

A Work Project, presented as part of the requirements for the Award of a Master's Degree in  
Finance from the Nova School of Business and Economics

# **TO INVEST OR NOT TO INVEST? THE FACTORS THAT SOLVE THE QUESTION**

ACROSS ALL SECTORS AND AGRICULTURE SECTOR

Rita Alexandra Ambrósio Vasconcelos - 38966

In partnership with:



A Project carried out on the Master's in Finance Program, under the supervision of:

Prof. Melissa Prado (Academic Advisor)

Dra. Sandra Pinho (Business Advisor)

January 9<sup>th</sup>, 2023

## **Abstract**

We examine macroeconomic and microeconomic factors that influence investment decisions taken by Portuguese SMEs. We find from a macroeconomic perspective, the EPU index, interest rate and inflation to be statistically significant and to drive down the investment rate, whereas the GDP growth rate has a positive impact. From a microeconomic perspective, we find lagged investment, EBITDA margin, lagged retention ratio, long-term debt, tangible collateralizable assets and firm size to be statistically significant factors positively influencing investment, whereas lagged effective tax rate and financing costs have a negative effect. In addition, motivated by the statistical relevance of collateralizable assets in explaining investments, we explore how bank financing can evolve within the context of a digital economy. Finally, a sectorial analysis on the agriculture sector s performed. We find that different factors affect investment in this sectors.

### **Keywords:**

Investment decisions, SMEs, Bank financing, Macroeconomic factors, Microeconomic factors, Intangibles, Portugal

## **Acknowledgements**

Firstly, we would like to thank our academic advisor, professor Melissa Prado, for all the support and guidance during the composition of this Work Project. We would also like to thank our business advisor, Dra. Sandra Pinho, and all remaining members of the DMEI team at BPI for the warm welcoming and all the valuable contributions during the project. Lastly, we are also grateful to professors Afonso Eça and António Martinho for their important insights that helped us shape the content here presented.

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209).

# Table of Contents

<b>1. Introduction</b>	<b>3</b>
<b>2. Literature Review</b>	<b>6</b>
2.1. The Portuguese Context	6
2.2. The Dependent Variable: Investment Rate	7
2.3. Macroeconomic Variables	7
2.4. Microeconomic Variables	15
<b>3. Methodology</b>	<b>26</b>
3.1. Dataset	26
3.2. Dependent variable: Investment rate	27
3.3. Independent variables and descriptive statistics	28
3.4. Econometric methodology	34
<b>4. Results and Discussion</b>	<b>38</b>
4.1. Macroeconomic model results	40
4.2. Microeconomic model results	44
<b>5. Financing Investment in a Digital Economy</b>	<b>55</b>
5.1. Characterization of intangible investments	56
5.2. The Portuguese context	58
5.3. How are banks adapting to the context of a digital economy?	63
5.4. How should BPI adapt to the market transformation?	67
<b>6. Conclusions</b>	<b>71</b>
<b>7. Limitations and Future research</b>	<b>72</b>
<b>8. Agriculture Sector Analysis</b>	<b>73</b>
<b>9. References</b>	<b>90</b>
<b>10. Appendix</b>	<b>98</b>

## 1. Introduction

Firm investment is crucial to stimulate the economic development and sustainable growth of a country (Wehinger 2011). Throughout the years, much literature refers to the numerous factors impacting firms' investment decisions (Farooq et al. 2021; Pacheco 2017; Farinha and Prego 2013). Given the significance of firm investment on economic activity, understanding the determinant factors behind firms' investment decisions is essential, which raises important questions. What are the effects of macroeconomic and microeconomic factors on firms' investment decisions? What drives firms to postpone their investment projects? Do the expected factors affect investment decisions as intuitively anticipated?

The research was done in collaboration with Banco BPI and aims to find an answer to the questions posed above. According to Wehinger (2011), financial institutions play a role in ensuring investment channels are in place for firms, while Gómez (2019) elaborated on how credit constraints deter firms' investments. In that regard, these findings set the motivation for BPI to extend its understanding of the factors influencing firms' investment decisions. Our analysis is focused on small and medium-sized enterprises (SMEs), excluding micro firms from our analyses. In addition, since microenterprises often exhibit investment patterns that are highly uncorrelated to internal factors and the macroeconomic scenario, their exclusion shields the models from probable outliers. In 2019, the aggregate investment of SMEs was around €16,218 million, demonstrating an upward trend in the last ten years, except for 2020 due to the pandemic crisis, reinforcing the importance of the analysis of factors affecting firms' investments.

Using data from *Banco de Portugal* database, a two-fold analysis is conducted, separating macroeconomic from microeconomic variables, on the relevant factors affecting the investment

decisions of non-financial private firms spread across all industries. Although the regression analysis is done separately, the choice of the variables is not random since most of the macroeconomic variables considered greatly influence the microeconomic indicators of the firms under consideration. The analysis consists of a dynamic panel data methodology, employing a GMM-System estimator, which was introduced by Arellano and Bover (1995) and improved by Blundell and Bond (1998). Our data consists of an unbalanced set of 55,739 SMEs for the period from 2006 to 2020. In 2019, the sample accounts for sales of approximately €47bn, and €83bn of total assets. Moreover, firms' aggregate investment in the sample amounts to €2.7bn, representing an investment rate of 10.5%.

The dependent variable presented in our model is defined as investment in both tangible and intangible assets (Farinha and Prego 2013). Although not currently relevant for BPI (since BPI does not finance intangible intensive firms with little to nontangible collateralizable assets), intangible assets were included in our model given the increasing importance that they have been assuming in the investments undertaken by firms (Thum-Thyssen et al. 2017). The set of macro and microeconomic explanatory factors chosen follow the relevance attributed to them by the literature further developed below. Our findings present that the Economic Policy Uncertainty Index (EPU), GDP growth rate, Inflation Rate, firm's profitability, internal funds (measured by the retention rate), external funds (stock of debt), financing cost, effective tax rate, the level of tangible assets to serve as collateral and firm size are significant factors in explaining investment decisions undertaken by firms.

Critically reflecting on the results obtained, key conclusions take us to a different section of this research. More specifically, we find strong dependability of investment decisions on tangible collateralizable assets. Evidence collected from cross-country banking sectors, suggests that banks' liquidity creation has been having a crucial role in boosting investment in tangible assets, while not contributing much to the growth of industries heavily reliant on intangible assets

(Beck et al. 2020). Nevertheless, the contribution of intangibles to output growth has been increasing considerably, being one to three times superior to the contribution of tangibles within the EU-15 (Thum-Thysen et al. 2017).

Furthermore, in Portugal, the lack of knowledge among the banking on how to evaluate the risk inherent to intangible assets and projects creates credit constraints for innovative firms (EIB Investment Survey 2021). The rise in the pace with which the world is moving towards a more knowledge-based economy is bound to force a change in the traditional banking system (Demmou and Franco 2021). In this regard, important questions are raised. How are banks and economies adapting to the increasing relevance of intangible-intensive firms? Can BPI position itself as a relevant player in financially supporting these firms?

Thus, the next section of this research is focused on analysing the challenges posed to traditional banks by the economic transformation in place. In that regard, we analyse the intangibles financing market in other economies. Given the literature findings of a rise in the importance of such market, we compose a set of recommendations for BPI to position itself as a relevant player in the digital economy to come, based on practices to achieve deep knowledge regarding intangible assets. The set of recommendations should help BPI to better evaluate the credit risk of intangible intensive firms, ultimately allowing the bank to benefit from competitive advantage within the Portuguese banking sector to the financing of innovative firms, contributing to a swift transition of the Portuguese economy to a knowledge-based one.

Finally, an additional individual analysis is performed on firms belonging to the agricultural sector. The sector was chosen given the marketing and historical relevance it has for BPI and because it aggregates a relevant share of firms with which BPI establishes lending relations. We indeed find that different factors affect firms' investment in this sector.

## 2. Literature Review

### 2.1. The Portuguese Context

According to the National Statistics Office, Portuguese SMEs are crucial to the development of the country's economy. In 2020, the Portuguese micro, small and medium sized enterprises accounted for 99.7% of all firms and 71.8% of the country's workforce. Moreover, non-financial SMEs were responsible for approximately 59.6% of the total turnover and 69% of the total aggregate investment. In 2020, Portuguese enterprises consisted of 89.6% of micro firms, 8.7% small firms and 1.4% medium-sized firms. Portuguese non-financial and private firms accounted for only 0.3% of large-sized firms (Banco de Portugal 2020).

Portuguese firms are also found to be more leveraged than their European peers (IMF 2019). This implies that Portuguese SMEs' risk profiles may differ from those usually perceived in other studies about the relationship between investment and firm situations. Even though this difference has decreased over time, the high levels of corporate debt in these enterprises is still transversal across industries.

The Commission Recommendation 2003/361/EC defined micro, small and medium-sized enterprises in the following way:

- "The category of micro, small and medium-sized enterprises (SMEs) is made up of firms which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million."
- "Within the SME category, a small enterprise is defined as a firm which employs fewer than 50 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 10 million."

- “Within the SME category, a microenterprise is defined as a firm which employs fewer than 10 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 2 million.”

## **2.2. The Dependent Variable: Investment Rate**

Studying the factors influencing corporate investment is crucial given the importance of firms’ investments for a country’s economic development, as previously denoted in Wehinger (2011). Moreover, several authors have studied certain factors impacting corporate investments for Portuguese SMEs in specific. Farinha and Prego (2013) explored how Portuguese firms’ financial status influenced their level of investment and Pacheco (2017) studied how firm specific factors, regarding their capital structure and profitability measures, impact their investment decisions. However, no papers are found to analyse the impact of both a macroeconomic and a microeconomic perspective on the factors affecting firms’ investments in the Portuguese context. Moreover, we also analyse more (micro) factors than those of the mentioned authors.

## **2.3. Macroeconomic Variables**

Given the influence of investments on the macroeconomic scenario of a country we are also interested in understanding if macroeconomic indicators produce changes to investment decisions taken at firm level. Below we present available literature in that regard.

### **2.3.1. Economic Policy Uncertainty**

Uncertainty is a crucial element influencing corporate investments, as firms prefer to operate more cautiously during periods of high uncertainty, consequently delaying investment choices

(Al-Thaqeb and Algharabali 2019). The Economic Policy Uncertainty Index (EPU) is a commonly used statistic to highlight the environment's uncertainty. The index is calculated using media coverage of policy-related economic uncertainty, tax code changes, and monetary policy changes.

Hassett and Metcalf (1999) and Fernandez-Villaverde et al. (2011) both in Kang et al. (2014) found that the impact of uncertainty is mediated by fiscal policy. They demonstrated that the stability of budget adjustments and tax credit work as a subsidy to boost firms' investment, whereas fiscal volatility produces a negative impact on economic activity.

Kang et al. (2014) discovered that firms' investments is affected by the interaction between firm specific uncertainty (or micro uncertainty) and economic policy uncertainty (or macro uncertainty). Precisely, this study demonstrated that EPU negatively impacts investment decisions of firms, and that the influence of economic policy uncertainty on firms' investments is stronger for firms with greater firm specific uncertainty. The uncertainty caused by the EPU shock in interaction with the uncertainty at the company level (volatility in stock prices) has a substantial impact on the investment choices made by the firm.

Baker et al. (2013) in Kang et al. (2014) described the components contributing for economic policy uncertainty (tax legislation expiry, news-based policy uncertainty, federal spending, and CPI). The author examined the influence of economic policy uncertainty on corporate investment for 2700 US companies from 1985 to 2010. Policy shocks based on the news have a major detrimental effect on the long-term investment decisions of businesses. In both the short-run and long-run, a shock to the federal government's expenditure policy has also a detrimental impact on corporate investment. Inflation and tax policy shocks are found not to have a major impact on investment at the company level. In addition, empirical data indicate

that the effect is quantitatively magnified throughout the years 2007–2010, indicating that this variable has a greater impact on investment decisions during times of crisis (Kang et al. 2014).

In addition, Julio and Yook (2012) discovered that political uncertainty influences the investment expenditures of businesses. According to the study, a rise in uncertainty can only reduce current investment if there is a possibility of a negative outcome. In the context of national elections, this implies that enterprises may postpone investment in expectation of potentially unfavourable changes to the country's general macroeconomic (taxes or monetary policies) and regulatory environment. Comparing election years to non-election years, firms' investment tends to fall by an average of 4.8% due to concerns regarding growth potential and economic circumstances. In certain instances, though, the results of an election might be interpreted as good news regardless of who ultimately wins.

Given the previously outlaid literature, it can be hypothesised that,

***Hypothesis 1:*** Uncertainty is significant and negatively related to investment activity.

### **2.3.2. GDP growth rate**

Unlike other macroeconomic metrics, a high GDP growth rate affects the whole economic cycle. For instance, when GDP increases, per capita income rises as well, resulting in an increase in consumer's demand. This shock impacts firms' operations as they have to meet this increase in demand for goods. Therefore, as firms' operations are internally related to each other, firms start to expand all their operations through capital expenditures, such as the purchase of additional machinery, buildings, and other assets (Farooq et al. 2021).

Accordingly, despite the GDP's impact on the entire economy, it also has an impact on the fundamentals of firms' investment decisions. According to Becker (2006), when the economy

is booming, firms increase their investment in more profitable projects to guarantee a return. Therefore, a threshold decline in the GDP growth rate has a detrimental effect on corporate investment decisions (Valadkhani 2009 in Farooq et al. 2021).

Additionally, a higher GDP growth rate boosts the whole economic cycle, which lowers corporate costs and improve the ease of doing business. This ease of doing business draws business owners' attention and leads to increased investment (Tokuoka 2013 in Farooq et al. 2021).

On the basis of these findings, it can be hypothesised that,

***Hypothesis 2:*** GDP growth rate is significant and has a positive effect on company investment.

### **2.3.3. Interest rate**

Literature on the impact the interest rate has on investment decisions is not fully clear. On the one hand, a survey made by Graham and Harvey (2001) revealed that investment choices are frequently made using rules of thumb, such as the payback period, instead of traditional economic models (mainly in small firms or by older, long-tenure CEOs). Moreover, members of J.P Morgan's corporate finance advisory group clarify why it is still improbable that the cost of capital for most firms suffers a material increase even if interest rates increase as they are forecasted to. This is due to the high and sticky hurdle rates (Morgan 2014). Both pieces of information imply that investment decisions may be less susceptible to variations in interest rates than assumed by traditional investment theory.

On the other hand, traditional investment theory believes changes in interest rates to have a significant impact on corporate investment, more specifically, a negative impact. According to

such theory, monetary policy can alter the desirable capital stock and investment, as the required capital stock is partly determined by the interest rate. The expected effects are that lower interest rates decrease the capital expenditures of a firm and induce a lower financing cost, which stimulates companies to invest more and boosts the amount of successful investment projects; in contrast, when interest rates are higher, investors are eventually discouraged from investing in fixed assets (Farooq et al. 2021).

On the basis of these findings, it can be hypothesised that,

***Hypothesis 3:*** Interest rate is significant and negatively related to investment level.

#### **2.3.4. Inflation rate**

Inflation is a key macroeconomic variable that affects numerous business activities in any country and threatens economic growth (Ayyoub, Chaudhry and Farooq 2011 in Farooq et al. 2021).

An increasing inflation rate indicates money is losing its value, which, ceteris paribus, decreases consumers' purchasing power and increases the cost of investing. Given this, periods of high inflation rates are associated with uncertainty and are considered unfavourable times for companies to invest (Farooq et al. 2021). Consequently, in high inflationary periods, there is a reduction in the investment activity of companies.

Prezas (1991) elaborated on how, for constant tax-paying firms, optimal investment is lower when inflation rate is higher, as the latter has an impact on the probability of accounting loss, interest tax shields and the real value of depreciation.

In addition, Hochman and Palmon (1983) demonstrated that the influence of inflation on investment is independent of a firms' capital structure.

Given the consensus on the impact inflation has on firms' investment decisions, it can be hypothesised that,

***Hypothesis 4:*** Inflation rate is significant and has an inverse relationship with corporate investment.

### **2.3.5. Fiscal policy**

Another important macroeconomic factor influencing firms' investment decisions is related to the fiscal policy pursued by the government. Possible measures of fiscal policy are direct transfers from the state to firms, in the form of subsidies for instance, and the decisions the government makes on the corporate tax rate. It is anticipated that changes in fiscal policy have significant effects on the capital structure of firms, which will ultimately affect firms' investment decisions. Tax policy changes, for instance, alter both the cash flows of investment opportunities and the corresponding discount rate, thus affecting investment decisions as well (Haley 1971). However, given the little variability throughout the years to the aggregate corporate tax rate charged on Portuguese firms, a macroeconomic variable of the corporate tax rate would not be a relevant explanatory variable. Thus, a variable of effective tax rate for each firm will be retrieved later on, as a microeconomic variable since this will present higher variability.

One important factor promoting firms' investments, especially within the Portuguese context, is related to the availability of European funds to finance the investment projects of both the state and the firms. European funds delivered to Portuguese firms under the scope of European Regional Development Fund (ERDF) have been crucial to stimulate firms' investments. As an example, the *Portugal 2020* fund, that falls within ERDF, amounted to 30.9B€; 20.3B€ of which have already been invested as of the second term of 2022. 41% of *Portugal 2020* is

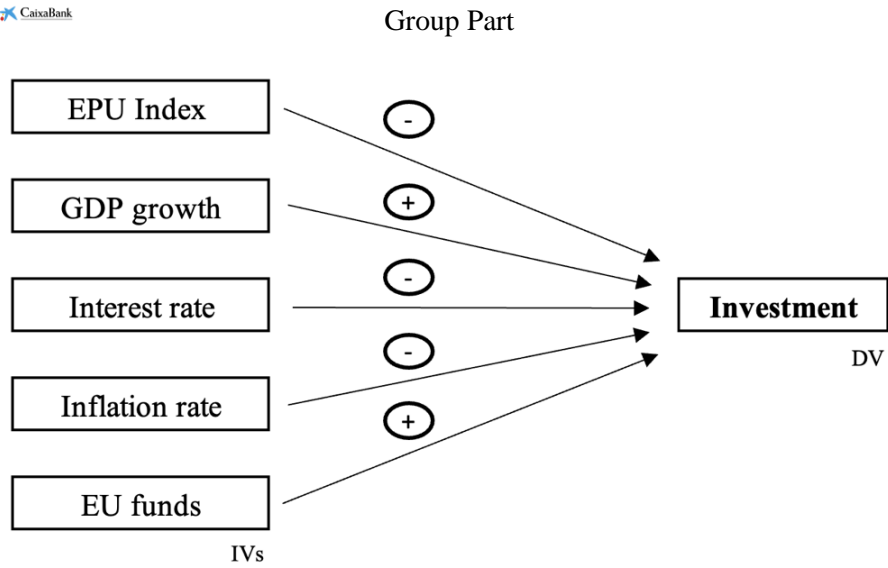
intended directly to improve the competitiveness of Portuguese firms, through the support of investments in both tangible and intangible assets, according to *Banco Português de Fomento* policy guidelines.

Thus, understanding how firms in Portugal have responded to past stimulus packages is particularly relevant given the additional funding that Portugal has received from the EU - *Portugal 2030*, which amounts to 23B€. *Portugal 2030* establishes, as a priority, the digitalization of the Portuguese economy, therefore much of the funding is expected to be allocated to projects able to foster the transition from an industrial to a knowledge-based economy.

Liu et al. (2018), based on evidence from the investments undertaken by Chinese firms, pointed out that stimulus packages implemented by the government allow both State Owned Enterprises (SOEs) and non-SOEs to obtain better access to bank loans and motivate them to incur in more investment, which is important to achieve economic recovery. The evidence is, however, weaker for SOEs when compared to non-SOEs and weaker also in regions where corruption is more widespread.

Within the European framework, Aiello et al. (2020) found grants and funds to be relevant drivers for investment in innovation by SMEs. This importance is especially notorious when comparing the investment pattern of EU and non-EU SMEs. The authors also found that the tougher access to credit by SMEs to finance their innovative investments induces them to search for alternative sources of funding, such as funds and grants. Public support is, therefore, shown to be important to the easing of constraints on access to credit for firms seeking to finance their innovative investments. Given this, it is hypothesized that,

***Hypothesis 5:*** Stimulus packages is significant and positively related to investment activity.



**Figure 1:** Summary of the expected relation between the Macroeconomic Variables and Investment

## 2.4. Microeconomic Variables

While the macroeconomic variables evaluate how firms are affected by the state of the economy irrespective of their capital structure, we find relevant to explore how firm-specific characteristics influence their investment decisions. We are also highly motivated by much discussion and conflicting results in the literature. Therefore, we decide to include and evaluate the effect of the chosen set of variables that are presented next.

### 2.4.1. Previous investment

Eberly et al. (2012) found evidence that points towards the statistical relevance of a lagged effect of investment in the investment decisions undertaken by firms in subsequent periods. Christiano et al. (2005) confirmed that the specification of investment adjustment costs predicts the manifestation of a lag-investment impact. In fact, the results of this study revealed lagged investment to be one of the most relevant predictors of a firms' current investment.

Such fact is also further sustained by Bloom et al. (2009) in Eberly et al. (2012). The author analysed a set of 4000 firms dispersed between the US, Europe, and Asia. The study is done by analysing the decision-making procedure that sustains the investment budget of plant managers. Often firm managers set it, by default, equal to last year's budget. If the plant manager disagrees with the budget and asks for increases to the amount invested, it increases the likelihood that the budget will not be approved by the firm's management. This is further evidence that demonstrates that past investment decisions impact current ones.

On the basis of these findings, it can be hypothesised that,

***Hypothesis 6:*** Previous Investment is significant and positively related with investment level.

## 2.4.2. Profitability

Companies with higher levels of profitability, according to Pacheco (2017), tend to invest more in the following year, confirming that profitability and investment move in the same direction. Nonetheless, Pacheco (2017) also found that the profitability variable may be either representing the importance of internal funds on investment, in case agency problems and financial constraints take place, or may be operating as an alternative for investment opportunities.

In particular, using micro-econometric procedures and detailed data from a sample of private and non-financial enterprises presented in the Bank of Spain Database from 1985 to 2001, Hernando and Martínez-Carrascal (2008) investigated how firms' tangible investment respond to a range of indicators (profitability being one) that are typically taken into consideration to describe the financial position of firms. The results for the sensitivity of investment to the profitability variable revealed to be statistically significant and positive.

These theories support the "investment-cash flow hypothesis." Investment-cash flow sensitivity (ICF) has been analysed extensively in corporate finance literature. According to several studies, companies that are already more susceptible to severe financing constraints have a larger investment-cash flow sensitivity. Consequently, firms' financial conditions, mainly cash flow levels, are critical drivers of corporate investment (Brown 2009). According to Pacheco (2017), information asymmetries between managers and its creditors may explain why investment decisions rely on firm's internal financial conditions.

On the basis of these findings, it can be hypothesised that,

***Hypothesis 7:*** Profitability is significant and positively related with the level of investment.

### 2.4.3. Internal funds

As mentioned previously, profits are one of the most important aspects of a business. Without profits, a company cannot think of internal sources of finance. Having this in mind, a possible metric to measure internal funds is the retention ratio, as it takes into consideration the share of net income retained to fund business' operations.

#### **Retention ratio**

Some researchers have studied, for many years, the influence that internal funds have on firms' investment decisions. In the first place, it is crucial to determine how firms can fund their projects and initiatives. Internal financing, debt financing, and equity issuance are the most common methods for companies to finance new investments. In addition, leasing is also a way that firms can acquire machinery and other production equipment. According to the "pecking order theory", companies rely first on internal funds, then on debt, and finally on equity issuance. This theory states that information asymmetries make internal funding less expensive than external funding, which is why companies should prioritize internal financing (Myers and Majluf 1984).

The question is whether or not internal funds are capable of independently explaining firms' investment decisions. There have been many studies (e.g. Oliner and Rudebusch 1992; Whited 1992) confirming that internal funds are able to explain investment spending for firms that are expected to face financing restrictions when accessing external financing.

Moreover, according to Vogt (1994), companies with low long-term dividend policies, and hence a high long-term retention ratio, are considerably more dependent on internal funds than firms with higher pay-out policies. This finding is coherent with the "pecking order theory",

which states that internal funds have a significant positive influence on business' investment expenditures.

Given the consensus on the influence that firm internal funds have on corporate investment decisions, it can be hypothesised that,

***Hypothesis 8:*** Retention Ratio is significant and positively related with the level of investment.

#### **2.4.4. Effective tax rate**

As previously mentioned, the effective tax rate is influenced by the tax policy pursued by the government. However, the effective tax rate, i.e. the taxes paid as a proportion of a firms' earnings, varies from company to company. This variation is mainly due to decisions made by the firms' managers regarding the allocation of the earnings or given some tax avoidance incentives in place (Sánchez-Ballesta et al. 2021). The fact that the effective tax rate varies across different firms, entails that this variable will be rather considered a microeconomic (firm-specific) one.

According to the Tax Foundation Database, the corporate tax rate has been declining over the years. The worldwide corporate tax rate averaged roughly 48% in 1980, while in 2020 it averaged approximately 36%. At the moment, the average rate in Portugal is 31.5%, ascending from an all-time minimum corporate tax rate of 26.5% registered in 2010.

According to Haley (1971), changes in corporate tax rates impact firms' investment decisions by changing the cash flows of investment opportunities and the rate used to discount these cash flows. Both the influence of these taxes on cash flows and the potential implications of firms' taxes on the discount rate have been widely analysed in literature.

Although a decrease in the effective tax rate decreases the interest tax shield value for firms that incur in debt to finance their investments, most literature found suggests that lower corporate tax rates might stimulate investments through the relaxation of liquidity constraints (Masso 2002) or by reducing banks' agency costs and bankruptcy rates (Strulik 2008), which positively impact companies' investment decisions.

Vartia (2008) also found that increasing the corporation tax rate has a detrimental effect on firm-level investment. Specifically, corporate income taxes discourage investment by increasing the cost of capital. Another part of this study is related to the potential linkages between taxes and productivity, which confirmed the theory that taxes impact productivity by multiple channels and that, due to distinguishing industry aspects, certain industries are intrinsically more impacted by tax rates than others.

Given the literature found, it can be hypothesised that,

***Hypothesis 9:*** Effective income tax rate is significant and negatively related to investment.

#### **2.4.5. External funds**

Regarding how the level of debt impacts firms' investment, literature is anything but in consensus. Nevertheless, numerous studies do agree that financing decisions undertaken by firms are in alignment with the "pecking-order theory". This indicates that firms rely primarily on internal funds, but when these are insufficient, firms prefer to use debt to fund (the rest of) their investment needs (Fama and French 2002; Pacheco 2017). It is, therefore, expected that debt can aid in explaining the investment patterns of SMEs.

Farinha and Prego (2013), using data of Portuguese firms, demonstrated that, the financial position of a firm is a significant factor as an explanatory variable of firms' investment

decisions. They found variables related to a firm's financial constraints, including leverage, to display a negative impact on investment. Moreover, other authors such as Cleary (1999) also found a negative relationship between debt and investment.

There is, however, a method that can create more interesting results regarding the impact that the level of debt has on firm investment— analysing both effects of short- and long-term debt, which Pacheco (2017) did. Initially, Pacheco (2017) hypothesised investment and debt to be positively related. However, in his results, total debt despite presenting a negative coefficient, was always insignificant. Then, he segmented debt according with its maturity (short- and long-term). He found that firms' level of short-term debt presents a negative and statistically significant coefficient with investment, on which he elaborated implying that if firms have payments due soon, this may motivate them to forgo investment projects. For long-term debt, in contrast, he found a positive coefficient, to which he explained that firms with higher investment rates seem to not be financially limited, as they are able to incur in more debt in order to finance larger investments. Moreover, these firms obtain accumulated assets, through the issued debt, which further eases the little limitations they have, as they can now provide a higher level of collaterals on the loans they ask for.

In addition, according to Vermeulen (2002) in Pacheco (2017), debt is more relevant in explaining investment during recessions and for small firms, indicating that larger firms may have other financing alternatives. In contrast, Farinha and Prego (2013) stated that larger firms are more capable of lowering informational asymmetries between the firm and creditors, and are financially constrained, given their financial situation seems to not be a determining factor in deterring investment for these firms. This implies that when a small firm and a larger firm are both financially constrained, the larger can more easily get access to credit than the small firm.

Given the literature found, it can be hypothesised that,

***Hypothesis 10:*** Stock of short-term debt is significant and negatively related with the level of investment.

***Hypothesis 11:*** Stock of long-term debt is significant and positively related with the level of investment.

#### **2.4.6. Assets to serve as collateral**

Firm-specific factors seem to be important to the perception of idiosyncratic risk that financial institutions attribute to certain firms when granting credit. One specific metric that much literature finds important for the risk analysis performed by banks when lending money is the firms' availability of tangible assets to serve as collateral.

The increasing availability of tangible assets on a company's balance sheet is expected to result in better conditions when obtaining credit, i.e., reduced interest rates paid on loans. Some studies have discovered evidence that confirms this relation. Titman (2013) stated the relevance of collateralizable tangible assets in debt financing, arguing that tangible assets are essential for firms to boost capital expenditure, particularly to innovation, in order to promote the expansion of the capabilities of existing technologies. Mayer (1990) in Gan (2007) agreed that the presence of tangible assets on a firm's balance sheet is fundamental since bank loans, the major source of external financing, are mostly backed by tangible collateral. This suggests that a higher availability of collateral facilitates debt financing and, consequently, fosters firms' investment activity. Gan (2007) also analysed whether a decline in collateral value impacts the investing activity of firms. The results demonstrated that decreases in the collateral value diminish firms' borrowing capacity, which in turn results in decreased investment rates (Gan 2007).

However, Gan (2007) argued that, despite the common consensus in the literature regarding the collateral channel impact, there are few studies recognizing and measuring its full economic effect.

Given the literature found, it can be hypothesised that,

***Hypothesis 12:*** Tangible assets to serve as collateral is significant and positively related with investment.

#### **2.4.7. Financing cost**

Binsbergen et al. (2010) found the firm-specific cost of debt to be mainly influenced by company characteristics such as the collateral value, the firm size, the level of intangibles and the firm's cash flows. The paper also found that there is a higher cost associated with being over levered than that associated with being under levered.

According to conventional investment theory, there should be a monotonic ordering of firms' investment levels based on how severe their financing constraints are. Such a theoretical assertion appears completely reasonable given that, in general, the more severely financially constrained a corporation is (either due to restrictions on credit availability or higher financing costs), the fewer the occasions in which the firm will still consider the investments to be worthwhile pursuing (Kasahara 2008). According to the author's model, the financially constrained firm invests later than the unconstrained firm, given its cost constraints. Nevertheless, the severely constrained firm, subject to both cost and no-financing limitations, might invest sooner than the unconstrained one. This outcome results from the severely constrained firm's pre-emptive incentive: even though it may encounter relatively high financing costs at the time, it might participate more actively in its investment decisions to

prevent additional financing risks in the future (Kasahara 2008). Thus, this would imply that despite higher financing costs, some firms may still choose to invest more.

Hirth and Uhrig-Homburg (2010) studied how the investment timing from firms is influenced by liquidity constraints and capital market frictions. Firms delay investments when such frictions and constraints, including the cost of debt, are expected to increase in the present. Whereas, when future financing costs are expected to rise, firms anticipate and accelerate their current investments.

Farinha and Prego (2013), through evidence collected from Portuguese SMEs for the period comprehended between 2006 and 2011, demonstrated that a firm's financial situation is significant as an explanatory factor of investment decisions, as they found a statistically significant negative coefficient for the cost of debt, implying that the likelihood of future investments to be profitable to pursue decreases as the cost of capital increases. These findings corroborate the idea that the financial strain organisations experience does influence their investment decisions.

Hoffmann and Kleimeier (2021) studied the cost of capital for innovative firms. The authors concluded that because innovative firms carry greater risks for lenders, derived from possible innovative failure, uncertain and volatile investment cash flows, and few assets to use as collateral, innovative firms end up facing greater financing constraints which are reflected in an increased financing cost, in comparison to non-innovative firms.

Given the literature discussed, it can be hypothesised that,

***Hypothesis 13:*** Cost of debt is significant and negatively related with investment.

### **2.4.8. Firm size in volume**

Literature on the impact firm size has on investment decisions is in disagreement. On the one hand, Beck et al. (2005) found firm size to be negatively correlated with financial constraints, which in turn curtails investment and firm growth. The authors consider financial constraints to be related with difficulties in dealing with bank bureaucracy, the need to have special connections with banks to access credit and collateral requirements demanded. In other words, the higher the firm is in volume, the less financial constraints it should be subject to. And, as fewer financial constraints are seen by Beck et al. (2005) to increase investment (due to the negative relation between the two), this implies that bigger firm size in volume increases investment.

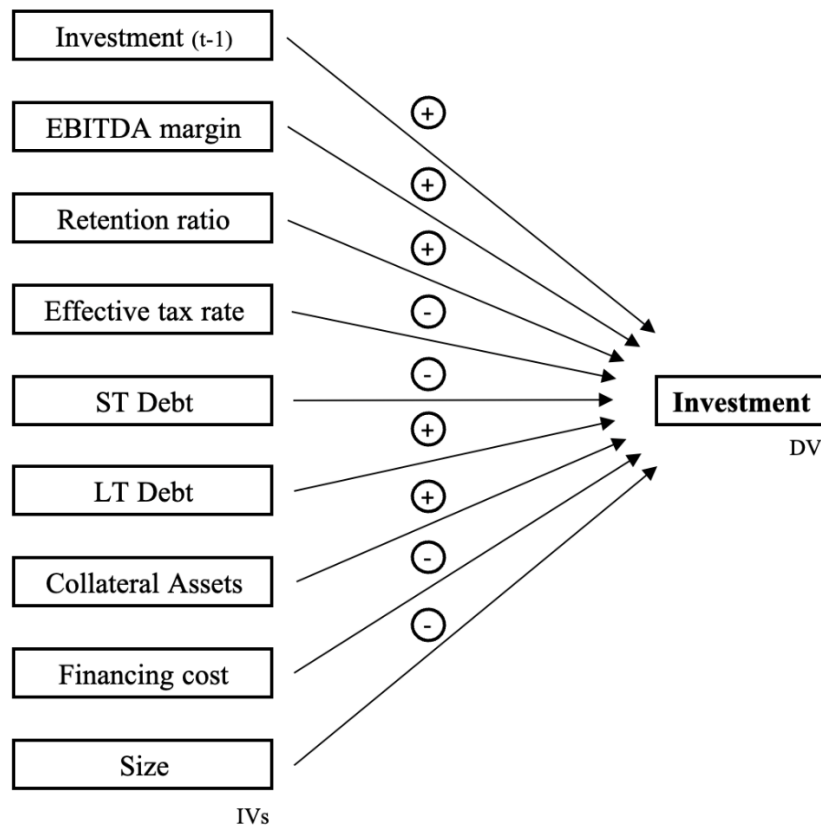
Similarly, Pacheco (2017) stated that smaller, often younger firms tend to be presented with a higher financing cost as these firms usually don't have much of an operating history and have fewer collaterals to serve as guarantee to loans, which leads them to be considered riskier. Thus, since the author also found a negative relation between financing cost and investment, smaller firms are expected to be subject to higher financing costs and in turn, incur in less investment. This suggests a positive relation between a firm's size and its rate of investment.

In spite of this, larger, therefore more mature and established firms, may present lower investment rates, possibly as a result of technological diminishing returns to scale and/or increasing returns to scale regarding external financing costs, which in turn, imply a negative effect of firm size on investment (Gebauer et al. 2017 in Pacheco 2017). Indeed, the results from the study by Pacheco (2017) demonstrated that a firm's size has a negative impact on a firms' investment rate.

Additionally, Pacheco (2017) asserted that smaller firms invest more, probably due to their desire to grow and achieve a minimum level of efficiency in order to survive. SMEs may also reduce investment levels once they reach beyond a certain size in order to stabilize their growth. Again, this implies a negative relation between firm size and investment.

Given this literature, it can be hypothesised that,

**Hypothesis 14:** Firm size is significant and negatively related with investment activity.



**Figure 2:** Summary of the expected relation between the Microeconomic Variables and Investment

## 3. Methodology

### 3.1. Dataset

The dataset chosen, both for the analysis of the macro and microeconomic factors will consist of a 14-year dataset which begins in 2006 and ends in 2020.

The analysis is focused on a set of Portuguese non-financial SMEs that exhibit annual sales revenues of at least 2 million euros. Micro firms are not included in the dataset, firstly given that, according to Banco BPI, the type of loans these firms usually request are not intended to be used as productive investment, and secondly since micro firms often exhibit incomplete and potential abnormal data.

We have collected micro variables from Central Balance Sheet - Harmonized Panel (CBHP) dataset from the *Banco de Portugal*. The macro variables used were retrieved directly from BPstat, the Tax Foundation website and from *Banco Português de Fomento* website. Data concerning CPI, real interest rate and GDP growth rate were gathered from BPstat website, historical information on the effective corporate tax rate was retrieved from Tax Foundation website and the information on the funds attributed to firms was taken from *Banco Português de Fomento* website.

We have deleted from the dataset all the observations which registered negative liabilities, assets and gross operating income, since such observations correspond to probable incomplete or incoherent data on the IES forms. In order to guarantee the exclusion of outliers which would damage the interpretation and significance of the considered dependent variables, we have eliminated from our dataset the set of observations belonging to the 1st and 99th percentile.

These conditions result in a sample consisting of 176,759 observations, across 55,739 firms. In 2019, the sample accounts for sales of approximately €47bn, and €83bn of total assets. Moreover, firms' aggregate investment in the sample amounts to €2.7bn, representing an investment rate of 10.5%.

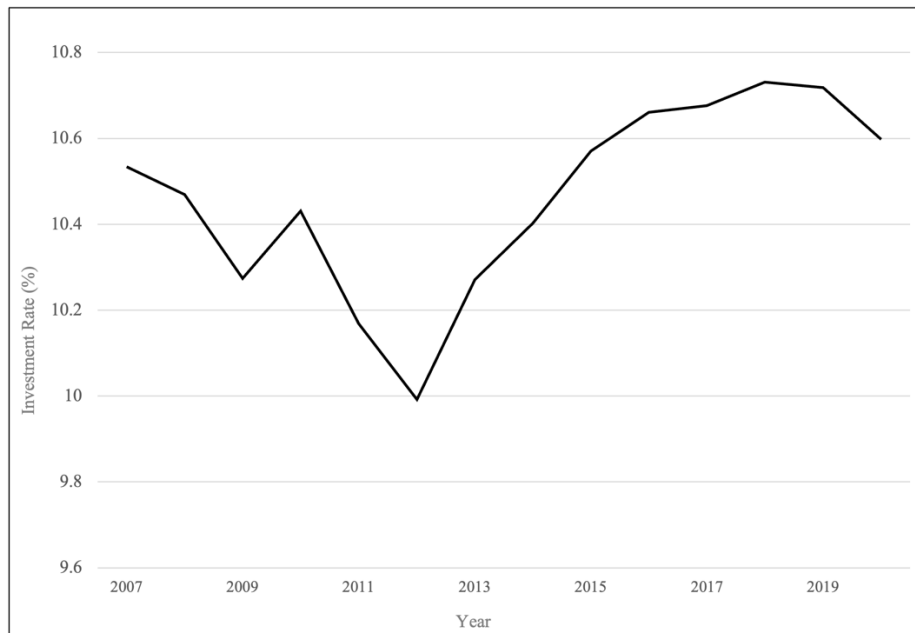
### **3.2. Dependent variable: Investment rate**

Productive investment incurred in by firms is considered in our model as the dependent variable. Although it can be commonly acknowledged that investment in CAPEX concerns a great part of productive investments, according to OECD, the stock of intangible assets of Portuguese firms has grown at a faster pace than the stock of tangible assets for the period between 1995 and 2014. This reason further motivates the inclusion of the investment in intangibles in the dependent variable for our regression model. Our dependent variable is defined as the logarithm of the annual change in tangible and intangible fixed assets (plus depreciation and amortization).

However, we find necessary to acknowledge and to point towards a possible limitation of the investment in CAPEX metric. Currently, it is common for firms to engage in leasing contracts in order to expand the stock of fixed capital available to them. According to the European Investment Fund, leasing was used to finance 16.7% of European SME's investments in fixed assets during 2010. However, it is important to note that such operational leasing contracts are not included in the tangible and intangible fixed assets account in the balance sheet (they only impact the profit and loss statement). Therefore, it is probable that the real investment of the considered set of companies in capital might be underestimated.

In 2019, the aggregate investment of SMEs was around €16,218 million. Graph 1 presents the evolution of the mean investment rate across all firms in our dataset. From the lowest point in

2012, due to the Portuguese financial crisis, the investment rate demonstrates an upward trend, with the exception of 2020 due to the pandemic crisis.



**Graph 1: Evolution of Investment Rate**

### 3.3. Independent variables and descriptive statistics

In the next section, we assess the relationship between our independent variables and several micro and macroeconomic indicators, performing a bivariate analysis, which allows for a brief overview of the relationship between the investment rate and the explanatory variables.

#### 3.3.1. Macroeconomic variables and empirical analysis

##### Economic Policy Uncertainty

One often used indicator to illustrate the uncertainty environment is the Economic Policy Uncertainty Index. Such index is built taking into account the newspaper coverage of policy-related economic events responsible for affecting uncertainty, changes to tax code law and changes to monetary policy. As observable in Graphs 1 and 2 in the Appendix, periods of higher

uncertainty coincide with periods in which investment decelerates. This is the case between the years of 2009-2012. It is assumed that firms decide to postpone investment in face of greater uncertainty around tax code and monetary policy changes. Similarly, during periods of lower uncertainty, the investment rate accelerates, as observed in the period between 2012-2014, for example.

### **GDP Growth**

The GDP growth rate is calculated as the annual change in the GDP. As seen in Graphs 1 and 3 in the Appendix, the variation in the investment rate has been somewhat correlated with the level of economic activity. Slowdowns in the investment rate coincide with years of economic recession (2010-2012), while increases to the pace of investment coincide with years of economic expansion (2014-2018, for example).

### **Interest Rate**

We are considering the real interest rate, which takes into account inflation adjustments. It is useful to note that the interest rate considered corresponds to that charged by banks for loans under 1M€. As can be observed in Graphs 1 and 4, increases in interest rates coincide with periods where the investment rate grows at a slower pace (for example, 2010-2012). Similarly, from 2012 to 2020, a downward trend of the interest rate coincides with an upward trend on the investment rate.

### **Inflation Rate**

The inflation rate is measured by changes in the consumer price index. By crossing the data in Graphs 1 and 5 in the Appendix, one can observe that periods when inflation decreases coincide with periods when investment rate increases (for example, 2007-2009). Similarly, in the period

from 2009 to 2012, a shift from a deflationary scenario to an inflationary one occurs and during the same time period the investment rate decelerates.

Moreover, following the same reasoning as with the interest rate, the graphs suggest there might be a lagged effect of the inflation rate on investment rate as well, thus, this effect is also included in our model.

### **European Union Funds**

The European Funds considered for our model are the ones under the ERDF initiative, that have been attributed to small and medium sized Portuguese, for the time span considered.

In Graph 6 in the Appendix, the evolution pattern seems to follow an upward trend up until the year of 2012. From that moment onwards, the funds suffer a sharp decrease, with the trend following a descending path until 2016, when it starts recovering.

It is, however, interesting to notice an unexpected occurrence in the evolutions of these variables. From 2012 onwards, the EU funds have a downward trend, whereas the investment rate follows an upward trend. This suggests these indicators evolve inversely between each other.

### **3.3.2. Microeconomic variables**

The Graphs 8, 12, 14, 16, and 18 in the Appendix display the evolution of the investment rate with respect to different levels of the variables of interest (considering the percentiles of order 10, 50 and 90).

### **Profitability**

The EBITDA margin was the chosen variable for the profitability, given that it is the profitability measure most often used by firms when making investment decisions since it incorporates all the costs that are relevant for firms.

Analysing Graphs 1 and 7 in the Appendix, the EBITDA margin and the dependent variable seem to move in the same direction. Graph 8 investigates the impact of different levels of firms' EBITDA margins on investment rate. One can observe that firms with higher levels of EBITDA margin are the ones investing the most, followed by the ones with a medium level and finally those with lower level. This fact further points to a positive relationship between firms' EBITDA margin and their investment patterns.

Moreover, when paying close attention to Graphs 1 and 7 in the Appendix, one can see the average EBITDA margin greatly increases from 2008 to 2009, whereas a rise in the investment rate is only observed in 2009 and 2010. This may suggest a lagged effect of profitability on the investment rate as well.

### **Internal Funds**

Comparing Graphs 1 and 9 in the Appendix, one can also observe these somewhat follow the same trends, except for slight deviations from this pattern, during the time period between 2010 and 2016. It can also be noted that the evolution of the retention ratio seems to precede that of the investment rate, suggesting a lagged effect of changes to the retention policy of firms on their level of investment.

### **Effective Tax Rate**

In Graphs 1 and 10 in the Appendix, the behaviour displayed by the effective tax rate and the investment rate appear to somewhat move in inverse directions. While the tax rate exhibits a downward trend for the time frame comprehended between 2012 and 2020, the investment rate displays a persistent growth starting in 2012 and stretching until 2018.

Moreover, following the same reasoning as with the previous variables, the graphs suggest there might be a lagged effect of the effective tax rate on investment rate as well, thus, this effect is also accounted for.

### **External Funds**

The debt level of the firm is segmented in short- and long-term debt. In Graphs 1 and 11 in the Appendix, one can observe that the share of short-term debt has been following a downwards trend whereas the share of long-term debt has been following an upwards trend. That is, firms appear to be engaging in a progressive change to their debt structure, substituting short- for long-term debt. Also, from Graph 12 in the Appendix, it can be denoted that firms that depend more heavily on long-term debt invest more than those that depend more on short-term debt.

### **Assets to serve as Collateral**

Comparing Graphs 1 and 13 in the Appendix, one can infer that periods when the share of firm's collateralizable assets coincide with periods when firms increase their pace of investment.

When extending the analysis to Graph 14, the expected impact collateralizable assets have on investment rate seems to be reinforced, since firms with greater levels of collaterals are those that exhibit greater investment rates. Indeed, firms with higher levels of collaterals present higher investment rates, followed by firms with a medium level of collaterals and finally, firms with low levels of collaterals. This outcome suggests that the value of assets to serve as collateral might be important to explain an easier access to credit by firms.

## **Financing Cost**

The financing cost was computed as the interest paid over the firm's total liabilities. The evolution of firms' financing cost can be observed in Graph 15 in the Appendix, presenting a downward trend since 2007, with the exception of the financial crisis period (2010 - 2012).

From Graph 16 in the Appendix, almost throughout the entire dataset, it is noteworthy that firms with low financing costs are those that exhibit the lowest investment rates, while the firms with medium financing costs are those that exhibit the greatest investment rates. This fact suggests that the inverse relationship between financing costs and investment rate does not occur. This seemingly unexpected finding might be explained by the fact that in a bivariate study, some factors that affect investment rates are not taken into account. For example, small businesses are thought to be riskier and hence have higher financing costs. Although they might face higher financing costs due to the firm's riskiness, they nonetheless have a high growth potential, which may account for the small enterprises' greater investment demand.

## **Firm Size**

Firm size was analysed both as a volume metric (logarithm of sales) and as a categorical variable (small and medium-sized firms). From Graph 17 in the Appendix, one can realize the occurrence of a downward trend for the period between 2007 and 2011 and an upward trend taking place from 2011 to 2019. This seems to be following somewhat the same trends as the dependent variable, suggesting that as the firm size increases, the firm invests more.

The analysis of Graph 18 in the Appendix presents medium firms display investment rates to be, on average, 2 percent greater than those displayed by small firms. This reinforces the analysis obtained from the firm size in volume, supporting the idea that as the firm size in volume is bigger, the investment rates are higher.

**Table 1:** Summary of Descriptive Statistics

<b>Explanatory Variables</b>	<b>Pre-Crisis (2006 - 2011)</b>	<b>Crisis year (2012)</b>	<b>Pos-Crisis (2013 - 2019)</b>	<b>Covid Crisis (2020)</b>
EPU Index	124.87	210.08	206.68	265.25
GDP Growth Rate	0.295	-4.050	1.943	-8.300
Interest Rate	6.579	7.080	3.884	2.220
Inflation Rate	2.017	2.760	0.660	-0.130
EU Funds	1,544.52	2,304.80	1,297.22	1,862.30
EBITDA Margin	0.065	0.011	0.083	0.032
Retention Ratio	0.064	0.060	0.079	0.069
Effective Tax Rate	0.369	0.505	0.352	0.235
Short-Term Debt	0.582	0.575	0.490	0.458
Long-Term Debt	0.145	0.174	0.182	0.239
Collateralizable Assets	0.282	0.286	0.282	0.287
Financing Cost	0.020	0.017	0.011	0.007
Firm Size in volume	14.032	13.99	14.130	14.050

Table 1 presents a summary of the above descriptive statistics analysis by different sample periods, and we find it more relevant to segment to pre- and post-financial crisis as well as the recent covid crisis. One can observe that in crisis years, factors such as EPU, interest rate and EU funds seem to increase, whereas GDP growth rate and EBITDA margin present lower levels for crisis years, as intuitively expected. Table 2 in Appendix presents a more detailed summary of each variables' descriptive statistics.

### 3.4. Econometric methodology

On an initial note, we would like to clarify that when selecting the explanatory factors, two risks were considered, both for the collective and for the individual analysis. On the one hand, we tried to avoid the risk of overfitting the model, through the insertion of too many variables. On the other hand, the variables choice was done in such a way that no extremely relevant factors were left outside of the model, in an attempt to shield the regression analysis performed later from omitted variable bias.

We intend to develop two distinct models to separately assess how macroeconomic and microeconomic factors influence corporate investments decisions. The aim of the econometric analysis is to determine the significance, test the sign and correlation between the factors already mentioned and the investment rate.

As we point to develop our analysis within groups, we decided that the appropriate model to use consists of a panel data methodology – this accounts for time series and a cross-sectional aspect. It is a subset of longitudinal data where observations occur for the same subjects each time, in our case, the behaviour of entities is observed across time. Considering our data structure - many panels and few measurement instances -, it is most suitable to use Dynamic Panel Data instead of Static.

The Dynamic Panel Data approach has several advantages over the Static variant. First, the possibility to account for the heterogeneity of the individuals and use of multiple instrumental variables to account for the endogeneity of the model's variables, often referred as "lagged variables". Notwithstanding, the use of General Method of Moments (GMM) is plagued by two major concerns: the proliferation of instruments and the serial autocorrelation of errors. These two concerns will be greater if the panel is comprised of a sample with a large time span and a small number of firms, which is the exact opposite of our situation.

The selected estimation methodology requires the application of the GMM-System estimator, which was introduced by Arellano and Bover (1995) and improved by Blundell and Bond (1998). The actual command in stata *xtabond2* was developed by Roodman (2005). We decided on this command instead of *xtabond* as it is preferable for our data structure. In addition, this model is appropriate when there are fixed individual effects, in this case, firm specific effects.

Running this command in stata, we are able to add options with it. We chose to add the following: *twostep*, which specifies a two-step estimator should be calculated, forcing the heteroscedastic weight matrix into the estimation; *robust*, which in a two-step estimation avoids downwardly skewing standard errors; *small*, demands small-sample rectifications to the covariance matrix; *nodiffsargan*, which prevents re-estimating the model for each difference-in-Sargan/Hansen test; *orthogonal*, requests the forward orthogonal deviations which is important in unbalanced panels (as is our case) so as to not magnify the gaps in the data.

For all estimations with *xtabond2*, the Hansen test and the Arellano and Bond test are presented. The Hansen test assesses the overidentification of instruments, meaning too many variables are being included in the model. As dynamic panel data requires no correlation in the errors term, the Arellano and Bond test investigates the first and second order conditions of the serial autocorrelation of errors (labelled AR 1 and AR 2).

The following macroeconomic and microeconomic regressions are performed in order to test the various hypothesis.

Macroeconomic Regression:

$$\text{Investment}_{i,t} = \beta_1 * \text{EPU}_{i,t} + \beta_2 * \text{GDP}_{i,t ; i,t-1} + \beta_3 * \text{Interest Rate}_{i,t} + \beta_4 * \text{Inflation}_{i,t ; i,t-1} + \beta_5 * \text{EU Funds}_{i,t} + (\text{S}_i + \varepsilon_{i,t}) \quad (1)$$

Microeconomic Regression:

$$\begin{aligned} \text{Investment}_{i,t} = & \beta_{1,2} * \text{Investment}_{i,t-1 ; i,t-2} + \beta_{3,4} * \text{EBITDA}_{i,t ; i,t-1} + \beta_{5,6} * \text{Retention}_{i,t ; i,t-1} \\ & + \beta_{7,8} * \text{Tax Rate}_{i,t ; i,t-1} + \beta_9 * \text{ST Debt}_{i,t} + \beta_{10} * \text{LT Debt}_{i,t} + \beta_{11} * \text{Collaterals}_{i,t} \\ & + \beta_{12} * \text{Financing Cost}_{i,t} + \beta_{13} * \text{Size}_{i,t} + (\theta_i + \text{S}_i + \varepsilon_{i,t}) \end{aligned} \quad (2)$$

where:  $Investment_{i,t}$  – firms'  $i$  investment rate at year  $t$ ;

$\beta$  – Estimation coefficients of the explanatory variables;

$X_{i,t}$  – Vector of explanatory variables of interest for the  $i$ -th firm at year  $t$  (EPU Index, GDP growth rate, Interest Rate, Inflation Rate, EU Funds, EBITDA Margin, Retention Ratio, Effective Tax Rate, Short-term Debt, Long-term Debt, Assets to serve as collateral, Financing Cost and Firm Size);

$X_{i,t-1}$  – Vector of lagged explanatory variables of interest for the  $i$ -th firm in year  $t-1$ ;

$\theta_i$  – Time effects controlling for macroeconomic impacts (using year dummies);

$S_i$  – Firm specific effects controlling for heterogeneity across firms;

$\varepsilon_{i,t}$  – Error term, accounting for unexplained impacts on  $Y_{i,t}$ .

## 4. Results and Discussion

**Table 3: Correlation Matrix**

	Investment Rate	EPU Index	GDP Growth	Interest Rate	Inflation	EU Funds	EBITDA Margin	Retention Ratio	Effective Tax Rate	ST Debt	LT Debt	Collateral Assets	Financing Cost	Firm Size
<b>Investment Rate</b>	1.000													
<b>EPU Index</b>	0.029	1.000												
<b>GDP Growth</b>	0.047	-0.199	1.000											
<b>Interest Rate</b>	-0.071	-0.727	-0.040	1.000										
<b>Inflation</b>	-0.027	-0.191	0.201	0.562	1.000									
<b>EU Funds</b>	-0.072	-0.024	-0.677	0.423	0.208	1.000								
<b>EBITDA Margin</b>	0.215	0.006	0.090	-0.054	-0.030	-0.099	1.000							
<b>Retention Ratio</b>	0.038	0.012	0.015	-0.024	-0.010	-0.023	0.004	1.000						
<b>Eff Tax Rate</b>	-0.012	-0.023	0.006	0.055	0.041	0.031	0.028	-0.019	1.000					
<b>ST Debt</b>	-0.154	-0.164	0.003	0.183	0.092	0.048	-0.392	0.030	-0.007	1.000				
<b>LT Debt</b>	0.090	0.101	-0.057	-0.089	-0.044	0.031	-0.069	-0.001	-0.022	-0.294	1.000			
<b>Collateral Assets</b>	0.293	0.024	-0.006	-0.023	-0.004	-0.002	0.128	-0.003	-0.052	-0.188	0.356	1.000		
<b>Financing Cost</b>	0.035	-0.278	0.005	0.308	0.164	0.047	0.030	-0.019	0.047	0.017	0.185	0.133	1.000	
<b>Firm Size</b>	0.484	0.034	0.031	-0.045	-0.016	-0.033	0.139	0.041	0.013	-0.063	-0.121	-0.094	0.020	1.000

The analysis of the correlation matrix as the one depicted in Table 3 is useful in order to ascertain possible collinearity taking place between the set of parameters chosen. The level of correlation to be attained in order to conclude the existence of collinearity between the factors is widely debated within the literature. For instance, Gujarati and Porter (2009) state that the correlation level beyond which collinearity may be inferred corresponds to 50%.

For that reason, particular attention should be addressed to the correlation values between inflation and interest rates, the GDP Growth and EU Funds, and the interest rate with the EPU index. However, it is important to note that such collinearity suspicions rely over a data set that is composed of merely 14 observations, that is, one observation per variable for each of the considered years under analysis. A reduced dataset implies little variability between the factors and that might be contributing for the apparent problem of multicollinearity between some of the macroeconomic factors.

Although the dataset is reduced, which implies natural limitations towards a valid interpretation of the correlation coefficients, it is still useful to check how the macroeconomic variables are related to each other. Some results, such as the strongly negative correlation between EU Funds and the GDP Growth, come as unexpected.

Moving to the analysis of the regression results, in order to analyse if the chosen model is the most appropriate, we studied the computed adjusted R-square. The result reveals the goodness of fit of the model to be 64%, which indicates that 64% of the change in firms' investment rate is explained by the independent variables under analysis. This result indicates our model is worthwhile studying.

In addition, we performed the Hansen and the Arellano-Bond tests, already explained in the previous section, to understand if the GMM-System estimator was the most appropriate estimation method for our data structure.

As the Dynamic Panel Data estimators are instrumental variables methods, it is particularly recommended to do the Hansen test, where the null hypothesis confirms the validity of all overidentification restrictions. According to Roodman (2009), the p-value presented in the result for this test should be in the range of  $0.05 \leq \text{p-value} < 0.8$ , being the optimal to find a probability  $0.1 \leq \text{p-value} < 0.25$ . The probability obtained in our model is equal to 0.212, meaning that the variables used in our model are valid, and consequently confirms the presence of no overidentification. In that regard, there is no indication to reject the null hypothesis.

Another important diagnostic when using a Dynamic Panel Data methodology is the Arellano-Bond Autocorrelation Test (AR), where the null hypothesis states that autocorrelation does not exist. By definition, the differenced equation exhibits residuals that are serial correlated. Nevertheless, the justification of the serial independence in the errors imply that the differenced equation residuals must not have a significant AR(2) behaviour. The second lags of endogenous variables are unlikely to be appropriate instruments for their existing values if this statistic is revealed to be significant. As the Arellano-Bond test for AR(2) in our model presents a probability equal to 0.112, we do not reject the null hypothesis, indicating that the error terms are not serially correlated.

That being so, both statistical tests confirmed that the conditions and restrictions of the estimations were found, avoiding overidentification and granting a better fit of the model.

#### 4.1. Macroeconomic model results

The regression results of our macroeconomic study are presented in Table 4. Besides the macroeconomic variables included in our model, we also decide to analyse the impact of crisis years on investment rate and its relationship with our macroeconomic variables themselves.

**Table 4:** Macroeconomic Regression

*Dynamic Panel-Data estimation, two-step system GMM*

<b>Variables</b>	<b>Coefficients</b>	<b>t-value</b>	<b>Probability</b>
<b>EPU Index</b>	- 0.007	-2.98	0.003***
<b>GDP Growth <math>t</math></b>	0.025	4.43	0.000***
<b>GDP Growth <math>t-1</math></b>	0.041	2.51	0.000***
<b>Interest Rate <math>t</math></b>	-0.060	-5.24	0.000***
<b>Inflation <math>t</math></b>	-0.012	-1.91	0.051*
<b>Inflation <math>t-1</math></b>	-0.025	-4.44	0.000***
<b>EU Funds</b>	-0.0001	0.52	0.602
<b>c</b>	10.886	66.37	0.000***

*Note: \*\*\* p-value<0.01, \*\* p-value<0.05, \* p-value<0.1*

##### 1. EPU index

The Economic Policy Uncertainty Index presents a statistically significant and negative coefficient, demonstrating that economic uncertainty is negatively related to firms' investment, which is in line with our hypothesis 1. On average, a one unit increase in the EPU index has a negative 0.7 percent effect on the investment rate. In fact, our findings are consistent with studies from many authors (Al-Thaqeb and Algharabali 2019; Kang et al.2014; Julio and Yook 2012). Their reasoning is that firms prefer to operate more cautiously during periods of high uncertainty, consequently postponing investment choices.

In addition, according to Baker et al. (2013) in Kang et al. (2014), this effect is quantitatively magnified throughout the years 2007–2010, indicating that this variable has a greater impact on investment decisions during times of crisis. To confirm this, we included a factor interaction between EPU index and a dummy for crisis years, to which we obtained a negative coefficient. In that regard, our findings are in line with the theory proposed by the mentioned author, thus it is possible to infer that in years of crisis, the uncertainty is higher.

This result validates our hypothesis 1, thus it should not be rejected, indicating that EPU index has a significant and negative impact on corporate investment decisions.

## **2. GDP growth rate**

For the GDP growth rate, we decide to introduce a lag to this variable in order to analyse both the effects the GDP growth rate in year  $t$  and in  $t-1$  have on investment in year  $t$ .

The GDP growth has the expected positive and significant statistics in both year  $t$  and year  $t-1$ , indicating that a high GDP growth rate creates new corporate investment options, as it encourages and stimulates the sectors of the economy. Our results show that on average, a one percent increase in the GDP growth rate for year  $t$  and  $t-1$  has a positive 3 and 4 percent, respectively, effect on investment rate.

This result was already expected, as many studies address the relationship between GDP growth and corporate investment activity (Farooq et al. 2021; Becker 2006). The reasoning behind these studies is that firms' activities are internally related to each other, then, when GDP rises, per capita income rises as well, resulting in an increase in consumer's demand. To satisfy the increase in consumer demand, firms expand their operations through capital expenditures.

Furthermore, our findings also show a negative correlation between crisis years and GDP growth, confirming that during crisis year, GDP suffers a contraction.

This result validates our hypothesis 2, thus it should not be rejected, implying that GDP growth rate of year  $t$  and year  $t-1$  has a significant and positive impact on year  $t$  firms' investment.

### **3. Interest rate**

Our results for the interest rate present a statistically significant negative coefficient, indicating that as interest rates increase or decrease, investment rates decrease or increase, respectively. Our results show that on average, a one percent increase in the interest rate has a negative 6 percent effect on the investment rate. These results align with our hypothesis 3 as well as with the conclusions of Farooq et al. (2021). The rationale behind their conclusions is that, *ceteris paribus*, higher interest rates mean a higher cost of investment, which in turn causes lower income investors to back away from investing and overall demand for investing is lower. Similarly, lower interest rates mean a lower cost of investment, which will stimulate investment and increase overall investment.

Nevertheless, the results for this variable should be considered with an important note in mind, as there is a probability of biasedness - the especially high correlations between interest rate and uncertainty and inflation may be affecting the results of this variable as they are all being included in the same model and present correlations above 0.5.

Having this in mind, we fail to reject hypothesis 3, as we have significant results for the interest rate affecting investment rates negatively.

### **4. Inflation Rate**

For Inflation, we also decide to analyse both the effects the inflation rate in year  $t$  and in  $t-1$  have on investment in year  $t$ .

The results show that, although not as relevant as other variables, both coefficients are statistically significant and influence investment negatively. For year  $t$  and year  $t-1$ , on average, a one percent increase in the inflation rate has a negative 1 and 2.5 percent effect on the investment rate, respectively. Our findings confirm the studies by Ayyoub, Chaudhry and Farooq (2011) in Farooq et al. 2021. Their reasoning is that higher inflation rates decrease purchasing power of consumers, which in turn will limit business opportunities and decrease investment, as it is the same as experiencing an unusual increase in the cost of investment (Farooq et al. 2021).

Moreover, our results show a positive correlation between crisis years and inflation, indicating that during crisis years, inflation suffers an increase. However, it is also important to note there is a possibility of biased results as inflation presents a strong correlation with interest rate.

Given the statistically significant negative relations found, we fail to reject our hypothesis 4 and state that inflation rate is a significant predictor of investment rate, affecting it negatively.

## **5. EU funds**

Regarding the stimulus packages from European funds for companies to invest, our results show that this relationship is not significant – we found a negative coefficient, but it is, however, statistically insignificant -, as well as it is not a relevant coefficient in magnitude. This non-significance result might be delivered by the fact that most of the firms present in our dataset were not included or supported financially with European funds, as only 44 thousand firms were supported under the ERDF programme and, within those 44 thousand firms, there are some micro firms, which were excluded from our data set. Although this variable has shown a non-significant statistical effect in our model, this does not mean this variable is economically insignificant, as EU funds are frequently used by a number of firms who would not be able to get bank funding for investment projects otherwise.

In addition, our results may also be biased due to a very high correlation between EU funds and GDP growth (-0.67), which are both being included in the same model which may cause bias issues. The results also show a positive correlation between crisis years and EU funds, indicating that during crisis years, more EU funds are distributed to ease the negative impact of the crisis.

This leads us to reject hypothesis 5, as we do not find a positive statistically significant relationship between EU funds and investment rates.

## 4.2. Microeconomic model results

The regression results of our microeconomic model are presented in Table 5. The significance level of all microeconomic explanatory variables are winsorized at 1%.

**Table 5:** Microeconomic Regression

*Dynamic Panel-Data estimation, two-step system GMM*

Variables	Coefficients	t-value	Probability
<b>Investment Rate t-1</b>	0.161	18.26	0.000***
<b>Investment Rate t-2</b>	0.044	5.46	0.000***
<b>EBITDA Margin t</b>	1.04	9.88	0.000***
<b>EBITDA Margin t-1</b>	0.817	6.06	0.000***
<b>Retention Ratio t</b>	-0.046	-1.61	0.106
<b>Retention Ratio t-1</b>	0.119	3.73	0.000***
<b>Eff Tax Rate t</b>	-0.009	-1.29	0.197
<b>Eff Tax Rate t-1</b>	-0.0137	-2.16	0.031**
<b>ST Debt</b>	0.063	1.38	0.166
<b>LT Debt</b>	0.752	11.54	0.000***
<b>Collateral Assets</b>	2.101	33.54	0.000***
<b>Financing Cost</b>	-5.827	-9.41	0.000***
<b>Firm Size</b>	0.681	43.67	0.000***
<b>c</b>	-2.42	-17.53	0.000***
<i>Note: *** p-value&lt;0.01, ** p-value&lt;0.05, * p-value&lt;0.1</i>			
<b>Hansen (p-value)</b>	0.212		
<b>AR 1 (p-value)</b>	0.000		
<b>AR 2 (p-value)</b>	0.112		

## **1. Previous investment**

As already mentioned, the dependent variable chosen in our model is the investment rate. Based on literature, we decide to study the effect of firms' previous investment in the current investment, including two lags of the investment rate as independent variables in our model. The results present a high t-value confirming the inference of a GMM model.

These significant and positive statistics indicate that the previous investment is one valid predictor of current investment. For year  $t-1$  and year  $t-2$ , on average, a one percent increase in previous investment has a positive 0.16 and 0.04 percent effect on the investment rate, respectively. This outcome is in line with our hypothesis 6 and with the results from Eberly et al. (2012) and Christiano et al. (2005). Their reasoning is that the specification of investment adjustment costs predicts the manifestation of a lag-investment impact. This indicates current investment plans seem to rely much on previous investment plans.

This leads us to not reject our hypothesis 6, indicating that firms' previous investments of year  $t-1$  and  $t-2$  have a significant and positive impact on investment.

However, it is important to note that when previous investment is retrieved of our model, the other variables coefficients maintain the same results and significance, confirming the robustness of our statistic results.

## **2. EBITDA Margin**

For this variable, we also decide to introduce a lag in order to study how EBITDA Margin in year  $t$  and year  $t-1$  affect investment rate of year  $t$ .

EBITDA Margin, both in year  $t$  and year  $t-1$ , present the expected significant and positive coefficients, implying that firms with higher EBITDA margins tend to invest more in year  $t$ .

Our findings show that, on average, a one percent increase in the profitability rate in year  $t$  and  $t-1$  has a positive 104 and 82, respectively, percent change on investment rate. This result is in line with our hypothesis 7 as well as with some authors (Pacheco 2017; Hernando and Martínez-Carrascal 2008; Brown 2009). These authors support the "investment-cash flow hypothesis", defending that firms that are already more susceptible to severe financing constraints have a larger investment-cash flow sensitivity.

In addition, in order to study if small firms rely more on their cash-flows than medium firms, we also performed another regression adding a factor with the interaction between EBITDA margin and a dummy for medium firms. We obtained the expected results, confirming that medium firms rely less on their cash-flows in comparison to small firms, suggesting that larger firms use more frequently external funds to finance their investments.

Having said that, hypothesis 8 should not be rejected, as we find that profitability in year  $t$  and  $t-1$  has a positive and statistically significant effect of approximately 104% and 82%, respectively, on investment rate.

### **3. Retention ratio**

With respect to the retention ratio variable, we also decided to introduce a lag to this variable and the results were quite interesting.

Analysing the retention ratio for year  $t-1$ , we obtain a positive statistically significant coefficient, indicating that retention ratio and investment rate move in the same direction. For year  $t-1$ , on average, a one percent increase in the retention ratio has a positive 12 percent effect on the investment rate. These findings are in line with some literature (Vogt 1994; Oliner and Rudebusch 1992; Whited 1992), including with the "pecking order theory" proposed by Myers and Majluf (1984).

However, when analysing the retention ratio for year  $t$ , we obtain a negative coefficient that is only significant at roughly a 90% confidence level. This may be due to the fact that the retention ratio at the end of year  $t$  is not a depiction of the retention ratio of the firm at the time they invested in that same year. One possible explanation for a negative sign in the coefficient of this variable is the fact that firms may choose to invest their internal funds in financial instruments, which are not included in our investment rate variable. As the interest rate paid for bank loans is sometimes lower than the opportunity cost of firms not investing their internal funds in financial instruments, firms may decide to finance their tangible investments with bank loans.

We also perform another regression adding a factor with the interaction between lagged retention ratio and a dummy for medium firms. Our findings present that besides the positive effect that the retention ratio and being a medium firm in comparison to a small one have on investment, the marginal effect of the retained earnings of a medium firm (in comparison to a small one) on investment rate is negative. This indicates that medium firms rely less on internal funds in comparison to small firms.

With this being said, we fail to reject hypothesis 8, as our results for year  $t-1$  present that retention ratio has a positive impact on investment rate.

#### **4. Effective tax rate**

Regarding Effective Tax Rate, we also decide to introduce a lag to this variable, in order to study the impact of this variable in year  $t$  and year  $t-1$  on investment rate of year  $t$ .

The results for effective tax rate in year  $t-1$  are in line with what we were expecting. This variable presents a significant and negative coefficient, indicating that companies with a higher effective tax rate in the year  $t-1$  tend to invest less in the following year. This finding is in line

with some authors (Sánchez-Ballesta et al., 2021; Masso, 2002; Strulik, 2008; Vartia, 2008). For year  $t-1$ , on average, a one percent increase in the effective tax rate has a negative 1.4 percent effect on investment rate. The rationale behind is that lower corporate tax rates might stimulate investments through the relaxation of liquidity constraints and through the decreasing of banks' agency costs and bankruptcy rates. In addition, the influence of these taxes on cash flows and the potential implications of firms' taxes on the discount rate is also suggested to impact firms' investment.

However, when looking at results of the effective tax rate for year  $t$ , it displays a negative coefficient but is not statistically significant. Possibly, these results may be due to the fact that during the year, firms do not yet know the actual effective tax rate they will be subject to at the end of the year, so its effect on that year's investment is not certain.

Thus, we fail to reject hypothesis 9 for year  $t-1$ , as our results for that period present that effective tax rate negatively impact the investment rate of year  $t$ . However, it is important to note that our results for this variable in year  $t$  presents non-significant results, thus our hypothesis only applies when studying the relation between effective tax rate in year  $t-1$  and investment rate in year  $t$ .

## **5. Short term debt**

Our results for the short-term debt impact on investment rate are not what we expected. We hypothesised short-term debt would be negatively related with investment rates, as we expect companies to forgo investment projects if they have high short-term payments due to be paid. However, we obtained a statistically insignificant coefficient. This is possibly due to errors in data gathering, as we can see in Table 1 that short-term debt and investment rate have a weak negative correlation, so they can have some influence on each other that is not being accurately

represented in our model. Also, a possible reason may be that short-term debt is usually used to finance a firm's day-to-day operations and not the type of investments we are considering.

Thus, we reject hypothesis 10, as we do not find a statistically significant negative relation between short-term debt and investment rate.

## **6. Long term debt**

For the long-term debt, in contrary to the short-term one, the results are the expected ones. We find a positive statistically significant coefficient, indicating that firms are able to incur in more investment by borrowing funds externally to fund their investment projects. Our results show that on average, a one percent increase in the long-term debt has a positive 75 percent change on the investment rate. Furthermore, the high magnitude of the t-value for this variable (11.5), implies we have high evidence against the null hypothesis.

This effect is in accordance with the results from Pacheco (2017), as he realized firms may be able to invest more due to the accumulated assets obtained through debt. Thus, higher long-term debt appears to foster investment. Pacheco (2017) indicated that creating incentives for businesses to switch from short-term debt to long-term debt might produce a likely beneficial element for investment.

In Table 1, it is also of noting that long-term debt and collateralizable assets have a medium-positive correlation, indicating that firms with higher collateralizable assets are able to secure external funds more easily, which in turn will allow them to invest in more assets that can later turn into collaterals.

In addition, we perform another regression adding a factor with the interaction between LT debt and a dummy for medium firms. Our results show that the influence long-term debt has on investment rate should be greater for medium firms in comparison to small ones. Moreover, we

also want to analyse the impact that leverage has in explaining investment during downturns. In order to do this, we performed two different regressions, one with a factor interaction between long-term debt and GDP growth, to which we obtain a negative coefficient indicating that in booming (recessing) times the effect of long-term debt on investment is lower (higher); the second regression included a factor interaction between long-term debt and crisis years dummy, to which we obtain a positive coefficient, confirming the results obtained before, as this indicates that during crisis years, long-term debt has a higher impact on investment.

Thus, we fail to reject hypothesis 11, as we find a statistically significant positive impact of long-term debt on investment rate.

## **7. Assets to serve as collateral**

The assets to serve as collateral presents a significant and positive coefficient, indicating that the increasing availability of tangible assets on a company's balance sheet is expected to result in better conditions when obtaining credit. Our results present that, on average, a one percent increase in the share of tangible collateralizable assets has a positive 210 percent change on the investment rate. Our findings align with our hypothesis 12 as well as with the conclusions of Titman (2013) and Gan (2007). Titman (2013) argued that the motivation behind this relation is that collateralizable tangible assets back firms' debt financing, resulting in a boost of capital on firms to invest and expand their capabilities. The study of Gan (2007) agrees with this, confirming that a greater availability of collateralizable assets in a firm's balance sheet is essential for a firm to contract debt, as this source of funding most often requires a tangible guarantee.

In addition, in order to analyse the influence of collateralizable assets on investment by firm size, we perform another regression adding a factor with the interaction between collateralizable assets and a dummy for medium firms. Our findings indicate that collateralizable assets have a

higher impact on investment for medium firms. This may be due to the higher amount of collateralizable assets that these firms own, implying better conditions when accessing to credit, which affects positively the investment activity when the latter is financed through loans.

Moreover, we also want to analyse the interaction between collateralizable assets and long-term debt. In this regard, we perform another regression with such interaction, and we obtain a negative coefficient. This indicates that the more collateralizable assets, the lower the impact of long-term debt on investment. Similarly, we also find a negative coefficient for the interaction between this variable and financing cost, again indicating that more assets to serve as collateral imply a lower impact of the financing cost on investment.

That being so, hypothesis 12 is not rejected, as we find that collateralizable assets has a statistically significant and positive impact on investment.

## **8. Financing cost**

Regarding the financing cost for firms, we find a statistically significant negative coefficient, as expected, indicating that as the cost of financing is higher or lower, firms invest less or more, respectively. Our results show that, on average, a one percent increase in the financing cost has a negative 583 percent change on the investment rate - which is the most relevant impact on investment rates that we have found through our analysis. Furthermore, the high magnitude of the t-value for this variable (-9.4), also implies we have high evidence against the null hypothesis.

This aligns with the results from Farinha and Prego (2013), suggesting that future expenditures are less likely to be worthwhile when financing costs increase.

To investigate the impact of the financing cost on the decision to invest for medium firms in comparison to small ones, we perform another regression adding a factor with the interaction

between financing cost and a dummy for medium firms. We obtain a negative coefficient for this interaction factor, indicating that the financing cost has a lower impact on investment for medium firms in comparison to small ones. One possible reason for this is that medium firms tend to have a lower financing cost, so this factor will not weight as much on the decision to invest for these medium firms in comparison to small ones.

From Table 1, it is also observable the correlation between financing cost and the interest rate, which is medium-positive strong. To build on this, we performed another regression with an interaction term between the firm's financing cost and the interest rate. We obtained a positive coefficient, meaning that the higher the interest rate, the higher the impact of the financing cost on the investment rate. This may be since obtaining loans and paying off loans will be significantly more expensive when interest rates are higher, as well as the cost of debt will be lower when interest rates are lower.

Thus, we fail to reject hypothesis 13, as we find a negative statistically significant coefficient for the impact of the financing cost on investment rates.

## **9. Firm size**

Our results regarding the effect of firm size in volume on investment decisions undertaken by firms are surprising as we were in line with the reasoning by Pacheco (2017), that smaller firms would invest more as they are trying to grow. However, we obtain a highly statistically significant and positive coefficient. Our results show that, on average, a one percent point increase in the firm size in volume has a positive 0.68 percent change on the investment rate.

Our findings align with those of Beck et al. (2005). They found a negative relation between firm size in volume with financial constraints, as well as a negative relation of financial constraints with investment, thus yielding a positive relation of firm size with investment.

Thus, we reject our hypothesis 14, as we find a statistically significant positive coefficient for the firm size in volume, which indicates it is positively related with investment rates, going against our hypothesis.

**Table 6:** Summary of expected and obtained results between explanatory variables and investment

<b>Explanatory Variables</b>	<b>Expected Relation</b>	<b>Observed Relation</b>	<b>Hypothesis failed to be rejected?</b>
<b>H1</b> EPU Index	-	-	YES
<b>H2</b> GDP Growth Rate	+	+	YES
<b>H3</b> Interest Rate	-	-	YES
<b>H4</b> Inflation Rate	-	-	YES
<b>H5</b> EU Funds	+	NS	NO
<b>H6</b> Previous Investment	+	+	YES
<b>H7</b> EBITDA Margin	+	+	YES
<b>H8</b> Retention Ratio			YES
<b>t</b>	+	NS	NO
<b>t - 1</b>	+	+	YES
<b>H9</b> Effective Tax Rate			YES
<b>t</b>	-	NS	NO
<b>t - 1</b>	-	-	YES
<b>H10</b> Short Term Debt	+	NS	NO
<b>H11</b> Long Term Debt	+	+	YES
<b>H12</b> Assets to serve as Collateral	+	+	YES
<b>H13</b> Financing Cost	-	-	YES
<b>H14</b> Firm Size	-	+	NO

*Note: "+" Positive Relation; "-" Negative Relation; NS - Non Significant*

In Table 6, one can observe that three of our initial hypotheses are globally rejected. Two of them, the EU funds and the short-term debt, both appear to be not statistically significant in explaining firm's investment, indicating that these factors do not relevantly impact firm's investment. The other hypothesis that is globally rejected concerns firm's size in volume, as the relationship found between this variable and firm's investment is opposite to the initially hypothesised one. However, this does not mean that firm size is not relevant in explaining firm's investment, it only means it affects investment positively instead of negatively, as expected.

Furthermore, two other hypotheses are partially rejected. Both the retention ratio and the effective tax rate for year  $t$  appear to be not statistically significant in explaining investment for year  $t$ . However, we do not globally reject these hypotheses as the variables in  $t-1$  are found to be relevant in explaining firm's investment.

## 5. Financing Investment in a Digital Economy

As previously suggested by much of the cited literature, tangible assets to serve as collateral play a key role in explaining a firm's investment behaviour. The results delivered by our regression analysis support such fact and the statistical relevance of the coefficient makes it one of the most impacting variables on the investment rates displayed by firms. Such fact was the igniting point to the topic that we approach on the last part of this document.

The economic transformation happening in most of the developed economies is making them more reliant on innovative investments and technological developments in order to achieve growth (OECD 2011). This transformation produces unavoidable changes to the composition of the balance sheets of firms, where the growing importance of intangibles can pose challenges to the availability of collaterals when seeking credit (Demmou et al. 2019). This fact seems to be consistent with the results obtained by Bańkowska et al. (2020), where European innovative firms were found to be the category of firms experiencing the greatest credit constraints when seeking financing.

In that regard, we recognized and found crucial to lay the foundations to the discussion about the role of commercial banking on a digital economy, especially by analysing its relationship with intangible assets. We acknowledge that such subject is far from having immediate consequences for BPI, especially given the characteristics of the Portuguese economy. Nonetheless, the recognition and valuation of strategic intangibles is something that, as later discussed, takes time and effort.

We acknowledge the limitations derived from the comparisons established below, especially given certain economic contexts that are distant from the Portuguese one. However, it is also

undeniable that the economic transition shifting most of the OECD countries towards knowledge-based economies is also happening in Portugal, as later explored.

By gathering and analysing information on how banks and countries have been adapting to this economic transition, the ultimate goal is to deliver a set of recommendations that will help BPI to better adapt and thrive in the context of a digital economy.

## **5.1. Characterization of intangible investments**

Over the last two decades, investment in intangibles has grown by 130% in the US and 87% in the EU-28 (Thum-Thyssen et al. 2017). Data collected by the ECB and the Eurostat demonstrates that the European average intangible investment amounts to 15% of total investments, as of 2017. The leading country in intangible investments is France, corresponding to 23% of total investments, followed by Germany at 15%, and Italy and Spain at 10%. Furthermore, a 2016 industry analysis from the European Union Intellectual Property Office found that Intellectual Property Rights (IPRs) intensive industries are responsible for 42% of EU's economic output and are also responsible for 93% of EU's exports.

However, the exponential growth in intangibles has not been followed by improvements to firm's valuation methods, such as improved accounting standards, in order to incorporate the value of intangibles and to mitigate the uncertainty generated among credit institutions (Thum-Thyssen et al. 2017).

The greater uncertainty derived from intangible specific characteristics prevents private institutions to extend their credit to firms that greatly rely on intangible assets or to firms that intend to invest directly in intangible projects. For that reason, the financing of intangibles is still much more dependent on private equity instruments and retained earnings rather than on

debt instruments (Cecchetti and Schoenholtz 2017). This scenario is confirmed by recent data provided by the ECB (Bańkowska et al. 2020). Nearly 70% of the European SMEs said to rely mainly on bank loans to fund investments in fixed assets, while only approximately 15% of the European SMEs were able to finance investments in innovative projects through bank loans. The EIB, through its Survey on Investment and Investment Finance (EIBIS), found European banks to only finance 38% of the investments performed by EU firms on R&D.

The European Investment Bank (EIB) subdivides investments in intangibles into four subcategories: I) Research and Development (R&D) which includes acquisition of intellectual property; II) software, data, website activities and IT networks; III) training of employees and IV) improvements to business process and organisation.

The previously acknowledged types of intangible assets vary immensely in regard to their characteristics. The difficult collateralisation of intangible assets result from the non-tradability and the lack of visibility affecting most intangibles, which entails a reduction of the scope for asset-backed financing strategies. Thum-Thyssen et al. (2017) also develops on the lower ex-ante verifiability of intangibles (inability of assessing their value before they have started generating cash flows) as an additional barrier. However, intellectual property seems to group the intangibles that can more easily overcome such limitations (Andrews and de Serres 2012). Indeed, Schneider (2019) found IPRs, such as patents and trademarks, to be extremely relevant for SMEs. The cited literature further developed that the correct identification and valuation of such valuable intangible assets enable the latter to be used as collateral for loans and motivates outside investment by clearly communicating the value of the firm.

Segol et al. (2021) found that the barriers to investment in intangibles assets in Europe are mainly due to a bank-based economic area. The authors found that lending rates, maturity and collateral requirements have negative effects on investments in multiple intangible assets. The

cited literature concludes that the European lending framework gives support to the credit guarantee schemes for the firms that are not able to provide enough collateral value. The state, as a guarantor, fights a market failure and helps alleviate financial constraints and promote investments in intangibles through many economies of the Union.

## **5.2. The Portuguese context**

COTEC, an association seeking to better understand and support innovative Portuguese firms, acknowledges that also in Portugal the transition to a more knowledge-based economy is gradually happening. Portuguese innovative firms are found to exhibit greater financial robustness than their non-innovative peers (COTEC 2021). The report further found that innovative firms have been able to generate, on average, seven new IPRs per year and the investment intensity in knowledge amounts to 4%. Innovative Portuguese firms displayed an average 15% CAGR of revenues during from 2019-2021, while the overall set of Portuguese SMEs displayed a growth rate of 4.2% in 2019 and -9.8% in 2020 (INE 2020).

In Portugal, the aggregate investment in intangibles in 2018, as a share of GDP, amounted to 6.8% while that in tangibles amounted to 13%. Portugal ranks below the European average for investments in intangibles, which equals 8.3% of GDP, and above the European average of investments in tangibles, which amounts to 12.1% of GDP (Villarroya 2021). The same study also found that 34.4% of total investments in Portugal were channelled to intangibles, while the remaining 65.6% were channelled to tangibles. The European average sits at 40.6% and 59.4%, respectively.

Portuguese SMEs are also found to be mostly concentrated in low productivity sectors, which is supported by the score of Portuguese SMEs in the Digital Intensity Index composed by the

EU. The index points that 40% of the Portuguese SMEs have extremely low values of digital intensity.

## **Innovation in Portugal**

As a consequence of the shift in EU and national policies to promote the digital transition, Portugal's Investment in R&D has grown by almost 3 times, from little over €1bn in 2015, to roughly €3bn, in 2019. More than half of such investment in R&D was led by private enterprises (DGEEC 2020).

An important consequence of the innovative path followed by the Portuguese economy is related to the emergence of start-ups. Start-ups can be defined as young projects that thrive to launch an innovative product, business model or market segment. Although Portuguese start-ups only account for little over than 1% of Portugal's GDP, they have been steadily growing both in number and in size. Currently, there are more than 2,000 start-ups actively operating in the country which allow Portugal to currently register a number of start-ups per capita that sits 13% above the European average (Startup Portugal 2021). Such facts helped the Portuguese to become the 17th most innovative EU country, according to EU's Innovation Scoreboard.

In 2021, the number of Portuguese unicorns grew to 7. As of 2021, the Portuguese unicorns achieved a market valuation of €34.2bn. Such value, in 2021, corresponded to 44% of the total market value for the 20 biggest publicly traded Portuguese firms.

### **5.2.1. How are innovative Portuguese SMEs financed?**

#### **Debt financing**

Commercial debt might be provided in three different ways: Unsecured lending, secured lending and guaranteed lending. It might look at first glance that a correct valuation of

intangible assets can only contribute to foster the use of such assets as collateral in secured lending. However, if financial institutions are able to value intangibles more accurately and from there derive better prospects about a firm's strength and growth potential, then it can also help to foster unsecured lending. From all the means of financing made available to firms, debt is the one where intangibles and intellectual property have the greatest potential do add value (Brassell and Boschmans 2019).

Debt remains the primary source of external financing for Portuguese SMEs. Such heavy reliance on debt financing is also supported by government guaranteed schemes through bank loans. Outstanding business loans to SMEs in 2020 in Portugal amounted €58.9bn, of which €13.6bn were guaranteed by the government. Government guarantees have grown from 5.4% of total loans in 2009 to 10.5% in 2018 and they have been especially important given that banks have tightened significantly the lending conditions imposed on SMEs, requiring better quality and higher collaterals. SMEs needing collaterals to access bank lending rose from 76.3% in 2009 to 89.9% in 2020 (OECD 2022).

Eça et al. (2022) found that the paradigm surrounding financing procedures of Portuguese SMEs has been changing throughout time. The greater digitalization of the economy has also altered the landscape surrounding financial intermediation. While not long ago the financing of SMEs was almost totally ensured by banks, nowadays it seems that Fintech's have been gaining relevance on such financing operations. The cited literature analyses the borrowing of funds of Portuguese SMEs by a Portuguese FinTech and concludes that FinTech lending allows for firms to expand their debt capacity, entailing a substitution of bank debt for FinTech debt. The differences in risk appetite portrayed by banks and FinTech's explain differences to the requirements set when extending credit. FinTech's are willing to lend to riskier firms at the

expense of greater interest charged. The risk in such lending can arise from the unsecured extension of credit which is often performed by FinTech's.

The European Investment Bank (EIB) asserted that Portugal needs to provide a solution to the credit constraints imposed on firms looking to finance their digital projects. It found that the lack of investment in R&D, lack of qualified workers and the difficult access to investment condemns Portuguese SMEs to sit below the European average in what regards the level of digital transformation. EIB further explained that such constraints are often due to a relevant intangible component that entangles the risk assessment from credit institutions and due to the lack of sufficient physical or tangible collaterals that SMEs have to offer. Such facts can also explain the persistent greater financing constraints faced by Portuguese firms, when compared to the European average (EIB Investment Survey 2021).

### **Equity financing**

Equity financing is a broadly used means of financing by intangible rich SMEs in their early stage of development. This is due to the fact that it does not impose maturity constraints on the repayment of capital and does not demand collaterals. Equity finance might be performed by angel investors, specialist funds, venture capital firms or even private equity houses. Equity financiers usually take interest on deals that occur when there is a rapidly expanding product or service business, or when there are technologies, software's and brands with clear demand.

In 2020, venture capital financing to Portuguese SMEs amounted to €42m (OECD 2022). Equity financing does not follow a clear pattern and it has always been irrelevant, in value, when compared to debt lending. From 2017 to 2021, equity financing either in the form of venture capital or angel-investors, amounted to €270m (OECD 2022).

The dynamics established by venture capital activities in Portugal are also partly due to the support given by the EIB. In 2008, the Portugal Venture Capital Initiative (PVCi) was established with the aim of promoting co-operation between several public and private entities in order to stimulate venture capital and private equity activities in Portugal. From 2008 until 2018, PVCi invested more than €320m in the Portuguese economy.

### **Portuguese government commitment with digitalisation**

The Portuguese government has already signalled the total alignment with the EU in promoting the transition of the Portuguese economy towards a more digital economy. At the European level, Next Generation EU includes a 10-year €800bn investment plan to ensure a smooth transition to a more digital, greener and social European Economy. *Portugal 2030* is the economic plan that began in 2021 and will last until 2027. It will distribute €23bn in order to attain the objectives set under the Next Generation EU plan previously mentioned. €5.3bn of those are targeted at ensuring the digital transformation of the Portuguese entrepreneurial landscape.

*Indústria 4.0* is the name of the national strategy set in place by the ministry of economy to promote the transformation of the Portuguese economy. This strategy sits upon three different scopes of action: to provide the Portuguese firms with the necessary tools to embrace the fourth industrial transformation, by promoting Portuguese suppliers of technology and by turning Portugal into a Tech-Hub in order to stimulate outside investment and know-how sharing between firms and entrepreneurs.

### **5.3. How are banks adapting to the context of a digital economy?**

#### **5.3.1. Venture capital activities performed by banks**

Hellmann et al. (2008) analysed data from banks operating in the US and found evidence that banks also use venture capital in order to build lending relationships. A prior relationship between a bank and a firm through venture capital markets increases the likelihood of the bank granting loan, and with more favourable conditions to that company in subsequent periods, which plays in favour of both parties involved.

Several European banks have been adapting and transforming their operations in order to provide an answer to the change in demand of consumers over financial products and the escalating relevance of Venture Capital firms and FinTech's. Banks' venture capital activities are funded with private investors' money, which allows for a transfer of the risk of such investments.

Barclays Ventures, a branch of Barclays, was created in 2018. Its scope of action is to adapt the available instruments offered by the bank, both financial and non-financial, to tackle the challenges posed by the technological progress of the market. As of today, Barclays Venture financed 142 firms through its venture capital activities.

Another example is that of Mouro Capital. Mouro Capital is the corporate venture capital division belonging to Santander Group. The firm is focused on supporting firms that will shape the future of financial services. Currently it has \$400m of assets under management, with investments made in start-ups spread across Europe, North America and Latin America.

In Portugal, there is within the banking sector, one relevant player in the venture capital activities. CaixaBI, the branch of *Caixa Geral de Depósitos* that deals with risk capital. With

over 20 years of experience, Caixa BI currently manages a total capital of €475m from start-ups spread across several industries.

Finally, the recent acquirer of BPI, CaixaBank also has a branch whose activity is targeted at venture capital operations. Caixa Capital Risc invests in innovative companies in their early stages of development, either through convertible loans or equity. The company currently holds investments in more than 100 companies, mainly in Spain, spread across sectors such as life sciences, information technologies and industrial technologies.

### **5.3.2. Intangible backed financing**

Bank lending against intangible assets, although widely recognized as a possible tool to promote smooth financing and spur investment amongst SMEs, has known little to no developments in recent years, except for south-east Asia. China, for instance, is the most active state-backed intellectual property (IP) financing market in the world, although not being the most relevant example for the point we want to address, as in this case, all of the risk is being supported by the government (due to the 100% guarantee scheme provided).

A 2021 WIPO report studies the developments on Singapore's IP-backed financing. Singapore started their journey in 2014 with several financial institutions establishing partnerships with IP property offices of the country. Under this scheme, the government shared the risk (often in 80%) of IP-backed loans with financial institutions. Up until 2018, roughly \$9m had been distributed to firms on such terms. The reduced size of the programme was mainly due to high upfront valuation costs of intangibles supported by firms that deterred a great number of applicants to bank loans.

The country exhibiting the most experience and mature practices on intangible backed financing is the United States. The main motivation for the use of IP assets as collateral was the 2008

crisis. Banks, which held a lot of collaterals in the form of real state, found their selves in an under-collateralised position following the downfall in the housing prices. As a solution to overcome the lack of tangible collaterals, banks started collateralizing IP assets.

In the United States, as opposed to other countries, the national intellectual property office (US Patent and Trademark Office) is focused solely on the rights and regulatory component of innovation, therefore all of the initiatives that connect intellectual property and intangible-backed financing are performed by the private sector. In recent times, the use of relevant patents as collateral for loans granted by banks has been increasingly popular. JP Morgan Chase leads the ranking for the most patents taken as collateral (over 48,000), followed by the Bank of America (47,000), the Citigroup (35,000), Wells Fargo (33,000), Wilmington Trust (32,000) and the Deutsche Bank (27,000).

Another consideration to make on intangible securities, specifically in the case for the US, relates to the loan agreement in case of default. It became common that specialized valuation firms evaluated portfolios of intangibles from several firms and attributed a “certified purchase asset price”, while ensuring the portfolios were marketable and well-protected. In case of default, banks would have enforceable rights over the portfolios that were given as collateral.

### **5.3.3. Challenges on intangible backed financing: valuation**

One of the greatest challenges for financial institutions upon the possibility of including intangibles as collaterals refers to its valuation. There are multiple ways to evaluate intangible assets, however such valuations are complex. The complexity derives from the insufficient number of transparent markets where intangibles are traded and because intangibles are extremely heterogeneous in regard to their characteristics. Also, the volatility in intangible prices, since they depend on various factors, poses additional challenges to their valuation.

Brassell and Maguire (2017) studied the valuation methods of intangibles and concluded the income approach and within that, the royalty method, to be the most commonly used valuation method. The income approach refers to the income contribution that the intangible delivers to the income of a company, based on market conditions and historical performance. Within the income approach, the royalty method corresponds to an estimate of how much a third party would pay to license the technology. The income approach and other valuation approaches have already been standardized and the standards most often considered are the International Valuation Standards Council (IVSC) and the International Standard, ISO 10668.

Nonetheless, the great amount of valuation methods, which can lead to distant valuations over the same asset, imply the need to earn the confidence of the market. Brassell and Boschmans (2019) found that can be achieved by having the evaluations performed by state backed organizations, multinational accounting practices or other private sector evaluation specialists.

#### **5.3.4. Challenges on intangible backed financing: illiquid secondary markets**

Certain characteristics of intangibles pose challenges to the mission of monetizing them, causing concerns near financial institutions regarding their liquidation, if ever taken as collateral. There is, however, secondary market activities taking place worldwide. Although most of the trade occurs informally, there are formal channels, such as auctions, where intangibles are traded (Brassell and Boschmans 2019).

Intangible assets can be sold or licensed to a third party. There is a great value derived from charging license fees and royalties to third parties for the use of certain intellectual property rights. In 2018, US cross border trade of IP rights entailed earnings, in the form of licensing fees and royalties, of \$129bn (Congressional Research Service 2020) and the value of the US market for licensing IPRs was worth \$61bn in 2019 (IBISWorld). This places the United States as an extremely active market in the trade of intangible assets. Recently, there has also been a

trend in the United States, motivated by a very much developed legal framework of protection of IPRs, for corporations to acquire portfolios of patent rights in order to successfully enforce them in case of infringement and from there derive profits (Brassell and Boschmans 2019).

#### **5.4. How should BPI adapt to the market transformation?**

Having characterized the situation and the developments that have happened in other countries regarding the financing of SMEs, in an increasingly digital world economy, where Portugal is no exception, we aim at delivering possible measures to be implemented in order to best assist BPI in adapting and thriving within a digital economy.

##### **5.4.1. The case for intangible backed loans**

Progresses in regard to intangible backed loans are still a distant reality. Firstly, in an initial stage, the incentives must be set in place by the government, by creating guarantee schemes for loans backed on intangibles and this way dissipating the risk falling upon financial institutions (Brassell and Boschmans 2019). As found earlier, this was crucial to the success inherent to the Chinese case. Secondly, intangible backed financing is also a distant reality given the general lack of knowledge regarding this asset class and its valuation from most of the financial institutions. Furthermore, intangible backed financing would face additional constraints in a market such as the Portuguese one, given the absence of liquid secondary markets for intangibles to be traded, as opposed to what takes place in the US. However, planned initiatives such as the Capital Market Union of the EU could help in improving the liquidity on secondary markets for such assets.

Although recognizing that this is still a distant reality, it is crucial that BPI sets the foundations in order to acquire knowledge on intangible assets. Some of the literature depicted below and collected from countries ranking in far better positions than Portugal when it comes to

innovation scoreboards, point towards the relevance and the benefits derived from a deep knowledge over intangibles.

## **5.4.2. Recommendations**

### **1. Building knowledge on intangibles through traditional credit lending**

Brassell and King (2013), after having studied the role of intellectual property in easing business finance in the UK, have recommended that banks should start paying more attention to the intangibles found on firms' balance sheets. That is the case since the authors found intangibles to provide the basis for greater profits and enterprise value of the firms detaining them. The authors also found that those who have used IP in financing suggest loss levels to be low. Such reality derives, firstly, from the fact that the specific IP being funded is usually an important business asset that underpins cash flow. Secondly, because it is usual that the senior management has financial stake in the IP, therefore it can bring the benefits that banks traditionally link to personal guarantees.

France Business Financing Observatory (OFE 2017) has signalled that the digital transformation of SMEs will likely represent a challenge since it will difficult firms' access to external financing. The Observatory's research found that, although the largest banks in France have capabilities and developed structure to support innovative companies, often front-line relationship managers lack in depth understanding of the business for its appropriate diagnosis and referral.

Fidrmuc et al. (2018) focused on the relationship established between German SMEs and the banking sector between 2005 and 2012. The results obtained by the cited literature show that firms that present high share of intangible assets do not experience constraints in accessing to credit when comparing to firms with low share of intangibles. However, firms with greater

share of intangible assets are more likely to engage in persistent and exclusive bank relations. The authors point that this might arise in an attempt to overcome information asymmetries when applying for a bank loan.

In line with some of the previous characterizations and recommendations of financing dynamics in European countries, we recommend BPI to start analysing the intangible assets present on companies' balance sheet when extending credit. This will improve BPI's understanding on intangible assets over time while ensuring that financing is being extended to firms that perform better than their non-innovative peers (COTEC 2021). Also, BPI should thrive to develop and maintain long-lasting relations with its most innovative clients. The long-term analysis of innovative firms' performance will not only reduce the information asymmetries regarding the role of some key intangible assets, as it will allow BPI to better grasp the categories of intangibles that contribute the most to foster such growth.

## **2. Building knowledge on intangibles through venture capital**

The positive growth prospects on the innovative pattern displayed by the Portuguese economy and the lack of dependence on public regulation to initiate this activity, lead us to advise BPI to start its own and specialized branch on venture capital. Following the initiatives undertaken by several European banks in recent years, BPI should take advantage of a relatively small and underdeveloped venture capital market in Portugal. In 2019, venture capital was the main source of financing for Portuguese start-ups (68.3% of total financing), but the majority of that capital (66.8%) came from international investors (BGI, EIT Digital).

BPI could make use of its vast knowledge on the Portuguese private sector and capitalize on CaixaBank's increased financial power and accumulated expertise, derived from its own venture capital activities in Spain, to rapidly establish itself as a key player in the Portuguese venture capital market.

By joining the venture capital market, BPI would also gain knowledge on the activities performed by a set of innovative firms as well as understand the dynamics associated to the use of key intangibles. Furthermore, as referred in Hellmann et al. (2008), this could be a way to develop long-term lending relationships with innovative firms.

We acknowledge that this recommendation might be conflicting with the strategy followed and designed for BPI by CaixaBank. CaixaBank has manifested its desire to extinguish the private equity activities led by BPI. The goal of CaixaBank is to focus the activity of BPI solely on commercial banking activities. However, we also acknowledge that the dynamics around the digital transformation of the Portuguese economy should entail an adaptation from BPI's activities in order to follow such transformations. The great expertise and know-how of BPI over the Portuguese economy, and specifically Portuguese firms, allied with the knowledge obtained by CaixaBank through their venture capital activities in Spain, should help promote a swift and successful implementation of BPI in the Portuguese venture capital market. Also, it is important to notice that venture capital activities are not constrained to the Portuguese market, as seen in the examples previously described.

Ultimately, we expect the development of deep knowledge regarding intangible assets derived by both of our recommendations to be a fundamental step for BPI to achieve competitive advantage when the time comes to use intangible assets as collateral.

## 6. Conclusions

We study the impact of several factors on the investment decisions taken by firms over tangible and intangible assets, from both a macroeconomic and microeconomic perspective. The dataset chosen for the analysis corresponds to Portuguese SMEs, except for micro firms.

Regarding the macroeconomic factors, we find EPU, inflation, and interest rate to be statistically significant factors that negatively affect firms' investment rates. On the other hand, we find the GDP growth rate to be statistically significant and to positively impact firms' investments. EU funds are found not to be statistically significant in explaining firms' investments, however, we do not reject the possibility of its economic relevance.

The microeconomic analysis demonstrated financing cost and lagged effective tax rate to be statistically significant and to deter firm investment. Previous investment, EBITDA margin, lagged retention ratio, the stock of long-term debt, and collateralizable assets are found to be statistically significant and to positively influence firm investment. The retention ratio and effective tax rate in year  $t$  are found not to be statistically significant.

We find the set of statistically significant variables with the most relevant coefficients to be the tangible assets to serve as collateral, the financing costs, and the level of long-term debt. These factors should be the ones most closely examined by BPI when assessing a company in order for the bank to better adjust the financial products it offers to the companies. The results on debt should entail BPI to provide loans with long maturity dates in order to spur firm investment, as short-term debt does not appear to have an impact on investment but long-term does.

The statistical significance and the relevance of the coefficient associated with collateralizable assets set the starting point for the research on the role of banks in a digital economy. Supported

by relevant literature on this topic, it is observable that banks and economies have been adapting in various regions of the world to the growing importance of intangible assets. Finally, we recommend BPI put some measures in place to develop in-depth knowledge of intangibles to better evaluate the risk inherent to innovative firms.

## **7. Limitations and Future research**

There are some limitations associated with the study here presented. Firstly, some potential factors influencing firms' investment decisions, such as the firms' credit rating among financial institutions, management's level of education, the sector where they are inserted, and some country-specific political, financial, and economic factors were not considered. Another limitation concerning the analysis performed regards the dataset used. Although micro firms indeed often present incoherent and counterintuitive data that result from their firm-specific context, we also acknowledge that their exclusion from the dataset prevents the interpretation of the results found for a vast majority of active Portuguese firms. Finally, our results are conditioned on the metrics used both for the dependent and the independent variables, which may in some cases affect the results.

Future research is suggested on examining the possibility for non-linear relationships between the variables in question; and on the recommendations delivered regarding the role of BPI in a digital economy, since this is a constantly changing and evolving reality.

## 8. Agriculture Sector Analysis

The choice of the sector presented below is based on the importance that it has for BPI, not only from an accounting perspective, but also from a marketing and historical perspective.

### 8.1. Agriculture Sector

The Portuguese Economic Activity Classification section A is agriculture, animal production, hunting, forestry and fishing. It includes all economic activities in the primary sector. Agricultural activity comprises goods and services specific to agriculture and animal production. Fishing includes, in addition to fishing, the collection of seaweed and other products from marine and inland waters and aquaculture.

The share of GDP the sector of agriculture, forestry and fishing is responsible for suffered a substantial decrease since 1995 in Portugal, from 5% to 2.2% in 2021 (The World Bank 2022). Nevertheless, it is possible to observe a slightly upward trend in the last 4 years. Although, as we can infer from this, such sector is not one of the most relevant sectors economically for Portugal, it is of great importance to BPI, as they are historically known to be a bank supporting agriculture investment.

Agriculture is a significant economic sector given its primary function of providing food and raw material along with income and employment for rural areas (Moldovan et al. 2020).

Are firms in the agriculture sector impacted differently by the microeconomic factors? How different are the macroeconomic factors affecting agricultural investment? The intent in this section of the research paper is to analyse factors affecting investment decisions undertaken by firms specifically to the agriculture, forestry, and fishing sector. The type of investment referred to here is productive investment (CAPEX), expected to have a long-term effect on the business,

and more specifically, in this sector, this should include, but not be limited to, development and expansion through investments in acquiring new technology, land and livestock.

### 8.1.1. Sector characterization

The agriculture, forestry and fishing sector, as of 2020, includes 9.8% of total companies in Portugal, in which around 86% of them are microenterprises, 11.5% are small firms, 2.2% are medium firms and 0.3% are large firms (GEE 2022). Moreover, the sector employs around 5% of the total employed people and contributes to a Gross Value Added of 2.2% of total GVA, from which 77% are from agriculture, 13.5% from forestry and 9.5% from fishing (GEE 2022).

A few indicators point toward an increase in efficiency within the sector: the overall liquidity ratio and solvability ratio have been increasing in the past few years (GEE 2022).

**Table 7:** Share of firms, turnover and assets per segment.

	Companies	Turnover	Assets
Agriculture	83.57%	80.83%	87.22%
Forestry	12.90%	14.63%	11.00%
Fishing	2.71%	5.91%	3.16%

Source: Banco de Portugal - Quadros do Sector

**Table 8:** Share of firms, people employed, turnover and GVA per district/region.

	Companies	Employed	Turnover	GVA
North	40.50%	30.90%	15.50%	20.60%
Centre	23.20%	22.90%	33.90%	30.20%
Lisbon	6.30%	9.20%	10.90%	10.40%
Alentejo	15.70%	24.00%	30.40%	26.20%
Algarve	4.90%	5.70%	4.10%	6.40%
Açores	5.70%	4.60%	4.30%	5.10%
Madeira	3.70%	2.70%	1.00%	1.10%

Source: GEE, República Portuguesa

In Table 7, it is observable that more

than 83% of the companies in this sector are

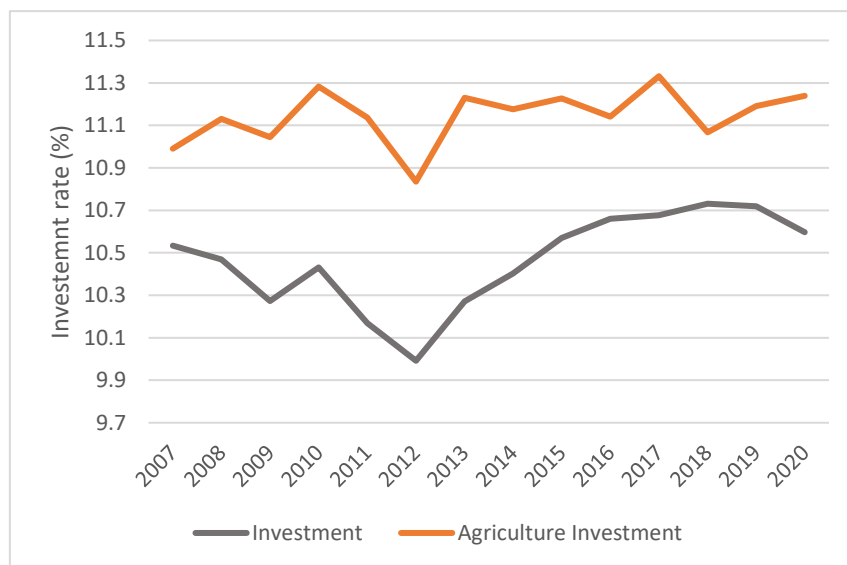
inserted in the agriculture

segment, whereas less than 13% belong to forestry and less than 3% belong to fishing.

Moreover, more than 80% and 87% of turnover and assets, respectively, belong to the agriculture segment. This clearly indicates that the agriculture segment is the one with the most relevance in this sector and is thus, based on such segment that the choosing of the factors for

analysis is focused. Moreover, for simplicity and due to its relevance, this sector is going to be referred to as agriculture sector in the rest of this section.

In Table 8, one can see that more than 40% (the majority) of companies in this sector are located in the North of Portugal, as well as it is the region that employs more people. However, more than 64% of the turnover and 56% of the GVA, respectively, come from firms based in the centre region of the country and from the Alentejo region. This implies that such firms, especially, are either much more efficient or of bigger dimension than those located in the Northern region of the country.



**Graph 19:** Evolution of Mean Agriculture Investment and Mean of Total Investment

In Graph 19, there are several key points to note. Firstly, the evolution of agriculture investment seems to be a little unstable in the sense that it has a very irregular pattern; nonetheless, it follows, if any, a very slight trend upward from 2007 to 2020, with a major down point happening in 2012, and less substantial ones in 2009, 2016 and 2018. Secondly, it can be observed that, *ceteris paribus*, firms in the agriculture sector present a higher investment rate than other firms. This can also be confirmed with the results obtained by including a dummy variable in the macro regression model presented for the investment across all sectors, to which

it shows a highly significant positive coefficient. In addition, agriculture investment presents a mean of 11.15, which is approximately 0.7 percent above the mean for total investment. Finally, it can also be observed that the evolutions of agriculture investment and total investment are not following similar patterns, indicating that agriculture investment may be affected by different factors than the ones considered for total investment.

### **8.1.2. Factors**

The microeconomic factors affecting investment decisions of a firm in the agriculture sector are not expected to be significantly different from those studied above across all sectors. Firms in this sector may, nonetheless, have a different exposure to such factors. This is briefly analysed below, but in the interest of focusing on the most important points, literature on the microeconomic factors studied above is not discussed again.

This analysis is, thus, focused on macroeconomic factors affecting agricultural investment, as these are expected to present more significant and relevant results.

The macroeconomic factors presented to be analysed include the inflation rate of raw materials, the years of harsher drought, agriculture, agriculture workers inserted in the family agricultural business, the EU funds attributed to agriculture, and finally, the location the firm is inserted in (to account for environmental characteristics of the locations, such as climate, soil fertility and even synergies from being located near various businesses within the same sector).

#### **4.1.2.1 Inflation of raw materials**

Inflation not only implies increases and decreases in the general price level, but rather it may create some inefficiencies and inequities derived from the inflation-induced changes in relative prices (Lins and Duncan 1980). Moreover, several authors asserted that in the short-term, high inflation rates result in a higher income variability to an agricultural firm, as input prices

respond more rapidly to inflationary pressures than output prices (Lins and Duncan 1980; Ruttan 1979). This means that with higher inflation rates, prices of input products agricultural firms must pay increase more quickly than do prices that the agricultural firm receives for their products. In addition, this leads farm input firms to pass price risks on to farmers (Lins and Duncan 1980). In turn, in the short-term, this may lead to reduced real net farm income, reduced liquidity and higher income instability (Lins and Duncan 1980).

White and Musser (1980) stated inflation influences the net present value (NPV) and thus, affects investment decisions. They indicated a higher inflation decreases the NPV of future payoffs, which in turn, reduces the incentive to invest. They add that inflation is very probable to considerably affect the area of financial management in a firm and conclude that inflation should thus be included as a dependent variable explaining firm's investment decisions.

Given the findings in the literature, it is hypothesized that,

***Hypothesis A:** Inflation of raw materials is significant and negatively related to agricultural investment.*

#### **4.1.2.2 Drought years**

Dai (2013) in Huynh et al. (2020) stated droughts were identified as one of the biggest disastrous consequences of climate change for economic activities. Huynh et al. (2020) studied the effect of droughts on businesses located in affected areas, and specifically, on the risk premia firms will be subject to. According to the authors, drought has a positive impact on equity capital costs, which is amplified by the intensity, duration, and financial costs resulting from such drought. They conclude climate change consequences pose large economic premiums on firms. This means that drought increases the firm risk and thus, its financing cost. In turn, this is anticipated to decrease a firm's investment level.

Quiroga and Suárez (2016) also found drought to affect crop production, which directly impacts agricultural businesses' profits, and indirectly affects their investment levels.

Furthermore, Marangos and Williams (2005) asserted drought increases economic uncertainty, which consequently, increases the risk of future agricultural investments and results in delayed investments. They add that the lack of water in times of drought affects employment opportunities, profits and leads to financial distress. The authors strongly concluded that droughts create significant challenges for farmers, governments and other participants in the agriculture sector, which in turn has important repercussions for investment decisions in this sector.

Given the literature found on this topic, it can be hypothesised that,

***Hypothesis B:*** *Drought years* is significant and has a negative impact on agricultural investment.

#### **4.1.2.3 Agriculture education**

Kwanmuang (2014) stated agricultural education directly increases the knowledge of farming. Moreover, he also claimed that many studies find a positive impact of the agricultural level of education on farm productivity and income. Similarly, Yasmeeen (2011) concluded that more educated farmers were able to better decide the type of product that would thrive under the conditions of that specific farm, thus increasing farm income.

Furthermore, Kwanmuang (2014) alleged that education has a spill over effect. He stated that the education level of co-workers or neighbours can impact the productivity of the agricultural business. This means that if the agricultural workforce is more educated, agricultural businesses productivity will be higher, resulting in higher profits, and ultimately, leading to higher investment levels.

Moreover, Kwanmuang (2014) noted that as the level of agricultural education increases, people have better perceived ideas towards farming as a stable career. He argues this increases support for people to start their education focused on agriculture earlier on, which creates positive attitudes towards agricultural policies, and indirectly positively affect farm investment.

The mentioned positive effects of higher education levels among agricultural workers on farm productivity and investment are, however, found to be more relevant in modernising agricultural environments in comparison to traditional ones (Lockheed et al. 1979).

On the basis of the mentioned finding, it can be hypothesised that,

***Hypothesis C:** Agriculture education is significant and positively related to agriculture investment.*

#### **4.1.2.4 Agriculture family workers**

Literature reveals that the size of the family, and the availability of a successor can be explanatory factors when analysing the time horizon considered for investment (Moldovan et al. 2020). Most agriculture businesses usually tend to be family companies, and as well as being part of the workforce, family members are also involved in management decisions (Moldovan et al. 2020).

Moldovan et al. (2020) discussed two possible impacts that family workers can have on the firm's investment decisions. First, a positive effect due to lower fixed costs resulting from part of the workforce being family members. Second, a negative effect resulting from higher levels of risk aversion among family members. Furthermore, it is of noting that in family agricultural businesses, it is complicated to distinguish the business expenses and assets from the family ones (Moldovan et al. 2020).

Suess-Reyes and Fuetsch (2016) also debated both effects. On the one hand, they argue that a family business wants to expand to create additional workplaces for family members, as well as to create further financial sources for the family through diversification and innovation, ultimately to improve the family's quality of life. This would imply that a higher share of family in the workforce positively impacts investment levels of these firms as they would want to expand more. On the other hand, the authors contended that despite such potential, that is not usually achieved in reality, and agricultural family businesses often fail to produce high levels of innovation, presenting more traditional approaches. They, as the authors above, claim this to be due to higher risk aversion. In general, Suess-Reyes and Fuetsch (2016) asserted that family businesses are usually innovative either in early stages (with the founder) or when a new generation takes over, but in between the patterns are usually more conservative.

Ideally, along with the share of the workforce that belongs to the family it would also be important to analyse other factors such as the family ambitions, the family climate (how they get along), their work-life balance and the potential of having a successor.

Given the finding of the literature on this topic, it can be hypothesised that,

***Hypothesis D:*** *Agriculture family workers* is significant and negatively related to agricultural investment.

#### **4.1.2.5 EU funds for agriculture**

Pearson et al. (1985) discussed how, specifically to the agricultural sector, informal loans are of great importance. He argued that although formal loans, granted by financial institutions, are still important to the sector, agricultural businesses usually prefer informal loans, which can be obtained by savings from the farming business or even from different businesses the agricultural businesses are engaged in. In this regard, he complements this with stating that this availability

of funds from informal sources can make the effect of government credit policies on agricultural investment less clear.

Literature on public funds for agricultural businesses presents numerous issues related to such funds and most of them refer back to the entrance of Portugal in the EU and discusses how the investment rates in the agricultural sector have decreased post-EU entrance (Moreira 2017).

Portuguese agriculture is said to have benefited from a steady stream of European funds after Portugal's integration into the EU in 1986. This was intended to modernize the industry and bring Portuguese agricultural growth more in line with that of more developed economies (Moreira 2017). The EU funds granted to agricultural businesses with the purpose of agricultural firm investment served as a substitute for private capital that was now available to be used in ventures that are more profitable (instead of agriculture), according to Moreira (2017), who claimed that the results of these funds were not quite what was expected given that investment levels decreased despite these funds and given that there was a crowding out effect. The evidence suggests that capital owners who would have otherwise invested in agriculture found other uses for their capital investment. The author also discussed other issues with these funds, mainly the fact that land propriety and largest farms were favored in the agreement between Portugal's authorities and the European Commission. This means smaller farms, possibly those who needed them the most, were not attributed such funds. The authors concluded that financialization trends that weakened agricultural investment prospects were reinforced by the way investment aids were administered to the largest investors.

On the basis of the literature findings, it can be hypothesised that,

***Hypothesis E:*** *EU agriculture funds* is significant and negatively impacts agriculture investment.

#### 4.1.2.6 Favourable location

The location of a firm is a factor that can control for several aspects affecting productivity and firm investment, mainly the climate, soil fertility, land availability and synergies of being in a cluster of firms in the same business sector (Ferreira et al. 2020).

Most agricultural activity present in the northern region of Portugal is of small scale and considered to be intensive agriculture (Scott et al. 1987). Scott et al. (1987) asserted that the high population density in the northwest of Portugal led to small, fragmented farms whose main focus is family consumption, with the exception of a few larger and more mechanized farms specialized in commercial sales. They added that whereas in Portugal more than one third of the cultivated areas are managed in units of 1 acre, if one is to consider the Alentejo region alone, it accounts for more than one half of the cultivated area, as three-fourths of the cultivated area are farms with more than 100 acres. This indicates that this region is dominated by larger farms than the ones in the north region of the country (Scott et al. 1987).

The northern region of Portugal is considered to have a more Atlantic climate (Firmino, 1999), while the climate present in regions such as the Alentejo and the south of the centre region (specially, Lis Valley) is described to be a mediterranean climate, which is characteristic of mild winters and dry hot summers, which are favorable to agriculture (Ferreira et al. 2020; Firmino 1999). Thus, if a firm is present in a favorable environment for its business, it will be able to generate more profits and thus incur in higher investment levels.

Given the findings on this factor, it can be hypothesised that,

***Hypothesis F: Favourable location is significant and positively related to agriculture investment.***

### 8.1.3. Methodology

#### Dataset

The data for analysis consists of micro data from Banco de Portugal's CBHP dataset and macro data retrieved from Pordata, except for the inflation of raw materials that was retrieved from Banco de Portugal's database as well. The period under analysis is from 2006 to 2020. Moreover, the type of firms to be analysed are small and medium-sized Portuguese private non-financial enterprises (micro enterprises are not included for analysis given the possibility of incomplete and incoherent data as well as the lower relevance in terms of turnover for credit provided by BPI).

The sample for this sector, considering the criteria above and the fact that anomalous observations are deleted, consists of 5,723 observations across 2,230 unique firms.

A dynamic panel data methodology is used to analyse the impact of the explanatory factors on agricultural investment, given the same reasons discussed above in the analysis across all sectors. Thus, the following regressions are estimated.

Microeconomic Regression:

$$\begin{aligned}
 \text{Agric Inv}_{i,t} = & \beta_{1,2} * \text{Investment}_{i,t-1 ; i,t-2} + \beta_{3,4} * \text{EBITDA}_{i,t ; i,t-1} + \beta_{5,6} * \text{Retention}_{i,t ; i,t-1} \\
 & + \beta_{7,8} * \text{Tax Rate}_{i,t ; i,t-1} + \beta_9 * \text{ST Debt}_{i,t} + \beta_{10} * \text{LT Debt}_{i,t} + \beta_{11} * \text{Collaterals}_{i,t} \\
 & + \beta_{12} * \text{Financing Cost}_{i,t} + \beta_{13} * \text{Size}_{i,t} + (\theta_i + S_i + \varepsilon_{i,t})
 \end{aligned} \tag{3}$$

Macroeconomic Regression:

$$\begin{aligned}
 \text{Agric Inv}_{i,t} = & \beta_1 * \text{Inflation}_{i,t} + \beta_2 * \text{Drought}_{i,t} + \beta_3 * \text{Education}_{i,t} + \beta_4 * \text{Family}_{i,t} + \beta_5 * \text{EU} \\
 & \text{Funds}_{i,t} + \beta_6 * \text{Location}_{i,t} + (S_i + \varepsilon_{i,t})
 \end{aligned} \tag{4}$$

where: **Agric Inv**<sub>*i,t*</sub> – agriculture firms' *i* investment rate at year *t*; **β** – Coefficients to estimate; **X**<sub>*i,t*</sub> – Vector of independent variables for the *i*-th firm at year *t*; **θ**<sub>*i*</sub> – Time effects controlling for macroeconomic impacts (using year dummies); **S**<sub>*i*</sub> – Firm specific effects controlling for heterogeneity across firms; **ε**<sub>*i,t*</sub> – Error describing the non-explained effects on **Y**<sub>*i,t*</sub>.

Table 9 in the Appendix describes the metric used for each variable included in the macroeconomic model. Moreover, tables 10 and 11 in the Appendix present the summary statistics for the variables included in the macro and micro models, respectively. Furthermore, tables 12 and 13 in the Appendix present the correlation matrix for the macro and micro variables, respectively.

### 8.1.4. Results and discussion

The regression results are presented below in tables 14 and 15.

**Table 14:** Microeconomic model for agricultural investment.

*Dynamic Panel-Data estimation, two-step system GMM*

Variables	Coefficients	t-value	Probability
<b>Investment Rate t-1</b>	0.181	3.58	0.000***
<b>EBITDA Margin t-1</b>	0.819	2.41	0.016**
<b>Retention Ratio t-1</b>	0.211	2.35	0.019**
<b>Eff Tax Rate t-1</b>	0.064	1.75	0.081*
<b>ST Debt</b>	-0.064	-0.3	0.764
<b>LT Debt</b>	0.037	0.16	0.873
<b>Collateral Assets</b>	2.557	10.4	0.000***
<b>Financing Cost</b>	-5.616	-1.79	0.074*
<b>Firm Size</b>	0.781	14.41	0.000***
<b>c</b>	-2.989	-5.24	0.000***

*Note: \*\*\* p-value<0.01, \*\* p-value<0.05, \* p-value<0.1*

**Table 15:** Macroeconomic model for agricultural investment.

*Dynamic Panel-Data estimation, two-step system GMM*

Variables	Coefficients	t-value	Probability
<b>Inflation raw materials</b>	-0.010	-1.800	0.072*
<b>Drought years</b>	-0.345	-2.170	0.030**
<b>Agriculture education</b>	0.139	2.200	0.028**
<b>Agriculture family workers</b>	-0.276	-3.580	0.000***
<b>EU agriculture funds</b>	-4.3E-09	-1.910	0.056*
<b>Favourable location</b>	0.594	2.300	0.021**
<b>c</b>	35.639	4.790	0.000***

*Note: \*\*\* p-value<0.01, \*\* p-value<0.05, \* p-value<0.1*

Briefly analysing the results of the microeconomic regression, one can understand the statistically significant and relevant factors affecting agricultural investment differ from those obtained for the same variables affecting investment across all sectors. It is of noting that the factors that actually are statistically significant affect agricultural investment in the same way they did for total investment, and with similar magnitudes. However, the most important finding in this regression is how debt is not statistically significant (nor is the financing cost at a 95% confidence level) in explaining agricultural investment, but the retention ratio is. These findings align with literature regarding how agricultural firms finance their investments – they prefer to use internal funds, mainly from retained profits or a family member injecting more capital (Pearson et al. 1985).

Regarding the macroeconomic model results, the inflation of raw materials presents a statistically significant (at a 90% confidence level) negative coefficient. On average, a one percent increase in the inflation rate of raw materials has a negative one percent impact on the agricultural investment rate. This result aligns with those of White and Musser (1980), who stated that an increase in the inflation rate decreases the NPV of the firm's future cash flows, which negatively affects firm investment. Thus, we fail to reject Hypothesis A, as a negative statistically significant impact of the inflation of raw materials on agricultural investment is obtained.

The dummy variable for the years of drought also presents a statistically significant negative coefficient, indicating that on average, in years of drought, agricultural investment suffers a negative impact of approximately 35 percent. The lack of water caused from droughts directly negatively impacts a crop's productivity, thus directly negatively impacts a firm's profits, which implies a decrease in investment (Quiroga & Suárez 2016). Therefore, we fail to reject hypothesis B, as a negative and statistically significant impact of 35 percent caused by droughts

is found on agricultural investment. Furthermore, introducing an interaction factor between drought years and small firms, this shows a positive coefficient, indicating that the negative impact of droughts on agricultural investment is less pronounced for smaller firms in comparison to medium firms. This confirms the literature of Huynh et al. (2020) in regard to the impact of drought depending on the severity of the issue, and for medium firms, as the share of land they produce in is higher, the financial impacts of droughts on such agricultural land are anticipated to be higher than those for small firms.

Moreover, agricultural education, accounting for the share of agriculture workers that have a higher education degree, is found to positively impact agricultural investment as it presents a statistically significant positive coefficient. On average, a one percent increase in the share of agriculture workers that have a higher education degree has a positive effect of approximately 14 percent on agricultural investment. This result aligns with the findings in the literature (Kwanmuang 2014), as higher knowledge directly impacts a firm's productivity and profits through the more efficient use of its resources (Yasmeen 2011). This leads us to fail to reject hypothesis C, as we find a statistically significant positive impact of agriculture education on agricultural investment.

In contrast, the results for agriculture family workers, which accounts for the share of the agriculture workforce that is working in a family agricultural business, present a highly statistically significant negative coefficient, indicating that on average, a one percent increase in the share of the workforce working in a family agricultural business has a negative impact of approximately 28 percent on agricultural investment. The reason behind this is that in a family business, the managers (the family) are more risk averse, leading them to incur in lower investment levels. This is possibly due to the fact that in a family agriculture business, the firm's assets and expenses are very difficult to distinguish from the family ones, which aligns with the

findings of Moldovan et al. (2020). Thus, we fail to reject hypothesis D, as a statistically significant negative impact on agriculture investment is found to be caused by the agriculture family workers.

Regarding agriculture education and agriculture family workers it is important to note that they share a very strong negative correlation (-0.7). On the one hand, such high correlation might be biasing the results, so they should be taken with caution. On the other hand, this suggests that a higher share of educated workers implies a lower share of family workers and vice-versa, which in real terms may indicate that family workers may not think it to be important to have a higher education degree since they can learn from their family members. Moreover, by including a factor in the model with the interaction between these two variables, we obtain a statistically significant positive coefficient, indicating that the negative impact of family agricultural workers on investment is less pronounced the higher the share of educated agricultural workers. This may be due to the fact that an agricultural family worker that is also educated is able to decide on better agricultural practices based on empirical and practical knowledge, which reduces the risk aversion to investment decisions by the family members and thus, this negative impact on investment is less pronounced.

The results also show that the EU funds attributed to agricultural purposes are statistically significant (at a 90% confidence level) in explaining firm's agricultural investment, with a negative effect. However, the magnitude of the coefficient is of such lower value that it appears to not be relevant economically. This result, nonetheless, is reasonable, as literature on this indicates that not only do firms prefer informal loans (Pearson et al. 1985) but also that such funds were used as a substitute for private capital that was now available to be used in more profitable financial activities other than agricultural endeavours (Moreira 2017). Thus, even though it is significant in explaining agricultural investment, it is not found to relevantly impact

it due to the crowding out effect it causes. Given the fact that this coefficient is only statistically significant at a 90% confidence level, and it is not relevant in magnitude, we can reject hypothesis E at a 95% confidence level.

Finally, the dummy for favourable location in regard to agricultural purposes, accounting for the south of the centre region of Portugal and the Alentejo region, shows a positive statistically significant coefficient. This indicates that on average, a firm that is based in these mentioned favourable locations has a positive impact of approximately 60 percent on its agricultural investment. The rationale behind this is that a firm based in a favourable location, is facing favourable climate conditions, soil conditions among others, which positively impacts its activities and thus increases its investment levels. This result aligns with those of Ferreira et al. (2020) and Firmino (1999). This leads us to fail to reject hypothesis F, as we find a statistically significant positive impact of approximately 60 percent on agricultural firm investment due to the fact that the firm is located in a favourable location.

Furthermore, including a dummy variable for small firms in the model, the results show that small firms invest less in agriculture when compared to medium firms in this sector.

### **8.1.5. Conclusions**

In this section, the impact of microeconomic and macroeconomic factors is analysed specifically for the agriculture sector. From a microeconomic perspective, considering the same factors as the ones considered for the analysis across all sectors, the results show that firms in the agriculture sector present a different exposure to such factors, mainly the fact that agricultural businesses investment decisions are more reliant on internal funds than external funds, as the latter are found to not be statistically significant to explain agricultural investment. This suggests that if banks want to significantly fund agricultural businesses, they should

establish incentives that make agricultural businesses prefer debt financing over internal financing.

From a macroeconomic perspective, the results demonstrate that the inflation of raw materials, drought years, and the share of the agricultural workforce that is working in the family agricultural businesses are all found to be statistically significant and impact firms' agricultural investment negatively. Whereas the share of the workforce that has a higher education degree and the location of the company being in the south of the centre region of Portugal or in the Alentejo region (considered favourable locations) are found to be statistically significant and affect agricultural investment positively. Firms and banks are not able to control the inflation on raw materials nor droughts, so all they can do is monitor these factors and respond quickly to them. Regarding the location, BPI can establish incentives for agricultural businesses to have at least part of their operations based in favourable locations. Moreover, BPI can also establish incentives for agricultural family workers (and all workers, but family ones especially) to get a higher education degree on agriculture in order to lessen the negative impact the family workers have on the agricultural firms' investment.

## 9. References

- Aiello, F, Bonanno, G, Rossi, SPS. 2020. “How firms finance innovation. Further empirics from European SMEs.” *Metroeconomica*. 71, 689– 714.
- Al-Thaqeb, A. and Algharabali, B. 2019. “Economic policy uncertainty: A literature review.” *The Journal of Economic Asymmetries*, 20, issue C.
- Andrews, D. and A. de Serres. 2012. “Intangible Assets, Resource Allocation and Growth: A Framework for Analysis.” *OECD Economics Department Working Paper*, No. 989.
- Arellano, M., & Bond, S. 1991. “Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations.” *Review of Economic Studies* , 58, 277-297.
- Arellano, M., & Bover, O. 1995. “Another Look at the Instrumental-Variable Estimation of Error-Components Models.” *Journal of Econometrics*, 69, 29-52.
- Bańkowska, K., Ferrando, A., Garcia, J. 2020. “Access to finance for small and medium-sized enterprises since the financial crisis: evidence from survey data.” ECB Economic Bulletin, 2020.
- Beck, T., Demirgüç-Kunt, A. and Maksimovic, V. 2005. “Financial and Legal Constraints to Growth: Does Firm Size Matter?” *The Journal of Finance*, 60, 137-177
- Beck, T., Döttling, R., Lambert, T. and Van Dijk, M. 2020. “Liquidity Creation, Investment, and Growth.” *Journal of Economic Growth*.
- Becker, T. A. 2006. “Output drops and the shocks that matter.” IMF Working Papers 06/172 (pp. 1–43).
- Binsbergen, J.H., Graham, J.R., Yang, J. 2010. “The Cost of Debt.” *The Journal of Finance*, 65, 2089-2136.

Blundell, R., & Bond, S. 1998. “Initial Conditions and Moment Restrictions in Dynamic Panel Data Models.” *Journal of Econometrics* , 87, 115-143.

Brassell, M. and K. Boschmans. 2019. “Fostering the use of intangibles to strengthen SME access to finance”, *OECD SME and Entrepreneurship Papers*, No. 12, OECD Publishing, Paris.

Brassell, M., King, K. 2013. “Banking and IP?: The role of intellectual property and intangible assets in facilitating business finance”. Intellectual Property Office.

Brassell, M., Maguire, J. 2017. “Hidden Value: A study of the UK IP Valuation Market.” Intellectual Property Office.

Brown, J., Petersen, B. 2009. “Why has the investment-cash flow sensitivity declined so sharply? Rising R&D and equity market developments.” *Journal of Banking & Finance*, 33(5), 971-984.

Cecchetti, S. G. and K. L. Schoenholtz, 2017. “Treasury Round II: The Capital Markets Report.” *Money, Banking and Financial Markets*.

Christiano, L. J., Eichenbaum, M., & Evans, C. L. 2005. “Nominal rigidities and the dynamic effects of a shock to monetary policy.” *Journal of political Economy*, 113(1), 1-45.

Cleary, S. 1999. “The Relationship between Firm Investment and Financial Status.” *The Journal of Finance*, 54, 673-692.

Congressional Research Service. 2020. *Intellectual Property Rights and International Trade*

COTEC Portugal (2021), *Relatório e Contas 2021*.

Demmou, L. and G. Franco. 2021. “Mind the financing gap: Enhancing the contribution of intangible assets to productivity.” *OECD Economics Department Working Papers*, No. 1681, OECD Publishing, Paris.

Demmou, L., Stefanescu, I., Arquie, A. 2019. “Productivity growth and finance: The role of intangible assets - a sector level analysis.” *OECD Economics Department Working Papers*, No 1547, OECD Publishing.

*Direção-Geral de Estatísticas da Educação e Ciência (DGEEC)*. 2020. “Inquérito ao potencial científico e tecnológico nacional 2019”

Eberly, J., Rebelo, S., and Vincent, N. 2012. “What explains the lagged-investment effect?” *Journal of Monetary Economics*, 59(4), 370-380.

Eça, A., Ferreira, M. A., Prado, M. P., and Rizzo, A. E. 2021. “The real effects of fintech lending on SMEs: Evidence from loan applications.” *ECB Working Paper*, No. 2022/2639.

ECB. 2021. “Survey on the access to finance of enterprises (SAFE).” *European Central Bank*.

EIB (2021). Investment Survey 2021

Fama, E., French, K. 2002. “Testing trade-off and pecking order predictions about dividends and debt.” *Review of Financial Studies*, 15(1), 1–33.

Farinha, L., and Prego, P. 2013. “Investment decisions and financial standing of Portuguese firms—recent evidence.” Economic Bulletin and Financial Stability Report Articles and Banco de Portugal Economic Studies.

Farooq, U., Ahmed, J., and Khan, S. 2021. “Do the macroeconomic factors influence the firm's investment decisions? A generalized method of moments (GMM) approach.” *International Journal of Finance & Economics*, 26(1), 790-801.

Ferreira, S., Oliveira, F., Gomes da Silva, F., Teixeira, M., Gonçalves, M., Eugénio, R., Damásio, H., & Gonçalves, J. M. 2020. “Assessment of factors constraining organic farming expansion in Lis Valley.” *Portugal. AgriEngineering*, 2(1), 111–127.

Fidrmuc, J., Schreiber, P., and Siddiqui, M. 2018. “Intangible Assets and the Determinants of a Single Bank Relation of German SMEs.” *European Journal of Business Science and Technology*, 4(1), 5-30.

Firmino, A. 1999. “Agriculture and landscape in Portugal.” *Landscape and Urban Planning*, 46(1-3), 83–91.

Gan, J. 2007. “Collateral, debt capacity, and corporate investment: Evidence from a natural experiment.” *Journal of Financial Economics*, 85(3), 709-734.

Gómez, M. G. P. 2019. “Credit constraints, firm investment and employment: Evidence from survey data.” *Journal of Banking & Finance*, 99, 121-141.

Graham, J. R., and Harvey, C. R. 2001. “The theory and practice of Corporate Finance: Evidence from the field.” *Journal of Financial Economics*, 60(2-3), 187–243.

Gujarati, D.N., Porter, D. C. 2009. *Basic econometrics*. New York: McGraw-Hill Irwin.

Haley, C. W. 1971. “Taxes, the cost of capital, and the firm's investment decisions.” *The Journal of Finance*, 26(4), 901-917.

Hellmann, T., Lindsey, L., and Puri, M. 2008. “Building Relationships Early: Banks in Venture Capital.” *The Review of Financial Studies*, 21(2), 513–541.

Hernando, I., and Martínez-Carrascal, C. 2008. “The impact of financial variables on firms’ real decisions: evidence from Spanish firm-level data.” *Journal of Macroeconomics*, 30(1), 543-561.

Hirth, S., Uhrig-Homburg, M. 2010. “Investment Timing when External Financing is Costly.” *Journal of Business Finance & Accounting*, 37, 929-949.

Hochman, S. and Palmon, O. 1983. “The Irrelevance of Capital Structure for the Impact of Inflation on Investment.” *The Journal of Finance*, 38, 785-794.

Hoffmann, AOI, Kleimeier, S. 2021. “Financial disclosure readability and innovative firms' cost of debt.” *International Review of Finance*; 21, 699– 713.

Huynh, T. D., Nguyen, T. H., & Truong, C. 2020. “Climate risk: The price of drought.” *Journal of Corporate Finance*, 65, 101750.

IMF. 2019. “Portugal: 2019 Article IV Consultation-Press Release; Staff Report; and Statement by the Executive Director for Portugal.”

Instituto Nacional de Estatística (INE)

Julio, B., Yook, Y. 2012. “Political Uncertainty and Corporate Investment Cycles.” *The Journal of Finance*, 67, 45-83.

- Kang, W., Lee, K., and Ratti, R. A. 2014. “Economic policy uncertainty and firm-level investment.” *Journal of Macroeconomics*, 39, 42-53.
- Kasahara, T. 2008. “Severity of financing constraints and firms' investments.” *Review of Financial Economics*, 17, 112-129
- Kwanmuang, K. 2014. “Factors Influencing Farm Investment Planning—A Case Study in Nakhon Si Thammarat Province, Thailand—.” *Journal of Developments in Sustainable Agriculture*, 9(1), 51-55
- Lins, D. A., & Duncan, M. 1980. “Inflation effects on financial performance and structure of the Farm Sector.” *American Journal of Agricultural Economics*, 62(5), 1049–1053.
- Liu, Q., Pan, X., Tian, G. 2018. “To what extent did the economic stimulus package influence bank lending and corporate investment decisions? Evidence from China.” *Journal of Banking & Finance*, 86, 177-193.
- Lockheed, M. E., Jamison, D. T., & Lau, L. J. 1979. “Farmer Education and farm efficiency: A survey.” *ETS Research Report Series*, 1979(2), i-74.
- Marangos, J., & Williams, C. 2005. “The Effect of Drought on Uncertainty and Agricultural Investment in Australia.” *Journal of Post Keynesian Economics*, 27(4), 575–594.
- Martínez-Carrascal, C., Ferrando, A. 2008. “The impact of financial position on investment: An analysis for non-financial corporations in the euro area.” *ECB Working Paper Series*, No 943.
- Masso, J. 2002. “Financing constraints as determinants of the investment behaviour of Estonian firms.” *Baltic Journal of Economics*, 3(1), 8-30.
- Moldovan, I., & Beileu, I. 2020. “An analysis of investment decisions in Agribusiness.” *16th Economic International Conference NCOE 4.0 2020*.
- Moreira, M. B. 2017. “Impacts of financialization on agricultural and Rural Investment: Lessons from the Portuguese case.” *Transforming the Rural*, 25–44.

Morgan, J. P. 2014. “Bridging the gap between interest rates and investments.” *JPM Corporate Finance Advisory*.

Myers, Stewart C., and Nicholas S. Majluf. 1984. “Corporate financing and investment decisions when firms have information that investors do not have.” *Journal of Financial Economics*, 13, 187-221.

OECD. 2011. “OECD Science, Technology and Industry Scoreboard 2011.” *OECD Publishing, Paris*.

OECD. 2022. “Financing SMEs and Entrepreneurs 2022: An OECD Scoreboard.” *OECD Publishing, Paris*.

OECD. 2022. “OECD Reviews of Innovation Policy. Germany 2022: Building Agility for Successful Transitions.” *OECD Reviews of Innovation Policy*, OECD Publishing, Paris.

OFE. 2017. “Financement des entreprises et nouveaux défis de la transformation numérique.”

Oliner, S. and G. Rudebusch. 1992. “Sources of the Financing Hierarchy for Business Investment.” *Review of Economics and Statistics*, 74, 643-654.

Pacheco, L. 2017. “Investment determinants at the firm-level: The case of Portuguese industrial SMEs.” *International Journal of Business Science & Applied Management (IJBSAM)*, 12(2), 1-17.

Pearson, S. R., Monke, E. A., & Avillez, F. 1985. “Sources of funds for agricultural investment in Portugal.” *Food Research Institute Studies*, 19(1387-2016-115994), 335-352.

Prezas, A.P. 1991. “Inflation, Investment, and Debt.” *Journal of Financial Research*, 14, 15-26.

Quiroga, S., & Suárez, C. 2016. “Climate change and drought effects on rural income distribution in the mediterranean: A case study for Spain.” *Natural Hazards and Earth System Sciences*, 16(6), 1369–1385.

R.Scott, P., Francisco, A., W., B. J., J., F. T., Royer, F., Timothy, J., Mark, L., Eric, M., & Stefan, T. 1987. “Portuguese agriculture in transition.” Cornell University Press.

Roodman, D. 2009. “How to do xtabond2: An introduction to difference and system GMM in Stata.” *The Stata journal*, 9(1), 86-136.

Roodman, D. M. 2005. “Xtabond2: Stata Module to Extend Xtabond Dynamic Panel Data Estimator.” *Washington, DC: Center for Global Development*.

Ruttan, V. W. 1979. “Inflation and productivity.” *American Journal of Agricultural Economics*, 61(5), 896–902.

Sánchez-Ballesta, JP, Yagüe, J. 2021. “Financial reporting incentives, earnings management, and tax avoidance in SMEs.” *Journal of Business Finance and Accounting*, 48, 1404–1433.

Schneider, M. 2019. “Intellectual property rights, the new currency.” *Journal of Intellectual Property Law*, 14(11), 825–826.

Segol, M., Kolev, A., and Maurin, L. 2021. “The impact of bank loan terms on intangible investment in Europe (No. 2021/05).” *EIB Working Papers*.

Startup Portugal. “2021. Startup & Entrepreneurial Ecosystem Report.” *Portugal 2021*.

Strulik, H. 2008. “The Credit Channel of Capital Tax Policy.” *Journal of Public Economic Theory*, 10, 717-742.

Suess-Reyes, J., & Fuetsch, E. 2016. “The Future of Family Farming: A literature review on innovative, sustainable and succession-oriented strategies.” *Journal of Rural Studies*, 47, 117–140.

Thum-Thysen, A., Voigt P., Maier C., Bilbao-Osorio, B. and Ognyanova, D. 2017. “Unlocking investment in intangible assets in Europe.” *Quarterly Report on the Euro Area (QREA)*, vol. 16(1), pages 23-35.

Titman, S. 2013. “Financial Markets and Investment Externalities.” *The Journal of Finance*, 68, 1307-1329.

Vartia, L. 2008. “How do taxes affect investment and productivity?: An industry-level analysis of OECD countries.” *OECD*.

Villarroya, J. M. 2021. “Digitalización e intangibles: la importancia de incentivar la financiación bancaria.” *Cuadernos de Información económica*, (281), 17-23.

Vogt, S. C. 1994. “The role of internal financial sources in firm financing and investment decisions.” *Review of Financial Economics*, 4(1), 1-24.

Wehinger, G. 2011. “Fostering long-term investment and economic growth. Summary of a high-level OECD financial roundtable.” *OECD Journal: Financial market trends*, 2011(1), 9-29.

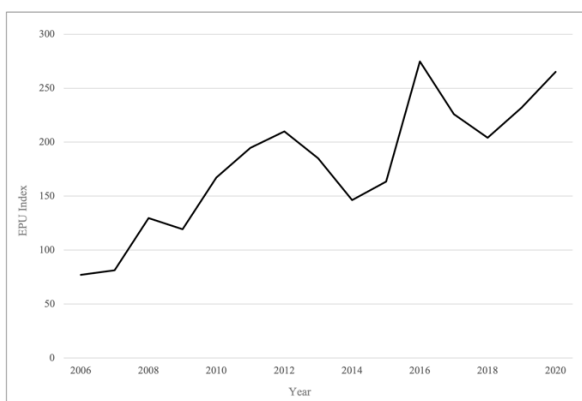
White, F. C., & Musser, W. N. 1980. “Inflation effects on farm financial management.” *American Journal of Agricultural Economics*, 62(5), 1060–1064.

Whited, T. 1992. “Debt, Liquidity Constraints, and Corporate Investment: Evidence from Panel Data.” *The Journal of Finance*, 47, 1425-1460.

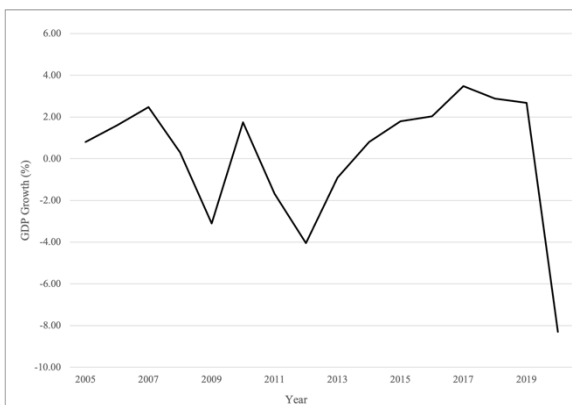
WIPO. 2021. “Unlocking IP-backed Financing: Country Perspectives.” *World Intellectual Property Organization*.

Yasmeen, K., Abbasian, E., & Hussain, T. 2011. “Impact of educated farmer on Agricultural Product.” *Journal of Public Administration and Governance*, 1(2), 158-164.

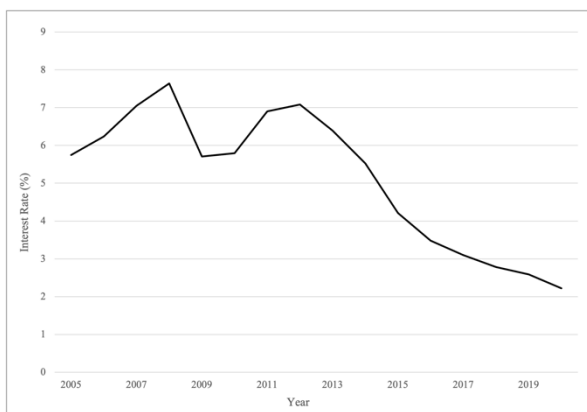
## 10. Appendix



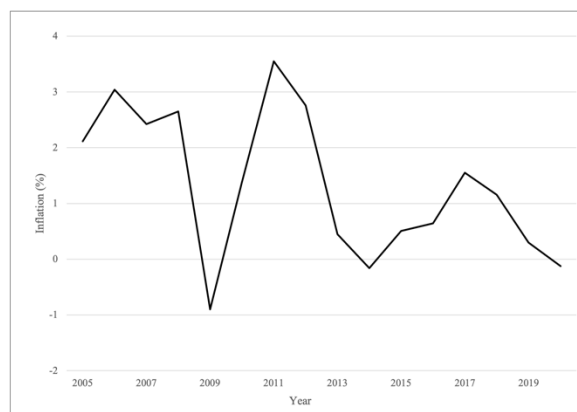
**Graph 2:** Evolution of EPU Index



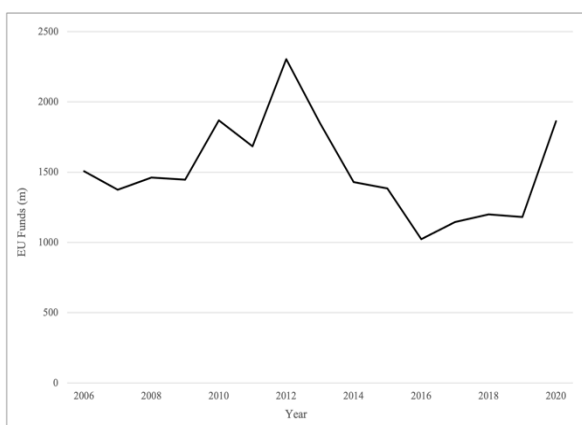
**Graph 3:** Evolution of GDP growth



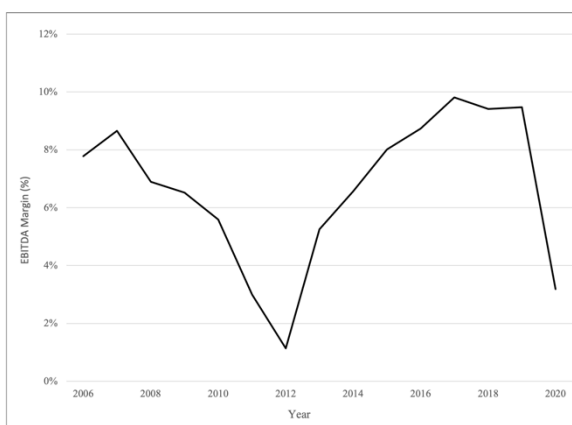
**Graph 4:** Evolution of Interest Rate



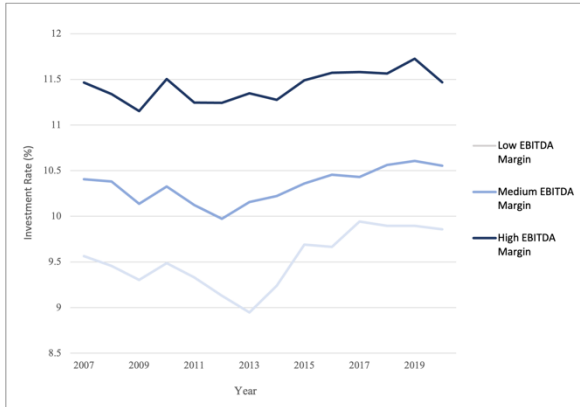
**Graph 5:** Evolution of Inflation Rate



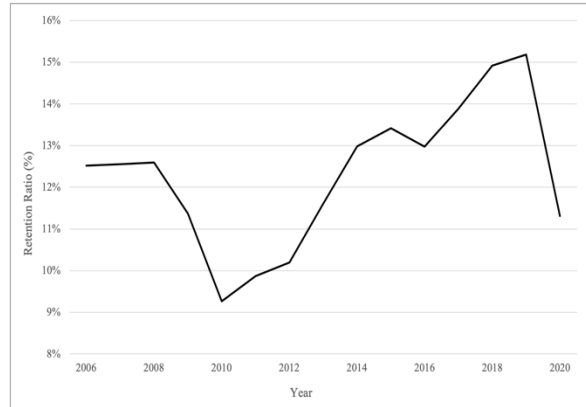
**Graph 6:** Evolution of EU Funds



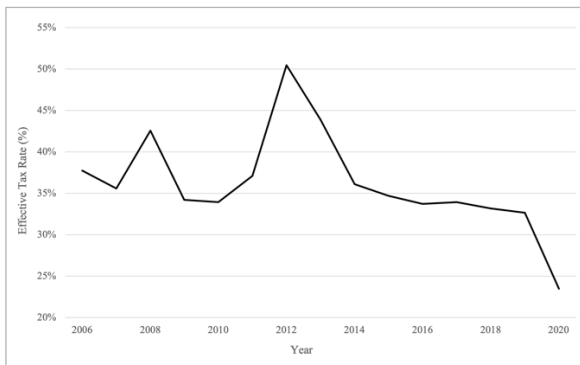
**Graph 7:** Evolution of EBITDA Margin



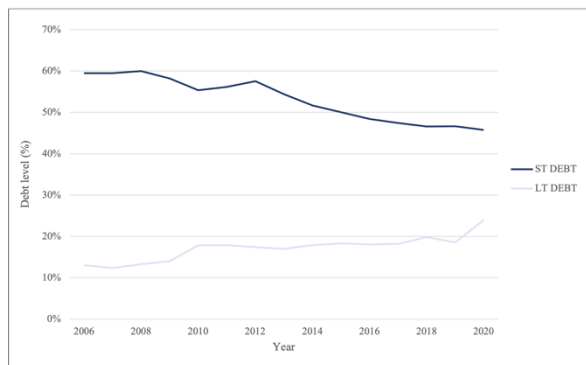
**Graph 8:** Evolution of Investment Rate according to different levels of EBITDA margins



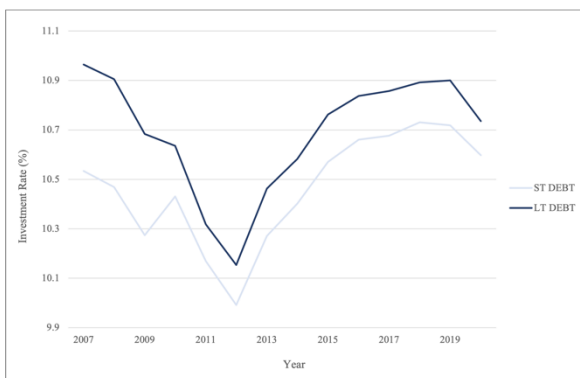
**Graph 9:** Evolution of the Retention Ratio



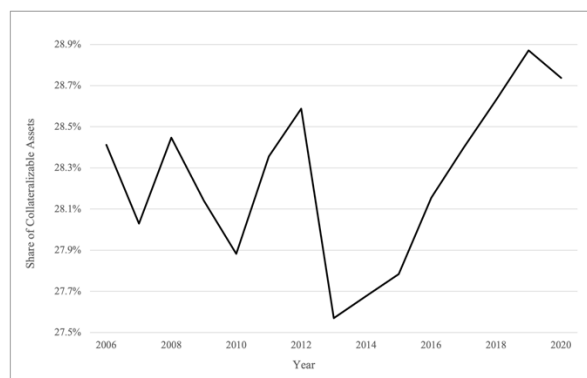
**Graph 10:** Effective Tax Rate



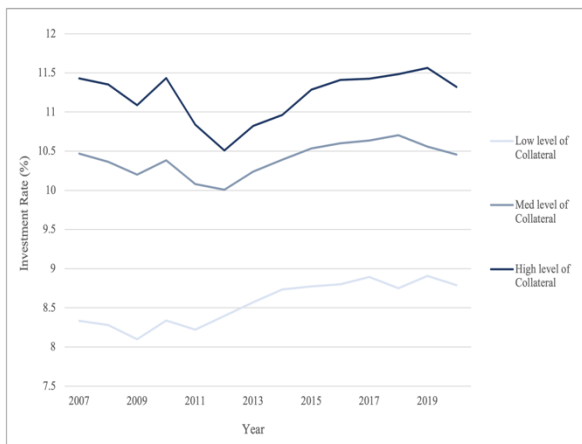
**Graph 11:** Evolution of Debt level



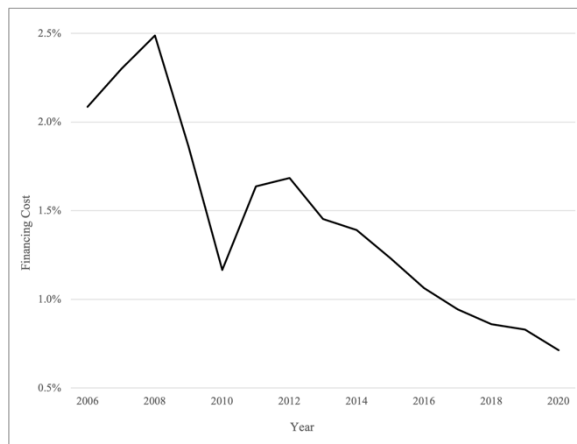
**Graph 12:** Evolution of Investment Rate according to different debt maturity



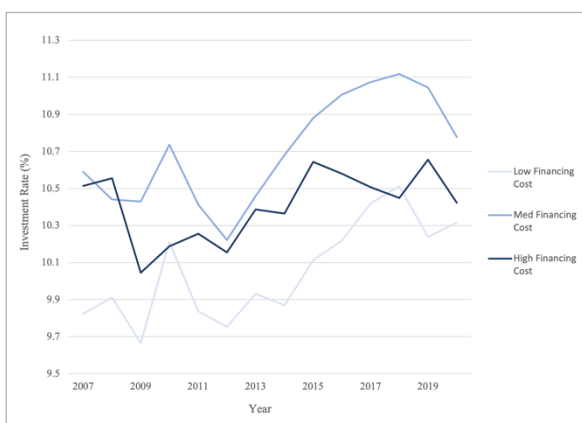
**Graph 13:** Evolution of Collateralizable Assets



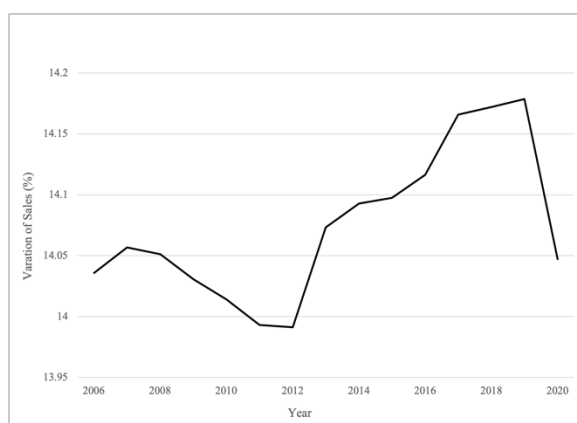
**Graph 14:** Evolution of the Investment Rate according to different levels of collateral



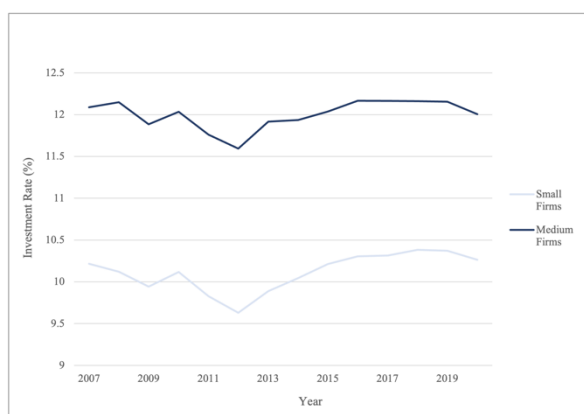
**Graph 15:** Evolution of Financing cost



**Graph 16:** Evolution of Investment Rate according to different financing cost levels



**Graph 17:** Evolution of the variation of sales



**Graph 18:** Evolution of Investment Rate by firm size

**Table 2: Summary Statistics**

Explanatory Variables	Observations	Mean	Standard Deviation	Minimum	Maximum
EPU Index	258,116	173.73	60.33	77	274.75
GDP Growth Rate	258,116	0.15	3.15	-8.3	3.48
Interest Rate	258,116	5.14	1.83	2.22	7.64
Inflation Rate	258,116	1.32	1.31	-0.9	3.55
EU Funds	258,116	1503.28	318.09	1022.3	2304.8
EBITDA Margin	257,418	0.07	0.21	-1.38	0.85
Retention Ratio	258,116	0.07	0.37	-1	1
Effective Tax Rate	258,116	0.36	0.93	-2.22	15.79
Short Term Debt	258,010	0.53	0.36	0.02	3.1
Long Term Debt	258,010	0.17	0.22	0	1.44
Assets to serve as Collateral	258,010	0.28	0.24	0	0.96
Financing Cost	257,865	0.02	0.02	0	0.11
Firm Size	257,418	14.07	1.39	2.3	20.96

**Table 9: Metric used for each variable in agricultural investment model**

Variable name	Metric	Observation
Agriculture investment	Logarithm of annual change in tangible and intangible fixed assets (plus depreciation and amortization)	Limitation that leasing contracts are not included in this metric even though they are productive investment
Inflation of raw materials	Variation in prices of raw materials	
Drought years	Dummy; 1 - years of observed harsher drought	Years considered: 2006, 2012, 2015, 2017, 2019
Agriculture education	Share of agriculture workers with a higher education degree	
Agriculture family workers	Share of agriculture workers working in the family business	
EU funds for agriculture	EU funds attributed to agriculture	
Favourable location	Dummy; 1 - favourable locations to agriculture	Locations considered: South of centre region (Leiria & Lisbon) and Alentejo region (Beja, Setúbal & Santarém)

**Table 10: Summary statistics of macroeconomic variables in agricultural investment model**

Variable	Obs	Mean	St. Dev	Min	Max
Inflation of raw materials	5,723	3.56	26.68	-42.7	70.8
Agriculture education	5,723	7.96	2.07	4.84	11.25
Agriculture family workers	5,723	90.16	2.07	87.26	93.49
Agriculture public funds	5,723	2.16E+08	6.6E+07	85000000	3.3E+08
Drought years	5,723	-	-	0	1
Favourable location	5,723	-	-	0	1

**Table 11:** Summary statistics of microeconomic variables in agricultural investment model

Variable	Obs	Mean	St. Dev	Min	Max
EBITDA margin	5,668	0.11	0.30	-1.38	0.85
Retention ratio	5,723	0.07	0.39	-1.00	1.00
Effective tax rate	5,723	0.25	0.71	-2.22	15.79
ST debt	5,713	0.52	0.51	0.02	3.10
LT debt	5,713	0.21	0.26	0.00	1.44
Collaterals	5,713	0.41	0.27	0.00	0.96
Financing cost	5,704	0.01	0.02	0.00	0.11
Firm size (in volume)	5,668	13.46	1.41	5.45	18.48

**Table 12:** Correlation matrix for agriculture macroeconomic variables

	Inflation	Drought	Educ	Family	Funds	Location
Inflation of raw materials	<b>1.000</b>					
Drought years	-0.189	<b>1.000</b>				
Agriculture education	-0.278	0.186	<b>1.000</b>			
Agriculture family workers	0.235	-0.197	-0.698	<b>1.000</b>		
Agriculture public funds	-0.237	0.328	0.247	-0.562	<b>1.000</b>	
Favourable location	-0.016	0.003	0.031	-0.011	-0.010	<b>1.000</b>

**Table 13:** Correlation matrix for agriculture macroeconomic variables

	EBITDA	Retention	Tax	ST debt	LT debt	Collaterals	Fin. Cost	Size
EBITDA margin	<b>1.000</b>							
Retention ratio	-0.043	<b>1.000</b>						
Effective tax rate	0.072	-0.007	<b>1.000</b>					
ST debt	-0.540	0.006	-0.059	<b>1.000</b>				
LT debt	-0.137	-0.029	-0.019	-0.249	<b>1.000</b>			
Collaterals	0.099	-0.026	-0.034	-0.226	0.272	<b>1.000</b>		
Financing cost	0.097	0.005	0.035	-0.130	0.119	0.187	<b>1.000</b>	
Firm size (in volume)	0.208	0.047	0.068	-0.245	-0.062	0.131	0.182	<b>1.000</b>