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FACULTY OF ECONOMICS AND BUSINESS ADMINISTRATION

Investment, Growth and the Access to Finance of Firms: An Empirical Analysis

Klaas Mulier

Supervisors: Prof. Dr. Koen Schoors (Ghent University, Supervisor)
Prof. Dr. Bruno Merlevede (Ghent University, Co-supervisor)

Submitted at Ghent University,

To the Faculty of Economics and Business Administration,

In fulfillment of the requirements for the degree of Doctor in Economics

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Doctoral committee: Prof. Dr. Marc De Clercq (Ghent University, Dean)

Prof. Dr. Patrick Van Kenhove (Ghent University, Academic Secretary)

Prof. Dr. Koen Schoors (Ghent University, Supervisor)

Prof. Dr. Bruno Merlevede (Ghent University, Co-supervisor)

Prof. Dr. Wouter De Maeseneire (Vlerick Business School)

Prof. Dr. Gerdie Everaert (Ghent University)

Annalisa Ferrando (European Central Bank)

Dr. Philip Vermeulen (European Central Bank)

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Klaas Mulier

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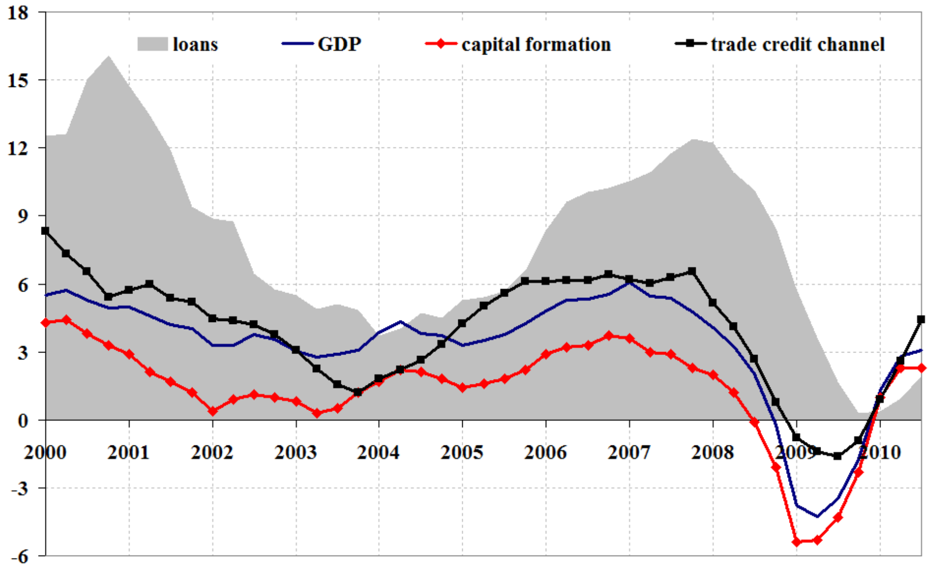
Introduction

The financial crisis has renewed the interest of researchers and policy makers in the link between the financial economy and the real economy. In his speech of 13 December 2012, Benoît Coeuré, Member of the Executive Board of the European Central Bank (ECB), said that *"the financing environment and access to finance for euro area corporates are important elements in the policy-making process of the ECB, both for standard and non-standard monetary policy decisions"*. The motivation for this statement is that frictions and dysfunctionalities in financial intermediation and the transmission mechanism influence firm investment, and hence growth and price stability.

Figure 1.1: Loans, capital formation, GDP and trade credit (euro area annual % changes)



Source: ECB and Eurostat, euro area integrated accounts. Notes: Annual % changes are the four-quarter sum of transactions over the amounts outstanding four quarters earlier for the loans and trade credit. Trade credit channel is the average of accounts receivable and payable, which are estimated by the ECB on the basis of partial information. The year-on-year % changes in euro area GDP and gross capital formation are expressed in seasonally adjusted current prices.

This dissertation focuses on these financial market frictions and their impact on firm investment and growth. Figure 1.1 shows the link between bank loans, investment (measured by gross capital formation) and GDP to illustrate the importance. It can be clearly seen that loan growth is highly related to investment growth and GDP growth. The figure also strikingly displays the recent financial crisis, with its giant drop in investment growth and GDP growth, which was unprecedented in the past decades. Therefore, a better insight on financial market frictions and their transmission to investment and growth is of the utmost importance. Chapters 2 and 3 focus on firm investment and the role of financial constraints. Chapter 4 analyzes whether firms substitute bank loans for trade credit in the production chain if the firm's access to regular finance has become difficult. Chapter 5, contributes to our understanding of the nature of financial constraints by investigating the determinants of firms' self-reported financial constraints during the recent financial crisis.

In his speech, Benoît Coeuré further stated that *"the ECB regards small and medium-sized enterprises (SMEs) as a crucial component of the euro area economy and that the ECB's deliberations on monetary policy systematically take into account the financial health of, and the growth prospects for, euro area SMEs ... Moreover, these SMEs are highly dependent on bank loans which are supplied at a higher cost and with a higher rejection rate than for larger firms, due to asymmetric information"*. The ECB director thus highlights the importance of SMEs in the euro area. This is not surprising since more than 99 percent of the European firms are SMEs, but he also acknowledges that they might face different financial conditions than large firms, as they are more likely to suffer from financial market frictions. Therefore, special attention is given to SMEs throughout this dissertation.

As stated earlier, the **second and third chapter** of this dissertation focus on the role of financial frictions for firm investment. More specifically, these chapters contribute to an ongoing debate in the literature on investment-cash flow sensitivities. This literature took a flight after the seminal contribution of Fazzari et al. (1988) and after the critique of Kaplan and Zingales (1997) on this seminal paper. According to neoclassical investment models, the investment decision should be independent of the financial decision. Stated differently, the actual investment of a firm should depend only on its optimal investment level, while the question whether the firm has the financial means to pursue this optimal investment should be irrelevant. This should be since, in the neoclassical view, firms will always be able to obtain the necessary funds in the financial market because financial markets are assumed to be perfect. Fazzari et al. (1988) were the first to reject this perfect financial market hypothesis by showing that the investment of firms does not only depend on the optimal investment level but also on the firm's own cash flow. Moreover, they showed that investment is more sensitive to cash flow for firms that are expected to have more difficulties to obtain funds from the financial market. This is because cash flow works as a mitigating factor for the frictions in the financial market, and those that suffer most from such frictions benefit most from additional cash flow.

Using investment-cash flow sensitivities to show that financial markets are not perfect became a popular method after Fazzari et al. (1988), but it was also heavily criticized. Many argued that there is no theoretical reason to assume that higher investment-cash flow sensitivities automatically follow from higher financial constraints, and some even showed the opposite. (Kaplan and Zingales, 1997; Cleary, 1999) Others argued that investment-cash flow sensitivities arise because in practice it is very difficult for economists to measure the firms optimal investment level, and that cash flow is significant for investment not because it is a reflection of constrained access to the financial market, but because cash flow is related to growth opportunities, which are part of the optimal investment decision. (Alti, 2003; Erickson and Whited, 2000; Cummins et al., 2006) This basically summarizes the ongoing debate and the second and third chapter of this dissertation try to address three main issues in this literature. 1) Can investment-cash flow sensitivities be seen as an indication of financial constraints? 2) Is the correlation between cash flow and growth opportunities responsible for the observed sensitivity of investment to cash flow? 3) How can the opposite findings between Fazzari et al. (1988) and Kaplan and Zingales (1997) be explained?

A new index to measure the access to external finance of firms is constructed in the second chapter. The advantage of the index is that it takes multiple components of access to finance simultaneously into account. The index, for instance, assumes that SMEs will suffer more from frictions in the financial market. It is shown that firms that are classified as financially constrained according to this index pay a higher interest rate on their external funds, which confirms that the index provides a good measure of financial constraints. It is especially for these constrained firms, which are characterised by a higher cost of finance, that a windfall gain in cash flow results in a larger drop of the interest rate. This drop makes external finance cheaper and hence more investment possible, resulting in positive investment-cash flow sensitivities. Indeed, in the second chapter it is shown that investment-cash flow sensitivities are larger for firms that face the most restricted credit supply according to the index and it is advocated that the cost of finance is the driving force behind investment-cash flow sensitivities. Thus, investment-cash flow sensitivities are related to higher financial constraints.

In the third chapter of this thesis it is analyzed how the opposite findings in the literature can be explained, given that the interest rate on external finance is the driver of investment-cash flow sensitivities? It is shown that cash flow volatility can explain this. The volatility of cash flow has implications for the signalling and expectations formation after a windfall gain in cash flow because a firm's demand for external finance not only depends on its current cash flow, but also on its future cash flow. For a given positive cash flow shock, it is more likely for firms with low cash flow volatility that this change in cash flow falls outside the normal fluctuations of the firm's cash flow, and hence the firm has an incentive to change its expectations about future cash flow. This will imply a larger relaxation of the financial constraints and thus a larger drop in the cost of finance which instigates more investment. It follows that investment-cash flow sensitivities are greater for firms with low cash flow volatility. The opposite findings in the literature might thus be explained by the differences in the definitions of financial constraints used by both sides. While it is shown in the second chapter that investment-cash flow sensitivities are more pronounced for financially constrained firms (in line with Fazzari et al. (1988)), the third chapter shows you may find the opposite if the definition of financial constraints is related to high cash flow volatility (as is likely the case for Kaplan and Zingales (1997); Cleary (1999)).

Both the second and third chapter of this thesis take into account that cash flow can be correlated with growth opportunities. To rule out the possibility that investment-cash flow sensitivities might be explained by this relationship a firm level control variable for such growth opportunities is included in the investment model, namely employment growth. It is assumed that firms with better growth opportunities will have higher employment growth. If investment is still sensitive to the firm's cash flow after controlling for growth opportunities, it is more certain to conclude that these investment-cash flow sensitivities reflect the role of cash flow in alleviating frictions in the financial market.

The first two studies thus show that investment-cash flow sensitivities decrease with the access to external finance (one side of the literature), and that investment-cash flow sensitivities decrease with the volatility of cash flow (which is related to the definition of constraints used in the other side of the literature). However, the driving mechanism behind investment-cash flow sensitivities is in both cases the same, namely the cost of finance.

The **fourth chapter** of this dissertation investigates the link between trade credit and firm growth. Figure 1.1 shows that there has been an increase in the use of trade credit during the recent financial crisis, in particular from mid-2009, which is likely to compensate the strong decline in short-term bank loans. Interestingly, the decline in the annual growth of trade credit payable and receivable between non-financial firms has been less pronounced than that in nominal GDP growth, which may indicate that trade credit between companies has played a buffer role in the recent crisis.

In the presence of financial market frictions it is crucial for firms to receive trade credit from their suppliers in order to prefinance production, but it is also important to extend trade credit in order to sell goods to their constrained customers. It is argued that not just the accounts payable or the accounts receivable matter, but rather the sum of both, which works as a credit channel of trade. Further, it is assumed that firms do not need to finance their accounts receivable with internal funds, but that firms may have a contract with a financial intermediary which allows them to draw on short term liabilities to finance a large portion of their accounts receivable. The interpretation is that this trade credit channel variable gives an idea of how much of the firm's operations are independent of frictions or imperfections in the financial market. In this perspective, this chapter also adds to the revived literature on the link between the financial sector and the real economy.

Using over 2.5 million observations for 600.000 firms in 8 euro area countries in the period 1993-2009, it is shown that firms use the trade credit channel to finance growth. In countries where the trade credit channel is more present, the marginal impact of the trade credit channel on growth is lower, but the total impact is still higher. In addition, firms that are more vulnerable to financial market imperfections and therefore more likely to be financially constrained (i.e. SMEs or young firms), are found to rely more on the trade credit channel to grow. Finally, it is shown that also the overall conditions of the financial market matter for the importance of the trade credit channel for growth, even after controlling for regulation in the product market. When there are less bank loans or debt securities available in the financial market, firms rely more on the trade credit channel to grow.

The **fifth chapter** of this dissertation focuses specifically on the access to finance during the financial crisis. After the onset of the financial crisis, the ECB and the European Commission initiated a survey to get a better view on the access to finance (and other problems) of SMEs. Although this Survey on the Access to Finance of small and medium sized Enterprises (SAFE) is quite detailed, it lacks information on the balance sheet and profit & loss account of the firms, like most other surveys.

Therefore, researchers have either used balance sheet and profit & loss account data to show the link between firm characteristics and firm growth or used survey data to show the link between financing obstacles and firm growth. It has thus not yet been possible to relate financing obstacles directly to the financial characteristics of firms, while this could potentially give us a better understanding of the nature of financing obstacles. This gap in the literature is addressed by trying to match 11886 firms from the SAFE survey dataset with their balance sheet information out of an extended dataset with 2.3 million firms.

Financial constraints are measured through firms' self-assessment on whether access to finance constitutes their most pressing problem. It is then investigated whether the firms that self-report to be financially constrained have different characteristics than financially unconstrained firms. This measure relates to the perception of firms about their access to finance. Therefore also a more objective measure of financial constraints is considered, which is related to whether the firms report to have actually applied for external finance. Again the characteristics of those that successfully obtained external finance are compared to those whose applications were rejected.

The empirical results based on a bivariate probit model show that financial ratios are important in explaining financial constraints. Measures related to the profitability of the firm are more robust than liquidity measures or leverage measures. The profitability of the firm is important to explain the actual financing obstacles encountered by firms but not the perceived financing obstacles. The finding that more profitable firms are less likely to face actual external financing obstacles can be seen as support for the balance sheet channel. Indeed, restrictive monetary policy induces interest rates to go up, putting pressure on profitability and hence net worth, leading to higher chances of facing a constrained credit supply. Further, firms that finance a higher share of their assets with short term loans are more likely to perceive access to finance as problematic. This is due to the fact that these firms need to roll over a high share of their debt yearly and they expect that this might become very difficult or costly when market conditions turn for the worse. Finally, it is shown that firm age, but surprisingly not size, is negatively related with perceived and actual access to external finance. In the chapter, it is argued that this can be due to the fact that small firms appear to self-select out of the actual loan-application process due to 'fear of rejection'. The results indicate that firms should strive for the highest profitability possible and should pounder on the desired maturity structure of their debt. Still, policy makers should be aware that firms may also be discriminated on the basis of age.

In sum, this dissertation explores the causes and consequences of the access to finance of firms. Chapter five shows that profitability is an important condition to obtain external finance and that the maturity structure of the firm's debt can explain the perception of financial constraints by firms. Importantly, age seems to be strongly related to both perceived and actual financing obstacles. Chapter 2 takes some of these causes into account to measure the degree of frictions that firms face to access the financial market. Moreover, it is shown that the investment of firms reacts positively when these frictions are relaxed (by a windfall in cash flow). The third chapter looks deeper into this investment literature. It provides an explanation for the conflicting evidence in this literature and shows how the volatility of cash flow may explain the opposite findings. Finally, the fourth chapter focuses on an alternative way to finance production, namely the trade credit channel. It is found that firms use the trade credit channel to grow, and that this firm behaviour is especially true for firms that are more likely to suffer from financial market frictions.

As shown in this dissertation, access to finance is an important concern for firms and financial constraints are transmitted via investment to the real economy. Therefore, it is unlikely that the issue of access to finance will lose the attention of policy makers any time soon.

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2

Investment Cash Flow Sensitivity and the Cost of External Finance[1]

2.1 Introduction

In recent years there has been an intense academic debate on investment dynamics and financial constraints. A firm is financially constrained if its investment is limited by its generation of internal funds, because it cannot obtain sufficient external funds to finance its investment plans. The empirical literature has found

[1]This chapter is the result of joint work with Koen Schoors and Bruno Merlevede

financial constraints to be elusive, mainly because we lack a direct measure of financial constraints everyone can agree on. Financial constraints are therefore usually measured indirectly through variables that are assumed to be related to financial constraints, but these assumptions always leave room for reasonable doubt. The literature often resorts to interpreting investment-cash flow sensitivities as an indication of firm-level constraints to obtain external finance. The fundamental problem is that the only certain thing one can state about firms that exhibit high investment-cash flow sensitivities is that their cash flow relates to investment, either directly or indirectly. However, the equilibrium decision to finance investment with cash flow, observed by the econometrician, is by definition a mixed supply and demand effect. The question remains whether these high sensitivities reflect an unsatisfied demand for external funds by the firm (supply effect), the preference for internal funds over external funds for a variety of underlying reasons (demand effect), or simply the fact that cash flow is correlated with an omitted variable (e.g. opportunities) that is also positively associated with investment. The empirical challenge is to disentangle these effects in the face of the understanding that a perfect identification methodology may not exist. To this purpose we analyze a large sample of unquoted firms in Nordic countries, Western European countries and Eastern European transition countries.

The first contribution to the literature is that we construct a new index to identify the supply of external finance. We argue that it is mainly the supply side in the market for external finance that is binding and restricts the investment of firms. Investment reacts positively to cash flow because the latter relaxes the constraints in the market for external finance, and this will be most prevalent for those that the constraint is most binding. Therefore, we will focus on the (in)elasticity of the supply curve for the identification of financial constraints. Besides traditional variables as age and size, this index also incorporates the average profitability of the firm (cash flow). We find that firms that are considered to be constrained according to our index show the highest investment cash flow sensitivities.

The second contribution is that we employ the additional information supplied by implicit interest rates to disentangle supply and demand effects. We argue that being financially constrained does not necessarily require that a firm is fully excluded from external funding, but merely that a firm cannot obtain external finance at a reasonably low cost. Indeed, for a given demand for external finance, firms that face a more restricted supply, pay a higher equilibrium interest rate for their finance. We show that firms that are considered financially constrained according to our index pay a higher interest rate. Moreover, using our measure of the interest rate, we show that the elasticity of the supply of finance is an important constraint in the market for external finance and that high interest rates may be a reliable indicator of credit constraints for all countries under study. Thus, starting from a given equilibrium in the market for external finance, a drop in the demand for external funds following a windfall gain in cash flow implies a drop in the interest rate, which will instigate additional investment and might explain the observed positive correlation between investment and cash flow. We provide new evidence consistent with the recent findings of Campbell et al. (2012) that the cost of capital is the driving force behind investment and its relation with internal funds.

The third contribution of this paper is that our findings are not driven by the possible correlation between cash flow and investment opportunities. If an increase in unobserved investment opportunities increases planned investment and implies elevated cash flows, then investment-cash flow sensitivities may arise in the absence of credit constraints. To avoid that our observed investment-cash flow sensititivities would merely reflect the presence of investment opportunities, we augment the empirical model with a firm level control variable for investment opportunities: employment growth. Firms will increase their workforce if they expect future growth opportunities. We show that employment growth is indeed positively related to both investment and cash flow and can thus be a good control variable. Finally, unlike most studies investigating financial constraints, we investigate several countries characterised by different economic and financial systems, as financial constraints may be specific to a country or a financial system, and restrict our dataset to unquoted firms, which are much more likely to face financial constraints than quoted firms.

The paper is organized as follows: we start in section 2.2 with an overview of the related literature. We describe the dataset in section 2.3. Section 2.4 presents the empirical approach and estimations, and finally, section 2.5 concludes.

2.2 Related literature

In their pioneering paper, Fazzari, Hubbard and Petersen (1988) (hereinafter FHP) find that the investment of firms with low dividend pay-out ratios (i.e. firms that are more likely to face financial constraints) is highly sensitive to the availability of cash flow. A number of subsequent contributions (Whited, 1992; Hoshi et al., 1992; Carpenter et al., 1994; Kashyap et al., 1994; Bond and Meghir, 1994; Carpenter et al., 1998; Mizen and Vermeulen, 2005) find results in line with FHP. The FHP results were challenged in 1997 by Kaplan and Zingales (hereinafter KZ). KZ show theoretically that a firm's profit maximizing investment choices do not yield a simple monotonic relation between financial constraints and investment-cash flow sensitivities, which invalidates the empirical strategy of the FHP strand of literature. In line with their theory, KZ show that in FHP's low dividend pay-out ratio sample, firm-year observations with weaker financial positions have lower investment-cash flow sensitivities. KZ's results were subsequently confirmed by a number of authors (Cleary, 1999, 2006; Cleary et al., 2007).

Several additional theoretical challenges to the FHP interpretation of investment-cash flow sensitivities were later developed. Alti (2003) assumes that young firms are uncertain about the quality of their projects and derive information about their projects from cash realizations. In this environment investment-cash flow sensitivities arise in the absence of any financial market imperfections, challenging the classical FHP interpretations. Erickson and Whited (2000) and Cummins et al. (2006) make similar comments that the significant role of cash flow for investment is related to investment opportunities, which are incorrectly measured by Q. However, Gilchrist and Himmelberg (1995) and later Carpenter and Guariglia (2008) still find that cash flow sensitivities are a reflection from underlying credit frictions since cash flow remains significant even when Q is measured correctly or, respectively, when investment opportunities are controlled for.
Another theoretical challenge comes from Cleary et al. (2007) who construct an investment model with two opposite dynamics, a cost effect and a revenue effect. They argue that the revenue effect prevails for firms with low (or negative) levels of internal funds. When cash flow drops for these firms, they need to invest more in order to generate more future revenues (cash flow). This results in a negative relationship between investment and cash flow for these firms. For high cash flow firms the cost effect dominates such that a drop in cash flow for these firms does not encourage them to take additional external funds -since the cost for these additional funds would be higher-, but to decrease investment, resulting in a positive sensitivity. The two effects together yield a U-shaped investment curve, which is in line with the basic KZ argument that there exists no simple monotonic relation between financial constraints and investment-cash flow sensitivities.
The empirical literature has tried to realign the contradictory theoretical predictions and empirical findings with respect to investment-cash flow sensitivities.

Allayannis and Mozumdar (2004) argue that some firms might be in such severe financial distress that investment cannot respond to cash flow, implying a lower sensitivity for financially more constrained firms. Their argument boils down to the proposition that the found sensitivity for firms in distress reflects a lower investment demand, rather than a credit supply constraint. The current literature appears to have reached a consensus about a U-shape form for the investment-cash flow relationship, as predicted by Cleary et al. (2007). A recent paper by Guariglia (2008) suggests that the opposite results found by FHP and KZ are due to different measures of financial constraints: while the FHP strand of the literature uses proxies for external financial constraints, such as firm size, age or dividend payout, the KZ strand of the literature uses proxies for firm liquidity that capture internal financial constraints. Guariglia (2008) shows that the Cleary et al. (2007) U-shape is present when considering a sample-split on the basis of internal funding (the KZ case), while the investment-cash flow sensitivity increases monotonically when splitting the sample according to external financial constraints (the FHP case). Becchetti et al. (2010) combine the traditional information on external financial constraints with qualitative information on self-declared credit rationing from a panel of Italian firms to assess the validity of the different points of view in the literature. They find that age and size are good predictors of the probability of being credit rationed. Also in support of the FHP results, Hadlock and Pierce (2010) show that an index based on firm size and age performs much better in predicting financial constraints than the widely used KZ index, although they argue that investment-cash flow sensitivities are not a good setting to investigate financial constraints.

Further, Duchin et al. (2010) show that investment dropped significantly in the financial crisis due to the negative supply shock to external finance that characterized the recent crisis. They show that this drop is greatest for firms that are financially constrained, but do not relate this to excess cash flow sensitivity. Campbell et al. (2012) provide evidence that the cost of capital could be the intervening variable that explains the relation between decreasing internal funds and decreasing corporate investment. Contrary to what one would expect from the findings of Duchin et al. (2010) and Campbell et al. (2012), Chen and Chen (2012) show that investment-cash flow sensitivities have disappeared during the financial crisis and conclude that they do not measure the credit frictions that were widely present during that period.

2.3 Data

The data set used in this paper covers the period 1996-2008 and consists of the profit and loss account and balance sheet data for six European countries gathered by Bureau Van Dijk Electronic Publishing in the Amadeus database. To make sure that none of our possible results are driven by country specific elements, we choose six countries with different backgrounds and sufficient data on the regression variables available. Belgium and France are two standard West European countries, Finland and Sweden represent the Scandinavian model and with the Czech Republic and Hungary, our sample also contains two transition countries. Following Cleary (1999), we exclude banks, insurance companies, other financial companies and utility firms from the dataset and retain firms from the following seven industries: agriculture and mining, manufacturing, construction, retail and wholesale trade, hotel and restaurants, services, and health and others (see Table 2.10 in the appendix for more details). Furthermore the sample consists of unquoted firms, which are more likely to face financial constraints than publicly quoted firms.

Table 2.1 shows descriptive statistics of the main variables of interest for our research. Investment (I_{it}) is measured as the sum of depreciation in year t and the change in tangible fixed assets from year $t-1$ to year t. Using this measure of investment allows comparability with many other papers in the literature[2]. The replacement value of the capital stock is calculated with the perpetual inventory formula (Blundell et al., 1992). Using tangible fixed assets as the historic value of the capital stock and assuming that in the first period the historic value equals the replacement cost, we calculate the capital stock as $K_{it+1} = K_{it} * (1-\delta) * (p_{t+1}/p_t) + I_{it+1}$. With δ representing the depreciation rate, which we assume to be constant at 5.5% and p_t is the price of investment goods, proxied by the gross total fixed capital formation deflator. Δs_{it} is the change in the log of real total sales, and measures sales growth. Δemp_{it} is the change in the log of real total costs of employees, and measures employment growth.[3] We use the costs of employees because the data on the actual number of employees has a lot more missing values in Amadeus.[4] Moreover, we can assume that the total costs are a better reflection of the number of full time employed workers, rather than the number itself. Later, in the empirical model we will use the beginning of period employment growth. CF_{it}/K_{it-1} represents a firm's cash flow, scaled by its beginning of period capital.

Further, to control for outliers, large mergers or typing errors we drop observations in the 1% tails of the distribution of both the level and first difference of the

[2] See for instance Mizen and Vermeulen (2005); Bloom et al. (2007); Guariglia (2008).

[3] real sales and real costs of employees are obtained by deflating the nominal values with the gdp deflator.

[4] We loose approximately 40 percent of the data when using the actual number of employees rather than the cost of employees. Nonetheless, later in the paper we will estimate one of the models with the actual number of employees as a robustness check.

Table 2.1: Descriptive statistics: sample means and standard deviations

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it}/K_{it-1}	0.112	0.111	0.122	0.144	0.075	0.151
	(0.102)	(0.132)	(0.149)	(0.202)	(0.128)	(0.186)
$k_{it-2} - s_{it-2}$	-1.565	-1.860	-1.562	-1.848	-1.023	-1.360
	(0.912)	(0.690)	(0.894)	(1.316)	(1.063)	(0.975)
Δs_{it}	0.020	0.009	0.023	0.007	-0.020	0.007
	(0.122)	(0.106)	(0.179)	(0.338)	(0.210)	(0.271)
Δemp_{it}	0.011	0.018	0.032	0.007	-0.008	0.060
	(0.081)	(0.106)	(0.181)	(0.467)	(0.132)	(0.207)
CF_{it}/K_{it-1}	0.282	0.417	0.477	0.392	0.205	0.278
	(0.309)	(0.361)	(0.513)	(1.027)	(0.317)	(0.312)
$\#firms$	2,555	69,801	9,876	31,396	2,101	1,405
$\#obs$	17,117	404,366	58,097	141,475	13,697	7,443

Notes. The Table shows sample means and in parentheses the corresponding standard deviations. The subscript i indexes firms, and the subscript t, time, where t = 1996-2008. I is the firm's investment, K the replacement value of the firm's capital stock and k its logarithm, s is the logarithm of total sales, emp is logarithm of total costs of employees, and finally CF represents a firm's cash flow.

regression variables. We also excluded firms with accounting periods that differ from the standard 12 months. Following Mizen and Vermeulen (2005) we also have a consecutive run of at least five observations for each firm. The descriptive statistics are relatively similar across the countries considered. The lower investment rate in the Czech Republic is partly due to the larger share of firms in the agricultural sector in the sample.

The descriptive statistics in Table 2.1 show that our data is similar to what is known from previous research. Investment levels are on average between 10 and 15 percent of the capital stock. Real sales growth is around 1 to 2 percent annually. Interestingly, this also appears to be the case for employment growth. Cash flow levels vary from 20 percent to 47 percent of the capital stock.

2.4 Empirical approach and estimation

2.4.1 The investment model

Our reduced form investment model is based on the error correction model (2.1) and follows the work of Bond et al. (2003), Mizen and Vermeulen (2005), Bloom et al. (2007) and Guariglia (2008). Changes in the capital stock are related to the optimal capital stock (k^*) and are dynamic, reflecting that capital adjustment is costly. As in the previous cited research, we use the approximation that $\Delta k_t \approx \frac{I_{it}}{K_{it-1}} - \delta_i$ and make the assumption that the optimal capital stock is related to output ($k^* \approx s$). This gives model (2.2) which can now be estimated with our data. (See the Appendix for a full derivation of the model.) The widely used structural Q-model of investment is not applicable because the firms in our dataset are unquoted and hence it is not possible to construct a tobin's q with our data.

$$\Delta k_t = \alpha_1 \Delta k_{t-1} + \alpha_2 (k_{it-2} - k^*_{it-2}) + \alpha_3 \Delta k^*_{it} + \alpha_4 \Delta k^*_{it-1} + \upsilon_i + \upsilon_t + \upsilon_{jt} + \varepsilon_{it} \quad (2.1)$$

$$\frac{I_{it}}{K_{it-1}} = \alpha_1 \frac{I_{it-1}}{K_{it-2}} + \alpha_2 (k_{it-2} - s_{it-2}) + \alpha_3 \Delta s_{it} + \alpha_4 \Delta s_{it-1} + \upsilon_i + \upsilon_t + \upsilon_{jt} + \varepsilon_{it} \quad (2.2)$$

Where I is the firm's investment, K the replacement value of the firm's capital stock and k its logarithm, s is the logarithm of real total sales. The subscript i

indexes firms, the subscript j industries and the subscript t, time, where t = 1996-2008. The error term consists of four components: an unobserved firm specific component υ_i, a time component to filter out business cycle effects υ_t, a time component which varies over industries accounting for industry specific effects υ_{jt} and finally an idiosyncratic component ε_{it}. The error-correction term $(k_{it-2} - s_{it-2})$ captures the long run equilibrium between capital and its target, proxied by sales.

The reduced form investment model (2.2) (as well as the majority of structural models in the literature) makes the assumption of perfect capital markets. This implies that a firm's investment decision is independent of its financial decision, and therefore, financial variables should not play a role for investment. Fazzari et al. (1988) were the first to test this assumption by including cash flow in the empirical specification. Since then, including cash flow has become a common way in the literature to test for capital market frictions, so we augment model (2.2) with cash flow $(\frac{CF_{it}}{K_{it-1}})$ to obtain the baseline model (2.3). As Bond and Van Reenen (2005) point out, this approach is valid in a structural model because all information about investment opportunities is captured by q and thus any information content of cash flow can be expected to reflect capital market imperfections.[5] While our reduced form model (2.3) bypasses the known problems with measurement error in q, it does not control for the possible information content of cash flow regarding investment opportunities and the expectation about future marginal revenue. To control for the latter, model (2.3) is augmented with firm level employment growth (Δemp_{it-1}) under the assumption that firms will increase their workforce if they

[5]This approach is no longer valid if the structural model is not correctly specified or when marginal q does not fully capture the future marginal revenue of investing. See Erickson and Whited (2000) and Cummins et al. (2006) on the problems with measurement error in q.

expect good investment opportunities.[6] Labour chosen at the beginning of the period thus controls for the unobserved opportunity shock. As labour is assumed to be more flexible than capital in the production process, employment reacts in period t and investment in period t+1 to expected opportunities $E_t[opp_{t+1}]$. When the opportunities hence realise in period t+1, they will affect cash flow in t+1 which might coincide with the augmented planned investment in t+1 due to opportunity shock. If investment reacts to cash flow because it reveals investment opportunities, cash flow should not be significant anymore after the inclusion of beginning of period employment growth as shown in model (2.4).

$$\begin{aligned} \frac{I_{it}}{K_{it-1}} &= \alpha_1 \frac{I_{it-1}}{K_{it-2}} + \alpha_2(k_{it-2} - s_{it-2}) + \alpha_3 \Delta s_{it} + \alpha_4 \Delta s_{it-1} \\ &\quad + \alpha_6 \frac{CF_{it}}{K_{it-1}} + \upsilon_i + \upsilon_t + \upsilon_{jt} + \varepsilon_{it} \end{aligned} \tag{2.3}$$

$$\begin{aligned} \frac{I_{it}}{K_{it-1}} &= \alpha_1 \frac{I_{it-1}}{K_{it-2}} + \alpha_2(k_{it-2} - s_{it-2}) + \alpha_3 \Delta s_{it} + \alpha_4 \Delta s_{it-1} \\ &\quad + \alpha_5 \Delta emp_{it-1} + \alpha_6 \frac{CF_{it}}{K_{it-1}} + \upsilon_i + \upsilon_t + \upsilon_{jt} + \varepsilon_{it} \end{aligned} \tag{2.4}$$

All specifications are estimated with the first difference General Method of Moments (GMM) estimator developed by Arellano and Bond (1991). The first difference GMM estimator is appropriate since it controls for biases due to unobserved firm-specific effects and the endogeneity of explanatory variables. Note that we are estimating a reduced form model and therefore we need to be careful in interpreting the results. Moreover, as the instruments used in the estimations sometimes differ between countries, we shall focus on the economic importance of the

[6]The literature on the identification of production functions uses a similar approach to control for shocks that are observed by the firm but not the econometrician. See for instance Olley and Pakes (1996), Levinsohn and Petrin (2003) and Ackerberg et al. (2006).

findings rather than on the cross country comparison. The measure of the interest rate introduced in section 2.4.3 will help us draw valid conclusions from the results. The instruments used for the endogenous variables are I_{it-2}/K_{it-3}, Δs_{it-2}, $k_{it-2} - s_{it-2}$, Δemp_{t-2}, CF_{it-2}/K_{it-3} and/or further lags. The exogenous time dummies and industry-time dummies are instrumented by themselves. Roodman (2009) warns for issues related to too many instruments used in the first difference GMM, but especially in the system GMM. Roodman (2009) points to efficiency problems that arise when the number of instruments is close to the number of crossections, which is likely not an issue in our case. Another issue relates to the weak power of the J-test when instruments are many, but note that few guidelines exist in the literature about how many instruments are too many to trust the J-statistic. Therefore, we try to cap the number of instruments per period as much as possible.

Table 2.2 presents the estimates of specification (2.3). The lagged investment term is negative in some countries and zero in others. The error correction term always has a significant negative sign, indicating that when capital is lower than its desired level, investment increases, ensuring a return to the equilibrium level. Table 2.2 further indicates a significant positive relationship between sales growth and investment. The positive and significant value for cash flow implies that an increase in cash flow enables firms to invest more. Since all the firms in our sample are unquoted it is likely that this observed investment-cash flow sensitivity is an indication of financial constraints. A bit surprising, while the point estimate of cash flow in Hungary is very similar to that in other countries, it is not significant at the 10 percent level, but we will come back to this when we do some robustness checks. Quantitatively, our results are similar across countries and consistent with previous research. Finally, $m2$ provides no indication that the instruments would

Table 2.2: Baseline Estimation: model (2.3)

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it-1}/K_{it-2}	-0.085	-0.182***	-0.204***	-0.008	0.016	-0.094**
	(0.054)	(0.028)	(0.021)	(0.103)	(0.027)	(0.044)
$k_{it-2} - s_{it-2}$	-0.218***	-0.191***	-0.247***	-0.165***	-0.127***	-0.195***
	(0.045)	(0.020)	(0.023)	(0.026)	(0.022)	(0.063)
Δs_{it}	0.214***	-0.075	0.152***	0.183***	0.123***	0.082
	(0.063)	(0.101)	(0.036)	(0.028)	(0.035)	(0.063)
Δs_{it-1}	0.209***	0.153***	0.258***	0.173***	0.141***	0.216***
	(0.042)	(0.031)	(0.021)	(0.026)	(0.021)	(0.044)
CF_{it}/K_{it-1}	0.080***	0.057***	0.029***	0.042***	0.078***	0.073
	(0.023)	(0.014)	(0.011)	(0.008)	(0.025)	(0.049)
$sector/year\ dummies$	YES	YES	YES	YES	YES	YES
$\#instruments$	139	89	283	117	251	167
$m2$	0.94	0.07	0.51	0.44	0.25	0.31
J	0.53	0.13	0.09	0.13	0.37	0.87
$\#firms$	2,555	69,801	9,876	31,396	2,101	1,405
$\#obs$	17,117	404,366	58,097	141,475	13,697	7,443

Notes. The Table shows the output for the GMM first difference estimation of specification (2.3). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

be correlated with the error term. The null hypothesis of no second order serial correlation cannot be rejected in all our regressions. Also the null hypothesis of instrument validity, known as the Sargan test of overidentifying restrictions (J), cannot be rejected in all our specifications.

As argued earlier, it could however be that the found investment-cash flow sensitivities in Table 2.1 are not a reflection of underlying financial constraints, but arise automatically because cash flow is related to investment opportunities and is hence also related to increased investment. To control for this we augment specification (2.3) with firm level employment growth and estimate model (2.4). Firms with better investment opportunities are likely to increase their workforce while firms with bad investment opportunities are likely to lay off some employees.

Table 2.3: Investment opportunities proxied by employment growth: correlations

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
$Corr(\Delta emp_{t-1}, I_t/K_{t-1})$	0.12***	0.10***	0.09***	0.07***	0.17***	0.17***
$Corr(\Delta emp_{t-1}, CF_t/K_{t-1})$	0.08***	0.08***	0.06***	0.03***	0.17***	0.14***
#obs	17,117	404,366	58,097	141,475	13.697	7,443

Notes. The Table shows correlations between employment growth and investment and between employment growth and cash flow. * indicates that the correlation is significantly different from zero at the 10% level; ** and ***, respectively at the 5% or 1% level.

Table 2.3 shows the correlation between employment growth on the one hand, and the investment level and cash flow on the other hand. Investment is positively related to employment growth in all the countries under investigation, showing that higher opportunities are indeed associated with higher levels of investment. It can also be seen that cash flow has a positive relation with employment growth, again in every country. This could be an indication that also cash flow is associated with higher opportunities. If this is what drives the sensitivity of investment to cash flow, then the sensitivity should disappear after including employment growth in the regression. However, it is clear from Table 2.4 that it must be something else that drives the investment-cash flow sensitivity. In Belgium, France, Finland, Sweden and the Czech Republic investment still reacts significantly positive to a windfall in cash flow. In Hungary, the investment is not sensitive to the availability of cash flow, but that was already the case before the inclusion of employment growth. Given that our sample contains mostly small firms this finding is consistent with Carpenter and Guariglia (2008), who augmented a Q-model of investment with firm level opportunities and found that the cash flow sensitivity remains unchanged (or even increased) for small firms. In contrast to Carpenter and Guariglia (2008) our proxy for firm level opportunities is a measure of employment growth, which has the advantage of being available in many datasets.

Further, the estimates for the lagged investment, the error correction term and sales growth parameters of model (2.4) are very comparable to those in model (2.3). The evidence on the impact of employment growth is not entirely robust. It is significantly positive in 5 countries and positive but insignificant in Belgium. This is however not so important, as for our purpose it is only necessary that it takes up any effect of opportunities on investment. After controlling for opportunities we are more confident in interpreting the significance of cash flow as a rejection of the perfect capital market hypothesis. Table 2.11 in the appendix shows that these findings broadly hold when we use employment growth calculated from the actual number of employees instead of the cost of employees to control for opportunities.

Table 2.4: Baseline Estimation: model (2.4)

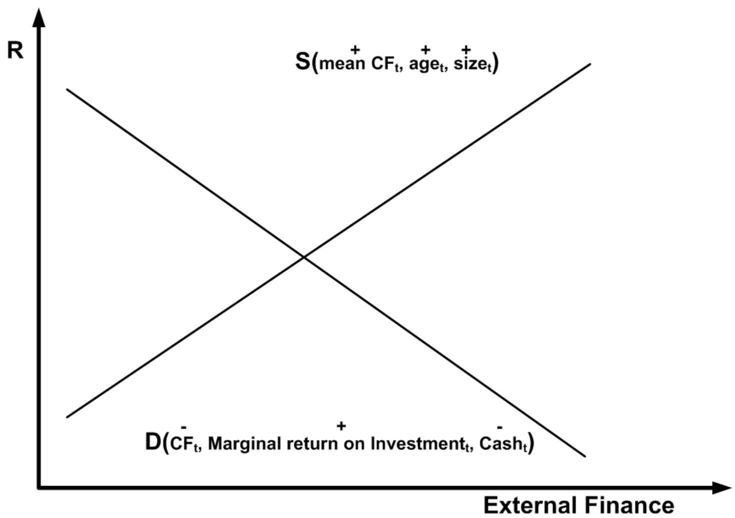
	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it-1}/K_{it-2}	-0.088**	-0.083	-0.218***	-0.121	0.007	-0.118**
	(0.044)	(0.085)	(0.020)	(0.079)	(0.039)	(0.048)
$k_{it-2}-s_{it-2}$	-0.220***	-0.157***	-0.260***	-0.198***	-0.130***	-0.208***
	(0.038)	(0.025)	(0.021)	(0.021)	(0.029)	(0.049)
Δs_{it}	0.204***	-0.027	0.180***	0.147***	0.120***	0.115**
	(0.059)	(0.079)	(0.034)	(0.023)	(0.039)	(0.052)
Δs_{it-1}	0.210***	0.148***	0.265***	0.201***	0.131***	0.224***
	(0.036)	(0.032)	(0.020)	(0.020)	(0.029)	(0.048)
Δemp_{it-1}	0.005	0.197***	0.014***	0.003*	0.054***	0.052***
	(0.012)	(0.080)	(0.005)	(0.002)	(0.015)	(0.017)
CF_{it}/K_{it-1}	0.081***	0.123***	0.024**	0.033***	0.078**	0.074
	(0.023)	(0.017)	(0.011)	(0.007)	(0.032)	(0.047)
$sector/year\ dummies$	YES	YES	YES	YES	YES	YES
$\#instruments$	158	119	356	181	296	201
$m2$	0.96	0.67	0.39	0.76	0.35	0.85
J	0.81	0.17	0.17	0.13	0.17	0.50
$\#firms$	2,555	69,801	9,876	31,396	2,101	1,405
$\#obs$	17,117	404,366	58,097	141,475	13,697	7,443

Notes. The Table shows the output for the GMM first difference estimation of specification (2.4). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with sector dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

2.4.2 The identification of financial constraints

To get a better identification of possible financial constraints, we focus on categories of firms that we ex-ante believe to have different probabilities of suffering from financial constraints. To do this we identify the supply curve that firms face in the market for external finance and calculate the implicit interest rate that firms pay on their external finance. If our identification is correct we should observe that, for a given demand for external finance, firms that are more constrained (i.e. face a more restricted supply) pay a higher interest rate on their debt.

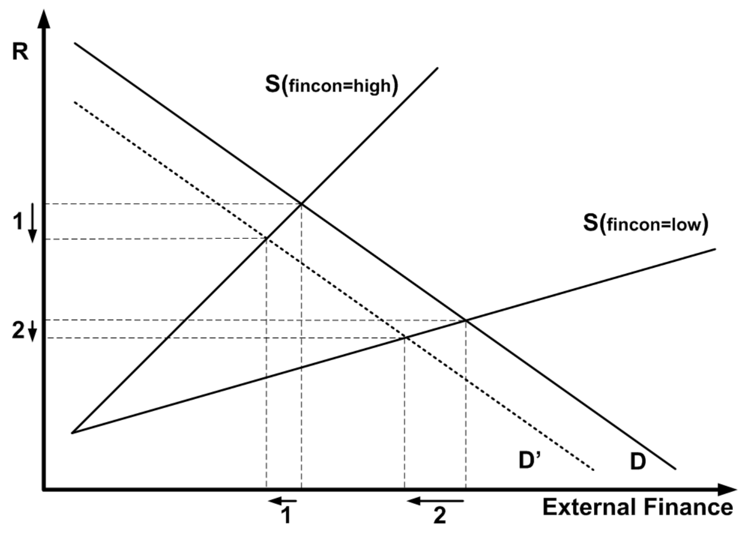
Figure 2.1: The market for external finance



As shown in Figure 2.1 we think of firm size, age and the average cash flow level as determinants of the supply curve. With respect to firm size and age, we believe that it is easier for financial institutions to gather sufficient information on larger firms (Bernanke et al., 1996) while older firms have better proven track records than young firms (Schiantarelli, 1995), which both decrease the degree of asymmetric information between lender and borrower. This, in turn, will increase the supply of external finance to larger and older firms (Rauh, 2006; Hadlock and Pierce, 2010). Further, since higher cash flows enable firms to repay their debt, external lenders will be less resilient in funding firms with higher cash flows. Firms with higher levels of cash flow will therefore be less likely to forgo net present value investments due to the lack of external finance available to them.

Figure 2.2 shows what we have in mind. If investment-cash flow sensitivities arise because cash flow relaxes constraints that firms face in the financial market, then this should be particularly important for firms that pay the highest interest rate for a given level of demand; or stated differently, for those firms that face the most inelastic supply of external funds. For such firms, a windfall gain in cash flow implies a greater drop in the cost of finance and hence a larger relaxation of the constraint.

Figure 2.2: The market for external finance: constrained vs unconstrained



In order to approximate the (elasticity of the) supply of finance to firms we measure for each of the above stated determinants whether a firm is scoring below or above the median of its industry in a given year. A firm gets a score of 1 for age if the firm is younger than the median firm in the same industry in our sample in a given year, and 2 otherwise. We then proceed in the same way for the size of the firm and the mean cash flow of the firm. We then sum the three scores and obtain for each firmyear a score between 3 (constrained supply of external finance) and 6 (unconstrained supply of external finance).

The main advantage of this approach is that it compiles multiple determinants of supply into one measure, that it is easy to compute, and applicable to almost any dataset available in economics. A scoring system like this is also flexible in the weight that is given to a certain discriminating variable. By using for instance the 75th percentile instead of the median, one can choose to put more or less weight on a variable. As we have no a priori assumptions on the importance that the four variables play in the supply of external finance, nor on the different role they might play across countries, we use the median as cut-off for each of them. A disadvantage of this approach is the interpretation of the index itself. While the interpretation of the scores 3 and 6 is still feasible (A score of 3 indicates that a firm is relatively young, relatively small and has relatively low levels of cash flow, and vice versa for a score of 6.), the scores in between are less straightforward to interpret.

Now, for the estimation purposes and to capture possible nonlinear effects of financial constraints, we generate a categorical variable $fincon = LOW_{it}$ which takes the value 1 if firm i gets a score of 5 or 6 in year t, and 0 otherwise, meaning unconstrained supply of external finance. Next, $fincon = HIGH_{it}$ takes the value 1 if firm i scores 3 or 4 in year t, and 0 otherwise, and implies that firm i faces a constrained supply of finance in year t. We interact these categorical variables with cash flow and estimate model (2.5) to test whether the most constrained firms display the highest investment-cash flow sensitivities. Table 2.8 in the Appendix shows that this approach classifies around 60 percent of the sample as unconstrained and 40 percent as highly constrained. Table 2.9 in the Appendix learns that the probability that a firm stays within a certain category for several years is rather high, especially for unconstrained firms. On average, every year less than 5 percent of the firms switch to a different constraint-group. This can be explained by the fact that two of our three determinants (size and age) do not change quickly over time. Nonetheless, a reasonable amount of firms in the sample do switch between groups over time.

$$\begin{aligned} I_{it}/K_{it-1} &= \alpha_1 I_{it-1}/K_{it-2} + \alpha_2(k_{it-2} - s_{it-2}) + \alpha_3 \Delta s_{it} + \alpha_4 \Delta s_{it-1} + \alpha_5 \Delta emp_{it-1} \\ &+ \alpha_{6a}\,[CF_{it}/K_{it-1} * fincon = LOW_{it}] \\ &+ \alpha_{6b}\,[CF_{it}/K_{it-1} * fincon = HIGH_{it}] + \upsilon_i + \upsilon_t + \upsilon_{jt} + \varepsilon_{it} \qquad (2.5) \end{aligned}$$

Before estimating model (2.5), we want to be more certain that our index is a correct measure of the supply of finance. As can be seen in Figure 2.2, constrained firms are expected to pay a higher interest rate on their external finance, and hence the interest rate that firms pay on their financial debt could be an important confirmation of our identification strategy. Therefore, we will try to actually measure this interest rate, and, in line with previous research, we will try to exploit this firm heterogeneity in the interest rate and relate it to investment-cash flow sensitivities in the next sections.

2.4.3 Interest rates as an additional measure of financial constraints

Our measure of the interest rate is calculated as the ratio of the total interest paid (as reported in the profit and loss account) over the interest carrying liabilities, which are defined as the sum of the long term liabilities and the short term financial liabilities.

Implicit interest rates are themselves the result of demand and supply effects. We argue that the interest rates of the firms and countries in our sample are on average consistent with a restricted supply of external finance and thus reflect the constraints in the financial market. We find indications for this conjecture by correlating the implicit interest rate with net trade credit, where net trade credit is defined as firm level trade credit liabilities minus firm level trade credit assets. Petersen and Rajan (1997) argue that debt enforcement theories and the equity-stake theory of trade credit explain why suppliers are still willing to lend to financially constrained firms. They find evidence suggesting that firms use more trade credit when credit from financial institutions or markets is limited or unavailable. In line with their suggestion that financially constrained firms use more trade credit, we find positive correlations between interest rates and net trade credit for all countries considered in our study (see Table 2.5, panel A). This is consistent with the interpretation that firms with more difficult access to external finance (higher interest rates) substitute external finance for net trade credit, while firms with easy access to external finance (low interest rates) also draw on external finance to invest in net trade credit. This indicates that it is mainly the supply of external finance and the associated cost of finance that is binding for firms.

Before analysing Table 2.5 it is important to note that the results are only designed to compare within countries. Several reasons come to mind. Cross country analysis might be hard to do since there are important institutional differences that we are (un)aware of and are hard to filter out (e.g. different central bank policy). The composition of the samples is not exactly the same in all countries, in terms of firm characteristics, sectoral presence, or even in terms of the years (boom/recession) that they are present. These reservations do however allow within country analysis as the construction of constraint-index is done for firms within the same year, within the same sector (and obviously within the same country).

Table 2.5: Financial constraints and the interest rate

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
Panel A						
$Corr(R, \frac{netTC}{K})$	0.13***	0.20***	0.21***	0.20***	0.08***	0.15***
Panel B						
$R\ (fincon = LOW)$	2.79%	2.26%	2.99%	3.70%	4.93%	4.67%
t-test $H_0 : low - high = 0$	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
$R\ (fincon = HIGH)$	3.29%	2.68%	3.79%	5.08%	6.23%	5.45%
$I/K\ (fincon = LOW)$	0.12	0.12	0.13	0.16	0.08	0.15
t-test $H_0 : low - high = 0$	0.00***	0.00***	0.00***	0.00***	0.00***	0.49
$I/K\ (fincon = HIGH)$	0.11	0.10	0.11	0.12	0.06	0.15
#obs	17,126	404,366	58,097	141,475	13.697	7,443

Notes. Panel A reports correlations of the implicit interest rate (R) with net trade credit (accounts payable (TCP) minus accounts receivable (TCR)). Where the net trade credit is denoted by the capital stock, and R is the ratio of the total interest paid over the interest carrying debt. The interest carrying liabilities are the sum of the long term liabilities and the short term financial liabilities. Panel B shows the average R that firms pay on their debt and the average investment level (I/K) for all the firms classified in a given constraint group. * indicates that the either the correlation or the conducted t-test is significantly different from zero at the 10% level; ** and ***, respectively at the 5% or 1% level.

As argued above, if our identification of constrained supply of external finance is correct, we should observe that firms that are more constrained pay a higher interest rate on their debt. Panel B of Table 2.5 shows that firms that are more constrained according to our index pay -on average- a higher interest rate on their financial debt. A t-test on the equality of the means shows that the mean interest rates are in each country statistical significantly different from each other for each constraint-group. Secondly, Table 2.5 documents that firms that face a constrained supply of external finance invest significantly less than unconstrained firms in all countries but Hungary. The evidence that firms for which external finance is more costly invest less should not be surprising as can be seen in Figure 2.2: a low supply of external finance is associated with a higher cost of finance and a lower amount of borrowed funds, which indirectly implies that constrained firms cannot invest as much as unconstrained firms. However, this can be seen as another indication that the index correctly measures the supply of finance. If the index would be positively correlated with the demand for finance, it could be possible to observe a demand driven higher interest rate for those firms that we consider financially constrained, but then they should also invest more instead of less. Table 2.5 thus shows that financial market frictions have real effects as firms that have more costly access to finance invest significantly less. Also Minton and Schrand (1999) found this direct negative relation between capital costs and investment levels.

2.4.4 Main results and robustness

Table 2.6 presents the estimates of model (2.5) for all the countries under investigation. Again we find the negative sign for the lagged investment level and the error correction term. Sales growth is positively related to investment and so are opportunities, as proxied by beginning of period employment growth. As predicted, investment-cash flow sensitivities increase as the supply of external finance decreases. The impact of cash flow on investment for firms that are considered to be financially constrained is larger in every country and significantly larger in five out of six countries. Also note that in Hungary investment-cash flow sensitivities are present for the subsample of firms that face a restricted supply of external finance. This confirms our hypothesis. As shown in the previous section constrained firms pay the highest interest rate on their debt, indicative of the restricted, more inelastic supply curve of external finance. As a consequence, a windfall gain in cash flow for these firms implies a larger drop in the cost of finance, leading to significantly higher investment.

In this paper we have argued that investment-cash flow sensitivities arise in the presence of financial market imperfections. In this case, the mechanism should not play any role for firms that do not have external funds. We try to falsify our hypothesis by estimating our simple model (2.4) for firms that do not make use of bank loans, which is the most important source of external finance for the firms in our sample. The results are shown Table 2.12 in the Appendix and support our hypothesis. Investment-cash flow sensitivities have disappeared in all countries. On average, around 17 percent of the firms in our data set do not have short and long term bank loans on their balance sheet. Remarkably, in Hungary more than half of the firms in the data set do not seem to have bank loans on their balance sheet, which could explain why we did not find significant investment-cash flow sensitivities for Hungary in Table 2.2 and Table 2.4, while we did for the other countries. This provides further evidence that investment-cash flow sensitivities are related to the relaxation of credit constraints (i.e. a drop in the cost of finance), induced by a windfall gain in cash flow.

Table 2.6: Investment-cash flow sensitivities: constrained vs unconstrained firms

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it-1}/K_{it-2}	-0.093*	-0.068	-0.209***	-0.116	-0.000	-0.143***
	(0.051)	(0.119)	(0.022)	(0.077)	(0.044)	(0.036)
$k_{it-2} - s_{it-2}$	-0.216***	-0.147***	-0.252***	-0.189***	-0.132***	-0.230***
	(0.042)	(0.028)	(0.024)	(0.021)	(0.030)	(0.040)
Δs_{it}	0.171***	0.024	0.231***	0.134***	0.121***	0.130***
	(0.045)	(0.075)	(0.050)	(0.023)	(0.045)	(0.041)
Δs_{it-1}	0.207***	0.133***	0.267***	0.193***	0.134***	0.242***
	(0.040)	(0.037)	(0.024)	(0.021)	(0.032)	(0.035)
Δemp_{it-1}	0.016	0.204***	0.008	0.004**	0.054***	0.049***
	(0.012)	(0.075)	(0.005)	(0.002)	(0.015)	(0.015)
CF_{it}/K_{it-1}*fincon=LOW	0.044**	0.127***	0.021*	0.021***	0.077***	0.053
	(0.021)	(0.026)	(0.012)	(0.006)	(0.030)	(0.045)
CF_{it}/K_{it-1}*fincon=HIGH	0.095***	0.167***	0.048***	0.064***	0.107**	0.153***
	(0.026)	(0.028)	(0.018)	(0.013)	(0.044)	(0.058)
$sector/year\ dummies$	YES	YES	YES	YES	YES	YES
$\#instruments$	341	113	197	209	341	277
$m2$	0.57	0.71	0.78	0.74	0.44	0.68
J	0.14	0.17	0.09	0.20	0.11	0.80
$\#firms$	2,555	69,801	9,876	31,396	2,101	1,405
$\#obs$	17,117	404,366	58,097	141,475	13,697	7,443
Wald tests						
$H_0 : low - high = 0$	0.04**	0.00***	0.03**	0.00***	0.35	0.02**

Notes. The Table shows the output for the GMM first difference estimation of specification (2.5). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

Moreover, our findings do not seem to be driven by country specific elements as we find that investment-cash flow sensitivities are highest for constrained firms in almost all countries investigated. As argued above, the instruments used in the regressions are not exactly the same in every country, nor is the composition of the sample exactly the same across countries; therefore, a cross-country comparison of the size of the mechanism should be avoided. Nonetheless, it is clear that - unrelated to the economic structure of a country- a windfall gain in cash flow instigates most investment to those firms that face the most restricted credit supply.

2.5 Conclusion

Consensus on what drives investment-cash flow sensitivities has yet to be reached. In this paper, we show that investment-cash flow sensitivities are related to capital market imperfections and rise with the interest rate on external funds. First, we create a new index to identify the supply of external finance that firms face in six European countries with different economic systems and institutions between 1996 and 2008. Firms that are classified as most constrained according to our index, pay on average the highest interest rate on their financial debt. Moreover, we show that the elasticity of the supply of external finance is important since firms that face a higher cost of external finance resort significantly more to other means (net trade credit) to finance their operations and have lower investment levels.

Further, we argue that it is especially for these constrained firms, characterised by a higher cost of finance, that a windfall gain in cash flow results in a larger drop of the interest rate, thereby making new investment possible. Indeed, the investment-

cash flow sensitivities are largest for the firms that face the most restricted credit supply according to our index.
Importantly, these findings are not related to the possible correlation between cash flow and investment opportunities (Erickson and Whited, 2000; Cummins et al., 2006), because we control for this relationship by augmenting the empirical model with a firm level control variable for opportunities: beginning of period employment growth. Firms will increase their workforce if they expect future growth opportunities. We show that employment growth is positively related to both investment and cash flow and can thus be a good control variable.

By providing new evidence consistent with the recent findings of Campbell et al. (2012) that the cost of capital is the driving force behind investment-cash flow sensitivities, this paper advocates the interpretation that these sensitivities reflect the role of cash flow in alleviating credit frictions, rather than differences in credit demand or investment opportunities. Our results also imply that credit market imperfections are still widely present and that policymakers may do well to ponder on the question how they could further alleviate these financial frictions and make investment and economic growth less dependent on internal cash flow generation.

We propose that future research on financial constraints complements the data on quantity outcomes with the information provided by implicit interest rates to ensure a better identification of financial constraints and more consistent tests of the underlying financial theories. Our results would be further reinforced if future studies affirm our findings with different measures of investment opportunities, possibly based on different data sources, such as firm surveys. Finally, this paper investigated the dynamics of investment in tangible fixed assets. Investigating investment-cash flow sensitivities in the context of other important types of investment such as for instance inventory investment is an interesting avenue for future research.

2.6 Appendix

Table 2.7: Definition of variables

p_t^f	gross fixed capital formation deflator$_t$
p_t^g	GDP deflator$_t$
I_{it+1}	$(tangible\ fixed\ assets_{it+1}/p_{t+1}^f - tangible\ fixed\ assets_{it}/p_t^f + depreciation_{it+1}/p_{t+1}^f$
$K_{it=0}$	$tangible\ fixed\ assets_{it=0}$
K_{it+1}	$K_{it} * (1-\delta) * (p_{t+1}^f/p_t^f) + I_{it+1}$
k_{it}	$\log(K_{it})$
$sales_{it}$	$nominal\ sales_{it}/p_t^g$
s_{it}	$log(sales_{it})$
CF_{it}	$cashflow_{it}/p_t^g$
$cost\ of\ employees_{it}$	$nominal\ cost\ of\ employees_{it}/p_t^g$
Δemp_{it}	$log(cost\ of\ employees)_{it} - log(cost\ of\ employees)_{it-1}$
$net\ TC_{it}$	$(accounts\ payable_{it} - accounts\ receivable_{it})/p_t^g$
R_{it}	$interest\ paid_{it}/(noncurrent\ liabilities_{it} + current\ liabilities_{it} - accounts\ payable_{it})$
bank loans	current liabilities loans + noncurrent liabilities long term debt

Model derivation

The error correction model for investment follows Bond et al. (2003), Mizen and Vermeulen (2005) and Guariglia (2008). This model starts from the assumption that the desired capital stock can be written as a log linear function of output (y_{it}) and the real user cost of capital[7] (j_{it}) and is shown by equation (2.6).

$$k_{it} = \upsilon_i + y_{it} + \sigma j_{it} \tag{2.6}$$

To account for adjustment costs, an autoregressive distributed lag specification with up to second-order dynamics of equation (2.6) is considered. Note that the long run unit elasticity of capital with respect to output in equation (2.6) implies the restriction that $(1-\alpha_1-\alpha_2)/(\beta_0+\beta_1+\beta_2)$=1 in equation (2.7).

$$k_{it} = \alpha_1 k_{it-1} + \alpha_2 k_{it-2} + \beta_0 y_{it} + \beta_1 y_{it-1} + \beta_2 y_{it-2} \tag{2.7}$$

This model can be rewritten to obtain the regression model (2.1). First subtract k_{t-1} from the left and right hand side to obtain equation (2.8). In the next step, add and subtract $(\alpha_1 - 1)k_{t-2}$ from the right hand side to obtain equation (2.9). Next, add and subtract $\beta_0 y_{t-1}$ from the right hand side to obtain equation (2.10). Finally, add and subtract $(\beta_0+\beta_1)y_{it-2}$ from the right hand side to obtain equation (2.11). Using the restriction that $(1-\alpha_1-\alpha_2)/(\beta_0+\beta_1+\beta_2)$ is equal to 1, equation (2.11) can be rewritten to get equation (2.12).

[7]In the empirical model, variation in the real user cost of capital is controlled for by time dummies and further subsumed by the fixed effects.

$$\Delta k_{it} = (\alpha_1 - 1)k_{it-1} + \alpha_2 k_{it-2} + \beta_0 y_{it} + \beta_1 y_{it-1} + \beta_2 y_{it-2} \quad (2.8)$$

$$\Delta k_{it} = (\alpha_1 - 1)\Delta k_{it-1} + (\alpha_1 - 1 + \alpha_2)k_{it-2} + \beta_0 y_{it} + \beta_1 y_{it-1} + \beta_2 y_{it-2} \quad (2.9)$$

$$\Delta k_{it} = (\alpha_1 - 1)\Delta k_{it-1} - (1 - \alpha_1 - \alpha_2)k_{it-2} + \beta_0 \Delta y_{it} + (\beta_0 + \beta_1)y_{it-1} + \beta_2 y_{it-2} \quad (2.10)$$

$$\Delta k_{it} = (\alpha_1 - 1)\Delta k_{it-1} - (1 - \alpha_1 - \alpha_2)k_{it-2} + \beta_0 \Delta y_{it} + (\beta_0 + \beta_1)\Delta y_{it-1} + (\beta_0 + \beta_1 + \beta_2)y_{it-2} \quad (2.11)$$

$$\Delta k_{it} = (\alpha_1 - 1)\Delta k_{it-1} - (1 - \alpha_1 - \alpha_2)(k_{it-2} - y_{it-2}) + \beta_0 \Delta y_{it} + (\beta_0 + \beta_1)\Delta y_{it-1} \quad (2.12)$$

Now equation (2.12) can easily be transformed into the empirical model (2.2) as shown below. It is assumed that the optimal capital stock is related to output ($y \approx s$), and that the percentage change in the capital stock is the investment rate: $\Delta k_t \approx \frac{I_{it}}{K_{it-1}} - \delta_i$, where δ_i is firm specific depreciation and is subsumed by the fixed effect.

$$\frac{I_{it}}{K_{it-1}} = \alpha_1 \frac{I_{it-1}}{K_{it-2}} + \alpha_2(k_{it-2} - s_{it-2}) + \alpha_3 \Delta s_{it} + \alpha_4 \Delta s_{it-1} + \upsilon_i + \upsilon_t + \upsilon_{jt} + \varepsilon_{it}$$

Table 2.8: Descriptive statistics: identification of financial constraints

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
$fincon = LOW$	55%	56%	58%	53%	67%	64%
$fincon = HIGH$	45%	44%	42%	47%	33%	36%
age	29	18	18	25	12	10
$total\ assets$	1.34	0.68	0.94	0.58	0.62	1.22
$meanCF/K$	0.37	0.51	0.69	0.44	0.28	0.66
#obs	17,117	404,366	58,097	141,475	13.697	7,443

Notes. In the top part, the Table shows the share of firms in a country that are classified in a given constraint group. In the bottom part, the variable means are presented for the given variables that are used to calculated the position of the supply curve of external finance. Age is in number of year. Totalassets is in million euro. For non-euro countries the exchange rate used for conversion is that of januari 1999. In concreto: EXR swedish krona/euro = 9.0826, EXR Czech koruna/euro = 35.107, EXR Hungarian forint/euro = 250.79 . Mean CF/K is the average cash flow to capital ratio of all observations for a given firm. The coefficient of variation is the standard deviation of the firm's cash flow to capital ratio, scaled by the firm's mean cash flow to capital ratio.

Table 2.9: Transition probabilities: chance of being in the same constraint group next period

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
$fincon = LOW$	97%	98%	98%	97%	98%	96%
$fincon = HIGH$	95%	94%	93%	96%	84%	80%
#obs	17,117	404,366	58,168	141,475	13.697	7,443

Notes. In the top part, the Table shows the share of firms in a country that are classified in a given constraint group. In the bottom part, the variable means are presented for the given variables that are used to calculated the position of the supply curve of external finance. Age is in number of year. Totalassets is in million euro for Belgium, France and Finland; otherwise in million units local currency. Mean CF/K is the average cash flow to capital ratio of all observations for a given firm. The coefficient of variation is the standard deviation of the firm's average cash flow to capital ratio, scaled by the firm's mean cash flow to capital ratio.

Table 2.10: Descriptive statistics: industrial composition of the sample

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
agriculture and mining	1%	1%	4%	5%	12%	6%
manufacturing	38%	20%	24%	21%	50%	41%
construction	11%	18%	15%	15%	8%	12%
retail and wholesale	39%	32%	26%	27%	20%	36%
hotel and restaurant	1%	11%	4%	4%	1%	0%
services	9%	11%	19%	21%	7%	5%
health and other	1%	7%	8%	7%	2%	1%
#*obs*	17,117	404,366	58,097	141,475	13.697	7,443

Notes. The Table shows the share of firms in a country that belong to the given sector in our sample. The nace 2-digit level is used to compose the sectors.

Table 2.11: Baseline Estimation: number of employees

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it-1}/K_{it-2}	-0.141**	-0.137	-0.259***	-0.177**	0.014	-0.264
	(0.063)	(0.142)	(0.034)	(0.082)	(0.034)	(0.528)
$k_{it-2} - s_{it-2}$	-0.265***	-0.177***	-0.293***	-0.247***	-0.116***	-0.300
	(0.052)	(0.049)	(0.039)	(0.028)	(0.031)	(0.332)
Δs_{it}	0.225***	0.196	0.223***	0.134***	0.076*	0.092
	(0.060)	(0.126)	(0.039)	(0.027)	(0.042)	(0.163)
Δs_{it-1}	0.251***	0.181***	0.303***	0.231***	0.123***	0.206
	(0.046)	(0.080)	(0.036)	(0.026)	(0.030)	(0.290)
Δemp_{it-1}	0.005	0.089**	0.014***	0.005	0.016***	-0.001
	(0.014)	(0.040)	(0.005)	(0.003)	(0.005)	(0.069)
CF_{it}/K_{it-1}	0.053*	0.120***	0.015	0.053***	0.070**	-0.045
	(0.027)	(0.038)	(0.017)	(0.014)	(0.035)	(0.256
$sector/year\ dummies$	YES	YES	YES	YES	YES	YES
$\#instruments$	145	104	334	164	187	117
$m2$	0.40	0.99	0.37	0.44	0.66	0.95
J	0.31	0.18	0.77	0.95	0.10	0.93
$\#obs$	14,551	335,002	36,144	89,917	11,548	651

Notes. The Table shows the output for the GMM first difference estimation of specification (2.4), but uses the actual number of employees instead of the cost of employees to calculate Δemp_{it-1}. The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with sector dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

Table 2.12: Baseline Estimation: no bank loans

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it-1}/K_{it-2}	-0.303***	-0.166***	-0.241***	-0.178***	-0.116	-0.117**
	(0.079)	(0.044)	(0.055)	(0.034)	(0.079)	(0.056)
$k_{it-2} - s_{it-2}$	-0.365***	-0.180***	-0.252***	-0.235***	-0.214***	-0.187***
	(0.070)	(0.067)	(0.060)	(0.039)	(0.064)	(0.066)
Δs_{it}	0.140***	0.126	0.178***	0.208***	0.150***	0.055
	(0.055)	(0.143)	(0.042)	(0.034)	(0.043)	(0.070)
Δs_{it-1}	0.359***	0.180*	0.263***	0.236***	0.193***	0.202***
	(0.065)	(0.098)	(0.054)	(0.037)	(0.060)	(0.061)
Δemp_{it-1}	-0.041	0.038	0.002	0.003	0.040	0.054***
	(0.028)	(0.068)	(0.010)	(0.003)	(0.032)	(0.020)
CF_{it}/K_{it-1}	0.028	0.079	0.025	0.010	0.022	0.103
	(0.034)	(0.051)	(0.021)	(0.013)	(0.025)	(0.071)
sector/year dummies	YES	YES	YES	YES	YES	YES
#instruments	154	104	354	166	296	158
m2	0.18	0.52	0.58	0.50	0.52	0.41
J	0.50	0.36	0.53	0.29	0.39	0.83
#obs	2,505	91,436	10,779	22,736	2,381	4,764

Notes. The Table shows the output for the GMM first difference estimation of specification (2.4), but only for the subsample that has no bankloans on their balance sheet. Bank loans include both short term and long term bank debt. The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with sector dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

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3

Investment Cash Flow Sensitivity: The Role of Cash Flow Volatility[1]

3.1 Introduction

Despite the large contradictions between Fazzari et al. (1988) and Kaplan and Zingales (1997), more than two decades later the academic society is still debating about investment-cash flow sensitivities. Understandable, not only is the concept of investment-cash flow sensitivities very appealing and relatively simple; invest-

[1]This chapter is the result of joint work with Koen Schoors and Bruno Merlevede.

ment itself may be the single most important determinant of economic growth. At first, researchers have tried to settle the debate by confirming or rejecting findings on either side, leading to an impressive number of papers, but no conclusion. In later contributions, some authors provided explanations for the conflicting evidence in the literature by focussing on the small differences between both sides, but they were unable to give a satisfactory answer to the question what drives investment-cash flow sensitivities. This paper takes a different approach. We focus on what both sides have in common, namely investment-cash flow sensitivities, because the key should lie in what drives these sensitivities, and check if cash flow volatility could be the omitted variable that can explain the findings in both sides of the literature.

In line with recent evidence of Campbell et al. (2012), we find that changes in the cost of external finance are the driving force behind investment-cash flow sensitivities. Moreover, we show that cash flow volatility plays a large role in the change of the cost of external finance and investment-cash flow sensitivities. While this literature is huge, by our knowledge, only a handful of papers have tried to relate cash flow volatility to investment-cash flow sensitivities. Our paper relates most to Cleary (2006), who suggested that cash flow volatility might be negatively related to investment-cash flow sensitivities, although he declared that it was beyond the scope of his paper to provide any formal tests. In contrast to Cleary (2006), it is exactly the contribution of this paper to clarify the role that cash flow volatility plays for investment-cash flow sensitivities.

We argue that a firm's demand for external finance does not only depend on current cash flow but also on future expected cash flow. This is important because now cash flow volatility has an indirect impact on the firm's demand for external funds. Firms with high cash flow volatility are less likely to derive much information from a positive cash flow shock today about cash flow tomorrow. In contrast, after a positive shock to cash flow today, the probability is higher that this shock falls outside the normal cash flow fluctuations for firms with low cash flow volatility, and therefore, they are also more likely to increase their expectations about future cash flow. As a result, the demand for and the price of external funds will drop more after a windfall gain in cash flow for firms with low cash flow volatility, leading to more investment. Our empirical analysis confirms that firms with low cash flow volatility display the highest investment-cash flow sensitivities.

After investigating how the demand for external finance is crucial for the interest rate on external funds, we include the supply of external finance in our analysis. It has been shown before that the more inelastic the supply of external finance is, the more the cost of external finance will change for a given change in demand. We show that investment-cash flow sensitivities are negatively related to the supply of external finance, which is in line with the findings of Fazzari et al. (1988). However, we also show that investment-cash flow sensitivities are negatively related to cash flow volatility. And as Cleary (2006) pointed out, cash flow volatility is inherently related to financial health, which is in line with Kaplan and Zingales (1997) and Cleary (1999). We thus show that although the results in both sides seem to be opposite, they are driven by the same mechanism: changes in the cost of external finance.

This paper further differs from the existing literature as, unlike most studies investigating financial constraints, the firms in our dataset are unquoted firms which are more likely to face financial constraints than publicly quoted firms. Moreover, we investigate six European countries characterised by different economies and financial systems. Belgium and France represent the West-European model, two Scandinavian countries are Finland and Sweden, and with the Czech Republic and

Hungary, two transition countries are investigated.

The paper is organized as follows: we start in section 3.2 with an overview of the related literature. We describe the dataset in section 3.3. The empirical approach and the estimations are presented in section 3.4, and finally, section 3.5 concludes.

3.2 Related literature

In the seminal paper in this literature, Fazzari et al. (1988) (hereinafter FHP) argue that the investment of financially constrained firms is more likely to depend on the availability of internal funds, than the investment of unconstrained firms. They provide evidence for their case by showing that the investment of firms with low dividend pay-out ratios is highly sensitive to the availability of cash flow. The simple rationale behind FHP's theory initiated a large number of contributions using different classifications of financial constraints, broadly confirming their results (Whited, 1992; Hoshi et al., 1992; Carpenter et al., 1994; Kashyap et al., 1994; Bond and Meghir, 1994; Carpenter et al., 1998; Mizen and Vermeulen, 2005). A big challenge to this literature came by Kaplan and Zingales (1997) (hereinafter KZ), who show in their theoretical contribution that a firm's profit maximizing investment choices do not yield a simple monotonic relation between financial constraints and investment-cash flow sensitivities. This invalidates the empirical strategy of the FHP strand of literature. In line with their theory, KZ show that in FHP's low dividend pay-out ratio sample, firm-year observations with weaker financial positions have lower investment-cash flow sensitivities. KZ's results were subsequently confirmed by a number of authors (Cleary, 1999, 2006; Cleary et al., 2007).

While in the meantime the FHP interpretation of investment-cash flow sensitivities was criticized from both a theoretical (Alti, 2003; Cleary et al., 2007) and an empirical (Erickson and Whited, 2000; Cummins et al., 2006) point of view, a number of authors have tried to reconcile the conflicting empirical evidence. For instance, Allayannis and Mozumdar (2004) argue that some firms might be in such severe financial distress that investment cannot respond to cash flow, implying a lower sensitivity for financially more constrained firms. Their argument boils down to the proposition that the sensitivity for firms in distress reflects a lower investment demand, rather than a credit supply constraint. Moyen (2004) simulates data from two models: an unconstrained model (access to external finance) and a constrained model (no access). After pooling the simulated data from both models, Moyen shows that unconstrained firms have higher investment-cash flow sensitivities than constrained firms (the KZ result). However, using the same data she also shows that firms with low dividends display the highest sensitivity (the FHP result). This follows from her model where low dividend firms are mostly from the unconstrained sample. This feature, however, does not stroke with what is found using real data. In fact, Cleary (2006) shows the opposite for 6 out of 7 large OECD countries. A recent paper by Guariglia (2008) suggests that the opposite results found by FHP and KZ are due to different measures of financial constraints: while the FHP strand of the literature uses proxies for external financial constraints, such as firm size, age or dividend payout, the KZ strand of the literature uses proxies for firm liquidity that capture internal financial constraints. Guariglia (2008) shows that the Cleary et al. (2007) U-shape is present when considering a sample-split on the basis of internal funding (the KZ case), while the investment-cash flow sensitivity increases monotonically when splitting the sample according to external financial constraints (the FHP case). Finally, Cleary (2006) investigates the interrelationships between the proxies used in both sides of the debate. Besides showing that the proxies are indeed related to each other, he hints that the contradictory findings in the literature might be caused by the volatility of cash flow. Cleary (2006) descriptively shows that the groups with on average lower cash flow volatility have the highest investment-cash flow sensitivity. Most authors that have tried to realign the conflicting results mainly have tried to explain the differences between both sides and acknowledge that they do not find an answer to the fundamental question of what is then driving investment-cash flow sensitivities. More recently, however, Campbell et al. (2012) and Mulier et al. (2013) provide evidence that the driving factor behind investment-cash flow sensitivities is the cost of external finance. Constrained firms pay a higher interest rate on their debt because they face a more inelastic supply of finance. Consequently, a windfall in cash flow results in a relatively larger drop of the cost of external funds for constrained firms, which instigates relatively more investment than for unconstrained firms.

The literature on cash flow volatility focuses mostly on risk management of corporations because cash flow volatility is costly. The costs of cash flow volatility can be related either to underinvestment in case of bad cash flow years (Stulz, 1990), to the increased probability of needing relatively expensive external finance (Froot et al., 1993; Minton and Schrand, 1999), or to the fact that firms with volatile cash flows are generally perceived as more risky, which increases the cost of external finance supplied to these firms (Minton and Schrand, 1999). Minton et al. (2002) show that cash flow volatility is an important variable in forecasting future cash flow and earnings levels. Despite extensive research on these topics, to our knowledge, only a handful of authors have considered cash flow volatility in the context of investment-cash flow sensitivities. Boyle and Guthrie (2003) construct an investment model with capital market frictions where firms with higher uncertainty about the ability to finance their investments (i.e. cash flow volatility) have a lower threshold to justify that investment, leading to higher investment and hence higher investment-cash flow sensitivities. In contrast to the predictions of Boyle and Guthrie's model, Cleary (2006) shows that high investment-cash flow sensitivities coincide with low cash flow volatility. Without formal testing, Cleary (2006) suggests that cash flow volatility could play an important role in this sensitivity debate and might even be responsible for the contradictory findings of FHP and KZ. Finally, D'Espallier et al. (2009) find that investment-cash flow sensitivity is negatively related to cash flow volatility for a sample of quoted firms in the United States.

3.3 Data

Our data set covers the period 1996-2008 and consists of the profit and loss account and balance sheet data for six European countries gathered by Bureau Van Dijk Electronic Publishing in the Amadeus database. To make sure that none of our results are driven by country specific elements, we choose six countries with different backgrounds for which we have good data coverage. Belgium and France are two standard West European countries, Finland and Sweden represent the Scandinavian model and with the Czech Republic and Hungary, our sample also contains two transition countries. Following Cleary (1999), we exclude banks, insurance companies, other financial companies and utility firms from the dataset and retain firms from the following seven industries: agriculture and mining, manufacturing, construction, retail and wholesale trade, hotel and restaurants, services, and health and others (see Table 3.9 in the appendix for more details). Furthermore the sample consists of unquoted firms, which are more likely to face financial constraints than publicly quoted firms.

Table 3.1 shows descriptive statistics of the main variables of interest for our research. Investment (I_{it}) is measured as the sum of depreciation in year t and the change in tangible fixed assets from year $t-1$ to year t. The replacement value of the capital stock is calculated with the perpetual inventory formula (Blundell et al., 1992). Using tangible fixed assets as the historic value of the capital stock and assuming that in the first period the historic value equals the replacement cost, we calculate the capital stock as $K_{it+1} = K_{it} * (1-\delta) * (p_{t+1}/p_t) + I_{it+1}$. With δ representing the depreciation rate, which we assume to be constant at 5.5% and p_t is the price of investment goods, proxied by the gross total fixed capital formation deflator. Δs_{it} is the change in the log of real total sales, and measures sales growth. Δemp_{it} is the change in the log of real total costs of employees, and measures employment growth.[2] We use the costs of employees because the data on the actual number of employees has considerably more missing values in Amadeus. Moreover, we can assume that the total costs are a better reflection of the number of full time employed workers, rather than the number itself. In the empirical model we use the beginning of period employment growth. CF_{it}/K_{it-1} represents a firm's cash flow, scaled by its beginning of period capital. Finally we use two different ways to measure cash flow volatility. The first uses the standard deviation of the cash flow to capital ratio ($stdev_i(CF_{it}/K_{it-1})$), the second is the coefficient of variation of cash flow ($CVCF_i$), which is the ratio of the standard deviation of cash flow to the mean of cash flow. Both cash flow volatility measures are thus time invariant for the firms in our sample.

[2] real sales and real costs of employees are obtained by deflating the nominal values with the gdp deflator.

Table 3.1: Descriptive statistics: sample means and standard deviations

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it}/K_{it-1}	0.112	0.111	0.122	0.144	0.075	0.151
	(0.102)	(0.132)	(0.149)	(0.202)	(0.128)	(0.186)
$k_{it-2} - s_{it-2}$	-1.565	-1.860	-1.562	-1.848	-1.023	-1.360
	(0.912)	(0.690)	(0.894)	(1.316)	(1.063)	(0.975)
Δs_{it}	0.020	0.009	0.023	0.007	-0.020	0.007
	(0.122)	(0.106)	(0.179)	(0.338)	(0.210)	(0.271)
Δemp_{it}	0.011	0.018	0.032	0.007	-0.008	0.060
	(0.081)	(0.106)	(0.181)	(0.467)	(0.132)	(0.207)
CF_{it}/K_{it-1}	0.282	0.417	0.477	0.392	0.205	0.278
	(0.309)	(0.361)	(0.513)	(1.027)	(0.317)	(0.312)
$stdev_i(CF_{it}/K_{it-1})$	0.303	0.364	0.643	0.492	0.293	1.062
	(0.484)	(0.289)	(0.790)	(0.739)	(0.655)	(3.742)
$CVCF_i$	0.579	0.552	0.642	1.439	0.814	0.790
	(0.635)	(0.382)	(0.542)	(2.115)	(1.230)	(1.159)
$\#firms$	2,555	69,801	9,876	31,396	2,101	1,405
$\#obs$	17,117	404,366	58,097	141,475	13,697	7,443

Notes. The Table shows sample means and in parentheses the corresponding standard deviations. The subscript i indexes firms, and the subscript t, time, where t = 1996-2008. I is the firm's investment, K the replacement value of the firm's capital stock and k its logarithm, s is the logarithm of total sales, emp is logarithm of total costs of employees, and finally CF represents a firm's cash flow. $CVCF_i$ is the coefficient of variation of cash flow.

Further, to control for outliers, large mergers or typing errors we drop observations in the 1% tails of the distribution of both the level and first difference of the regression variables. We also excluded firms with accounting periods that differ from the standard 12 months. Following Mizen and Vermeulen (2005) we also have a consecutive run of at least five observations for each firm. The descriptive statistics are relatively similar across the countries considered. The lower investment rate in the Czech Republic is partly due to the larger share of firms in the agricultural sector in the sample.

The descriptive statistics in Table 3.1 show that our data is very similar to what is known from previous research. Investment levels are on average between 10 and 15 percent of the capital stock. Real sales growth is around 1 to 2 percent annually. Also employment growth is around 2 percent on average in our sample. Average cash flow levels vary from 20 percent to 47 percent of the capital stock. Finally, the volatility of cash flow is very comparable across countries. Hungarian firms appear to have the most volatile cash flows when the standard deviation of cash flow to capital is used to measure volatility. This is no longer true when look at the coefficient of variation of cash flow. Here it seems that Swedish firms have quite high cash flow volatility.

3.4 Empirical approach and estimation

3.4.1 The baseline specification

The baseline specification is the error correction model (3.1) that follows the work of Bond et al. (2003), Mizen and Vermeulen (2005), Guariglia (2008) and Bloom et al. (2007). (See Appendix 2.6 for a full derivation of the model)

$$\begin{aligned}\frac{I_{it}}{K_{it-1}} &= \alpha_0 + \alpha_1 \frac{I_{it-1}}{K_{it-2}} + \alpha_2 (k_{it-2} - s_{it-2}) + \alpha_3 \Delta s_{it} + \alpha_4 \Delta s_{it-1} \\ &\quad + \alpha_5 \Delta emp_{it-1} + \alpha_6 \frac{CF_{it}}{K_{it-1}} + \upsilon_i + \upsilon_t + \upsilon_{jt} + \varepsilon_{it} \qquad (3.1)\end{aligned}$$

Where I is the firm's investment, K the replacement value of the firm's capital stock and k its logarithm, s is the logarithm of real total sales, emp is the log of real total costs of employees, and finally CF represents a firm's cash flow. The subscript i indexes firms, the subscript j industries and the subscript t, time, where t = 1996-2008. The error term consists of four components: an unobserved firm specific component υ_i, a time component to filter out business cycle effects υ_t, a time component which varies over industries accounting for industry specific effects υ_{jt} and finally an idiosyncratic component ε_{it}. The error-correction term $(k_{it-2} - s_{it-2})$, which is derived from the capital adjustment cost, captures the long run equilibrium between capital and its target, proxied by sales.

The Q-model of investment cannot be used here as the firms in our dataset are unquoted. This bypasses the problems with measurement error in marginal q (Erickson and Whited, 2000; Alti, 2003; Cummins et al., 2006), but might not sufficiently control for the possible information content of cash flow regarding investment opportunities. We control for the latter by including firm level employment growth under the assumption that firms that expect good investment opportunities will increase their workforce as in Mulier et al. (2013). If investment reacts to cash flow because it reveals investment opportunities, cash flow should not be significant anymore after the inclusion of beginning of period employment growth in (3.1). Controlling for this possible relationship might be especially important if one assumes that the revelation of investment opportunities by cash flow is different if cash flow is highly volatile or not (cf. (3.2) and (3.3) below).

All specifications are estimated with the first difference General Method of Moments (GMM) estimator developed by Arellano and Bond (1991). The first difference GMM estimator is appropriate since it controls for biases due to unobserved firm-specific effects and the endogeneity of explanatory variables. Note that we are estimating a reduced form model and therefore we need to be careful in interpreting the results. Moreover, the instruments used in the estimations sometimes differ between countries, so the parameters should not be the subject of a cross-country comparison. The instruments used for the endogenous variables are I_{it-2}/K_{it-3}, Δs_{it-2}, $k_{it-2} - s_{it-2}$, Δemp_{t-2}, CF_{it-2}/K_{it-3} and/or further lags. The exogenous time dummies and industry-time dummies are instrumented by themselves. Roodman (2009) warns for issues related to too many instruments used in the first difference GMM, but especially in the system GMM. Roodman (2009) points to efficiency problems that arise when the number of instruments is close to the number of crossections, which is likely not an issue in our case. Another issue relates to the weak power of the J-test when instruments are many, but note that few guidelines exist in the literature about how many instruments are too many to trust the J-statistic. Therefore, we try to cap the number of instruments per period as much as possible.

Table 3.2: Baseline Estimation

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it-1}/K_{it-2}	-0.088**	-0.083	-0.218***	-0.121	0.007	-0.118**
	(0.044)	(0.085)	(0.020)	(0.079)	(0.039)	(0.048)
$k_{it-2} - s_{it-2}$	-0.220***	-0.157***	-0.260***	-0.198***	-0.130***	-0.208***
	(0.038)	(0.025)	(0.021)	(0.021)	(0.029)	(0.049)
Δs_{it}	0.204***	-0.027	0.180***	0.147***	0.120***	0.115**
	(0.059)	(0.079)	(0.034)	(0.023)	(0.039)	(0.052)
Δs_{it-1}	0.210***	0.148***	0.265***	0.201***	0.131***	0.224***
	(0.036)	(0.032)	(0.020)	(0.020)	(0.029)	(0.048)
Δemp_{it-1}	0.005	0.197***	0.014***	0.003*	0.054***	0.052***
	(0.012)	(0.080)	(0.005)	(0.002)	(0.015)	(0.017)
CF_{it}/K_{it-1}	0.081***	0.123***	0.024**	0.033***	0.078**	0.074
	(0.023)	(0.017)	(0.011)	(0.007)	(0.032)	(0.047)
$sector/year\ dummies$	YES	YES	YES	YES	YES	YES
$\#instruments$	158	119	356	181	296	201
$m2$	0.96	0.67	0.39	0.76	0.35	0.85
J	0.81	0.17	0.17	0.13	0.17	0.50
$\#firms$	2,555	69,801	9,876	31,396	2,101	1,405
$\#obs$	17,117	404,366	58,097	141,475	13,697	7,443

Notes. The Table shows the output for the GMM first difference estimation of specification (3.1). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with sector dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

Table 3.2 presents the estimates of specification (3.1) for our six countries. The lagged investment term is negative in some countries and zero in others. The error correction term always has a significant negative sign, indicating that when capital is below its desired level, investment increases, ensuring a return to the equilibrium level. Table 3.2 further indicates a significant positive relationship between sales growth and investment. Further, firms with better opportunities, as proxied by employment growth, invest significantly more in France, Finland, Sweden, the Czech Republic and Hungary. The positive and significant coefficient for cash flow implies that an increase in cash flow enables firms to invest more, even after controlling for investment opportunities. Since all firms in our sample are unquoted it is very likely that this observed investment-cash flow sensitivity is an indication of financial constraints. Although the point estimate of cash flow in Hungary is very similar to that in other countries, it is not significant at the 10 percent level. Quantitatively, our results are quite similar across countries and consistent with previous research. Finally, the $m2$-statistic provides no indication that the instruments are correlated with the error term. The null hypothesis of no second order serial correlation cannot be rejected in all our regressions. The null hypothesis of instrument validity, known as the Sargan test of overidentifying restrictions (J), can also not be rejected in all our specifications.

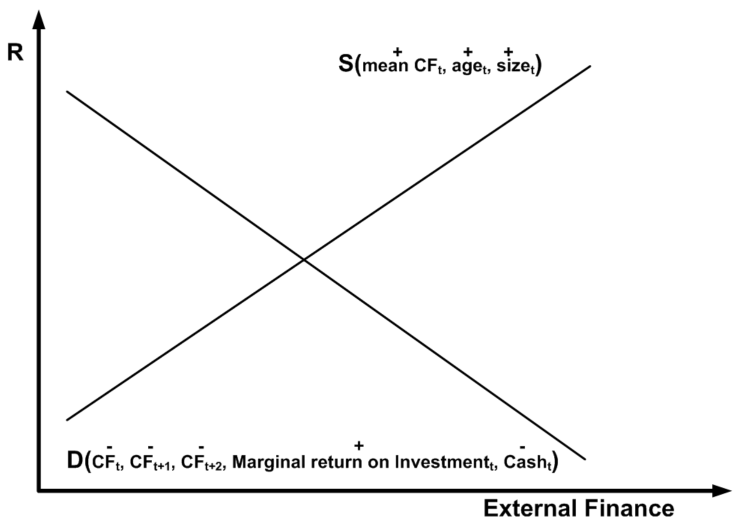
3.4.2 The identification of the volatility effect

As argued in Mulier et al. (2013), being financially constrained is not so much a question of finding sufficient external finance, but the question is at which cost a firm is able to obtain external finance. Figure 3.1 shows how the price of external finance is set for a given firm. A firm's demand depends positively on the marginal return on investment and negatively on its cash balance and available cash flow. Moreover, as shown in Figure 3.1 we assume that a firm's demand for external finance is forward looking, and hence that a firm's current demand for finance also depends on its future expected cash flow.[3] The supply of finance to the firm will increase with its average profitability (mean cash flow). The supply of finance will also increase as the information asymmetry (measured by age and size) between firm and lender decreases. Further, we assume that firms do not have sufficient

[3]For brevity and simplicity Figures 3.1 and 3.2 take only CF_{t+1} and CF_{t+2} as future cash flow.

internal funds to finance their investment and thus have to resort to external funds, therefore the interest rate on external funds can be seen as a proxy for the marginal cost of investment. Firms will demand external funds until the marginal cost (R) of investment equals the marginal benefit of their planned investment level.

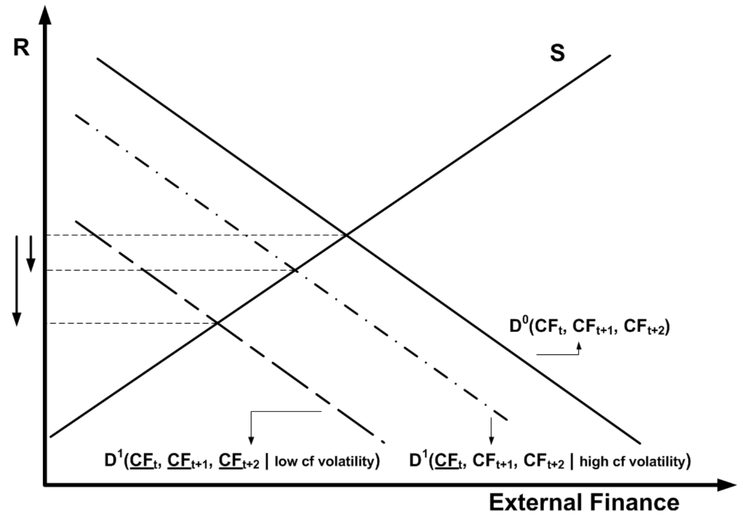
Figure 3.1: The market for external finance



From this, it follows that an increase in cash flow shifts the demand curve down to the left, which implies a drop in the cost of external finance R. So, the marginal cost of investment has decreased and it has become profitable to start some investment projects which were not profitable before. Profit maximizing behaviour implies that a firm will then increase investment until a new equilibrium is reached. In this way, investment reacts positively to changes in cash flow, resulting in the observed investment-cash flow sensitivities.

When a firm's demand not only depends on its current cash flow, but also on its future cash flow, it bears important implications for the firm's reaction to a positive cash flow shock, as shown in Figure 3.2. In this setup, cash flow volatility

Figure 3.2: The market for external finance: forward looking demand



becomes an important notion for the expectations formation of cash flow because it influences the information that a firm will derive from a windfall gain in cash flow. For a given change in cash flow, it is more likely for firms with high cash flow volatility that this change falls within the normal fluctuations of the firm's cash flow, and hence the firm has no incentive to change its expectations about future cash flow. Assume that a firm with low cash flow volatility and a firm with high cash flow volatility observe exactly the same positive increase in cash flow (CF_t is now $\underline{CF}_t$) and had the same initial demand for external finance D^0. For the firm with high cash flow volatility, changes in cash flow are quite uninformative, so this will be the only factor that changes and consequently its demand curve shifts slightly to the left. The firm with low cash flow volatility, on the contrary, will also adjust his expectations about future cash flow upwards (CF_{t+1} and CF_{t+2} are now $\underline{CF}_{t+1}$ and $\underline{CF}_{t+2}$), so its demand curve will shift more to the left. Consequently, keeping everything else equal, the more the demand curve shifts down in reaction to a windfall gain in cash flow, the more the interest rate on external finance decreases, the more the marginal cost of investment decreases, and the more the actual investment will increase. Given that both actions resulted from the same increase in cash flow, it follows that the investment-cash flow sensitivity is greater for firms with low cash flow volatility.

We thus derive the hypothesis that firms with lower cash flow volatility should display the highest investment-cash flow sensitivities. To test this hypothesis, we use two different measures of cash flow volatility: the standard deviation of the cash flow to capital ratio ($stdev_i(CF_{it}/K_{it-1})$) and the coefficient of variation of cash flow ($CVCF_i$). The distribution of these volatility measures is used to generate several categorical variables, which we then interact with cash flow to obtain specification (3.2), that augments (3.1) with several interaction terms.

$$
\begin{aligned}
I_{it}/K_{it-1} \quad = \quad & \alpha_0 + \alpha_1 I_{it-1}/K_{it-2} + \alpha_2(k_{it-2} - s_{it-2}) + \alpha_3 \Delta s_{it} + \alpha_4 \Delta s_{it-1} + \alpha_5 \Delta emp_{it-1} \\
& + \alpha_{6a}\left[CF_{it}/K_{it-1} * LOWVOL_{it}\right] \\
& + \alpha_{6b}\left[CF_{it}/K_{it-1} * MEDVOL_{it}\right] \\
& + \alpha_{6c}\left[CF_{it}/K_{it-1} * HIGHVOL_{it}\right] + \upsilon_i + \upsilon_t + \upsilon_{jt} + \varepsilon_{it}
\end{aligned}
\tag{3.2}
$$

Where $LOWVOL1_{it}$ takes the value 1 if firm i's standard deviation of cash flow to capital is among the lowest 25 percentile of its industry in year t, and 0 otherwise. Vice versa $HIGHVOL1_{it}$, takes the value 1 if firm i's standard deviation of the cash flow to capital ratio is in the highest quartile in i's industry in year t, and 0 otherwise. The dummy $MEDVOL1_{it}$ represents then all remaining observations, i.e. 1 - $LOWVOL1_{it}$ - $HIGHVOL1_{it}$.

We also create, $LOWVOL2_{it}$, $MEDVOL2_{it}$ and $HIGHVOL2_{it}$, where $LOWVOL2_{it}$ takes the value 1 if firm i's coefficient of variation of cash flow is lower than the 25 percentile of its industry coefficient of variation of cash flow in year t, and 0 otherwise. $MEDVOL2_{it}$, takes the value 1 if firm i's coefficient of variation of cash flow lies in the second or third quartile in its industry in year t, and 0 otherwise. The dummy $HIGHVOL2_{it}$ is equal to 1 when firm i's coefficient of variation of cash flow is among the highest 25 percentile in its industry in year t, and is equal to 0 otherwise.

Note that these categorical variables are time-varying, in contrast to the volatility variables on which they are based. This is important in order to address the unbalanced nature of our panel data. Think of firms A and B with the same measured cash flow volatility, but firm A is present in our dataset from 1996 to 2000 and firm B from 2004 to 2008, where the latter includes the start of the financial crisis. It is obvious that due to macroeconomic influences, the measured cash flow volatility of firms A and B, although nominally the same, should not necessarily be valued the same. Our approach thus allows that firm A is classified as having highly volatile cash flow, while firm B is classified as having low cash flow volatility. A possible drawback of this approach is that a firm can be classified as having low cash flow volatility in year t and having medium cash flow volatility in year $t+1$, even though it was based on the same value.

The above stated procedure of determining low, medium, and high cash flow volatility firms makes the difference between the variance of the cash flow itself and the variance of shocks to the cash flow unimportant, as long as the cash flow of firms in a specific industry follows the same data generating process. Suppose for example that cash flow is generated by an $AR(1)$ process $CF_t = \delta + \theta CF_{t-1} + \varepsilon_t$.[4] With σ^2 as variance of ε, the variance of CF becomes $\sigma^2 / \left(1 - \theta^2\right)$. The difference between both variances now depends on the parameter θ, if θ is the same

[4] Note that under an $AR(1)$ process an equally large shock is likely to shift future expectations relatively more for firms with a small variance of ε.

across firms in a given industry the use of either σ^2 or $\sigma^2/\left(1-\theta^2\right)$ will classify firms in the same volatility categories. Given the nature of our data, we are unable to estimate a firm-specific θ_i. Estimates for e.g. Belgium reveal $\theta = 0.34$, splitting the sample along age or size criteria reveals no statistically different θs for small and large firms or for young and old firms.

In Table 3.3, the estimates of model (3.2) are presented using the standard deviation of the cash flow to capital ratio as measure of volatility. Again we find the negative sign for the lagged investment level and the error correction term. Sales growth is positively related to investment and so are opportunities. As our theory predicted, the sensitivity of investment to changes in cash flow decreases with the volatility of cash flow. The effect is quite large: the investment-cash flow sensitivity is more than twice as large in firmyears with the lowest cash flow volatility compared to firmyears with the highest cash flow volatility. A Wald test shows that this difference in investment-cash flow sensitivity is significant in every country. In Finland and Hungary, the sensitivities even disappear for the most volatile group. Remarkably, in contrast to the baseline model, investment does seem to react to cash flow in Hungary for some subsamples, but the significance is modest. The fact that we do not find significant investment-cash flow sensitivities in Hungary actually fits our model, given that Hungarian firms tend to have the highest cash flow volatility (as shown in Table 3.1).

Table 3.3: Volatility interactions: standard deviation of CF_{it}/K_{it-1}

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it-1}/K_{it-2}	-0.096**	-0.124***	-0.205***	-0.113***	-0.001	-0.161*
	(0.044)	(0.020)	(0.027)	(0.013)	(0.029)	(0.092)
$k_{it-2} - s_{it-2}$	-0.232***	-0.210***	-0.246***	-0.169***	-0.140***	-0.221***
	(0.038)	(0.019)	(0.030)	(0.014)	(0.024)	(0.062)
Δs_{it}	0.194***	-0.165**	0.265***	0.146***	0.094***	0.113**
	(0.053)	(0.079)	(0.071)	(0.027)	(0.033)	(0.055)
Δs_{it-1}	0.218**	0.228***	0.265***	0.175***	0.136***	0.237***
	(0.036)	(0.027)	(0.031)	(0.014)	(0.024)	(0.060)
Δemp_{it-1}	0.005	0.053	0.004	0.002	0.057***	0.046***
	(0.012)	(0.039)	(0.006)	(0.002)	(0.015)	(0.016)
$CF_{it}/K_{it-1} * LOWVOL1_{it}$ (α_{6a})	0.188***	0.076***	0.144***	0.200***	0.319***	0.278***
	(0.064)	(0.027)	(0.047)	(0.074)	(0.119)	(0.103)
$CF_{it}/K_{it-1} * MEDVOL1_{it}$ (α_{6b})	0.125***	0.051***	0.065***	0.201***	0.091**	0.166**
	(0.033)	(0.017)	(0.023)	(0.028)	(0.036)	(0.069)
$CF_{it}/K_{it-1} * HIGHVOL1_{it}$ (α_{6c})	0.049**	0.038***	0.024	0.045***	0.059**	0.075
	(0.023)	(0.012)	(0.014)	(0.008)	(0.027)	(0.066)
$sector/year\ dummies$	YES	YES	YES	YES	YES	YES
$\#instruments$	205	140	175	153	319	156
$m2$	0.88	0.18	0.91	0.07	0.31	0.71
J	0.98	0.09	0.43	0.13	0.13	0.76
$\#obs$	17,117	404,366	58,097	141,475	13,697	7,443
Wald tests						
$H_0 : \alpha_{6a} - \alpha_{6b} = 0$	0.27	0.08*	0.05**	0.98	0.05**	0.09*
$H_0 : \alpha_{6b} - \alpha_{6c} = 0$	0.02**	0.05**	0.02**	0.00***	0.41	0.23
$H_0 : \alpha_{6a} - \alpha_{6c} = 0$	0.03**	0.03**	0.01***	0.03**	0.03**	0.07*

Notes. The Table shows the output for the GMM first difference estimation of specification (3.2). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. The Wald test shows the p-values. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

Table 3.4: Volatility interactions: coeficient of variation of CF_{it}

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it-1}/K_{it-2}	-0.050	-0.193***	-0.205***	-0.198***	-0.012	-0.156**
	(0.042)	(0.030)	(0.033)	(0.032)	(0.029)	(0.065)
$k_{it-2} - s_{it-2}$	-0.179***	-0.203***	-0.243***	-0.204***	-0.144***	-0.248***
	(0.037)	(0.020)	(0.037)	(0.020)	(0.024)	(0.075)
Δs_{it}	0.133***	0.132	0.179***	0.188***	0.111***	0.129**
	(0.051)	(0.098)	(0.044)	(0.032)	(0.034)	(0.060)
Δs_{it-1}	0.173***	0.219***	0.252***	0.207***	0.143***	0.251***
	(0.035)	(0.048)	(0.036)	(0.017)	(0.024)	(0.065)
Δemp_{it-1}	0.012	0.046	0.014***	0.001	0.053***	0.052***
	(0.013)	(0.089)	(0.005)	(0.002)	(0.016)	(0.016)
$CF_{it}/K_{it-1} * LOWVOL2_{it}$ (α_{6a})	0.111***	0.036**	0.032**	0.054***	0.110**	0.209***
	(0.039)	(0.018)	(0.016)	(0.014)	(0.045)	(0.061)
$CF_{it}/K_{it-1} * MEDVOL2_{it}$ (α_{6b})	0.076**	0.027	0.028**	0.030***	0.097***	0.057
	(0.030)	(0.020)	(0.013)	(0.008)	(0.035)	(0.050)
$CF_{it}/K_{it-1} * HIGHVOL2_{it}$ (α_{6c})	0.026	-0.012	0.020	0.042***	0.023	0.059
	(0.031)	(0.028)	(0.021)	(0.015)	(0.025)	(0.059)
sector/year dummies	YES	YES	YES	YES	YES	YES
#instruments	241	110	364	118	340	267
m2	0.70	0.09	0.38	0.99	0.36	0.73
J	0.26	0.87	0.09	0.25	0.08	0.85
#obs	17,117	404,366	58,097	141,475	13,697	7,443
Wald tests						
$H_0 : \alpha_{6a} - \alpha_{6b} = 0$	0.41	0.39	0.79	0.08*	0.72	0.00**
$H_0 : \alpha_{6b} - \alpha_{6c} = 0$	0.21	0.03**	0.68	0.43	0.04**	0.98
$H_0 : \alpha_{6a} - \alpha_{6c} = 0$	0.08*	0.02**	0.56	0.52	0.05**	0.04**

Notes. The Table shows the output for the GMM first difference estimation of specification (3.2). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. The Wald test shows the p-values. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

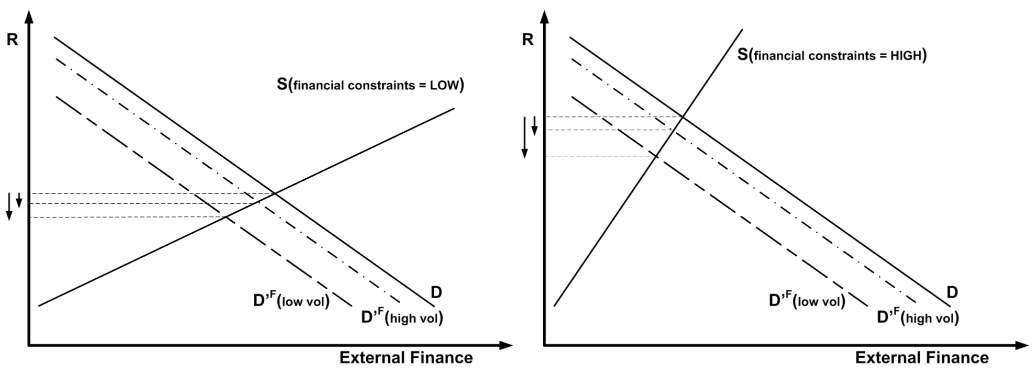
Table 3.4 also shows the results from estimating specification (3.2), but now cash flow is interacted with dummies measuring volatility by the coefficient of variation of cash flow. For brevity only the interaction parameters with cash flow will be discussed. Again, the investment-cash flow sensitivities are greatest for the group with the lowest cash flow volatility, but the effect seems to be less strong between the low and the medium volatility subsample than in Table 3.3. The difference between the low and the high volatility group is still considerable and a Wald test shows that this differnce in the sensitivity is significant in all countries except Finland and Sweden. However, in Sweden the sensitivity of the low volatility group is significantly higher then the medium volatile group at the ten percent level.

Our findings thus do not seem to be driven by country specific elements as we find that investment-cash flow sensitivities are highest for firms with low cash flow volatility in all countries investigated. Neither are the results driven by the time invariant nature of the cash flow volatility measures. Table 3.11 and Table 3.12 in the Appendix show that the results of Tables 3.3 and 3.4 are robust when we use a time varying counterpart of the standard deviation of the cash flow to capital ratio or a time varying counterpart of the coefficient of variation of cash flow. As argued above, the instruments used in the regressions are not exactly the same in every country, nor is the sectoral composition of the sample exactly the same across countries; therefore, a cross-country comparison of the size of the mechanism should be avoided. Nonetheless, the evidence shows that a windfall gain in cash flow instigates the most investment for those firms that are most likely to increase their expectations about future cash flows, namely those with the lowest cash flow volatility. Importantly, this finding is not related to investment opportunities that might be better reflected by cash flow in the low volatility sample than in the high volatility sample.

3.4.3 The interaction with financial constraints

When investment-cash flow sensitivities result from the change in the cost of external finance following a change in cash flow, then investment cash flow sensitivities are likely to be stronger for firms facing a more inelastic (constrained) supply of external funds. Combining the recent evidence of Campbell et al. (2012) and Mulier et al. (2013) with the predictions derived in the previous section, we should find that investment-cash flow sensitivities are highest for financially constrained firms with low cash flow volatility and lowest for financially unconstrained firms with high cash flow volatility. Figure 3.3 shows this mechanism for a firm facing an unconstrained supply (left) and a constrained supply of external finance (right).

Figure 3.3: Low vs high cash flow volatility for unconstrained firms (left) or constrained firms (right)



To identify the supply of external finance to firms, we focus on categories of firms that we ex-ante believe to have different probabilities of suffering from financial constraints. We think of firm size, age, and average cash flow levels as determinants of the supply curve (cf. Figure 3.1). With respect to firm size and age, it is easier for financial institutions to gather sufficient information on larger firms (Bernanke et al., 1996) while older firms have better track records than young firms (Schiantarelli, 1995). Both decrease the degree of asymmetric information between lender and borrower. This, in turn, will increase the supply of external finance to larger and older firms (Hadlock and Pierce, 2010). Further, since higher cash flows enables firms to repay their debt, external lenders will be less resilient in funding firms with higher cash flows. Firms with higher levels of cash flow will therefore be less likely to forgo net present value investments due to the lack of external finance available to them.

In order to approximate the supply of finance we calculate for each of the above stated determinants whether a firm is scoring below or above the median of its industry in a given year. A firm gets a score of 1 for age if the firm is younger than median firm in the same industry in our sample in a given year, and 2 otherwise. We then proceed in the same way for the size of the firm and the mean cash flow of the firm. We then sum the three scores and obtain for each firmyear a score between 3 (constrained supply of external finance) and 6 (unconstrained supply of external finance).

To allow for possible nonlinear effects of financial constraints, we generate a categorical variable $finconLOW_{it}$ which takes the value 1 if firm i gets a score of 5 or 6 in year t, and 0 otherwise, meaning unconstrained supply of external finance. Next, $finconHIGH_{it}$ takes the value 1 if firm i scores 3 or 4 in year t, and 0 otherwise, and implies that firm i faces a constrained supply of finance in year t. These categorical variables are interacted with cash flow to estimate model (3.3) and test whether the most constrained firms with low cash flow volatility display the highest investment-cash flow sensitivities. Table 3.8 in the Appendix shows that this approach classifies around 60 percent of the sample as unconstrained and around 40 percent as constrained.

$$\begin{aligned} I_{it}/K_{it-1} = {} & \alpha_0 + \alpha_1 I_{it-1}/K_{it-2} + \alpha_2 (k_{it-2} - s_{it-2}) + \alpha_3 \Delta s_{it} + \alpha_4 \Delta s_{it-1} + \alpha_5 \Delta emp_{it-1} \\ & + \alpha_{6a} \left[finconLOW_{it} * CF_{it}/K_{it-1} * LOWVOL_{it} \right] \\ & + \alpha_{6b} \left[finconLOW_{it} * CF_{it}/K_{it-1} * MEDVOL_{it} \right] \\ & + \alpha_{6c} \left[finconLOW_{it} * CF_{it}/K_{it-1} * HIGHVOL_{it} \right] \\ & + \alpha_{7a} \left[finconHIGH_{it} * CF_{it}/K_{it-1} * LOWVOL_{it} \right] \\ & + \alpha_{7b} \left[finconHIGH_{it} * CF_{it}/K_{it-1} * MEDVOL_{it} \right] \\ & + \alpha_{7c} \left[finconHIGH_{it} * CF_{it}/K_{it-1} * HIGHVOL_{it} \right] + \upsilon_i + \upsilon_t + \upsilon_{jt} + \varepsilon_{it} \end{aligned} \tag{3.3}$$

Table 3.5 presents the results of the estimation of model (3.3), where the standard deviation of cash flow scaled by capital is used to discriminate among volatility groups. As in the previous section, only the investment-cash flow sensitivities will be discussed for brevity. A first observation is that as in Table 3.3, cash flow seems to be more important for investment if the firm has low cash flow volatility instead of high cash flow volatility, and this appears to be mainly true for firms facing a constrained supply of external finance. Taking a closer look on the financially constrained firms and comparing the investment-cash flow sensitivity between the low and high cash flow volatility subsample firms, a Wald test shows that firms with the lowest volatility display a higher sensitivity in all countries but Hungary. Secondly, in line with previous research, firms with high financial constraints seem to have higher investment-cash flow sensitivities than firms with low constraints. The sensitivity of 15 out of 18 volatility subsamples is higher for constrained firms than unconstrained firms in the same volatility subsample. Looking at the low cash flow volatility subsample and comparing the investment-cash flow sensitivity between the high and low constrained firms, a Wald test shows that constrained firms display a higher sensitivity in 4 out of 6 countries. A third interesting observation is that even among financially constrained firms a large heterogeneity of investment-cash flow sensitivities can be found, independent of to the degree of constraints they face. These findings are perfectly in line with the hypotheses derived in the previous section and the implications of these findings will be discussed in detail below.

In Table 3.6 the estimation results of model (3.3) are shown, where the coefficient of variation of cash flow is used to measure cash flow volatility. It can be seen that the main findings of Table 3.5 are generally confirmed. Investment-cash flow sensitivities tend to be larger for constrained firms than for unconstrained firms, and investment-cash flow sensitivities seem to be negatively related to cash flow volatility. Taking a closer look on the financially constrained firms and comparing the low with the high volatility subsample, the Wald test indicates that sensitivities are highest for low cash flow volatility firms in all countries except France and Finland. Looking at the firms with low cash flow volatility and comparing the low with the high financially constrained subsample, a Wald test shows that sensitivities are highest for constrained firms in all countries except the Czech Republic and Hungary. Moreover, the results seem to be unrelated to country specific elements, as they hold for all six countries investigated. Again, the results are not driven by the time invariant nature of the cash flow volatility measures. Tables 3.13 and 3.14 in the Appendix show that the results of Tables 3.3 and 3.4 are quite robust when we use a time varying counterpart of the standard deviation of the cash flow to capital ratio or a time varying counterpart of the coefficient of variation of cash flow.

Table 3.5: Financial constraints and volatility interactions: standard deviation of CF_{it}/K_{it-1}

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it-1}/K_{it-2}	-0.139***	-0.128***	-0.221***	-0.103***	-0.014	-0.236
	(0.046)	(0.016)	(0.023)	(0.014)	(0.058)	(0.296)
$k_{it-2} - s_{it-2}$	-0.264***	-0.204***	-0.264***	-0.162***	-0.144***	-0.240*
	(0.040)	(0.018)	(0.026)	(0.015)	(0.057)	(0.0140)
Δs_{it}	0.183***	-0.064	0.250***	0.106***	0.075	0.134
	(0.049)	(0.061)	(0.044)	(0.024)	(0.064)	(0.087)
Δs_{it-1}	0.245***	0.236***	0.281***	0.167***	0.135***	0.251**
	(0.037)	(0.023)	(0.025)	(0.014)	(0.055)	(0.103)
Δemp_{it-1}	0.010	0.051*	0.007	0.003*	0.051***	0.058***
	(0.013)	(0.030)	(0.005)	(0.002)	(0.018)	(0.018)
$fineonLOW_{it}*$						
$CF_{it}/K_{it-1} * LOWVOL1_{it}$ (α_{6a})	0.114	0.087***	0.071	0.102	0.588***	0.098
	(0.084)	(0.026)	(0.047)	(0.087)	(0.183)	(0.135)
$CF_{it}/K_{it-1} * MEDVOL1_{it}$ (α_{6b})	0.087**	0.063***	0.030*	0.173***	0.085*	0.071
	(0.036)	(0.015)	(0.017)	(0.028)	(0.049)	(0.118)
$CF_{it}/K_{it-1} * HIGHVOL1_{it}$ (α_{6c})	0.034	0.046***	0.026**	0.032***	0.095*	0.069
	(0.025)	(0.011)	(0.012)	(0.007)	(0.050)	(0.067)
$finconHIGH_{it}*$						
$CF_{it}/K_{it-1} * LOWVOL1_{it}$ (α_{7a})	0.203***	0.111***	0.148***	0.306***	0.415***	0.291***
	(0.069)	(0.024)	(0.041)	(0.085)	(0.158)	(0.107)
$CF_{it}/K_{it-1} * MEDVOL1_{it}$ (α_{7b})	0.109***	0.068***	0.064***	0.252***	0.185**	0.180*
	(0.042)	(0.015)	(0.022)	(0.037)	(0.089)	(0.101)
$CF_{it}/K_{it-1} * HIGHVOL1_{it}$ (α_{7c})	0.086***	0.050***	0.019	0.069***	0.088	0.188
	(0.032)	(0.012)	(0.018)	(0.014)	(0.060)	(0.188)
$sector/year\ dummies$	YES	YES	YES	YES	YES	YES
$\#instruments$	263	191	336	216	151	248
$m2$	0.66	0.27	0.86	0.14	0.35	0.71
J	0.38	0.04	0.20	0.53	0.21	0.16
$\#obs$	17,117	404,366	58,097	141,475	13,697	7,443
Wald tests						
$H_0 : \alpha_{7a} - \alpha_{7c} = 0$	0.10*	0.00***	0.00***	0.00***	0.05**	0.55
$H_0 : \alpha_{7a} - \alpha_{6a} = 0$	0.23	0.08*	0.06*	0.03**	0.22	0.08*

Notes. The Table shows the output for the GMM first difference estimation of specification (3.3). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. The Wald test shows the p-values. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

Table 3.6: Financial constraints and volatility interactions: coefficient of variation of CF_{it}

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it-1}/K_{it-2}	-0.126***	-0.370***	-0.224***	-0.094***	-0.012	-0.115***
	(0.048)	(0.111)	(0.021)	(0.032)	(0.029)	(0.037)
$k_{it-2} - s_{it-2}$	-0.247***	-0.326***	-0.265***	-0.200***	-0.124***	-0.197***
	(0.042)	(0.036)	(0.023)	(0.020)	(0.030)	(0.038)
Δs_{it}	0.209***	0.104	0.209***	0.164***	0.113***	0.110**
	(0.047)	(0.074)	(0.031)	(0.031)	(0.031)	(0.055)
Δs_{it-1}	0.238***	0.411***	0.275***	0.202***	0.103***	0.205***
	(0.040)	(0.055)	(0.022)	(0.017)	(0.043)	(0.039)
Δemp_{it-1}	0.008	0.301***	0.011**	0.002	0.161***	0.048***
	(0.012)	(0.080)	(0.005)	(0.002)	(0.043)	(0.016)
$fincon LOW_{it}*$						
$CF_{it}/K_{it-1} * LOWVOL2_{it}$ (α_{6a})	0.105**	0.027	0.006	0.044***	0.162***	0.154**
	(0.044)	(0.023)	(0.016)	(0.014)	(0.063)	(0.070)
$CF_{it}/K_{it-1} * MEDVOL2_{it}$ (α_{6b})	0.070**	0.028	0.019	0.024***	0.134***	0.052
	(0.028)	(0.026)	(0.012)	(0.008)	(0.035)	(0.047)
$CF_{it}/K_{it-1} * HIGHVOL2_{it}$ (α_{6c})	0.064**	0.014	0.011	0.025	0.044	0.079
	(0.029)	(0.024)	(0.019)	(0.016)	(0.039)	(0.059)
$fincon HIGH_{it}*$						
$CF_{it}/K_{it-1} * LOWVOL2_{it}$ (α_{7a})	0.228***	0.048**	0.056**	0.089***	0.243***	0.261***
	(0.068)	(0.023)	(0.022)	(0.021)	(0.066)	(0.083)
$CF_{it}/K_{it-1} * MEDVOL2_{it}$ (α_{7b})	0.107***	0.057**	0.031*	0.060***	0.099**	0.152**
	(0.032)	(0.025)	(0.017)	(0.019)	(0.049)	(0.070)
$CF_{it}/K_{it-1} * HIGHVOL2_{it}$ (α_{7c})	0.022	0.051**	0.016	0.044**	-0.017	-0.054
	(0.057)	(0.025)	(0.026)	(0.022)	(0.095)	(0.103)
$sector/year\ dummies$	YES	YES	YES	YES	YES	YES
$\#instruments$	262	143	538	139	457	257
$m2$	0.46	0.15	0.42	0.91	0.87	0.78
J	0.60	0.29	0.21	0.08	0.25	0.65
$\#obs$	17,117	404,366	58,097	141,475	13,697	7,443
Wald tests						
$H_0 : \alpha_{7a} - \alpha_{7c} = 0$	0.01***	0.84	0.17	0.10*	0.04**	0.00***
$H_0 : \alpha_{7a} - \alpha_{6a} = 0$	0.07*	0.03**	0.02**	0.04**	0.20	0.16

Notes. The Table shows the output for the GMM first difference estimation of specification (3.3). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. The Wald test shows the p-values. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

In line with the seminal findings of FHP, we have shown that investment-cash flow sensitivities are higher for firms that face a restricted supply of external finance. However, within the group of constrained firms, investment-cash flow sensitivities are highest for firms with low cash flow volatility and lowest for firms with high cash flow volatility. This experiment is closely related to that of KZ. Among the constrained group of FHP, they classified firms as unconstrained if their CFO stated to have solid financial positions. Cleary (2006) notes that these are probably the firms that are likely to have relatively low cash flow volatility, and thus it is not surprising that KZ find that these unconstrained firms have the highest investment-cash flow sensitivities. On the other end, Allayannis and Mozumdar (2004) showed that KZ's constrained group was dominated by very distressed firms. Note that these are exactly the firms that will not have changing expectations about future cash flows and are therefore likely to have lower investment-cash flow sensitivities.

In fact, as Cleary (2006) states, the very nature of indexes like the Z-score imply that firms with low cash flow volatility are classified as financially healthier. This relates to the point of Guariglia (2008) that both sides of the literature use different proxies to measure financial constraints. While the FHP strand of the literature typically uses variables as age or size that determine the supply of external finance, the KZ strand of the literature uses variables that measure financial health, which mainly influences the demand because financial health is probably strongly correlated with cash flow volatility.

This literature is centred around financial constraints and many authors have therefore focused on the supply of external finance, but surprisingly not on the price of external finance. Recent findings[5] have shown that the price of external finance

[5]See Campbell et al. (2012) and Mulier et al. (2013).

plays the intermediating role for investment and investment-cash flow sensitivities. When one considers the price of external finance as subject of investigation, it is also important to consider the impact of the demand side, which is exactly the innovation of this paper. Our findings are important because, in contrast to earlier research, they are not only able to explain the contradictory findings between FHP and KZ, which are caused by cash flow volatility, but they also give a clear indication that they are driven by the same mechanism, namely, changes in the cost of external finance.

3.5 Conclusion

Recent evidence by Campbell et al. (2012) has shown that the cost of capital plays a fundamental role for investment-cash flow sensitivities. At first sight, this notion strongly supports the findings of Fazzari et al. (1988) (FHP), however, if true, it should also be compatible with the results of Kaplan and Zingales (1997) (KZ).

In this paper we provide evidence that cash flow volatility can explain the contradictory findings in the literature. Cash flow volatility influences the change in the demand for external finance after a cash flow shock, because the demand for external finance is forward looking and also depends on future expected cash flow. For a given cash flow shock, it is more likely that this signals firms with low cash flow volatility as the probability is higher for them that this shock falls outside their normal cash flow fluctuations, and therefore, they are also more likely to change their expectations about future cash flow. This implies that, for the same contemporaneous increase in cash flow, the demand for external finance will drop more for firms with low cash flow volatility, and consequently also the cost of external finance drops more. As a drop in the cost of external finance enables additional investment, the incentive to invest will be largest for those firms with the highest drop, namely those with low cash flow volatility. Empirical analysis in 6 countries confirms that investment-cash flow sensitivities are highest for firms with low cash flow volatility.

Further, we interact the implications of cash flow volatility with financial constraints that firms face. First, considering firms with the same volatility, investment-cash flow sensitivities will be higher for financially constrained firms (i.e. those facing an inelastic supply of external finance). Indeed, for a given change in cash flow, the change in the demand for external funds will be the same, but the change in the price of external funds will be greater for firms facing a more restricted, inelastic supply. These are basically the FHP results. Second, considering firms with the same level of financial constraints, investment-cash flow sensitivities will be higher for firms with low cash flow volatility. Indeed, for a given change in cash flow, the elasticity of the supply of external funds is the same, but the change in the price of external funds will be greater for firms with a larger change in the demand of funds. Cleary (2006) pointed out that cash flow volatility is inherently related to financial health, as frequently used in the KZ strand of the literature, and thus these findings are consistent with the KZ findings.

Our findings are important because, in contrast to earlier research, they might not only be able to explain the contradictory findings between FHP and KZ, they also give a clear indication about the mechanism that drives them, namely, changes in the cost of external finance. An interesting avenue for future research would be to use the COMPUSTAT data of FHP and KZ and investigate to what extent the opposite findings are driven by cash flow volatility.

3.6 Appendix

Table 3.7: Definition of variables

p_t^f	gross fixed capital formation deflator$_t$
p_t^g	GDP deflator$_t$
I_{it+1}	$(tangible\ fixed\ assets_{it+1}/p_{t+1}^f - tangible\ fixed\ assets_{it}/p_t^f + depreciation_{it+1}/p_{t+1}^f$
$K_{it=0}$	$tangible\ fixed\ assets_{it=0}$
K_{it+1}	$K_{it} * (1-\delta) * (p_{t+1}^f/p_t^f) + I_{it+1}$
k_{it}	$\log(K_{it})$
$sales_{it}$	$nominal\ sales_{it}/p_t^g$
s_{it}	$log(sales_{it})$
CF_{it}	$cashflow_{it}/p_t^g$
$cost\ of\ employees_{it}$	$nominal\ cost\ of\ employees_{it}/p_t^g$
Δemp_{it}	$log(cost\ of\ employees)_{it} - log(cost\ of\ employees)_{it-1}$
$stdev_i(CF_{it}/K_{it-1})$	$standard\ deviation\ (CF_{it}/K_{it-1})$
$CVCF_i$	$standard\ deviation\ (CF_it)/mean\ (CF_it)$

Table 3.8: Descriptive statistics: identification of financial constraints

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
$finconLOW$	55%	56%	58%	53%	67%	65%
$finconHIGH$	45%	44%	42%	47%	33%	35%
age	29	18	18	25	12	10
$total\ assets$	1.34	0.68	0.94	0.58	0.62	1.22
$meanCF/K$	0.37	0.51	0.69	0.44	0.28	0.66
#obs	17,117	404,366	58,097	141,475	13,697	7,443

Notes. In the top part, the Table shows the share of firms in a country that are classified in a given constraint group. In the bottom part, the variable means are presented for the given variables that are used to calculated the position of the supply curve of external finance. Age is in number of year. Totalassets is in million euro. For non-euro countries the exchange rate used for conversion is that of januari 1999. In concreto: EXR swedish krona/euro = 9.0826, EXR Czech koruna/euro = 35.107, EXR Hungarian forint/euro = 250.79 . Mean CF/K is the average cash flow to capital ratio of all observations for a given firm. The coefficient of variation is the standard deviation of the firm's cash flow to capital ratio, scaled by the firm's mean cash flow to capital ratio.

Table 3.9: Descriptive statistics: industrial composition of the sample

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
$agriculture\ and\ mining$	1%	1%	4%	5%	12%	6%
$manufacturing$	38%	20%	24%	21%	50%	41%
$construction$	11%	18%	15%	15%	8%	12%
$retail\ and\ wholesale$	39%	32%	26%	27%	20%	36%
$hotel\ and\ restaurant$	1%	11%	4%	4%	1%	0%
$services$	9%	11%	19%	21%	7%	5%
$health\ and\ other$	1%	7%	8%	7%	2%	1%
#obs	17,117	404,366	58,097	141,475	13,697	7,443

Notes. The Table shows the share of firms in a country that belong to the given sector in our sample. The nace 2-digit level is used to compose the sectors.

As robustness check we also consider the time varying counterpart of our two volatility measures (the standard deviation of the cash flow to capital ratio and the coefficient of variation of cash flow). The time varying counterparts are constructed as the moving average of a five year rolling window of the respective volatility measures. Again we generate dummy variables related to the distribution of the time varying volatility measures to test the hypotheses developed in section 4.2.

First, three dummies $LOWVOL1_{it}^{tv}$, $MEDVOL1_{it}^{tv}$ and $HIGHVOL1_{it}^{tv}$ are created, where $LOWVOL1_{it}^{tv}$ takes the value 1 if firm i's time varying standard deviation of cash flow to capital is among the lowest 25 percentile of its industry in year t, and 0 otherwise. Vice versa $HIGHVOL1_{it}^{tv}$, takes the value 1 if firm i's time varying standard deviation of the cash flow to capital ratio is in the highest quartile in i's industry in year t, and 0 otherwise. The dummy $MEDVOL1_{it}^{tv}$ represents then all remaining observations in between, i.e. 1 - $LOWVOL1_{it}^{tv}$ - $HIGHVOL1_{it}^{tv}$.
Secondly, $LOWVOL2_{it}^{tv}$, $MEDVOL2_{it}^{tv}$ and $HIGHVOL2_{it}^{tv}$ are created, where $LOWVOL2_{it}^{tv}$ takes the value 1 if firm i's time varying coefficient of variation of cash flow is lower than the 25 percentile of its industry time varying coefficient of variation of cash flow in year t, and 0 otherwise. $MEDVOL2_{it}^{tv}$, takes the value 1 if firm i's time varying coefficient of variation of cash flow lies in the second or third quartile in its industry in year t, and 0 otherwise. The dummy $HIGHVOL2_{it}^{tv}$ is equal to 1 when firm i's time varying coefficient of variation of cash flow is among the highest 25 percentile in its industry in year t, and is equal to 0 otherwise.

Table 3.10 shows the relation between all the measures of cash flow volatility and age and size. The Table shows subsample means and standard deviations, where a firm are considered young (old) when its age is below (above) the median age in the firms industry in a given year. A firm is categorized as small (large) if the firm's totalassets are below (above) the median totalassets in the firms industry in a given year. It can first be noted that the time varying volatility measures are generally lower than the time invariant counterpart. Further, cash flow tends to be more volatile for young or small firms rather than old or large firms, and this is especially true for the distinction between small and large when the (time varying) coefficient of variation of cash flow is used to measure volatility.

Table 3.10: Descriptive statistics: sample means and standard deviations of the volatity variables

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
$\mathbf{stdev_i(CF_{it}/K_{it-1})}$						
young	0.311	0.361	0.661	0.508	0.329	1.144
	(0.499)	(0.282)	(0.797)	(0.744)	(0.788)	(3.516)
old	0.295	0.348	0.622	0.474	0.242	1.015
	(0.469)	(0.276)	(0.783)	(0.733)	(0.409)	(4.242)
small	0.300	0.345	0.613	0.526	0.314	1.214
	(0.448)	(0.266)	(0.749)	(0.714)	(0.633)	(4.344)
large	0.306	0.362	0.672	0.459	0.273	0.849
	(0.518)	(0.290)	(0.828)	(0.761)	(0.670)	(2.718)
$\mathbf{CVCF_i}$						
young	0.560	0.546	0.650	1.507	0.822	0.805
	(0.602)	(0.369)	(0.797)	(2.193)	(1.175)	(1.239)
old	0.599	0.558	0.633	1.361	0.808	0.745
	(0.665)	(0.382)	(0.540)	(2.020)	(1.308)	(1.074)
small	0.598	0.641	0.734	1.756	0.924	0.837
	(0.674)	(0.421)	(0.607)	(2.386)	(1.443)	(1.173)
large	0.560	0.463	0.550	1.123	0.728	0.737
	(0.588)	(0.299)	(0.450)	(1.751)	(1.027)	(1.138)
$\mathbf{stdev_{it}(CF_{it}/K_{it-1})}$						
young	0.113	0.174	0.227	0.390	0.119	0.197
	(0.204)	(0.126)	(0.250)	(0.660)	(0.316)	(0.633)
old	0.107	0.162	0.210	0.355	0.107	0.183
	(0.165)	(0.120)	(0.236)	(0.638)	(0.154)	(0.311)
small	0.111	0.172	0.224	0.403	0.123	0.216
	(0.203)	(0.123)	(0.232)	(0.626)	(0.183)	(0.650)
large	0.109	0.164	0.215	0.344	0.106	0.164
	(0.203)	(0.123)	(0.255)	(0.671)	(0.306)	(0.213)
$\mathbf{CVCF_{it}}$						
young	0.494	0.468	0.580	1.232	0.865	0.750
	(0.747)	(0.417)	(0.662)	(2.250)	(1.711)	(1.375)
old	0.522	0.477	0.559	1.112	0.802	0.722
	(0.805)	(0.449)	(0.669)	(2.122)	(1.568)	(1.373)
small	0.521	0.567	0.682	1.526	1.009	0.809
	(0.787)	(0.497)	(0.767)	(2.569)	(1.925)	(1.499)
large	0.494	0.378	0.457	0.827	0.699	0.671
	(0.765)	(0.332)	(0.521)	(1.663)	(1.373)	(1.119)

Notes. The Table shows sample means and in parentheses the corresponding standard deviations. The subscript i indexes firms, and the subscript t, time, where t = 1996-2008. A firm is categorized as young (old) when its age is below (above) the median age in the firms industry in a given year. A firm is categorized as small (large) if the firm's totalassets are below (above) the median totalassets in the firms industry in a given year.

Table 3.11: Volatility interactions: time varying standard deviation of CF_{it}/K_{it-1}

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it-1}/K_{it-2}	-0.091	-0.168***	-0.234***	-0.106***	-0.007	-0.150***
	(0.079)	(0.021)	(0.039)	(0.014)	(0.031)	(0.048)
$k_{it-2}-s_{it-2}$	-0.219***	-0.196***	-0.278***	-0.165***	-0.138***	-0.239***
	(0.071)	(0.017)	(0.044)	(0.016)	(0.026)	(0.059)
Δs_{it}	0.201***	-0.077	0.301***	0.121***	0.102***	0.120
	(0.059)	(0.066)	(0.091)	(0.025)	(0.039)	(0.216)
Δs_{it-1}	0.211***	0.183***	0.296***	0.170***	0.139***	0.248***
	(0.061)	(0.026)	(0.046)	(0.015)	(0.026)	(0.097)
Δemp_{it-1}	0.011	-0.018	0.003	0.003**	0.052***	0.046***
	(0.015)	(0.042)	(0.007)	(0.002)	(0.015)	(0.017)
$CF_{it}/K_{it-1}*LOWVOL1^{tv}_{it}$ (α_{6a})	0.179**	0.101***	0.208***	0.183**	0.218**	0.277
	(0.081)	(0.025)	(0.063)	(0.092)	(0.107)	(0.653)
$CF_{it}/K_{it-1}*MEDVOL1^{tv}_{it}$ (α_{6b})	0.199***	0.088***	0.074**	0.200***	0.150**	0.171
	(0.054)	(0.017)	(0.036)	(0.039)	(0.060)	(0.124)
$CF_{it}/K_{it-1}*HIGHVOL1^{tv}_{it}$ (α_{6c})	0.080**	0.063***	0.018	0.047***	0.074**	0.093
	(0.034)	(0.011)	(0.023)	(0.011)	(0.030)	(0.083)
$sector/year\ dummies$	YES	YES	YES	YES	YES	YES
$\#instruments$	184	152	161	183	307	168
$m2$	0.60	0.15	0.98	0.13	0.39	0.47
J	0.61	0.25	0.11	0.62	0.15	0.19
$\#obs$	17,117	404,366	58,097	141,475	13,697	7,443
Wald tests						
$H_0:\alpha_{6a}-\alpha_{6b}=0$	0.70	0.27	0.00***	0.84	0.46	0.85
$H_0:\alpha_{6b}-\alpha_{6c}=0$	0.02**	0.00***	0.01***	0.00***	0.19	0.32
$H_0:\alpha_{6a}-\alpha_{6c}=0$	0.21	0.02**	0.00***	0.14	0.18	0.76

Notes. The Table shows the output for the GMM first difference estimation of specification (3.3). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. The Wald test shows the p-values. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

Table 3.12: Volatility interactions: time varying coeficient of variation of CF_{it}

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it-1}/K_{it-2}	-0.075	-0.148***	-0.211***	-0.098***	-0.002	-0.135***
	(0.062)	(0.011)	(0.034)	(0.012)	(0.028)	(0.042)
$k_{it-2} - s_{it-2}$	-0.201***	-0.214***	-0.251***	-0.163***	-0.131***	-0.223***
	(0.046)	(0.013)	(0.040)	(0.013)	(0.023)	(0.045)
Δs_{it}	0.168*	0.014	0.183***	0.107***	0.133***	0.130**
	(0.094)	(0.058)	(0.038)	(0.022)	(0.032)	(0.061)
Δs_{it-1}	0.196***	0.229***	0.260***	0.167***	0.137***	0.236***
	(0.043)	(0.021)	(0.035)	(0.013)	(0.023)	(0.046)
Δemp_{it-1}	0.010	0.023***	0.012**	0.004***	0.051***	0.042***
	(0.015)	(0.006)	(0.005)	(0.001)	(0.015)	(0.015)
$CF_{it}/K_{it-1} * LOWVOL2_{it}^{tv}$ (α_{6a})	0.105**	0.065***	0.040**	0.118***	0.124**	0.197**
	(0.047)	(0.011)	(0.020)	(0.042)	(0.050)	(0.088)
$CF_{it}/K_{it-1} * MEDVOL2_{it}^{tv}$ (α_{6b})	0.063*	0.062***	0.032**	0.046***	0.128***	0.064
	(0.034)	(0.011)	(0.015)	(0.016)	(0.041)	(0.067)
$CF_{it}/K_{it-1} * HIGHVOL2_{it}^{tv}$ (α_{6c})	0.025	0.047***	0.030	0.032*	0.027	0.074
	(0.033)	(0.013)	(0.021)	(0.017)	(0.022)	(0.083)
sector/year dummies	YES	YES	YES	YES	YES	YES
#instruments	242	155	538	205	367	247
m2	0.75	0.28	0.42	0.23	0.37	0.61
J	0.33	0.01	0.06	0.03	0.35	0.74
#obs	17,117	404,366	58,097	141,475	13,697	7,443
Wald tests						
$H_0 : \alpha_{6a} - \alpha_{6b} = 0$	0.28	0.47	0.65	0.08*	0.94	0.04**
$H_0 : \alpha_{6b} - \alpha_{6c} = 0$	0.32	0.04**	0.94	0.57	0.02**	0.90
$H_0 : \alpha_{6a} - \alpha_{6c} = 0$	0.13	0.02**	0.69	0.06*	0.07*	0.19

Notes. The Table shows the output for the GMM first difference estimation of specification (3.2). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. The Wald test shows the p-values. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

Table 3.13: Financial constraints and volatility interactions: time varying standard deviation of CF_{it}/K_{it-1}

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it-1}/K_{it-2}	-0.117**	-0.149***	-0.234***	-0.101***	0.017	-0.160***
	(0.056)	(0.016)	(0.025)	(0.014)	(0.033)	(0.048)
$k_{it-2} - s_{it-2}$	-0.243***	-0.204***	-0.277***	-0.160***	-0.115***	-0.273***
	(0.047)	(0.016)	(0.029)	(0.016)	(0.029)	(0.054)
Δs_{it}	0.192***	-0.024	0.209***	0.108***	0.110***	0.156**
	(0.053)	(0.047)	(0.041)	(0.025)	(0.039)	(0.066)
Δs_{it-1}	0.233***	0.224***	0.286***	0.165***	0.119***	0.285***
	(0.045)	(0.022)	(0.027)	(0.015)	(0.029)	(0.055)
Δemp_{it-1}	0.013	0.045	0.012**	0.003*	0.047***	0.006
	(0.013)	(0.030)	(0.005)	(0.002)	(0.016)	(0.095)
$finconLOW_{it}*$						
$CF_{it}/K_{it-1} * LOWVOL1^{tv}_{it}$ (α_{6a})	0.183*	0.069***	0.108**	-0.014	0.188	-0.035
	(0.096)	(0.021)	(0.045)	(0.120)	(0.153)	(0.227)
$CF_{it}/K_{it-1} * MEDVOL1^{tv}_{it}$ (α_{6b})	0.186***	0.061***	0.012	0.144***	0.194**	0.022
	(0.051)	(0.014)	(0.020)	(0.040)	(0.077)	(0.201)
$CF_{it}/K_{it-1} * HIGHVOL1^{tv}_{it}$ (α_{6c})	0.055*	0.049***	0.011	0.043***	0.068*	-0.026
	(0.030)	(0.010)	(0.014)	(0.014)	(0.038)	(0.074)
$finconHIGH_{it}*$						
$CF_{it}/K_{it-1} * LOWVOL1^{tv}_{it}$ (α_{7a})	0.227***	0.086***	0.130***	0.305***	0.365**	0.727*
	(0.092)	(0.022)	(0.049)	(0.104)	(0.172)	(0.379)
$CF_{it}/K_{it-1} * MEDVOL1^{tv}_{it}$ (α_{7b})	0.226***	0.078***	0.068**	0.275***	0.231**	0.093
	(0.073)	(0.015)	(0.030)	(0.053)	(0.110)	(0.225)
$CF_{it}/K_{it-1} * HIGHVOL1^{tv}_{it}$ (α_{7c})	0.126***	0.051***	0.010	0.057***	0.116**	0.014
	(0.036)	(0.011)	(0.021)	(0.018)	(0.053)	(0.155)
$sector/year\ dummies$	YES	YES	YES	YES	YES	YES
$\#instruments$	211	305	390	201	283	219
$m2$	0.41	0.85	0.41	0.15	0.28	0.46
J	0.48	0.07	0.29	0.74	0.07	0.80
$\#obs$	17,117	404,366	58,097	141,475	13,697	7,443
Wald tests						
$H_0 : \alpha_{7a} - \alpha_{7c} = 0$	0.24	0.04**	0.00***	0.02**	0.15	0.09*
$H_0 : \alpha_{7a} - \alpha_{6a} = 0$	0.61	0.21	0.61	0.01***	0.21	0.02**

Notes. The Table shows the output for the GMM first difference estimation of specification (3.3). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. The Wald test shows the p-values. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

Table 3.14: Financial constraints and volatility interactions: time varying coefficient of variation of CF_{it}

	Belgium	France	Finland	Sweden	Czech Rep	Hungary
I_{it-1}/K_{it-2}	-0.150***	-0.154***	-0.215***	-0.143***	-0.018	-0.116***
	(0.056)	(0.017)	(0.023)	(0.012)	(0.034)	(0.035)
$k_{it-2}-s_{it-2}$	-0.189***	-0.182**	-0.257***	-0.209***	-0.140***	-0.191***
	(0.027)	(0.018)	(0.025)	(0.014)	(0.030)	(0.039)
Δs_{it}	0.127***	0.000	0.200***	0.149***	0.144***	0.086**
	(0.032)	(0.054)	(0.040)	(0.022)	(0.046)	(0.039)
Δs_{it-1}	0.184***	0.196***	0.268***	0.210***	0.144***	0.198***
	(0.027)	(0.024)	(0.025)	(0.013)	(0.030)	(0.037)
Δemp_{it-1}	0.028**	-0.006	0.012**	0.003**	0.042***	0.045***
	(0.012)	(0.032)	(0.005)	(0.001)	(0.015)	(0.015)
$finconLOW_{it}*$						
$CF_{it}/K_{it-1}*LOWVOL2_{it}^{tv}$ (α_{6a})	0.076**	0.074***	0.004	0.024	0.096*	0.259***
	(0.039)	(0.012)	(0.019)	(0.024)	(0.053)	(0.084)
$CF_{it}/K_{it-1}*MEDVOL2_{it}^{tv}$ (α_{6b})	0.060**	0.076***	0.011	0.023*	0.078	0.048
	(0.024)	(0.013)	(0.015)	(0.013)	(0.065)	(0.064)
$CF_{it}/K_{it-1}*HIGHVOL2_{it}^{tv}$ (α_{6c})	0.008	0.054***	0.005	0.024	0.024	0.024
	(0.021)	(0.014)	(0.023)	(0.021)	(0.029)	(0.057)
$finconHIGH_{it}*$						
$CF_{it}/K_{it-1}*LOWVOL2_{it}^{tv}$ (α_{7a})	0.123**	0.088***	0.086***	0.060*	0.236***	0.198*
	(0.058)	(0.014)	(0.030)	(0.036)	(0.062)	(0.108)
$CF_{it}/K_{it-1}*MEDVOL2_{it}^{tv}$ (α_{7b})	0.112***	0.078***	0.052**	0.037**	0.043	0.235***
	(0.030)	(0.014)	(0.022)	(0.018)	(0.058)	(0.086)
$CF_{it}/K_{it-1}*HIGHVOL2_{it}^{tv}$ (α_{7c})	0.074**	0.072***	-0.021	-0.008	0.066	0.008
	(0.035)	(0.016)	(0.037)	(0.015)	(0.062)	(0.121)
$sector/year\ dummies$	YES	YES	YES	YES	YES	YES
$\#instruments$	506	179	390	290	257	321
$m2$	0.06	0.11	0.43	0.08	0.56	0.92
J	0.49	0.01	0.12	0.09	0.30	0.88
$\#obs$	17,117	404,366	58,097	141,475	13,697	7,443
Wald tests						
$H_0:\alpha_{7a}-\alpha_{7c}=0$	0.44	0.20	0.01***	0.07*	0.04**	0.20
$H_0:\alpha_{7a}-\alpha_{6a}=0$	0.42	0.14	0.00***	0.31	0.02**	0.48

Notes. The Table shows the output for the GMM first difference estimation of specification (3.3). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. The Wald test shows the p-values. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

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4

Do Firms Use the Trade Credit Channel to Manage Growth?[1]

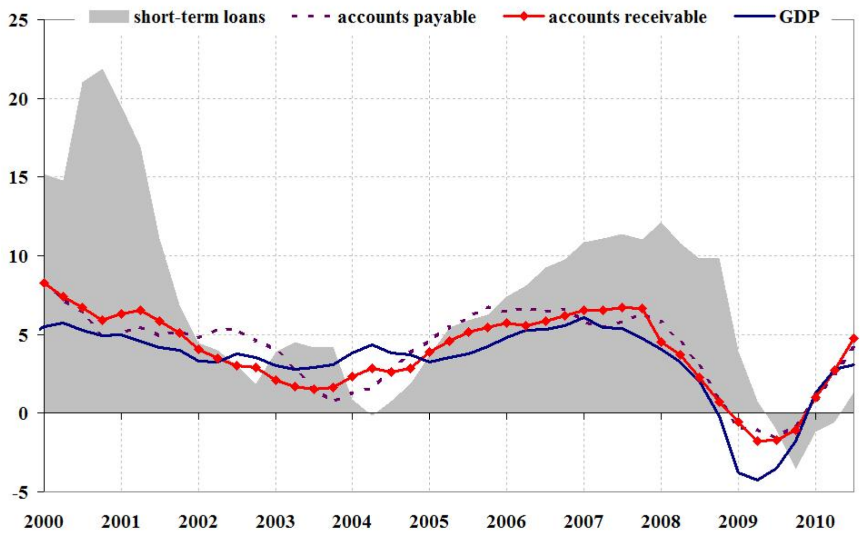
4.1 Introduction

Trade credit is an important source of finance for firms, especially when firms find it difficult to obtain external funding via credit institutions. Over recent years, trade credit in the form of accounts payable and receivable of euro area non-financial firms has moved broadly in line with the business cycle. This con-

[1]This chapter is the result of joint work with Annalisa Ferrando (ECB).

firms the typically procyclical pattern of accounts payable and receivable, as they are closely linked to the exchange of goods and services and, hence, to economic activity (see Figure 4.1). In general, the flows of trade credit have remained a stable source of finance for euro area companies but tended to decline when bank credit was becoming easily accessible since 2005.

Figure 4.1: Trade credit, short-term loans and euro area GDP (annual percentage changes)

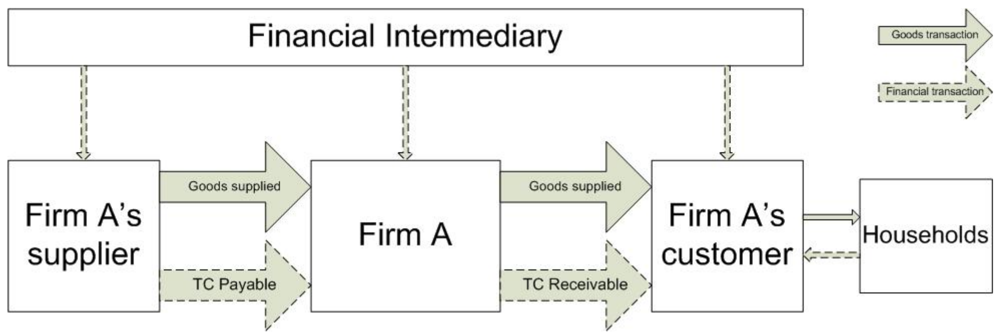


Source: ECB and Eurostat, euro area integrated accounts. Notes: Annual percentage changes are calculated as the four-quarter sum of transactions over the amounts outstanding four quarters earlier. Accounts receivable and payable are estimated by the ECB on the basis of partial information. The year-on-year percentage changes in euro area GDP are expressed in seasonally adjusted current prices.

During the recent financial crisis there has been an increase in the use of trade credit, in particular from mid-2009, likely to compensate the strong decline in short-term bank loans, which can be seen in Figure 4.1. Interestingly, the fact that the decline in the annual growth of accounts payable and receivable between non-financial firms has been less pronounced than that in nominal GDP growth may indicate that trade credit between companies has played a buffer role in the recent crisis.

If so, it is important to know through which mechanism trade credit plays this role. Trade credit is provided when there is a delay between the delivery of goods and services and the payment for them. While early trade credit theories relate the use of trade credit to the presence of information asymmetries and the monitoring advantage that suppliers have over banks, more recent analyses focus on the importance of trade credit (mainly in the form of accounts receivable) as a cash management tool. As illustrated in Figure 4.2, the use of trade credit of a firm is indeed twofold and is interlinked with the need to finance production. A firm can be seen as a supplier and therefore its accounts receivable (TCR) are a proxy for how much it lends to customers. However, a firm is also a customer and its accounts payable (TCP) are its borrowing from suppliers. Moreover it is often shown that firms that receive trade credit from their own suppliers are more likely to extend trade credit to their customers.

Figure 4.2: Firm performance and the financial environment



Notes. Figure based on Petersen and Rajan (1997).

In this paper we argue that it is the combination of both aspects of trade credit (accounts payable and receivable) that is important for a firm's performance. First, because firms manage both their accounts payable and accounts receivable to optimize their firm performance. And second, because in our view there is an interaction between the financial market and this trade credit channel. In the textbook example, all firms in a production chain finance their production through a financial intermediary, and so, every firm is paid for his goods at the moment of delivery. If, for some reason, these financial intermediaries do not (or no longer) provide sufficient means to finance production, firms might deliver the goods to their costumers down the chain without requiring immediate payment. Hence each customer, as seen in Figure 4.2, will receive trade credit (TCP) from his supplier and in turn he will extend trade credit (TCR) to his own customers. This chain continues until the final firm sells his goods to the households, after which the final goods firm repays his trade credit and, after that, every firm up the production chain.

Overall, it is thus crucial for a firm to receive trade credit from its suppliers in order to finance production, but it is also important to extend trade credit in order to sell its goods to its constrained customers. We argue that firms do not need to finance these accounts receivable with internal funds fully, but that firms may have a contract with a financial intermediary which allows them to draw on short term liabilities to finance a large portion of their accounts receivable. Mester et al. (2001) cite such a contract between a small-business borrower and a Canadian bank:

> *"Total outstandings are not to exceed 75% of good accounts receivable, excluding accounts over 90 days and inter-company accounts plus 50% of inventory, up to a maximum of $5 million dollars, including raw material, work in process and finished products, less priority claims."*

Basically, such credit lines imply that most of a firm's accounts receivable do not affect the firm's working capital and that the bank is indirectly financing the firm's customers, while it is still the firm (and not the bank) that is bearing the monitoring costs and the default risk.[2] This mechanism, where receivables are partially self-financing, has not received much attention in the literature, although it has been noted by few authors (Stowe et al., 1980; Mian and Smith, 1992; Mester et al., 2001; Burkart and Ellingsen, 2004).

In order to protect their accounts receivables from credit risk related to losses, firms can purchase credit insurance. Moreover, firms with insured receivables will be more likely to get a bank contract that allows them to draw on short term liabilities with receivables as pledged collateral. According to the International Credit Insurance and Surety Association (ICISA) in 2010 its members insured trade credit in excess of 1,6 trillion euro. This popular form of protection thus enables suppliers to significantly increase their overall sales turnover, reduce credit risk related losses and improve the profitability of their business.[3]

The balance sheet data used in this paper (see below) provide some 'smoking gun' evidence of the mechanism. Looking at Table 4.1, the first two columns show the mean of accounts receivable scaled by total assets and the mean of short term liabilities, excluding accounts payable, scaled by total assets. The table reveals that they are similar in magnitude and therefore does not reject the hypothesis that firms draw on short term liabilities to finance a large part of their receivables rather than using cash. More importantly, column 3 of Table 4.1 shows the correlation between the flow of accounts receivable and the flow of short term liabilities, where the flow is measured as the year-on-year change and both flows are scaled by total assets. We find that increases in accounts receivable are strongly related

[2] As argued in the literature, there are many economic reasons why a firm would perform these tasks rather than a financial intermediary.

[3] See for instance Jones (2010) or "Credit Insurance for European SMEs: A Guide to Assessing the Need to Manage Liquidity Risk" published by the European Commission in 2003.

to increases in short term liabilities, moreover, the fourth column of Table 4.1 shows that increases in accounts receivable are much less related to decreasing cash balances. The correlations in columns 3 and 4 can be seen as further evidence of the mechanism just explained. Even though the destination of these additional short term liabilities is fixed, namely to be invested in sales, the mechanism gives the firm more freedom to invest its cash, its accounts payable or other short term loans, and ultimately it favours growth in addition to boosting the firm's sales.

Table 4.1: Descriptive statistics: correlations

	$\frac{TCR}{totalassets}$	$\frac{ST\ liabilities}{totalassets}$	$Corr(\frac{\Delta TCR}{totalassets}, \frac{\Delta ST\ liabilities}{totalassets})$	$Corr(\frac{\Delta TCR}{totalassets}, \frac{\Delta Cash}{totalassets})$
BE	0.35	0.29	0.40***	-0.01
DE	0.20	0.25	0.13***	-0.03***
ES	0.39	0.27	0.50***	-0.04***
FI	0.17	0.29	0.31***	-0.03***
FR	0.31	0.34	0.36***	-0.06***
IT	0.37	0.32	0.34***	-0.05***
NL	0.35	0.34	0.52***	-0.04***
PT	0.34	0.35	0.28***	-0.12***

Source: AMADEUS, Bureau van Dijk Electronic publishing, authors' calculations. Notes. *TCR* are accounts receivable, *ST liabilities* are short-term liabilities excluding accounts payable. *Cash* is cash and cash equivalent. *** indicates significance at 1% level.

There are several reasons why we choose to sum accounts receivable and payable into what we call 'the trade credit channel'. First and foremost, both types of trade credit are an indication of how much of the firm's operations are shielded from developments in the financial sector. Either from the firm's own financing perspective (the firm can finance production with more ease if its suppliers provide working capital) or that of its customers (the firm can sell more if it can alleviate the financial constraints of its customers). Taking the sum thus gives an idea of how much of the firm's production is independent of frictions or imper-

fections in the financial market. In this perspective, our paper also adds to the revived literature on the link between the financial sector and the real economy. Secondly, because we are interested in the implications of the total trade credit channel on firm growth, we want both accounts payable and receivable simultaneously in the analysis. Unfortunately, as they are strongly correlated with each other, in the regression analysis this would give rise to multicollinearity problems. Therefore, we take the sum to see the total impact of trade credit on firm growth. The drawback of this approach is that we are unable to capture the exact impact of each type of trade credit. However, we will test whether one of both components has a different impact on growth, or stated differently, we will test whether the composition of the trade credit channel is important[4]
For the above stated reasons, we think that the trade credit channel could be particularly important for firms located in countries where the financial intermediary sector is not sufficiently developed, or within a country for firms that typically suffer more from financial market imperfections, e.g. young or small firms. These hypotheses are respectively elaborated in section 4.4.2 and section 4.4.3.

This paper contributes to the existing literature in several important ways. First, while many theories of accounts payable and accounts receivable are related to firm performance, there have been no direct tests on whether firms actively use them to manage their growth. By our knowledge, only the work of Fisman and Love (2003) tries to investigate this link. Their work resembles our paper the most, but Fisman and Love's data are on industry level. By contrast, this paper uses approximately 2.5 million firm level observations, which consist mainly of small and medium sized enterprises, to test whether firms depend on the trade credit channel for growth. Secondly, we use a dynamic growth model as empirical spec-

[4]Table 4.11 in the Appendix refers to this question, but we come back to this is issue later in section 4.4.

ification in contrast to a static model as used by Fisman and Love (2003). Our findings thus shed some additional light on the robustness of their results. And thirdly, we argue that it is not only the accounts payable, but also the accounts receivable that are important for a firm's performance. Moreover, we show that firms that are more likely to be financially constrained, i.e. young or small firms, rely more on the trade credit channel to grow. Our analysis focuses on 8 euro area countries, which are characterised by some degree of heterogeneity in their financial systems. The econometric results indicate that the overall conditions of the financial market matter for the importance of the trade credit channel for growth. Also noteworthy, in countries where the trade credit channel is more present, the marginal impact is lower, but the total impact tends to be higher. The remainder of the paper is structured as follows: section 4.2 reviews the relevant literature with a focus on the link between trade credit and firm performance. Section 4.3 presents the dataset used in the analysis and some stylized facts based on them. Section 4.4 introduces the empirical approach and the econometric results. Also the implications for firm performance related to firm heterogeneity and country heterogeneity will be discussed. Some conclusions are given in the final section.

4.2 Literature

In a model without bank loans, Bougheas et al. (2009) show that, for a given liquidity, an increase in production will require an increase in trade credit. A higher production is associated with a higher production cost which, for a given (insufficient) amount of liquidity, implies that the firm will need to take more trade credit. So trade credit works as an alternative mean to finance production. Also Cuñat

(2007) argues that fast growing firms may finance themselves with trade credit when other types of finance are not sufficiently available. Fisman and Love (2003) extend the analysis to link trade credit substitutability for institutional financing to the overall development of the financial sector. They find evidence that industries that use more trade credit grow relatively faster in countries with poorly developed financial markets. More empirical support of a link between trade credit and firm performance comes from Boissay and Gropp (2007), who show that firms that are confronted with a liquidity shortage (shock) try to overcome this distressed situation by passing on one fourth of the shock to their suppliers by taking more trade credit.

In addition to taking credit from their suppliers, firms simultaneously offer trade credit to their customers. In fact, most firms have higher amounts of accounts receivable than accounts payable (See Figure 4.5 and Figure 4.6 in the Appendix). Firms use trade receivables as a tool for implicit price discrimination across customers, in cases where it is not possible, for instance on account of legal restrictions, to discriminate directly on the basis of prices (Meltzer, 1960). In such cases, firms with a stronger market position may choose to make greater recourse to accounts receivable, selling to customers on credit with a view to enhancing their competitive position in the market. Petersen and Rajan (1997) showed that firms with high profit margins, i.e. those that would benefit most from making additional sales via price discrimination, indeed have higher accounts receivable. More recent, Bougheas et al. (2009) argue that accounts receivable are important for the performance of inventory management. For a given aggregate demand, higher production increases inventories in their model; and minimization of the (inventory) costs implies that firms will increase accounts receivable offered in order to sell more and consequently hold less inventories. Furthermore, accounts receivable are proven to be a useful tool when there is considerable uncertainty about the quality of a firm's product among potential customers. The firm can increase its sales by allowing delayed payments, such that the customer can witness the quality before paying (Ng et al., 1999; Deloof and Jegers, 1996). Finally, firms provide more trade credit to customers that are in temporary distress. This also enhances their sales, since otherwise the distressed customer would not be able to buy the goods. Firms will however only offer additional trade credit when they believe there is a future surplus of having a long-lasting relation with that customer (Cuñat, 2007).

Although the above stated theories of accounts receivable are positively related to firm performance, they seem to be in contrast with the idea that accounts payable are used to finance the firm. On first sight, one could argue that each euro of accounts payable cannot be used to finance the activities when the firm provides that same euro as accounts receivable to a customer. Actually, as stated in the introduction, the main reason why this is not so, and probably also why firms are willing to offer so much accounts receivable, is because banks are willing to provide loans once the accounts receivable are pledged as collateral. This is especially the case when firms insure their receivables against the probability that the customer defaults.

4.3 Data

Our firm level data is taken from AMADEUS, a commercial database provided by Bureau van Dijk Electronic Publishing. This is a comprehensive, pan-European database containing financial information on over 10 million public and private companies. We select non-financial firms in the euro area between 1993 and 2009 that have reported non-negative accounts payable and receivable in their balance sheets. After performing some data filtering in order to clean the data (see the Appendix), we obtain an unbalanced panel of approximately 600.000 firms and 2.5 million observations. The final sample contains data for eight euro area countries (Belgium, Germany, Spain, Finland, France, Italy, Netherlands and Portugal) for which we have enough observations to run our econometric analyses. Due to different accounting reporting practises for Spain, we restricted the Spanish sample to companies having strictly positive instead of non-negative accounts payable. Compared with the data from Cayssials and Kremp (2010), this does not affect the representativeness of our Spanish sample[5]. As shown in Table 4.2, in spite of the large number of observations, the coverage differs a lot across countries. French companies cover almost half of the entire sample while on average the percentage of SMEs is around 90% but ranging from less than 40% in the Netherlands to more than 98% in Spain (See Table 4.8 in the Appendix). The low percentage of SMEs in the Netherlands is due to the low coverage of Dutch SMEs in AMADEUS. Finally, firms are on average relatively mature and SMEs are mostly also the youngest.

Looking at our variables of interest, it is evident that the use of trade credit differs a lot across euro area countries, sectors of activity and size. In general, firms appear to have more accounts receivable than payable on their balance sheets. Approximately 64% percent of the firms in our sample have more accounts receivable than accounts payable. Moreover, trade credit (payable and receivable) is relatively more prevalent in Mediterranean countries (see Figure 4.5 and Figure 4.6 in the Appendix). In general, country differences may be accounted for by the heterogeneous institutional structures and trade credit payment conditions. A

[5]Cayssials and Kremp (2010) use data from the European BACH (Bank for the Accounts of Companies Harmonised) and ESD (European Sectoral references Database) databases.

Table 4.2: Descriptive statistics: sample means

	BE	DE	ES	FI	FR	IT	NL	PT
$growth^{av}$	0.08	0.08	0.09	0.11	0.06	0.09	0.09	0.08
$bank\ loans$	0.21	0.22	0.23	0.22	0.10	0.23	0.11	0.27
$growth^{s}$	0.04	0.08	0.06	0.07	0.04	0.05	0.05	0.02
$log(size)$	9.04	8.55	9.11	6.21	6.62	7.64	10.7	5.99
age	25.9	27.0	20.3	16.2	17.2	17.4	35.5	16.1
$TC^{channel}$	0.35	0.15	0.45	0.14	0.30	0.51	0.27	0.44
TCP^{days}	54	21	63	21	48	83	27	58
TCR^{days}	73	33	103	30	60	103	69	102
$\#\ obs$	67,408	53,728	167,697	88,318	1,171,221	590,569	14,017	281,365
$\#\ firms$	9,988	23,290	28,470	22,461	228,634	187,379	3,152	110,050

Source: AMADEUS, Bureau van Dijk Electronic publishing, authors' calculations. Notes. The Table shows the sample means of the regression variables for each country. $Growth^{av}$ is defined as the rate of growth of real added value; *bank loans* is the sum of short term and long term bank loans, scaled by total sales; $growth^{s}$ is defined as the rate of growth of real sales; size is measured by total assets; age is the age of firms in years; $TC^{channel}$ is the sum of accounts payable and receivable divided by sales. TCP^{days} and TCR^{days} is the average maturity of accounts payable and receivable in terms of days.

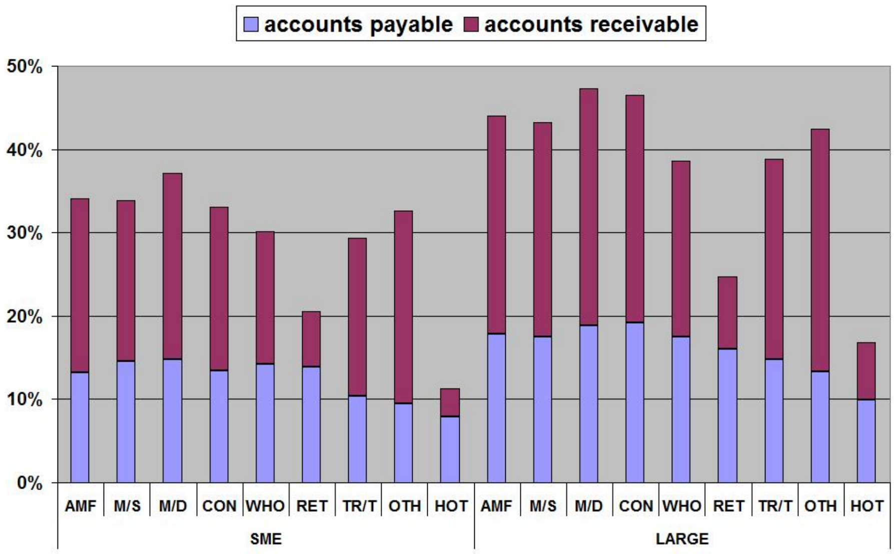
possible explanation for this is that trade credit should be more important than bank credit when creditor protection is weaker, because cash is easily diverted, while this is more difficult in the case of inputs, and the illiquidity of inputs facilitates trade credit.[6] This is found to hold true for French Civil Law countries (BE, FR, IT, NL, PT and ES), which are characterised by weaker legal protection.[7] Effective payment periods are longer in Mediterranean countries. In Germany and Finland, the average maturity of trade credit payable and receivable is around one month. For countries like Spain, Italy or Portugal the average days of outstanding trade credit payables is well over fifty days, while for trade credit receivables it is even more than hundred days. These differences are in line with the evidence provided by Cayssials and Kremp (2010). Country differences are mainly attributed to the characteristics of the underlying contracts. As explained by Marotta (2005), the initial terms of payment are usually longer for instance in Italy, Spain and Por-

[6] Burkart and Ellingsen (2004); Demirguc-Kunt and Maksimovic (2002)

[7] La Porta et al. (1998)

tugal with respect to Nordic countries, the availability of discounts is more limited and often there are no penalties for late payments in the former group of countries. Another stylized fact derived from our dataset is that trade credit is more diffused in sectors where there is a physical good involved, although it relates also to the provision of services (Figure 4.3). Furthermore, as in Giannetti et al. (2011), the use of trade credit is higher for manufacturers of differentiated goods than for those of standardized goods[8].

Figure 4.3: Trade payables and trade receivables across sectors and firm size (% of sales)



Source: AMADEUS, Bureau van Djik Electronic publishing and own calculations. Notes. Based on an unbalanced panel of 600.000 companies that are reporting the use of trade credit. Average period:1993-2009. AMF: agriculture, mining and fishing; M/S: manufacturing/standardized goods; M/D: manufacturing/differentiated goods; CON: construction; WHO: wholesale trade; RET: retail trade; TR/T: transport and telecom, OTH: other business activities; HOT: hotels and restaurants. The definitions of small, medium and large firms are as defined in Table 4.8 in the Appendix.

Viewed in terms of firm size, trade credit is particularly important for SMEs, in

[8]See the Appendix for a definition on differentiated and standardized goods manufacturing goods.

particular in times of financial strains, when firms find it difficult to obtain external funding from credit institutions. Early trade credit theories relate the use of trade credit to the presence of information asymmetries and the monitoring advantage that suppliers have over banks.[9] More specifically, the line of reasoning is usually as follows: some firms (typically small firms with little collateral) are unable to obtain bank loans because it is too costly for the bank to monitor them. For suppliers of those firms, by contrast, monitoring and bargaining costs may be lower in the context of an established long-term relationship, since they frequently conduct business with the small firms and may also have the power to cut off the supply to such firms or to repossess the goods in the event of defaulted repayment. The aforementioned informational and bargaining advantages that a supplier has over a bank might provide the supplier with an opportunity to extend credit to the buyer, even if that buyer does not seem creditworthy to the bank.[10] Nonetheless, as our data show, trade credit is also widely used by large firms, but mainly as a cash management tool: by delaying payments, firms may be better able to match their cash flow to their needs. Firms that receive trade credit from their own suppliers are more likely to extend trade credit receivables to their customers.

[9] See Petersen and Rajan (1997) for a review of the literature and Fisman and Love (2003).

[10] See Petersen and Rajan (1997); Frank and Maksimovic (2005).

4.4 Empirical approach and estimation

4.4.1 The baseline specification

Our econometric model follows Coluzzi et al. (2012) who use an augmented version of the law of proportionate effect (LPE), as proposed by Goddard et al. (2002), to estimate the impact of financing obstacles on firm performance. The basic intuition of the LPE (equation (1)) is that firm growth is mean reverting to its optimal industry size. Coluzzi et al. (2012) add economic meaning to the simple LPE specification through the inclusion of economic variables that are believed to deterministically affect growth. Although our paper is most closely related to the work of Fisman and Love (2003), we do not follow their empirical strategy because we believe that growth is a dynamic process. Therefore, we prefer a simple dynamic growth model rather than the static model of Fisman and Love (2003).

$$
\begin{aligned}
growth^{av}_{it} &= \alpha_0 + \alpha_1\ growth^{av}_{it-1} + \alpha_2\ TC\ Channel_{it-1} + \alpha_3\ bank\ loans_{it-1} \\
&+ \alpha_4\ growth^{sales}_{it-1} + \alpha_5\ log(size)_{it-1} + \alpha_6\ log(age)_{it-1} \\
&+ \upsilon_i + \upsilon_t + \upsilon_{jt} + \varepsilon_{it} \qquad (4.1)
\end{aligned}
$$

Where the growth of added value ($growth^{av}$) is calculated as the difference between the real[11] added value and lagged real added value, divided by the lagged real added value. Added value is defined as the sum of profit (loss) for the period and minority interest, taxation, cost of employees, depreciation and interest paid.

[11] A variable in real terms is calculated as the variable in nominal terms divided by the GDP deflator.

The trade credit channel is constructed as the sum of accounts payable and accounts receivable, scaled by total sales. Following Coluzzi et al. (2012) and Hesmati (2001), who showed that access to bank loans is an important driver of firm growth, we also include the sum of short term and long term bank loans scaled by total sales in the specification. We try to account for firm opportunities by including sales growth[12], which is the growth rate of real total sales. Further, by taking the log of total assets and the log of age into account we ensure that any impact of the trade credit channel on growth is not driven by firm size or age. The explanatory variables are lagged one period to reduce possible endogeneity problems. For the trade credit channel this is also important to avoid a potential accounting correlation between higher sales via receivables, which lead directly to higher added value via profits. By keeping sales growth constant and by keeping bank loans per production (proxied by sales) constant, the trade credit channel measures the effect of having a higher share of the firm's production shielded from developments in the financial sector; either because suppliers finance a higher share of production, or because constrained customers buy a higher share of production on credit. The error term consists of four components: an unobserved firm specific component υ_i, a time component to filter out business cycle effects υ_t, a time component which varies over industries accounting for industry specific effects υ_{jt} and finally an idiosyncratic component ε_{it}.

All specifications are estimated with the first difference General Method of Moments (GMM) estimator developed by Arellano and Bond (1991). The first difference GMM estimator is appropriate since it controls for biases due to unobserved firm-specific effects and the possible endogeneity of explanatory variables. Blundell and Bond (1998) showed that adding instruments in levels to estimate the

[12]For instance Gomes (2001) suggests to use changes in profit or sales to account for growth opportunities.

differenced equation considerably improves the efficiency of the first difference estimator in smaller samples. Given the size of our sample we use the first difference GMM.

Table 4.3: Baseline estimation: specification (1)

	BE	DE	ES	FI	FR	IT	NL	PT
$growth^{av}$	-0.075**	-0.067**	-0.055	-0.139***	-0.319***	-0.121***	-0.160***	-0.103***
$TC^{channel}$	0.593***	0.454***	0.525***	1.006***	0.740***	0.327***	0.727***	0.342***
bank loans	0.301***	0.089*	0.413***	0.471***	0.067**	0.012	0.144*	0.301***
$growth^{s}$	0.110**	0.048***	0.064**	0.091***	0.568***	0.128***	0.080***	0.076***
$log(size)$	-0.469**	0.056	-0.391***	-0.472***	-0.257***	-0.102**	-0.306***	-0.296***
$log(age)$	-0.073	-0.161***	-0.066*	-0.049*	-0.008	-0.111***	-0.039	-0.143***
$m2$	0.75	0.41	0.13	0.27	0.53	0.17	0.71	0.92
J	0.07	0.35	0.12	0.17	0.08	0.00	0.29	0.00
# obs	67,408	53,728	167,697	88,318	1,171,221	590,569	14,017	281,365

Notes. The Table shows the output for the GMM first difference estimation of specification (1). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level. For the definition of the variables see notes of Table 4.2.

Table 4.3 shows the results for the first difference GMM estimation of the baseline specification. The $m2$ statistics provide no indication that the instruments would be correlated with the error term. The null hypothesis of no second order serial correlation cannot be rejected in all the regressions. We also report the results of the Sargan test of overidentifying restrictions J as a test for instrument validity, although Blundell et al. (2000) report Monte-Carlo evidence that this test tends to over-reject, especially when the data are persistent and the number of time-series observations large. According to the information derived from the $m2$ statistics and the Sargan test, we used different sets of lagged instruments across countries, ranging from instruments starting in $t-2$ for Belgium and The Netherlands till instruments starting in $t-7$ in France. For each country we choose the lag structure that best fits the $m2$ and J tests. We believe that different growth dynamics of firms between countries could be driving this, and so we need different lag structures to take this into account. As the results across countries are not coming from estimations with identical instruments, we focus more on the economic and statistical significance of the independent variables. However, Table 4.9 in the Appendix shows that the results in Table 4.3 do not significantly change when specification (1) is estimated with identical instruments ($t-2$ and further) for all countries.

Starting from the estimated coefficients of past firm growth rates, they are negative and significant in most countries, thus rejecting the LPE hypothesis of growth not depending on past performance. Further, the implication of the LPE that initial size should also not affect growth is not supported by the results, namely larger firms grow significantly slower and firms that have grown a lot in the previous period are more likely to grow slower this period. Table 4.3 further shows that access to bank loans fosters growth in all countries except Italy. Firms with better opportunities -proxied by sales growth- grow faster in all countries. Next, the stylised fact that younger firms tend to grow faster is confirmed as age is negatively related to firm growth, although the coefficients are not always statistically significant. More importantly, the parameter on the trade credit channel is positive and significantly different from zero in all countries investigated, confirming the hypothesis that firms use the trade credit channel to manage their growth.

A useful exercise is to compare the quantitative impact of the trade credit channel within each country. In order to draw meaningful cross-country conclusions from this exercise, it is necessary that the results are drawn from identical estimations for each country. For this reason, and also to check whether the results in Table

4.3 are robust to the instruments used, we show in Table 4.9 in the Appendix the estimation results for the baseline specification (1) with identical instruments. The results appear to be very robust to the different sets of instruments.

The first two columns of Table 4.4 report the estimated α_2 and the average size of the trade credit channel within each country. Interestingly, if these figures are compared, it appears that the sensitivity of growth to the variation in the trade credit channel is largest for countries where the trade credit channel itself is smaller, like Germany or Finland, but also in the Netherlands. In countries where the trade credit channel is intensively used, like Spain, Italy or Portugal, the marginal impact of the channel on growth is lower. However, when we quantify the overall impact we find that this is still higher in countries where the trade credit channel is large. In the third column of Table 4.4 the difference in the growth rate of added value is calculated, keeping all other things equal, between a firm of the 25th and 75th percentile of the trade credit channel. In countries where the total value of accounts payable and receivable is less than one fourth of the value of total sales, the difference in firm growth between firms in the 25th and 75th percentile of the trade credit channel is more or less 10%. In countries where almost half of the total sales is sold and bought on credit, this difference in growth is more than 14%. The last column of Table 4.4 displays the impact of a one standard deviation increase in the trade credit channel on firm growth, measured in units standard deviation of growth of added value. One standard deviation is measured, for each country, as the mean of all the firm level standard deviations. In countries where the trade credit channel is less widespread, a one standard deviation increase in the channel leads -ceteris paribus- to a 0.09-0.13 standard deviation increase in firm growth. In Portugal and Spain, where goods are commonly bought and sold on credit, a one standard deviation change in the trade credit channel implies a 0.13-0.16 standard deviation change in firm growth.

Table 4.4: Quantitative impact of the trade credit channel within countries

	GMM	$TC^{channel}$		(25 vs 75)	(1 std.dev.)
BE	0.567***	0.35		12%	0.15
DE	0.468***	0.15		6%	0.09
ES	0.530***	0.45		16%	0.16
FI	1.006***	0.14		12%	0.15
FR	0.517**	0.30		13%	0.15
IT	0.373***	0.52		13%	0.13
NL	0.688***	0.27		11%	0.14
PT	0.342***	0.44		14%	0.13

Notes. The Table first shows the output for the parameter on the trade credit channel in the first difference GMM estimation of specification (1) with the same lag length used as instruments for all countries. The total output of these estimations can be found in Table 9 in the Appendix. The estimates are robust to heteroscedastic standard errors. The specifications were estimated with time dummies and time dummies interacted with industry dummies. The second column gives the mean of the trade credit channel, i.e. $\frac{TCP+TCR}{sales}$. The third column gives the -ceteris paribus- percentage difference in growth induced by the TC Channel between a firm in the 25th percentile of the TC Channel and 75th percentile. The fourth column gives the -ceteris paribus- standard deviation difference in growth induced by a standard deviation in the TC Channel. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

In Table 4.10 in the Appendix, specification (1) is augmented with the trade credit channel interacted with the ratio of payables to receivables to test whether the composition of the trade credit channel is relevant for the importance of the trade credit channel on growth. Or stated differently: to test whether the significant impact of the trade credit is only driven by the accounts payable or only by the accounts receivable. The interaction term appears to be never significant. This indicates that is thus equally important for a firm to receive trade credit from its suppliers in order to finance production independent from financial intermediaries, or to extend trade credit in order to sell the production to its customers, independent from their access to finance. Furthermore, Table 4.11 and Table 4.12 in the Appendix show, respectively, that only including accounts payable or accounts receivable in the regressions tends to overestimate the importance of the trade credit channel.

4.4.2 Implications of firm heterogeneity: size and age

As reported in the literature, small firms, which are characterised by a small amount of collateral relative to their liabilities, tend to have more problems to access external finance. In this respect, accounts payable could be particular important as alternative source of finance. At the same time, the cash management tool argument suggests that also large firms tend to use accounts payable but also accounts receivable. In order to test the behaviour of firms with different sizes, we construct a dummy variable -SMALL- where firms are classified according to their total assets falling below the 25th percentile.[13] Table 4.5 reports the country estimations of our baseline model (1) augmented by the interaction of the trade credit channel variable with the size dummy. The estimations confirm that the trade credit channel is important for firm growth in general, but the magnitude of its impact is higher for smaller firms in each country, and significantly so in six out of eight countries. For small firms it is thus more important to manage growth via the trade credit channel than for large firms.

Turning to age, Gertler (1988) was one of the first to argue that firm age is an important determinant of financial constraints. Because young firms are more likely to experience difficulties in raising external funds, we hypothesize that the trade credit channel should play a bigger role for young firms than for older firms. To test this, again we augment the baseline specification (1) by interacting the trade

[13]The dummies are constructed per year and per sector. A firm i is for instance small in year t when its total assets are in the 25th percentile of all the firms in that year t in the same sector.

Table 4.5: Firm heterogeneity: Size

	BE	DE	ES	FI	FR	IT	NL	PT
$growth^{av}$	-0.152***	-0.067***	-0.154***	-0.140***	-0.309***	-0.117***	-0.162***	-0.085**
$TC^{channel}$	0.801***	0.344***	0.296**	1.017***	0.762***	0.432***	0.722***	0.325***
$TC^{channel}_{SMALL}$	0.435**	0.090	1.905***	0.646***	0.888**	0.198***	0.183	0.357***
bank loans	0.270***	0.068	0.270***	0.478***	0.126**	0.153***	0.133*	0.393***
$growth^{s}$	0.144*	0.051***	0.146***	0.089***	0.570***	0.130***	0.079***	0.160***
$log(size)$	-0.309***	0.126	-0.310***	-0.491***	-0.310***	-0.104	-0.284***	-0.386***
$log(age)$	-0.068*	-0.205***	-0.082***	-0.040	0.015	-0.119***	-0.025	-0.006
$m2$	0.43	0.38	0.60	0.24	0.82	0.11	0.69	0.35
J	0.09	0.18	0.02	0.18	0.10	0.00	0.47	0.00

Notes. The Table shows the output for the first difference GMM estimation of specification (1) augmented with an interaction term. The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level. $TC^{channel}_{small}$ is defined as the product of the trade credit channel and a size dummy identifying small companies (below 25th percentile of total assets). For the definition of the other variables see notes of Table 4.2.

credit channel variable with a dummy for age -YOUNG. We define young firms those firms that are less than 5 years old, which involves between 5 to 10 percent of our sample (see Table 4.8 in the Appendix). Table 4.6 confirms once again that the accounts payable and receivable form an important channel to manage firm growth. Moreover, the younger a firm is, the more important this channel becomes. A straightforward finding since more mature firms are more likely to have successful track records and may enter repeated relations with lenders, which both mitigate the problem of information asymmetries and thereby relaxes the need for an alternative financing channel (Gertler, 1988). This appears to be true for most countries in our sample, although the impact of age interacted with the trade credit channel is not always significant.

Table 4.6: Firm heterogeneity: Age

	BE	DE	ES	FI	FR	IT	NL	PT
$growth^{av}$	-0.189**	-0.210***	-0.177***	-0.138***	-0.302**	-0.130***	-0.158***	-0.143***
$TC^{channel}$	0.545***	0.323***	0.250**	0.975***	0.792***	0.419***	0.641***	0.379***
$TC^{channel}_{YOUNG}$	0.200**	0.361**	0.120**	0.084	0.063**	0.094***	0.091	0.087*
bank loans	0.290***	0.103**	0.348***	0.480***	0.146**	0.181***	0.133*	0.367***
$growth^{s}$	0.127**	0.111***	0.147***	0.088***	0.548***	0.160***	0.084**	0.163***
$log(size)$	-0.432*	0.064	-0.460***	-0.490***	-0.337***	-0.238***	-0.249*	-0.557***
$log(age)$	-0.032	-0.232***	-0.004	-0.040	0.028	-0.020***	-0.016	-0.008
$m2$	0.95	0.34	0.30	0.29	0.82	0.29	0.75	0.29
J	0.15	0.27	0.09	0.20	0.01	0.00	0.45	0.00

Notes. The Table shows the output for the GMM first difference estimation of specification (1). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level. For the definition of the variables see notes of Table 4.2.

4.4.3 Implications of country heterogeneity

It has recently been shown that developed and well functioning financial markets are important in promoting economic growth. Mainly because in such markets, financial intermediaries allocate sufficient funds until marginal revenues equalise marginal costs, without discriminating among borrowers. Thus, first of all, the size of the financial sector needs to be large enough, otherwise some firms would need to resort to other channels to finance their activities. Research has indicated that firms use more trade credit when access to credit institutions is difficult, either because financial markets are less developed (Fisman and Love, 2003) or when the financial market is not liberalised (Ge and Qiu, 2007). Secondly, even in developed financial markets, when monetary authorities are conducting a restrictive policy, the supply of external finance may decrease significantly, such that a sufficient allocation of funds to all demanding borrowers may no longer be possible, creating the need for alternative channels to finance growth. Several empirical studies have shown that firms substitute bank loans for trade credit in an effort to limit the impact of the traditional bank lending channel (Nilsen, 2002; De Blasio, 2005; Choi and Kim, 2005; Guariglia and Mateut, 2006) or, as shown in Figure 4.2, to limit the impact of a financial crisis (Love et al., 2007).

Even though all eight countries in our euro area sample are considered to have well developed financial markets, they are still quite heterogeneous today and they have changed significantly throughout the last two decades, which is almost entirely covered by our sample period 1993-2009. When we consider the total amount of bank loans as a percentage of GDP, for instance, bank loan availability has increased more than 30 percentage points in Belgium and almost 150 percentage points in Spain over the sample period. The heterogeneity is even bigger in the debt securities market. The issuance of debt securities as a fraction of GDP was on

average around 6 percent in 1993 and doubled in 2009 up to 12 percent of GDP. However, differences across countries remain large with the issuance of French firms at around 18 percent and that of Spanish firms still less than 2 percent. This gives us an opportunity to test whether there is an interaction between the state and evolution of the financial market on the one hand and the trade credit channel on the other hand. Based on the theories and previous empirical findings stated above, we expect a negative relation.
Further, the evolution of the bank loan to GDP ratio might have a trend over the period, which could also capture developments in the regulation of the product market. These product market deregulations could also have reduced market imperfections and thus the role of trade credit. In an attempt to disentangle this additional factor, we include a variable that captures the deregulation process in the product markets that took place during the period.[14]

To test the hypotheses related to the development of the financial market, we append the data for all eight countries into one panel containing all countries and we generate two interaction variables. The first is $TC_{ijt}^{channel} * \frac{bankloans_{jt}}{GDP_{jt}}$, which interacts the trade credit channel of firm i in country j in year t with the total amount of bank loans as a fraction of GDP in that country j in that year t. In Table 4.7 this interaction is indicated as $TC_{CAP1}^{channel}$. Table 4.7 shows that euro area firms use the trade credit channel to finance growth, moreover, this channel is less important in years/countries where there is a larger supply of bank loans. And while the estimate on the interaction seems rather small, it is economically important. It implies that for Italy, everything else equal, the marginal impact of the trade credit

[14]The indicator used in the analysis measures the knock in effects of non-manufacturing regulation on the cost structures faced by firms that use the output as intermediate inputs in the production process (Nicoletti et al., 2000; Conway and Nicoletti, 2008). It is found that tight regulation of the product markets have a large negative impact on investment (Alesina et al., 2005) and profitability.

channel declined by almost 9% between 1993 and 2009 because of the increase in bank loan availability.

Table 4.7: Country heterogeneity: financial market development

	ALL COUNTRIES	ALL COUNTRIES	ALL COUNTRIES
$growth^{av}$	-0.118***	-0.118***	-0.120***
$TC^{channel}$	0.520***	0.551***	0.424***
$TC^{channel}_{CAP1}$	-0.0003*		
$TC^{channel}_{CAP2}$		-0.0065***	
$TC^{channel}_{PMR}$			0.491***
bank loans	0.232***	0.212***	0.252***
$growth^{s}$	0.089***	0.090***	0.090***
$log(size)$	-0.278***	-0.226***	-0.293***
$log(age)$	-0.088***	-0.096***	-0.087***
PMR	-0.731***	-0.400***	-0.584***
$m2$	0.31	0.25	0.37
J	0.00	0.00	0.00
# *obs*	2,429,618	2,429,618	2,429,618

Notes. The Table shows the output for the first difference GMM estimation of specification (1) augmented with the given interaction term indicating the level of market capitalisation, where $CAP1$ stands for $\frac{bankloans_{jt}}{GDP_{jt}}$ and $CAP2$ for $\frac{debtsecurities_{jt}}{GDP_{jt}}$. The OECD indicator of Product Market Regulation (*PMR*) is a variable that measures the degree to which policies promote or inhibit competition in areas of the product market where competition is viable. The indicators cover formal regulations in the following areas: state control of business enterprises; legal and administrative barriers to entrepreneurship; barriers to international trade and investment. The indicator varies across sectors, countries and time. Data are available until 2007. The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level.

Second, we generate $TC^{channel}_{ijt} * \frac{debtsecurities_{jt}}{GDP_{jt}}$, which interacts the trade credit channel of firm i in country j in year t with the total amount of debt securities issued as a fraction of GDP in that country j in year t. In Table 4.7 this interaction is indicated as $TC_{CAP2}^{channel}$. Column 2 of Table 4.7 provides evidence in favour of the hypothesis that the use of the trade credit channel to manage firm growth is more important in years/countries where firms issue less debt securities to finance themselves. Again, the interaction term is economically relevant. In 2009 using the trade credit channel to stimulate growth was 13% more important in Finland than in Portugal, because of a smaller debt securities market in Finland.

Finally, Table 4.7 shows that firms operating in higher regulated product markets seem to display lower growth levels, indicating that deregulation fosters growth. Moreover, the third column of Table 4.7 reveals that the trade credit channel is more important for firms in higher regulated product markets. An in depth analysis of this finding goes beyond the scope of this paper, but it is clear that this should be on the agenda for future research.

4.5 Conclusion

The use of trade credit of a firm is a twofold process in which a firm can receive trade credit from its suppliers (accounts payable) and, in turn, can extend trade credit to its customers (accounts receivable). While many theories of accounts payable and receivable are related to firm performance, there has not been a direct test whether firms actively use both to manage their growth. In this paper we argue that it is not just the accounts payables or just the accounts receivable that matter, but the sum of the two, which works as a credit channel of trade. As a contribution to previous studies, we perform an augmented version of the Gibrat LPE to test whether the trade credit channel has a direct impact on firm performance after having taken into consideration the usual determinants of growth.

The results show that the economic impact of the trade credit channel is indeed important and that this is particularly true for firms in those euro area countries where the trade credit channel is more present. Further, the richness of our dataset allows us to focus on two different types of heterogeneity: at country level as we analyse eight euro area countries, and at firm level as our analysis is based on 600.000 firms. Focusing on country heterogeneity, we find that the degree of development of the financial system matters. In those countries where the supply of bank loans or debt securities is larger, the sensitivity of firm growth to the trade credit channel is smaller. Focusing on the heterogeneity across firms, we find that those firms that are more vulnerable to financial market imperfections (i.e. young or small firms) rely more on the trade credit channel to grow.

Our results also fit the revived literature on the link between the financial market and the real economy. Firm operations that make more use of the trade credit channel can be more shielded from developments in the financial sector. This would however only be valid under the assumption that firms' use of accounts receivable as collateral to draw on short term liabilities is still valid in periods of restricted credit supply. Future research in this direction is needed to validate our findings. The found relation between trade credit and product market regulation is another interesting avenue for future work.

4.6 Appendix

Both consolidated and unconsolidated annual accounts are available in Amadeus and these are comparable across countries. Amadeus also provides qualitative information such as number of employees and if a firm is listed on a stock market. In our sample we are careful to consider firms with unconsolidated accounts (mainly small and medium-sized ones) only when they do not present consolidated accounts in Amadeus. We construct nine non-financial sectors[15]: 1) agriculture, mining and fishing; 2) manufacturing of standardized goods; 3) manufacturing of differentiated goods; 4) construction; 5) wholesale trade; 6) retail trade; 7) transport and telecommunications; 8) hotel and 9) other business activities. We exclude other non-financial sectors such as (utility firms, renting, leasing and holding companies) for which trade credit does not appear to be important. The original dataset contains financial information for the period 1990-2009; we drop the first three years because of poor coverage and we lose another year of observations to compute variables as first differences of the balance sheet items. We only use end of year data. Concerning our variables of interest, we apply a series of filters. We eliminate the observations of firms with errors in their financial statements (for instance when total assets are negative) and when their values are unreasonable (for instance when trade credit payables or receivables over total assets are greater than 1). Finally we eliminate 1% of the extreme values taking into consideration differences across sectors and countries and we consider only firms with at least 4

[15]Following Giannetti et al. (2011) we take the nature of the manufactured good into account: standardized good or differentiated good, because they argue that use of trade credit is significantly different given the type of good. Differentiated manufacturing goods are in the following sectors: furniture and fixture, printing and publishing, rubber and plastic products, stone, glass and clay products, fabricated metal products, machinery, electrical and electronic equipment, transportation equipment, instruments and miscellaneous products. All other goods produced in the remaining sectors within manufacturing industry are considered standardised goods.

consecutive years of observations. Table 4.2 and Table 4.8 report the descriptive statistics for the sample that is finally used in the regressions.

Table 4.8: Sample distribution across firms size

	BE	DE	ES	FI	FR	IT	NL	PT
small	50%	49%	93%	89%	88%	83%	7%	91%
medium sized	37%	27%	6%	8%	9%	14%	34%	7%
large	13%	24%	1%	3%	3%	3%	59%	2%
young	4%	8%	4%	12%	11%	9%	5%	11%
# *obs*	67,408	53,728	167,697	88,318	1,171,221	590,569	14,017	281,365
# *firms*	9,988	23,290	28,470	22,461	228,634	187,379	3,152	110,050

Source: AMADEUS, Bureau van Dijk Electronic publishing and own calculations. The table reports the distinction based on the official definition of the European Commission that considers small firms those with less than 50 employees, up to 10 million euro of turnover and 10 million euro of assets, large firms those with more than 250 employees, more than 50 million euro of turnover and 43 million euro of assets. Medium size firms are those between small and large. Young firms are those that are younger then 5 years old.

Table 4.9: Baseline estimation: specification (1) with identical instruments (t-2 and further)

	BE	DE	ES	FI	FR	IT	NL	PT
$growth^{av}$	-0.156***	-0.074***	-0.127***	-0.139***	-0.146***	-0.097***	-0.156***	-0.103***
$TC^{channel}$	0.567***	0.468***	0.530***	1.006***	0.517***	0.373***	0.688***	0.342***
bank loans	0.249***	0.125***	0.380***	0.471***	0.192***	0.108***	0.131*	0.301***
$growth^{s}$	0.104***	0.043***	0.105***	0.091***	0.122***	0.065***	0.079***	0.076***
$log(size)$	-0.361***	-0.108	-0.430***	-0.472***	-0.135***	-0.119***	-0.276***	-0.296***
$log(age)$	-0.062**	-0.111*	-0.033	-0.049*	-0.101***	-0.151***	-0.031	-0.143***
$m2$	0.52	0.41	0.98	0.27	0.88	0.01	0.77	0.92
J	0.01	0.04	0.00	0.17	0.00	0.00	0.36	0.00

Notes. The Table shows the output for the GMM first difference estimation of specification (1). The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level. For the definition of the variables see notes of Table 4.2.

Table 4.10: Importance of the composition of the trade credit channel

	BE	DE	ES	FI	FR	IT	NL	PT
$growth^{av}$	-0.227***	-0.069***	-0.216***	-0.129***	-0.301***	-0.122***	-0.162***	-0.075*
$TC^{channel}$	0.607***	0.467***	0.628***	1.248***	0.444**	0.369***	0.619***	0.338***
$TC^{channel} * \frac{TCP}{TCR}$	0.022	0.031	0.002	-0.006	0.079	0.009	0.218	0.017
bank loans	0.300***	0.221***	0.368***	0.562***	0.405***	0.182***	0.149	0.269***
$growth^{s}$	0.147***	0.043**	0.196***	0.067*	0.456***	0.137***	0.082***	0.167***
$log(size)$	-0.501**	-0.217*	-0.556***	-0.544***	-0.596***	-0.289***	-0.296	-0.347***
$log(age)$	-0.107**	-0.086	-0.021	-0.012	0.059*	-0.055***	-0.033	-0.023
$m2$	0.78	0.70	0.32	0.11	0.65	0.20	0.65	0.19
J	0.11	0.40	0.00	0.70	0.51	0.00	0.12	0.03

Notes. The Table shows the output for the GMM first difference estimation of specification (1), augmented with the trade credit channel interacted with the ratio of payables to receivables. The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level. For the definition of the variables see notes of Table 4.2.

Table 4.11: Baseline estimation: accounts payable overestimates the impact of the tade credit channel

	BE	DE	ES	FI	FR	IT	NL	PT
$growth^{av}$	-0.153***	-0.060**	-0.103**	-0.136***	-0.313***	-0.122***	-0.159***	-0.100***
TCP	1.047***	0.437***	0.705***	1.550***	0.931***	0.517***	1.297***	0.385***
$bank\ loans$	0.342***	0.055	0.455***	0.465***	0.072**	0.188***	0.211	0.281***
$growth^{s}$	0.101***	0.043**	0.093***	0.090***	0.563***	0.145***	0.070	0.075***
$log(size)$	-0.544**	0.150	-0.315***	-0.439***	-0.255***	-0.226***	-0.312	-0.144***
$log(age)$	-0.056	-0.180***	-0.092**	-0.054*	-0.004	-0.061***	-0.045	-0.193***
$m2$	0.70	0.44	0.60	0.31	0.61	0.16	0.70	0.93
J	0.13	0.68	0.10	0.23	0.08	0.00	0.07	0.00

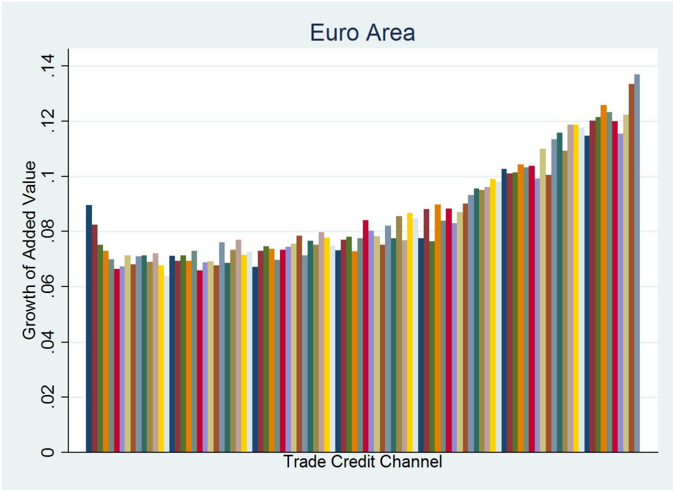
Notes. The Table shows the output for the GMM first difference estimation of specification (1), but with accounts payable scaled by total sales instead of the trade credit channel. The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level. For the definition of the variables see notes of Table 4.2.

Table 4.12: Baseline estimation: accounts receivable overestimates the impact of the tade credit channel

	BE	DE	ES	FI	FR	IT	NL	PT
$growth^{av}$	-0.155**	-0.060**	-0.077**	-0.129***	-0.287***	-0.122***	-0.162***	-0.104***
TCR	0.636***	0.514***	0.604***	0.752***	0.921***	0.462***	0.905***	0.397***
bank loans	0.288***	0.027	0.498***	0.513***	0.064**	0.192***	0.164	0.328***
$growth^{s}$	0.112**	0.043**	0.074***	0.091***	0.537***	0.140***	0.073	0.077***
$log(size)$	-0.379	0.124	-0.716***	-0.518***	-0.228***	-0.285***	-0.412	-0.332***
$log(age)$	-0.093	-0.182***	-0.045	-0.044	-0.015	-0.064***	-0.025	-0.126***
$m2$	0.69	0.44	0.25	0.70	0.97	0.18	0.70	0.87
J	0.05	0.74	0.04	0.15	0.10	0.00	0.34	0.00

Notes. The Table shows the output for the GMM first difference estimation of specification (1), but with accounts receivable scaled by total sales instead of the trade credit channel. The estimates are robust to heteroscedastic standard errors. All specifications were estimated with time dummies and time dummies interacted with industry dummies. m2 shows the p-value of the test of serial correlation in the error terms, under the null of no serial correlation. Values presented for the J-statistic are p-values of the test of overidentifying restrictions of the instruments, under the null of instrument validity. * indicates significance at, the 10% level; ** and ***, respectively at the 5% or 1% level. For the definition of the variables see notes of Table 4.2.

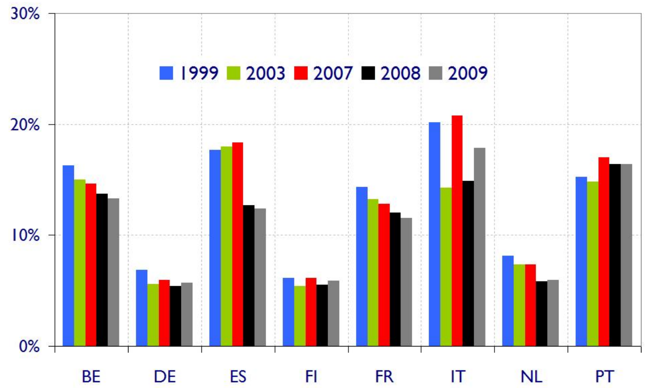
Figure 4.4: Firm growth and the trade credit channel



Source: AMADEUS, Bureau van Djik Electronic publishing and own calculations. Notes. The Figure shows mean growth rates of added value for the observations belonging to each percentile of the trade credit channel in our sample.

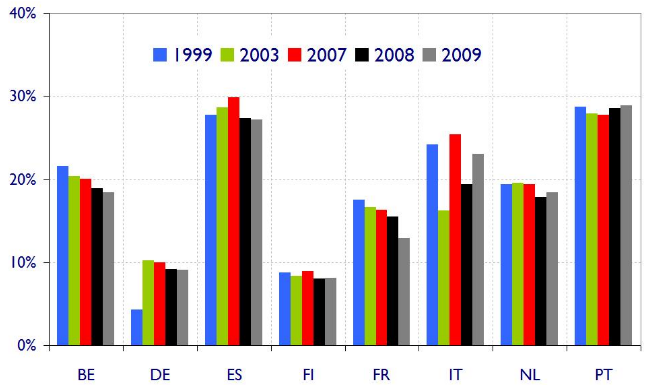
Figure 4.4 provides some evidence of a positive relation between the trade credit channel and firm growth. The graph displays the mean growth rate of added value for all observations belonging to a percentile of the trade credit channel from 1993 to 2009 for all 8 euro area countries in our sample.

Figure 4.5: Accounts payable as percentage of total sales



Source: AMADEUS, Bureau van Dijk Electronic publishing and own calculations.

Figure 4.6: Accounts receivable as percentage of total sales



Source: AMADEUS, Bureau van Dijk Electronic publishing and own calculations.

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5

Firms' Financial Constraints: Do Perceptions Match the Actual Situation?[1]

5.1 Introduction

The financial positions of firms and the access to external finance of firms are crucial for the investment in and the development of an economy. This statement

[1]This chapter is the result of joint work with Annalisa Ferrando (ECB).

has become conventional wisdom in the finance literature. Most contributions to this literature have either used balance sheet data to show the link between (constrained) investment or growth and financial characteristics (Fazzari et al., 1988, 2000; Carpenter and Petersen, 2002), or survey data to show the link between perceived financing obstacles and growth (Beck et al., 2006; Brown et al., 2011). Unfortunately, the first strand is lacking direct information on the financing obstacles that firms face, while the second strand lacks balance sheet and profit and loss account data of the firms investigated. Therefore it has not yet been possible to relate financing obstacles to the financial positions of firms. Yet, the existence of this link is crucial for the relevance of the policy recommendations made in the two strands of the literature stated above. A number of authors have tried to fill this gap by using survey data to construct an index of financing obstacles and then applied this formula to a second dataset with balance sheet information, in order to relate this index to firm level investment or growth (Lamont et al., 2001; Coluzzi et al., 2009; Hadlock and Pierce, 2010).[2]

This paper attempts to fill this gap by taking the opposite approach, namely we match data from a large dataset containing balance sheet information with the data from a survey on financing obstacles. This way we obtain a unique dataset containing direct information on the financing obstacles that firms face linked with the financial characteristics of those firms. Moreover, the survey that we use for our analysis was conducted during the financial crisis, which makes financing obstacles likely to be present and therefore this creates an excellent opportunity to examine the link between financial characteristics and financing obstacles.

We draw on the Survey on the Access to Finance of small and medium-sized En-

[2]See Silva and Carreira (2012) for an overview on the literature related to measuring financial constraints.

terprises (SAFE)[3] for a sample of more than 10.000 firms in the euro area and try to match these firms with their balance sheet information in the Bureau van Dijk Amadeus database (containing approximately 2.3 million firms). The main challenge is that the identity of the firms in the SAFE survey -as with most surveys- is confidential, and thus we need to develop a statistical matching approach based on characteristics common in both datasets to overcome the identity problem. In order to maximize the use of the data available in the survey, the non-parametric Nearest Neighbour Distance Hot Deck (NNDHD) matching procedure as suggested by D'Orazio et al. (2006) is applied. Then, using this unique dataset we investigate which financial and non-financial characteristics are correlated with financial constraints. This way we hope to get a better understanding of the nature of financial constraints.

From the survey results we measure financing obstacles through firms' self-assessment on whether access to finance constitutes their most pressing problem. We also consider a more objective measure of financing obstacles which is related to the results of firms' actual applications to external financing. To relate financing obstacles to the financial positions of firms, we regress the two variables on a set of financial (profitability, liquidity, leverage) and non-financial (age, size) characteristics, which are commonly used in the literature to assess whether firms are financially constrained and control for the ownership of the firm, the year, and the country and sector in which the firm is located.

Our findings show that age and profitability are important for explaining access to external finance. Younger firms are more likely to perceive access to finance as highly problematic. Moreover, they are also more likely to face actual financ-

[3]The survey is conducted by the ECB and European Commission. See Ferrando and Griesshaber (2011) and Artola and Genre (2011) for a thorough analysis of the survey results.

ing obstacles. Firms with lower profit margins, lower return on equity or higher coverage ratios have a higher probability of facing actual financing obstacles, but there is no relation with the perceived problems of access to finance. On the contrary, the perceived financial constraints, but not the actual constraints, increase significantly when firms have more short term debt. Finally, we find some indications that firms with sufficient liquidity and firms with lower leverage ratios are less likely to be financially constrained. Although the latter findings are not robust when we include firm age and size in the regressions, the analysis indicates that information derived from "hard" data is useful to determine the probability that firms perceive and face actual financial obstacles.

The remainder of the paper is organized as follows. Section 5.2 describes the data sources and the methodology we used in the matching procedure. Section 5.3 introduces the measures of financial constraints as derived from the survey and from the financial accounts with a quick glance to the existing literature on financial constraints. The section also includes a first comparison of the characteristics of firms that are self-reporting financing obstacles. Section 5.4 describes the empirical results while section 5.5 includes some robustness checks. Section 5.6 draws some conclusions.

5.2 Data and methodology

The two main data sources for our analysis are the ECB and European Commission survey on access to finance of small and medium-sized enterprises (SAFE) and the AMADEUS database gathered by Bureau van Dijk.

The SAFE has been carried out five times between the summer of 2009 and

September 2011. It contains firm-level information mainly related to major structural characteristics (size, sector, firm autonomy, turnover, firm age and ownership) as well as to firms' assessments of recent short-term developments regarding their financing needs and access to finance[4]. The sample contains only non-financial firms, excluding those in agriculture, public administration and financial services. For the purposes of our analysis, we draw on the second, the third and the fifth wave of the survey[5], which are covering the developments of the second half of 2009, and the second and third quarter of 2010 and 2011, respectively. This period is marked by the financial crisis, which has left deep scars in the financial markets. Moreover, the at that time emerging debt crisis also put serious pressure on the profitability of the banking sector, making the general conditions for firms to access external capital in the euro area very tough[6]. Pooling together the three waves allows us to have a panel with 13291 observations of which most firms are only present once, making it a highly unbalanced sample[7]. We consider firms from countries in the euro area, and due to data availability the final sample includes firms from Belgium, Finland, France, Germany, Greece, Italy, the Netherlands, Portugal and Spain.

Balance sheet information is derived from the complete AMADEUS database.

[4]A report containing the main results of the survey is published in the ECB website every six months For more information regarding the survey as well as the reports on the individual waves see http://www.ecb.europa.eu/stats/money/surveys/sme/html/index.en.html. See also ECB (2011).

[5]Because we match with yearly balance sheet data, we use only one wave per year that corresponds best to the balance sheet data. For instance, the first and the second wave cover the same accounting year, so we choose to retain the second. The fourth wave of SAFE covers the last quarter of 2010 and the first quarter of 2011, and thus leaves the question to which accounting year that this wave corresponds.

[6]See the results of the ECB's bank lending survey in January 2010 and October 2010. http://www.ecb.europa.eu/stats/money/surveys/lend/html/index.en.html

[7]See Table 5.1 and Figure 5.1 in the appendix for more details on the composition of our panel.

This is a comprehensive, pan-European database containing financial information on over 10 million public and private companies. The information is collected by specialised national service providers and is homogenised applying uniform formats in order to allow accurate cross-country comparisons. We select non-financial corporations in the euro area in 2008, 2009 and 2010[8]. After performing some data filtering in order to clean the data, we obtained an unbalanced panel of approximately 2.3 million firms and 3.2 million observations. 115.000 firms are present in all years, 674.000 firms are present in two years, and 1.5 million firms are present only once.

5.2.1 Construction of the matched panel

We use the non-parametric Nearest Neighbour Distance Hot Deck (NNDHD) matching to match each firm in SAFE with its 'nearest neighbour balance sheet' in Amadeus.

The procedure applies as follows. First, we classify all firms in SAFE and in Amadeus in a priori defined groups so that firms from one dataset can only be matched with firms in the same group in the other dataset. The groups take into account the following characteristics, which are mainly derived from the structural characteristics of the SAFE: nationality, sector, turnover-class and year. Both in SAFE and Amadeus, we consider firms located in Belgium, Finland, France, Germany, Greece, Italy, the Netherlands, Portugal or Spain. In these countries we identify seven sectors: mining; construction; manufacturing, wholesale and re-

[8]We match the survey data of a given year with balance sheet data of the year prior to the survey year. For example, we match the 2008 balance sheet data with the second half of 2009 survey data. The rationale is that these are the most recent balance sheet data that firms had available to convince financial intermediaries to provide them external finance.

tail trade; transport and storage; real estate; and other services to business and persons. Further, within each sector, firms are grouped according to their yearly turnover: turnover lower than 2 million euro; between 2 million euro and 10 million euro; between 10 and 50 million euro; and higher than 50 million euro. Finally, firm-year observations belong to 2009, 2010 or 2011. The specification of 9 countries, 7 sectors, 4 turnover-classes and 3 years leads to a maximum of 756 groups, and each firm-year observation in SAFE and in Amadeus belongs to one of these groups. It is important to note that this classification ensures us that, for instance, a Belgian manufacturing firm with 5 million euro turnover that responded to the SAFE survey in 2011 can only be matched with a firm in Amadeus that is a Belgian manufacturing firm with turnover between 2 and 10 million euro in 2010. Table 5.4 describes how rich the Amadeus dataset is to match with. For instance, a French firm in SAFE has on average 43126 possible matches available in Amadeus, but there is a group in France for which a firm in SAFE has only 42 possible matches in the same group in Amadeus and there is a group in France for which a firm in SAFE has 94929 possible matches in the same group in Amadeus.

Table 5.4 HERE

In a second step, we apply the NNDHD matching procedure within the identified groups on the basis of the number of employees and the exact age of the firm, using the Gower distance function[9]. This procedure computes the distance $d_{S,A}$ among the values in vector S (for SAFE) (for both variables, age and number of employees) and all n rows of A (for Amadeus) (the same 2 variables (age and employees) observed on n firms) and then matches the firm from the SAFE with the firm from Amadeus with the smallest distance:

[9] See D'Orazio et al. (2006) for programming details.

$$d_{S,A} = \frac{1}{T}\sum_{t=1}^{T}\left[\frac{1}{2}\frac{|X_S^{age} - X_A^{age}|}{Range^{age}} + \frac{1}{2}\frac{|X_S^{empl} - X_A^{empl}|}{Range^{empl}}\right] \tag{5.1}$$

This means that within a certain group, a firm in SAFE is matched with the firm from Amadeus that is the best match in terms of age and number of employees for all available years. If a firm in SAFE can be matched with several firms in Amadeus that have the same minimum distance, then one of these firms is chosen at random. In the sample, the number of available matches at minimum distance ranges from 1 to 1279 firms. In 31% of the matches, the minimum distance is zero, implying a perfect match in terms of group, age and number of employees.[10] Further, the Gower distance has the attractive feature that the distance is normalised between zero and one, allowing some interpretation of the distance obtained. 77% of our matches has a distance less than 0.01, indicating a close match.

One obvious drawback of the matching is that one can never be completely certain that the firm from SAFE would have the same financial characteristics as the firm from Amadeus that it is matched with. However, we believe that we can overcome this problem with the careful setup of the panel. Financial characteristics of firms are generally specific to the turnover class, the age of the firm, the sector that the firm operates in, and to a lesser extent the country of residence. On the contrary, the financial characteristics vary much less within these groups and the same holds for the variation in perceived problems of access to finance in the survey. Table 5.6 shows that the variance of the financial characteristics is smaller within a group than within the total sample in 78% of the cases. (see Tables 5.2 and 5.3 for a definition on the financial characteristics and financial constraints.) By only allowing matching within the groups identified in the previous section, we avoid that firms in the survey would be matched with firms that generally have different

[10]Note that by construction there will always be a perfect match in terms of group.

financial characteristics. Table 5.5 further illustrates this importance. It can be seen in the second and third column that the experience of financial constraints, which we derive from the survey, decreases with the turnover class of the firm and depends on the year. Column four and five of Table 5.5 uses balance sheet information to show that financial characteristics also depend on the groups defined. For instance the debt burden, which can be seen as the interest rate that firms pay on their debt, decreases with size of the firm's turnover and also decreased during the crisis period, in line with the decrease of the ECB's main policy rate. Additionally, firms with high turnover appear to have lower cash holdings and during the crisis firms have tried to increase their cash balances as they try to take precautionary measures. Therefore, it will be important to restrict the matching to within the 756 groups.

Tables 5.5 and 5.6 HERE

Moreover, taking a closer look at the matched panel also provides some evidence that validates the matching strategy. In question Q2 of the survey firms are asked whether their profit margin has increased, remained unchanged or decreased in the past six months. The comparison of their answers to the actual profit margin after the matching (as calculated from the balance sheet) shows Table 5.7 that, indeed, those firms that signalled an increase in their profit margin display a higher profit margin than the other firms in the matched sample. In question Q2 firms are also asked whether their turnover has increased, remained unchanged or deteriorated during the past six months. After the matching we find that the sales growth of firms that indicated an increasing turnover is significantly higher than other firms. Additionally in question Q2 firms are asked whether their net interest expenses have increased, remained unchanged or decreased during the past six months. Table 5.7 reveals that firms, for which the interest expenses increased, pay significantly more interest on their debt than the other firms. Further, in question Q4(e) firms indicate if they have used trade credit in the past 6 months or not. Comparing the answer of the trade credit use in question Q4(e) to the actual trade credit (measured as a percentage of total assets or as a percentage of total sales) of the firm after matching, shows in Table 5.7 that firms that did not use trade credit in the past six months hold significantly less trade credit on their balance sheets.

Table 5.7 HERE

5.3 Assessing financial constraints

5.3.1 Measures derived from survey data

Following Ferrando and Griesshaber (2011), the presence of major financing obstacles is measured via the following question (Q0 in the questionnaire): "What is currently the most pressing problem your firm is facing?". Firms could choose among a set of potential problems ranging from finding customers and the presence of competition to increased costs of production of labour and the presence of regulation. Firms that choose the "Access to Finance" from the provided options are then considered as facing major financing obstacles. It is important to note that the wording of the question in SAFE is very different from the wording of the surveys used in the preceding literature (Beck et al., 2006). SAFE asks respondents to pick the most pressing problem from a set of seven different possibilities,

whereas the other surveys typically ask firms to rank a given problem on a certain scale (e.g. 4, major obstacle to 1, no obstacle, see Beck et al. (2006)). Consequently, in SAFE we do not observe the actual levels of financing obstacles within a firm as well as whether access to finance is the second most pressing problem or the third most pressing, etc. (firms cannot signal more than one problem), whereas we consistently observe the degree of financing obstacles in the other surveys. In this way it could be that at in our sample we underestimate the existence of firms that consider access to finance as a pressing (although not the most pressing) problem. Nevertheless, our measurement has a bright side as we avoid the danger of bias caused by possible tendencies of some firms to give generally more negative (or positive) evaluations. In the SAFE, firms are forced to put the existence of financing obstacles in relation to other potential problems. Therefore, their answer is more likely to reflect a serious problem or obstacle that the respective firm is facing.
However the reply may of course only be based on the general perception of the respondent and is not a priori based on its actual experience. An alternative way to identify firms facing financing constraints can be based on their actual experience in applying for either a loan, trade credit or other external financing tools. Indeed, respondents to the SAFE survey are being asked in questions Q7A and Q7B whether they have applied or not for a bank loan and whether they were successful in getting any type of financing, and what was the reason not to have applied for external finance. From these questions we generate our two main categorical variables of interest: finance problem and finance obstacle (See Table 5.3).

Finance problem takes the value 1 when a firm has chosen 'access to finance' as its most pressing problem, and 0 otherwise. Importantly, access to finance seems to be a persistent variable in our short panel. More than 51 percent of the firms that chose access to finance as most pressing problem signalled that it was still the main problem during the next wave. Moreover, 92 percent of the firms that did not signal access to finance as most pressing problem in one wave also did not in the following wave. The second variable, finance obstacle, is also a categorical variable and takes the value 0 when a firm has successfully applied for a source of external finance[11] (i.e. no obstacle), and 1 when a firm has applied but the application has been rejected or when a firm received only a part of the finance it has requested. Finance obstacle also takes the value 1 when a firm had to refuse a loan because the costs were too high or the terms and conditions were too bad. Also for this variable we find persistence in the sample: 74 percent of the firms that faced actual financing obstacles in a given wave encountered the same problems almost a year after, and around 79 percent of the firms without problems in one wave reported similarly in the following wave. Table 5.8 shows the percentage of firms that perceived access to finance as most pressing problem (finance problem) or that actually encountered problems to access external financing sources (finance obstacle) as reported by the survey. Major heterogeneities are clearly related to the geographical environment. In general it can be noted that firms located in the southern European countries suffer more from financial constraints. Some differences can be noted at country level as a higher percentage of Dutch and Belgian firms encounter actual financing constraints relative to their perceived financing constraints. Note that finance obstacle has much less observations. This is mainly because many firms indicated that they did not apply for external finance because they have sufficient internal funds at their disposal. As they did not demand external funds, we cannot discriminate whether they face external financing obstacles or not, and they are therefore not taken into account. We also did not take firms into account that acknowledged that they did not apply for external finance be-

[11] This includes bank loans, trade credit and other external financing sources. Other external financing sources include equity or debt issuance, leasing, factoring and loans from other lenders.

cause they feared a possible rejection. However, a sensitivity test where the firms that feared a possible rejection are included in the variable finance obstacle will shed some interesting light on the role of firm size for financial constraints, but we will come back to this later.

Table 5.8 HERE

5.3.2 Determinants of financial constraints using firms' accounts and firms' characteristics

The way financial constraints are measured is a very sensitive issue in the literature investigating the link between financial variables and firm behaviour. Theory offers only limited guidance in this domain, so that a clear-cut consensus has still to emerge. The theoretical model of Myers and Majluf (1984) shows that firms may give up valuable investment opportunities when internal sources of funds are not sufficient. Consequently, the higher sensitivity of investment or firms' growth to internal sources was taken as evidence for the presence of financing constraints (Fazzari et al., 1988, 2000; Carpenter and Petersen, 2002). However, after the seminal paper of Kaplan and Zingales (1997, 2000), several studies have criticised the empirical test based on the cash flow sensitivity. One of the arguments has been that even financially successful firms may rely systematically on internal sources of financing because of factors not related to the unavailability of low cost external funds, and consequently they may exhibit high investment-cash flow sensitivity. Additional critiques have been put forward by Ericson and Whited (2000); Alti (2003); Bond et al. (2004), all arguing that the cash flow already contains information about a firm's investment opportunities. A different way of testing the presence of financing constraints focuses on the role played by the cash flow sensitivity of cash holdings (Almeida et al., 2004).

Alternative strategies consist of simply classifying firms according to various proxies of informational asymmetries (as these represent the main source of financial market imperfections). Hence, variables such as size, age, dividend policy, membership in a group or conglomerate, existence of bond rating, and concentration of ownership are used to capture ways to cope with imperfect information, which hinders access to capital markets (see for instance Gertler (1988); Devereux and Schiantarelli (1990); Hoshi et al. (1991); Bond and Meghir (1994); Gilchrist and Himmelberg (1995); Schiantarelli (1995); Cleary (2006)).

In this paper we rely on a set of measures of financial constraints that take into consideration the above-mentioned contributions to the literature. The set comprises profitability ratios, liquidity ratios, leverage ratios and variables that typically proxy the presence of asymmetric information. We are aware of the shortcomings in these measures. For instance, they often capture one dimension of access to financial markets: a firm may be liquid but nonetheless present a bad financial situation; on the other hand strong fundamentals may compensate for a temporary shortage of liquid assets. Similarly, a high leverage, while signalling potential dangers, suggests also that the firm has enjoyed, at least in the recent past, wide access to external financial funds. Hence, one could argue that highly leveraged firms are not always financially constrained. In the next section we discuss the financial indicators used in the empirical analysis and their expected relation with financial constraints.

Profitability

More profitable firms should have easier access to external finance as they generate more cash flow which increases the likelihood that they will be able to repay their loans. At the same time, more profitable firms have more internal funds at their disposal which might decrease their actual demand for external funds. It is therefore important to note that in this paper we control for this demand effect by excluding those firms that replied they were not searching for external finance because of sufficient internal funds from our dependent variable financing obstacle. The effect that we measure is therefore the impact of solvability on the willingness of financial intermediaries to grant external finance to firms. First, the return on equity, measured as the ratio of profit/loss for the period scaled by total shareholder funds, indicates the firm's efficiency in generating value for it's shareholders and can be considered as a general indicator of a firm's solvency. A second variable that we construct is the coverage ratio which measures the operating risk of the firm and is calculated as the ratio of operating profits (or loss) to interest paid. If it's greater than 1 it means that the firm generates sufficient operating profits to cover the interest expenses on it's debt. (Guariglia and Mateut, 2006; Carbò-Valverde et al., 2011) Finally, we test whether the profit margin is an important determinant of perceived or actual financing obstacles. The profit margin is constructed as the ratio of net profits/losses for the period to total sales. We expect that firms that are able to generate more euro profits per euro sales will be less likely to perceive access to finance as problematic. Moreover, as high profit margins are sometimes related to market power (Petersen and Rajan, 1997), these firms can more easily increase their surplus when needed, and are therefore less likely to default and face actual financing obstacles.

Liquidity

As argued by Holmström and Tirole (2000), firms need to manage their liquidity balances such that they can continue their investment and production plans even in the occurrence of a negative liquidity shock. By discontinuing its investments the firm lowers its expected future profits which increases its likelihood of default and thus increases the probability that banks will be unwilling to supply external finance. Generally, the importance of working capital and the value of cash in the presence of financial constraints have been highlighted by several authors (Fazzari and Petersen, 1993; Faulkender and Wang, 2006; Dasgupta and Sengupta, 2007). To test these theories, we first measure the firm's working capital as current assets less current liabilities, scaled by total assets. Secondly, we calculate the working capital required as the sum of the firm's inventories and accounts receivable less accounts payables, again scaled by total assets. Finally, by measuring the firms cash position as the amount of cash and cash equivalents scaled by total assets, we investigate the role of the firm's cash.

Leverage

The positive relation between leverage and default probability follows from the rationale that firms with higher debt-to-asset ratios need higher profits to be able to repay their debt, and are therefore more likely to default. This relationship is also reflected by the firm's rating in case the firm has one. (Molina, 2005) We first measure the firm's leverage by its debt-to-assets ratio, and expect a negative relation with the actual financing obstacle that firms face. The expected relation between leverage and perceived financing problem is twofold. On the one hand, a high leveraged firm might feel unconstrained as it holds a lot of debt on its balance sheet, but on the other hand, this might make it difficult or costly for the firm to find new debt.

As cash is commonly viewed as negative debt, most valuation models subtract the amount of cash from the level of outstanding debt to know the firm's 'true' leverage. The reasoning is that firms can use their cash to reduce their debt immediately. They might choose to do so when the cost of borrowing is significantly higher than the yield on cash, and increasing debt when a new investment project arises is not a constraint. However, Acharya et al. (2007) showed that even constrained firms might use excess cash flows to reduce their debt, rather than to transfer the cash to future periods. Therefore, we construct a variable: leverage cleaned, which subtracts the firm's cash from its total outstanding debt, and scales that by total assets.

The maturity structure of the firm's outstanding debt can play a role in the firm's perceived access to finance. Firms that finance a high share of their assets with short term liabilities need to roll over a high share of their debt yearly, which might become very costly when market conditions turn for the worse. Indeed, Love et al. (2007) showed that firms with higher short term debt to asset ratios were more vulnerable to financial market imperfections during the East-Asian financial crisis. To test the importance of this in the euro area during the global financial crisis, we construct the variable: short term loans, which is the amount of debt (loans and marketable securities) maturing at the end of the year scaled by the firm's total assets.

Asymmetric information

(Gertler, 1988) was one of the first to argue that firm age is an important determinant of financial constraints. The rationale for this is that more mature firms are more likely to have successful track records and may enter repeated relations with lenders, both mitigating the problem of information asymmetries and thereby decreasing the probability of being financially constrained. Additionally, the literature suggests that small firms, which are characterised by a small amount of collateral relative to their liabilities, tend to have more problems to access external finance (Schiantarelli, 1995). Hence, small-sized enterprises (Berger and Udell, 2005) and young enterprises (Rauh, 2006; Fee et al., 2009) face different and often greater financing problems than public, large and more mature firms. More recently, Hadlock and Pierce (2010) focus on the importance of the combination of firm size and age as predictors of potential asymmetric and contracting problems. In order to determine the relevance of the financial ratios derived in the above sections on financing obstacles, it would be important to control for the age and size of the firm. Thus, we consider both the log of age and the log of total assets.

5.3.3 What are financially constrained firms like?

Before turning to the empirical section, we perform a simple t-test on the equality of the means of the groups defined by our variables of interest. Do firms that signalled access to finance as main problem have other characteristics than firms that indicated another problem as most pressing problem? And what about firms that face actual financing obstacles? Table 5.10 reveals that firms that signal access to finance to be their most pressing problem and firms that face actual financing obstacles have similar characteristics. Namely, they seem to be significantly less profitable as measured by their return on equity, coverage ratio or profit margin. They also tend to be less liquid, more specific they have significantly less working capital and less working capital required. Further, they finance a higher share of their assets with short term loans and have a higher debt to asset ratios, even when debt is cleaned for cash holdings. Finally, they appear to be younger and smaller than unconstrained firms. Almost all of these findings are in line with our expectations and can hence, in our view, also be seen as a validation of the matching strategy.

Table 5.10 HERE

5.4 Empirical approach and estimation

Our empirical analysis aims to investigate the existence of underlying factors that determine both firms' perception of financing obstacles and firms' actual financing obstacles. As in previous studies we model the probability of firms facing financing obstacles as a linear function of the characteristics available from the survey data (as in Ferrando and Griesshaber (2011)) and to this we add the set of financial ratios derived from the balance sheet data:

$$
\begin{aligned}
FinanceProblem_{i,t} &= \alpha_0 + \alpha_1 FinancialRatio_{i,t} + \sum_j \alpha_j FirmControls(j)_{i,t} + \\
&\quad \sum_k \alpha_k Country_k + \sum_s \alpha_s Sector_s + \sum_t \alpha_t Year_t + \varepsilon_{i,t} \quad (5.2) \\
FinanceObstacle_{i,t} &= \beta_0 + \beta_1 FinancialRatio_{i,t} + \sum_j \beta_j FirmControls(j)_{i,t} + \\
&\quad \sum_k \beta_k Country_k + \sum_s \beta_s Sector_s + \sum_t \beta_t Year_t + \mu_{i,t} \quad (5.3)
\end{aligned}
$$

where $FinanceProblem$ and $FinanceObstacle$ are the responses by firm i at time t that indicates access to finance as most pressing problem and the actual financing obstacles faced, respectively. $FinancialRatio$ is the set of ratios that summarises the financial conditions of the firm, as elaborated in section 3.2.1 to section 3.2.3. $FirmControls$ is a vector of major firm attributes, namely ownership structure, firm age and size.[12] $Country$ is a vector of country dummies to control for country-specific impacts on firms' responses. $Sector$ is a vector of sector dummies, controlling for sectoral speficic effects of financial constraints and $Year$ is a set of year dummies. Given that both dependent variables are dichotomous, we consider a probit model to estimate the two equations. We assume that the disturbance parameters, $\varepsilon_{i,t}$ and $\mu_{i,t}$, have a normal distribution and use standard maximum likelihood estimation. As it is likely that the two dependent variables are correlated and determined from a similar set of explanatory variables, we use a bivariate probit model. Formally, we consider that the two equations are simultaneously estimated together under the assumption that:

$$COV\left(\mu_{i,k,t}, \varepsilon_{i,k,t}\right) = \rho \neq 0$$

As explained in the literature (Poirer, 1980), the use of a bivariate probit estimation is more efficient than the use of two independent equations when the error terms of the two decisions are correlated. The results show that the assumption of a correlation in the errors is valid (See Tables 5.11-5.15) as ρ is statistically different form zero and equal to 0.6. As expected, firms that faced actual financing obstacles between the last six months of 2009 until the third quarter of 2011 tend to report that access to finance was the most pressing problem.

[12] In the estimations we always control for ownership, in a second set of regressions we also include firm age and firm size as controls.

Tables 5.11 to 5.13 HERE

In all the estimations we always include country, sector and year dummies as well as a control dummy for ownership (Panel A); in a second set of regressions we also include firm age and firm size as controls (Panel B). The ownership dummy takes the value 0 if a firm is owned by shareholders, other firms or business associates and the value 1 if the owner is a single person, a family, or when the firm has venture capital or business angel funding.

Focusing first on the variables that measure the profitability of the firm, panel A of Table 5.11 shows that firms with a lower return on equity or a higher coverage ratio are more likely to face actual credit constraints. The profit margin of the firm seems to be important in explaining the likelihood of both the perceived access to finance and the actual finance obstacle. Firms with higher profit margins are less likely to perceive access to finance as their most pressing problem; moreover they are also less likely to face actual financing obstacles. Panel B indicates that the profit margin no longer appears to be significant for the perceived financing problems once controlled for age and size. Further, panel B shows that all three profitability measures: the return on equity, the coverage ratio and the profit margin are significantly related to the experience of actual financing obstacles, even after controlling for size and age. This finding shows that the balance sheet channel might play an important role in transmission mechanism of monetary policy. Namely, a decreasing policy rate is associated with lower costs of funding (see for instance Table 5.5 and decrease in the debt burden over the sample period), which should contribute positively to the profitability of firms and hence their net worth increases, leading to a lower probability of facing a constrained supply of credit.

Table 5.12 shows the results for the variables that capture the liquidity of the firm.

Panel A and B reveal that firms with better liquidity positions as measured by working capital, are less likely to be constrained in their actual applications for external finance or to perceive access to finance problematic, even after controlling for age and size. Surprisingly, the more narrow definition working capital requirement or the cash holdings of firms do not seem to contain information regarding the perceived and actual financing obstacles.

The impact of leverage on financial constraints is shown in Table 5.13. Panel A shows that firms with higher leverage are more likely to perceive access to finance as most pressing problem as well as to face actual credit obstacles. The same is found for the leverage cleaned variable, where debt is reduced by the cash holdings. However, once we control for age and size, panel B indicates that leverage is not significant anymore. In contrast to what we expected, the amount of short term debt seems to play no significant role in the perceived and actual financing obstacles.

In a last set of tests, we jointly estimate a model with a significant profitability, liquidity and leverage measure. Tables 5.14 and 5.15 show that the conclusions drawn above generally hold. Firms with higher return on equity are less likely to face actual financing obstacles and firms with more working capital are less likely to perceive access to finance problematic or face financing obstacles. Leverage appears to be no longer significant once controlled for the profitability and liquidity of the firm.

Table 5.14 and 5.15 HERE

Further, firm age, but not firm size, is significant and negatively related to both our measures of financial constraints. Younger firms are not only the ones that perceive access to finance as their most pressing problem, they are also more likely to face actual financing obstacles. This is in line with the recent findings of Berger and Udell (2005); Rauh (2006); Fee et al. (2009); Hadlock and Pierce (2010) and indicates that capital market imperfections play an important role. It is however remarkable that, in contrast to these authors, we do not find a strong significant impact of firm size. Curiously, when we include 'did not apply out of fear of rejection'=1 in our dependent variable *FinanceObstacle*, size is negative and strongly significant in all regressions, while the conclusions regarding the other variables remain largely unchanged.[13] This indicates that those firms that are self-selecting them out of the loan-application process are especially small firms.

Finally, we take a look at our control variables (For brevity, the ownership dummy, country dummies, sector dummies and time dummies are not shown in the tables, but were always included in the regressions). The ownership dummy is significant and positively related to both perceived financing problems and actual financing obstacles. This stresses the importance of the role of ownership and the existence of internal capital markets for the financial constraints that firms belonging to groups (do not) face. Country dummies with SMEs located in Spain and Greece are facing significantly higher constraints than firms in Belgium (which is our reference country in the estimation). We control also for the sectors of SMEs but sectoral dummies are almost never significant. As for the time dummies, it is found that firms are more likely to face actual obstacles in 2010 and 2011 relative to 2009. The time dummies show no significant differences across time concerning the perceived access to finance.

In sum, we find that financial characteristics can explain self-reported financial

[13]Table 5.16 shows this for one regression, the other regressions are not shown here for brevety but are available upon request from the authors.

constraints by firms. This implies that firms should thoroughly consider their financial decisions. However, also firm age plays a large role for financial constraints. Small firms appear not to apply for external finance 'out of fear of rejection', although we find no evidence that they have different financial characteristics. Therefore, they are not less likely to obtain finance than other firms with the same age or financial characteristics and thus they should be encouraged to actually apply.

5.5 Robustness

Our matching strategy randomly picks a match when multiple matches are available at the same minimal Gower distance. This random feature is appealing as it does not create any unwanted dependency in our sample; however, it also implies that the characteristics of our matched sample may be partly specific to this randomness. Especially because approximately 37 percent of the matches involved a random draw between two or more corresponding firms.[14] And so, the estimated parameters and the inference based on our matched sample might be biased. Secondly, 13291 observations from the total euro area population might be a too small subsample, also leading to biased estimates. For these considerations, we bootstrap 200 subsamples with replacement from our full SAFE survey sample and redo the matching for every bootstrapped subsample. This leaves us with 200 'new' samples from the total population, for which we then do the bivariate probit analysis. Tables 5.18 to 5.20 show the median parameter estimate found for these 200 bivariate probit regressions, and between brackets the 95 percentile

[14] Table 5.17 in the Appendix shows that most multiple matches are available in those countries or sectors where most data is available in Amadeus (see Table 5.1).

confidence interval, given by the 2.5 and the 97.5 percentile of that parameter estimate from those 200 estimates, to indicate the likelihood of the median parameter estimate.

Tables 5.18 to 5.20 HERE

It can be seen in Table 5.18 that our findings concerning profitability are quite robust. Especially after controlling for age and size, we find that firms with higher return on equity, with lower coverage ratio and with higher profit margins are less likely to face actual financing obstacles. Again there seems to be no impact of profitability on the perceived financial problems. Looking at the effect of the liquidity ratios on our measures of financial constraints in Table 5.19, it can be seen that the results are less strong than what the analysis of the full matched sample suggested. Firms that lack working capital are more likely to face actual financing problems and they are more likely to put access to finance as their main problem, however, this relation seems to be insignificant once controlled for the age and size of the firm. For the working capital required and the cash balances we find again no significant role. Further, Table 5.20 shows that firms with higher leverage ratios have a higher probability of being financially constrained. This finding does not hold when we take into account that cash may be viewed as negative debt and calculate the leverage cleaned for cash holdings, and both leverage measures are not significant when we control for firm age and size. Interestingly, the importance of the maturity structure of the debt seems to be more clear once controlled for the potential bias related to multiple matches. Firms that finance a high share of their assets with short term liabilities are more likely to have the perception that access to finance is difficult; presumably because they need to roll over a high share of their debt yearly during a financial crisis. This perception is still significant after controlling for size and age. The results from the bootstrapped panel regressions also indicate that age is an important determinant of financial constraints. Younger firms are significantly more likely to perceive and face actual financing constraints. Size does again not seem to be significant.

Table 5.21 HERE

In a final test, we jointly estimate a model with profit margin, working capital and short term loans. Table 5.21 shows that the conclusions drawn above mainly hold. Firms with higher profit margins are less likely to face actual financing obstacles and firms that finance a higher share of their assets with short term loans are more likely to perceive access to finance problematic, taking into account the age and size of the firm.

5.6 Conclusion

The main aim of this paper was to investigate the role of financial and non-financial firm characteristics to get a better understanding of the nature of perceived and actual financing obstacles during the recent financial crisis. Its novelty is related to the availability of a unique dataset containing direct information on financing obstacles as reported by firms in the SAFE survey and the financial characteristics of those firms. To obtain this dataset we use a non parametric matching procedure to match 11886 firms from the SAFE survey dataset with their balance sheet information out of the Amadeus dataset with 2.3 million firms.

Perceived financial constraints are measured through firms' self-assessment on whether access to finance constitutes their most pressing problem. We also consider a more objective measure of financing obstacles which is related to the firms' actual applications for external financing. It is then investigated whether the firms that self-report to be financially constrained have different characteristics than financially unconstrained firms.

Our empirical results based on a bivariate probit model show that various measures related to the profitability of the firm are more significant and robust in predicting the financing obstacles encountered by firms than liquidity or leverage ratios. The finding that more profitable firms are less likely to face actual external financing obstacles can be seen as support for the balance sheet channel. Further, firms that finance a higher share of their assets with short term loans are more likely to perceive access to finance as problematic. This is due to the fact that these firms need to roll over a high share of their debt yearly and they expect that this might become very difficult or costly when market conditions turn for the worse. Finally, we show that firm age, but surprisingly not size, is negatively related with perceived and actual access to external finance. We have argued that this can be due to the fact that small firms appear to self-select them out of the loan-application process due to 'fear of rejection'.

The results indicate that firms should strive for the highest profitability possible and should pounder on the desired maturity structure of their debt. Still, policy makers should be aware that firms may also be discriminated on the basis of age. Further research is desirable to confirm the pecular role that size might play for the self-selection out the loan-application process.

5.7 Appendix

Table 5.1: Description of the unbalanced panel

	Year 2009	Year 2010	Year 2011	#*obs* (total)
#*obs*	2,799			2,799
#*obs*		2,671		2,671
#*obs*			5,187	5,187
#*obs*	700	700		1,400
#*obs*		279	279	558
#*obs*	74		74	148
#*obs*	176	176	176	528
#*obs* (total)	3,749	3,826	5,716	13,291

Figure 5.1: Firm distribution in SAFE (in percentage of the total sample)

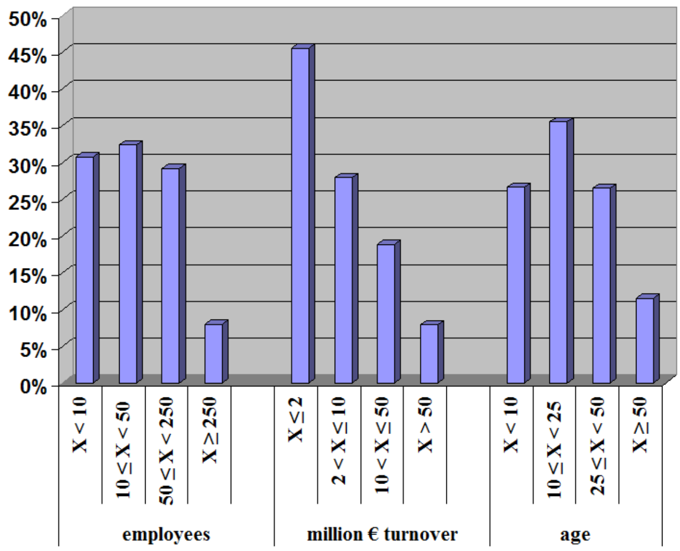

Table 5.2: Construction of Variables (as denominated in Amadeus)

Variable	Definition
Return on equity	profit or loss of the period / total shareholder funds
Coverage ratio	operating profit or loss / interest payment
Profit margin	profit or loss of the period / total sales
Workcap	(current assets - current liabilities) / total assets
Workcap required	(accounts receivable + inventories - accounts payable) / total assets
Cash	cash and cash equivalent / total assets
Debt	current liabilities + non current liabilities
Leverage	debt / total assets
Leverage cleaned	(debt - cash and cash equivalent) / total assets
Short term loans	loans with maturity less than one year / total assets
Log(age)	log(1+ age)
Log(total assets)	log(1+ total assets)
Debt burden	interest payment / (debt-accounts payable)

Table 5.3: Construction of Variables (as denominated in SAFE)

Question	Answer	Variable	Value
Q0			
What is currently your	finding customers	finance problem	0
most pressing problem?	Competition	finance problem	0
	Access to finance	finance problem	1
	Costs of production or labour	finance problem	0
	Availability skilled staff/managers	finance problem	0
	Regulation	finance problem	0
	Other	finance problem	0
	DK/NA	finance problem	missing
Q7a			
In the past 6 months which	Didn't apply, sufficient internal funds	finance obstacle	missing
action did you take with	Didn't apply because other reasons	finance obstacle	missing
respect to bank loans,	Didn't apply out of fear of rejection	finance obstacle	missing
trade credit or other	Applied	finance obstacle	go to Q7b
external finance?	DK/NA	finance obstacle	missing
Q7b			
If you applied for bank loans,	Applied and got everything	finance obstacle	0
trade credit or other external	Applied but only got part of it	finance obstacle	1
finance in the past 6 months,	Applied but refused, cost too high	finance obstacle	1
what was the outcome?	Applied but was rejected	finance obstacle	1
	DK/NA	finance obstacle	missing
D6			
Who are the owners of	Shareholders/quoted firm	ownershipdummy	0
your firm?	Other firms or business associates	ownershipdummy	0
	family or entrepreneurs	ownershipdummy	1
	Venture capital firm/business angels	ownershipdummy	1
	Natural person/one owner only	ownershipdummy	1
	Other	ownershipdummy	missing
	DK/NA	ownershipdummy	missing

Table 5.4: Available matches in Amadeus within each group

	mean	median	min	max	total
BE	1,909	1,480	10	4,232	65,920
DE	921	732	1	2,319	29,143
ES	33,308	34,107	2	67,663	440,784
FI	1,800	1,814	5	3,867	61,560
FR	43,126	41,729	42	94,929	884,855
GR	2,923	3,231	1	5,047	67,929
IT	37,841	39,359	20	70,352	972,321
NL	261	225	1	572	8,232
PT	51,028	45,704	4	88,524	705,609
mining	556	527	1	1,009	14,344
construction	14,013	15,464	3	26,356	206,594
manufacturing	32,649	34,107	17	70,352	840,508
retail and wholesale	53,052	54,884	77	94,925	1,202,486
transpot and storage	7,310	8,874	8	12,465	171,782
real estate	6,541	6,448	1	13,043	94,697
other services	42,623	45,704	21	72,708	705,942
X≤2 mill. euro	50,683	54,014	4	94,930	2,196,194
2 mill. euro<X≤10 mill. euro	18,348	16,026	1	39,625	688,373
10 mill. eruo<X≤50 mill. euro	7,560	6,052	1	16,884	267,317
X>50 mill. euro	1,690	1,292	1	3,959	84,469
2008	35,337	32,095	3	85,398	1,083,822
2009	45,542	41,703	1	94,929	1,309,480
2010	36,519	39,359	1	88,232	843,051

Notes. The Table shows the number of observations in each group in Amadeus that is available for the matching.

Table 5.5: Financial constraints, financial characteristics and the importance of groups

	Finance Problem	Finance Obstacle	Debt Burden$_{t-1}$	Cash$_{t-1}$
Turnover Class				
X≤2 mill. euro	18.5%	45.2%	2.87%	0.125
2 mill. euro<X≤10 mill. euro	17.1%	40.7%	2.33%	0.105
10 mill. eruo<X≤50 mill. euro	13.8%	36.8%	2.15%	0.081
X>50 mill. euro	11.7%	34.3%	2.24%	0.059
Year				
2009	19.2%	37.8%	3.20%	0.111
2010	15.0%	42.4%	2.66%	0.115
2011	16.2%	43.0%	2.02%	0.125

Notes.

Table 5.6: Descriptive statistics

	# groups	% groups where variance within group < variance total sample
Return on equity	733	74%
Coverage ratio	733	62%
Profit margin	733	72%
Workcap	733	87%
Workcap requirement	733	87%
Cash	733	77%
Leverage	733	84%
Leverage cleaned	733	83%
Short term loans	733	75%
Total	733	78%

Notes. The first column shows the number of groups that are used for the NNDHD matching. The second column shows the percentage of groups for which the given variable has a smaller variance within the group than in the total sample. Calculations are done on the total Amadeus sample out which is matched.

Table 5.7: Comparison of firms' qualitative answers on changes in turnover, profit margin, interest rates and use of trade credit

				Data source
	Profit margin increased=0	Profit margin increased=1	T-test	safe
Profit margin	0.008	0.015	0.12	amadeus
	Turnover increased=0	Turnover increased=1	T-test	safe
Sales growth	-0.026	0.027	0.05**	amadeus
	Interest rate increased=0	Interest rate increased=1	T-test	safe
Debt burden	2.3%	2.6%	0.01***	amadeus
	Trade credit used=0	Trade credit used=1	T-test	safe
Trade Credit to assets	0.146	0.167	0.02**	amadeus
Trade Credit to sales	0.112	0.158	0.00***	amadeus

Notes. The Table gives the mean values of the variables split by the bivariate outcome of the categorical variable and the p-value of the corresponding t-test on the equality of the means. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 5.8: Country distribution, finance problem and finance obstacle

	Finance Problem	*#obs*	Finance Obstacle	*#obs*
BE	7.3%	740	21.3%	80
DE	13.6%	2,376	25.4%	311
ES	26.4%	2,336	39.3%	638
FI	6.7%	658	6.5%	46
FR	12.7%	2,385	19.1%	408
GR	33.8%	745	47.2%	178
IT	16.2%	2,413	29.5%	572
NL	12.1%	848	50.0%	66
PT	16.6%	790	32.1%	131
total	16.7%	13,291	31.1%	2,430

Notes. The Table shows the number of observations that belong to that country in our sample and the percentage of those observations that had more than one possible match at minimal distance (i.e. the percentage of observations that involved a random draw).

Table 5.9: Descriptive statistics

	mean	median	minimum	maximum	*#obs*
Profitability					
Return on equity	0.106	0.071	-2.444	2.177	13,291
Coverage ratio	7.355	2.344	-50.75	99.90	13,291
Profit margin	0.009	0.012	-0.874	0.343	13,291
Liquidity					
Workcap	0.161	0.155	-1.000	1.000	13,291
Workcap requirement	0.287	0.259	-0.788	1.000	13,291
Cash	0.113	0.051	0.000	0.950	13,291
Leverage					
Leverage	0.708	0.712	0.000	4.232	13,291
Leverage cleaned	0.595	0.621	-0.814	4.000	13,291
Short term loans	0.085	0.023	0.000	0.815	13,291
Asymmetric info					
Age	23.28	19.00	1.000	160.0	13,291
Log(assets)	7.884	7.760	1.098	18.51	13,291
Debt burden	2.50%	2.03%	0.00%	31.4%	13,291

Notes. The Table shows the mean, median, minimum and maximum for the variables of the matched sample.

Table 5.10: Firm characteristics by constraint-group: t-test on the equality of means

	Finance Problem=0	Finance Problem=1	T-test	Finance Obstacle=0	Finance Obstacle=1	T-test
Profitability						
Return on equity	0.108	0.094	0.08*	0.099	0.062	0.02**
Coverage ratio	10.14	8.725	0.01***	8.153	6.445	0.02**
Profit margin	0.010	0.002	0.00***	0.011	-0.000	0.00***
Liquidity						
Workcap	0.162	0.144	0.01***	0.160	0.123	0.00***
Workcap requirement	0.282	0.313	0.00***	0.288	0.312	0.01***
Cash	0.113	0.110	0.18	0.099	0.099	0.52
Leverage						
Leverage	0.706	0.719	0.04**	0.697	0.730	0.00***
Leverage cleaned	0.592	0.609	0.02**	0.598	0.632	0.01***
short term loans	0.083	0.095	0.00***	0.091	0.101	0.04**
Asymmetric info						
age	23.98	19.76	0.00***	24.67	20.88	0.00***
log(assets)	7.928	7.663	0.00***	8.323	8.073	0.00***
debt burden	2.5%	2.7%	0.00***	2.4%	2.5%	0.07*

Notes. The Table gives the mean values of the variables split by constraint-group and the p-value of the corresponding t-test on the equality of the means between the constrained observations and the unconstrained observations. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 5.11: Bivariate probit regression: Profitability

	(A1)		(A2)		(A3)	
Panel A	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle
Return on equity	-0.009	-0.113*				
	(0.061)	(0.062)				
Coverage ratio			-0.001	-0.003**		
			(0.001)	(0.001)		
Profit margin					-0.527*	-0.621**
					(0.281)	(0.285)
ρ	0.637***		0.626***		0.635***	
	(0.026)		(0.039)		(0.039)	
Control dummies	YES		YES		YES	
#obs	2,381		2.267		2,381	

	(B1)		(B2)		(B3)	
Panel B	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle
Return on equity	-0.036	-0.137**				
	(0.060)	(0.061)				
Coverage ratio			-0.001	-0.003**		
			(0.001)	(0.039)		
Profit margin					-0.437	-0.563**
					(0.285)	(0.285)
log(total assets)	-0.023	-0.006	-0.024	-0.003	-0.021	-0.004
	(0.016)	(0.015)	(0.016)	(0.015)	(0.016)	(0.015)
log(age)	-0.144***	-0.135***	-0.123***	-0.124***	-0.143***	-0.127***
	(0.036)	(0.035)	(0.036)	(0.036)	(0.036)	(0.035)
ρ	0.626***		0.618***		0.625***	
	(0.039)		(0.040)		(0.039)	
Control dummies	YES		YES		YES	
#obs	2,381		2,267		2,381	

Notes. The Table shows the results of the bivariate probit estimation for the matched panel. Heterscedasticity robust standard errors in parentheses. Control dummies: ownership dummy, country dummies, sector dummies and year dummies are included in all regressions. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 5.12: Bivariate probit regression: Liquidity

	(A1)		(A2)		(A3)	
Panel A	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle
Workcap	-0.253***	-0.251***				
	(0.090)	(0.088)				
Workcap requirement			0.147	-0.088		
			(0.112)	(0.109)		
Cash					0.032	-0.134
					(0.215)	(0.212)
ρ	0.633***		0.638***		0.636***	
	(0.039)		(0.039)		(0.039)	
Control dummies	YES		YES		YES	
#obs	2,381		2.381		2,381	
	(B1)		**(B2)**		**(B3)**	
Panel B	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle
Workcap	-0.193**	-0.205**				
	(0.090)	(0.061)				
Workcap requirement			0.169	-0.064		
			(0.113)	(0.110)		
Cash					-0.059	0.095
					(0.219)	(0.216)
log(total assets)	-0.022	-0.005	-0.021	-0.007	-0.023	-0.005
	(0.016)	(0.015)	(0.016)	(0.015)	(0.016)	(0.015)
log(age)	-0.134***	-0.120***	-0.148***	-0.127***	-0.143***	-0.129***
	(0.036)	(0.035)	(0.036)	(0.035)	(0.036)	(0.035)
ρ	0.624***		0.628***		0.626***	
	(0.039)		(0.039)		(0.039)	
Control dummies	YES		YES		YES	
#obs	2,381		2,381		2,381	

Notes. The Table shows the results of the bivariate probit estimation for the matched panel. Heterscedasticity robust standard errors in parentheses. Control dummies: ownership dummy, country dummies, sector dummies and year dummies are included in all regressions. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 5.13: Bivariate probit regression: Leverage

	(A1)		(A2)		(A3)	
Panel A	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle
Leverage	0.184**	0.200**				
	(0.092)	(0.090)				
Leverage cleaned			0.142*	0.140*		
			(0.081)	(0.079)		
Short term loans					0.302	0.106
					(0.211)	(0.203)
ρ	0.634***		0.635***		0.636***	
	(0.039)		(0.039)		(0.039)	
Control dummies	YES		YES		YES	
#obs	2,381		2.381		2,381	

	(B1)		(B2)		(B3)	
Panel B	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle
Leverage	0.081	0.127				
	(0.094)	(0.091)				
Leverage cleaned			0.073	0.087		
			(0.082)	(0.079)		
Short term loans					0.319	0.120
					(0.211)	(0.202)
log(total assets)	-0.021	-0.004	-0.022	-0.006	-0.023	-0.006
	(0.016)	(0.015)	(0.016)	(0.015)	(0.016)	(0.015)
log(age)	-0.139***	-0.121***	-0.139***	-0.123***	-0.144***	-0.129***
	(0.036)	(0.035)	(0.036)	(0.035)	(0.036)	(0.035)
ρ	0.626***		0.626***		0.626***	
	(0.039)		(0.039)		(0.039)	
Control dummies	YES		YES		YES	
#obs	2,381		2,381		2,381	

Notes. The Table shows the results of the bivariate probit estimation for the matched panel. Heterscedasticity robust standard errors in parentheses. Control dummies: ownership dummy, country dummies, sector dummies and year dummies are included in all regressions. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 5.14: Bivariate probit regression: Total

	(1)		(2)	
	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle
Return on equity	-0.009	-0.117*	-0.035	-0.138**
	(0.060)	(0.062)	(0.060)	(0.061)
Workcap	-0.236**	-0.267***	-0.167*	-0.213**
	(0.129)	(0.092)	(0.095)	(0.092)
Short term loans	0.129	-0.105	0.192	-0.054
	(0.220)	(0.213)	(0.221)	(0.213)
log(total assets)			-0.022	-0.006
			(0.016)	(0.015)
log(age)			-0.138***	-0.125***
			(0.036)	(0.035)
ρ	0.634***		0.625***	
	(0.039)		(0.039)	
Control dummies	YES		YES	
#obs	2,381		2,381	

Notes. The Table shows the results of the bivariate probit estimation for the matched panel. Heterscedasticity robust standard errors in parentheses. Control dummies: ownership dummy, country dummies, sector dummies and year dummies are included in all regressions. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 5.15: Bivariate probit regression: Total

	(1)		(2)	
	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle
Return on equity	-0.012	-0.117*	-0.036	-0.137**
	(0.060)	(0.062)	(0.060)	(0.061)
Workcap	-0.226**	-0.205*	-0.225**	-0.200*
	(0.113)	(0.110)	(0.114)	(0.110)
Leverage	0.046	0.081	-0.057	0.009
	(0.116)	(0.112)	(0.120)	(0.114)
log(total assets)			-0.023	-0.005
			(0.016)	(0.015)
log(age)			-0.138***	-0.125***
			(0.036)	(0.035)
ρ	0.633***		0.625***	
	(0.039)		(0.039)	
Control dummies	YES		YES	
#obs	2,381		2,381	

Notes. The Table shows the results of the bivariate probit estimation for the matched panel. Heterscedasticity robust standard errors in parentheses. Control dummies: ownership dummy, country dummies, sector dummies and year dummies are included in all regressions. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 5.16: Bivariate probit regression: Total, finance obstacle including fear of rejection

	(1)		(2)	
	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle
Return on equity	0.035	-0.094*	0.010	-0.131***
	(0.049)	(0.049)	(0.049)	(0.049)
Workcap	-0.241**	-0.160*	-0.246**	-0.174*
	(0.097)	(0.095)	(0.097)	(0.095)
Leverage	0.026	0.135	-0.098	-0.031
	(0.105)	(0.105)	(0.108)	(0.107)
log(total assets)			-0.032**	-0.057***
			(0.014)	(0.013)
log(age)			-0.134***	-0.153***
			(0.030)	(0.030)
ρ	0.665***		0.546***	
	(0.033)		(0.033)	
Control dummies	YES		YES	
#obs	3,192		3,192	

Notes. The Table shows the results of the bivariate probit estimation for the matched panel. Heterscedasticity robust standard errors in parentheses. Control dummies: ownership dummy, country dummies, sector dummies and year dummies are included in all regressions. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 5.17: Country and sectoral distribution, percentage matches with multiple donors at minimal distance

	#obs	*% multiple matches*
BE	740	18.11%
DE	2,376	5.38%
ES	2,336	42.21%
FI	658	35.25%
FR	2,385	52.91%
GR	745	41.20%
IT	2,413	56.69%
NL	848	9.31%
PT	790	60.63%
total	13,291	37.43%
mining	128	4.69%
construction	1,336	25.67%
manufacturing	3,456	29.63%
retail and wholesale	3,414	50.00%
transpot and storage	687	25.18%
real estate	102	29.41%
other services	4,168	40.59%
total	13,291	37.43%

Notes. The Table shows the number of observations that belong to the given sector or country in our sample and the percentage of those observations that had more than one possible match at minimal distance (i.e. the percentage of observations that involved a random draw).

Table 5.18: Robustness check with bootstrapped sample. Bivariate probit regression: Profitability

	(A1)		(A2)		(A3)	
Panel A	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle
Return on equity	0.016	-0.067				
	[-0.096,0.131]	[-0.199,0.074]				
Coverage ratio			-0.001	-0.003**		
			[-0.004,0.002]	[-0.006,-0.000]		
Profit margin					-0.424	-0.875***
					[-1.252,0.328]	[-1.513,-0.189]
Control dummies	YES		YES		YES	
	(A1)		(A2)		(A3)	
Panel A	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle
Return on equity	-0.016	-0.095*				
	[-0.130,0.105]	[-0.232,0.043]				
Coverage ratio			-0.001	-0.003*		
			[-0.004,0.003]	[-0.006,0.000]		
Profit margin					-0.333	-0.814**
					[-1.158,0.443]	[-1.444,-0.149]
log(total assets)	-0.021	-0.004	-0.022	-0.002	-0.019	-0.003
	[-0.059,0.012]	[-0.038,0.023]	[-0.059,0.010]	[-0.038,0.026]	[-0.054,0.015]	[-0.034,0.026]
log(age)	-0.147***	-0.137***	-0.134***	-0.133***	-0.154***	-0.140***
	[-0.211,-0.075]	[-0.210,-0.066]	[-0.223,-0.064]	[-0.242,-0.067]	[-0.217,-0.081]	[-0.217,-0.071]
Control dummies	YES		YES		YES	

Notes. The Table shows the median parameter estimate of the bivariate probit estimation on 200 bootstrapped samples. The 90 percent confidence interval corresponding to those 200 bootstrapped sample estimates is shown between squared brackets. Control dummies: ownership dummy, country dummies, sector dummies and year dummies are included in all regressions. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 5.19: Robustness check with bootstrapped sample. Bivariate probit regression: Liquidity

	(A1)		(A2)		(A3)	
Panel A	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle
Workcap	-0.176*	-0.188***				
	[-0.340,0.019]	[-0.367,-0.018]				
Workcap requirement			0.061	-0.094		
			[-0.200,0.255]	[-0.329,0.125]		
Cash					0.057	0.096
					[-0.375,0.461]	[-0.345,0.476]
Control dummies	YES		YES		YES	
	(A1)		(A2)		(A3)	
Panel A	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle
Workcap	-0.109	-0.134				
	[-0.283,0.092]	[-0.302,0.053]				
Workcap requirement			0.081	-0.072		
			[-0.172,0.289]	[-0.291,0.141]		
Cash					-0.029	0.073
					[-0.452,0.442]	[-0.384,0.472]
log(total assets)	-0.022	-0.004	-0.020	-0.005	-0.022	-0.003
	[-0.060,0.011]	[-0.039,0.024]	[-0.058,0.012]	[-0.041,0.021]	[-0.057,0.011]	[-0.039,0.025]
log(age)	-0.138***	-0.124***	-0.148***	-0.132***	-0.147***	-0.135***
	[-0.204,-0.068]	[-0.201,-0.051]	[-0.213,-0.079]	[-0.208,-0.060]	[-0.211,-0.076]	[-0.206,-0.064]
Control dummies	YES		YES		YES	

Notes. The Table shows the median parameter estimate of the bivariate probit estimation on 200 bootstrapped samples. The 90 percent confidence interval corresponding to those 200 bootstrapped sample estimates is shown between squared brackets. Control dummies: ownership dummy, country dummies, sector dummies and year dummies are included in all regressions. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 5.20: Robustness check with bootstrapped sample. Bivariate probit regression: Leverage

Panel A	(A1) Finance Problem	(A1) Finance Obstacle	(A2) Finance Problem	(A2) Finance Obstacle	(A3) Finance Problem	(A3) Finance Obstacle
Leverage	0.197	0.287**				
	[-0.021,0.424]	[0.048,0.542]				
Leverage cleaned			0.081	0.109		
			[-0.061,0.237]	[-0.061,0.255]		
Short term loans					0.432*	0.172
					[-0.014,0.861]	[-0.263,0.548]
Control dummies	YES		YES		YES	
Panel A	(A1) Finance Problem	(A1) Finance Obstacle	(A2) Finance Problem	(A2) Finance Obstacle	(A3) Finance Problem	(A3) Finance Obstacle
Leverage	0.065	0.190				
	[-0.186,0.340]	[-0.065,0.501]				
Leverage cleaned			0.004	0.048		
			[-0.151,0.192]	[-0.107,0.221]		
Short term loans					0.427*	0.168
					[-0.012,0.845]	[-0.260,0.549]
log(total assets)	-0.024	-0.005	-0.021	-0.004	-0.022	-0.004
	[-0.060,0.008]	[-0.042,0.023]	[-0.057,0.012]	[-0.037,0.023]	[-0.057,0.012]	[-0.038,0.023]
log(age)	-0.132***	-0.109***	-0.146***	-0.130***	-0.147***	-0.133***
	[-0.207,-0.053]	[-0.185,-0.032]	[-0.212,-0.074]	[-0.205,-0.059]	[-0.209,-0.077]	[-0.207,-0.062]
Control dummies	YES		YES		YES	

Notes. The Table shows the median parameter estimate of the bivariate probit estimation on 200 bootstrapped samples. The 90 percent confidence interval corresponding to those 200 bootstrapped sample estimates is shown between squared brackets. Control dummies: ownership dummy, country dummies, sector dummies and year dummies are included in all regressions. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 5.21: Robustness check with bootstrapped sample. Bivariate probit regression: Total

	(A1)		(A2)	
Panel A	Finance Problem	Finance Obstacle	Finance Problem	Finance Obstacle
Profit margin	-0.361	-0.785**	-0.319	-0.769**
	[-1.114,0.446]	[-1.439,-0.073]	[-1.082,0.528]	[-1.423,-0.039]
Workcap	-0.094	-0.189*	-0.023	-0.126
	[-0.303,0.089]	[-0.357,0.020]	[-0.227,0.178]	[-0.291,0.109]
Short term loans	0.389	0.044	0.415*	0.085
	[-0.066,0.837]	[-0.371,0.496]	[-0.011,0.884]	[-0.336,0.515]
log(total assets)			-0.020	-0.004
			[-0.056,0.014]	[-0.035,0.026]
log(age)			-0.150***	-0.131***
			[-0.220,-0.075]	[-0.209,-0.059]
Control dummies	YES		YES	

Notes. The Table shows the median parameter estimate of the bivariate probit estimation on 200 bootstrapped samples. The 90 percent confidence interval corresponding to those 200 bootstrapped sample estimates is shown between squared brackets. Control dummies: ownership dummy, country dummies, sector dummies and year dummies are included in all regressions. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

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