complex, and perhaps in-surmountable, data problems" (p. 1).

1.3. The Investment in Portuguese Firms

This section presents and discusses the empirical literature about the investment in Portugal mainly using a microeconomic approach and two macroeconomic approaches analyzed Portugal among European context (Table I summarizes). The financial aspects that include the recent period of crisis are highlighted.

Despite the effects of the economic and financial crisis the Portuguese GFCF as a share of GDP remained above average Euro area from 2000 to 2010 (Eurostat, 2012; Pina & Abreu, 2012). Barkbu et al. (2015) results show that: the high funding costs and the financial constraints, the high corporate leverage and political uncertainty

conditioned the investment of European companies in the period 1998Q2-2012Q1; in Portugal, the corporate leverage and the financial constraints had negatively affected private investment. In line with these results, Farinha and Prego (2013) concluded that the Portuguese investment between 2006 and 2011 is negatively associated with the cost of capital, the interest debt burden and the indebtedness increase.

TABLE I
EMPIRICAL STUDIES OF INVESTMENT IN PORTUGAL

Authors (Year)	**Database(s) Period of information (Frequency)**	**Countries (Unit of analysis)**	**Main conclusions**
Barbosa et al. (2007)	Central Balance-Sheet Database (CBSD) of Banco de Portugal based on Simplified Business Information (IES) 1995-2006 (Annual)	Portugal (Portuguese non-financial corporations)	The financial situation of firms is essential to the evolution of investment (interest, indebtedness and size have a negative impact on investment as opposed to sales and profitability). Mixed results of sensibility of export companies.
Barkbu et al. (2015)	AMECO, WEO, EUROSTAT, ECB 1990-2012/13 (Quarterly)	Portugal, Germany, France, Italy, Spain, Ireland and Greece (countries)	The corporate leverage and financial constraints have a negative impact on investment.
Farinha & Prego (2013)	CBSD of Banco de Portugal (based on IES) 2006-2011 (Annual)	Portugal (Portuguese non-financial corporations of private sector)	The financial situation of firms is essential to the evolution of investment (interest, funding costs and indebtedness have a negative impact on investment as opposed to sales and profitability). Results heterogeneous by size.
Pina & Abreu (2012)	EUROSTAT, OECD, BdP 2000-2010	Portugal and Euro Area countries (countries)	Between 2005-2011 there was a significant drop in total exports.

Source: Author's construction based on Barbosa et al. (2007); Barkbu et al. (2015); Farinha & Prego (2013); Maria & Serra (2008) and Pina & Abreu (2012).

Kothari et al. (2014) refer that the diminishing of investment in UK between 2008 and 2009 is not only due to the weak financial conditions of the companies to bet on good projects (it is difficult the access to bank financing) but also because there is a

lack of investment opportunities. Similar results are obtained for Portugal over the period 2008-2014, according to the ICI[6].

The relationship between investment/CF sensitivity and financial constraints is studied by several authors and suggest some debate since get to opposite results. For example, Mizen and Vermeulen (2005), analyzing UK and Germany, affirmed that the private investment is more sensitive to the CFs fluctuations for companies financially constrained. Also for Portugal in 1995-2005, Barbosa et al. (2007) and Farinha and Prego (2013) conclude that investment is less sensitive to financial pressure for large companies.

In brief, the empirical literature for Portugal indicates that the main determinants of investment in Portugal are: the size of company, the sales growth, the macroeconomic context, the share of exports on sales and the financial position of the company (see fourth column in Table I).

2. Empirical Analysis

After the presentation of theories and results about investment behavior (points 1.2 and 1.3) it is evident that there are of difficulties to parametrize the investment behavior. Additionally, to have a full image of investment behavior a large scope of information is needed (e.g. institutional data; firm's governance and strategies detailed; detailed accounting data). The empirical analysis carried out in the present research takes advantage of a very rich Portuguese accounting database (SCIE), much richer than other studies in the literature (e.g.: panel data for eight years; distinction between investment in tangible and intangible assets) but it does not include information about the strategy and the governance in each firm.

[6] See in *Figure* F1. From 2008, the difficulty in obtaining bank loans is one of the main obstacles of investment in Portugal.

2.1. Database: Integrated Business Accounts System (SCIE) and Sample

This research has as main informative support the accounting microdata of SCIE for the period 2004-2011. SCIE is an annual database based on administrative data following IES (INE, 2014b, 2015) and accessible to the scientific community through protocol. This database covers an extensive list of accounting variables (about 80 for the period 2004-2009 and 262 for 2010-2011) allowing the building of financial ratios.

The empirical studies about investment behavior are based on diverse units of analysis (firm, sector, or countries) and databases (e.g. Amadeus, AMECO, CBSD, US Industrial Census and Compustat and Qualitative Surveys). The adoption of SCIE as the main database, has clear advantages over other databases like Amadeus database (BVD, 2015) which is used for example in Marrocu et al. (2012) and Mizen and Vermeulen (2005) because SCIE covers better the universe of the Portuguese firms. SCIE provides detailed information by sector (5 CAE code digits desegregation), rather than AMECO database (Santos, 2007) used by Banerjee et al. (2015) and Barkbu et al. (2015). The type of data included in SCIE is similar to CBSD (BdP, 2015b) used by Barbosa et al. (2007) and Farinha and Prego (2013). Using SCIE database it is possible to analyze a balanced panel data like other studies have done (Barbosa et al., 2007; Bond & Van Reenen, 2007; Bond et al., 2003; Caballero et al., 1995; Farinha & Prego, 2013; Janz, 1997; Marrocu et al., 2012). On contrary, business survey data used by several authors (Farla, 2013; Jorgenson & Handel, 1971; Maria & Serra, 2008) do not allow to build balanced panel data.

A sample of firms belonging to six traditional Portuguese sectors (Food Products, Textiles, Wearing, Footwear, Wood and Furniture) incorporating annually about 43,000 companies and in the total study period (2004-2011) 340,836 observations

for micro, small, medium and large companies was characterized in detail[7] (Table AI). The balanced panel specially built for the current research includes 1,273 firms observed in eight consecutive years which corresponds to 10,184 observations of small, medium and large firms. Because the composition of the database (number of variables) is not constant across time specific samples were built by periods and investment types (e.g. tangible and intangible assets).

2.2. Investment Dynamics

The analysis of the investment evolution in these sectors is measured by the *investment rate* by firm following calculation formula defined by INE (2014b, 2015) and Eurostat (2015a): GFCF divided by Gross Added Value at factor costs (GAV_{fc}). Figures A1 and A2 in Appendix A illustrate the difference between the behavior of Portuguese investment comparing with Euro Area investment (Figure A1), and the investment in the traditional sectors (Figure A2). The mean of investment rate in traditional sector during the period 2004-2011 has lower values, compared to Portuguese investment, respectively 13.6% and 20.3%. The profile across time is also distinct in both groups: for the global values the maximum value is attained in 2008 and in traditional sectors the maximum values are attained in year 2006 and 2008. The crisis, evidenced in the decline 2008-2009 for the whole private sector (Figure A1), had a larger impact compared to the rate of investment in the traditional sector. The tangible-intangible mix of the investment by firms are heterogeneous by sector and by size. The main component of investment is the tangible investment which represents about 97% of the investment by sector (Table AV). Textiles has the highest relative share of investment in intangibles in 2010 (3.80%) and the second highest share in 2011

[7] Firm size categories based on number of employees following criteria of Statistics Portugal (INE, 2014b, 2015): micro (1-9); small (10-49); medium (50-249) and large (≥ 250).

(4.63%) and, by contrast, Footwear has the lowest share in 2010 (1.64%) and 2011 (1.03%). In 2010-2011, all of sectors reduced tangible investment by firm (Table AV) with two exceptions: Footwear which increased and Food Products that remained constant. In tangible investment, the Food Products has the highest intensity and Wearing has the lowest share in 2010-2011. In intangible investment, the levels of investment are higher in the Footwear at the beginning of the period (2004) but in middle period, the Food Products (2006-2007) and Furniture (2008-2009) present the best share (Table AVI). The Footwear and the Wood show a good financial performance measure by ROA and the Wood and Textiles have the higher productivity (Figure A4).

The large firms, compared to medium and small firms, have a larger fluctuation of investment and more concentrated in time, and higher shares in total investment in 2006 and 2008. However, from 2010 on, the small companies present the highest share of investment (Figure A3). The large firms show the highest rate in intangible investment, despite of share have been decreasing during last observed years (9.31% in 2006 and 0.94% in 2011) (Table AVII).

2.3. Methodology: Modelling and Variables

The modelling of the behavior of investment in this dissertation adopts different specifications based on the literature and uses balanced panel data[8] for 1,273 firms and 8 years of observations (N=10,184). The panel data analysis is adopted because: (i) increases the number of observations which provides more accurate estimates of the coefficients; (ii) provides greater efficiency in the estimation models; (iii) allows the inclusion of lagged variables (reducing the problem of multicollinearity); and (iv) takes

[8] The linear models were tested previously of the adaption of panel analysis. Results from linear models are briefly presented in Appendix C. The software used for these estimations is IBM SPSS 22®.

into account individual heterogeneity (unobservable fixed effects specific of firms) (Arellano & Bond 1991; Bond, 2002; Cameron & Trivedi, 2010; Wooldridge, 2010). The software used in all estimations is STATA 12®.

There are different linear panel-data models (Cameron & Trivedi, 2010). In this research the models adopted are: Pooled OLS (POLS), Fixed Effects (FE) and Random Effects (RE). The use of this empirical strategy follows Aivazian, Ge & Qiu (2005). The empirical strategy starts with the estimation of POLS where the observations are pooled across time and cross-sectional unit. After, FE are tested where the unobserved effects are correlated with the explanatory variables and finally RE are applied where does not exist correlation with the explanatory variables (Cameron & Trivedi, 2010; Wooldridge, 2012).

2.3.1. Dependent and Independent Variables

Based on the literature, alternative dependent variables of Investment Rate are computed and different explanatory variables are selected for the modelling of firm's investment behavior (Table II summarizes).

TABLE II
DESCRIPTION OF DEPENDENT AND INDEPENDENT VARIABLES

	Description	Observ.
Dependent Variable (including in the models 1, 2, 3 and 4)		
Investment Rate $(Inv_{i,t})$	Total annual expenditure for tangible and intangible investment in relation capital stock (in percent) $\frac{Gross\ Fixed\ Capital\ Formation}{Capital\ Stock} \times 100$	(i) (ii)
Investment Tangible Rate $(Invtangrate_{i,t})$	Total annual expenditure for tangible investment in relation the gross added value at factor costs (in percent) $\frac{Tangible\ Investment}{Gross\ Added\ Value\ at\ factor\ costs\ (GAV_{fc})} \times 100$	-
Investment Intangible Rate $(Invintangrate_{i,t})$	Total annual expenditure for intangible investment in relation the gross added value at factor costs (in percent) $\frac{Intangible\ Investment}{GAV_{fc}} \times 100$	-

TABLE II (cont.)

Explanatory Variables (including in models 1, 2, 3 and 4)		
Crisis (cri_t)	=1 if the year is between 2009 and 2011; 0 otherwise (2004-2008)	(a) (b)
Capital Stock ($K_{i,t}$)	$\sum_{t=2004}^{n} GFCF_t$ (in 10^6 euros)	-
ROA ($ROA_{i,t}$)	Return on assets: operating income divided by total assets. It is comparable to the firm's unlevered return on equity. $\frac{Operating\ Income}{Assets}$	(b) (c) (d)
Sales ($sales_{i,t}$)	Firms sales (in 10^6 euros)	(e) (f) (b)
Gross Operating Profit ($profi_{i,t}$)	Funds raised by the company (in 10^6 euros)	(a)
Investment/Cash Flow sensitivity ($cshf_{i,t}$)	$\frac{Gross\ Operating\ Profit}{Capital\ Stock}$	(g) (h) (i)
Average Wage ($avgw_{i,t}$)	Average wage by employee (euros) $\frac{Expenditures\ with\ employees}{Employees\ in\ firm}$	-
Exports ($exprt_t$)	=1 if at least 25% of sales are done in external markets; 0 otherwise $\frac{sales\ for\ community\ and\ non\ community\ market}{Total\ of\ sales} \times 100 > 25\%$	-
Funding Costs ($fcost_{i,t}$)	$\frac{Paid\ Interest}{Liabilities}$	(b) (c)
R&D Personal ($empr\&d_{i,t}$)	Number of the R&D employees in relation to the total of employees $\frac{Employees\ in\ firm\ focus\ on\ R\&D}{Employees\ in\ firm}$	-
Employees ($emp_{i,t}$)	Number of the total employees in firm	(j)
Sector	10 = 1 if sector is food products; 0 otherwise**;** 13 = 1 if sector is textiles; 0 otherwise; 14 = 1 if sector is wearing; 0 otherwise**;** 15 = 1 if sector is footwear; 0 otherwise**;** 16 = 1 if sector is wood and cork; 0 otherwise; 31 = 1 if sector is furniture; 0 otherwise.	-
Size	Small companies *(Size S)* = 1 if the companies has between 10-45 employees; 0 otherwise*;* Medium companies *(Size M)* = 1 if the companies has between 45-249 employees; 0 otherwise*;* Large companies *(Size L)* = 1 if the companies has higher than 250 employees; 0 otherwise	-

Adapted from (i) Barbosa et al. (2007) (ii) Fazzari et al. (1988) (a) Kothari et al. (2014) (b) Farinha & Prego (2013) (c) Barbosa et al. (2007) (d) Neves (2012) (e) Von Kalckreuth (2001) (f) Aivazian et al. (2005) (g) Chirinko & Von Kalckreuth (2002) (h) Fazzari et al. (1988) (i) Cleary (1999) (j) Marrocu et al. (2012).
Source: Author's construction.

Explanatory variables are related to: the kind of manufacture *(sector)*; the economics features such as company size *(size)*; the type of investment (tangible and intangible

investment); the financing constrains[9] *(financial autonomy, interest, indebtedness, solvability)*; the share of sales in the external market (*exports*); the cost with employees and innovation (average wage, R&D Personal) and the cost of non-equity funding (funding costs)[10].

2.3.2. Sets of Analysis and Model Specifications

Different sets of analysis are created following the criteria: availability of data across years, type of investment (in tangible or intangible assets), sector (6 sectors) and size (3 categories). The four model specifications analyzed in detail result from a selection based on a large scope of empirical tests for each sample considered. The relation between the four models, associated samples, and tables with results are summarized in Figure 1. The models are: two for total investment using the full sample, by the six sub-sectors and by size (*Model 1* and *Model 2*); and two when investment behavior is analyzed in separate for tangible and intangible assets (*Model 3* and *Model 4* respectively). Because there is an additional availability of some variables[11], for the two last years of the database (2010 and 2011), two periods are considered: 2004-2011 and 2010-2011[12].

[9] See in Appendix A.3. Figure A4 and A5 the financial ratios and variables by size over period 2004-2011 and 2010-2011.
[10] See in Appendix B in Table BIII some variables tested but not include in models due to weak results.
[11] For period 2010-2011 the data include, additionally to 2004-2009: Exports (*expr*), R&D Personal (*empr&d*), Interest and Funding cost (*fcost*); and investment tangible (*invtangrate*) and intangible (*invintangrate*) rate can be studied in separated.
[12] For theoretical reasons were made apart estimates for the period 2004-2008 and 2009-2011 to test structural changes before and after the crisis but it is concluded that when the variable crisis was missing of the model, or by the lags, it is not included in the regression, the results became unsatisfactory. So, this division was rejected.

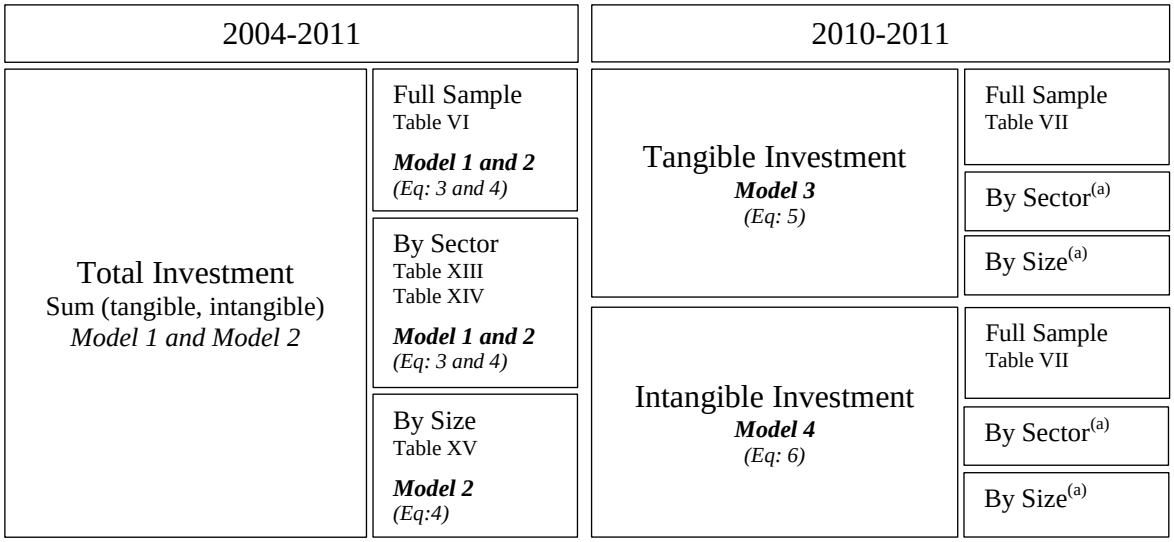

Figure 1. Resume of the Models for Total, Tangible and Intangible Investment
The Total Investment is computed GFCF divided by Capital Stock (K_t); the Tangible Investment (rate) is computed tangible investment divided by GAV_{fc} and the Intangible Investment (rate) is computed intangible investment divided by GAV_{fc}.
(a)The model presents statistically insignificant coefficients.
Source: Author's construction

The equation of the ***Model 1*** is:

$$Inv_{i,t} = \beta_0 + \alpha_1 cri_t + \beta_1 K_{i,t-1} + \beta_2 \log(ROA)_{i,t} + \beta_3 sales_{i,t-1} + \mu_t + \varepsilon_{i,t} \quad (3)$$

where investment rate $(Inv_{i,t})$ is defined as the investment (GFCF) divided by capital stock $(K_{i,t})$ is the dependent variable; $cri_{i,t}$ is an year dummy variable; $K_{i,t-1}$ a proxy of stock of capital of firm i at time t-1; $\log ROA_{i,t}$ is the logarithm of return on asset; $sales_{i,t-1}$ is the lagged value of sales of firm i. Term μ_t is the fixed effect, containing all factors that do not vary over time; and $\varepsilon_{i,t}$ is the error term.

Model 2 is represented by the following equation:

$$Inv_{i,t} = \beta_0 + \alpha_1 cri_t + \beta_1 K_{i,t-1} + \beta_2 \log(profi)_{i,t} + \beta_3 sales_{i,t-1} + \beta_4 cshf_{i,t} + \beta_5 \log(avgw)_{i,t} + \mu_t + \varepsilon_{i,t} \quad (4)$$

where the common variables with Model 1 have the same meaning previously announced and $log(profi)_{i,t}$ is the logarithm of Gross Operating Profit (GPO) by firms; $cshf_{i,t}$ is a proxy of investment/cash flow sensitivity of firm i at time t and $log(avgw)_{i,t}$ is the logarithm of the average wage of each firm.

For tangible (Model 3) and intangible assets (Model 4) investment, the dependent variable (rate of investment) follows the definition proposed by INE (2014b, 2015). ***Model 3*** is represented by:

$$Invtangrate_{i,t} = \delta_0 + \gamma_1 expr_t + \delta_1 \log fcost_{i,t} + \delta_2 empr\&d_{i,t} + \delta_3 \log(emp)_{i,t} + \mu_t + \varepsilon_{i,t} \quad (5)$$

where dependent variable $Invtangrate_{i,t}$ is defined as tangible investment divided by GAV_{fc}; $expr_t$ is dummy variable (equal to 1 if at least 25% of the sales are done in foreign markets and equal to 0 otherwise); $log(fcost)_{i,t}$ is the logarithm of funding cost; $empr\&d_{i,t}$ is the share of employees in R&D in total firm's employment; $log(emp)_{i,t}$ is the logarithm of number of employees in firm; term μ_t is the fixed effect, containing all factors that do not vary over time; and $\varepsilon_{i,t}$ is the error term.

For the ***Model 4***, the dependent variables are equal to ***Model 3***, but the dependent variable $Invintangrate_{i,t}$ is defined as the intangible investment divided by GAV_{fc}.

$$Invintangrate_{i,t} = \delta_0 + \gamma_1 expr_t + \delta_1 \log fcost_{i,t} + \delta_2 empr\&d_{i,t} + \delta_3 \log(emp)_{i,t} + \mu_t + \varepsilon_{i,t} \quad (6)$$

3. Results and Discussion

Results

Three different methodologies (POLS, FE and RE) are used to estimate the four models adopted: *Model 1* and *2* (Total Investment), *Model 3* (Tangible Investment) and *Model 4* (Intangible Investment). The same methodologies are also used to test these models by sector and by size. Table III and IV show the results.

TABLE III
REGRESSION ANALYSIS OF TOTAL INVESTMENT (2004-2011)

	Model 1			**Model 2**		
	Pooling regression	Fixed effect	Random effect	Pooling regression	Fixed effect	Random effect
Crisis (cri_t)	-21.7022*** (-46.4497)	-21.4617*** (-40.2779)	-21.6861*** (-44.5189)	-19.4908*** (-41.8046)	-17.5443*** (-28.9722)	-19.4810*** (-41.4658)
Capital Stock ($K_{i,t-1}$)	-0.0000*** (-6.2703)	-0.0000*** (-3.4699)	-0.0000*** (-4.0848)	-0.0000*** (-6.4650)	-0.0000*** (-3.6974)	-0.0000*** (-4.1571)
$\log(ROA)_{i,t}$	1.3715*** (5.4713)	0.2436 (0.6758)	1.2794*** (4.9190)	-	-	-
Total of sales ($sales_{i,t-1}$)	0.0000*** (3.0289)	-0.0000 (-1.3521)	0.0000*** (2.7913)	0.0000*** (4.1029)	-0.0000 (-0.8953)	0.0000*** (3.0250)
$\log(profi)_{i,t}$	-	-	-	0.6005*** (3.1378)	-0.5440 (-1.1678)	0.6084*** (3.0484)
Invest/CF sensitivity ($cshf_{i,t}$)	-	-	-	1.4583*** (9.2438)	1.1513*** (7.3314)	1.4440*** (8.8325)
Average wage $\log(avgw)_{i,t}$	-	-	-	-8.0343*** (-8.8284)	-24.6456*** (-7.8007)	-8.1749*** (-8.7576)
Intercept	41.5243*** (49.3233)	39.0274*** (33.7579)	41.2406*** (46.2289)	102.4977*** (13.4685)	272.3349*** (9.2662)	103.7354*** (13.3926)
F(X,Y)	616.84 X=4 Y=7514	504.69 X=4 Y=1267	-	492.27 X=6 Y=8299	420.93 X=6 Y=1271	-
Wald $X^2(Z)$	-	-	2226.29 Z=4	-	-	2699.08 Z=6
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Root MSE	21.372	-	-	20.875	-	-
Observations	7,519	7,519	7,519	8,306	8,306	8,306
Groups		1,268	1,268		1,272	1,272
R-squared	0.2179	0.2468[(a)]		0.2525	0.2800[(a)]	

Robust t-statistics in parentheses for POLS and FE and z-statistics for RE. Significance levels: *** 1% ** 5% * 10%.
[(a)]Within R^2.

The impacts of the variables on investment in POLS and RE had the expected signs (Table III, *Models 1* and *Model 2*). The crisis, the stock capital (lagged) and the average wage have a negative impact on total investment. Symmetrically, the ROA, the total of sales (lagged), the GPO and investment/cash flow sensitivity have a positive impact[13].

The *Model 3*, for tangible investment, the qualitative and statistical significance of results is weak since only two variables present statistically significant results and

[13] The *Model 1* and *2* was also studied for Tangible and Intangible Investment but the results are not shown because both models produced weak quality results.

one of them presents a signal that is not expected. Moreover, the model has a very low R^2 in POLS (Table IV). The *Model 4* for intangible investment, in POLS and RE, have the expected signal for the coefficients are the expected: exports and total of employees are positive.

TABLE IV
REGRESSION ANALYSIS OF SPECIFIC INVESTMENT (2010-2011)

Dependent variable: $^{Intangible\ Investment_t}\ _{GAV_{fc_t}}$

	Model 3			**Model 4** (Full Sample)		
	Pooling regression	Fixed effect	Random effect	Pooling regression	Fixed effect	Random effect
Exports $expr_t$	-1.9825* (-1.7121)	9.7230** (2.4036)	-1.9825* (-1.8176)	0.2867*** (3.0987)	-0.0973 (-0.3758)	0.2493*** (2.6085)
Funding costs $\log(fcost)_{i,t}$	1.5853*** (3.2186)	4.9504*** (3.1092)	1.5853*** (3.2667)	0.0497*** (3.2990)	-0.0024 (-0.0685)	0.0453*** (2.8582)
R&D Personal $empr\&d_{i,t}$	2.0430 (0.1024)	-134.4824 (-1.3857)	2.0430 (0.0951)	7.4016 (1.5335)	4.2866** (2.2201)	7.1331 (1.2431)
Total of employees $\log(emp)_{i,t}$	-0.8417 (-0.8897)	-26.9921 (-0.9676)	-4.2259*** (-3.3322)	0.1248** (2.4336)	0.5649 (1.2517)	0.1345** (2.1638)
Intercept	19.9708*** (3.3588)	130.4464 (1.2112)	19.9708*** (3.4160)	0.0395 (0.2319)	-1.6953 (-1.0170)	-0.0058 (-0.0289)
F(4,X)	3.26 X=2138	4.73 X=1120	-	8.11 X=2138	1.26 X=1120	-
Wald $X^2(5)$	-	-	13.71	-	-	21.12
Prob > F	0.0113	0.0009	0.0083	0.0000	0.2836	0.0003
Root MSE	33.888	-	-	1.7109	-	-
Observat.	2,143	2,143	2,143	2,143	2,143	2,143
Groups		1,121	1,121		1,121	1,121
R-squared	0.0059	0.0241[(a)]		0.0217	0.0017[(a)]	

Robust t-statistics in parentheses for POLS and FE and z-statistics for RE. Significance levels: *** 1% ** 5% * 10%.
[(a)]Within R^2.

Two statistical tests (Langragian Muliplier (LM) of Breusch-Pagan and Hausman test) are used to discover which empirical methodology (among POLS, FE and RE) is most appropriate (Aivazian et al., 2005) (Table V). The LM of Breusch-Pagan compare the Pooling regression (null hypothesis: $\mu_t = 0$) versus the random effects. The null hypothesis is rejected at the 1% at the significant level, it means that the POLS is not suitable for the *Model 1* and *Model 4*. For *Model 2* and *Model 3*, the results suggest the opposite: the POLS is the best model at 1% at the significant level.

The Hausman specific test compare the random effects model (null hypothesis) versus fixed effects model. The null hypothesis is rejected at the 1% at the significant level for both models, it means that the FE models is appropriate for *Model 1* and *Model 2*. For *Model 3* and *Model 4*, RE is preferred.

TABLE V
BREUSCH-PAGAN (LM) AND HAUSMAN TEST

	Model 1 Total Investment	Model 2 Total Investment	Model 3 Tangible Investment	Model 4 Intangible Investment
LM test	Chi-Sq(1)=10.00*** (P=0.0000)	Chi-Sq(1)=0.81 (P=0.1844)	Chi-Sq(1)=0.00 (P=0.100)	Chi-Sq(1)=267.88*** (P=0.0000)
Hausman test	Chi-Sq(2)=34.82*** (P=0.0000)	Chi-Sq(4)=143.11*** (P=0.0000)	Chi-Sq(4)=9.41* (P=0.0517)	Chi-Sq(4)=4.11 (P=0.3914)

Robust t-statistics in parentheses. Significance levels: *** 1% ** 5% * 10%.

The obtained results are influenced by the estimation models adopted. Through the tests carried out, the adequate models are: for Model 1 - FE and RE; for Model 2 - POLS and FE; for Model 3 - POLS and RE; and for Model 4 - RE.

Besides the Langragian Muliplier (LM) of Breusch-Pagan and the Hausman tests, to check the results' quality, it is necessary to study if models have multicollinearity and heteroskedasticity. The multicollinearity is the correlation among independent variables and if its presence affects the efficiency of the estimated coefficients leading to incorrect conclusions (Wooldridge, 2012). Since the correlation between most of the variables (Table DVII and DVIII) is lower than 0.30, it means that collinearity is not a relevant problem in the models tested. The variance inflation factor calculation that finds out if the variance is inflated when a regressor is not orthogonal to the other regressors (Cameron & Trivedi, 2010; Wooldridge, 2012) produces the same conclusion. Consequently, the multicollinearity is not considered to be a serious problem in these models.

The heteroskedasticity exists when the variance of the unobserved factors modifies across diverse fragments that are determined by values of the explanatory

variables (Wooldridge, 2012). Through the Wald test and the heteroskedasticity test (Cameron & Trivedi, 2005), it is confirmed that the variance of the error term, given the explanatory variables, is not constant in all of models once the probability is zero and consequently the null hypothesis is rejected: absence of heteroskedasticity at the 1% significant level. To surpass this problem, it is used the White's robust standard errors test (Cameron & Trivedi, 2010; Aivazian et al., 2005) which will allows getting consistent standard errors calculations. All t-statistics and z-statistics presented in Tables III and IV are taking in consideration the consistent standard errors.

The same specifications adopted to the global sample are also tested by sector of activity (6 sectors) and by firm size (3 categories) in order to verify if the variables that explain the investment for those particular sub-sectors are similar to the variables explaining the investment at more aggregate level. An initial analysis focuses on the signals of the variables (Table EI and EII) and next on its significance using the POLS. Only models that have passed into the POLS procedures were taken into account for the analysis of the FE and RE. This criterion has done due to simplicity and direct analysis of the model.

For Total Investment by sector (i.e. without distinction between tangible and intangible), the two models (*Model 1* and *Model 2*) provide strong results only for some sectors (Food Products, Textiles, Wearing and Furniture). Table VI shows the results by sector over the period 2004-2011 for *Model 1* and Table VII for *Model 2*.

The *Model 2* is the best model for small and medium companies (see Table VIII) the same does not apply for large companies were the results are weak (not shown).

The signs for the impact of the variables on investment in POLS and RE by sector except for the Textiles (Tables VI and VII) and by size (Table VIII) are the

expected. Applying the statistical tests previously presented, it is possible to state that the POLS is suitable though LM statistic test because the null hypothesis is not rejected at the 1% at the significant level for these subsectors and size and through Hausman test the null hypothesis is rejected at the 1% at the significant level.

TABLE VI
TOTAL INVESTMENT BY SECTOR: MODEL 1

Dependent variable: $^{GFCF_t}/_{K_t}$

	Textiles			**Wearing**		
	Pooling regression	Fixed effect	Random effect	Pooling regression	Fixed effect	Random effect
Crisis (cri_t)	-17.8252***	-16.4874***	-17.7594***	-26.7674***	-26.5889***	-26.7674***
	(-12.8037)	(-10.8230)	(-12.6016)	(-22.1731)	(-17.0993)	(-21.8756)
Capital Stock ($K_{i,t-1}$)	-0.0000**	-0.0000***	-0.0000**	-0.0000***	-0.0000**	-0.0000***
	(-2.4217)	(-2.7523)	(-2.2419)	(-4.4450)	(-2.4298)	(-3.6378)
$\log(ROA)_{i,t}$	1.2594*	0.3374	1.2032*	2.2812***	0.7424	2.2812***
	(1.6651)	(0.3752)	(1.8484)	(3.6970)	(0.8319)	(3.6767)
Total of sales ($sales_{i,t-1}$)	-0.0000**	-0.0000	-0.0000**	0.0000*	0.0000	0.0000**
	(-2.3557)	(-0.0949)	(-2.2480)	(1.8533)	(0.7345)	(2.0660)
Intercept	38.1349***	35.3114***	37.9673***	52.1662***	47.9793***	52.1662***
	(13.9427)	(11.6082)	(15.7803)	(26.9046)	(15.2106)	(26.9444)
F(4,X)	47,75 X=782	38,68 X=131	-	195,49 X=1516	151,05 X=263	-
Wald $X^2(4)$	-	-	189,87	-	-	653,17
Prob > F	0,0000	0,0000	-	0,0000	0,0000	-
Root MSE	20,828	-	-	23,044	-	-
Observations	787	787	787	1,521	1,521	1,521
Groups		132	132		264	264
R-squared	0.1780	0.1881[(a)]		0,3020	0.3359[(a)]	

Robust t-statistics in parentheses for POLS and FE and z-statistics for RE. Results of all models by sector available upon request from the author. Significance levels: *** 1% ** 5% * 10%.
[(a)]Within R^2.

TABLE VII
TOTAL INVESTMENT BY SECTOR: MODEL 2

Dependent variable: $^{GFCF_t}/_{K_t}$

	Food Products			**Furniture**		
	Pooling regression	Fixed effect	Random effect	Pooling regression	Fixed effect	Random effect
Crisis (cri_t)	-16.2033***	-14.1676***	-16.1880***	-21.9833***	-18.0075***	-21.9833***
	(-22.2265)	(-16.6266)	(-21.8102)	(-14.4355)	(-8.5839)	(-15.2996)
Capital Stock ($K_{i,t-1}$)	-0.0000***	-0.0000***	-0.0000***	-0.0000***	-0.0000*	-0.0000***
	(-5.8294)	(-3.5746)	(-3.9581)	(-5.4987)	(-1.9287)	(-3.2993)
Total of sales ($sales_{i,t-1}$)	0.0000***	-0.0000	0.0000**	0.0000***	0.0000	0.0000***
	(3.0987)	(-0.9820)	(2.4016)	(3.8314)	(0.7567)	(3.0275)
$\log(profi)_{i,t}$	1.0569***	-1.5748**	1.0471***	2.9351***	0.4323	2.9351***
	(3.7023)	(-2.1483)	(3.5327)	(3.6873)	(0.2859)	(3.8989)
Invest/CF sensitivity ($cshf_{i,t}$)	2.2325***	1.6127*	2.1904***	0.9596**	0.7866*	0.9596**
	(2.8435)	(1.8381)	(2.9427)	(2.1619)	(1.7158)	(2.2049)

TABLE VII (cont.)

Average wage $\log(avgw)_{i,t}$	-3.6400*** (-3.0221)	-18.5490*** (-5.7045)	-3.7496*** (-3.0184)	-15.7832*** (-5.9324)	-47.6201*** (-5.2980)	-15.7832*** (-6.4510)
Intercept	52.3168*** (5.2398)	225.5150*** (7.3492)	53.4916*** (5.2603)	152.2448*** (6.6706)	476.9106*** (5.8556)	152.2448*** (7.1379)
F(6,X)	154,12 X=3314	133,70 X=504	-	95,25 X=1041	105,53 X=161	-
Wald $X^2(6)$	-	-	830,93	-	-	698,69
Prob > F	0,0000	0,0000	-	0,0000	0,0000	-
Root MSE	19,054	-	-	22,644	-	-
Observations	3,321	3,321	3,321	1,048	1,048	1,048
Groups		505	505		162	162
R-squared	0.1984	0.2380[(a)]		0.3165	0,3606[(a)]	

Robust t-statistics in parentheses for POLS and FE and z-statistics for RE. Results of all models by sector available upon request from the author Significance levels: *** 1% ** 5% * 10%.
[(a)]Within R^2.

It means that the FE models are appropriate for these subsectors and size, except for the Food Products and Textiles. For these two models at the 1% at the significant level the RE models is more suitable.

There is no evidence of the existence of multicollinearity among variables at 1% level of significant but there is evidence of heteroskedasticity. To solve this problem the White's robust standard errors is used. All t-statistics and z-statistics presented in the Tables VI to VIII are taking in consideration the consistent standard errors.

Summarizing, to explain the behavior of investment, the POLS is more suitable for *Model 2* (Total Investment) and *Model 3* (Tangible Investment) and the FE is more appropriate for *Model 1* (Total Investment) and RE for *Model 4* (Intangible Investment). By sector and by size is most suitable using a POLS and RE (Table VI to VIII).

TABLE VIII
TOTAL INVESTMENT BY SIZE: MODEL 2

	Dependent variable: $\frac{GFCF_t}{K_t}$					
	Size S			**Size M**		
	Pooling regression	Fixed effect	Random effect	Pooling regression	Fixed effect	Random effect
Crisis (cri_t)	-18.2530*** (-31.1106)	-14.7621*** (-16.5839)	-18.2530*** (-27.6611)	-18.2350*** (-21.5937)	-14.3470*** (-12.9404)	-18.0981*** (-20.5669)
Capital Stock $(K_{i,t-1})$	-0.0000*** (-8.2295)	-0.0000*** (-6.2163)	-0.0000*** (-4.9317)	-0.0000*** (-4.3741)	-0.0000*** (-4.0883)	-0.0000*** (-3.0625)
Total of sales	0.0000*** (3.0861)	0.0000 (1.5873)	0.0000** (2.1818)	0.0000*** (3.6821)	-0.0000 (-0.2987)	0.0000*** (2.6604)

TABLE VIII (cont.)

$(sales_{i,t-1})$						
$\log(profi)_{i,t}$	1.9128*** (6.0397)	0.2655 (0.5067)	1.9128*** (5.5916)	1.3309*** (2.7650)	-0.9948 (-0.9490)	1.3090** (2.5318)
Invest/CF sensitivity $(cshf_{i,t})$	1.5053*** (10.4563)	1.2220*** (10.1845)	1.5053*** (10.6439)	1.0069*** (3.3472)	0.8141* (1.9084)	0.9668*** (3.0936)
Average wage $\log(avgw)_{i,t}$	-9.3753*** (-8.2777)	-19.3280*** (-6.1037)	-9.3753*** (-7.8872)	-6.7685*** (-3.8216)	-40.0302*** (-6.6495)	-7.3285*** (-3.8694)
Intercept	101.2668*** (10.3434)	213.2170*** (7.2688)	101.2668*** (9.6366)	79.1435*** (5.1183)	426.1594*** (7.3694)	84.7972*** (5.2218)
F(6,X)	373,16 X=5897	299,58 X=905	-	129,51 X=2159	110,02 X=328	-
Wald $X^2(6)$	-	-	2122,15	-	-	697,01
Prob > F	0,0000	0,0000	-	0,0000	0,0000	-
Root MSE	21,22	-	-	19,584	-	-
Observations	5,904	5,904	5,904	2,166	2,166	2,166
Groups		906	906		329	329
R-squared	0.2698	0.3103[(a)]		0.2432	0.3069[(a)]	

Robust t-statistics in parentheses for POLS and FE and z-statistics for RE. Results of all models by size available upon request from the author. Significance levels: *** 1% ** 5% * 10%.
[(a)]Within R^2.

Results Discussion

Next, the empirical results obtained are contrasted with empirical evidence found in the literature (Banerjee et al., 2015; Barbosa et al., 2007; Bond & Van Reenen, 2007; Chirinko & Kalckreuth, 2002; Chirinko, 1993; Farinha & Prego, 2013; Jorgenson and Handel, 1971; Mizen & Velmouren, 2005; Von Kalckreuth, 2001). The focus of the discussion in the models were the results are stronger and the methodology attain better results: for total investment the *Model 2* and POLS methodology; and for Intangible Investment the *Model 4* and RE methodology.

Through the *Model 2*, using POLS it was observed that, as expected, the variables crisis *(cri_t)*, capital stock *($K_{i,t-1}$)* and average wage *$log(avgw)_{i,t}$* have a positive impact on investment rate of Portuguese firms of traditional manufacturing sector. The **crisis** always affects negatively the Investment and the recent crisis is expected to affect it in a more intensive way because it was borne in the financial system with the inherent consequences on the funding policies of the investment and on the decrease of the demand in the markets (domestic and external) where the firms studied operate. This

converges with the results obtained by Banerjee et al. (2015) for the period 1990Q1-2014Q3; Barkbu et al. (2015) for the period 1990-2012/13; Farinha & Prego (2013) for period the 2006-2011; and Kothari et al. (2014) for period the 1952-2010. The **capital stock** corresponds to productive capacity installed and it is expected that the investment rate decreases if the level of utilization of productive capacity is low (Barkbu et al., 2015; Clark et al. 1979; Oliner et al., 1995; Von Kalckreuth, 2001). Portugal is a country with a low ratio of capital per worker (BdP, 2014) which penalizes growth and productivity in sectors that used the factor human capital as main production factor, which is the case of most companies belonging to the traditional sector. Given the theoretical association between investment and productivity (Haskel et al., 2012 and Marrocu et al., 2012) it is expected that the *labor productivity* were statistically significant in the models tested, however, this only happened in linear models tested but not presented here.

The total of **sales** $(sales_{i,t-1})$, the **GPO** $log(profi)_{i,t}$ and the **investment/cash flow sensitivity** $(cshf_{i,t})$ have a positive impact on Total Investment. The positive impact on investment rate of **sales lagged by one year**, that captures the potential growth of the companies, converge to the results obtained in previous studies (Aivazian et al., 2005; Farinha & Prego, 2013; Von Kalckreuth, 2001). These results are also in line with the accelerator theory confirming the sensitivity of the investment rate to demand changes[14].

The **real growth of sales** is one of the most important factors for investment decisions (Von Kalckreuth, 2001). The expectations about future sales, which can be approximated by sales in the previous year, conditioned the investment rate of

[14] It would be expected that the lagged by more than one period (adopted by Von Kalckreuth, 2001) and the variation between two consecutive periods of sales (used by Barbosa et al., 2007; Bond et al., 2003 and Chirinko & Von Kalckreuth, 2002) produced significant results, however, after testing it, the results for those lagged variables are not statistical significant.

companies. Expectations regarding the financial and economic conditions of a country influence investment decisions (Banerjee et al., 2015; Chirinko, 1993). The positive estimation coefficient of **investment/cash flow sensitivity** means that the cash flow has a positive impact on investment rate so the funds that are created by the firm facilitate the investment because they contribute also to its funding and reflect the good performance of the firm. Chirinko and Von Kalckreuth (2002), using Generalized Method of Models (GMM), Fazzari et al. (1988) and Mizen and Vermeulen (2005) concluded that the investment/cash flows are higher for financial constrained companies. However, Chirinko and Von Kalckreuth (2002), using Ordinary Least Squares (OLS) estimators, and Cleary (1999) obtained symmetrical results. A possible reason, for these mixed results is the different model specification and econometric methodologies (e.g. GMM or OLS).

Through the *Model 4* (Intangible Investment), using RE, the variables that have a positive impact on investment rate of intangible assets are: the exports ($expr_t$), the funding cost $log(fcost)_{i,t}$ and total of employees $log(emp)_{i,t}$. The positive coefficient of exports shows that companies that invest more in intangible assets are export companies. The same association is not verified in tangible investment (*Model 3* – Table IV). From other tested variables and financial ratios only the funding cost $log(fcost)_{i,t}$ reveals a positive impact. Barbosa et al. (2007) and Farinha & Prego (2013) also studied the funding costs and Barbosa et al. (2007) conclude that for the exporting firms the decisions of investment are more affected by the productivity than for the financial situation.

By size, the results converge with results obtained by Marrocu et al. (2012) corroborating that the scale factor affects investment. The firm size was tested using

alternative measurement (e.g. lagged and not lagged of employment and turnover) and different specifications (incorporating in *Model 1* to *4*) and autonomously when tested models for subsamples according to the size of the companies in analysis. Although it is expected by literature (Bond & Van Reenen, 2007) that the highest technological level corresponds to a high rate of investment, the phenomenon, approximated by the variable percentage of employees in R&D does not present statistically significant.

By sector, the results show that sectors have different investment intensity and dynamics and the models specification vary across sectors (Table EI). Jorgenson and Handel (1971) studied the variation of investment behavior in regulated and in manufacturing UK firms[15] and also concluded that the dynamic across sectors differs. Using a POLS, the total investment of firms belonging to Textiles and Wearing is explained by *Model 1* (Table VI) and Food Products and Furniture by *Model 2* (Table VII). The estimated coefficients for these sectors are similar to the global investment. The exception is the Textiles where the crisis, the capital stock have a negative impact and the ROA and total of sales have a positive impact on investment rate.

By size categories there are also differences among the results obtained by the three subsamples analyzed. *Model 2*, considered to be a suitable model for small and medium companies (Table VIII) shows that: the crisis, the capital stock and average wage have a negative impact; and the total of sales, the gross profit operating and investment/cash flow sensitivity have a positive impact. For the period 1995-2005 large firms present high indebtedness (Barbosa et al., 2007) and high levels of debt is one factor that limits the investment prospects. In *Model 2* variables such as the level of indebtedness, financing costs and interest charges were tested, with weak statistical results. This result is probably explained because in large enterprises, the investment is

[15] This paper studies four sub-industries of the regulated sector: railroads, other transportation, public utilities, and communications.

not much affected by the financial situation (Farinha & Prego, 2013). The interest payment and the financial autonomy were also tested in various models but did not show to be statistically significant. It was expected this difference in results by size of companies, since small businesses have a riskier profile and a greater need to invest while larger companies are more mature businesses regarding their life (Barbosa et al., 2007); Farinha & Prego, 2013). For large companies, the *Model 2* did not become statistically significant.

Several studies (Chirinko & Von Kalckreuth, 2002; Cleary, 1999; Fazzari et al., 1988; Mizen & Velmouren, 2005) focus on the differing results in respect to the sensitivity of investment to the CF, however, make no specific differentiation by firm size. Small and medium sized companies as they face more restrictions on access to credit have greater sensitivity of investment to CF unlike large companies because of its size and importance in the market have easier access to credit (Banerjee et al., 2015; Pina & Abreu, 2012). There is thus a direct relationship with the CF investment for it is also influenced by monetary and financial policies, in particular with regard to restrictions on the investment loan (Banerjee et al., 2015).

4. Conclusions and Suggestions for Futures Research

Based on the analysis of panel data and descriptive statistics the following conclusions were obtained:

First, as expected, given the macroeconomic performance of the investment, in traditional sectors the crisis had a negative and decisive influence on firms' total investment (sum of tangible and intangible). The crisis is also the major explanatory determinant of investment behavior in four sectors (Food Products, Textiles, Wearing and Wood, and Furniture).

Second, using the lagged value of sales as a proxy, the demand expectations, affect total investment positively. This result is consistent with accelerator theories and the role of expectations in the private investment behavior.

Third, the results regarding the explanation of investment based on panel data, are influenced by the estimation methodologies adopted (POLS, FE and RE). There are strong indications that the specific characteristics of each company (e.g. firm's strategy), assumed constant over time, decisively influenced investment behavior because the Hausman test results suggest that the appropriate methodology for *Model 1* and *2* are the FE.

Fourth, the determinants of investment in tangible assets (*Model 3*) are different from investment in intangible assets (*Model 4*), and both differ from total investment (*Models 1* and *2*). In intangible investment, which corresponds to a low portion (about 4%) of total investment, positive determinants for investment were found to be the percentage of sales in the foreign market and the size of the company. *Model 3* presented weak results.

Fifth, the ROA and the investment/cash flow sensitivities associated with funding through equity contribute positively to investment when POLS estimates are used.

Sixth, a high accumulated capital stock from previous years does not encourage investment, particularly in a context of decreasing demand. Thus, the results showing a negative association between capital stock and investment converge with this reasoning.

Seventh, for some financial ratios and variables, the results from the models are not statically significant (variables: *financial autonomy, interest, indebtedness, D/E and solvability*). There is also a strong empirical evidence from survey data (ICI) that

Portuguese firms do not evaluate financial restrictions has the main obstacle to investment during the period under analysis.

Eighth, the investment in four subsectors (Food Products, Textiles, Wearing and Furniture) had a similar performance to that of total investment of the six sectors. For two subsectors (Footwear and Wood) no explanatory models common to those obtained for other samples were found.

Ninth, the financial situation of the firms belonging to a traditional sector contrasts across the six subsectors considered. Descriptive analysis shows that the Textile sector, which employs the largest share of workers, presented the highest value for financial autonomy. By contrast, the Wearing and Wood sector showed the lowest level of financial autonomy as well as the lowest labor productivity. The structure of capital measured by the debt-to-equity ratio (D/E) by firm, declined significantly across time in the most of sectors. For example, Wearing and Wood dropped from 7.8 in 2005 to -0.49 in 2009, and Furniture fell from 6.5 in 2007 to 2.1 in 2008.

Tenth, the separate study for each category of firm size (small, medium and large) indicates that the determinants of investment for small and medium firms are similar. For large enterprises, a minor share in the panel sample, the results are inconclusive as to the explanation for investment.

Eleventh, the qualitative information about the factors limiting investment collected from the entrepreneurs by Portuguese Investment Survey (ICI) does not contradict the quantitative results obtained from the modelling and descriptives. *Deterioration of sales perspectives* is the main reason for not investing (about 55%) while *interest* (interest rate level) and *financial autonomy* (self-funding capacity) are identified as having the lowest relevance, especially at the beginning of the period.

There are several limitations of the present study that need to be addressed: (i) because in modelling, a balanced panel of eight years is used, the conclusions only apply to the firms which survived during that period, i.e. have observations for all period 2004-2011. Consequently, there is a sample selection bias in the analysis, and the explanations found cannot extend to all firms operating during 2004-2011; (ii) because data are available for only some variables over the period 2010-2011 it precludes further examination of the causes of investment for the period 2004-2009; (iii) furthermore, the database does not include information about strategy, governance model or history of the firm, all of which affect investment behavior. Nor does it include enough information to create instrumental variables that could enable the use of other methodologies.

Future research could combine two lines of development: the inclusion of new variables and the application of more complex methodologies. The results suggest that non-accounting data sources should add explanatory factors: the specific characteristics of the firms (e.g. strategy); qualitative data from investment surveys (e.g. CFO expectations, following Shleifer (2015)); credit market conditions (e.g. obtained through ECB survey (BdP, 2015c)); and institutional and contextual variables (e.g. investment policies and political stability). Another topic worthy of further research is the study of longer panel data (i.e. with additional years of observation), because real investment, creating productive capacity, is by nature a decision that has effects in the medium or long run. Also related to the timing of investment is the time lag that usually exists between the fixed capital investment decision and the effective operation of the fixed capital.

Finally, there is room for improvement in the methodologies applied to the study of investment. For example, the use of the instrumental variables, such as in the GMM, developed by Arellano and Bond (1991) and Blundell and Bond (2000), following Bond & Van Reenen (2007), Bond (2002), Bond et al. (2003), Chirinko & Von Kalckreuth (2002), Janz (1997) and Von Kalckreuth (2001), could contribute to improving the models.

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Appendixes

Appendix A. Business Cycle, Databases and Samples

A.1. Original Data (2004-2011)

The original data has 43,000 firms and 340,836 observations. This data include the micro, small, medium and large firms. Size categories are based on the number of employees according to Statistic Portugal (2014): micro (1-9); small (10-49); medium (50-249) and large (≥ 250). The main steps of samples construction are presented at the end of this point.

TABLE AI

MANUFACTURING FIRMS BY TRADITIONAL SECTOR (2004-2011)

Year	Total number of firms	%[b]	Manufacture of Food Products 10[a]		Manufacture of Textiles 13		Manufacture of Wearing Apparel 14[a]		Manufacture of Leather 15		Manufacture of Wood and Cork 16		Manufacture of Furniture 31	
			N	%	N	%	N	%	N	%	N	%	N	%
2004	47,109	100	10,055	21.34	4,324	9.18	13,256	28.14	3,423	7.27	8,672	18.41	7,379	15.66
2005	45,863	100	10,124	22.07	4,245	9.26	12,541	27.34	3,321	7.24	8,404	18.32	7,228	15.76
2006	44,288	100	10,191	23.01	4,065	9.18	11,846	26.75	3,189	7.20	8,067	18.21	6,930	15.65
2007	44,069	100	10,328	23.44	4,115	9.18	11,879	26.96	3,137	7.12	7,857	17.83	6,753	15.32
2008	43,399	100	10,375	23,91	4,033	9.29	11,643	26.83	3,119	7.19	7,632	17.59	6,597	15.20
2009	40,875	100	10,098	24,70	3,811	9.32	10,688	26.15	2,932	7.17	7,168	17.54	6,178	15.11
2010	38,087	100	9,741	25.58	3,539	9.29	9,729	25.54	2,773	7.28	6,580	17.28	5,725	15.03
2011	37,146	100	9,582	25.80	3,429	9.23	9,388	25.27	2,996	8.07	6,290	16.93	5,461	14.70

[a]Manufacture of Food Products and of Wearing Apparel are the sectors with the largest number of firms in 2010 and 2011. [b]Due to rounding, the sum of the percentage does not exactly 100. (N=380,836)

Source: Author's calculation based on SCIE microdata.

TABLE AII

TRADITIONAL SECTOR FIRMS BY SIZE CATEGORIES (2004-2011)

	2004		2005		2006		2007		2008		2009		2010		2011	
	N	%[a]	N	%[a]	N	%[a]	N	%[a]	N	%[a]	N	%[a]	N	%[a]	N	%[a]
Micro	38,251	81.20	37,196	81.10	35,722	80.66	35,597	80.78	35,160	81.02	33,271	81.40	30,757	80.75	30,062	80.93
Small	7,263	15.42	7,155	15.60	7,104	16.04	7,019	15.93	6,835	15.75	6,331	15.49	6,096	16.01	5,838	15.72
Medium	1,467	3.11	1,390	3.03	1,352	3.05	339	3.04	1,297	2.99	1,182	2.89	1,145	3.01	1,153	3.10
Large	128	0.27	122	0.27	110	0.25	114	0.26	107	0.25	91	0.22	89	0.23	93	0.25
Total	47109	100	45863	100	44288	100	44069	100	43399	100	40875	100	38087	100	37146	100

[a]Due to the rounding, the sum of the percentage does not exactly equal 100. (N=380,836).

Source: Author's calculation based on SCIE microdata.

TABLE AIII

TURNOVER AND TOTAL OF EMPLOYEES BY SIZE (2011)

	Turnover		Total of employees	
	Mean	%	Mean	%
Micro	82662,65	0.12	2,29	0.39
Small	1070171,53	1.54	20,11	3.44
Medium	8648219,42	12.44	93,94	16.09
Large	59739108,59	85.91	467,46	80.07
Total	69540162,18	100	583,80	100

Unit: mean by firm. (N=380,836)
Source: Author's construction based on SCIE microdata.

TABLE AIV

SHARE OF TURNOVER AND TOTAL EMPLOYEES IN %

	2004	2005	2006	2007	2008	2009	2010	2011
Turnover	37.98%	37.18%	36.10%	35.38%	35.19%	35.33%	34,44%	34.24%
Total of Employees	52.36%	51.94%	51.54%	51.12%	50.53%	49.99%	49.89%	49.87%

(N=380,836)
Source: Author's construction based on SCIE microdata.

Table AI shows that the most relevant sectors in number of companies are the Wearing (between 2004 and 2009) and the Food Products (from 2010).

In 2011, the micro companies are the main size category representing about 81% of the total (Table AII). The large companies represent only 0.3% of the total number of firms (Table AII), but correspond to 86% of the total turnover and 80% of the total employment in six sectors (Table AIII).

Construction of Sample

From original data of SCIE are built three specific databases supporting one part of the empirical analysis: (i) one that embraces the whole sector including micro, small, medium and large companies and wherein support Appendix A.1 (ii) another that excluded micro companies and corresponds to 11,869 companies which are present in the database at least one of the eight years and it is excluded the companies that changed the sector under review of Appendix A.2 based on it (iii) finally, required by the modelling of balanced panel data, the sample only was restricted to companies that had at least 8 years, i.e. the companies are present in SCIE for the period 2004-2011. With this, the sample comprises 10,184 observations that correspond the 1,273 firms. It is based on this sample that are achieved and discussed all the results from the point 2.3 and Appendix A.3.

A.2. Small, Medium and Large Enterprises (2004-2011)

Some observations were eliminated: the firms that changed the sector. The higher incidence period of these changes was in the 2008-2009 period. In the sample were removed 11 companies where 5 corresponds to the passage of Wood and Furniture and the remaining correspond to the passage of Textiles for the Footwear. This data exclude the micro firms and the firms that changed the sector and it is considered only the positive values in GFCF and GAV_{fc} so the sample has 11,869 observations.

TABLE AV

INVESTMENT STRUCTURE BY FIRM (2010-2011)

			Sector					
		Total	Food Products	Textiles	Wearing	Footwear	Wood	Furniture
2010	Tangible Investment	97.34	97.63	96.20	97.02	98.36	98.00	96.56
	Intangible Investment	2.66	2.37	3.80	2.98	1.64	2.00	3.44
	Total (%)	100	100	100	100	100	100	100
2011	Tangible Investment	97.20	97.63	95.64	96.73	98.97	97.81	95.34
	Intangible Investment	2.80	2.37	4.63	3.27	1.03	2.19	4.66
	Total (%)	100	100	100	100	100	100	100

(N=11,869)
Source: Author's construction based on SCIE microdata.

TABLE AVI

INVESTMENT RATE MEAN BY SECTOR (2004-2011)

		2004	2005	2006	2007	2008	2009	2010	2011
Total number of non-financial firms		6,905	7,691	6,359	6,284	6,033	5,213	5,437	4,918
Total investment rate mean		14.57	13.06	24.29	24.46	24.65	28.48	23.25	21.66
Sector	Food Products	28.29	27.11	39.22	38.71	38.19	31.34	29.74	39.58
	Textiles	27.27	10.80	16.07	21.52	18.31	17.42	17.16	14.51
	Wearing	4.33	3.89	15.58	13.96	11.95	32.26	10.35	9.26
	Footwear	10.00	7.54	16.95	15.33	14.97	11.20	12.26	13.88
	Wood	20.17	16.24	25.27	23.05	48.57	44.88	34.87	23.90
	Furniture	6.73	18.26	25.01	35.73	22.49	30.30	48.68	18.83
Tangible investment rate mean								23.98	22.64
Sector	Food Products	n.a	n.a	n.a	n.a	n.a	n.a	30.47	41.24
	Textiles	n.a	n.a	n.a	n.a	n.a	n.a	18.64	15.37
	Wearing	n.a	n.a	n.a	n.a	n.a	n.a	10.86	9.41
	Footwear	n.a	n.a	n.a	n.a	n.a	n.a	12.79	14.73
	Wood	n.a	n.a	n.a	n.a	n.a	n.a	35.56	24.56
	Furniture	n.a	n.a	n.a	n.a	n.a	n.a	49.58	20.59
Intangible investment rate mean		0.79	0.76	1.19	0.68	0.70	1.07	0.38	0.42
Sector	Food Products	1.03	0.72	1.25	1.47	0.97	1.33	0.60	0.67
	Textiles	0.72	2.68	1.12	0.62	0.83	0.57	0.44	0.48
	Wearing	0.47	0.33	1.03	0.27	0.45	0.76	0.22	0.31
	Footwear	1.48	1.71	0.19	0.51	0.30	0.28	0.22	0.20
	Wood	0.93	0.41	0.57	0.35	0.44	0.77	0.22	0.30
	Furniture	0.52	0.34	0.54	0.61	1.23	2.87	0.53	0.32

n.a: not available data in the microdata. Unit: mean by firm. (N=11,869)

The Investment Rate is GFCF divided by GAV_{fc}; Tangible investment rate is tangible investment divided by GAV_{fc}; and Intangible investment rate is intangible investment divided by GAV_{fc}.

Source: Author's calculation based on SCIE microdata.

TABLE AVII

INVESTMENT RATE MEAN BY SIZE CATEGORIES (2004-2011)

		2004	2005	2006	2007	2008	2009	2010	2011
Total number of nonfinancial firms		6,905	7,691	6,359	6,284	6,033	5,213	5,437	4,918
Total investment rate mean		14.57	13.06	24.29	24.46	24.65	28.48	23.25	21.66
Size	Small	14.26	12.52	24.94	25.37	25.92	29.37	24.94	23.53
	Medium	15.83	15.57	21.18	20.23	18.78	24.26	16.06	14.48
	Large	16.92	16.70	25.16	24.45	26.06	29.93	13.82	14.88
Tangible Investment rate mean								23.98	22.64
Size	Small	n.a	n.a	n.a	n.a	n.a	n.a	25.63	24.68
	Medium	n.a	n.a	n.a	n.a	n.a	n.a	17.00	14.80
	Large	n.a	n.a	n.a	n.a	n.a	n.a	14.84	15.51
Intangible Investment rate mean		0.79	0.76	1.19	0.68	0.70	1.07	0.38	0.42
Size	Small	0.66	0.66	1.10	1.15	0.54	0.65	0.37	0.41
	Medium	1.30	1.14	0.98	1.56	1.37	3.02	0.40	0.38
	Large	2.78	2.06	9.31	0.68	1.15	1.38	0.77	0.94

n.a: not available data in the microdata. Unit: mean by firm. (N=11,869)

The Investment Rate is GFCF divided by GAV_{fc}; Tangible investment rate is tangible investment divided by GAV_{fc} and Intangible investment rate is intangible investment divided by GAV_{fc}.

Source: Author's calculation based on SCIE microdata.

A.3. Panel Data (2004-2011)

The final sample considers the small, medium and large companies that has at least 8 years of life, the positive values in GFCF and GAV_{fc} and excludes the companies that changed the sector: 1,273 firms and 10,184 observations.

A.4 Limitations of Database

The database has some restrictions in available data covering this period not including some data to compute variables. In this way, the capital stock variable $(K_{i,t})$ is a proxy of sum of GFCF because there is no available information about depreciations rate; the GPO variable is a proxy of cash flow; the R&D Personal $(empr\&d_{i,t})$ due to the availability of data only for the 2011 was made a proxy for the 2010 values (no real data) with exactly amounts.

For accounting data, there are measures that were inadequate for econometric models, e.g., it is report expenses on purchase of fixed capital but not exhibit in detail how it was distributed the same expenditure by type of assets (Bond & Reenen, 2007).

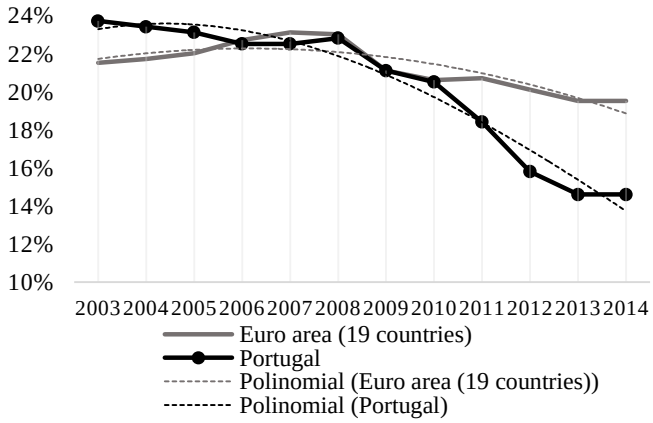

Figure A1. Gross Fixed Capital Formation - Investment (% of GDP)

Source: Eurostat (2015c); 2013 and 2014 are estimates.

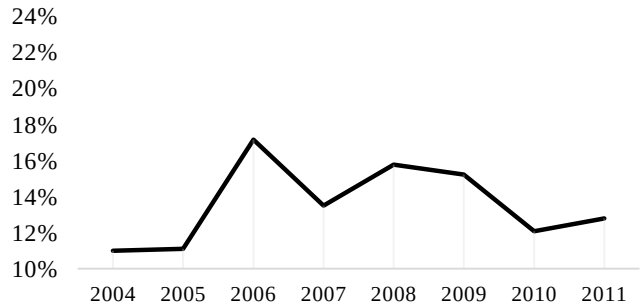

Figure A2. Investment Rate in the Portuguese Traditional Sector (2004-2011)

The investment rate is computed GFCF divided by GAV_{fc} . Different definition is adopted in modelling investment behavior. Firms included are the micro, small, medium and large companies and the $GAV_{fc} > 0$. (N=380,836)

Source: Author's construction based on SCIE microdata.

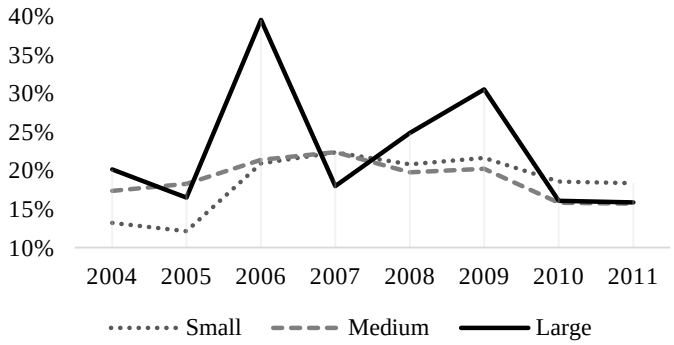

Figure A3. Investment Rate by Size, Portuguese Traditional Sectors (2004-2011)

The investment rate is computed GFCF divided by GAV_{fc}. Different definition is adopted in modelling investment behavior. Firms included are the small, medium and large companies and the $GAV_{fc} > 0$. (N=11,869)

Source: Author's construction based on SCIE microdata.

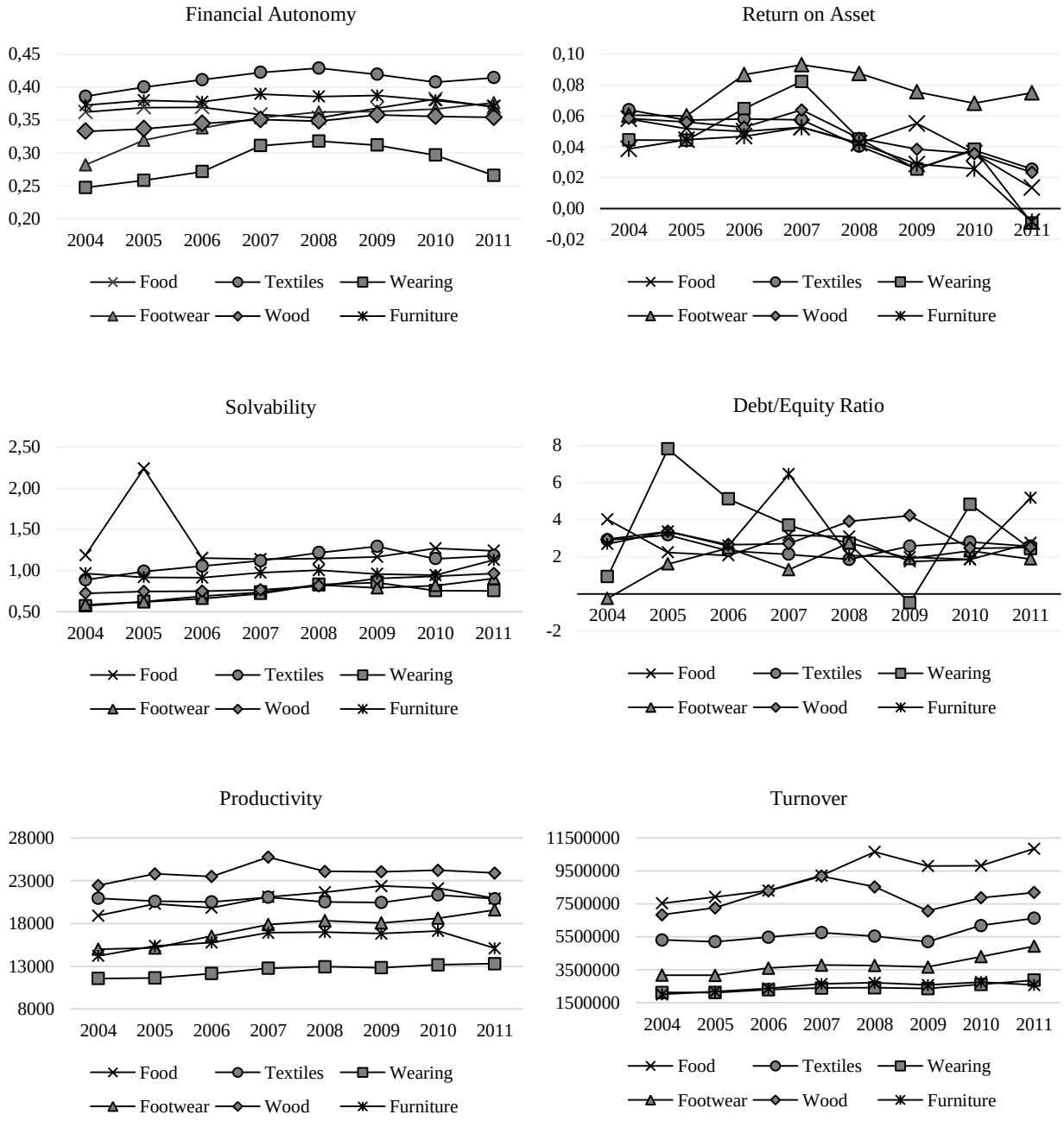

Figure A4. Financial Ratios and Variables by Sector (2004-2011)

Unit: mean by firm. See Table BIII for definitions of variables. (N=10,184)
Source: Author's construction.

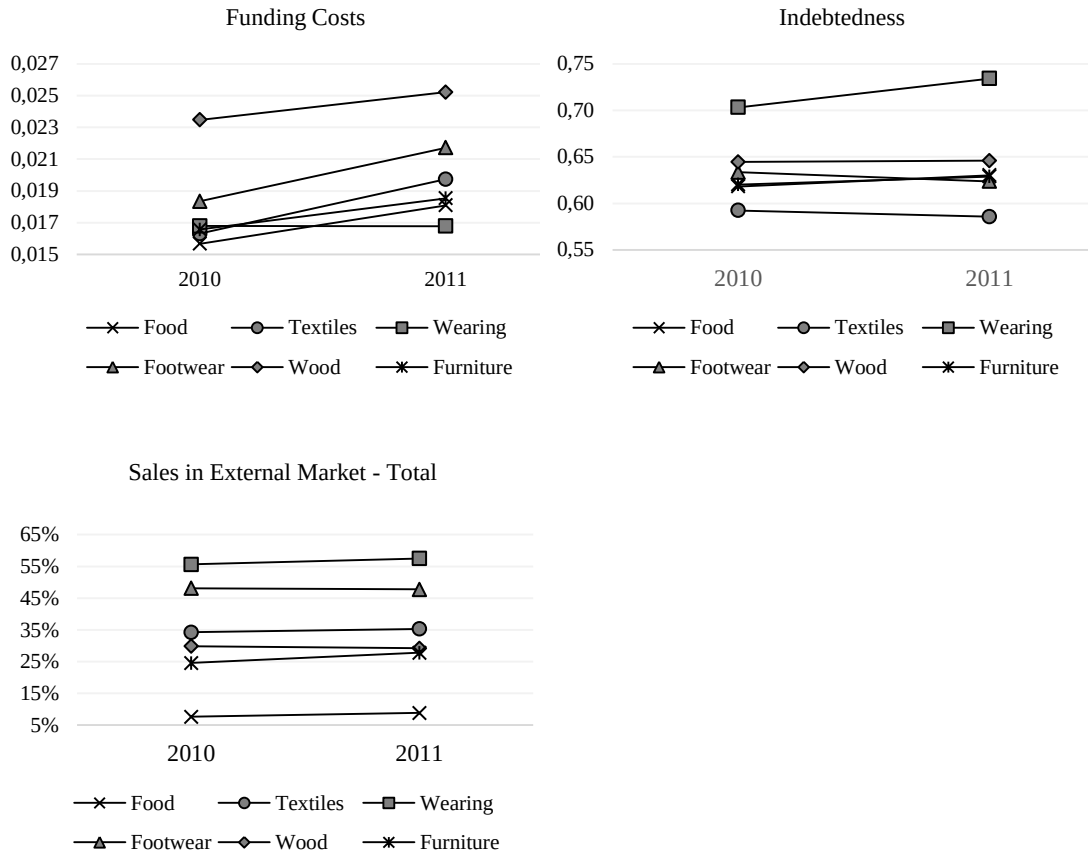

Figure A5. Financial Ratios and Variables by Sector (2010-2011)

Unit: mean by firm. See Table BIII for definitions of variables. (N=10,184)
Source: Author's construction.

Appendix B. Description of Variables

TABLE BI
TANGIBLE INVESTMENT CATEGORIES

Tangible Investment	Lands and natural resources investment
	Buildings and others construction investment
	Biological assets of production investment
	Basic equipment investment
	Transport equipment investment
	Office equipment investment
	Biological equipment investment
	Others tangible assets investment

Source: Author's construction based on SCIE microdata and Methodology, Rodrigues (2014) and IFRS.

TABLE BII
INTANGIBLE INVESTMENT CATEGORIES

Intangible Investment	Development project investment
	Goodwill investment
	Computer software investment
	Industrial property investment
	Other intangible assets investment

Source: Author's construction based on SCIE microdata and Methodology, Rodrigues (2014) and IFRS.

TABLE BIII
DEFINITION OF FIRM-LEVEL VARIABLES TESTED BUT NOT INCLUDED IN THE MODELS

	Description	Obs.
Dependent Variable		
Investment Rate 1	"This ratio relates the investment of non-financial businesses in fixed assets (buildings, machinery etc.) to the value added created during the production process" (Eurostat) (in perncent)	(a) (b)

TABLE BIII (cont.)

	$\frac{GFCF}{GAV_{fc}} \times 100$	
Investment Rate 2	Total annual expenditure for tangible and intangible investment in relation capital stock of previous year (in percent) $\frac{GFCF_t}{Capital\ Stock_{t-1}} \times 100$	(c) (d) (e) (f) (g) (h)
Investment Rate 3	Total annual expenditure for tangible and intangible investment in relation capital stock1 (in percent) $\frac{GFCF}{Capital\ Stock\ 1} \times 100$	-
Investment Rate 4	Total annual expenditure for tangible and intangible investment in relation the total of assets (in percent) $\frac{GFCF}{Asset} \times 100$	(i)
Explanatory Variables		
GFCF	Gross Fixed Capital Formation: total annual expenditure for tangible and intangible investment (in 10^6 euros)	-
Turnover	Firms turnover (in 10^6 euros)	-
Labor Productivity	Represents the contribution of labor used by the company $\frac{Gross\ Added\ Value\ at\ fator\ costs}{Employees\ in\ firm}$	(a)
Sales in External Market	Total: Openness on the community and non-community market: the percentage of the establishment's sales (in percent) $\frac{sales\ for\ community\ and\ non\ community\ market}{Total\ of\ sales} \times 100$ and =1 if at least 50% of sales are done in external markets; 0 otherwise $\frac{sales\ for\ community\ and\ non\ community\ market}{Total\ of\ sales} \times 100 > 50\%$ Community, EU-markets: Openness only on the community market: the percentage of the establishment's sales (in percent) $\frac{sales\ for\ community\ market}{Total\ of\ sales} \times 100$ Non-Community, Extra-EU markets: Openness only on the non-community market: the percentage of the establishment's sales (in percent) $\frac{sales\ for\ non\ community\ market}{Total\ of\ sales} \times 100$	-
Financial Autonomy	Measures the total assets that are funded by equity $\frac{Equity}{Assets}$	(a)
Interest	Weight interest costs to Gross Operating Income $\frac{Paid\ Interest}{Gross\ Operating\ Income}$	(c) (j)
Indebtedness	Reflects the share of debt capital in the financing of companies $\frac{Liabilities}{Liabilities + Equity}$	(a) (l)
Debt to Equity	$\frac{Liabilities}{Equiy}$	(l)
Solvability	Evaluates the company's ability to solve the liabilities assumed in the short, medium and long term $\frac{Equity}{Liabilities}$	(a) (l)
Capital Stock1	$\sum_{t=2004}^{n} GFCF_t - Desinvestment\ total_t$ (in 10^6 euros)	-

Adapted by (a) INE (2014b, 2015) (b) Eurostat (2015a) (c) Farinha & Prego (2013) (d) Oliner et al. (1995) (e) Von Kalckreuth (2001) (f) Mizen & Vermeulen (2005) (g) Bond et al. (2003) (h) Aivazian et al. (2005) (i) Kothari et al. (2014) (j) Barbosa et al. (2007) (l) Neves (2012)
Source: Author's construction.

Appendix C. Linear Models

In this research, at first, were tested linear models for period 2004-2011. Using as dependent variables the investment rate defined by INE and Eurostat (Investment Rate 1) and investment intangible rate ($Invintangrate_{i,t}$), the results obtained were not consistent with literature review. Therefore, the linear models are inadequate models to study the investment as was to be expected by the characteristics of

investment (pro-cyclical and usable component). Nevertheless, the main conclusions from the linear models were: first, the high importance of the sector remove the relevance of other variables; second, the sales growth rate becomes insignificant leading to think that expectations may influence the investment only after the occurrence of the crisis and third, from 2008, the lagged of productivity is positively related to the investment. On the other hand, using as dependent variable the investment intangible rate the conclusions are different: the sector loses relevance; financial ratios become explanatory variables (productivity has a positively impact and operating profitability a negatively impact) and total exports have a significant weight in intangible investment in 2011.

Appendix D. Descriptive Statistics and Correlations

TABLE DI

SUMMARY STATISTICS FOR DEPENDENT VARIABLES

	Mean	25th percentile	Median	75th percentile	Standard deviation
Full Sample 2004-2011 | N=10,184					
$Inv_{i,t}$	36.259	8.832	24.213	57.162	32.978
Full Sample 2010-2011 | N=2,546					
$Invtangrate_{i,t}$	8.660	0.000	0.623	7.045	33.400
$Invintangrate_{i,t}$	0.341	0.000	0.000	0.003	1.596

Source: Author's calculation based on SCIE microdata.

TABLE DII

SUMMARY STATISTICS FOR DEPENDENT VARIABLES BY SECTOR

	Mean	25th percentile	Median	75th percentile	Standard deviation
Food Products 2004-2011 | N=4,048					
$Inv_{i,t}$	33.9717	8.3469	22.7781	49.8389	31.90900
Food Products 2010-2011 | N=1,012					
$Invtangrate_{i,t}$	11.7739	0.0000	0.8103	9.4553	43.9502
$Invintangrate_{i,t}$	0.2548	0.0000	0.0000	0.0000	1.1764
Textiles 2004-2011 | N=1,056					
$Inv_{i,t}$	34.0591	7.1830	21.7080	52.2328	32.96271
Textiles 2010-2011 | N=264					
$Invtangrate_{i,t}$	8.0978	0.0000	0.7769	8.3771	19.7713
$Invintangrate_{i,t}$	0.4895	0.0000	0.0000	0.0752	2.0530
Wearing 2004-2011 | N=2,112					
$Inv_{i,t}$	40.3614	9.9884	28.6450	66.2504	34.13353
Wearing 2010-2011 | N=528					
$Invtangrate_{i,t}$	3.7625	0.0000	0.3615	3.1443	10.3048
$Invintangrate_{i,t}$	0.2884	0.0000	0.0000	0.0000	1.4381
Footwear 2004-2011 | N=688					
$Inv_{i,t}$	38.7985	12.1113	28.4203	56.8133	32.29408
Footwear 2010-2011 | N=172					
$Invtangrate_{i,t}$	5.6251	0.0000	1.3295	7.1671	10.3714
$Invintangrate_{i,t}$	0.3466	0.0000	0.0000	0.0577	1.6240
Wood 2004-2011 | N=984					
$Inv_{i,t}$	33.8310	7.7354	21.2596	53.3933	32.28371
Wood 2010-2011 | N=246					
$Invtangrate_{i,t}$	8.5714	0.0000	0.3766	7.3694	30.3431
$Invintangrate_{i,t}$	0.1429	0.0000	0.0000	0.0000	0.6783
Furniture 2004-2011 | N=1,296					
$Inv_{i,t}$	39.0068	8.6711	26.3769	69.5064	34.31893
Furniture 2010-2011 | N=324					
$Invtangrate_{i,t}$	9.0531	0.0000	0.8284	7.1641	37.7123
$Invintangrate_{i,t}$	0.7214	0.0000	0.0000	0.1430	2.6398

Source: Author's calculation based on SCIE microdata.

TABLE DIII

SUMMARY STATISTICS FOR DEPENDENT VARIABLES BY SIZE

	Mean	25th percentile	Median	75th percentile	Standard deviation
Small 2004-2011 | N=7,248					
$Inv_{i,t}$	37.0825	8.8294	25.1689	59.8921	33.20155
Small 2010-2011 | N=1,722					
$Invtangrate_{i,t}$	9.2203	0.0000	0.4945	6.4905	38.8885
$Invintangrate_{i,t}$	0.2752	0.0000	0.0000	0.0000	1.5142
Medium 2004-2011 | N=2,640					
$Inv_{i,t}$	34.3257	8.7622	21.5525	52.1727	32.47874
Medium 2010-2011 | N=738					
$Invtangrate_{i,t}$	7.4232	0.0000	0.9253	7.3226	17.3478
$Invintangrate_{i,t}$	0.4090	0.0000	0.0000	0.1306	1.5143
Large 2004-2011 | N=296					
$Inv_{i,t}$	33.3422	9.6822	22.6651	47.3674	31.06721
Large 2010-2011 | N=86					
$Invtangrate_{i,t}$	8.0612	0.1492	1.8441	11.9760	12.3597
$Invintangrate_{i,t}$	1.0707	0.0000	0.0669	0.6375	3.0502

Source: Author's calculation based on SCIE microdata.

TABLE DIV

SUMMARY STATISTICS FOR INDEPENDENT VARIABLES

	Mean	25th percentile	Median	75th percentile	Standard deviation
Full Sample 2004-2011 | N=10,184					
cri_t	0.38	0.00	0.00	1.00	0.484
$K_{i,t}$	1259143.73	68322.00	238490.00	775817.50	5337253.76
$\log(ROA)_{i,t}$	-3.086	-3.653	-3.037	-2.419	1.007
$sales_{i,t}$	5798199.37	378745.25	1291794.00	4173297.50	24782365.081
$log(profi)_{i,t}$	11.927	10.854	11.892	12.937	1.539
$cshf_{i,t}$	4.992	0.229	0.506	1.295	249.436
$\log(avgw)_{i,t}$	9.348	9.111	9.321	9.558	0.341
Full Sample 2010-2011 | N=2,546					
$expr_t$	0.33	0.00	0.00	1.00	0.470
$\log(fcost)_{i,t}$	-4.51	-5.00	-4.17	-3.61	1.46
$empr\&d_{i,t}$	0.002	0.00	0.00	0.00	0.014
$\log(emp)_{i,t}$	14.4860	13.373	14.331	15.401	1.417

Source: Author's calculation based on SCIE microdata.

TABLE DV

SUMMARY STATISTICS FOR INDEPENDENT VARIABLES BY SECTOR

	Mean	25th percentile	Median	75th percentile	Standard deviation
Food Products 2004-2011 | N=4,048					
cri_t	0.38	0.00	0.00	1.00	0.48
$K_{i,t}$	2046493.72	112292.50	344850.50	1091095.25	7971553.11
$\log(ROA)_{i,t}$	-3.0840	-3.6637	-3.0108	-2.3894	1.0501
$sales_{i,t}$	8959920.10	462542.50	1371678.50	5428309.25	36913002.42
$log(profi)_{i,t}$	12.0295	10.8743	11.9171	13.0832	1.6459
$cshf_{i,t}$	0.9219	0.1825	0.3722	0.8490	5.3100
$\log(avgw)_{i,t}$	9.4100	9.1722	9.3797	9.6131	0.3553
Food Products 2010-2011 | N=1,012					
$expr_t$	0.12	0.00	0.00	0.00	0.321
$\log(fcost)_{i,t}$	-4.6047	-5.0885	-4.1638	-3.6478	1.5120
$empr\&d_{i,t}$	0.0019	0.0000	0.0000	0.0000	0.0113
$\log(emp)_{i,t}$	3.6261	2.8904	3.4012	4.1705	0.9297
Textiles 2004-2011 | N=1,056					
cri_t	0.38	0.00	0.00	1.00	0.48
$K_{i,t}$	1398228.04	117654.25	397567.50	1278296.75	3554442.65
$\log(ROA)_{i,t}$	-3.1965	-3.7502	-3.1807	-2.5710	0.9693

TABLE DV (cont.)

$sales_{i,t}$	4818571.69	18779.50	1559983.50	5906835.50	8385618.16
$log(profi)_{i,t}$	12.4815	11.4734	12.5252	13.5299	1.4410
$chsf_{i,t}$	3.1510	0.2729	0.5684	1.4320	29.1995
$\log(avgw)_{i,t}$	9.4100	9.1722	9.3797	9.6131	0.3553
Textiles 2010-2011 | N=264					
$expr_t$	0.47	0.00	0.00	1.00	0.50
$\log(fcost)_{i,t}$	-4.5321	-4.9734	-4.0544	-3.5647	1.6318
$empr\&d_{i,t}$	0.0025	0.0000	0.0000	0.0000	0.0086
$\log(emp)_{i,t}$	3.8433	3.1355	3.7377	4.5299	0.9493
Wearing 2004-2011 | N=2,112					
cri_t	0.38	0.00	0.00	1.00	0.48
$K_{i,t}$	253783.09	15898.25	68742.00	236899.25	608569.88
$\log(ROA)_{i,t}$	-2.9170	-3.5269	-2.8667	-2.2118	1.0048
$sales_{i,t}$	2075625.73	0.00	375798.00	2192204.00	4599164.03
$log(profi)_{i,t}$	11.1719	10.1921	11.0693	12.1460	1.4107
$cshf_{i,t}$	3.5248	0.2687	0.7727	2.7383	16.7758
$\log(avgw)_{i,t}$	9.1486	8.9806	9.1224	9.3038	0.2617
Wearing 2010-2011 | N=528					
$expr_t$	0.65	0.00	1.00	1.00	0.477
$\log(fcost)_{i,t}$	-4.5499	-5.1057	-4.3651	-3.6447	1.3384
$empr\&d_{i,t}$	0.0003	0.0000	0.0000	0.0000	0.0030
$\log(emp)_{i,t}$	3.6561	2.9957	3.5694	4.1705	0.81074
Footwear 2004-2011 | N=688					
cri_t	0.38	0.00	0.00	1.00	0.48
$K_{i,t}$	648577.86	83191.25	270259.00	717506.75	1510801.09
$\log(ROA)_{i,t}$	-2.8106	-3.4221	-2.7769	-2.1352	0.9721
$sales_{i,t}$	3705050.60	968155.50	2498124.50	5001491.50	4151725.84
$log(profi)_{i,t}$	12.1705	11.4364	12.3109	12.9420	1.1988
$cshf_{i,t}$	46.6041	0.3609	0.6783	1.8469	958.0300
$\log(avgw)_{i,t}$	9.3262	9.1289	9.3019	9.5131	0.2767
Footwear 2010-2011 | N=172					
$expr_t$	0.54	0.00	1.00	1.00	0.50
$\log(fcost)_{i,t}$	-4.6599	-5.0888	-4.2652	-3.7946	1.8370
$empr\&d_{i,t}$	0.0021	0.0000	0.0000	0.0000	0.0096
$\log(emp)_{i,t}$	3.9408	3.4094	3.9219	4.4998	0.7887
Wood 2004-2011 | N=984					
cri_t	0.38	0.00	0.00	1.00	0.48
$K_{i,t}$	1325561.92	123626.50	388536.50	1129654.75	3128838.01
$\log(ROA)_{i,t}$	-3.1815	-3.6414	-3.1333	-2.6778	0.8806
$sales_{i,t}$	7722440.78	885065.25	2401933.50	5504381.00	22346279.41
$log(profi)_{i,t}$	12.4610	11.5320	12.4886	13.3175	1.3807
$cshf_{i,t}$	1.2976	0.2896	0.6152	1.3281	3.6908
$\log(avgw)_{i,t}$	9.5473	9.3312	9.5366	9.7407	0.34508
Wood 2010-2011 | N=246					
$expr_{i,t}$	0.41	0.00	0.00	1.00	0.49
$\log(fcost)_{i,t}$	-4.1240	-4.5374	-3.8347	-3.3254	1.2039
$empr\&d_{i,t}$	0.0017	0.0000	0.0000	0.0000	0.0068
$\log(emp)_{i,t}$	3.6106	2.9444	3.4499	4.1666	0.87469
Furniture 2004-2011 | N=1,296					
cri_t	0.38	0.00	0.00	1.00	0.48
$K_{i,t}$	598626.53	55390.25	177607.00	597581.25	1277551.31
$\log(ROA)_{i,t}$	-3.3456	-3.8390	-3.2970	-2.7532	0.9355
$sales_{i,t}$	2437512.40	563986.75	1139207.00	2638519.00	4492795.44
$log(profi)_{i,t}$	11.7672	10.9303	11.7213	12.6331	1.2481
$cshf_{i,t}$	2.3121	0.2464	0.5398	1.4742	9.3348
$\log(avgw)_{i,t}$	9.2749	9.0577	9.2393	9.5047	0.3121
Furniture 2010-2011 | N=324					
$expr_t$	0.36	0.00	0.00	1.00	0.48
$\log(fcost)_{i,t}$	-4.3936	-4.8251	-4.1619	-3.6455	1.1971
$empr\&d_{i,t}$	0.0045	0.0000	0.0000	0.0000	0.0299

TABLE DV (cont.)

$\log(emp)_{i,t}$	3.5284	2.9444	3.4811	3.9512	0.7475

Source: Author's calculation based on SCIE microdata.

TABLE DVI

SUMMARY STATISTICS FOR INDEPENDENT VARIABLES BY SIZE

	Mean	25th percentile	Median	75th percentile	Standard deviation
Small 2004-2011 | N=7,248					
cri_t	0.38	0.00	0.00	1.00	0.48
$K_{i,t}$	394921.03	48796.00	144560.50	418281.75	754403.19
$\log(ROA)_{i,t}$	-3.0596	-3.6351	-3.0170	-2.3931	1.0090
$sales_{i,t}$	1719611.50	288605.75	765596.50	1953578.50	2929598.39
$log(profi)_{i,t}$	11.3814	10.5457	11.3878	12.2491	1.2597
$cshf_{i,t}$	5.8047	0.2258	0.5046	1.2862	294.7777
$\log(avgw)_{i,t}$	9.2894	9.0629	9.2533	9.4974	0.3322
Small 2010-2011 | N=1,722					
$expr_t$	0.22	0.00	0.00	0.00	0.41
$\log(fcost)_{i,t}$	-4.5441	-5.1189	-4.2138	-3.6342	1.4282
$empr\&d_{i,t}$	0.0006	0.0000	0.0000	0.0000	0.0068
$\log(emp)_{i,t}$	3.1681	2.8332	3.1781	3.5553	0.4462
Medium 2004-2011 | N=2,640					
cri_t	0.38	0.00	0.00	1.00	0.48
$K_{i,t}$	2303366.14	272696.75	774342.50	2111352.25	5749948.51
$\log(ROA)_{i,t}$	-3.1482	-3.6916	-3.1020	-2.4955	0.9920
$sales_{i,t}$	10477046.19	2427646.75	5209168.50	11500263.00	21873526.98
$log(profi)_{i,t}$	13.0847	12.3776	13.1059	13.8590	1.2170
$cshf_{i,t}$	3.1758	0.2376	0.5091	1.3106	38.0792
$\log(avgw)_{i,t}$	9.4792	9.2706	9.4458	9.6539	0.3223
Medium 2010-2011 | N=738					
$expr_t$	0.54	0.00	1.00	1.00	0.50
$\log(fcost)_{i,t}$	-4.4271	-4.8009	-4.0552	-3.5561	1.4989
$empr\&d_{i,t}$	0.0043	0.0000	0.0000	0.0000	0.0218
$\log(emp)_{i,t}$	4.5351	4.2195	4.4773	4.8122	0.4098
Large 2004-2011 | N=296					
cri_t	0.38	0.00	0.00	1.00	0.49
$K_{i,t}$	13107586.33	1743223.25	4938851.00	13489743.25	22463134.63
$\log(ROA)_{i,t}$	-3.1799	-3.7697	-3.0471	-2.3568	1.0575
$sales_{i,t}$	63938230.91	19480454.50	36855282.00	67459089.50	112751364.95
$Log(profi)_{i,t}$	14.9184	14.2877	14.9151	15.6411	1.1594
$cshf_{i,t}$	1.2977	0.1949	0.5274	1.2223	2.8517
$\log(avgw)_{i,t}$	9.5975	9.3995	9.5499	9.7982	0.2822
Large 2010-2011 | N=86					
$expr_t$	0.54	0.00	1.00	1.00	0.50
$\log(fcost)_{i,t}$	-4.6665	-5.0015	-4.2361	-3.6902	1.5821
$empr\&d_{i,t}$	0.0081	0.0000	0.0000	0.0072	0.0201
$\log(emp)_{i,t}$	6.0626	5.6827	5.9623	6.3669	0.4414

Source: Author's calculation based on SCIE microdata.

Through previous tables, it is observed that there are trends in average values by firm of several independent variables in full sample. The variables capital stock $(K_{i,t})$ and total of sales $(sales_{i,t})$ present average values by firm different being the Food Products and the large firms higher values. The variable return on assets $log(ROA)_{i,t}$ and funding cost $log(fcost)_{i,t}$ exhibit negative values and the values are close of mean and median. The export intensity across sectors is another differentiating factor. The Wearing is considered, in mean, the most exporter sector and the Food Products the least exporter. A common factor by sector and by size of company is the similar and low value in the average wage per worker approximately 9.5%. The firms belong to Textiles (0.49%) and Furniture (0.72%) and large firms (1.07%) have higher investment in intangible assets.

TABLE DVII

CORRELATION VARIABLES OF MODEL 1 AND 2

	Investment Rate ($Inv_{i,t}$)	Crisis ($cri_{i,t}$)	Capital Stock ($K_{i,t}$)	$\log(profi)_{i,t}$	Total of sales ($sales_{i,t}$)	Invest/CF sensitivity ($cshf_{i,t}$)	Average wage $\log(avwg)_{i,t}$
Investment Rate ($Inv_{i,t}$)	1						
Crisis ($cri_{i,t}$)	-0,520*	1					
Capital Stock ($K_{i,t-1}$)	-0,097**	0,114**	1				
$\log(profi)_{i,t}$	-0,035**	0,002	0,388**	1			
Total of sales ($sales_{i,t-1}$)	-0,028**	0,014	0,745**	0,401**	1		
Invest/CF sensitivity ($cshf_{i,t}$)	-0,033**	-0,015	-0,004	0,000	-0,003	1	
Average wage $\log(avgw)_{i,t}$	-0,217	0,191**	0,254**	0,566**	0,272**	-0,016	1

Significance levels of correlations: ** 1% and * 5%.

Source: Author's calculation based on SCIE microdata.

TABLE DVIII

CORRELATION VARIABLES OF MODEL 3 AND 4

	Investment Tangible Rate $Invtangrate_{i,t}$	Investment Intangible Rate $Invtangrate_{i,t}$	Exports $expr_t$	Funding costs $\log(fcost)_{i,t}$	R&D Personal $empr\&d_{i,t}$	Total of employees $\log(emp)_{i,t}$
Investment Tangible Rate $Invtangrate_{i,t}$	1					
Investment Intangible Rate $Invtangrate_{i,t}$	0,033	1				
Exports $expr_t$	-0,031	0,107**	1			
Funding costs $\log(cost)_{i,t}$	0,062**	0,050*	0,072**	1		
R&D Personal $empr\&d_{i,t}$	0,001	0,080**	0,047*	0,035	1	
Total of employees $\log(emp)_{i,t}$	-0,028	0,106**	0,341**	0,018	0,146**	1

Significance levels of correlations: ** 1% and * 5%.

Source: Author's calculation based on SCIE microdata.

Appendix E. Summary Results for Investment Models

TABLE EI

MAIN QUALITATIVE RESULTS FOR TOTAL INVESTMENT MODEL BY SECTOR

	Model 1						Model 2					
	Food	Textiles[(a)]	Wearing[(a)]	Footwear	Wood	Furniture[(a)]	Food[(a)]	Textiles	Wearing	Footwear	Wood	Furniture[(a)]
Crisis (cri_t)	○	-	-	○	○	-	-	○	○	○	○	-
Capital Stock $(K_{i,t-1})$	○	-	-	○	○	-						
$\log(ROA)_{i,t}$	○	+	+	○	○	+	-	○	○	○	○	-
Total of sales $(sales_{i,t-1})$	○	-	+	○	○	+	+	○	○	○	○	+
$\log(profi)_{i,t}$							+	○	○	○	○	+
Invest/CF sensitivity $(cshf_{i,t})$							+	○	○	○	○	+
Average wage $\log(avwage)_{i,t}$							-	○	○	○	○	-
Intercept	○	+	+	○	○	+	+	○	○	○	○	+

[(a)] It is an appropriate model because all of variables are statically significant using pooling regression. The estimated coefficients are present in detail in framework (Table VI and Table VII).

TABLE EII

MAIN QUALITATIVE RESULTS FOR TOTAL INVESTMENT MODEL BY SIZE

	Model 1			Model 2		
	Size S[(a)]	Size M[(a)]	Size L	Size S[(a)]	Size M[(a)]	Size L
Crisis (cri_t)	-	-	○	-	-	○
Capital Stock $(K_{i,t-1})$	-	-	○	-	-	○
$\log(ROA)_{i,t}$	+	+	○			
Total of sales $(sales_{i,t-1})$	+	+	○	+	+	○
$\log(profi)_{i,t}$				+	+	○
Invest/CF sensitivity $(cshf_{i,t})$				+	+	○
Average wage $\log(avwage)_{i,t}$				-	-	○
Intercept	+	+	○	+	+	○

Note: Some variables tested in Model 3 and 4 were also tested in these models but the results were not good and other variables have not been tested by lack available data.

[(a)] It is an appropriate model because all of variables are statically significant using pooling regression. It considered that the Model 2 is more suitable due to the estimated coefficients and R-squared. The estimated coefficients and all other information about this model are present in detail in framework (Table VIII).

Source: Author's construction.

Appendix F. The Portuguese Investment Qualitative Survey

The ICI is preformed every six months by Statistics Portugal (INE), to all sectors belonging to the CAE Rev. 3[16], to understand in more depth the progress and investment obstacles in Portuguese companies. Following Eurostat, ICI is a quantitative and qualitative survey made Portuguese's businessman about yours economic activity expectations and allow analyze the behavior, limitations and composition of GFCF not making the difference between tangible and intangible assets (INE, 2012). The question of survey has a qualitative component that evaluates the trend of sales and businessman expectations in relation to prices, output and employment and a quantitative component that evaluates the main obstacles for investment and the impact of investment amount in number of employees in company (INE, 2014a).

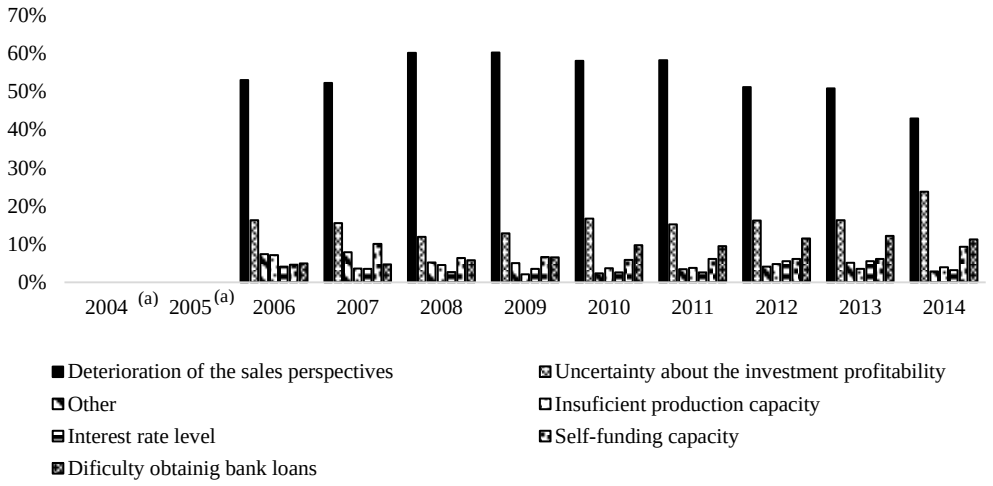

Figure F1. Main Factor Limiting Investment[(b)] for Manufacturing Industries (2004-2014)

[(a)] n.a: not available data (INE, several years, xls data). [(b)] Only one factor can be selected by the respondents.

Source: Author's construction based on ICI (INE, several years).

[16] Correspond to NACE Rev.2