Title: The financing constraints hypothesis and inventory investment decisions of firms.

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ABSTRACT

In the last two decades there was an increasing interest of researchers on the impact of financing constraints on investment expenses of firms. However, the vast empirical literature that followed focused, mainly, on fixed investment and less attention has been given to the effect of financing constraints on inventory investment decisions of firms (Hubbard, 1998).

The present paper aims to shed some light on this relationship by testing the financing constraints hypothesis on inventory investment, for a sample of Portuguese manufacturing firms. The findings obtained appear to support the hypothesis that some types of firms face financing constraints, especially those that show a weak balance sheet position (as measured by the interest coverage ratio). These findings complement previous work by Carpenter et al. (1998,1994) and Guariglia (1999). Moreover, this paper, also, contributes to the literature by including in the analysis the effect of business risk in conjunction with the hypothesis of financing constraints.

In what concerns policy implications derived from the findings of this paper, an issue that can be highlighted is its relation with the literature on business cycle fluctuations. Indeed, it is possible to say that this paper adds evidence about the existence of a “balance sheet channel” in the transmission mechanism for monetary policy, as suggested by Gertler and Gilchrist (1994) and Bernanke and Gertler (1995).

Key-words: Inventory Investment; Financing constraints; Information problems, Balance sheet position, Business risk

JEL codes: D92; E22; G31

1 INTRODUCTION

The empirical literature on the determinants of investment decisions of firms has gained a renewed interest since the publication of Fazzari et al.'s paper in 1988. In fact, these authors showed that, at least for some kinds of firms (e. g. small, young and low retention firms), investment plans could be affected by the level of internal funds available, which contradicts the predictions of the investment models that assume perfect capital markets (e.g. Q-model of Tobin (1969)). In these models it is assumed that firms can obtain all the financing they need to implement investment projects, providing that the expected marginal return exceeds the cost of capital.

The empirical results obtained by Fazzari et al. (1988), and the vast empirical literature that followed[1], lend empirical support to the theoretical developments that emerged since the 1970s on the effects of information problems in financial markets, as the works of Jensen and Meckling (1976) on agency theory, and Stiglitz and Weiss (1981) and Myers and Majluf (1984) on asymmetric information problems had demonstrated.

This new theoretical body emphasized the fact that the existence of information problems in financial markets could create a wedge between the cost of internal and external finance (Carpenter et al., 1994). In other words, firms can face financing constraints. One can say that a firm faces financing constraints when it cannot obtain all the funds it needs, regardless of their opportunity cost. This fact can lead to a hierarchy of finance, as a result of the different costs of the sources of financing (Myers, 1984). Therefore, if the cost of external finance for a firm vary inversely with its net worth, the retention of profits over the years can have a direct impact on investment decisions of firms since it strengthens a firm's net worth and, as a consequence, it is likely that creditors are more able to lend funds to the firm, which is seen as a less risky one. In this context, it would be expected that firms might increase their investment expenses.

The empirical literature has been concentrated, mostly, on the relationship between business fixed investment and internal funds (or cash flows), and less attention has been given to the impact of financing constraints on inventory investment decisions of firms. In fact, to our best knowledge, only a small number of papers (Tsoulakas, 2006, Guariglia, 1999, Guariglia and Mateut, 2010, Carpenter et al., 1998, 1994,

[1] For a comprehensive review of this literature see, for example, Hubbard (1998).

Cunningham, 2004) have addressed empirically the relationship between financing constraints and inventory investment.

The present paper aims at contributing to the empirical literature by focusing on the impact of financing constraints on inventory investment for a panel of Portuguese manufacturing firms. In fact, the study of the inventory behaviour is important for several reasons. Firstly, as emphasised by Blinder and Maccini (1991: 73), «inventory movements are dominant features of business cycles». A possible explanation for this fact is that imperfections in capital markets can hinder the access of firms to external funds, leading to fluctuations in inventory investment (Carpenter et al., 1994). Secondly, as argued by Carpenter et al. (1994), inventory investment has lower adjustment costs than fixed investment. Hence, it is likely that firms prefer to reduce inventory investment first when confronted with a negative shock on internal finance than fixed investment. Therefore, an excess sensitivity of inventory investment to changes in cash flows would be expected.

An important contribution of this paper to the literature is the analysis of the impact of a firm's level of business risk together with the financing constraints hypothesis. In fact, it is shown that internally generated funds are particularly important for firms with a high level of business risk and have no impact otherwise.

The remainder of the paper is organized as follows. Section 2 presents a brief review of the literature on financing constraints and inventory investment. Section 3 describes the research methodology followed, namely, the construction of the sample, the variables used, the criterion chosen to group firms, and the econometric specification adopted. Section 4 presents the regression results obtained and examines its robustness. In Section 5 a discussion of the results is presented. Finally, Section 6 draws the main conclusions of the paper.

2 LITERATURE REVIEW

The empirical literature on the relationship between financing constraints and inventory investment of firms as documented the importance of internal funds. For example, Brown and Haegler (2004) have presented a model of optimal inventory investment focusing on the role played by financing constraints. They showed that «when a firm faces financial restrictions, it may be unable to produce as much as it has sold after a poor demand realisation». On the contrary, «when inventories are below their optimum level, a firm's production may exceed sales following a strong demand realisation» (Brown and Haegler, 2004). This behaviour does not rely on the presence of serially correlated exogenous shocks. Therefore, it is possible that inventory investment might play a significant role in the occurrence of business cycles through its potential to amplify exogenous shocks (Brown and Haegler, 2004).

Carpenter et al. (1994) emphasise that, when there are large fluctuations in cash flow over the business cycle, firms tend to make large adjustments to inventories, given that it is a liquid reversible investment with low adjustment costs, which allows offsetting shocks to cash flow. Therefore, it would be expected that the presence of financing constraints induce a positive correlation between inventory investment and cash flows (Carpenter et al., 1994). In their study for a panel of US manufacturing firms, they found that firms absorb shocks to internal funds through changes in inventory investment. Moreover, they concluded that, although this effect was stronger for small firms, even inventory investment of large firms is affected by fluctuations on cash flows. This result was corroborated by Carpenter et al. (1998), where it was found that three different financial variables (stock of cash, coverage ratio and cash flow) have an impact on inventory investment. However, as the authors stressed, «cash flow is the most successful in explaining the facts about inventory investment across firm size and across different time periods». Also Gertler and Gilchrist (1994) studied the impact of financial factors on inventory investment and concluded that the «coverage ratio is a highly significant predictor for small firm inventory behaviour but not for large firms».

Guariglia and Mateut (2010), using a panel of UK firms, analysed the impact of a firms' financial health on the inventory accumulation of firms more and less likely to face financial constraints, on the context of global engagement. They found that smaller, younger, more risky firms, and firms that are not globally engaged show higher sensitivities of inventory investment to financial variables. Moreover, when they distinguish among purely domestic financially constrained firms, globally engaged

financially constrained firms, and financially unconstrained firms, they found that the effects of financial health are statistically significant only for the former group, implying that global engagement contributes to firms alleviate financing constraints.

In another study by Guariglia and Mateut (2006), it was found that «when trade credit is added as a regressor to an inventory investment equation which already includes the coverage ratio, it generally affects the inventory investment at both financially constrained and unconstrained firms. Yet, the coverage ratio variable remains significant for the former firms». Additionally, it was found that «when the effect of the coverage ratio at financially constrained firms is further differentiated across constrained firms making a high and low use of trade credit, the coverage ratio only affects inventory investment at the latter firms». Those authors suggested, therefore, that «using trade credit can help firms to offset liquidity problems».

Guariglia (1999), using a panel of UK manufacturing firms, also found a strong relationship between internal funds and inventory investment, stronger for firms with weak balance sheets, during periods of recession and tight monetary policy. This link has appeared to be particularly important for work-in-process and raw material inventories that are characterized by low adjustment and liquidation costs (Guariglia, 1999).

Finally, Tsoukalas (2006) developed another type of test to assess the impact of internal funds on inventory investment. This test highlights the consequences of ignoring parameter heterogeneity for the behaviour of inventories. Therefore, using the mean group estimator that preserves parameter heterogeneity, it was shown that small firms' inventory responses to cash flow shocks are significantly stronger relative to large firms than previously recognized (Tsoukalas, 2006).

3 RESEARCH METHODOLOGY

3.1 Sample and variables

The study undertaken was based on a panel of firms belonging to the Portuguese manufacturing sector, for a period between 1990 and 2000. The data was provided by the Bank of Portugal Central Balance-Sheet Department. This department gathers economic and financial information for a sample of non-financial corporations.

In order to be included in the sample firms had to meet several criteria[2]. Firstly, only private firms, belonging to the manufacturing sector, with at least 20 employees, were considered. Secondly, only companies that presented values for all variables and for every year of the period considered were selected. Finally, outlier values were deleted from the sample. These resulted in a balanced panel data set comprising 603 firms.

As far as the variables used in the regression equation were concerned, they were calculated from the firms' accounting information and comprised the following. Inventory (I) which includes raw-materials and finished goods. Total assets (TA) of the firm. Sales (S) represented by the firm's total turnover. Cash flow (CF) corresponding to the sum of profits and depreciation allowances. Stock of liquid assets (LA) given by the sum of cash, deposits and marketable securities. The final variable used was interest-bearing shot-term liabilities of the firm (STD).

3.2 Criterion to classify firms

An empirical issue arising in this type of studies (that wants to measure the impact of financing constraints on investment decisions of firms) is how to identify the degree of financing constraints that a firm faces.

In this study the interest coverage ratio[3] was used to group firms according to its degree of financial restrictions. According to Guariglia (1999: 44) «the coverage ratio can be thought of as a proxy for the premium that firms have to pay for external finance. In particular, one can think of a firm's cost of external funds being a decreasing

[2] It should be noticed that the identification of each firm was not known to the authors in order to meet statistical confidentiality. Firms were, only, identified by a number.
[3] This was computed as the ratio between operating income and interest expenses of a firm.

function of the coverage ratio». On the other hand, Mills et al. (1995) justify the use of this criterion on the grounds that one of the uses of the operating earnings of a firm is to service debt. Hence, higher leverage of a firm means that a higher proportion of operating earnings are used to pay both interest and principal. Therefore, if for some reason, there is a decline in a firm's operating earnings, it is likely that it will face difficulties in meeting its obligations which could lead to a cut in its level of investment.

Accordingly, the sample was divided into three groups of firms: (a) the low coverage ratio firms, including those with an interest coverage ratio less than one (therefore, firms severely financially constrained); (b) the medium coverage ratio firms, including those with a coverage ratio larger than one but less than five (therefore, firms facing some degree of financing constraints); and (c) the high coverage ratio firms, including those with a coverage ratio larger than five (therefore, firms not financially constrained). Table I shows the descriptive statistics.

TABLE I – Descriptive statistics for low, medium and high interest coverage ratio firms.

Variables	*Low coverage ratio firms*		*Medium coverage ratio firms*		*High coverage ratio firms*	
	Median	S.D.	Median	S.D.	Median	S.D.
ΔI/TA	0.006	0.087	0.010	0.067	0.006	0.069
I/TA	0.214	0.137	0.183	0.131	0.151	0.128
S/TA	0.945	0.602	1.176	0.599	1.325	0.735
CF/TA	0.053	0.087	0.081	0.064	0.123	0.091
LA/TA	0.018	0.061	0.027	0.072	0.045	0.106
STD/TA	0.086	0.126	0.098	0.119	0.028	0.092
IC	0.681	234.6	1.559	4.731	5.919	924.9

From the table, it can be seen that firms with low interest coverage ratios have, in relation with those with high coverage ones: (a) an inventory-total assets ratio 40% higher; (b) a cash flow- and liquid assets-total assets ratios almost 60% lower; and (c) a short-term debt-sales ratio three times higher. These figures may suggest that financial factors have a larger impact on investment inventory for firms with low interest coverage ratios.

3.3 Econometric specification

To analyse the impact of financing constraints on inventory investment decisions of a sample of Portuguese manufacturing firms a modified version of Lovell's model (1961) was used. In fact, the model was extended to include financial variables that are a proxy to the financial position of a firm. Therefore, the specification adopted for the econometric inventory investment equation was:

$$\Delta I_{it} = \alpha_i + \alpha_t + \beta_1 \Delta I_{it-1} + \beta_2 I_{it-1} + \beta_3 S_{it} + \beta_4 S_{it-1} + \beta_5 CF_{it} + \beta_6 LA_{it-1} + \beta_7 STD_{it-1} + \varepsilon_{it}$$

Equation 1

All variables were divided by total assets (TA) to address the problem of heteroscedasticity. α_i corresponds to the firm effect, α_t to the time effect and ε_{it} is the error term. The subscripts *i* and *t* correspond to firm and time, respectively.

The first four explanatory variables aim at capturing the stock-adjustment behaviour of firms with respect to inventories, following the rationale of Lovell's model (1961). In fact, there is a target inventory level, so firms try to adjust their inventory orders to that optimal level. Previous-period inventories and previous and contemporaneous sales are supposed to play an important role in inventory investment (Iturriaga, 2000).

In the context of the study undertaken, this provides a method to control for investment opportunities, by isolating the effect of cash flows as a sole financial issue, and not as a proxy for some omitted variable.

The main focus of attention when analysing regression results is the coefficient on the cash flow (CF) variable. If internal funds are an important determinant of investment decisions of firms, the estimated coefficient of this variable should be statistically significant and have a positive sign. Moreover, it would, also, be expected that its value would be higher for firms facing higher financing constraints (such as low coverage ratio firms). In fact, as emphasised by Carpenter et al. (1998: 513) «large fluctuations in cash flow over the business cycle may cause firms to make large adjustments to inventories […] to partially offset shocks to cash flow».

To reflect more directly the balance sheet effects on investment decisions, two stock variables were also included, as suggested by Carpenter et al. (1994). One is the lagged liquid assets (LA) variable, which reflects the fact that firms can use their accumulated stock of cash to finance the acquisition of inventories, in the presence of financing constraints. Therefore, a positive relationship between inventory investment and liquidity would be expected. The other variable is lagged short-term debt (STD) reflecting the impact of leverage on the decisions of firms. In this case, a negative relationship would be expected.

4 ESTIMATION RESULTS

4.1 Main results

Given the possible endogeneity of the regressors that may occur as a result of the dynamic nature of the econometric specification, the Generalized Method of Moments (GMM) estimation procedure was adopted, as proposed by Arellano and Bond (1991). All equations were estimated in first differences to eliminate the firm-specific time-invariant effects. Lags of the dependent and explanatory variables were used as instruments. Table II shows regression results.

TABLE II – Regression results for firms classified according to their interest coverage ratio.

Independent Variables	*Low coverage ratio firms*	*Medium coverage ratio firms*	*High coverage ratio firms*
ΔI_{it-1}	0.230*	0.164*	0.160*
	(0.015)	(0.023)	(0.024)
I_{it-1}	-1.204*	-1.034*	-1.158*
	(0.047)	(0.032)	(0.042)
S_{it}	-0.137*	-0.082*	-0.058*
	(0.013)	(0.007)	(0.007)
S_{it-1}	0.079*	0.057*	0.030*
	(0.009)	(0.008)	(0.006)
CF_{it}	0.171*	0.096**	0.009
	(0.029)	(0.052)	(0.023)
LA_{it-1}	0.072***	-0.020	-0.015
	(0.042)	(0.028)	(0.022)
STD_{it-1}	-0.046**	0.027	-0.058*
	(0.023)	(0.018)	(0.018)
Sargan test	0.334	0.042	0.076
Nº Obs.	1272	2272	1280

Note: Dependent variable, ΔI_{it}. All variables divided by total assets (TA) to account for heteroscedasticity. The GMM first-differences estimation procedure was adopted. Lagged values of all right-side variables were used as instruments. Time dummies were included in the regressions. Standard errors are in parenthesis. *, ** and *** indicate significance at 1%, 5% and 10% level, respectively.

The regression results obtained can be summarised as follows. Firstly, the negative signs of the coefficients estimated for the variable inventory stocks are in accordance with what would be expected in a context of stock adjustment behaviour by firms. Secondly, the negative sign of the coefficient of contemporaneous sales suggests the presence of a buffer-stock effect and the positive sign of the lagged sales is consistent with a positive accelerator effect of inventories, as pointed out by Carpenter et al (1994). In fact, the empirical results are consistent with this view and show a significant and negative influence of the previous inventories and present sales, and a less significant negative influence of previous sales, as in the case of Iturriaga (2009).

Finally, the results obtained seem to indicate that firms facing higher financing constraints tend to rely more on internal funds to finance their inventory investment, as was expected. On one hand, the estimated coefficient of the cash flow variable is higher for low coverage firms than for medium- and high coverage ones. Moreover, for high coverage ratio firms the cash flow coefficient has no statistical significance. On the other hand, the liquid assets variable is only statistically different from zero for low coverage ratio firms.

4.2 Robustness check

Although the results of the previous sub-section seem, clearly, to suggest that inventory investment of firms can be affected by the existence of financing constraints, this relationship was further investigated by analysing whether these results could be influenced by: (a) the estimation technique used; (b) some firm characteristic; and (c) phase of business cycle.

4.2.1 Alternative estimation technique

The first method used to check the robustness of the results obtained was the adoption of a different estimation technique. In fact, the instrumental variables estimation procedure was applied to the following econometric investment equation:

$$\Delta I_{it} = \textit{Intercept} + \beta_1 I_{it-1} + \beta_2 S_{it} + \beta_3 S_{it-1} + \beta_4 CF_{it} + \beta_5 LA_{it-1} + \beta_6 STD_{it-1} + \alpha_i + \alpha_t + \varepsilon_{it}$$

Equation 2

Once again, all variables were divided by total assets (TA) to address the problem of heteroscedasticity. The variables have the same meaning as previously.

The regression results shown in Table III support, again, the hypothesis that inventory investment of more financially constrained firms is more depend on the existence of adequate cash flows than of financially healthier firms. In fact, only for low interest coverage ratio firms the coefficient of the cash flow variable is properly signed and has statistical significance.

TABLE III – Regression results for firms classified according to their interest coverage ratio using instrumental variables estimation technique.

Independent Variables	*Low coverage ratio firms*	*Medium coverage ratio firms*	*High coverage ratio firms*
Intercept	0.025*	0.017*	0.024*
	(0.006)	(0.004)	(0.005)
I_{it-1}	-0.063*	-0.027*	-0.044*
	(0.015)	(0.010)	(0.013)
S_{it}	-0.129*	-0.077*	-0.060*
	(0.008)	(0.004)	(0.005)
S_{it-1}	0.116*	0.074*	0.058*
	(0.008)	(0.004)	(0.004)
CF_{it}	0.149*	-0.002	-0.028
	(0.023)	(0.020)	(0.018)
LA_{it-1}	0.009	0.021	0.004
	(0.034)	(0.017)	(0.016)
STD_{it-1}	-0.016	0.020**	-0.024
	(0.017)	(0.010)	(0.018)
Adjusted R^2	0.18	0.12	0.15
Nº Obs.	1590	2840	1600

Note: Dependent variable, ΔI_{it}. All variables divided by total assets (TA) to account for heteroscedasticity. The instrumental variables estimation technique was used. Lagged values of all right-side variables were used as instruments. Time dummies were included in the regressions. Standard errors are in parenthesis. *, ** and *** indicate significance at 1%, 5% and 10% level, respectively.

4.2.2 Firm characteristics

Regarding the impact of some characteristic of the firm on the results, three features were analysed: the impact of size, age and degree of business risk of the firm. Therefore, the initial regression equation (Equation 1) was modified in order to include a dummy variable (DV) reflecting the characteristic of the firm being analysed. This dummy variable is interacted with the variable cash flow, and the econometric specification becomes[4]:

$$\Delta I_{it} = \alpha_i + \alpha_t + \beta_1 \Delta I_{it-1} + \beta_2 I_{it-1} + \beta_3 S_{it} + \beta_4 S_{it-1} + \beta_5 CF_{it} + \beta_6 CF_{it}*DV + \beta_7 LA_{it-1} + \beta_8 STD_{it-1} + \varepsilon_{it}$$

Equation 3

A firm's size was the first characteristic considered. The hypothesis under test was whether the impact of cash flows is higher for small firms than for larger ones[5]. Actually, some authors (e.g. Gelos and Werner (2002), Chow and Fung (2000), Kim (1999), Schiantarelli (1996), Gilchrist and Himmelberg (1995)) argue that larger firms would be less affected by financing constraints than small ones. Several reasons may justify this argument. Firstly, larger companies have an easier access to capital

[4] Again, the GMM estimation procedure was adopted.
[5] Size was measured by sales value.

markets, due to the possibility of using the firm's assets as collateral. Secondly, larger companies can use more different sources of funds than smaller companies, which allow large companies to reduce the risk of financing. Finally, it is likely that small firms suffer more from the idiosyncratic risk.

Table IV shows regression results when the cash flow variable is interacted with a size dummy variable (SF). The dummy variable is equal to one if it is a small firm and zero otherwise.

TABLE IV – Regression results for firms classified according to their interest coverage ratio when the regressor in the cash flow variable is interacted with a size (*SF*) dummy variable.

Independent Variables	*Low coverage ratio firms*	*Medium coverage ratio firms*	*High coverage ratio firms*
ΔI_{it-1}	0.229*	0.158*	0.158*
	(0.016)	(0.023)	(0.024)
I_{it-1}	-1.199*	-1.024*	-1.158*
	(0.047)	(0.031)	(0.043)
S_{it}	-0.136*	-0.081*	-0.058*
	(0.013)	(0.007)	(0.007)
S_{it-1}	0.080*	0.056*	0.030*
	(0.009)	(0.008)	(0.006)
$CF_{it}* SF_i$	0.162*	0.021	-0.042***
	(0.040)	(0.035)	(0.024)
$CF_{it}*(1-SF_i)$	0.180*	0.198	0.063**
	(0.040)	(0.124)	(0.030)
LA_{it-1}	0.068***	-0.019	-0.014
	(0.042)	(0.028)	(0.022)
STD_{it-1}	-0.044**	0.023	-0.058*
	(0.023)	(0.017)	(0.019)
Sargan test	0.309	0.036	0.071
Nº Obs.	1272	2272	1280

Note: Dependent variable, ΔI_{it}. All variables divided by total assets (TA) to account for heteroscedasticity. The GMM first-differences estimation procedure was adopted. Lagged values of all right-side variables were used as instruments. Time dummies were included in the regressions. Standard errors are in parenthesis. *, ** and *** indicate significance at 1%, 5% and 10% level, respectively.

From the table, it can be seen that for low coverage ratio firms the impact of internal funds is, practically, independent of a firm's size. Actually, the coefficients of the interaction terms are very similar to the one obtained for cash flow in Table II. Therefore, one can interpret this result as a signal that for lenders what is more important is the financial status of a firm. When a firm is in financial distress[6], it is seen as a highly risky one, regardless of its size. Therefore, investment is dependent on the availability of cash flows.

[6] As would be the case for firms with an interest coverage ratio less than one.

For medium coverage ratio firms the interaction terms have no statistical significance, whereas for high coverage ones they have a marginal statistical significance, although the estimated parameter is incorrectly signed for small firms.

Age was the second feature of a firm analysed. The hypothesis under test was whether the impact of cash flows is higher for young firms than for mature ones. Actually, some authors (e.g. Kim (1999), Chirinko and Schaller (1995), and Oliner and Rudebusch (1992)) argue that these firms would be less affected by financing constraints than young firms. Two main reasons justify this rationale. Firstly, creditors have, in general, more information about mature firms, since they have been visible for a longer period of time in the market. Secondly, mature firms can establish continued relationships with creditors and suppliers based on mutual confidence, which helps alleviate information problems.

Table V shows regression results when the cash flow variable is interacted with an age dummy variable (YF). The dummy variable is equal to one if it is a young firm and zero otherwise.

TABLE V – Regression results for firms classified according to their interest coverage ratio when the regressor in the cash flow variable is interacted with an age (*YF*) dummy variable.

Independent Variables	*Low coverage ratio firms*	*Medium coverage ratio firms*	*High coverage ratio firms*
ΔI_{it-1}	0.230*	0.165*	0.157*
	(0.015)	(0.023)	(0.024)
I_{it-1}	-1.201*	-1.037*	-1.154*
	(0.047)	(0.032)	(0.042)
S_{it}	-0.138*	-0.080*	-0.058*
	(0.013)	(0.007)	(0.007)
S_{it-1}	0.079*	0.057*	0.030*
	(0.009)	(0.008)	(0.006)
$CF_{it}* YF_i$	0.228*	0.0002	-0.016
	(0.053)	(0.034)	(0.032)
$CF_{it}*(1-YF_i)$	0.139*	0.189**	0.059***
	(0.032)	(0.096)	(0.033)
LA_{it-1}	0.069***	-0.020	-0.014
	(0.042)	(0.028)	(0.022)
STD_{it-1}	-0.048**	0.027*	-0.057*
	(0.023)	(0.018)	(0.019)
Sargan test	0.330	0.040	0.085
Nº Obs.	1272	2272	1280

Note: Dependent variable, ΔI_{it}. All variables divided by total assets (TA) to account for heteroscedasticity. The GMM first-differences estimation procedure was adopted. Lagged values of all right-side variables were used as instruments. Time dummies were included in the regressions. Standard errors are in parenthesis. *, ** and *** indicate significance at 1%, 5% and 10% level, respectively.

As was expected the impact of internal funds is higher for younger firms than for mature firms, in the case of low coverage ratio firms. In fact, the coefficient estimated for young firms is sixty four per cent higher than that for mature ones. In the case of firms not so financially constrained, it is seen that cash flow has no statistical significance.

The last feature considered was the degree of business risk of a firm. The hypothesis under test was whether the impact of cash flows is higher for firms with high business risk than for low business risk firms. The reasoning here is that if one more source of risk is added to the financial risk, the adequate level of internal funds becomes even more important in order to a firm minimise the negative impact of business and financial risks, as perceived by potential lenders of investment funds.

In this study, business risky was measured as the coefficient of variation of operating income, calculated for the period under analysis (1990-2000). The reason to use this measure of risk follows from Damodaran (2001): «a firm with high operating leverage will also have higher variability in operating income than would a firm producing a similar product with low operating leverage. Others things remaining equal, the higher variance in operating income will lead to a higher beta for the firm with high operating leverage».

Table VI shows regression results when the cash flow variable is interacted with a business risk dummy variable (CVE). The dummy variable is equal to one if the firm shows a higher business risk and zero if not.

From the table, two facts can be highlighted. Firstly, the variable cash flow only has statistical significance for firms with high business risk, regardless the level of interest coverage. Secondly, for these kind of firms, the coefficient of the cash flow variable is two and a half and four and a half times higher for low coverage ratio firms than for medium- and high coverage ratio ones, respectively.

TABLE VI – Regression results for firms classified according to their interest coverage ratio when the regressor in the cash flow variable is interacted with a business risk (*CVE*) dummy variable.

Independent Variables	*Low coverage ratio firms*	*Medium coverage ratio firms*	*High coverage ratio firms*
ΔI_{it-1}	0.230*	0.164*	0.159*
	(0.015)	(0.023)	(0.024)
I_{it-1}	-1.202*	-1.031*	-1.161*
	(0.046)	(0.031)	(0.042)
S_{it}	-0.137*	-0.082*	-0.058*
	(0.013)	(0.008)	(0.007)
S_{it-1}	0.079*	0.057*	0.030*
	(0.009)	(0.008)	(0.006)
CF_{it}* CVE_i	0.171*	0.064**	0.038***
	(0.029)	(0.035)	(0.024)
CF_{it}*(1-CVE_i)	0.143	0.120	-0.058
	(0.122)	(0.130)	(0.043)
LA_{it-1}	0.070***	-0.021	-0.018
	(0.042)	(0.028)	(0.022)
STD_{it-1}	-0.046**	0.025	-0.059*
	(0.022)	(0.018)	(0.018)
Sargan test	0.334	0.042	0.068
Nº Obs.	1272	2272	1280

Note: Dependent variable, ΔI_{it}. All variables divided by total assets (TA) to account for heteroscedasticity. The GMM first-differences estimation procedure was adopted. Lagged values of all right-side variables were used as instruments. Time dummies were included in the regressions. Standard errors are in parenthesis. *, ** and *** indicate significance at 1%, 5% and 10% level, respectively.

4.2.3 Phase of business cycle

As a last robustness check of results, it was assessed whether the phase of business cycle has a differentiate impact on investment decisions of firms. That is, whether cash flow is more important in recession years than in periods of economic growth. In fact, it can be argued that negative shocks on cash flows are likely to have an enhanced impact on firms' investment decisions in periods of recession, especially for those with weaker balance sheets. Therefore, an increase in the level of generated cash flows might help this type of firms to alleviate the problems raised by the fact that lenders would be less willing to lend money to them.

Given that the firms included in the sample belong to the manufacturing sector the industrial production index was used to identify recession years (as suggested by Vermeulen, 2002). Table VII shows the evolution of this index for the period under analysis, and one can conclude that years 1992 and 1993 were recession years.

TABLE VII – Industrial Production Index for the Portuguese Manufacturing Sector.

Year	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*
Value	100.0	100.4	97.8	92.2	92.6	95.9	97.4	101.7	104.3	105.8	106.2

Source: INE – Portuguese National Institute of Statistics

Table VIII shows regression results when the cash flow variable is interacted with a business cycle dummy variable (RY). The dummy variable assumes the value of one if it is a recession year and zero otherwise.

TABLE VIII – Regression results for firms classified according to their interest coverage ratio when the regressor in the cash flow variable is interacted with a business cycle (*RY*) dummy variable.

Independent Variables	*Low coverage ratio firms*	*Medium coverage ratio firms*	*High coverage ratio firms*
ΔI_{it-1}	0.230*	0.163*	0.159*
	(0.015)	(0.023)	(0.025)
I_{it-1}	-1.210*	-1.032*	-1.158*
	(0.047)	(0.032)	(0.042)
S_{it}	-0.136*	-0.083*	-0.058*
	(0.013)	(0.007)	(0.007)
S_{it-1}	0.078*	0.057*	0.030*
	(0.008)	(0.008)	(0.006)
$CF_{it}* RY_i$	0.106**	0.079	-0.002
	(0.043)	(0.050)	(0.042)
$CF_{it}*(1-RY_i)$	0.192*	0.115***	0.013
	(0.034)	(0.063)	(0.025)
LA_{it-1}	0.072***	-0.018	-0.015
	(0.042)	(0.028)	(0.022)
STD_{it-1}	-0.050**	0.028***	-0.057*
	(0.022)	(0.018)	(0.019)
Sargan test	0.360	0.042	0.079
Nº Obs.	1272	2272	1280

Note: Dependent variable, ΔI_{it}. All variables divided by total assets (TA) to account for heteroscedasticity. The GMM first-differences estimation procedure was adopted. Lagged values of all right-side variables were used as instruments. Time dummies were included in the regressions. Standard errors are in parenthesis. *, ** and *** indicate significance at 1%, 5% and 10% level, respectively.

In the table, it can be seen that, for financially healthier firms, the level of internal funds has no impact on investment outlays, regardless of the phase of business cycle, whereas, for firms in worse financial position, cash flow has an impact on its investment decisions, for both recession and expansion years. However, contrary to what would be expected, the influence of cash flow is higher for periods of expansion than recession.

5 DISCUSSION OF RESULTS

From the results obtained in the previous section, it seems clear that financing constraints can have an impact on inventory investment decisions of firms in poor financial status (this was assessed based on the interest coverage ratio). In fact, a monotonic relationship was found between inventory investment and internal funds (for the three groups of firms considered) and that the cash flow variable has no statistical significance for high coverage ratio firms, regardless of the specification of the

regression equation or the estimation technique adopted. Therefore, these results do not corroborate the hypothesis that the relationship between investment and internal funds could be U-shaped, as predicted in the models of Cleary et al. (2007), Kasahara (2008) or Lyandres (2007).

Secondly, a firm's size does not change the impact of cash flow on inventory investment, since the magnitude of the estimated coefficient for the cash flow variable was very similar, whether a small or a large firm. In fact, it could be argued that for the latter the severity of financing constraints would be relaxed as they can use the firm's assets as collateral, hence reducing the risk for potential lenders. However, this was not the case, contrary to what has been found by Tsoulakas (2006) and Carpenter et al. (1998).

Thirdly, the influence of internal funds is higher for young firms than for mature firms. This result may give support to the pecking order hypothesis (Myers, 1984) on the capital structure literature. In fact, for firms less known in the market it would be preferred to finance investments with internal funds in order to avoid forgoing valuable investment opportunities.

Fourthly, an important contribution of this paper was the analysis of the impact of business risk simultaneously with the financing constraints hypothesis. The result obtained in this regard was clear: for firms with more uncertain and volatile operating earnings, internal funds are important, regardless of its financial position. Obviously, they are even more important for firms in a weaker financial position.

Finally, it was found that cash flows have no impact on investment of financially healthier firms, regardless of the phase of the business cycle, but affect investment of firms in poor financial situation, both in periods of recession and economic expansion. However, it was, also, found that for these firms cash flow is more important in years of expansion than recession. This result differs from the one obtained by Guariglia (1999), who found that cash flow has an impact of the same magnitude on investment of firms in poor financial position, both in periods of economic recession or expansion.

Although the evidence obtained in this study, regarding the financing constraints-inventory investment relationship, seems to be sufficiently robust, one caveat should be made. The results might be influenced by the frequency of the data used. Actually, given the nature of inventories, it is likely that firms adjust their level of inventories very

quickly in response to a change in its cash flows or financial position. In fact, as emphasised by Guariglia (1999: 59) «when annual data are used […] it is possible that the estimated effects of the coverage ratio and cash flow on inventory investment appear to be weaker than in reality».

6 CONCLUSIONS

In the last two decades there was an increasing interest of researchers on the impact of financing constraints on investment expenses of firms. However, the main focus of attention of researchers has been concentrated on business fixed investment instead of inventory investment. Yet the study of this type of investment is important, namely, because of its impact on business cycle fluctuations.

Therefore, the objective of this paper was to shed some light on the inventory investment-financing constraints relationship, by focusing on a panel of Portuguese manufacturing firms. The findings obtained in the empirical study appear to support the hypothesis that firms with a weak balance sheet position (as measured by the interest coverage ratio) face financing constraints. Hence, inventory investment of this type of firms is more dependent on the availability of adequate cash flows than of the financially healthier firms.

In what concerns policy implications derived from the findings of this paper, an issue that can be highlighted is its relation with the literature on business cycle fluctuations. Indeed, it is possible to say that this paper adds evidence about the existence of a “balance sheet channel” in the transmission mechanism for monetary policy, as suggested by Gertler and Gilchrist (1994) and Bernanke and Gertler (1995), given that, in this study, firms were classified according to its interest coverage ratio, which is a good proxy for the strengthening of a firm’s balance sheet.

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