FINANCIAL LEVERAGE AND INVESTMENT DECISIONS: EVIDENCE FROM PORTUGUESE LISTED COMPANIES

by

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Master thesis in Finance and Taxation

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Biographical Note

Daniel Tomé was born in Porto in 1993. He became the Portuguese Go Champion in 2011, 2012 and 2013, and represented Portugal in the 33rd World Amateur Go Championship (WAGC 2012) in China and in the 9th Korea Prime Minister's Cup World Amateur Baduk Championship (KPMC 2014) in South Korea. In 2015, he obtained his undergraduate degree in Economics from the University of Porto.

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Abstract

This study examines the impact of financial leverage on investment decisions of Portuguese listed companies and the extent to which it can be explained by the existing capital structure and agency theories. Using panel data from 2010 to 2015, we find a negative relationship between investment and leverage, and that this negative relationship is stronger for firms with high growth opportunities than for those with low growth opportunities. Our results are robust to alternative empirical specifications and support the debt overhang hypothesis, but contradict the overinvestment hypothesis and previous findings that leverage has a disciplining role for firms with low growth opportunities.

JEL classification: G31; G32

Keywords: Financial leverage; Investment decision; Portugal; Corporate finance

Resumo

Este estudo analisa o impacto da alavancagem financeira nas decisões de investimento das empresas cotadas portuguesas e em que medida este pode ser explicado pelas teorias de estrutura de capital e de agência existentes. Usando dados em painel para o período de 2010 a 2015, encontramos uma relação negativa entre investimento e alavancagem, e que esta relação negativa é mais forte para empresas com elevadas oportunidades de crescimento do para aquelas com baixas oportunidades de crescimento. Os nossos resultados são robustos a diferentes especificações e apoiam a hipótese de subinvestimento devido a "debt overhang", mas contradizem a hipótese de sobreinvestimento evidenciada em estudos anteriores segundo a qual a alavancagem exerce um "papel disciplinador" sobre empresas com baixas oportunidades de crescimento.

Classificação JEL: G31; G32

Palavras-chave: Alavancagem financeira; Decisão de investimento; Portugal; Finanças corporativas

1. Introduction

This thesis aims at contributing to the existing literature on the relationship between leverage and investment by focusing particularly on the impact of financial leverage on investment in 44 Portuguese companies listed on the Euronext Lisbon over the period 2010–2015.

A central issue in corporate finance is the impact that financial leverage has on firms' investment decisions. In a context of increasing global competition, investment is vital for firms' growth and long-term survival, as well as for countries' productivity and economic growth. Therefore, this research topic is of interest to scholars, managers and policy-makers.

Financial leverage is the use of debt to finance a firm's assets and projects (Odit and Chittoo, 2008). As a source of investment financing, leverage has both positive and negative aspects. By borrowing money at a certain interest rate and with it acquiring assets with a higher expected rate of return, a firm may increase its return on equity, magnify its earnings, and thus increase its profitability. There are also often tax advantages associated with borrowing because interest payments are tax deductible. But leverage magnifies both earnings and losses. The existence of too much debt in the capital structure of firms may lead to financial distress, which increases their financial and bankruptcy risks, as evidenced by the recent global financial crisis.

According to the capital structure irrelevance theory proposed by Modigliani and Miller (1958), in a world of perfect capital markets, no transaction costs, and no taxes, the use of leverage would be irrelevant to investment decisions. But many empirical studies have since shown that leverage does have a significant impact on investment (Lang et al., 1996; Aivazian et al., 2005a; Ahn et al., 2006; Odit and Chittoo, 2008; Jiming et al., 2010, among others), so we must take imperfect market conditions and agency problems into account.

In a world with market frictions and information asymmetries, interactions between management, shareholders and debtholders give rise to agency problems which may entail underinvestment or overinvestment incentives (Aivazian et al., 2005a).

Myers (1977) first identified the underinvestment problem by noting that, due to agency conflicts between shareholders and debtholders, when a firm is highly leveraged (i.e., when it has significantly more debt than equity) it may forgo valuable investment opportunities if too much of the new benefits would have to be shared with debtholders. Myers argued that "debt overhang" could also lead to potential underinvestment by making it more difficult for a firm to raise funds to finance positive net present value (NPV) projects.

Another agency problem is overinvestment, which occurs when managers of firms with free cash flow at their disposal invest in negative NPV projects. Leverage can play a "disciplinary role" and help prevent managers from investing in projects with negative NPV by committing firms to pay cash as interest and principal and thus limiting the free cash flow available to them, curbing overinvestment (Jensen, 1986; Stulz, 1990).

Myers (1977), Jensen (1986) and Stulz (1990) have shown that leverage can have a negative effect on investment. Subsequently, Lang et al. (1996) suggested that investment is negatively related to leverage, but only for firms with low growth opportunities.

Low-growth firms may not have sufficient resources to generate revenue in order to repay the debt along with interest, and thus be forced to pass up valuable investment opportunities. In contrast, high-growth firms may more readily avail themselves of investment opportunities by using leverage because they have enough cash flow to repay their debt, which mitigates the financial distress and bankruptcy risk arising from its use (Sajid et al., 2016).

Aivazian et al. (2005a) extended the specification of Lang et al. (1996) to a panel setting and also found a negative relationship between investment and leverage, and that this relationship was significantly stronger for firms with low growth opportunities. To estimate the impact of leverage on investment, we follow a similar approach to the one used by Lang et al. (1996) and Aivazian et al. (2005a), and in the second part of our investigation we too

test for differences in the impact of leverage on investment for high versus low growth opportunity firms.

The empirical literature using Portuguese data on this topic is scarce. Barbosa et al. (2007) and Farinha and Prego (2013) found that financial standing is relevant for investment, but did not use Tobin's Q as a measure of investment opportunities. Serrasqueiro et al. (2007), in their study of investment determinants following the approach of Aivazian et al. (2005a) and using this measure, concluded that growth opportunities are irrelevant as an explanatory variable for the investment decisions of Portuguese listed companies. The present study expands the methodology and models of these authors, and attempts to confirm their findings for a more recent time period.

In order to investigate the relationship between financial leverage and investment as described above, we selected a sample of 44 Portuguese non-financial companies (excluding football clubs and firms with missing market capitalization data) listed on the Euronext Lisbon over the period 2010–2015. To measure leverage, we used two alternative ratios: book value of total liabilities divided by book value of total assets, and book value of long-term debt divided by total assets. The second ratio is used by Aivazian et al. (2005a) but not by Serrasqueiro et al. (2007). In line with the extant literature, we expect the variables leverage, Tobin's Q, cash flow and sales to be related to firms' investment.

We estimate our regressions using three different methods: pooled OLS, random effects, and fixed effects. In the first equation, we follow the model used by Aivazian et al. (2005a); in the second, we expand their model by including two additional variables: return on assets (ROA), to control for the profitability of the firm (Aivazian et al., 2005b; Odit and Chittoo, 2008), and the natural logarithm of total assets (Haque, 2014), to measure and more explicitly control for the effect of firm size. Finally, in order to demarcate between firms with high growth opportunities and low growth opportunities, we follow Aivazian et al. (2005a) and Serrasqueiro et al. (2007) and add a dummy variable to the first equation to examine the role of growth opportunities in the relationship between leverage and investment.

Our results show that leverage has a negative impact on corporate investment in Portugal. This finding is consistent with prior research. However, contrary to Aivazian et al. (2005a), but in line with Serrasqueiro et al. (2007), we do not find evidence that the negative relationship between leverage and investment is significantly stronger for firms with low growth opportunities than for those with high growth opportunities. Our results differ from those of Serrasqueiro et al. (2007) in that unlike them we found the coefficient of the interaction variable in question ($D\times$Leverage) to be significant across various specifications.

This thesis contributes to the extant literature by providing new evidence on the relationship between leverage and investment decisions. The analysis of the impact of financial leverage of Portuguese firms on their investment decisions is particularly pertinent and useful at the present time, considering their high level of indebtedness (Barbosa et al., 2007). Despite the relevance of this topic, there are very few articles based on Portuguese data in the empirical literature (Farinha and Prego, 2013). Most previous studies have been restricted to US firms, and their findings may not be valid for Portuguese firms. By considering Portuguese non-financial firms listed on the Euronext Lisbon over the more recent and post-financial crisis period 2010–2015, our research thus provides insights and a timely analysis on the Portuguese economy. In order to give a more in-depth view of the relationship between leverage and investment, we expand the model of Lang et al. (1996) and Aivazian et al. (2005a) by including profitability (Aivazian et al., 2005b; Odit and Chittoo, 2008) and firm size (Haque, 2014) as control variables. To address the potential problem of heteroskedasticity (ignored by Serrasqueiro et al., 2007, and by more recent studies such as those by Jiming et al., 2010, Haque, 2014, and Sajid et al., 2016) we use robust standard errors not just for the pooling regression (Aivazian et al., 2005a) but also for the fixed and random effects models, and introduce a heteroskedasticity-robust Hausman test of fixed versus random effects obtained by the STATA command "xtoverid" (Schaffer and Stillman, 2010). Our findings partly corroborate those of Serrasqueiro et al. (2007) and suggest that leverage may have a stronger negative impact on investment for Portuguese firms with high growth opportunities than for firms with low growth opportunities, which supports Myers's (1977) underinvestment prediction that firms with high growth

opportunities may pass up positive NPV projects due to the debt overhang problem, but contradicts the agency theory argument that leverage has a disciplining role for firms with low growth opportunities.

The remainder of this thesis is organized as follows. Section 2 presents a brief review of the extant literature on the relationship between financial leverage and investment decisions, and our hypotheses development. Section 3 describes the variables and the sample selection process. The research methodology adopted in this thesis and univariate results are evidenced on Section 4. The empirical results are reported and discussed in Section 5. Section 6 presents a summary of the results, concluding remarks and suggestions for further research.

2. Literature Review and Hypotheses Development

The impact of financial leverage on firm investment decisions is a central issue in corporate finance. Several authors have investigated the relationship between financial leverage and investment using different approaches, time periods and geographical contexts, reaching conflicting results.

2.1 The leverage irrelevance theorem

Modigliani and Miller (1958) proposed the capital structure irrelevance theory by arguing that, under perfect market conditions, the investment policy of a firm should be based only on factors that affect the profitability, cash flow and net worth of a firm. These include production technology, market interest rates and future demand of its products, but not financial leverage, because financial risk can be diversified away by marginal investors in perfect capital markets. Miller (1990) subsequently argued that we should not "waste our limited worrying capacity on second-order and largely self-correcting problems like financial leveraging." But the theory of capital structure irrelevance only holds if the perfect market assumptions underlying their analysis, including symmetric information, no transaction costs, and no taxes, are satisfied.

Many researchers have challenged this proposition. Myers (1977), Jensen (1986), Stulz (1990), Whited (1992) and Lang et al. (1996) suggested that financial leverage could be relevant to investment decisions given the presence of asymmetric information and imperfect market conditions in the corporate world, such as institutional restrictions and transactional costs. They argued that asymmetric information in particular gives rise to agency costs (conflicts of interest between management, shareholders and debtholders) that may result in underinvestment or overinvestment.

2.2 Agency problems

There is support for both the underinvestment and the overinvestment agency theories of financial leverage in the extant empirical literature (Aivazian et al., 2005a).

2.2.1 Underinvestment

The underinvestment theory posits that the cost of external capital and the possibility of default induce levered firms to decrease investment. This implies a negative relationship between leverage and investment.

According to Myers (1977), high leverage "overhang" reduces the incentives of high growth firms to invest in new positive net present value (NPV) projects because their profits would have to be shared with debt holders rather than with shareholders. This makes highly levered firms less likely to exploit valuable growth opportunities, leading to the underinvestment problem of debt financing, which may negatively affect the firm's value. Higher leverage can also discourage investment by increasing the risk of default and consequently raising the cost of obtaining further external finance (Mills et al., 1994).

The potential underinvestment incentives created by debt can be reduced if the firm takes corrective measures and lowers its leverage by recognizing growth opportunities sufficiently early on (Aivazian and Callen, 1980).

2.2.2 Overinvestment

The agency problem known as overinvestment arises from a conflict between managers and shareholders (Jensen, 1986; Stulz, 1990) because the former have a propensity to constantly expand the scale of the business even through investments in risky or negative NPV projects to the detriment of the latter, thereby reducing the value of the firm (Hillier et al. 2010).

The overinvestment problem caused by the agency costs of free cash flow is expected to be more severe in low-Q firms which have fewer positive NPV investment opportunities (Jensen, 1986).

Leverage can potentially prevent managers from investing free cash flows in projects with negative NPV and reduce overinvestment, as described in the next subsection.

2.2.2.1 The “disciplinary role” of leverage

The ability of managers to undertake poor projects after having funded all positive NPV projects and waste resources by overinvesting can be restrained by debt financing, which performs a “disciplinary role” by forcing managers to serve their commitments by paying cash as interest and principal and thus preventing them from wasting cash flows (Jensen, 1986; Haque, 2014). Leverage is therefore considered to be a mechanism for overcoming the overinvestment problem.

Like Jensen (1986), Grossman and Hart (1982), Stulz (1990), Novaes and Zingales (1995) and Hart and Moore (1995) have all argued that debt financing has a positive impact on the value of the firm by forcing managers to pay out excess funds to service debt and thus restraining unprofitable overinvestment.

Overall, the extant empirical literature provides support to the theory that leverage has a disciplining role for firms with low growth opportunities, likely costing underinvestment, but restraining overinvestment.

2.3 Hypotheses development

2.3.1 Main hypotheses

The primary aim of this study is to investigate the impact of financial leverage on firms' investment decisions. From the theoretical and empirical results discussed in the previous sections, which establish the relevance of financial leverage for investment, we present our first hypothesis as follows:

H1a: There is significant relationship between financial leverage and investment.

Most previous empirical studies have identified a negative relationship between leverage and investment (Lang et al., 1996; Aivazian et al., 2005a; Ahn et al., 2006; Odit and Chittoo, 2008; Firth et al., 2008; Jiming et al., 2010; Dang, 2011; Haque, 2014; Sajid et al., 2016), with few exceptions (Rajakumar, 2005; Riaz, 2012).

On the one hand, as we have seen, raising debt can refrain managers from overinvestment; on the other hand, as Stulz (1990) warns, increased financial leverage does not necessarily lead to a reduction in agency costs, and can in fact aggravate the underinvestment problem. Therefore, based on the literature, we predict a negative sign for the coefficient of leverage, i.e., we expect a strong negative relationship between leverage and firm investment:

H1b: There is negative and significant relationship between financial leverage and investment.

2.3.1.1 The role of growth opportunities

The importance and influence of growth opportunities on the relationship between financial leverage and investment has been emphasized in several studies. Stulz (1990) argued that a firm's debt level choice may depend on the type of growth options available to it. Firms with high growth opportunities (with Tobin's Q greater than one) are expected to have higher cash flows, which mitigates adverse selection and moral hazard problems in capital markets (Aivazian et al. 2005a), relaxing financial constraints. High-growth firms may thus more readily avail themselves of investment opportunities by the use of leverage (Sajid et al., 2016), as a consequence of having easier access to capital markets and lower bankruptcy risk arising from the use of debt. Low-growth firms, in contrast, may not be able to generate enough revenue in order to repay the debt along with interest, and thus be forced to pass up valuable investment opportunities. This difference between high- and low-growth firms has been confirmed by empirical studies in various contexts. Lang et al. (1996) analyzed a large sample of US industrial firms over the period 1970–1989 and argued that leverage "does not reduce growth for firms known to have good investment opportunities", but found a strong negative relationship between leverage and investment for industrial firms with fewer investment opportunities. Aivazian et al. (2005a), investigating the impact of leverage on investment for 1035 Canadian industrial companies from 1982 to 1999, found a negative relationship between leverage and investment, and that this negative relationship is stronger for firms with low growth opportunities. Odit and Chitto (2008) examined the impact of financial leverage on the investment decisions of 27 Mauritian firms for the period

1990–2004 and also found a significant negative relationship between leverage and investment for low investment opportunity firms. Based on these findings, we hypothesize the following:

H1c: There is a negative and significant relationship between financial leverage and investment, and this negative relationship is significantly stronger for firms with low growth opportunities.

In an empirical study of the determinants of investment of 38 Portuguese listed companies for the period 1998–2004, Serrasqueiro et al. (2007) reported a significant negative relationship between leverage and investment, but did not find a significant relationship between growth opportunities and investment, nor that the negative relationship between leverage and investment was significantly stronger for firms with low growth opportunities than for those with high growth opportunities. Their results contradicted the arguments put forward by Grossman and Hart (1982), Jensen (1986) and Stulz (1990) that leverage has a disciplining role for firms with low growth opportunities which prevents them from investing in negative NPV projects. Hypothesis H1c allows us to empirically test these arguments and to either confirm or refute previous findings, in the Portuguese context, for a more recent period.

2.3.2 Secondary hypotheses

In addition to our primary hypotheses, we also test five secondary hypotheses.

Numerous empirical studies have identified a positive relationship between cash flows and corporate investment (McConnell and Servaes, 1995; Farinha, 1995; Lang et al., 1996; Aivazian et al., 2005a; Serrasqueiro et al., 2007, among others), which may be evidence of financing constraints, and is consistent with the “free cash flow” hypothesis (Jensen, 1986) according to which managers tend to waste free cash flows by investing in negative NPV projects rather than distribute them to shareholders. Myers and Majluf (1984) proposed a different explanation of the cash flow–investment relationship based on information asymmetries between managers and outside investors, arguing that these create a “pecking order” hierarchy in companies' financial policy where managers prefer to finance

investments with internally generated funds to avoid the costs of external financing, which can lead them to forego positive NPV investments. The availability of internal funds may thus be an important determinant of investment. Firms with enough cash inflows can utilize them in investing activities (Odit and Chittoo, 2008), so we hypothesize that:

H2: There is a positive and significant relationship between cash flow and investment.

Tobin's Q is commonly used as a proxy for growth opportunities. It compares the market value of a firm with the replacement or book value of its assets. A Tobin's Q greater than one signifies that the market value of the firm is greater than the recorded value of its assets (Odit and Chittoo, 2008), indicating high growth opportunities. The greater a firm's Tobin's Q, the greater its growth opportunities. In accordance with most previous literature, we assume that firms increase their investment in response to higher growth opportunities, i.e., we expect the relationship between Tobin's Q and investment to be positive:

H3: There is positive and significant relationship between Tobin's Q and investment.

Sales, or sales growth (Odit and Chittoo, 2008), play a significant role in explaining firm investment. Aivazian et al. (2005a) identified a positive and significant relationship between sales and investment. This significant relationship confirms the relevance of factors external to the firm as determinants of investment, and lends support to the neoclassical theory according to which investment decisions depend essentially on such external factors (Serrasqueiro et. al., 2007). As sales growth may provide an incentive for firms to increase their level of investment and so expand their market share (Serrasqueiro et. al., 2012), we predict that:

H4: There is positive and significant relationship between sales and investment.

Profitability has also been found to be a significant determinant of investment. Aivazian et al. (2005b) and Odit and Chittoo (2008) included return on assets (ROA) in their regressions, to control for firm profitability and performance, and reported a positive and significant coefficient, which implies that firms with higher profitability tend to have higher investment rates. Firms that are more profitable have access to greater retained earnings and

may use them to finance their investments, consistent with the pecking order theory. We therefore expect profitability to have a positive impact on investment:

H5: There is a positive and significant relationship between profitability and investment.

Firm size may also have an impact on investment. The results of the studies by Barbosa et al. (2007) and Farinha and Prego (2013) of Portuguese firms' financial standing and investment decisions suggest a negative relationship between the size of the firm and its investment rate. However, larger firms are expected to have lower information asymmetries (Farinha and Prego, 2013; Haque, 2014), be more diversified (Antão and Bonfim, 2008), have lower bankruptcy risk, and consequently have easier access to external financing. They thus tend to be subject to fewer liquidity constraints than smaller firms (Farinha and Prego, 2013), and can more easily raise debt to finance their investments (Haque, 2014). For these reasons, we predict a positive relationship between firm size and investment:

H6: There is a positive and significant relationship between firm size and investment.

3. Variables Definition and Sample Selection

3.1 Variables Definition

In this study, we use seven variables to examine the relationship between leverage and investment. Cash flow, Tobin's Q, sales, profitability and firm size are included as control variables.

3.1.1 Dependent variable

Our dependent variable is net investment, measured as capital expenditures minus depreciation, deflated by lagged net fixed assets (Aivazian et al., 2005a; Odit and Chittoo, 2008).

3.1.2 Independent variables

We use two measures of leverage: the ratio of the book value of total liabilities to the book value of total assets, and the ratio of the book value of long-term debt to total assets, in order to distinguish between short-term and long-term debt. The second ratio "emphasizes the dominant role of long-term debt as a determinant of investment" (Aivazian et al., 2005a).

Cash flow is measured as the sum of earnings before extraordinary items and depreciation (Aivazian et al., 2005a; Odit and Chittoo, 2008).

Tobin's Q controls for growth opportunities and is defined as the market value of assets divided by the book value of assets (Aivazian et al., 2005a).

Sales is measured as the ratio of net sales to lagged net fixed assets (Aivazian et al., 2005a).

As a proxy for profitability, we use return on assets (ROA) measured as the ratio of net profits to average total assets, in the same year as the dependent variable (Aivazian et al., 2005b), to control for firm performance.

To measure and control for the effect of firm size, we use the natural logarithm of total assets (Haque, 2014). A similar variable was used by Barbosa et al. (2007).

Table 1 summarizes the variable definitions, data sources, and the expected signs of the regression coefficients.

Table 1: Variables: measurement, source code, and expected signs of the explanatory variables

Variables	Measurement	DS Code	Predicted Sign
Investment (dependent)	(Capital expenditure	WC04601	
	– Depreciation)	WC01148	
	/ Lagged net fixed assets	WC02999	
		WC02201	
		WC02649	
Leverage	Total liabilities	WC03351	–
	/ Total assets	WC02999	
Leverage 2	Long term debt	WC03251	–
	/ Total assets	WC02999	
Cash flow	Earnings before extraordinary items	WC01751	+
	+ Depreciation	WC01148	
Tobin's Q	(Market capitalization	WC08001	+
	+ Market value of liabilities)	WC03351	
	/ Total assets	WC02999	
Sales	Net sales	WC01001	+
	/ Lagged net fixed assets	WC02999	
		WC02201	
		WC02649	
Profitability	Net profit / Average total assets	WC08326	+
Size	Log (Total assets)	WC02999	+

This table presents the variable definitions and the predicted signs of the coefficients. Net fixed assets are calculated as Total assets − Total current assets − Total intangibles and goodwill (Sajid et al., 2016). Source code: DATASTREAM.

3.2 Sample Selection

The data used in this study has been obtained from DATASTREAM, a financial database provided by Thomson Reuter, and complemented with data collected from SABI, a financial database provided by Bureau van Dijk, and companies' annual reports. We start with an initial sample of 53 Portuguese non-financial companies listed on the Euronext Lisbon, as reported in the SABI database. We exclude four football club companies (following Serrasqueiro et al., 2007), and five companies with missing market capitalization data (needed to calculate Tobin's Q) for all years of the sample period. Our final dataset consists of an unbalanced panel of 211 firm-year observations of 44[1] Portuguese publicly traded companies for a period of six years from 2010 to 2015.

[1] The final sample of Serrasqueiro et al. (2007), who used a similar procedure, was composed of 38 Portuguese listed companies.

4. Methodology and Univariate Analysis

4.1 Methodology

We use three regression equations to test the hypotheses developed in Section 2. The first is the reduced-form investment equation of Aivazian et al. (2005a), adapted from Lang et al. (1996), which is as follows:

$$I_{i,t}/K_{i,t-1} = \alpha + \beta_1\left(CF_{i,t}/K_{i,t-1}\right) + \beta_2 Q_{i,t-1} + \beta_3 LEVERAGE_{i,t-1} + \beta_4\left(SALES_{i,t-1}/K_{i,t-1}\right) + \lambda_t + \mu_i + \varepsilon_{i,t} \quad (1)$$

where $I_{i,t}$ is the net investment of firm *i* at time *t*; $K_{i,t-1}$ is lagged net fixed assets; $CF_{i,t}$ is the cash flow of firm *i* at time *t*; $Q_{i,t-1}$ is lagged Tobin's Q; $LEVERAGE_{i,t-1}$ is lagged leverage; $SALES_{i,t-1}$ is lagged net sales; α is the intercept; λ_t is a set of year dummies to control for time fixed effects; μ_i is the individual effect of firm *i*, and $\varepsilon_{i,t}$ is the error term.

In addition to this baseline specification, we attempt to give a more comprehensive view of the relationship between leverage and investment of Portuguese firms and improve the explanatory power of Aivazian et al. (2005a)'s model by adding two other possible determinants of investment as control variables: profitability (Aivazian et al., 2005b; Odit and Chittoo, 2008) and firm size (Haque, 2014). The introduction of these two variables allows us to test hypotheses H5 and H6. Our proposed model specification is:

$$I_{i,t}/K_{i,t-1} = \alpha + \beta_1\left(CF_{i,t}/K_{i,t-1}\right) + \beta_2 Q_{i,t-1} + \beta_3 LEVERAGE_{i,t-1} + \beta_4\left(SALES_{i,t-1}/K_{i,t-1}\right) + \beta_5 ROA_{i,t} + \beta_6 SIZE_{i,t-1} + \lambda_t + \mu_i + \varepsilon_{i,t} \quad (2)$$

where $ROA_{i,t}$ is the profitability of firm *i* at time *t*, and $SIZE_{i,t-1}$ is the size of firm *i* in the previous period.

We estimate the regression equations using pooled OLS, but following Aivazian et al. (2005a) we also employ random and fixed effects models to assess the robustness of the results and control for individual firm heterogeneity.

To test for random effects and so determine whether the random effects model, which assumes that the unobservable individual effects are not correlated with the regressors, is more appropriate than pooled OLS, we use Breusch and Pagan's (1980) Lagrange Multiplier (LM) test, the null hypothesis of which is that there are no random effects. To verify whether the random effects model is more efficient than the fixed effects model, which assumes that the unobservable individual effects are correlated with the regressors, we use Hausman's (1978) specification test. The results allow us to reject the null hypothesis of both tests. In line with previous empirical studies, we conclude that the fixed effects model is the most appropriate specification.

We also consider the possibility of first-order autocorrelation in the error terms. Following Aivazian et al. (2005a), we estimate a fixed effects model with first-order autocorrelation, assuming $\varepsilon_{i,t} = \rho\varepsilon_{i,t-1} + z_{i,t}$, where $z_{i,t}$ is independently and identically distributed, and in agreement with them we find that the estimated coefficients are similar to those of the fixed effects model without controlling for autocorrelation.

To examine the role of growth opportunities in the relationship between financial leverage and investment, as described in Section 2.3.1.1, and for our results to be comparable to those of previous studies, particularly to that of Serrasqueiro et al. (2007) of Portuguese listed companies, we adopt the methodology of Aivazian et al. (2005a) and add an interaction term between leverage and a dummy variable that takes the value of one for firms with high growth opportunities ($\text{Tobin's Q} > 1$), and the value of zero otherwise, to the first model. The specification then becomes:

$$\begin{aligned} I_{i,t}/K_{i,t-1} = \alpha &+ \beta_1\left(CF_{i,t}/K_{i,t-1}\right) + \beta_2 Q_{i,t-1} + \beta_3 LEVERAGE_{i,t-1} \\ &+ \beta_4 D_{i,t-1} \times LEVERAGE_{i,t-1} + \beta_5\left(SALES_{i,t-1}/K_{i,t-1}\right) \\ &+ \lambda_t + \mu_i + \varepsilon_{i,t} \end{aligned} \tag{3}$$

where D is a dummy variable equal to 1 if $\text{Tobin's Q} > 1$, and 0 otherwise. This allows us to measure the impact of financial leverage on investment contingent on the growth opportunities available to the firms, and test hypothesis H1c.

The study of Serrasqueiro et al. (2007), and more recent studies like those of Jiming et al. (2010), Haque (2014) and Sajid et al. (2016), do not consider, or even mention, the potential problem of heteroskedasticity. To make our results comparable to those of Serrasqueiro et al. (2007), we too estimate our models with classical (non-robust) standard errors, but since the variance of the error terms may differ across firms, and in the presence of heteroskedasticity standard errors may be biased, we also run separate regressions using White's correction for heteroskedasticity to get consistent standard errors, and go further than Lang et al. (1996) and Aivazian et al. (2005a) by using it not just for the pooled OLS but also for the random and fixed effects models. After correcting the standard errors for heteroskedasticity, the coefficient estimates remain the same, but the significance of the variables may change. In the first two regression equations, the levels of significance of our key variables remain the same with and without robust standard errors, so we only report the latter results for reasons of space, but for the last regression equation we present the results of both estimations in Table 6.

4.1.1 Robust Hausman test using the STATA command "xtoverid"

Under the assumption of homoscedasticity, we use the Hausman specification test described in the previous section to determine whether the fixed effects model is preferable to the random effects model, and, in line with Aivazian et al. (2005a), conclude that the fixed effects model is the most appropriate to estimate the investment equations. To allow for the possibility of heteroskedasticity, Aivazian et al. (2005a) use the Huber/White/Sandwich estimators of standard errors, but only "for the pooling regression". In this study, we estimate not just the pooling regressions but also the random and fixed effects models with robust (Huber/White/Sandwich) standard errors, presented in Panel B of Table 6 for equation (3). This, however, violates the assumptions of the Hausman test, which is invalid in the presence of heteroscedasticity.

To overcome this problem, we conduct a Hausman-like test of fixed versus random effects based on the generalized method of moments (GMM) approach (using an artificial regression) proposed by Arellano (1993), obtained by the STATA command "xtoverid" provided by Schaffer and Stillman (2010), a generalization of the traditional Hausman test

which “unlike the Hausman version, […] extends straightforwardly to heteroskedastic- and cluster-robust versions” (Schaffer and Stillman, 2010). The results of this test allow us to reject the null hypothesis that random effects are consistent, at the 1% significance level, and again conclude that the fixed effects model is more appropriate than the random effects model.

4.2 Univariate Analysis

Table 2 provides summary statistics for the data employed in our analysis. The ratio of net investment to lagged net fixed assets has a mean of -0.008, close to zero as in Serrasqueiro et al. (2007), and a standard deviation of 0.089. The mean of Tobin’s Q is 1.028, and though lower than Serrasqueiro et al. (2007)’s 1.448 for their sample period prior to the 2008 financial crisis, it can still be interpreted as indicating market expectations of high growth opportunities for Portuguese firms over our sample period. The mean of the ratio of total liabilities to total assets is 0.696, while the mean of the ratio of long-term debt to total assets is 0.253, which suggests that Portuguese firms rely significantly more on short-term debt financing. Return on assets (ROA) exhibits high volatility, with a mean of 2.999 and a standard deviation nearly four times the mean.

The correlations between the independent variables are reported in Table 3. The two measures of leverage used in this study are, as expected, significantly correlated. Leverage as measured by the ratio of total liabilities to total assets is positively correlated with growth opportunities as measured by Tobin’s Q and with profitability, but negatively correlated with sales. The correlations between the independent variables, and the correlation between investment and leverage (-0.10), are generally low, which suggests that endogeneity among the explanatory variables may not be relevant in this study (Serrasqueiro et al., 2007) and that multicollinearity is not a serious problem (Aivazian et al., 2005a). Cash flow and profitability have the highest correlation (0.63), but it is still lower than that of most previous studies, and since multicollinearity is a problem of degree, not of kind (Odit and Chittoo, 2008), its impact is not severe enough to affect the estimates.

Table 2: Summary statistics

	Mean	25th percentile	Median	75th percentile	Standard deviation
$\frac{\text{Net Investment}_t}{\text{Net fixed assets}_{t-1}}$	-0.008158	-0.046538	-0.001302	0.032612	0.088799
$\frac{\text{Cash Flow}_t}{\text{Net Fixed Assets}_{t-1}}$	0.163389	0.026676	0.115924	0.246505	0.360715
Tobin's Q_{t-1}	1.028086	0.810013	0.958758	1.156766	0.384478
$\left(\frac{\text{Total liabilities}}{\text{Total assets}}\right)_{t-1}$	0.695946	0.532235	0.704333	0.812284	0.251884
$\left(\frac{\text{Long term debt}}{\text{Total assets}}\right)_{t-1}$	0.253190	0.113841	0.246858	0.361848	0.164535
$\left(\frac{\text{Net Sales}}{\text{Net Fixed Assets}}\right)_{t-1}$	3.209591	0.918755	1.616655	3.896289	4.369955
ROA_t	2.999147	0.990000	3.250000	5.300000	11.92013
Size_{t-1}	13.21231	12.12000	13.24934	14.77184	1.883266

This table presents the descriptive statistics of the variables defined in Table 1. The sample covers the period 2010–2015 with an unbalanced panel of 211 observations of 44 firms.

Table 3: Correlation between independent variables

	$\frac{\text{Cash Flow}_t}{\text{Net Fixed Assets}_{t-1}}$	Tobin's Q_{t-1}	$\frac{\text{Total liabilities}_{t-1}}{\text{Total assets}_{t-1}}$	$\frac{\text{Long term debt}_{t-1}}{\text{Total assets}_{t-1}}$	$\frac{\text{Net Sales}_{t-1}}{\text{Net Fixed Assets}_{t-1}}$	ROA_t	Size_{t-1}
$\frac{\text{Cash flow}_t}{\text{Net Fixed Assets}_{t-1}}$	1.00						
Tobin's Q_{t-1}	0.20***	1.00					
$\frac{\text{Total liabilities}_{t-1}}{\text{Total assets}_{t-1}}$	0.10	0.42***	1.00				
$\frac{\text{Long term debt}_{t-1}}{\text{Total assets}_{t-1}}$	-0.16**	0.08	0.39***	1.00			
$\frac{\text{Net Sales}_{t-1}}{\text{Net Fixed Assets}_{t-1}}$	0.37***	-0.03	-0.12*	-0.31***	1.00		
ROA_t	0.63***	0.26***	0.28***	-0.05	0.03	1.00	
Size_{t-1}	-0.08	0.09	-0.03	0.32***	-0.21***	-0.05	1.00

This table presents the correlations among the independent variables. * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

5. Results

The results of the reduced-form investment equation (1) are reported in Table 4. We find that financial leverage, measured as the ratio of total liabilities to total assets, has a negative impact on net investment, at the 1% significance level. Consistent with hypotheses H1a and H1b, we conclude that there is a significant negative relationship between financial leverage and investment for Portuguese listed firms during the sample period 2010–2015.

Rows 6 and 7 of Table 4 present the chi-square and p-values of the Lagrange Multiplier (LM) and Hausman tests, respectively. The null hypothesis of the LM test is rejected at the 1% significance level, indicating that the random effects model is preferable to pooled OLS in estimating the investment equation. We also reject the null hypothesis of the Hausman test at the 1% significance level, and thus conclude that the fixed effects model is the most appropriate specification, and that the pooled and random effects models underestimate the impact of financial leverage on investment. The same holds true for equations (2) and (3). The F-statistics for all models are significant at the 0.0001 level, with adjusted R2 values ranging from 0.431 to 0.479 for the fixed effects regression models.

A one unit increase in leverage, measured as the ratio of total liabilities to total assets, decreases net investment by 0.215 (Row 2 of Table 4). This negative relationship between leverage and investment lends support both to the theory that higher leverage likely leads to the agency problem of underinvestment due to debt overhang and to the overinvestment hypothesis that leverage has a "disciplinary role" on managers by committing them to pay out funds, which they could otherwise invest, to service debt.

The ratio of long-term debt to total assets, our second measure of leverage (used by Aivazian et al., 2005a, but not by Serrasqueiro et al., 2007), has a positive but statistically insignificant impact on net investment in all specifications, so we ignore it in the subsequent equations. In our univariate analysis (section 4.2), we suggested that Portuguese firms, in order to maintain financial flexibility, rely significantly more on short-term debt than on

long-term debt to finance their investments. The positive but insignificant coefficient of long-term debt indicates that overinvestment may be present but is not severe.

The impact of cash flow on investment is statistically significant at the 1% level and has the expected positive sign, consistent with the free cash flow hypothesis and with the existence of financing constraints possibly arising from information asymmetries. The positive and significant coefficient of cash flow (0.142) supports H2. Like debt financing, the availability of internally generated funds is thus an important determinant of investment, which highlights the relevance of internal factors for the firm's investment decisions.

Growth opportunities, as measured by Tobin's Q, have a positive but statistically insignificant impact on net investment in equation (1). In equation (2), where profitability and firm size are included as control variables, yielding the highest adjusted R2 value, growth opportunities are significant at the 10% level (Table 5, Row 3) in the fixed effects specification. Finally, in equation (3), which is directly comparable to that of Serrasqueiro et al. (2007), we find that growth opportunities have a positive and statistically significant effect on net investment in the pooled, random effects and fixed effects models at the 1%, 5% and 10% levels, respectively. These results provide partial support for H3.

The relationship between sales and investment is statistically significant in all models, but has a negative sign, which is inconsistent with H4. While it is surprising that as the demand for a firm's goods and services increases its net investment decreases, i.e. that sales is a restrictive determinant of investment over the sample period, the sales coefficient is small (-0.006) and close to zero. The same applies for the profitability variable in equation (2), which has a small but negative effect on investment, significant at the 1% level, contradicting H5. This negative relationship between return on assets and investment does not necessarily mean that profits are not being reinvested: higher investment, by increasing total assets, can increase the denominator of the return on assets ratio and decrease its numerator through depreciation.

Firm size has a positive and statistically significant effect on investment at the 1% level, in line with H6. Access to external finance, which influences investment decisions,

Table 4: Regression results of equation (1): baseline specification

	Panel A: Leverage = (Total liabilities/Total assets)$_{t-1}$				Panel B: Leverage = (Long term debt/Total assets)$_{t-1}$			
	Pooling	Random effects	Fixed effects	FE with AR (1)	Pooling	Random effects	Fixed effects	FE with AR (1)
Intercept	0.036	0.043*	0.088*	0.193***	0.011	0.009	0.007	0.095*
	(1.60)	(1.79)	(1.96)	(3.55)	(0.49)	(0.38)	(0.15)	(1.77)
Leverage	-0.078***	-0.086***	-0.215***	-0.241***	-0.029	-0.006	0.017	0.014
	(-3.18)	(-3.16)	(-3.55)	(-3.88)	(-0.76)	(-0.15)	(0.29)	(0.22)
Tobin's Q_{t-1}	0.025	0.020	0.050	0.003	0.005	-0.003	-0.018	-0.071
	(1.50)	(1.12)	(1.23)	(0.07)	(0.31)	(-0.19)	(-0.49)	(-1.59)
$\frac{\text{Cash Flow}_t}{\text{Net Fixed Assets}_{t-1}}$	0.073***	0.098***	0.142***	0.189***	0.069***	0.093***	0.115***	0.154***
	(4.17)	(6.03)	(6.71)	(8.04)	(3.87)	(5.52)	(5.59)	(6.67)
$\frac{\text{Net Sales}_{t-1}}{\text{Net Fixed Assets}_{t-1}}$	-0.009***	-0.008***	-0.006**	-0.020***	-0.008***	-0.008***	-0.004	-0.017***
	(-6.16)	(-5.43)	(-1.97)	(-5.04)	(-5.66)	(-4.57)	(-1.28)	(-4.11)
LM test	Chi^2 (1) = 20.18***				Chi^2 (1) = 22.73***			
Hausman test	Chi^2 (8) = 91.99***				Chi^2 (8) = 46.97***			
Observations	211	211	211		211	211	211	
Adj. R^2	0.166	0.152	0.431		0.127	0.116	0.386	

This table provides the regression results of investment equation (1) for Portuguese publicly traded firms from 2010–2015 using alternative models (pooled OLS, random effects model, and fixed effects model) and two measures of leverage. The Lagrangian Multiplier (LM) test is used to test the random effects model versus the pooling regression. The Hausman test is used to test the fixed effects model versus the random effects model. * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

Table 5: Regression results of equation (2): alternative specification

	$\text{Leverage} = (\text{Total liabilities}/\text{Total assets})_{t-1}$			
	Pooling	Random effects	Fixed effects	FE with AR (1)
Intercept	-0.066	-0.069	-0.685**	-0.797***
	(1.42)	(-1.31)	(-2.29)	(-2.69)
Leverage	-0.065**	-0.064**	-0.144**	-0.154**
	(-2.60)	(-2.28)	(-2.02)	(-2.20)
Tobin's Q_{t-1}	0.021	0.018	0.073*	0.024
	(1.26)	(0.97)	(1.81)	(0.59)
$\frac{\text{Cash Flow}_{\text{t}}}{\text{Net Fixed Assets}_{\text{t}-1}}$	0.092***	0.130***	0.199***	0.278***
	(4.06)	(6.17)	(6.99)	(9.11)
$\frac{\text{Net Sales}_{\text{t}-1}}{\text{Net Fixed Assets}_{\text{t}-1}}$	-0.008***	-0.009***	-0.009***	-0.027***
	(-5.76)	(-5.47)	(-2.95)	(-6.43)
ROA_{t}	-0.001	-0.001**	-0.002***	-0.003***
	(-1.26)	(-2.23)	(-2.85)	(-4.18)
$\text{Size}_{\text{t}-1}$	0.007**	0.008**	0.054**	0.071***
	(2.40)	(2.14)	(2.40)	(3.10)
Hausman test	Chi^2 (10) = 51.52***			
Observations	209	209	209	
Adj. R^2	0.189	0.178	0.479	

This table provides the regression results of investment equation (2) for Portuguese publicly traded firms from 2010–2015 using alternative models (pooled OLS, random effects model, and fixed effects model). * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

may vary with firm size, as larger firms tend to have lower information asymmetries. Normalizing the variables (dividing them by net fixed assets) was not sufficient to eliminate this size effect.

We have seen that financial leverage has a negative and significant impact on net investment, which supports the view that capital structure plays an important role in determining investment decisions.

In order to differentiate the impact of financial leverage on investment in firms with high growth opportunities from that in firms with low growth opportunities, we added an interaction term between leverage and the dummy variable defined in Section 4.1 to equation (1). The results of these regressions with classical standard errors (used in most previous studies, including that of Serrasqueiro et al., 2007, which do not take heteroskedasticity into account) and with robust standard errors (used by Aivazian et al., 2005a, for the pooled regression, and by us for the pooled, random and fixed effects models) are shown in Panel A and Panel B, respectively, of Table 6.

We find that the coefficient of the interaction term (D×Leverage) is statistically significant in the pooled OLS and in the random effects models at the 5% level, but not in the fixed effects model without robust standard errors. Serrasqueiro et al. (2007), in their study of the investment determinants of Portuguese listed companies, found this interaction term between the dummy variable and leverage to be statistically insignificant across all specifications. In contrast, after correcting for heteroskedasticity, we find that the coefficient of the interaction term is statistically significant in the pooled OLS and random effects models with robust standard errors at the 1% level, and in the fixed effects model with robust standard errors at the 5% level.

We reject the null hypothesis of the robust Hausman test, presented in Row 9 of Table 6, at the 1% significance level, which indicates once again that the fixed effects model is the most appropriate specification. The results of the fixed effects regression with robust standard errors do not change the estimated coefficients from the regression without robust standard errors, and the statistical significance of the variables leverage, cash flows and sales remains

unchanged, so our main conclusions are not altered. However, the interaction term between the dummy variable and leverage becomes statistically significant at the 5% level (p-value of 0.036), and the growth opportunities variable loses its previous statistical significance at the 10% level (p-value of 0.109). The coefficient of the interaction term was expected to have a positive sign, but we find that it is negative in all specifications, which contradicts hypothesis H1c that the documented negative relationship between financial leverage and investment is stronger for firms with low growth opportunities.

The finding that the negative relationship between leverage and investment is stronger for firms with high growth opportunities, while not in line with most empirical studies, is not unprecedented (e.g., Serrasqueiro et al., 2007, in their study of Portuguese firms, report a negative, though statistically insignificant, coefficient for the interaction term in three different model specifications, and Chen et al., 2013, in their study of Chinese firms, found that the negative effect of financial leverage on investment is significantly stronger for high-growth firms), but further research is needed. Our results suggest that financial leverage may aggravate the underinvestment problem for firms with high growth opportunities.

Table 6: Regression results of equation (3): differences in the role of leverage for high versus low growth firms

	Panel A: Leverage $= (\text{Total liabilities}/\text{Total assets})_{t-1}$ Non-robust standard errors			Panel B: Leverage $= (\text{Total liabilities}/\text{Total assets})_{t-1}$ Robust standard errors		
	Pooling	Random effects	Fixed effects	Pooling	Random effects	Fixed effects
Intercept	-0.002	0.008	0.062	-0.002	0.008	0.062
	(-0.06)	(0.27)	(1.30)	(-0.07)	(0.22)	(1.36)
Leverage	-0.043	-0.054*	-0.193***	-0.043	-0.054	-0.193***
	(-1.53)	(-1.78)	(-3.11)	(-1.49)	(-1.30)	(-2.93)
Tobin's Q_{t-1}	0.053***	0.047**	0.073*	0.053***	0.047*	0.073
	(2.63)	(2.20)	(1.68)	(2.70)	(1.70)	(1.64)
$\frac{\text{Cash Flow}_t}{\text{Net Fixed Assets}_{t-1}}$	0.071***	0.096***	0.142***	0.071	0.096*	0.142***
	(4.13)	(5.94)	(6.72)	(1.22)	(1.82)	(3.03)
$\frac{\text{Net Sales}_{t-1}}{\text{Net Fixed Assets}_{t-1}}$	-0.009***	-0.008***	-0.006**	-0.009**	-0.008***	-0.006**
	(-6.16)	(-5.44)	(-2.03)	(-2.57)	(-5.29)	(-1.90)
$D\times$Leverage	-0.049**	-0.046**	-0.038	-0.049***	-0.046***	-0.038**
	(-2.40)	(-2.30)	(-1.49)	(-2.60)	(-2.71)	(-2.17)
LM test	Chi^2 (1) = 18.15***					
Hausman test	Chi^2 (9) = 83.29***					
Robust Hausman test				Chi^2 (8) = 63.871***		
Observations	211	211	211	211	211	211
Adj. R^2	0.185	0.166	0.436	0.185	0.166	0.436

This table provides the regression results of investment equation (3) for Portuguese publicly traded firms from 2010–2015 using alternative models (pooled OLS, random effects model, and fixed effects model). The t-statistics of the regressions in Panel B are based on heteroskedastic-consistent (White-robust) standard errors. The robust Hausman test, obtained by the STATA command "xtoverid", is used to test the fixed effects model versus the random effects model for the regressions with robust standard errors. * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

6. Conclusions

This thesis examined the relationship between financial leverage and investment for Portuguese listed companies between 2010 and 2015. We found that financial leverage, measured as the ratio of total liabilities to total assets, has a negative and significant impact on investment across all specifications, which supports our main hypothesis that there is a negative and significant relationship between financial leverage and investment as predicted by agency theory, confirming that capital structure plays a significant role in determining investment decisions.

Our results indicate that the pooled and random effects models underestimate the impact of financial leverage on investment, and that the fixed effects model is the most appropriate specification. We extended the analysis of the investment decisions of Portuguese listed companies by Serrasqueiro et al. (2007) to a more recent time period, included two additional control variables, tested another measure of leverage, and further addressed the problem of heteroskedasticity by using robust standard errors not just for the pooled OLS but also for the random and fixed effects models. While they found the interaction term between leverage and a dummy variable that takes the value of one for firms with high growth opportunities and zero otherwise to be statistically insignificant in all models, we found it to be significant in the pooled and random effects models without robust standard errors, as well as in the pooled, random and fixed effects models with robust standard errors.

The coefficient of the interaction term (D×Leverage) was negative, which implies that the negative effect of leverage on investment is stronger for firms with high growth opportunities, and contradicts the hypothesis that leverage plays a disciplining role for firms with low growth opportunities. We conclude that debt financing in firms with low growth opportunities was not sufficient to alleviate the agency problem of overinvestment resulting from a shortage of positive NPV projects and managerial self-interest, and that financial leverage constrains investment and exacerbates the underinvestment problem due to debt overhang for firms with high growth opportunities. Further research is needed to confirm

these findings, but based on the results of this study it is recommended that firms with high growth opportunities consider lowering their leverage ratios in order to mitigate the debt overhang problem (Myers, 1977), retain financial flexibility, and be able to exploit those valuable growth opportunities.

There are several potential limitations to this study. First, we assumed that investment decisions depend only on current and one-year lagged independent variables. Second, other measures (such as the price-to-earnings ratio, instead of Tobin's Q) could be used to both measure firms' growth opportunities and distinguish between high- and low-growth firms. Third, given the limited sample size, our results should be interpreted with caution. Future studies may consider other factors, including macroeconomic conditions such as interest rates, monetary policy and uncertainty, and explore different methodologies such as a dynamic simultaneous equation model, in order to further assess the relationship between financial leverage and investment decisions.

7. References

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