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Measuring firms' financial constraints: Evidence for Portugal through different approaches

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Measuring firms' financial constraints: Evidence for Portugal through different approaches

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Abstract:
Today's shortage of financial resources calls for the attention of researchers to the problem of financial constraints faced by firms. In this paper we analyse firms' financial constraints by estimating both investment-cash flow sensitivities and cash-cash flow sensitivities upon a large unbalanced panel of Portuguese firms in order to obtain robust findings. Additionally, we classify firms according to characteristics that are generally believed to indicate the presence of constraints (size, age and dividend payment). Our results clearly show that Portuguese firms are, in general, financially constrained. Furthermore, we verify that such constraints are more severe for certain groups of firms, in particular those firms that are smaller and do not pay dividends. However, we do not find evidence that age as a good proxy for financial constraints. Finally, we cast some doubts on the direct implementation of the SA index as a measure of financial constraints.
Keywords: Financial constraints; Firm-level studies; Portugal.
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1. Introduction

The recent financial crisis, the severest since 1920's Great Depression, has showed that the study of the impact of financial constraints upon firm dynamics needs further attention of researchers. In fact, despite economic theory provides some insights on the causes and effects of financial constraints, empirical literature has struggled to find consistent measures of these constraints. Firms have both internal and external forms of financing their operational and investment activities. Even if we abstain from thinking in terms of opportunity costs, obtaining funds externally requires a premium to be paid, which is associated with the risk that external investors have to bear when they decide to lend. Thus, the existence of information asymmetries (Stiglitz and Weiss, 1981; Myers and Majluf, 1984) sets a wedge between the costs of internal and external sources of finance, creating a financial hierarchy and aggravating the constraints faced by firms.

The purpose of this paper is threefold: (a) identify and measure the level of financial distress faced by firms; (b) identify the group(s) of firms that suffer the most with financial constraints by distinguishing them according to their characteristics; (c) evaluate and compare the validity and accuracy of the measures that are usually employed to analyse financial constraints. To accomplish this task, we proceed in two steps. First we perform an *a priori* classification of firms into financially constrained and unconstrained based on their characteristics and financial information available from our dataset. Second, we estimate two empirical models from different approaches, in order evaluate the level of such constraints across groups of firms. The use of different approaches will also allow us to draw conclusions on the consistency, advantages and disadvantages of such methodologies. To conduct our empirical test we use an unbalanced panel of Portuguese firms covering the period 1996-2004.

Making use of investment literature, we will resort to an investment accelerator model, within Bond et al. (2003) framework, in order to estimate the sensitivity of investment to cash-flow (hereafter ICFS), the traditional measure of financial constraints. Meanwhile, we borrow some insights from recent literature on liquidity demand to estimate the sensitivity of cash stocks to cash-flow (hereafter CCFS), a relatively new approach to measure financial constraints proposed by Almeida et al. (2004). Additionally, we will also be able to evaluate the interesting Size and Age index (hereafter SA index) of financial constraints suggested by Hadlock and Pierce (2010). Our results, while supporting previous literature on the inverse relationship between size, dividend policy and financial constraints, they cast some doubts on previously devised relationships between age and the level of constraints. Finally, we raise some doubts on the direct use of the SA index to sort firms according to their constraints.

This paper is rather original in the sense that: (a) it explores a recent methodology to measure financial constraints (CCFS) that, although appearing useful and consistent, to our knowledge has barely been used yet; (b) it tests a new way of classifying firms by their level of financial distress (SA index), that, as far as we know, has not yet been used except in its introductory paper (Hadlock and Pierce, 2010); (c) it is the first to explore this dataset to analyse financial constraints for the Portuguese economy—only a few works have investigated financial constraints in Portugal, but with different datasets and methodologies (see Cabral and Mata, 2003 or Oliveira and Fortunato, 2006).

The paper is organized as follows. Section 2 will overview and summarize the existent literature on financial constraints. In Section 3 we will discuss the dataset and variables used. Section 4 describes the empirical methodology followed, while Section 5 presents the main results. Finally, Section 6 pulls the pieces together and concludes.

2. Measuring financial constraints

Financial constraints is a rather abstract concept since it cannot be directly observable. In fact, it is quite difficult to come up with a clear-cut definition. As a starting point, in the spirit of Kaplan and Zingales (1997), we can apply a precise, but broader definition by stating that financial constraints are present whenever there is a wedge between the costs of obtaining internal and external funds. The problem with such definition is that it virtually covers every firm. As an alternative, we prefer to define financial constraint as the inability of a firm to raise the necessary amounts (usually due to external finance shortage) to finance their investment and growth. Perhaps due to this abstract nature of the concept, there is no clear methodology to determine financial constraints. Many researchers still devote their time in trying to find a method to identify and quantify this directly unobservable relationship. However, such measures are built on fragile relationships and proxies for financial constraints.

Considerable debate surrounds the best measure to use in the analysis of financial constraints. Since the seminal work of Fazzari, Hubbard and Petersen (1988) (hereafter FHP), that introduced Investment-Cash Flow Sensitivities as way to measure such constraints, several researchers have tried to develop consistent measures of financial constraints. The rationale used consisted in classifying firms *a priori* as constrained and unconstrained, based on their dividend policy. By assuming that constrained firms, in order to finance their investment, “retain all of the low-cost internal funds they can generate” and so pay lower dividends, FHP proceed to the estimation of ICFS for each class of firms. They regress investment on cash-flow, estimated Q (control for investment opportunities) and year and firm dummies upon a sample consisting of 422 USA firms (1970-1984). Their findings, that low-dividend firms exhibit higher ICFS than high-dividend ones, suggested that low-dividend firms, by investing more of their extra cash-flows, are more financially constrained.

Despite that most empirical studies build on this relationship, subsequent literature has pointed three main critiques. The first arguments against this measure come from Kaplan and Zingales (1997) (hereafter KZ). They point out that, not only certain assumptions made on the curvature of the cost function of external finance were not met, but also that the classification scheme used by FHP was flawed. In particular, due to precautionary savings and potentially risky adverse management, the dividend policy is an inaccurate sorting variable. As an alternative they focus their classification on qualitative information from firms' financial statements.

The second main critique, concerns problems associated with using Q as a proxy for investment opportunities. First, it is impossible to measure marginal Q and thus the empirical approximation (average Q; see Hayashi, 1981) entails potential missmeasurements due to the violation of certain assumptions, such as imperfect competition and the relationship between firms' investment and financial decisions in these particular types of models (see Chirinko, 1993, and Hubbard, 1998, for a discussion). Second, Cash-Flow might itself contain information about investment opportunities, particularly for firms that face high uncertainty about their investment projects (usually young and growth firms), so cash flow might indicate the direction to go by revealing additional information on the projects' quality. As a result, one should expect that part of the ICFS is due to investment opportunities that were not captured by Q. In fact, Alti (2003), in a financially frictionless model, shows that even after Q correction firms still present significant ICFS.

Finally, several authors such as Povel and Raith (2002), Cleary et al. (2007) or Lyandres (2007) found the ICFS relationship to be non-monotonic. They argue that ICFS are U-shaped with respect to constraints due to the risk associated with firm default and the efforts of investors in trying to avoid such liquidation losses—by providing larger amounts to mitigate the risk of default—, for sufficiently low levels of internal funds. In this case, a decrease in internal funds below a certain threshold would imply an increase in investment. Overall, these critiques cast serious doubts on the robustness of ICFS as a measure of financial constraints.

As an alternative to ICFS, some researchers derive a reduced form Euler equation from a structural model and check if parameter restrictions are met. If not, then, for a certain sample there is evidence for the presence of constraints (e.g. Whited, 1992, Harhoff, 1998). However, this methodology does not allow to measure the degree t which firms are financially constrained, therefore we will abstain from using it.

Recently, analyzing firm's demand for cash, Almeida et al. (2004) advance that the level of financial constraints can be measured by the sensitivity of cash stock to cash flow. They argue that only constrained firms will manage liquidity to maximize their value. The rationale behind is that while constrained firms need to save cash out of cash flows in order to take advantage of future investment opportunities, unconstrained firms do not, as they are able to resort to external finance. Meanwhile, firms that hold cash incur in opportunity costs associated with present investment opportunities. As a result, only constrained firms will need to optimize their cash stocks over time, in order to maximize their profits and hedge future shocks. Therefore, one can expect that estimates on the sensitivity of cash stocks to cash-flow would be positive and significant for constrained firms, while no such relation should be expected for unconstrained ones.

To our knowledge, only a few works have used this approach so far. Specifically, Han and Qiu (2006) for US publicly traded companies from 1997 to 2002, corroborate this finding. However other recent works do not support this view. Pál and Ferrando (2009) found that, for Euro-area firms between 1994 and 2003, all firms presented positive and significant CCFS. Meanwhile, Lin (2007), for publicly traded Taiwanese firms between 1990 and 2004, also finds that, contrary to Almeida et al. (2004), both constrained and unconstrained firms present significant CCFS but, as expected, such sensitivity is higher for constrained firms. Finally, while some authors find that financial development alleviates financial constraints—see Carreira and Silva (2009) for a survey—, Khurana et al. (2005), analyzing firm-level data for 35 countries between 1994-2002, find that there is a negative association between financial development and CCFS providing further evidence that this methodology is a useful measure of firm's financial constraints.

With respect to classification schemes, several authors point out different variables that can be used to sort and distinguish firms according to a level of financial distress. Examples of these are (a) dividend payout ratio; (b) firm self evaluation; (c) cash stocks; (d) degree of leverage; (e) age; (f) size; (g) institutional affiliation; (h) credit ratings (see Carreira and Silva, 2009).

Also building on previous relations found in empirical literature, indexes of financial constraints have been advanced. Examples can be found in the KZ index of Lamont et al. (2001), the WW index of Whited and Wu (2006) and the index proposed by Musso and Schiavo (2008). In particular, the SA (Size and Age) index proposed by Hadlock and Pierce (2010) seems to be appealing since it draws on two variables that are "more exogenous" than the ones typically used. Additionally, not only it allows for a quadratic (thus non-monotonic) relationship to constraints, but it is also of simple implementation.

In this paper we will use different measures proposed by previous empirical literature in an attempt to consistently distinguish financially constrained and unconstrained firms while assessing the severity of such constraints. It is clear that no consistent measure of financial constraints has yet been developed and the difficulty associated with the abstract concept of financial makes it harder to find such a perfect measure. Keeping this caveat in mind, we attempt to clarify the financing problems of Portuguese firms and compare different approaches to measure constraints. Inferences using this sample, representative of Portuguese firms, may be made with respect to, at least, the EU economy (cf. Cabral, 2007). However, some specific characteristics of the Portuguese economy must be taken into account. In particular, if indeed firms in economies with less developed financial markets suffer from more severe financial constraints, then, with respect to, for example the UK economy, firms in Portugal are expected to present high levels of financial constraints.

3. Methodology

In order to investigate the financial constraints faced by Portuguese firms we borrow insights from two different approaches: (a) investment demand based on an investment accelerator model; (b) liquidity demand, modelling cash holdings as a function of the sources and uses of funds

3.1. Model 1—Investment-Cash Flow Sensitivity

Since the primordial FHP's regression of investment on cash-flow, controlling for investment opportunities, researchers have used derivate specifications to estimate ICFS. In particular, Harhoff (1998) follows Bond et al.(2003) and derives an empirical equation for the estimation of ICFS based on an accelerator specification:

$$\frac{I_{i,t}}{K_{i,t-1}} = \rho \frac{I_{i,t-1}}{K_{i,t-2}} + \beta_1 \Delta y_{i,t} + \beta_2 \Delta y_{i,t-1} + \beta_3 \frac{CF_{i,t}}{K_{i,t-1}} + \beta_4 \frac{CF_{i,t-1}}{K_{i,t-2}} + d_t + \alpha_i + \varepsilon_{i,t} \quad (1)$$

where $I_{i,t}$ is investment for firm *i* in period *t*, $K_{i,t-1}$ beginning of period t total assets, $\Delta y_{i,t}$ is output growth (measured as sales growth), $CF_{i,t}$ is cash-flow, d_t are time dummies, α_i controls for unobserved firm heterogeneity and $\varepsilon_{i,t}$ is the error term.

This particular accelerator specification has the advantageous feature of not requiring the computation of Tobin's Q (the ratio between the total market value and asset value of a firm). We refrain from using this measure for two different reasons. The first is due to the fact that we would only be able to calculate it for a relatively small subsample of firms (only those that are publicly traded), thus losing significant information, in particular, observations of smaller and younger firms. Consequently, we would obtain a biased sample with respect to financial constraints, not only because it is generally agreed that smaller and younger firms face severer constraints—only a few are publicly traded—, but also due to the fact that information on publicly traded firms is legally required and so, information asymmetry problems are diluted for such firms, potentially reducing financing problems. The second reason is more of a theoretical one. Firstly, marginal Q is unobservable, so researchers use average Q as an approximation—see Hyashi, 1981, for the derivation of average Q. Secondly, the introduction of Q directly into the estimation of investment models for the purpose of analysing financial constraints may cause the estimated sensitivities to cash-flows to be overestimated as they might contain information about investment opportunities that were not captured by Q—Alti, 2003, in a model where financial frictions are absent, shows that, even after Q correction, firms exhibit sensitivities to cash-flow. As a result, using Q as a proxy, is not enough to control for investment opportunities and so, inferences about cash- flow sensitivities will be biased.

For the estimation of this model we resort to the Arellano-Bond first differences estimator that allows us to eliminate firm specific effects, takes into account heteroskedasticity and autocorrelation, while allowing for the presence of endogenous variables. As a result, suitable instruments have to be devised. We use the twice and further lagged values of the right handside variables in the equation (until a maximum of 4 lags), two-digit industry indicators (CAE.Rev 2.1), variation interest paid, age, size, a dummy for firms that invest in R&D, exports and imports—see Arellano and Bond, 1991, for a detailed discussion of the estimator and Rodman, 2009, for STATA implementation.

3.2. Model 2—Cash-Cash Flow Sensitivity

Almeida et al. (2004) construct an alternative model of liquidity demand and derive an empirical equation to estimate the sensitivity of cash to cash-flows. In a few words, the model is based on constrained versus unconstrained firms' cash management. If a firm is constrained—its internal funds are insufficient to finance all positive net present value projects—it has to pass up some investments in the current period in order to be able to finance potentially better projects in the future. By being forced to manage liquidity, constrained firms will save cash out of cash-flows, while no systematic relationship should be found for unconstrained firms. The financial nature of the cash stock variable is a shield against missmeasurements in Q (sales growth in our case) and investment opportunities hidden in cash-flow because it is not expected that firms will increase their cash stocks if cash-flow signals a new/better investment opportunity, unless they are financially constrained. As a result, we have the following empirical specification:

$$\Delta CS_{i,t} = \beta_0 + \beta_1 CF_{i,t} + \beta_2 \Delta y_{i,t} + \beta_3 S_{i,t} + \beta_4 I_{i,t} + \beta_5 \Delta NWC_{i,t} + \beta_6 \Delta STDEBT_{i,t} + \varepsilon_{i,t} \qquad (2)$$

where $\Delta CS_{i,t}$ is the variation in cash stocks, $S_{i,t}$ is a control for firm size (log of total assets), $\Delta NWC_{i,t}$ is the variation of noncash net working capital, $\Delta STDEBT_{i,t}$ is the variation of short term-debt and $\varepsilon_{i,t}$ the error term. For the very same reasons stated above, we shall use sales growth ($\Delta y_{i,t}$) instead of Q as a proxy for investment opportunities.

However, we will implement a slight modification to the model. In the spirit of Lin (2007), we substitute the variation of short term-debt by the sum of net debt and equity issuances ($ISS_{i,t}$) and interest rate variation ($\Delta INT_{i,t}$). The former modification is due to the fact that debt and equity issuances, while being a signal of easier access to external funds, might have a significant impact upon cash stocks (by accounting procedures), so we control for such effect. With respect to the latter, firms may decide to reduce their borrowings or pay back debt according to expected interest expenses. However, instead of benchmark interest rates variations, we use variations of interest paid, which allows for firm variation and thus can also be seen as a form of credit rating. In both specifications, all variables are scaled by total assets. The augmented empirical equation is as follows:

$$\Delta CS_{i,t} = \beta_0 + \beta_1 CF_{i,t} + \beta_2 \Delta y_{i,t} + \beta_3 S_{i,t} + \beta_4 I_{i,t} + \beta_5 \Delta NWC_{i,t} + \beta_6 ISS_{i,t} + \beta_7 \Delta INT_{i,t} + \varepsilon_{i,t}. \qquad (3)$$

The financial and investment covariates are endogenous, so there is a need to estimate the model using instrumental variables (2-Step GMM) along with fixed effects to take account of unobserved firm-level heterogeneity and panel-robust standard errors. The set of instruments includes twice lagged cash flow, twice lagged sales growth, lagged investment, lagged variation of noncash net working capital, two-digit industry indicators (for overall samples), size (measured as number of employees), lagged bond issuance and lagged variation in interest payments.

3.3 Classification Schemes

For the purpose of comparing both ICFS and CCFS across different groups of firms, we perform an *a priori* classification of firms by their “degree" of financial distress. For this purpose we create subsamples by the following firm characteristics that are either generally agreed to or believed to proxy for financial constraints: size, age (and both, SA index) and dividend payment (see Carreira and Silva, 2009). However, we refrain from using financial variables to sort firms and focus on relatively exogenous variables in order not to incur in regression problems resulting from the simultaneous presence of a variable in the estimated equation and classification scheme. Still, for the case of CCFS estimation, this simultaneity might be present due to the high correlation between S and SIZE, though we take the appropriate precautions in order to provide robust results. Finally, the reason to include dividend policy as a sorting variable draws from the fact that it is by large the most common classification scheme used since the seminal work of FHP.

Firm Size. It is reasonable to expect that smaller firms face more severe financial constraints since such firms do not have the reach or visibility that larger firms have, so investors have difficulties in screening the quality of projects. As a result, smaller firms tend to be more credit rationed (e.g. Petersen and Rajan, 1995). As an example, if a firm is large enough to be quoted, information with respect to this firm will be widely available. We measure firm size as number of employees instead of either sales or assets, since in our view it is a much “more exogenous” variable. Accordingly, we create an indicator variable *DIM* that takes values between 1 and 4. The partitions were set at 50, 100 and 250 employees. These thresholds result from an adjustment of the European Commission firm size classification to the specificity of our dataset.[1] First, since the information reported by firms with less than 20 employees is not reliable, we consider that, for the purpose of this paper, small firms have between 20-49 employees. Second, the threshold 100 employees (in line with OECD standards) allows to distinguish, within the 50-250 heterogeneous class, medium-small from medium-large firms. Additionally, it deals with possible representativeness problems associated with the fact that, in our dataset, firms with less

[1] European Commission sets upper thresholds at 10, 50 and 250 employees for micro, small and medium enterprises, respectively.

than 100 employees are drawn randomly, while for firms with more than 100 employees the universe is represented. Finally, we have considered setting the last threshold at 500 employees (OECD benchmark), but this would be of no interest since there are only a few firms that would enter this upper category in Portugal. Finally, note that this sample partition is quite problematic as it is done directly using the variable SIZE (employees) which is highly correlated with the covariate S (total assets) in the CCFS regression.

Firm Age. If a firm has just been created, not much information is available to potential investors. Over time, firms tend to build relationships with creditors, banks and investors in general, allowing them to obtain external funds in an easier manner as lenders gain some insight in both firms' characteristics and quality. As a result, one should expect that younger firms face more severe financial constraints. Accordingly we create an indicator variable *AGEq* that takes the values 1, 2, and 3 if a firm is under 10, 10-40, and over 40 years old, respectively. The first threshold allows to accommodate the dynamics of entry and exit observed at early years (see for e.g. Bellone et al., 2008 for the intensity of the selection process, or Coad, 2010 for departures from an exponential distribution of age), thus distinguishing young from mature firms. However, a possible relative inertia of older firms (Hannan, 2005) or even a change in firm objectives, led us to define an upper class of old firms.[2] Still, different specifications were tested in order to provide robust results.

The SA index. The previous two variables (size and age) seem particularly appealing since they are somewhat "more exogenous" than other variables. In fact, in a recent work, Hadlock and Pierce (2010) develop an index of constraints based on these two proxies. The index is constructed as follows:

$$\mathrm{SA} = -0.737 * \mathrm{Size} + 0.043 * \mathrm{Size}^2 - 0.040 * \mathrm{Age} \quad (4)$$

[2] Coad (2010) argues that old firms are older than expected by the exponential benchmark possibly due to a shift from a profit-maximization behaviour to a risk-averse policy of long lasting survival.

where, *Size* is firm's size measured as log of inflation-adjusted assets and *Age* is the number of years with stock price listed on their Compustat database. However, we will measure *Age* by the number of years in activity in order to avoid sample selection bias (firms that are publicly traded face lower constraints). Hadlock and Pierce (2010) report a flattening of the relation above the 95th percentile and cap those observations. We opt to winsorize them at the top 5% in order to get an approximation to their measure while not losing too much information.[3] Note that they use quoted firms which are usually larger/older. Finally we split the sample according to terciles, as suggested, classifying the top (bottom) firms as financially constrained (unconstrained). However, one must bear in mind that this index is constructed upon a variable S that is a covariate in the CCFS regression.

Dividend policy. We will also resort to the primordial classification scheme in FHP based on dividend payment since, despite arguable, firms that pay dividends are expected not to be constrained. Thus, we compute dummies that equal 1 if a firm has pays dividends and 0 otherwise.

4. Data

The dataset used in this work was constructed from the combination of both *Inquérito às Empresas Harmonizado* (IEH), an annual business survey conducted by the Portuguese Statistical Office (INE), and *Ficheiro de Unidades Estatísticas* (FUE), also collected by INE. The former dataset comprises detailed information on firms' balance sheets. On the other hand, resorting to FUE, that contains information about firm's generic characteristics—including size, age and main sector of activity (CAE-Rev. 2.1)—, allows

[3] We tested the construction of the index with capped variables above the 95th centile but results do not differ significantly. See section 5.3 for these results.

to track firms trough time, thus constructing a large unbalanced panel of firms.[4] This dataset comprises the universe of firms operating in Portugal with more than 100 employees and a random sample of firms with less than 100 employees. The sample is representative of the Portuguese sector disaggregation.

For the purpose of this paper the following cleaning procedures were necessary. First, we eliminated firms with less than 20 employees due to the lack of quality of information reported by such firms. Second, we focus only on the industry and part of the services sector, thus eliminating the agricultural (also includes husbandry, forestry, fishing, *inter alia*) and financial sectors (inclusion of this sector would naturally bias the estimation favouring unconstrained firms). Observations that were reported either missing or with unreasonable values were dropped. In some specific circumstances, unreasonable values suffered a treatment in order to achieve coherent values.[5] As a result we have a large unbalanced panel of 22.651 firms for the period 1996-2004 resulting in 86.455 observations.

The advantage of using this dataset is that it comprises detailed financial information from firm's balance sheets thus providing some insight on their status regarding financial constraints. In particular, it allows us to develop a classification scheme that groups firms into different levels of financial constraints. Additionally, resorting to FUE allows us to construct an unique and comprehensive dataset covering the universe of firms operating in Portugal with more than 100 employees and a large representative sample of Portuguese firms with more than 20 employees. Furthermore, the dataset comprises a broad

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[4] These two data sources were matched using a code number, also provided by INE that uniquely identifies each firm for different surveys along the successive years.

[5] These cases include specific observations whose correct values were possible to obtain from other variables or resulting from changes in signal mistyping errors.

range of industries. Finally, the large sample period (1996-2004) is adequate to take into account macroeconomic cyclical variations.

However, a major pitfall of this dataset is the inexistence of market information about the firms, since we only have access to a code number of each firm, thus not being able to match the dataset with information from, for example, stock markets. Still, only a few firms in Portugal are publicly traded and so the benefits of such extension of the dataset would be negligible. Additionally, information of firms is limited to a relatively low level of disaggregation of balance sheets. Finally, by dropping from the database all firms with less than 20 employees, we are cutting off a large number of observations, even though they would lack in quality and would further increase the unbalancedness of the panel.

5. Empirical Results

5.1. Summary statistics

Table 1 provides a brief summary of the selected variables, used in the estimation of Model (1), for the global sample and by classification scheme subsamples. Both means and standard deviations are reported. An interesting pattern that can be observed is that mean investment decreases with firm age. In other words, older firms tend to invest less than younger firms. A symptom of financial constraints might emerge from the comparison of firm's dividend policy, since firms that pay dividends have, on average, lower cash-flows than firms that do not pay dividends and so, the former are possibly retaining less funds than the latter. Furthermore, smaller firms exhibit lower output growth while younger firms' output growth is larger than older firms. Table 2 reports the same statistics for the estimation of Model (2). In addition to the patterns previously discerned, younger firms, on average, have larger cash-flows and issue more debt and equity (the latter due to short-term debt issuances as expected).

Table 1: Summary statistics of Model (1) variables

Variables	Total	Size classes				Age classes			SA index			Dividend payment	
		[20;50[	[50;100[	[100;250[	[250;+∞[	[0;10[	[10;40[	[40;+∞[	1st tercile	2nd terciles	3rd tercile	No	Yes
$I_{i,t}/K_{i,t-1}$	0.0750	0.0731	0.0743	0.0740	0.0726	0.0940	0.0735	0.0705	0.0721	0.0730	0.0722	0.0810	0.0732
	(0.108)	(0.114)	(0.107)	(0.100)	(0.095)	(0.136)	(0.104)	(0.107)	(0.111)	(0.098)	(0.101)	(0.106)	(0.118)
$I_{i,t-1}/K_{i,t-2}$	0.0867	0.0826	0.0865	0.0877	0.0900	0.1052	0.0858	0.0797	0.0798	0.0851	0.0894	0.0985	0.0817
	(0.119)	(0.124)	(0.118)	(0.111)	(0.112)	(0.141)	(0.115)	(0.115)	(0.117)	(0.113)	(0.120)	(0.121)	(0.124)
$\Delta y_{i,t}$	0.0410	0.0237	0.0355	0.0372	0.0775	0.0864	0.0357	0.0283	0.0134	0.0368	0.0601	0.0512	0.0409
	(0.280)	(0.297)	(0.260)	(0.258)	(0.259)	(0.374)	(0.274)	(0.231)	(0.284)	(0.282)	(0.255)	(0.258)	(0.309)
$\Delta y_{i,t-1}$	0.0627	0.0436	0.0616	0.0621	0.1081	0.1269	0.0581	0.0439	0.0282	0.0593	0.0839	0.0983	0.0527
	(0.285)	(0.302)	(0.275)	(0.262)	(0.279)	(0.367)	(0.280)	(0.234)	(0.295)	(0.291)	(0.263)	(0.249)	(0.321)
$CF_{i,t}/K_{i,t-1}$	0.0947	0.0914	0.0952	0.0945	0.1015	0.1088	0.0948	0.0835	0.0835	0.0969	0.0985	0.1085	0.0719
	(0.094)	(0.096)	(0.089)	(0.090)	(0.095)	(0.116)	(0.089)	(0.093)	(0.103)	(0.086)	(0.090)	(0.078)	(0.122)
$CF_{i,t-1}/K_{i,t-2}$	0.1020	0.0995	0.1026	0.1029	0.1078	0.1140	0.1031	0.0897	0.0912	0.1055	0.1049	0.1211	0.0715
	(0.093)	(0.094)	(0.089)	(0.090)	(0.097)	(0.112)	(0.090)	(0.091)	(0.100)	(0.087)	(0.091)	(0.076)	(0.121)
Observations	18,359	5,206	4,382	4,831	2,402	1,611	12,830	3,212	4,434	5,088	7,278	7,483	4,562
Number of firms	6,242	2,308	1,726	1,597	751	854	4,481	1,158	1,709	2,056	2,443	3,423	2,399

Notes: Both total sample and subsamples' mean values of the main variables used to estimate equation (1) are reported. Standard deviations are given in parenthesis.

Table 2: Summary statistics of Model (2) variables

Variables	Total	Size classes				Age classes			SA index			Dividend payment	
		[20;50[	[50;100[	[100;250[	[250;+∞[	[0;10[	[10;40[	[40;+∞[	1st tercile	2nd terciles	3rd tercile	No	Yes
$\Delta CS_{i,t}$	0.0025	0.0026	0.0019	0.0018	0.0037	0.0049	0.0020	0.0031	0.0021	0.0021	0.0032	0.0009	0.0038
	(0.062)	(0.069)	(0.056)	(0.057)	(0.062)	(0.074)	(0.062)	(0.056)	(0.069)	(0.058)	(0.055)	(0.062)	(0.063)
$CF_{i,t}$	0.0850	0.0841	0.0857	0.0854	0.0911	0.0954	0.0858	0.0769	0.0740	0.0884	0.0888	0.0996	0.0631
	(0.089)	(0.089)	(0.082)	(0.085)	(0.089)	(0.106)	(0.086)	(0.088)	(0.103)	(0.080)	(0.082)	(0.069)	(0.124)
$\Delta y_{i,t}$	0.0368	0.0244	0.0276	0.0288	0.0672	0.0873	0.0338	0.0232	0.0128	0.0353	0.0534	0.0517	0.0375
	(0.288)	(0.302)	(0.263)	(0.256)	(0.255)	(0.379)	(0.286)	(0.237)	(0.297)	(0.280)	(0.258)	(0.255)	(0.318)
$S_{i,t}$	15.5388	14.5668	15.4039	15.9403	17.3994	15.5210	15.4890	15.7404	14.3135	15.2460	16.6363	15.6070	15.3988
	(1.448)	(1.112)	(0.972)	(1.132)	(1.523)	(1.804)	(1.371)	(1.520)	(1.082)	(1.029)	(1.170)	(1.368)	(1.694)
$I_{i,t}$	0.0629	0.0614	0.0607	0.0626	0.0601	0.0760	0.0621	0.0593	0.0631	0.0621	0.0589	0.0695	0.0623
	(0.081)	(0.085)	(0.078)	(0.076)	(0.070)	(0.097)	(0.079)	(0.080)	(0.086)	(0.075)	(0.073)	(0.081)	(0.087)
$\Delta NWC_{i,t}$	-0.0478	-0.0411	-0.0460	-0.0520	-0.0518	-0.0558	-0.0460	-0.0505	-0.0541	-0.0429	-0.0432	-0.0448	-0.0591
	(0.166)	(0.177)	(0.154)	(0.156)	(0.149)	(0.200)	(0.164)	(0.154)	(0.184)	(0.157)	(0.149)	(0.148)	(0.213)
$ISS_{i,t}$	0.0349	0.0311	0.0326	0.0284	0.0381	0.0386	0.0355	0.0308	0.0361	0.0376	0.0343	0.0429	0.0301
	(0.209)	(0.215)	(0.201)	(0.204)	(0.196)	(0.252)	(0.208)	(0.191)	(0.202)	(0.184)	(0.209)	(0.191)	(0.254)
$\Delta INT_{i,t}$	-0.0005	-0.0007	-0.0007	-0.0006	-0.0002	-0.0002	-0.0006	-0.0005	-0.0007	-0.0006	-0.0005	-0.0002	-0.0009
	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)	(0.009)	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)	(0.010)
Observations	17,283	5,032	3,569	4,045	2,020	1,602	12,459	3,222	3,981	4,313	6,576	5,417	3,533
Number of firms	4,771	1,396	1,022	1,109	562	468	3,475	898	1,099	1,220	1,830	1,559	957

Notes: Both total sample and subsamples' mean values of the main variables used to estimate equation (2) are reported. Standard deviations are given in parenthesis.

Tables 3 and 4 present the correlations and its significance levels across the main variables used for the ICFS and CCFS estimations, respectively. It is possible to observe that correlations are significant for most variables used in both Model (1) and (2). Exceptions are the small and non-significant correlations between cash stock variation and both size (total assets) and variation of interest paid for Model (2). Still for the same model, negative correlations between cash stock variation and both investment and non-cash net working capital are as expected as they are demands and not sources of cash. Finally, the correlation between cash-flow and debt and equity issuances is negative possibly indicating that either when there is a shortage in internal funds, firms resort to issuances or, on the contrary, when firms have large cash flows they use them to reduce debt.

Table 3: Correlation matrix of Model (1) variables

VARIABLES	$I_{i,t}/K_{i,t-1}$	$I_{i,t-1}/K_{i,t-2}$	$\Delta y_{i,t}$	$\Delta y_{i,t-1}$	$CF_{i,t}/K_{i,t-1}$	$CF_{i,t-1}/K_{i,t-2}$
$I_{i,t}/K_{i,t-1}$	1.00					
$I_{i,t-1}/K_{i,t-2}$	0.30***	1.00				
$\Delta y_{i,t}$	0.12***	0.10***	1.00			
$\Delta y_{i,t-1}$	0.08***	0.11***	0.16***	1.00		
$CF_{i,t}/K_{i,t-1}$	0.27***	0.19***	0.28***	0.18***	1.00	
$CF_{i,t-1}/K_{i,t-2}$	0.22***	0.28***	0.10***	0.25***	0.67***	1.00

Notes: ***, **, and * denote statistical significance at the .01, .05, and .10 levels, respectively.

Table 4: Correlation matrix of Model (2) variables

VARIABLES	$\Delta CS_{i,t}$	$CF_{i,t}$	$\Delta y_{i,t}$	$S_{i,t}$	$I_{i,t}$	$\Delta NWC_{i,t}$	$ISS_{i,t}$	$\Delta INT_{i,t}$
$\Delta CS_{i,t}$	1.00							
$CF_{i,t}$	0.10***	1.00						
$\Delta y_{i,t}$	0.12***	0.24***	1.00					
$S_{i,t}$	0.00	-0.02***	0.04***	1.00				
$I_{i,t}$	-0.05***	0.19***	0.09***	-0.09***	1.00			
$\Delta NWC_{i,t}$	-0.23***	0.11***	-0.01**	0.04***	-0.26***	1.00		
$ISS_{i,t}$	0.14***	-0.12***	0.20***	0.05***	0.24***	0.00	1.00	
$\Delta INT_{i,t}$	0.00	-0.04***	0.13***	0.02***	0.09***	-0.05***	0.19***	1.00

Notes: ***, **, and * denote statistical significance at the .01, .05, and .10 levels, respectively.

5.2. Overall sample estimation

The regression of Model (1) reports an extremely high sensitivity of investment to cash flow (0.3195), significant at the 5% level, as it is shown in Table 5. This means that Portuguese firms, on average, increase their investment in 32 cents for each euro of extra cash flow, illustrative of the financial distress faced by such firms. We test for the overall significance of the regression obtaining a highly significant Wald test statistic (309.7). A Hansen test, which does not reject the orthogonality of instruments, is also performed.

Table 5: Investment-Cash Flow Sensitivity estimation

Variables	Coefficient
$I_{i,t-1}/K_{i,t-2}$	0.1388***
	(9.084)
$\Delta y_{i,t}$	0.0633**
	(2.316)
$\Delta y_{i,t-1}$	-0.0009
	(-0.204)
$CF_{i,t}/K_{i,t-1}$	0.3195**
	(2.382)
$CF_{i,t-1}/K_{i,t-2}$	0.0805
	(1.490)
Year dummies	Yes
Observations	18,359
Number of firms	6,242
Hansen chi2 p-value	0.395
Wald Chi2	309.7

Notes: Regression of model (1). Robust z-statistics are in parenthesis. ***, **, and * denote statistical significance at the .01, .05, and .10 levels, respectively. Further test statistics available from the authors on request.

Meanwhile, as expected, the regression of Model (2) reports positive and significant sensitivities of cash to cash-flow confirming that, in general, Portuguese firms face financial constraints. As it is shown in Table 6, coefficients reported on cash flow are significantly different from zero at the 1% level for the total sample. The reported R-squared (0.176) is within the usual in these models, while the Hansen test does not reject the null of orthogonal instruments. The estimated CCFS is 0.1817, meaning that Portuguese firms, on average, save 18 cents out of each euro of cash flow which is symptomatic of the presence of severe financial constraints.

Table 6: Cash-Cash Flow Sensitivity estimation

Variables	Coefficient
$CF_{i,t}$	0.1817***
	(10.678)
$\Delta y_{i,t}$	0.0142***
	(4.983)
$S_{i,t}$	0.0135***
	(3.603)
$I_{i,t}$	-0.2157***
	(-18.691)
$\Delta NWC_{i,t}$	-0.1478***
	(-23.760)
$ISS_{i,t}$	0.0783***
	(18.429)
$\Delta INT_{i,t}$	-0.3322***
	(-3.759)
Observations	15,277
Number of firms	4,771
Hansen chi2 p-value	0.435
R-squared	0.176

Notes: Regression of model (2). Robust z-statistics are in parenthesis. ***, **, and * denote statistical significance at the .01, .05, and .10 levels, respectively. Further test statistics available from the authors on request.

Note that quite high coefficients on cash-flow may arise from three different reasons. First, the equation (3) used to estimate Model (2) is somewhat close to an accounting identity so sensitivities might be overestimated. Second, for both Models, due to the relative underdevelopment of Portuguese financial markets, one would expect that firms operating in Portugal would face severe financial constraints. Finally, sales growth might not be capturing investment opportunities, since its use as a proxy is questionable. As a result, especially for Model (1), coefficients on cash-flow are possibly overestimated.

5.3. Classification schemes

Size. Both estimates used to measure financial constraints provide evidence that there is an inverse relationship between firm size and financial constraints. With respect to ICFS analysis, as it is shown in Table 7, those seem to affect only the smallest firms (with less than 50 employees), that invest 37 cents out of an extra euro of cash flow (significant at the 10% level). On the other hand, the estimates on ICFS for larger firms are not statistically different from zero, indicating that such firms do not suffer from financial distress.

Table 7: Investment-Cash Flow Sensitivity estimation by firm size classes

	Size classes			
Variables	[20;50[	[50;100[	[100;250[	[250;+∞[
$I_{i,t-1}/K_{i,t-2}$	0.1261***	0.1432***	0.1018***	0.0872***
	(3.951)	(4.968)	(4.050)	(2.625)
$\Delta y_{i,t}$	-0.0047	0.0018	0.0280	0.0218
	(-0.304)	(0.077)	(1.140)	(0.712)
$\Delta y_{i,t-1}$	0.0022	-0.0080	0.0043	0.0105
	(0.331)	(-1.172)	(0.642)	(0.939)
$CF_{i,t}/K_{i,t-1}$	0.3738*	0.0332	-0.0463	0.2419
	(1.873)	(0.184)	(-0.238)	(1.162)
$CF_{i,t-1}/K_{i,t-2}$	-0.0156	0.1144	0.2324**	0.0433
	(-0.200)	(1.397)	(2.481)	(0.349)
Year dummies	Yes	Yes	Yes	Yes
Observations	4,998	3,923	4,483	2,232
Number of firms	2,206	1,549	1,471	709
Hansen chi2 p-value	0.028	0.934	0.013	0.908
Wald Chi2	27.99	84.61	74.39	156.0

Notes: Regression of model (1) for size subsamples. Robust z-statistics are in parenthesis. ***, **, and * denote statistical significance at the .01, .05, and .10 levels, respectively. Further test statistics available from the authors on request.

As to CCFS analysis (Table 8), besides reporting a descending trend, coefficients on cash-flow for the subsamples of firms with less than 50 employees, between 50 and 100 employees and between 100 and 250 employees (0.2876, 0.2025 and 0.0977, respectively) are all significant at the 1% level. Still, for very large firms (≥250 employees), the reported coefficient on cash-flow (0.1034) is only statistically significant at the 5%. This indicates that we might be in presence of a negative relationship between size and financial constraints. Note that there is a potential bias caused by the correlation between DIM (classes of firms by employees) and the covariate S (log total assets). We tested an alternative regression excluding S but the results do not differ significantly.[6]

Table 8: Cash-Cash Flow Sensitivity estimation by firm size classes

	Size classes			
Variables	[20;50[	[50;100[	[100;250[	[250;+∞[
$CF_{i,t}$	0.2876***	0.2025***	0.0977***	0.1034**
	(7.119)	(5.042)	(3.150)	(2.557)
$\Delta y_{i,t}$	0.0119**	0.0138**	0.0171***	-0.0038
	(2.066)	(2.060)	(2.862)	(-0.526)
$S_{i,t}$	0.0056	0.0071	0.0073	0.0198**
	(0.562)	(0.904)	(1.043)	(2.339)
$I_{i,t}$	-0.2540***	-0.1991***	-0.1841***	-0.2099***
	(-10.151)	(-8.208)	(-8.505)	(-5.924)
$\Delta NWC_{i,t}$	-0.1754***	-0.1369***	-0.1391***	-0.1588***
	(-14.247)	(-9.405)	(-10.907)	(-8.014)
$ISS_{i,t}$	0.1117***	0.0776***	0.0562***	0.0696***
	(12.110)	(7.640)	(7.163)	(6.296)
$\Delta INT_{i,t}$	-0.4581***	-0.1242	-0.5055***	-0.5447*
	(-2.635)	(-0.682)	(-3.252)	(-1.927)
Observations	3,901	2,970	3,621	1,845
R-squared	1,396	1,022	1,109	562
Number of firms	0.234	0.174	0.150	0.163
Hansen chi2 p-value	0.427	0.138	0.239	0.568

Notes: Regression of model (2) for size subsamples. Robust z-statistics are in parenthesis. ***, **, and * denote statistical significance at the .01, .05, and .10 levels, respectively. Further test statistics available from the authors on request.

[6] With respect to the CCFS estimates, these are slightly lower (0.1515) for the second size group and slightly higher (0.1091) for the third group. The same coefficient for the top and bottom groups remains unchanged, as do so significance levels for all groupings. Further results on these regressions are available from authors on request.

Age. With respect to age, we do not find a clear pattern that links age to financial constraints. Whilst the estimates on ICFS by age groups renders us a puzzle, since we would not expect higher sensitivities for older firms, as we can see in Table 9. Additionally, very old firms' investment seems not to react neither to investment opportunities, nor to previous investment, which adds to the argument that possibly these firms are either "inert" or have different objectives. On the other hand, the results for Model (2) regression exhibit a clear inverse relationship between age and constraints, as one can observe in Table 10. While for the oldest firms, cash-flow appears to have a small impact on cash stocks (estimated coefficient is 0.0957 and significant at the 5% level), the opposite is true for young and mature firms, that save 28 and 19 cents out of every euro of extra cash-flow, respectively (both statistically significant at 1% level).

Table 9: Investment-Cash Flow Sensitivity estimation by age classes

	Age classes		
Variables	[0;10[	[10;40[	[40;+∞[
$I_{i,t-1}/K_{i,t-2}$	0.1698***	0.1456***	0.0547
	(2.717)	(7.665)	(1.471)
$\Delta y_{i,t}$	0.0786**	0.0489*	0.0305
	(1.967)	(1.859)	(0.734)
$\Delta y_{i,t-1}$	0.0085	-0.0067	-0.0034
	(0.540)	(-1.323)	(-0.320)
$CF_{i,t}/K_{i,t-1}$	0.2474	0.4398**	0.5021***
	(1.396)	(2.352)	(2.772)
$CF_{i,t-1}/K_{i,t-2}$	0.0058	0.0828	0.1632*
	(0.052)	(1.202)	(1.803)
Year dummies	Yes	Yes	Yes
Observations	1,611	12,830	3,212
Number of firms	854	4,481	1,158
Hansen chi2 p-value	0.058	0.024	0.275
Wald Chi2	44.71	228.9	26.70

Notes: Regression of model (1) for age subsamples. Robust z-statistics are in parenthesis. ***, **, and * denote statistical significance at the .01, .05, and .10 levels, respectively. Further test statistics available from the authors on request.

Table 10: Cash-Cash Flow Sensitivity estimation by age classes

Variables	Age classes [0;10[	[10;40[	[40;+∞[
$CF_{i,t}$	0.2759***	0.1876***	0.0957**
	(0.079)	(0.020)	(0.038)
$\Delta y_{i,t}$	0.0185	0.0121***	0.0255***
	(0.012)	(0.003)	(0.008)
$S_{i,t}$	0.0175	0.0130***	0.0089
	(0.017)	(0.004)	(0.009)
$I_{i,t}$	-0.1799***	-0.2337***	-0.1535***
	(0.043)	(0.014)	(0.024)
$\Delta NWC_{i,t}$	-0.1368***	-0.1578***	-0.1071***
	(0.022)	(0.007)	(0.015)
$ISS_{i,t}$	0.0634***	0.0819***	0.0693***
	(0.017)	(0.005)	(0.009)
$\Delta INT_{i,t}$	-0.1939	-0.3172***	-0.2152
	(0.374)	(0.102)	(0.201)
Observations	1,119	10,910	2,796
Number of firms	468	3,475	898
R-squared	0.644	0.324	0.519
Hansen chi2 p-value	0.170	0.192	0.127

Notes: Regression of model (2) for age subsamples. Robust z-statistics are in parenthesis. ***, **, and * denote statistical significance at the .01, .05, and .10 levels, respectively. Further test statistics available from the authors on request.

SA index. Our results appear not to support the findings of Hadlock and Pierce (2010) that present the SA index as way to sort firms by their degree of financial distress. With respect to investment demand, only for the bottom tercile of the SA index, do firms exhibit a statistically significant sensitivity of investment to cash flow (0.5620), as it is reported in Table 11. This result is counter-intuitive, since we would expect the most constrained firms (top tercile) to exhibit higher and statistically significant ICFS. The same findings are obtained with respect to the framework of demand for liquidity. Albeit all grouping regressions report significant estimates (at the 1% level). Estimates on cash-flow sensitivities are 0.2346, 0.2236 and 0.0674 respectively for the bottom, middle and top terciles, as reported in Table 12. The decreasing coefficients reported are against the use of the SA index as a measure of financial constraints, since the results are the exact opposite to the ones expected. Main issues are not altered by capping age and size (total assets) instead of winsorizing these variables.[7]

Table 11: Investment-Cash Flow Sensitivity estimation by SA index terciles

	SA index		
Variables	1st tercile	2nd terciles	3rd tercile
$I_{i,t-1}/K_{i,t-2}$	0.0776***	0.1146***	0.1477***
	(2.749)	(4.849)	(6.460)
$\Delta y_{i,t}$	-0.0142	0.0059	0.0105
	(-0.419)	(0.253)	(0.294)
$\Delta y_{i,t-1}$	0.0030	0.0051	-0.0054
	(0.392)	(0.773)	(-0.732)
$CF_{i,t}/K_{i,t-1}$	0.5620***	0.2134	0.2010
	(3.788)	(1.336)	(0.916)
$CF_{i,t-1}/K_{i,t-2}$	0.0436	0.0647	0.1353
	(0.617)	(0.827)	(1.283)
Year dummies	Yes	Yes	Yes
Observations	4,194	4,594	7,067
Number of firms	1,611	1,852	2,369
Hansen chi2 p-value	0.214	0.311	0.552
Wald Chi2	44.38	97.42	229.0

Notes: Regression of model (1) for SA index subsamples. Robust z-statistics are in parenthesis. ***, **, and * denote statistical significance at the .01, .05, and .10 levels, respectively. Further test statistics available from the authors on request.

Note that there is a potential bias caused by the inclusion of S (log total assets) in both the regression and classification scheme. Still, we tested an alternative regression excluding S but the results do not differ significantly.[8] Nevertheless, these results may be due to the weight of $Size^2$ in the index being overestimated, meaning that large firms actually manage to get into the top tercile (most constrained firms) due to this positive term, when in fact they are not financially constrained. In fact, while for the bottom tercile mean

[7] Statistics not reported but available from authors on request.

[8] With respect to the CCFS estimates, these are slightly higher (0.2452, 0.2348 and 0.0715) for the bottom, middle and top terciles, respectively. The same significance levels remain unchanged for all groupings. Further results on these regressions are available from authors on request.

S (SIZE) is 13.90 (56.12), for the top tercile it is 16.32 (229.32)—statistics not reported. Therefore, the parameters used in the index calculations appear to be extremely sensitive to different economic realities. Finally, the mixed results found for age subsamples, might also help to explain the inaccurate classification of constraints by the index. As a result, although being very intuitive, care must be taken when using this index. In particular, if data on firm self-assessment of constraints is available, which unfortunately is not our case, then reestimation of the index coefficients is certainly warranted.

Table 12: Cash-Cash Flow Sensitivity estimation by SA index terciles

	SA index		
Variables	1st tercile	2nd terciles	3rd tercile
$CF_{i,t}$	0.2346***	0.2236***	0.0674***
	(6.965)	(5.931)	(2.638)
$\Delta y_{i,t}$	0.0252***	0.0067	0.0084*
	(4.456)	(1.109)	(1.737)
$S_{i,t}$	0.0293***	0.0249***	0.0085
	(3.172)	(2.715)	(1.592)
$I_{i,t}$	-0.2401***	-0.2331***	-0.1838***
	(-9.339)	(-9.246)	(-10.669)
$\Delta NWC_{i,t}$	-0.1617***	-0.1543***	-0.1275***
	(-11.217)	(-12.205)	(-12.412)
$ISS_{i,t}$	0.0909***	0.0799***	0.0570***
	(9.119)	(8.309)	(9.296)
$\Delta INT_{i,t}$	-0.5017***	-0.2000	-0.3381**
	(-2.654)	(-1.125)	(-2.363)
Observations	3,320	3,520	5,879
Number of firms	1,099	1,220	1,830
R-squared	0.218	0.174	0.128
Hansen chi2 p-value	0.824	0.331	0.917

Notes: Regression of model (2) for SA index subsamples. Robust z-statistics are in parenthesis. ***, **, and * denote statistical significance at the .01, .05, and .10 levels, respectively. Further test statistics available from the authors on request.

Dividend policy. Dividend policy was the main classification scheme primarily used to distinguish financially constrained from unconstrained firms. Both estimations confirm that dividend policy may be used to sort firms into financially constrained and unconstrained, as it is shown in Tables 13 and 14. First, for Model (1), the pattern is clear since firms that pay no dividends appear to invest 97 cents out of every 1 euro of extra cash-flow while the same estimate for firms that pay dividends is not statistically significant. Second, CCFS are higher for firms that pay no dividends (0.2277 against 0.1278), both statistically significant at the 1% level. However, the differences in ICFS are substantially larger than those of CCFS, possibly indicating that financial constraints measured through the former might be overestimated. It may be possible to argue that using ICFS might drive researchers to report firms as financially constrained more often, or at a larger degree than it should be expected.

Table 13: Investment-Cash Flow Sensitivity estimation by dividend policy

	Dividend payment	
Variables	No	Yes
$I_{i,t-1}/K_{i,t-2}$	0.1654***	0.1484***
	(6.089)	(4.340)
$\Delta y_{i,t}$	0.0619	-0.0352
	(1.449)	(-0.895)
$\Delta y_{i,t-1}$	-0.0050	0.0163
	(-0.643)	(1.434)
$CF_{i,t}/K_{i,t-1}$	0.9711***	0.1525
	(3.059)	(1.182)
$CF_{i,t-1}/K_{i,t-2}$	-0.1712	0.0001
	(-1.097)	(0.001)
Year dummies	Yes	Yes
Observations	6,673	3,523
Number of firms	3,038	1,754
Hansen chi2 p-value	0.367	0.451
Wald Chi2	101.0	42.93

Notes: Regression of model (1) for dividend policy subsamples. Robust z-statistics are in parenthesis. ***, **, and * denote statistical significance at the .01, .05, and .10 levels, respectively. Further test statistics available from the authors on request.

Table 14: Cash-Cash Flow Sensitivity estimation by dividend policy

Variables	Dividend payment: No	Dividend payment: Yes
$CF_{i,t}$	0.2277***	0.1278***
	(4.833)	(3.930)
$\Delta y_{i,t}$	0.0157***	0.0106
	(2.603)	(1.312)
$S_{i,t}$	0.0182*	0.0032
	(1.932)	(0.301)
$I_{i,t}$	-0.2989***	-0.1423***
	(-11.876)	(-4.986)
$\Delta NWC_{i,t}$	-0.1791***	-0.0922***
	(-13.163)	(-7.861)
$ISS_{i,t}$	0.1181***	0.0604***
	(12.652)	(6.805)
$\Delta INT_{i,t}$	-0.2528	-0.3364*
	(-1.414)	(-1.755)
Observations	3,834	2,543
Number of firms	1,559	957
R-squared	0.240	0.125
Hansen chi2 p-value	0.733	0.693

Notes: Regression of model (2) for dividend policy subsamples Robust z-statistics in parenthesis. ***, **, and * denote statistical significance at the .01, .05, and .10 levels, respectively. Further test statistics available from the authors on request.

Overall, firms appear to be extremely financially constrained in Portugal, which might be due to relative underdevelopment of financial markets. However, despite the problems, described above, associated with the estimation of ICFS and the fact that the CCFS test may be relatively close to an accounting identity, some patters rose from the data indicating a potential inverse relationship between size, dividend policy, the SA index and financial constraints. As to age, the results are mixed and should be dealt with caution in order to ascertain if they originate from problems associated with the estimations, flawed classification schemes, or even erroneous theoretical assumptions.

6. Concluding remarks

In this paper we have analysed the financial constraints faced by firms by estimating investment-cash flow sensitivities and cash-cash flow sensitivities upon a large unbalanced panel of Portuguese firms. Additionally we split our sample according to firm's characteristics that are believed to be good proxies for financial constraints (size, age and dividend policy) as well as resorting to a new index of constraints (SA index) in order to both test the validity of such classification schemes and compare measurement methodologies.

Our results, while supporting previous literature on the inverse relationship between size, dividend policy and financial constraints, they cast some doubts on previously devised relationships between age and the level of constraints. As to the SA index, it is clear that the model should be calibrated according to each economic reality in order to provide correct constraints classification.

This work adds to the discussion over financial constraints both by providing new results on the Portuguese (and perhaps also European) economy and by testing and comparing different methodologies used to measure constraints and classify firms by their financial distress.

Finally, this paper reveals serious difficulties of firms in resorting to external finance. So, despite a need for particular analysis of such measures, policies should be taken to alleviate firm's financial constraints, in particular, those aimed at firms with smaller size. These policies should be discriminative and specially devised for firms with favourable growth prospects but financially constrained.

Future research should aim essentially at five goals: (a) develop more consistent measures of financial constraints; (b) analyse entry using a pool of potential entrants and controlling for selection biases; (c) analyse exit distinguishing different modes exiting the market; (d) explore suitable policies to alleviate financial constraints; (e) analyse financial constraints in different sectors of economic activity.

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Appendix: Construction of variables

From the data at our disposal we were able to create the following variables:
Size (SIZE): Measured as the number of employees
Size (S): Computed as log inflation-adjusted assets (deflation through the GDP deflator)
Age (AGE): Computed as the difference between the current year and the year of establishment of the firm plus one
Investment (I | invest): Measured as additions to plant, property and equipment- gross investment
Output (Y | y): Measured as total sales and services
Cash- flow (CF | cf): Computed as net income before taxes plus depreciation
Cash stock (CS | cs): Measured as total cash holdings
Investment Opportunities(DY | dy): In most empirical studies, investment opportunities are measured using average Tobin's Q (the ratio between the total market value and asset value of a firm). However, we refrain from using this measure and instead use sales growth. This measure is often used in empirical work on countries with less developed financial markets where information on firm's market value is scarcer (see for eg. Budina et al., 2000 or Konings et al., 2003). In some cases lagged sales may even outperform Q (see FHP p. 173,174).
Dividends (DIV): Computed as an indicator due to the lack of quality in the variable Reserves. The variable will take value 0 if the firm does not pay dividends and the value 1 if a firm pays dividends.
Debt and equity issuances (Issuances): Sum of debt and equity issuances. For the year 2001 equity issuances are reported as missing. The reason lies in legal changes that took place with the introduction of euros (most firms adjusted their equity not necessarily meaning issuing equity).
Non-cash net working capital (NWK | nwk): Difference between non-cash current assets and current liabilities.

All variables of interest were winsorized at 1% level in order to avoid problems with outliers in the estimation procedures. Deflators used include the Industrial Production Price Index and Labour Cost Index, both drawn from INE, and the GDP deflator, drawn from the Portuguese Central Bank (BdP). Nevertheless, no deflators were used when a variable was constructed as a ratio of two nominal values (normalized). In such cases we assume that the price growth rates are homogeneous. All variables in low caps result from a normalization procedure (the variable of interest is divided by total assets). Finally, prefixes D_(d_) are added for first difference of variables (normalised variables) of interest.

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