SMEs' INVESTMENT DETERMINANTS: EMPIRICAL EVIDENCE USING QUANTILE APPROACH

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Abstract. This paper makes an important contribution to the literature on SMEs, namely investigating whether the relationships between determinants and investment are dependent on the level of investment. Based on a sample of Portuguese SMEs, using two-step estimation method, firstly using probit regression and secondly using quantile regressions, we find significant non-linearities in relationships formed between determinants and investment over the distribution of investment. In particular, we find that: 1) sales, age and growth opportunities are restrictive determinants of investment for low levels of investment, but positive determinants of investment for high levels of investment; 2) debt and the interest rate are restrictive determinants of investment but only for low and intermediate levels of investment; 3) cash flow is a positive determinant of investment, but is more important for investment regarding low levels of investment; 4) GNP is a positive determinant of investment, but only for high levels of investment; and 5) investment in the previous period is a positive determinant of investment in the present period, but only for intermediate and high levels of investment. The relevance of the various theories explaining firm investment depends on SMEs' level of investment.

Keywords: investment, quantile regressions, SMEs, survival analysis, two-step estimation method.

1. Introduction

Various theories have tried to explain firm investment. Neoclassical Theory, Free Cash Flow Theory and Agency Theory are particularly important in this context.

According to Neoclassical Theory (Hall, Jorgenson 1967; Jorgenson 1971; Chirinko 1993) investment is explained by firms' exogenous variables, sales being particularly

important in this context. If sales increase, firms increase investment, and if sales fall, they reduce investment.

Based on the information asymmetry in relationships formed between owners/managers and creditors, the studies by Fazzari *et al.* (1988) and Fazzari and Petersen (1993) originated Free Cash Flow Theory. According to Free Cash Flow Theory, unlike what is proposed by Neoclassical Theory, investment depends on firms' endogenous factors, cash flow being particularly important in explaining firm investment. The high sensitivity of investment to variations in cash flow indicates the severe constraints felt by firms in financing their investment.

Finally, Agency Theory bases its assumptions on the conflicts, on one hand between owners and managers, and on the other, between owners/managers and creditors. In this particular context, use of debt is particularly relevant with the aim of lessening conflicts between owners and managers and between owners/managers and creditors.

The various studies about firms' investment determinants (for example, Fazzari *et al.* 1988; Fazzari, Petersen 1993; Lang *et al.* 1996; Mizen, Vermeulen 2004; Aivazian *et al.* 2005; Bond, Van Reenen 2007; Junlu *et al.* 2009; Sun, Nobuyoshi 2009) consider the central tendency of investment, and do not check whether relationships between determinants and investment tend to be similar for low and high levels of investment.

In Europe in general, and Portugal in particular, SMEs are particular importance to the economy. In Portugal, SMEs represent 99.68% of total number of firms, and representing 72.5% of employment, 57.9% of turnover, and 59.8% of gross added value at factor costs, in relation to the total of firms (National Institute of Statistics 2010). SMEs in Portugal are special importance for employment and economic growth.

Given the importance of SMEs as agents of change and for creating employment and economic growth, this study aims to investigate whether the relationships between determinants and investment are identical in SMEs with low and high levels of investment. The study is particularly important since it allows us to suggest different guidelines for economic policy according to SMEs having low or high levels of investment.

To fulfil the objective of this paper, we consider a sample of 1845 SMEs. To solve conveniently the problem of possible bias in the results obtained, due to the survival issue, we use the two-step estimation method proposed by Heckman (1979). At a first stage, considering all SMEs, both surviving and non-surving, we estimate probit regressions. At a second stage, we use quantile regressions to determine relationships between determinants and investment.

This paper makes important contributions to the literature on SMEs. Firstly, it is pioneering in applying quantile regressions to the study of SME investment determinants. Secondly, it shows there are significant non-linearities in the relationships established between determinants and SME investment. Thirdly, it presents a wide range of SME investment determinants. Fourthly, it shows that the applicability of the different explanatory theories of investment depends, in the SME context, on the level of investment, i.e., if SMEs have high or low levels of investment. Fifthly, given use of the two-step

estimation method, the paper makes an additional contribution to the literature, namely identifying the positive and restrictive determinants of SME survival.

After this introduction, the paper has the following structure: section 2 presents the hypotheses for investigation; section 3 presents the methodology used, namely the database, variables and method of estimation; section 4 presents the results obtained; section 5 goes on to discuss these results; and finally, section 6 presents the conclusion and implications of the study.

2. Investigation hypotheses

2.1. Sales

According to Neoclassical Theory, sales stand out in explaining firm investment. If sales increase, firms increase investment and if sales fall, they reduce investment (Hall, Jorgenson 1967; Jorgenson 1971; Chirinko 1993). Regarding the importance of sales as a central determinant in explaining investment, Eisner (1963) and Chirinko (1993) conclude that sales have clear statistical predominance over any other variable in explaining firm investment. Various studies, among which we could highlight those of McConnell and Servaes (1995), Lang *et al.* (1996), Aivazian *et al.* (2005) and Serrasqueiro *et al.* (2008), identify a positive relationship between sales and investment. These studies were made in the context of large firms.

In SMEs, the importance of sales is expected to be less than in the case of large firms. In multiple situations, for small firms, sales are more relevant for coping with occasional difficulties in cash management than for making investment.

We can expect sales to have a limited effect on investment when SMEs have low levels of investment, a situation which should be reversed for SMEs with high levels of investment. Therefore, for SMEs that invest less, the sales variable should have little expression in the market, and as such an effect of apprehension and incapacity in relation to investment should result, as SMEs that make little investment jeopardize their survival in the market. For SMEs with high levels of investment, those higher levels of investment could be a consequence of a positive evolution of sales.

Based on the arguments presented, we formulate the following hypothesis:

H1: he positive relationship between sales and investment is of a greater magnitude for SMEs with high levels of investment than for SMEs with low levels of investment.

2.2. Cash flow

The studies by Fazzari *et al.* (1988) and Fazzari and Petersen (1993) indicate that cash flow is a relevant determinant in explaining firm investment. According to the authors, the greater sensitivity of investment to cash flow indicates that firms are financially restricted. The conclusions of these authors gave rise to Free Cash Flow Theory, a theory which disputes the arguments of Neoclassical Theory since it considers that firms' endogenous determinants, with special prominence for cash flow, are relevant in explaining firm investment.

Fazzari *et al.* (1988) show that firm investment is dependent on cash flow, finding a positive relationship between the level of firms' cash flow and investment. The authors also show that the sensitivity of investment to variations in cash flow is greater in firms that are more susceptible to credit rationing, due to the information asymmetry in the relationships between shareholders/owners and creditors. In this context, Hoshi *et al.* (1991) conclude that in firms with a better relationship with creditors, and consequently subject to fewer problems of information asymmetry, investment is less sensitive to cash flow variations than in firms with a worse relationship with creditors, the latter type of firms being more dependent on cash flow for investment, given the greater information asymmetry and consequently lesser capacity to obtain credit.

Fazzari *et al.* (1988), Hoshi *et al.* (1991), Fazzari and Petersen (1993), Hubbard *et al.* (1995), Kaplan and Zingales (1997, 2000), Cleary (1999), Vermeulen (2002), Mizen and Vermeulen (2004), Bond and Van Reenen (2007), Junlu *et al.* (2009) and Sun and Nobuyoshi (2009) find empirical evidence of a positive relationship between cash flow and firm investment. The relevance of cash flow in determining firms' investment decisions is due to the information asymmetry in relationships between shareholders/owners and creditors, with cash flow being more relevant in explaining firms' investment the smaller their size and the poorer the relationship with creditors. Fazzari *et al.* (1988) conclude that SMEs face greater restrictions in accessing external finance, and so become more dependent on internal funds as a means to finance investment.

Gertler and Gilchrist (1994), Petersen and Rajan (1995) and Vermeulen (2002) argue that cash flow is a particularly relevant variable in explaining investment in SMEs, given the lesser possibility of obtaining credit due to the reduced capacity to provide collateral and greater likelihood of bankruptcy.

Considering that SMEs with low levels of investment are more affected by financial constraints, we can expect their investment to be more sensitive to cash flow, compared to what happens in SMEs with high levels of investment and probably less affected by fnancial constraints.

Based on the arguments presented, we formulate the following hypothesis for investigation:

H2: The positive relationship between cash flow and investment is of a greater magnitude in SMEs with low levels of investment than in SMEs with high levels of investment.

2.3. Debt

According to Jensen and Meckling (1976), there are two types of agency conflicts: 1) conflicts between owners/managers and creditors; and 2) conflicts between owners and managers.

In the SME context, agency problems between owners/managers and creditors are particularly important, since in the great majority of cases ownership and management of SMEs is in the same hands.

Jensen and Meckling (1976) state that when a firm uses outside capital, conflicts of interest arise between shareholders/owners and creditors. A higher level of debt, whether to reduce the agency costs of equity or for any other reason, can lead the firm to face another type of cost: the agency cost associated with external capital. This cost, generated by the conflict of interests between shareholders/owners and creditors, greatly limits firms' recourse to debt. Lenders restrict firms' level of credit, since shareholders/ owners can invest in high-risk projects aiming to increase the value of equity rather than the value of the debt. Therefore, if the project succeeds, owners receive most of the profits, but on the other hand, if it fails creditors bear most of the costs (Jensen, Meckling 1976). Based on agency problems, Myers (1977) and Zwiebel (1996), conclude that a negative relationship is to be expected between debt and the level of firm investment, given that creditors make access to credit more difficult in situations of greater information asymmetry concerning the profitability and risk of projects, with finance only being channelled to more profitable and less risky projects.

Myers (1977), Jensen (1986), Stulz (1990), McConnell and Servaes (1995), Lang *et al.* (1996), Aivazian *et al.* (2005), Ahn *et al.* (2006), Firth *et al.* (2008) Lee and Ratti (2008) obtain a negative relationship between debt and investment. In addition, Lee and Ratti (2008) find that relationship to be of a greater magnitude in small firms.

As firms invest more, we can expect the possible negative effect of debt on investment to be weaker. This may happen because firms that invest more give a positive sign to lenders, in such a way that the agency costs arising from the conflict between owners/ shareholders and creditors diminish. So the firms that invest most can resort to debt as a way to finance their projects, as creditors eventually make it less difficult tol access debt. On the contrary, the firms that invest least continue to give the market a sign of lack of vitality and confidence, and so creditors increase the cost of capital as a way of minimizing the information asymmetry concerning the profitability and risk of projects, preventing firms from investing in low-profitability, high-risk projects.

Based on the arguments presented, we formulate the following hypothesis for investigation:

H3: The negative relationship between debt and investment is of greater magnitude in SMEs with low levels of investment than in SMEs with high levels of investment.

2.4. Age

Authors such as Fazzari *et al.* (1988) and Johansen (1994) state that SMEs face greater obstacles in obtaining external finance.

Beck *et al.* (2006) argue that firm age serves as a proxy for their financial constraints, although this lessens as firms grow.

The SMEs that make least investment will be made up of young firms that invest less due to liquidity constraints and older SMEs that invest less due to having fewer growth opportunities. Therefore, if for SMEs that invest less the relationship between investment and age is negative, this means the reduction in young firms' financial constraints does not get over the lack of profitable projects. If the opposite happens for firms that invest less, this means age reduces liquidity constraints.

SME age can serve as an important proxy for reputation and credibility (Diamond 1989; Ang 1991), allowing access to external finance on more advantageous terms, which may contribute decisively to age leading firms to invest more. We can therefore expect the impact of age on investment to be greater in SMEs with high levels of investment than in SMEs with low levels of investment.

Based on the arguments above, we formulate the following hypothesis for investigation:

H4: The positive relationship between age and investment is of a greater magnitude in SMEs with high levels of investment than in SMEs with low levels of investment.

2.5. Growth opportunities

Authors like Fazzari *et al.* (1988), Ascioglu *et al.* (2008), Carpenter and Guariglia (2008), Junlu *et al.* (2009) and Sun and Nobuyoshi (2009) find a positive relationhip between investment and growth opportunities.

Carpenter and Guariglia (2008) conclude that growth opportunities can be particularly relevant in explaining SME investment, due to these firms being more subject to financial constraints arising from evaluation by creditors. Therefore, growth opportunities may contribute to lessening those financial constraints, since they can serve as an important sign to creditors of vitality and possibilities for growth.

We can expect growth opportunities to have an effect of greater magnitude on investment in SMEs with high levels of investment than in SMEs with low levels of investment, as SMEs that invest most manage to take advantage of the growth opportunities that arise.

Based on the arguments above, we formulate the following hypothesis for investigation:

H5: The positive relationship between growth opportunities and investment is of a greater magnitude in SMEs with high levels of investment than in SMEs with low levels of investment.

2.6. Interest rate

According to Neoclassical Theory, interest rates are an important determinant of firm investment. Bernanke and Gertler (1995) and Gilchrist *et al.* (2005) conclude there is a link between investment and monetary policy, stating that the cost of credit, and consequent effects on firms' investment, necessarily has an effect on the economy. Bernanke and Gertler (1995), Gilchrist *et al.* (2005, 2006) state that increases in interest rates mean diminished investment.

The more relevant the problems of information asymmetry associated with relationships formed between firms' owners/managers and creditors, the greater the possibility of creditors hindering firms' access to credit by increasing interest rates (Ghosh, Ghosh, 2006). In general, problems of information asymmetry are known to be more severe in the SME context, and so there is a greater possiblity of this type of firm having particular difficulty in accessing external finance.

We can expect that interest rates, in defining the cost of capital, have a more negative effect in SMEs that invest less. SMEs with low levels of investment could be more restricted financially due to the greater relevance of problems of information asym-

metry, and so the negative impact of interest rates on investment could be of a greater magnitude, compared to what occurs in SMEs with high levels of investment.

Based on the arguments presented, we formulate the following hypothesis for investigation:

H6: The negative relationship between interest rate and investment is of a greater magnitude in SMEs with low levels of investment than in SMEs with high levels of investment.

2.7. Gross national product

Various authors (Acar, Zehir 2010; Balkyte, Peleckis 2010; Berbel-Pineda, Ramírez-Hurtado 2011; Travkina, Tvaronavičiene 2011) suggest that factors not easily controllable by the firms have an influence on their performamance.

Bernanke and Gertler (1989), Gertler and Gilchrist (1994), Bernanke and Gertler (1996), Oliner and Rudebusch (1996), and Vermeulen (2002), state that SMEs, having particular difficulty in diversifying their sources of finance, are more exposed to changes in the economic climate.

At times of economic recession, we can expect external capital markets to be more restrictive in granting credit, with SMEs also having less capacity to retain cash flow. In these circumstances, SME investment will be expected to diminish. In periods of economic growth, on one hand SMEs will have easier access to credit, and on the other be more able to retain cash flow, making it easier to increase investment.

The effects of economic growth on investment could be more relevant when SMEs have high levels of investment, since these are firms in a period of growth and so the marginal effect of economic growth could mean a greater increase in investment than in the case of SMEs with low levels of investment and consequently greater difficulty in managing their financial resources.

Based on the arguments presented, we formulate the following hypothesis for investigation:

H7: The positive relationship between GNP and investment is of a greater magnitude in SMEs with high levels of investment than in SMEs with low levels of investment.

3. Investigation methodology

3.1. Database

This study uses the SABI (Iberian Balance-Sheet Analysis System) database supplied by Bureau van Dijks for the period 1999–2006[1].

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[1] The choice of the period 1999–2006 was due to two reasons: 1) has not had access to data subsequent to 2006; and 2) the period between 1999 and 2006 was a period of some stability of microeconomics and macroeconomics aggregates in Portugal. This allows us to make a correct analysis of the SMEs investment determinants in Portugal, without the need to include *dummy* variables to representing periods of significant alterations of microeconomics and macroeconomics conditions. The introduction of these *dummy* variables could result in problems of robustness of the estimated results.

Aiming to analyze SMEs, we select firms based on the European Union recommendation L124/36, (2003/361/CE). According to this recommendation, a firm is considered an SME when it meets two of the following three criteria: 1) fewer than 250 employees; 2) annual total assets under 43 million euros; and 3) business turnover under 50 million euros.

So as to solve the problem of possible result bias due to the survival issue, and also aiming to obtain a more representative sample of the Portuguese SME situation, we consider three types of SMEs: 1) SMEs belonging to the market for the whole period of analysis (1999–2006); 2) SMEs leaving the market during the period of analysis (1999–2006); and 3) SMEs entering the market during the period of analysis (1999–2006).

Based on the above criteria, the final sample is composed as follows: 1) 1411 SMEs that belong to the market for the whole period of analysis (1999–2006), corresponding to 9877 observations; 2) 236 SMEs that enter the market during the period of analysis (1999–2006), corresponding to 1228 observations; and 3) 198 SMEs that leave the market during the period of analysis (1999–2006), corresponding to 948 observations. Therefore, the final sample consists of 1845[2] SMEs, corresponding to a total number of 12053 observations.

The final sample composition is presented in Table 1 below.

Table 1. Sample description

	SMEs	
	Number of Firms	Observations
Incumbent firms in all period 1999–2006	1411	9877
Firms entering in the period 1999–2006	236	1228
Firms exiting in the period 1999–2006	198	948
Total Number of Firms	1845	
Total Number of Observations		12053

3.2. Definition of variables

The independent variables used in this study are as follows[3]: Sales, Cash Flow, Debt, Age, Growth Opportunities, Interest Rate and Gross National Product. To test the dynamics of investment over time, we also use lagged investment, to test whether the persistence of investment is identical for SMEs with low and high levels of investment.

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[2] In this period there were three mergers of two SMEs, one in 2001, another in 2003 and, finally, another in 2004. We choice not consider the three mergers of two SMEs in database, because of course we should not consider the existence of two SMEs until a certain time and after the time of merger we consider only one SME, a procedure which could bias the estimated results.

[3] The independent variables used in this study, both in the present period and the previous period, were used in various studies about firms' investment determinants, for example: Fazzari *et al.* (1988); Fazzari and Petersen (1993); Lang *et al.* (1996); Degryse and Jong (2001); Aivazian *et al.* (2005); DeMarzo and Fishman (2007), Ascioglu *et al.* (2008), Brown *et al.* (2009).

The variables used in this study were measured as follows:

- $I_{i,t}$ is net investment, given by the ratio of variation of fixed capital less amortization and depreciation in the present period to fixed assets in the previous period;
- $I_{i,t-1}$ is the lagged net investment;
- $SALES_{i,t-1}$ are sales in the previous period, given by the logarithm of business turnover in the previous period;
- $CF_{i,t}$ is cash flow in the present period, given by the ratio of operational results after payment of interest plus depreciation divided by total assets in the present period;
- $LEV_{i,t-1}$ is debt in the previous period, given by the ratio of total debt in the previous period to total assets in the previous period;
- $AGE_{i,t-1}$ is firm age, given by the logarithm of the number of years firms have been in existence;
- $GO_{i,t-1}$ are growth opportunities in the previous period, given by the sales growth firm in the previous period;
- IR_t is the market interest rate in the present period, represented by the 3-month euribor rate;
- GNP_t is Gross National Product in the present period, given by the logarithm of Gross National Product.

All the monetary variables were deflated using a deflater constructed based on the GNP deflater in each year. The base year considered for deflation of monetary variables was 2006.

It should be noted that all estimations include annual dummy variables in order to measure other effects of the economic climate not measured by the interest rate and Gross National Product, on variations in SME investment. In addition, we consider sector dummy variables to measure the impact of possibly different relationships between determinants and investment according to firms belonging to different economic sub-sectors. Just as Blanco-Mazagatos *et al.* (2007), we consider the following sector dummy variables[4]: 1) agriculture; 2) forestry and fishing; 3) construction; 4) manufacturing industry; 5) wholesale and retail; and 6) services.

3.3. Survival analysis

Construction of a sample of firm data including only firms that operate in the market during the entire period of analysis could create bias in the results, due to not considering the situation of firms that left the market during the period of analysis. Indeed, we would expect relationships between determinants and investment to be of a different nature for surviving and non-surviving firms. Not considering in the sample firms that leave the market could lead to bias in the relationships formed between determinants

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[4] In all activity sectors considered in this study (agriculture, forestry and fishing, construction, manufacturing industry, wholesale and retail, services) are survival SMEs and non-survival SMEs. The existence of survival SMEs and non-survival SMEs in all activity sectors guarantee the existence of some sectoral homogeneity of the sample. This sectoral homogeneity of the sample contributing to the robustness of the empirical evidence obtained in this paper.

and investment. According to Heckman (1979), Calvo (2006) and Lotti *et al.* (2009) one way to eliminate this selection problem is to use the two-step estimation method proposed by Heckman (1979).

At a first stage, and considering the total sample, both firms remaining in the market and those leaving the market, we estimate a model of probability of firm survival, based on the probit regression analysis.

The dependent variable takes the value of 1 when the firm survives and the value of 0 when it leaves the market. Just as Calvo (2006), we will consider as explanatory variables of the probit regression the determinants used at the second stage of estimation. The probit regression to estimate can be presented as follows:

$$\Pr(\delta_{i,t} = 1) = \alpha_0 + \theta I_{i,t-1} + \gamma_1 SALES_{i,t-1} + \gamma_2 CF_{i,t} + \gamma_3 LEV_{i,t-1} + \gamma_4 AGE_{i,t-1} + \gamma_5 GO_{i,t-1} +$$
$$\gamma_6 IR_t + \gamma_7 GNP_t + D_S + d_t + z_{i,t}, \tag{1}$$

where: $I_{i,t-1}$ is investment in the previous period; $SALES_{i,t-1}$ are sales in the previous period; $CF_{i,t}$ is cash flow in the present period; $LEV_{i,t-1}$ is debt in the previous period; $AGE_{i,t-1}$ is age in the previous period; $GO_{i,t-1}$ are growth opportunities in the previous period; IR_t is the interest rate in the present period; GNP_t is GNP in the present period; D_s are sector *dummy* variables; d_t are annual *dummy* variables; and $z_{i,t}$ is the error.

Based on the probit regressions, estimated in the first step, we calculate the inverse Mill's ratio[5], and use it as an additional explanatory variable in the second step when estimating relationships between determinants and investment through quantile regressions.

3.4. Quantile regression

Use of quantile regressions is normal when aiming to check whether relationships between the dependent variable and independent variables are dependent on the level of the dependent variable.

With the objective of testing whether the relationships between determinants and investment are identical as a function of the level of SME investment, we turn to quantile regressions. In this way, we can check whether relationships between SME investment and its determinants are different for low and high levels of investment.

This type of model conditioned to a quantile regression has received considerable attention, as it leads to a more complete statistical analysis of the stochastic relationship between random variables (Knight 1989; Weiss 1991; Hasan, Koenker 1997; Rogers 2001; Koenker, Xiao 2004; Serrasqueiro *et al.* 2010).

Using the quantile regression estimator developed by Koenker and Hallock (2001), which considers that the conditional distribution quantile θ of the dependent variable

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[5] To see in detail the formula for calculating the inverse Mill's ratio, consult Heckman (1979).

$(Y_{i,t})$ is a linear function of the vector representing the independent variables $(Z_{i,t})$, the regression conditioned to the quantiles can be presented as follows:

$$Y_{i,t} = \beta_0 + \beta_{\theta1}`Z_{i,t} + z_{\theta i,t} \tag{2}$$

and,

$$Q_\theta (Y_{i,t} / Z_{i,t}) \equiv \inf \left\{ Y_{i,t} : F_{i,t}(Y_{i,t} / Z_{i,t}) \geq \theta \right\} = \beta_0 + \beta_{\theta1}`Z_{i,t}, \tag{3}$$

with the following restriction:

$$Q_\theta (z_{\theta i,t} / Z_{i,t}) = 0, \tag{4}$$

where: $Y_{i,t}$ $I_{i,t}$ and $Z_{i,t} = (I_{i,t-1}; SALES_{i,t-1}; CF_{i,t}; LEV_{i,t-1}; AGE_{i,t-1}; GO_{i,t-1}; IR_t;$ $GNP_t; \lambda_{i,t}; D_S; d_t)$, i represents the firm $i = [1,...,1845]$, t is the period $t = [1,...7]$, $Q_\theta(z_{\theta i,t} / X_{i,t})$ is the nth quantile conditioned to $Y_{i,t}$, being conditional in relation to the vector $Z_{i,t}$ referring to the independent variables, $\beta_{\theta1}$ corresponds to the vector of parameters estimated for the different values of θ of $[0,1]$, $z_{\theta i,t}$ is the error, and $F_{i,t}(./Z_{i,t})$ represents the function of conditional distribution.

In this way, we aim to study the determinants of SME investment, following a regression conditioned to the quantiles, in which $\theta = 5°, 10°, 25°, 50°, 75°, 90°, 95°$. Estimating the quantiles conditioned to the regression for the different values of θ, we will have the distribution of the variable $Y_{i,t}$, conditioned to the corresponding values of $Z_{i,t}$ for the values of i $(i = 1,...,1845)$ and t $(t = 1,...7)$.

So as to guarantee the robustness of results in relation to the parameters estimated for the different quantiles, we use the bootstrap matrix method proposed by Buchinsky (1995, 1998). Based on the Monte Carlo simulations, Buchinsky (1995) concludes that the bootstrap matrix method is most advisable for data samples with a rather low number of observations, being considered a valid method in the presence of the most varied forms of heterogeneity.

To test for possible non-linearity, over all investment distribution, for each of the determinants considered in this study, we use the Chow test. For each investment determinant, the null hypothesis indicates non-existence of non-linearities between determinants and investment over the distribution of investment, and the alternative hypothesis indicating the existence of non-linearities between determinants and investment over investment distribution.

4. Results

4.1. Descriptive statistics and correlation matrix

The descriptive statistics of the variables used in this study are presented in Table 2 below.

Investment is found to have quite volatile behaviour, since the standard deviation is considerably above the mean. The variables of cash flow and growth opportunities are also volatile, the volatility of growth opportunities being greater, as the standard

deviation of this variable is considerably above the mean. The behaviour of the other variables is not very volatile, the standard deviation of the variables being less than the respective means.

The results of the correlations between variables are presented in Table 3.

Table 2. Descriptive statistics

			SMEs		
Variables	N	Mean	Stand. Desv.	Minimum	Maximum
$INV_{i,t}$	12053	0.04657	0.16271	−0.47821	1.43872
$SALES_{i,t}$	12053	15.2119	0.28443	10.43111	17.68112
$CF_{i,t}$	12053	0.06339	0.16034	−1.7171	0.62717
$LEV_{i,t}$	12053	0.66825	0.23627	0.00017	0.99829
$AGE_{i,t}$	12053	2.71621	0.45165	0	5.09621
$GO_{i,t}$	12053	0.08942	0.378678	−2.61521	16.7067
IR_t	7	3.08571	0.97518	2.1	4.9
GNP_t	7	11.9314	0.78981	11.9133	11.9540

Table 3. Correlation matrix

	$INV_{i,t}$	$INV_{i,t-1}$	$SALES_{i,t-1}$	$CF_{i,t}$	$LEV_{i,t-1}$	$AGE_{i,t-1}$	$GO_{i,t-1}$	IR_t	GNP_t	$\lambda_{i,t}$
$INV_{i,t}$	1									
$INV_{i,t-1}$	0.238***	1								
$SALES_{i,t-1}$	0.148***	0.139***	1							
$CF_{i,t}$	0.437***	0.382***	0.051**	1						
$LEV_{i,t-1}$	−0.109***	−0.105***	−0.034*	−0.122***	1					
$AGE_{i,t-1}$	−0.010	−0.007	0.255***	0.081***	0.137***	1				
$GO_{i,t-1}$	0.008	0.009	0.298***	−0.039*	−0.022	−0.156***	1			
IR_t	−0.411***	−0.371***	0.011	0.266***	−0.327***	0.050**	−0.020	1		
GNP_t	0.318***	0.304***	0.149***	0.012	0.112***	0.031*	0.288***	−0.123***	1	
$\lambda_{i,t}$	−0.202***	−0.194***	−0.098***	−0.008	0.024	−0.167***	−0.013	0.009	−0.007	1

Notes: 1. ***Statistical significant at 1% level; **Statistical Significant at 5% level; *Statistical significant at 10% level

Aivazian *et al.* (2005) conclude that the problem of collinearity between explanatory variables may be particularly relevant when the correlation coefficients are above 30%. The correlation coefficients of the independent variables are not too high, despite those between cash flow, interest rate and GNP, and investment in the previous period, as well as between debt and the interest rate, being above 30%. In general, the correlation coefficients indicate the problem of collinearity between explanatory variables is not particularly relevant in this study.

4.2. Survival analysis

Table 4 presents the results of the survival analysis, referring to the first step of the Heckman (1979) method.

Table 4. Survival analysis

Dependent Variable: Pr($\delta_{i,t}$ = 1)	
Independent Variables	I
$I_{i,t-1}$	0.0574***
	(0.0109)
$SALES_{i,t-1}$	0.0483**
	(0.0235)
$CF_{i,t}$	0.2192***
	(0.0516)
$LEV_{i,t-1}$	0.1181**
	(0.0551)
$AGE_{i,t-1}$	0.0608***
	(0.0178)
$GO_{i,t-1}$	0.1013
	(0.1439)
IR_t	−0.1091**
	(0.0530)
GNP_t	0.0178***
	(0.0056)
$CONS$	0.0271*
	(0.0144)
Pseudo R^2	0.5647
Log Likelihood	−812.90
Firms	1845
Observations	12053

Notes: 1. Standard deviations in parenthesis. 2. ***Statistical significant at 1% level; **Statistical significant at 5% level; *Statistical significance at 10% level. 3. The estimates include sectoral *dummy* variables, but not show. 4. The estimates include time *dummy* variables but not show

The empirical evidence obtained lets us conclude that investment in the previous period, cash flow, sales, debt, age and GNP are determinants stimulating SME survival. On the contrary, the interest rate is a restrictive factor of SME survival. Finally, we find that growth opportunities neither restrict nor stimulate SME survival.

4.3. Investment determinants

Table 5 presents the results of the quantile regressions, corresponding to the second step of the estimation method proposed by Heckman (1979), with the aim of determining the relationships between determinants and SME investment, over the distribution of SME investment.

Table 5. Investment determinants

Independent Variables:	Dependent Variable: $I_{i,t}$							
	OLS	5qt	10qt	25qt	50qt	75qt	90qt	95qt
$I_{i,t-1}$	0.0811***	0.0336	0.0241	0.0542**	0.0792***	0.0830***	0.1048***	0.1179***
	(0.02189)	(0.1266)	(0.1189)	(0.0271)	(0.0179)	(0.0207)	(0.0235)	(0.0314)
$SALES_{i,t-1}$	0.1544**	−0.1945***	−0.1280***	−0.0661**	0.0111	0.0724	0.2182***	0.2992***
	(0.0731)	(0.0388)	(0.0341)	(0.0327)	(0.0498)	(0.0616)	(0.0678)	(0.0716)
$CF_{i,t}$	0.8664***	1.2462***	1.1762***	1.0895***	0.8972***	0.6533***	0.5201***	0.4075**
	(0.1871)	(0.2103)	(0.1981)	(0.1544)	(0.2041)	(0.1516)	(0.1449)	(0.1992)
$LEV_{i,t-1}$	−0.0755**	−0.2672***	−0.2513***	−0.2141***	−0.1972***	−0.1113***	−0.0572**	−0.0196
	(0.0369)	(0.0618)	(0.0516)	(0.0498)	(0.0445)	(0.0313)	(0.0276)	(0.0217)
$AGE_{i,t-1}$	−0.0224	−0.0872**	−0.0611**	−0.0123	0.0452***	0.0396**	0.0469**	0.0537***
	(0.0718)	(0.0425)	(0.0298)	(0.0346)	(0.0121)	(0.0176)	(0.0228)	(0.0165)
$GO_{i,t-1}$	0.0098	−0.1544***	−0.0817**	−0.0214	0.0192	0.1099**	0.1692**	0.3144***
	(0.0278)	(0.0391)	(0.0403)	(0.0487)	(0.0360)	(0.0511)	(0.0813)	(0.0944)
IR_t	−0.0800***	−0.2400***	−0.2112***	−0.1595***	−0.1460***	−0.0511**	0.0139	0.0101
	(0.0167)	(0.0401)	(0.0388)	(0.0486)	(0.0345)	(0.0249)	(0.0233)	(0.0218)
GNP_t	0.0132***	0.0013	0.0011	0.0059**	0.0090**	0.0136***	0.0218***	0.0286***
	(0.0043)	(0.0034)	(0.0031)	(0.0027)	(0.0043)	(0.0041)	(0.0046)	(0.0051)
$\lambda_{i,t}$	−0.1491***	−0.1197***	−0.1315***	−0.1098***	−0.1742***	−0.1813***	−0.1697***	−0.1544***
	(0.0463)	(0.0372)	(0.0409)	(0.0287)	(0.0362)	(0.0414)	(0.0376)	(0.0334)
CONS	0.0118	0.0194	0.0241*	0.0143	0.0231	0.0081	0.0045	0.0067
	(0.0316)	(0.0372)	(0.0126)	(0.0237)	(0.0268)	(0.0209)	(0.0178)	(0.0249)
R^2/Pseudo R^2	0.3254	0.3143	0.2915	0.2712	0.3145	0.3598	0.3416	0.3189
Firms	1647	1647	1647	1647	1647	1647	1647	1647
Observations	11105	11105	11105	11105	11105	11105	11105	11105

Notes: 1. Standard deviations in parenthesis. 2. ***Statistical significant at 1% level; **Statistical significant at 5% level; *Statistical signicant at 10% level. 3. The estimates include sectoral *dummy* variables, but not show. 4. The estimates include time *dummy* variables but not show

The multiple empírical evidence obtained allows us to conclude that:

1) The relationship between investment in the previous period and investment in the present period is not statistically significant for low levels of investment, being positive and statistically significant for moderate and high levels of investment.

2) For low levels of investment, we find a negative and statistically significant relationship between sales and investment. However, for high levels of investment, the relationship between sales and investment is positive and statistically significant.

3) The relationship between cash flow and investment is positive and statistically significant, whatever the level of investment. However, the relative importance of cash flow for SME investment seems to be greater for low levels of investment.

4) Except for particularly high levels of investment (95th quantile), whatever the level of investment considered, we find a negative and statistically significant

relationship between debt and investment. We also find that the negative influence of debt on investment diminishes over investment distribution.

5) A negative and statistically significant relationship is found between age and investment for low levels of investment. On the contrary, for moderate and high levels of investment, there is a positive and statistically significant relationship between age and investment.

6) We also find a negative and statistically significant relationship between growth opportunities and investment for low levels of investment, and the relationship being positive and statistically significant in situations of moderate and high investment.

7) The relationship between interest rate and investment is negative and statistically significant, except in situations of particularly high levels of investment (90th and 95th quantiles). We also find that the relative importance of the interest rate on diminished investment becomes less as the level of investment increases.

8) Except in situations of low investment (5th and 10th quantiles), there is a positive and statistically significant relationship between GNP and investment. The positive influence of GNP on investment becomes greater as the level of investment increases.

Estimating relationships between determinants and investment with the OLS regression, we find the variables of investment in the previous period, cash flow, sales and GNP influence investment positively. On the contrary, debt and the interest rate influence investment negatively. Finally, age and growth opportunities do not influence investment.

For all the quantiles considered, there is a negative and statistically significant relationship between the inverse Mill's ratio and investment. We find, therefore, that use of the inverse Mill's ratio in the quantile regressions allows efficient solution of possible problems of bias of the estimated parameters measuring relationships between determinants and investment.

Table 6 shows the result of the Chow test checking for the possibility of non-linearity between determinants and SME investment over investment distribution.

The results show that, for all the determinants of investment considered in this study, we reject the null hypothesis of non-existence of non-linearity between determinants and investment for different levels of investment. We also found, for all investment determinants considered, that the individual test of equality of estimated parameters between lower and higher quantiles of the SMEs investment distribution[6], us to confirm the existence of different relationships between determinants and investment in lower and higher quantiles. Which reinforces the idea that the level of SME`s investment influence the relationships established between determinants and investment over SMEs investment distribution.

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[6] qt5 versus qt75, qt10 versus qt90, and qt25 versus qt95.

Table 6. Investiment Determinants – Chow Test

Variables	Non-Linearities Test Global Test	Non-Linearities Test qt5 versus qt75	Non-Linearities Test qt10 versus qt90	Non-Linearities Test qt25 versus qt95
$I_{i,t-1}$ $F(1,11105)$	21.08*** (0.0000)	19.10*** (0.0000)	23.87*** (0.0000)	10.87*** (0.0000)
$SALES_{i,t-1}$ $F(1,11105)$	42.17*** (0.0000)	23.10*** (0.0000)	41.90*** (0.0000)	43.85*** (0.0000)
$CF_{i,t}$ $F(1,11105)$	17.56*** (0.0000)	15.99*** (0.0000)	17.12*** (0.0000)	17.84*** (0.0000)
$LEV_{i,t-1}$ $F(1,11105)$	25.09*** (0.0000)	21.31*** (0.0000)	24.95*** (0.0000)	25.61*** (0.0000)
$AGE_{i,t-1}$ $F(1,11105)$	38.90*** (0.0000)	42.90*** (0.0000)	39.45*** (0.0000)	25.10*** (0.0000)
$GO_{i,t-1}$ $F(1,11105)$	44.76*** (0.0000)	36.79*** (0.0000)	35.14*** (0.00000)	46.10*** (0.0000)
IR_{t} $F(1,11105)$	18.11*** (0.0000)	17.81*** (0.0000)	19.77*** (0.0000)	14.30*** (0.0000)
GNP_{t} $F(1,11105)$	16.24*** (0.0000)	12.89*** (0.0000)	17.55*** (0.0000)	18.06*** (0.0000)

Notes: 1. Probabilities in parenthesis. 2. ***Statistical significance at 1% level

5. Discussion of the results

According to Neoclassical Theory, firms' investment decisions are independent of their financial structure, and so cash flow and debt are irrelevant in explaining investment decisions, emphasizing sales as the central variable of investment.

As can be observed in Figure 1, sales have a special influence on SME investment, but only for high levels of investment, as they are a restrictive determinant of investment for low levels of investment.

This empirical evidence lets us corroborate the previously formulated hypothesis H1, since sales are of greater relative importance for investment in SMEs with high levels of investment than for SMEs with low levels of investment. The difference identified is re-inforced by the Chow test, which lets us conclude there are significant non-linearities in the relationship between sales and investment over the distribution of SME investment.

The empirical evidence obtained suggests that the assumptions of Neoclassical Theory (Hall, Jorgenson 1967, 1971; Chirinko 1993), that firms adjust their investment as a function of sales, are only corroborated by the empirical evidence found here when SMEs have high levels of investment. Therefore, the empirical evidence obtained does not corroborate the assumptions of Neoclassical Theory when SMEs have low and moderate levels of investment. Contrary to what is stated by Eisner (1963) and Chirinko (1993), in the SME context, sales are not statistically predominant over other possible determinants in explaining investment. Besides, the empirical evidence only corrobo-

rates that obtained by McConnell and Servaes (1995), Lang *et al.* (1996), Aivazian *et al.* (2005) and Serrasqueiro *et al.* (2008), evidence obtained in the context of large firms, when SMEs have high levels of investment.

The empirical evidence suggests that firms investing less do not adjust their level of investment as a function of sales, probably due to their reluctance to increase investment in market conditions which may be particularly adverse. For SMEs with high investment levels, possibly favourable market conditions may contribute to SMEs adjusting investment as a function of sales, aiming to increase their share of the market. It is also important to mention that the strategy of adjusting investment in SMEs with high levels of investment, as a function of sales, could be appropriate, since sales are a positive determinant of SME survival, so allowing them to conciliate strategies of survival with strategies of diversification.

Figure 2 presents the relationship between cash flow and investment over investment distribution.
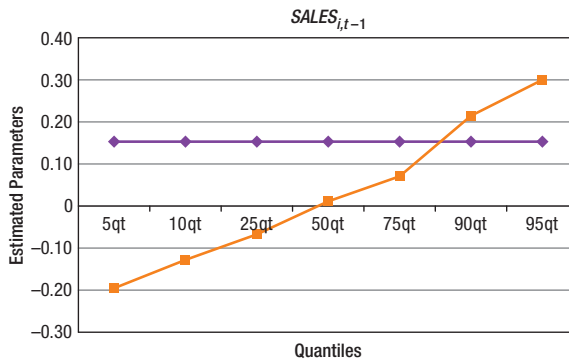
Fig. 1. Estimated parameters of relationship between $I_{i,t}$ and $SALES_{i,t-1}$
Notes: 1. The linear relationship represents OLS regression.
2. The non-linear relationship represents quantile regressions
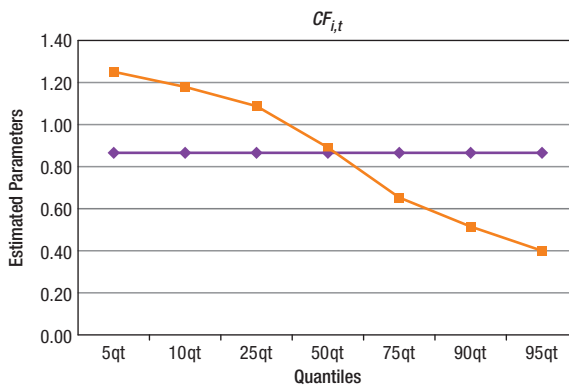
Fig. 2. Estimated parameters of relationship between $I_{i,t}$ and $CF_{i,t}$
Notes: 1. The linear relationship represents OLS regression.
2. The non-linear relationship represents quantile regressions

The relationship between cash flow and investment is positive and statistically significant over all investment distribution. However, as observed in the figure presented above, that influence is greater when our subject of analysis is SMEs with low levels of investment. The result of the Chow test shows there are significant non-linearities between cash flow and investment over investment distribution. Based on the results obtained, we can consider the previously formulated hypothesis H2 as valid, since cash flow is of greater relative importance for increased investment in SMEs with low levels of investment than in SMEs with high levels of investment.

Firstly, the fact that cash flow is a determinant stimulating SME investment lets us corroborate the assumptions of Free Cash Flow Theory (Fazzari *et al.* 1988; Fazzari, Petersen 1993), since investment is also dependent on firms' endogenous factors, and not only influenced by exogenous factors, as forecast by Neoclassical Theory.

Secondly, the fact there is a positive and statistically significant relationship between cash flow and investment, over the whole distribution of SME investment, shows the particular importance of cash flow in financing SME investment, corroborating the arguments of Gertler and Gilchrist (1994), Petersen and Rajan (1995) and Vermeulen (2002), as well as the empirical evidence obtained by Fazzari *et al.* (1988), Hoshi *et al.* (1991), Fazzari and Petersen (1993), Hubbard *et al.* (1995), Kaplan and Zingales (1997, 2000), Cleary (1999), Vermeulen (2002), Mizen and Vermeulen (2004), Bond and Van Reenen (2007), Junlu *et al.* (2009) and Sun and Nobuyoshi (2009).

Thirdly, the empirical evidence suggests that in the SMEs that invest least, investment is more sensitive to variations in cash flow, that sensitivity diminishing as SMEs invest more. This being so, the empirical evidence obtained in this study could agree with the conclusions of Fazzari *et al.* (1988) and Hoshi *et al.* (1991), since naturally, low SME investment could be affected by the greater importance of problems of information asymmetry in relationships between SME owners/managers and creditors. Therefore, the empirical evidence obtained in this study is seen to corroborate the conclusions of De Jorge Moreno and Castillo (2011), that investment is influenced by the corporate governance of firms.

Fourthly, the fact that cash flow contributes to increased likelihood of SME survival also indicates the importance of cash flow in the activity of this type of firm.

Concerning the relationship identified between debt and investment in SMEs, we find a negative and statistically significant relationship except in the highest quantile of investment distribution (95th quantile). Nevertheless, as can been observed in the following Figure 3, the magnitude of the negative relationship between debt and investment diminishes as we advance along the distribution of SME investment.

The results of the Chow test show there are significant non-linearities in the relationship between debt and investment over the distribution of SME investment. Based on the empirical evidence obtained, we can consider the previously formulated hypothesis H3 as valid, since the negative relationship between debt and investment is of greater relative importance in SMEs with low levels of investment than in SMEs with high levels of investment.
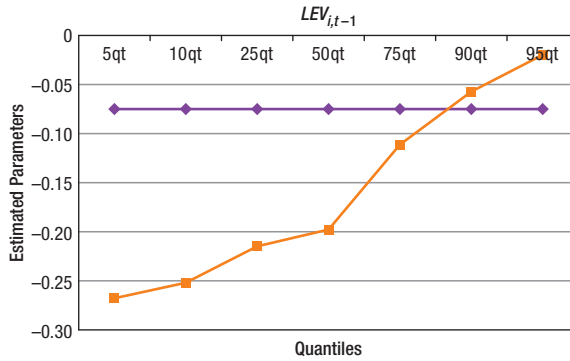
Fig. 3. Estimated parameters of relationship between $I_{i,t}$ and LEV$_{i,t-1}$
Notes: 1. The linear relationship represents OLS regression.
2. The non-linear relationship represents quantile regressions

Agency problems (Jensen, Meckling 1976; Myers 1977; Zwiebel 1996) appear to be particularly relevant in SME activity, being more important in SMEs that make least investment. Creditors may realize the particular difficulties of SMEs that invest least, making terms of access to credit difficult for them, which could mean payment of high credit costs, making it impossible to take advantage of good investment opportunities and contributing to a negative effect of debt on investment. This conclusion may be a particular problem for SMEs with low levels of investment, since debt is a positive determinant of SME survival, possibly due to its importance in situations where SMEs lack sufficient internal funding to fulfil the multiple investment opportunities arising.

For the SMEs that invest most (95th quantile) the effect of debt is not diminished investment. This may happen because creditors can recognize the good investment opportunities presented to this type of SME, and grant credit easily. The fact that debt does not mean diminished investment in SMEs when they have particularly high levels of investment contradicts the empirical evidence obtained in other studies[7] (Myers 1977; Jensen 1986; Stulz 1990; McConnell, Servaes 1995; Lang *et al.* 1996; Aivazian *et al.* 2005; Ahn *et al.* 2006; Firth *et al.* 2008; Lee, Ratti 2008). The empirical evidence appears to corroborate the conclusions of Lee and Ratti (2008), since the SMEs that invest least may find their growth particularly restricted, being smaller than the SMEs that invest most, with a consequently more negative effect of debt on investment, due to the fact that creditors do not recognize good growth opportunities in this type of SME and make terms of credit difficult.

The following Figure 4 presents the relationships identified between age and investment, over the distribution of SME investment.

The empirical evidence obtained shows that age is a restrictive determinant of investment in SMEs with low levels of investment, but a determinant promoting investment

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[7] However, these studies do not use quantile regressions as the method of estimation, and so do not consider the possibility of the relationship between debt and investment being of a different nature over investment distribution.
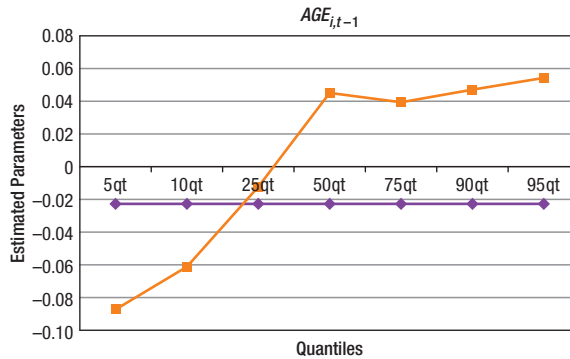
Fig. 4. Estimated parameters of relationship between $I_{i,t}$ and $AGE_{i,t-1}$
Notes: 1. The linear relationship represents OLS regression.
2. The non-linear relationship represents quantile regressions

when SMEs have high levels of investment. The results of the Chow test confirm there are significant non-linearities between age and investment over the distribution of SME investment. We can therefore conclude that the positive relationship between age and investment is of a greater magnitude in SMEs with high levels of investment than in SMEs with low levels of investment, and so we can accept the previously formulated hypothesis H4 as valid.

Age may function as a proxy for the reputation and credibility of SMEs (Diamond 1989; Ang 1991), contributing to SMEs being able to obtain external finance on more advantageous terms, which allows them to increase investment and make efficient use of their business opportunities.

It is important to mention that age is a determinant promoting SME survival. Therefore, the marginal increase in age may be fundamental in SMEs with high levels of investment, allowing significant increase in investment due to creditors recognizing their good investment opportunities together with reputation and credibility, so contributing to their survival in their operating markets.

The following Figure 5 presents the relationships between growth opportunities and investment over the distribution of SME investment.

Growth opportunities are found to be a restrictive determinant of investment in SMEs with low levels of investment, but a determinant promoting SME investment when they have high levels of investment. The results of the Chow test show there are significant non-linearities between growth opportunities and investment over the distribution of SME investment. We can therefore consider the previously formulated hypothesis H5 as valid, since growth opportunities are of greater relative importance for increased investment in SMEs with high levels of investment than for SMEs with low levels of investment.

Growth opportunities seem to be particularly relevant for increased investment in SMEs with high levels of investment, possibly due to creditors recognizing good business opportunities in this type of firm, diminishing the information asymmetry in relationships
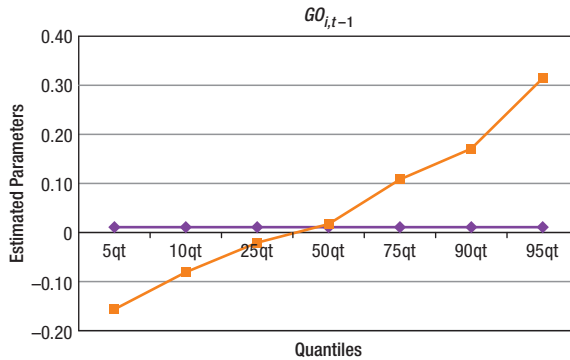
Fig. 5. Estimated parameters of relationship between $I_{i,t}$ and $GO_{i,t-1}$
Notes: 1. The linear relationship represents OLS regression.
2. The non-linear relationship represents quantile regressions

formed between owners/managers of these firms and creditors. The empirical evidence obtained corroborates partially the conclusions of Carpenter and Guariglia (2008), as well as the empirical evidence obtained in other studies[8] (Fazzari *et al.* 1988; Ascioglu *et al.* 2008; Carpenter, Guariglia 2008; Junlu *et al.* 2009; Sun, Nobuyoshi 2009), since growth opportunities are only a positive determinant of investment in SMEs with high levels of investment, being a restrictive determinant of investment when SMEs have low levels of investment. Indeed, creditors may interpret low investment as a sign of business difficulties, and so make credit terms difficult, as a consequence of attributing a high business risk to growth opportunities in this type of SME.

Figure 6 presents the relationships formed between interest rate and investment over the distribution of SME investment.

A negative relationship is found between interest rate and investment over the distribution of SME investment. However, that negative relationship diminishes in magnitude and statistical significance, the relationship becoming practically nil and without statistical significance when SMEs have high levels of investment (90th and 95th quantiles). The results of the Chow test confirm the existence of significant non-linearities in relationships between interest rate and investment over the distribution of SME investment. The previously formulated hypothesis H6 can therefore be considered valid, since the negative relationship between interest rate and investment is of a greater magnitude when SMEs have low levels of investment than when they have high levels of investment.

According to the conclusions of Bernanke and Gertler (1995) and Gilchrist *et al.* (2005), interest rates are found to influence firm investment in general, and that of SMEs in particular. SMEs in general being particularly affected by problems of information

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[8] However, these studies do not use quantile regressions as the method of estimation, and so do not test for possible non-linearities in the relationships formed between growth opportunities and investment over the distribution of investment.
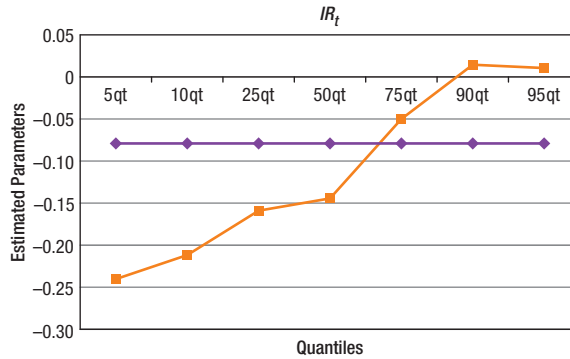
Fig. 6. Estimated parameters of relationship between $I_{i,t}$ and IR_t
Notes: 1. The linear relationship represents OLS regression.
2. The non-linear relationship represents quantile regressions

asymmetry in the relationships they form with creditors, those problems seem to affect particularly SMEs with low and moderate levels of investment. When SMEs, through high investment, give signs to the market of the capacity to survive and good future growth, creditors, recoginizing those characteristics, may make terms of credit easier, compared to the case of SMEs with low and moderate levels of investment. The empirical evidence obtained in this study seems to corroborate the arguments of Ghosh and Ghosh (2006), since interest rates appear to harm essentially SMEs with low levels of investment and consequently greater information asymmetry associated with the relationships formed with creditors. Higher interest rates may jeopardize particularly the survival of firms with low and moderate levels of investment, since they are seen to be a restrictive determinant of SME survival.

Figure 7 presents the relationships formed between GNP and investment over the distribution of SME investment.
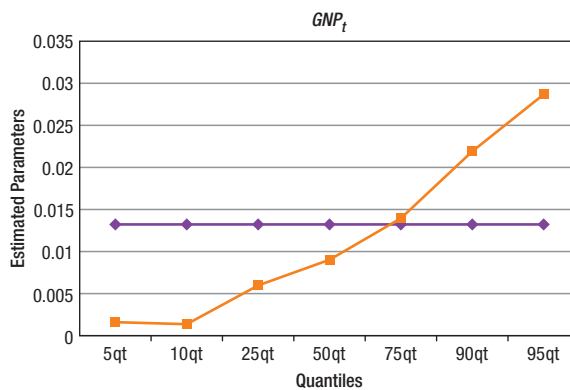

Fig. 7. Estimated parameters of relationship between $I_{i,t}$ and GNP_t
Notes: 1. The linear relationship represents OLS regression.
2. The non-linear relationship represents quantile regressions

The empirical evidence obtained allows us to conclude that GNP is a determinant stimulating investment in SMEs when they have moderate and high levels of investment, but is neither a positive nor restrictive factor of investment in SMEs when they have low levels of investment. We also find that the magnitude of the impact of GNP on investment is greater, the greater the investment. The result of the Chow test shows there are significant non-linearities in the relationships formed between GNP and investment over the distribution of SME investment. We can therefore accept as valid the previously formulated hypothesis H7, since GNP is of greater relative importance for increased investment in SMEs with high levels of investment than for increased investment in SMEs with low levels of investment.

The results confirm that changes in the economic climate in general (Kildienė *et al.* 2011; Valackienė, Virbickaitė 2011), and in GNP in particular, have an effect on SME activity, especially when firms have moderate and high levels of investment, corroborating in these circumstances what is stated by Bernanke and Gertler (1989) and Bernanke *et al.* (1996)., Gertler and Gilchrist (1994), Oliner and Rudebusch (1996) and Vermeulen (2002). However, that positive effect appears to be particularly relevant when SMEs have moderate and high levels of investment, suggesting that the marginal effect could be more relevant in SMEs with more investment, and consequently greater growth, than in SMEs with lower levels, and so the latter may not take advantage of the opportunities conferred by economic growth due to the particular financial difficulties they may be facing. GNP is also found to be a determinant promoting SME survival. This result combined with the effect of GNP on investment in SMEs with moderate and high levels of investment gives increased importance to a favourable economic climate for the activity of this type of SME.

Finally, we also find significant non-linearities in the relationships formed between investment in the present period and investment in the previous period over the distribution of SME investment. The results of the Chow test confirm that situation. The relationships between investment in the present period and investment in the previous period are presented in Figure 8.
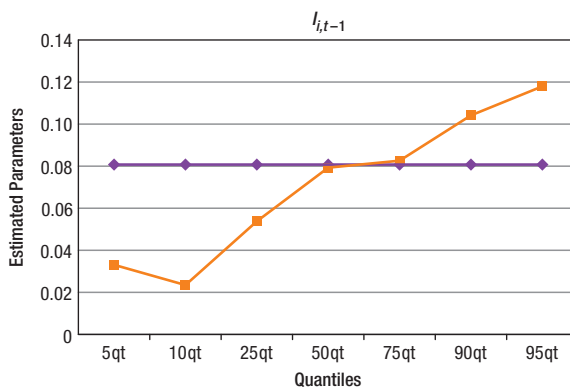

Fig. 8. Estimated parameters of relationship between $I_{i,t}$ and $I_{i,t-1}$
Notes: 1. The linear relationship represents OLS regression.
2. The non-linear relationship represents quantile regressions

The fact that investment is persistent only when SMEs have moderate and high levels of investment indicates that investment is only of a continuous nature over time when SMEs do not have low levels of investment. When SMEs have low levels of investment, the particular difficulties borne by firms may mean occasional, rather than continuous investment, which does not allow consolidation in their markets of operation. This aspect is all the more important, due to the fact of investment being a determinant promoting SME survival. Therefore, non-continuous investment in SMEs with low levels of investment may mean diminished likelihood of this type of SME surviving.

6. Conclusion and implications

Based on a sample of 1845 SMEs, and using the two-step method proposed by Heckman (1979) in estimation, we investigate whether the relationships between determinants and investment are of the same nature over the distribution of SME investment. The multiple empirical evidence obtained indicates there are significant non-linearities between determinants and investment over the distribution of SME investment.

Firstly, sales are found to be a determinant promoting investment in SMEs when they have high levels of investment, but are a restrictive determinant of investment when SMEs have low levels of investment. This result shows that one of the assumptions of Neoclassical Theory, namely that of firms adjusting investment as a function of sales, is only applicable in the case of SMEs with high levels of investment.

Secondly, cash flow is a determinant promoting investment over all the distribuion of SME investment. This result contradicts the assumptions of Neoclassical Theory, corroborating those of Free Cash Flow Theory, since SME investment is not only dependent on exogenous determinants, firms' endogenous determinants being very relevant in explaining SME investment. In addition, we find the relative importance of cash flow in explaining investment is greater when SMEs have low levels of investment than when investment levels are high. We can therefore conclude that Free Cash Flow Theory is particularly applicable in situations where SMEs have low levels of investment, i.e., when they may be particularly restricted in financing their investment opportunities.

Thirdly, debt is a restrictive determinant of SME investment, except when investment levels are particularly high. Creditors may make access to debt difficult for SMEs with low and moderate levels of investment, since they do not recognize good business opportunities in this type of SME. We can conclude that Agency Theory, namely concerning agency problems between owners/managers and creditors, is particularly applicable in the investment decisions of SMEs when they have low and moderate levels of investment.

Fourthly, age and growth opportunities are positive determinants of investment in SMEs with high levels of investment, but determinants restricting investment when investment levels are low. For one thing, age appears to serve as a proxy for reputation and credibility in SMES with high levels of investment, and for another, creditors seem to recognize good opportunities for future business in SMEs with high levels of investment. This empirical evidence suggests that age and growth opportunities contribute

to reducing the information asymmetry in relationships formed between SME owners/ managers and creditors when these firms have high levels of investment.

Fifthly, macroeconomic variables are relevant in explaining SME investment. Interest rates are a restrictive determinant of SME investment, particularly when they have low and moderate levels of investment. Higher interest rates may affect particularly SMEs with investment difficulties, since it is these SMEs that are more restricted financially. As for GNP, it is a determinant stimulating investment in SMEs when they have moderate and high levels of investment. The marginal effect of the favourable economic climate seems to be particularly relevant in explaining SME investment in situations where investment is moderate and high.

Sixth, persistence of investment over time is seen in situations where SMEs have moderate and high levels of investment, but not when investment levels are low. This result shows that SMEs with low levels of investment may have particular difficulty in making investments of a continuous nature, this contributing to a greater likelihood of bankruptcy.

To summarize, the multiple empirical evidence obtained in this study shows that the applicability of various theories for explaining firm investment depends particularly on the level of SME investment. Neoclassical Theory is particularly applied I high levels of investment, and Free Cash-Flow Theory and Agency Theory are particularly applied in low levels of investment.

The findings allow us to suggest important measures for economic policy in general, and industrial policy in particular. Given the particular importance of problems of information asymmetry associated with relationships between SME owners/managers and creditors, we suggest the creation of special lines of credit for SMEs with low levels of investment, to allow them to survive in their markets of operation. Increased investment seems to be an important condition for creditors to recognize good possibilities for future business, and so facilitate terms of credit. This may be particularly important in situations where internal finance is insufficient to fund the multiple investment opportunities that may arise for SMEs. For SMEs with high levels of investment, given the importance of sales and GNP as determinants promoting investment, we suggest policies to incentivize increased sales at times of economic recession, with the objective of allowing these firms to direct their investment towards diversification of activities.

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