Working paper research
n° 87 July 2006

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WORKING PAPERS - RESEARCH SERIES

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We would like to thank Paul Butzen, Steven Ongena, Egon Zakrajsek, an anonymous referee and participants to the ECB workshop on "Corporate finance and monetary policy", May 2006, for useful suggestions.

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Imprint: Responsibility according to the Belgian law: Jean Hilgers, Member of the Board of Directors, National Bank of Belgium.

ISSN: 1375-680X

Abstract

We test whether firms with a single bank are better shielded from loss of credit and investment cuts in periods of adverse cash flow shocks than firms with multiple bank relationships. Our estimates of the cash flow sensitivity of investment show that both types of firms are equally subject to financing constraints that bind only in the event of adverse cash flow shocks. In these periods, firms incur lower cuts in investment expenditures when they can obtain extra credit. In periods of adverse cash flow shocks, the probability of obtaining extra bank debt becomes more sensitive to the size and leverage of the firm.

JEL-code : D92.

Keywords: financial constraints, lending relationships, firm investment, firm financing.

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1. Introduction

This paper investigates whether developing a single bank relationship helps firms to circumvent exceptional liquidity shortages. More precisely, we test whether having a single versus multiple bank relationships has an effect on the availability of finance and investment spending during times of adverse cash flow shocks. Adverse cash flow shocks are defined as large drops in cash flow (relative to the capital stock of the firm) from the previous year level. We argue that it is especially in times of adverse cash flows that financial constraints are more likely to be binding and that firms more strongly need external finance. If in these periods firms cannot restore liquidity fully, through the use of external finance, they have to reduce spending, including investment spending. To the extent that strong bank relationships alleviate asymmetric information problems, and that firms with a single bank have a closer lending relationship than firms with multiple banks, adverse cash flow shocks would have different effects on financing and investment for firms with a single versus multiple bank relationships.

Asymmetric information problems can generate financial constraints, whereby firms have limited access to external finance, and as a consequence, have to restrict spending below the optimal level (Jensen and Meckling, 1976, Stiglitz and Weiss, 1981, Myers and Majluf, 1984). An extensive empirical literature, beginning with Fazzari et al (1988) identifies *the types of firms that are subject to financial constraints*[1]. We deviate from this literature in that we identify *periods where financial constraints are binding*. We analyse whether firms suffer from financial constraints in times of exceptional liquidity shortages. We then test whether firms that have a single bank relationship are better shielded from financial constraints.

Economic theory suggests that lending relationships are useful in overcoming asymmetric information problems between creditors and their clients. When a bank has developed a strong relationship with a firm, "soft" information about the creditworthiness of the firm can be collected by the bank. This can then be used in the bank's credit decisions. Consequently, firms with deep lending relationships may benefit from better credit conditions. A large empirical literature has investigated the benefits of strong banking relationships. Results suggest an ambiguous effect of lending relationships on the loan rate (Petersen and Rajan, 1994, Berger and Udell, 1995, d'Auria et al, 1999, Degryse and Van Cayseele, 2000), but increased credit availability (Chirinko and Elston, 2006), among others in bad times (Elsas and Krahnen, 1998, Vickery 2005), and reduced financial constraints (Hoshi et al, 1991, Elston, 1998, Garcia Marco and Ocaña, 1999, Houston and James, 2001).

[1] Typical firms characteristics that have been pointed out are, for example, firms' size, more opaque uncertain activities such as R&D activities, lower dividend pay out, high leverage or low bond ratings.

We are aware that a bank relationship has many dimensions. In the bank relationship literature the strength of the relationship has been defined according to either the length of the relationship (Berger and Udell, 1995, Degryse and Van Cayseele, 2000), the scope of the relationship (the types and number of financial services provided by the bank to the firm, as in Degryse and Van Cayseele, 2000), banks ownership of the firm (Chirinko and Elston, 2006, Elsas, 1998, Garcia Marco and Ocaña, 1999), or the number of banks (Petersen and Rajan, 1994, Harhoff and Körting, 1998, Houston and James, 2001). This paper is therefore closer to the last three papers as it focuses on the effect of a single versus multiple bank relationships.

We proceed in three steps. First, we examine whether firms experience stronger financial constraints in periods of adverse cash flow shocks. Following Fazzari et al (1988) we interpret the finding of different cash flow sensitivity of investment as evidence of different degree of financial constraints. Our estimates suggest that financial constraints bind only in periods of adverse cash flow shocks. We then test whether firms ' investment reacts differently in these periods as a function of having a single bank relationship. Second, we analyse directly the restoration of liquidity after an adverse cash flow shock. We assess whether firms obtain extra credit from their banks, or whether they make use of trade credit (which can be considered as a more expensive substitute for bank debt). Our results indicate that firms that receive extra bank debt cut their investment spending to a much lower extent. We then test whether firms that have a single bank relationship obtain larger amounts of additional bank credit than firms with multiple bank relationships (conditional on obtaining extra bank debt), and find no significant difference. Third and finally, we investigate the determinants of the probability of obtaining extra bank debt. A probit regression reveals that although we find that firms with a single bank have a lower probability of obtaining bank credit in all times, this probability is not lower in bad times. Ultimately, the paper aims at answering whether having more than 1 bank relationship matters in bad times both for the real and financial side of the firm. The rest of the paper is structured as follows. In section 2 we briefly describe the related literature. In section 3 we describe our data. In section 4 we investigate whether firm investment is affected by adverse cash flow shocks and whether having more than 1 bank relationships matters. In section 5 we investigate the behaviour of the firm financing when faced by an adverse cash flow shock. In Section 6 we investigate the probability of obtaining extra bank debt. Section 7 concludes.

2. Related literature on bank relationships

A number of papers try to explain the motives for having multiple bank relationships. In general, multiple bank relationships should be costly as banks need to somehow charge the firm for the information gathering, screening and monitoring, in the credit process. On the other hand, being tied

to only 1 bank, firms can be vulnerable to a hold-up problem in which the bank (that has all the important information on the firm) extracts rents from the firm. When going into a relationship with another bank, firms therefore should weigh the extra costs of monitoring with the benefit of competition between banks (Rajan, 1992, Von Thadden, 1992). We do not examine the determinants of the number of bank relationships[2], but investigate whether, when and how can bank relationships reduce financial constraints.

There are also other reasons why firms might prefer multiple bank relationships. Detragiache et al. (2000) develop a model in which firms choose multiple relationships to avoid being denied refinancing of long term projects when their bank faces liquidity problems. Increasing the number of bank relationships increases the probability that at least one informed bank will refinance the projects. In our paper we rather investigate the liquidity of the firm, and test whether a firm that has more than 1 bank relationship has a higher probability of obtaining a loan when the firm has a liquidity problem

The empirical evidence on the impact of the strength of bank relationship reports ambiguous effects on the loan rate, and in general, a positive impact of credit availability and a reduction of the degree of financial constraints. Several empirical papers have found a link between the strength of bank relationships a firm has and the availability and cost of bank finance. Berger and Udell (1995) provide evidence that the loan rates are lower the longer the bank relationship. D'Auria et al. (1999) show that the interest rates charged by a bank are lower the larger the share of firm's debt in that bank, all other firm and bank characteristics being equal. Degryse and Van Cayseele (2000) find that long lasting lending relationships increase the loan rate, while wider bank-relationships (i.e. when the firm buys different products and services from the same bank) reduce the loan rate. Chirinko and Elston (2006) show that in the German banking system, bank affiliated firms do not benefit from more long-term bank debt than independent firms, after controlling for a set of firm's characteristics. Petersen and Rajan's (1994) results indicate that the loan rate increases with the number of banks a firm has, on a set of small U.S. firms. They also find that the amount of trade debt paid late is positively related to the number of banks, i.e. the more banks a firm has, the more it pays its trade debt late. This suggests that the availability of bank credit worsens as firms have more bank relationships. Harhoff and Körting (1998) follow Petersen and Rajan (1994) by using trade debt to infer the availability of external finance. They confirm their finding that trade debt paid late increases with the number of banks, on a set of small German firms. Cole (1998), also using

2 For such analysis, see for example Ongena and Smith (2000). They investigate empirically the determinants of the number of bank relationships in a set of large firms of 20 European countries. They find that next to size of the firms also country specific reasons such as the efficiency of the judicial system and the enforcement of creditor rights explain cross-country differences in the number of bank relationships.

small U.S. firms, finds that the number of banks a firm has, has a negative effect on the probability of being extended a loan. In general therefore the literature has found that more bank relationships are associated with worse credit availability.

The present paper considers in particular the role of banks in periods of adverse liquidity shocks. Some other papers have explicitly analysed the availability of credit in bad times. Elsas and Krahnen (1998) show that house banks in Germany increase their financing share of firms when these firms face rating downgrades, thereby providing an insurance service. Suzuki and Wright (1985) argue that in Japan keiretsu members benefit from rescue operations from banks of the group. Vickery (2005) investigates the role of banks in Asia during the Asian financial crisis. Firms with close relationships to banks were less likely to be denied credit by banks. Interestingly, he finds that close bank relationships were not leading to greater access to credit prior to the crisis, so that relationships only seems important in bad times. Berlin and Mester (1998) argue that, in case of interest rate shocks, banks may smooth interest rate fluctuations for clients with which they maintain strong relationships, and even reallocate their credits towards them. Conigliani et al (1997) show evidence that the probability of an increase in the interest rates charged on bank loans following a monetary tightening is higher for more indebted firms and for firms with a larger number of lending banks.

In this paper, we first test whether firms that have closer ties to their bank (proxied by having a single bank relationship) face less financial constraints, thanks to reduced asymmetric information problems as evidenced by a lower cash flow sensitivity of investment (along the line initiated by Fazzari et al, 1998). A number of papers have investigated this question. In a Q model of investment for a sample of Japanese firms, Hoshi et al. (1991) find that firms with close ties to a bank (in a Keiretsu) are less sensitive to cash flow than independent firms. Elston (1998) finds that German firms that are partially owned by banks show less sensitivity to cash flow. Garcia-Marco and Ocafia (1999) show that the Euler equation derived from the neoclassical model without financing constraints, holds for firms which are partly owned by banks, while it fails for the other firms. For US listed firms, Houston and James (2001) find that the cash flow sensitivity of investment is significantly greater for firms that rely on one single bank than for firms with multiple bank relationships, contrary to other papers in the literature they argue that information asymmetries might be less severe for firms with multiple bank relationships. On the other hand they also find that for moderate investment levels bank dependent firms (i.e. firms with little public debt) show lower cash flow sensitivity, while for large investment levels bank-dependent firms show larger sensitivity. They interpret this as evidence that banks are unwilling to finance large investment projects.

3. Data

3.1 Dataset

We combine two datasets which are collected by the National Bank of Belgium. The first is the annual accounts dataset from the Balance Sheet Office which reports annual balance sheets and profits and losses accounts of firms since 1985. The second is the Credit Register dataset from the Central Credit Office, which collects information on all credit lines and loans (the amount authorised and the amount taken up) at the end of the month from each bank to each firm, from 1997 onwards. The annual accounts dataset is fully representative of Belgian non-financial firms. Indeed, by legal obligation, nearly every firm in Belgium has to report its annual accounts[3]. Further, almost all banks have to report most of their loans and credit lines[4] to the Central Credit Office[5]. We consider all sectors of economic activity, so we do not focus on manufacturing firms.

We do not keep all the firms that are matched in the two datasets. First, we do not consider very small firms. The choice of excluding very small firms is simply imposed to us by the fact that the detail of the information provided to the Balance sheet office depends on the size of the firm and that very small firms need to provide much less detail to the annual accounts dataset.[6] Importantly, therefore compared to Petersen and Rajan (1994), Harhoff and Körting (1998) and Cole (1998) the median firm in our dataset is much larger, i.e. 7.5 million euros in total assets. For the Belgian economy, these firms are considered as medium or large. Third, we remove outliers from the data, trimming on investment-capital ratio, cash flow capital ratio, sales growth, output-capital ratio as well as a set of financial ratios in order to clean our sample from financially distressed firms. Fourth, we also require the firms to have at least 7 consecutive annual accounts. Finally we only consider firms with annual accounts that cover the period from January to December[7]. The data appendix

3 In general, except for financial intermediaries, who have to obey special rules, all firms governed by Belgian law have to report their annual accounts.

4 Banks do not report to the Credit Register in two cases: (1) when the sum of all credits of a bank to a firm does not exceed 25,000 Euros, (2) branches of foreign banks do not report to the Credit Register, on the contrary to subsidiaries of foreign banks.

5 Only Degryse et al (2005) have used this dataset; they analyse the effect of bank mergers on bank relationships for small firms. Degryse and Van Cayseele (2000) have also examined the effects of bank relationships in Belgium, but they made use of a smaller database.

6 Although small firms also have to report their annual account and credits, the information they provide is less precise. For example they do not have to report sales. Further since credits are reported only when total credits from a bank is higher than 25.000 euros, there is a risk of mismeasurement of the lending relationship. Only firms that exceed certain thresholds provide enough information in the annual accounts dataset for our analysis. We consider firms for which yearly average of its workforce is at least 100 or when at least two of the following thresholds were exceeded: (1) yearly average of workforce: 50, (2) turnover (excluding VAT): EUR 6,250,000, (3) balance sheet total: EUR 3,125,000. (The values of the latter two thresholds are altered every four years in order to take account of inflation).

7 This is ensures consistency within the sample and time-consistency with the deflators used.

describes in more details the variables definition and trimming procedure. Our final unbalanced panel includes 8415 observations on 1448 firms. The dataset covers the period 1997-2002.

One should note that, given our trimming procedure, firms typically associated with financing constraints, such as small firms, firms that experience high and rapid growth, or financially distressed firms, are absent from our sample. Therefore we do not expect to have firms that are financially constrained over all periods of time. Rather we investigate whether these firms may experience financial constraints occasionally, in periods of exceptional adverse liquidity shocks. We then examine whether having a single versus multiple bank relationships may help to overcome these liquidity shortages.

We define adverse cash flow reductions as the 1st quartile of changes in cash flow over capital. These represent a minimal reduction of the cash flow to capital ratio of 0.05 (i.e. 5% of the capital stock of the firm.)

We adopt the following definition of a bank relationship: firm x has a relationship with bank y as soon as bank y reports a loan, credit line or collateral for that firm. We then construct an indicator that is equal to one when the firm has a single bank. Note that the indicator may vary over time as firms change their number of bank relationships.

Other indicators of bank relationships have been used in the literature. Degryse and Van Cayseele (2000) use a measure of the scope of the bank relationship based on the number of bank services provided to the firm. Since we have information on all types of credit, credit lines and collateral, we could in principle construct such an indicator. However, we have no information on other types of services than credit. Further the literature is mute as to what type of credit strengthens the relationship, and therefore on the appropriate weighting to apply to the various credit types.

Some other papers, in particular those analysing the German bank system, focus on the role of house banks. (See for example Elsas and Krahnen, 1998). Indeed, firms may have multiple banks, but with a strong relationship with only one of these. House banks are sometimes identified by the banks' equity stake in the firm. Such information is unavailable in our dataset.

Finally, some authors insist on the duration of the bank relationship (see, for example, Berger and Udell, 1995, or Degryse and Van Cayseele, 2000. In our sample Credit register data covers only 6 years, which puts strong limitations on such a measure.

3.2 Single versus multiple bank relationships

We report in Table 1 the number of observations according to the number of bank relationships. 92% of the firms in our sample have 4 or less than 4 bank relationships. The average number of bank relationships is 2.6. The 25% percentile is 2 bank relationships and the 75% percentile is 3 bank relationships. These numbers are very comparable (albeit slightly larger) than the numbers for the US or Germany. By comparison, the small German firms in Harhoff and Körting (1998) (that are smaller than ours) have on average 1.8 bank relationships. In their sample the 25% percentile is 1 bank relationship and the 75% percentile is 2 bank relationships. Petersen and Rajan (1994) report that in their sample of small US firms, the smallest firms tend to have just over 1 lender, while the largest firms have about three lenders. So generally, firms either have only 1 bank relationship or when they have more than 1 relationship they have just a few relationships. In the following we will therefore mostly (although not exclusively) concentrate on the differences of firms when they have just one or more than 1 (i.e. multiple) relationships. From the moment a firm has more than 1 relationship, at least 2 banks should have information about the firm so that the firm in principle could use bank competition to obtain favourable borrowing conditions.

Table 1- Number of bank relationships

# bank relationships	N	%
1	1606	19%
2	2879	34%
3	2154	26%
4	1086	13%
5 or more	408	8%

Table 2 reports the median value of asset size, some financial ratios and profitability, distinguishing between firms with a single bank relationship and firms with multiple bank relationships. Differences are tested for using a Chi-squared test of significant differences in the medians. First, the median firm with a single bank relationship is significantly smaller than the median firm with multiple bank relationships. Total assets amounts to 5 millions euros for the median firm with a single bank against 8.4 millions euros for the median firm with multiple bank relationships. Second, compared to the median firm with multiple bank relationships, the median firm with a single bank relationships also has significantly less bank debt (as a fraction of assets) (12% versus 18%), less long term bank debt (4.7% versus 7.3%), less short term bank debt (0%versus 4.7%) and less credit lines (7% versus 13.5%). The lower amount of credit lines for single bank relationship firms implies less liquidity buffer. This may make them more likely to be financially constrained, especially in case of

adverse liquidity shocks. Houston and James (2001) argue that the credit lines to asset ratio is a measure of 'slack' in the banking relationship. For large US listed firms, they find a median credit lines to asset ratio of 8% for firms with 1 bank relationship versus 11% for firms with multiple bank relationships. So more bank relationships are clearly associated with more bank debt and more 'slack' in the banking relationship. However the stylized fact that single bank relationship firms have less bank credit does not imply by itself that these firms are 'constrained' in any sense. Given a fixed cost of setting up a relationship, firms that are in less need of external finance may optimally choose to have just one bank. Third, there is no significant difference in the ratio of net trade debt (i.e. trade debt minus trade credit) over assets between firms with a single bank and firms with multiple bank relationships. This provides another indication that firms with a single bank are not necessarily constrained as one would expect that otherwise if they were constrained, they might combine lower bank debt with higher net trade debt. Fourth, the median firm with a single bank relationships is also slightly more profitable (with a profit to asset ratio of 13%) than the median multiple bank relationship firm (with a profit to asset ratio of 12%). This is not simply due to the fact that firms with a single bank have lower interest charges as they have lower bank debt. The last two rows of Table 2 shows that earnings before taxes is higher for firms with a single bank relationship, whether we include interest charges or not

Table 2 - Number of bank relationships size, financial ratios and profitability (medians)

	1 bank	> 1 bank	X^2	
assets (million euros)	5.099	8.447	211.45	***
bank debt/assets	0.121	0.181	69.35	***
LT bank debt/assets	0.047	0.073	32.09	***
ST bank debt/assets	0.006	0.047	106.60	***
unused lines of credit /assets	0.070	0.135	295.99	***
Net trade debt/assets	-0.078	-0.072	1.94	
profits/assets	0.134	0.124	13.78	***
EBIT/assets	0.052	0.045	15.56	***
EBT/assets	0.042	0.032	19.75	***

EBIT: earnings before interest and taxes, EBT: earnings before taxes
X^2 Chi-squared test of differences in the medians
*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

The role of bank relationships for the availability of bank finance is complicated by the fact that generally size is positively associated with the number of bank relationships. Ceteris paribus, larger firms have more bank relationships. This finding is quite robust and has been found also by Petersen and Rajan (1994) for U.S. firms, Ongena and Smith (2000) for a sample of very large firms in 20 European countries and Harhoff and Körting (1998) and Elsas and Krahnen (1998) for German firms. It can also be found in our dataset.

Firms with a single bank relationship should suffer less from asymmetric information problems. However small firms are generally associated with more asymmetric information problems. It is therefore possible that small firms endogenously choose more often to just have 1 bank relationship. In essence whereas their size makes them more vulnerable to asymmetric information problems, they can try to alleviate this by having one strong bank relationship.

In the literature there have been suggested a number of explanations for the positive association between firm size and the number of bank relationships. First, the cost of information gathering could be lower for larger firms, so that the advantages of a single bank relationship may be lower for large firms. Second, the gain of multiple banks becomes higher as firms having ties to multiple banks, firms may be better able to solve the hold-up problem, i.e. reduce the monopolistic power of a single bank. Third, given that the nominal amount of lending should increase with firm size, banks themselves may favour syndicated credits for risk reduction purposes. Fourth, larger firms might need more specialized services and have different specialized banks for different services.

However, it should be emphasized that having multiple bank relationships is certainly not a perfect proxy for size. Table 3 shows that for firms with assets below 4 million euros, the occurrence of a single bank relationship is 34%. The occurrence of a single bank relationship declines gradually as firms get larger. However still 11% of the firms with assets above 16 million euros have only 1 bank relationship. Further evidence that the number of bank relationship is not a proxy for size is given in Appendix. Table A.1. reports a Probit regression for having a single vs. multiple bank relationship. These estimations confirm that, in general, larger firms tend to have multiple bank relationships. In addition, firms with multiple bank relationships also have lower investment rate, less cash flow but larger credit lines, as well as higher bank debt.

Table 3 - Size and a single bank relationships

	number of observations	% of firms with 1 bank
assets <= 4	1788	0.34
4 < assets <=8	2593	0.19
8 < assets <=16	1848	0.14
16 < assets	2186	0.11
entire sample	8415	0.19

Table 4 below provides a first examination of the relationship between the amount of bank credit firms have and the number of bank relationships and/or the size of the firm. Given the correlation

between number of bank relationships and size, the positive relationship between bank debt over asset and bank relationships found in table 2 could potentially be spurious if it is truly size that matters for access to bank finance. To check this, we regress the ratio of bank debt over assets on bank relationship and size dummies. We define 4 bank relationship dummies (D2, D3, D4 and D5P, signifying 2, 3, 4 and 5 or more bank relationships respectively) and 3 size class dummies (DSIZ4_8, DSIZ8_16 and DSIZ16 signifying asset size between 4 and 8 million, between 8 and 16 million euros and more than 16 million euros). Table 4 reports the results of the OLS regression of bank debt over assets on those 7 dummies. The first column presents the results without industry dummies; the second column includes time and industry dummies. The constant term of the regression represents the average bank debt over assets ratio for firms with a single bank relationship and the smallest size (below 4 millions euros).

Table 4 - Bank debt as a function of bank relationships and size

OLS results Dependent variable: bank/assets						
	coef.	std err		coef.	std err	
c	0.165	25.53	***	0.126	14.71	***
D2	0.012	2.50	***	0.010	2.15	**
D3	0.026	4.96	***	0.029	5.63	***
D4	0.051	8.03	***	0.055	8.93	***
D5P	0.053	4.86	***	0.064	5.97	***
DSIZ4_8	0.009	1.67	*	0.009	1.87	*
DSIZ8_16	0.027	4.78	***	0.025	4.56	***
DSIZ16	0.000	0.07		-0.001	-0.21	

8415 observations. All equations include time dummies
*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level

The regression results in table 4 show that firms have statistically significantly more bank debt (relative to assets) the more bank relationships they have, *controlling for size*. The difference is also economically significant. Whereas the smallest single bank relationship firms have a ratio of bank debt to assets of 0.17, the same small firms have a bank debt ratio of 0.18 if they have 2 bank relationships, 0.195 if they have three relationships and 0.221 if they have 4 relationships. Note that one should not necessarily interpret this result as if by increasing the number of banks relationships, firms are able to increase the amount of bank debt they carry. The causality could run the other way. Some firms might not be able to increase the number of bank relationships they have. And firms that want (and have access!) to have more bank debt may endogenously choose to have more banks, i.e. want to avoid having only a single relationship when increasing bank debt.

Also size is associated with bank debt, controlling for bank relationships. Firms that have assets lower than 4 million do not have significantly less debt than firms with assets above 4 but below

8 million. The amount of bank debt increases by 0.027 for firms between 8 and 16 million. It declines again for firms larger than 16 million euros of assets to the level of the firms below 8 million euros. So only medium sized firms between 8 and 16 million assets have higher bank debt. One possible explanation is that the smallest firms are quantity constrained in obtaining bank finance. As firms expand and get larger they are able to obtain more bank debt. The largest firms however, likely have access to other sources of finance besides bank debt, such as equity or bond debt. The finding that the largest firms have less bank debt is consistent with the findings in Houston and James (1996) that bank borrowing decreases in size for large publicly traded US firms.

4. Adverse cash flow shocks, investment and bank relationships

The results above have shown that firms with a single relationship have on average less bank debt; however this does not imply that they are more financially constrained. This section uses a test along the lines of Fazzari et al (1988)[8] to check whether firms experience different degrees of financial constraints in periods of adverse cash flow shocks than in normal business conditions, and whether there are differences between firms with a single bank and firms with multiple bank relationships. Based on the idea that when firms have limited access to external sources of finance, investment depends more extensively on internally generated liquidity (i.e. cash flow), the test interprets differences in the cash flow sensitivity of investment as evidence of differences in the degree of financial constraints. We estimate an error correction model for investment, as in Bond et al.(2003) or Mairesse et al.(1999)[9]

$$I_{it}/K_{it-1} = \delta_i+\delta_t+\alpha_1.I_{it-1}/K_{it-2}+\alpha_2.\Delta y_{it}+\alpha_3.\Delta y_{it-1}+\alpha_4.CF_{it}/K_{it-1}+\alpha_5.(y_{it-2}-k_{it-2})+\varepsilon_{it} \quad (1)$$

where I_{it}/K_{it-1} is the investment rate, Δy_{it} is sales growth, CF_{it}/K_{it-1} is the cash flow to capital ratio and $(y_{it-2}-k_{it-2})$ is the log of the output to capital ratio. We first estimate (1) to check whether in our dataset firm investment spending is sensitive to cash flow fluctuations irrespective of whether adverse cash flow shocks have occurred or not and irrespective of whether firms have a single or multiple bank relationships, i.e. we test whether α_4 is positive. Interacting the cash flow variable with a dummy D_1, indicating the presence of only 1 bank relationship provides a test whether firms that

8 Alternative strategies have been used. One is based on the Q theory of investment, and amounts to estimate the cash flow sensitivity of investment in a Q equation. We can not follow this line of research because that would restrict our sample to quoted firms alone.

Another strand of the literature uses a more structural approach that consists in estimating the Euler equation that would prevail when the firms are financially unconstrained. Rejection of the intertemporal equilibrium is taken as evidence of financial constraints. However, rejection of the Euler equation may not only be due to financial constraints but also to a misspecification of the underlying theoretical model.

9 A more general specification would allow for the lagged cash flow-capital ratio. However, preliminary estimates suggests that due to colinearity this broader specification produces insignificant coefficients.

have 1 bank relationship are subject to stronger financial constraints than firms with multiple relationships. We test first if during times of adverse cash flow shocks, sensitivity to cash flow is higher (irrespective of bank relationships). We then test whether bank relationships matter during times of adverse cash flow shocks.

Evaluating the degree of financial constraints by comparing the cash flow sensitivity of investment across different subsamples has become standard in the literature. However, it has been criticised on several grounds. First, it has been argued that because cash flow may proxy for future profits or future sales, finding a positive cash flow sensitivity of investment cannot be taken as evidence of financial constraints. We examine this issue along the lines of Bond et al (2003). In table A.2. in the appendix we find no evidence that cash flow helps to forecast future sales growth. Further, there is no a priori reason why cash flow should proxy differently for profit in single versus multiple bank relationship firms, whereas it is the difference in the cash flow sensitivity that is interpreted as evidence in favour of financing constraints. Our estimates of forecasting models of sales growth, in the spirit of Bond et al. (2003), show weak evidence of cash flow proxying for future profits. Second, Kaplan and Zingales (1997, 2000) and Cleary (1999) show that firms that are classified as the most financially constrained are less sensitive to cash flow. This is consistent with the finding of Allayannis and Mozundar (2004) that financially distressed firms - identified as firms with negative cash flows - become insensitive to cash flow fluctuations. This suggests that the relation between the degree of financial constraints and the cash flow sensitivity of investment may not be monotonic but rather concave, i.e. increasing with the degree of financial constraints and then decreasing in case of financial distress. As explained in section 3, we clean our sample for distressed firms; we are therefore confident that in our sample negative cash flow shocks are not synonymous of financial distress. Rather they capture times of stronger liquidity rationing.

All equations are estimated with fixed effects and time dummies. We consider all variables as endogenous. We use the System GMM estimator of Arellano and Bover (1995) and Blundell and Bond (1998)[10]. Standard errors of the coefficients are corrected for small sample bias using Windmeijer (2004)'s correction[11]. In the investment equation, the instrument set for the difference equation is the Arellano-Bond matrix for I_{it-2}/K_{it-3}, I_{it-3}/K_{it-4}, stacked Δy_{it-2}, Δy_{it-3}, CF_{it-2}/K_{it-3}, CF_{it-3}/K_{it-4}, $(y_{it-2}-k_{it-2})$ and $(y_{it-3}-k_{it-3})$[12]. The instrument set for the level equation are Arellano-Bond matrices for $\Delta(I_{t-1}/K_{t-2})$, $\Delta\Delta y_{t-1}$, $\Delta(CF_{t-1}/K_{t-2})$, $\Delta(y_{it-2}-k_{it-2})$. When the equations are estimated with interactions terms we also include the dummies in the instrument set. Table 5 provides a summary of the variables used in the regression.

10 Blundell and Bond (1998) show that the first-differenced GMM estimator of Arellano and Bond (1991) suffers from small sample biases and low precision, and that exploiting the additional moment conditions of the system-GMM estimator allows to substantially improve the estimators.

11 The second-step estimator of SGMM typically underestimates the true standard errors.

12 We restrict the number of lags in the instrument set to avoid potential overfitting problems.

Table 5 - investment equations variables

	single bank relationship			multiple bank relationships.		
	Mean	Std	median	mean	std	median
I_t/K_{t-1}	0.12	0.19	0.06	0.11	0.15	0.07
$\log(Y_t/Y_{t-1})$	0.03	0.14	0.02	0.03	0.13	0.03
CF_t/K_{t-1}	0.26	0.43	0.16	0.25	0.33	0.16
Y_t/K_{t-1}	6.45	9.56	2.97	5.82	8.58	3.06

Table 6 reports the SGMM estimates of equation (1). The Sargan, m1 and m2 statistics report no misspecification or identifying restriction bias. All coefficients have the expected sign. The error correction term is not significant. First we estimate equation (1) for the full sample. The cash flow coefficient is high and significant at 0.19 indicating that in the full dataset, investment is sensitive to cash flow. In the second column, we test whether cash flow sensitivity is lower for firms with a single bank. The coefficient of the interaction term $D_1.CF_{it}/K_{it-1}$ is negative at -0.10, but it is imprecisely estimated and not significantly different from zero. The results indicate that, irrespective of adverse cash flow periods, there is no significant difference in the degree of financial constraints for firms with a single relationship versus firms with multiple bank relationships.

It could be however that financial constraints are stronger in periods of adverse liquidity shocks.
If bank relationships are valuable, they should be most valuable in times of adverse cash flow shocks. Adverse cash flow shocks reduce the internal liquidity available for firm investment spending. In these periods, a single bank relationship could be more valuable and should lead to easier restoring of liquidity. Firms that are able to increase external finance should reduce investment spending by a lower extent. The findings of Petersen and Rajan (1994), Harhoff and Körting (1998) and Cole (1998) indicate that the availability of bank debt is higher for firms with a single bank relationship. On the other hand however the findings by Houston and James (2001) imply the contrary.

We first check, in column (3) whether cash flow sensitivity is higher in periods of adverse cash flow shocks. The interaction term between the dummy for adverse cash flow shocks and the cash flow-capital ratio is high, positive and significant at 0.29. The coefficient in front of CF_{it}/K_{it-1} which now measures cash flow sensitivity outside periods of adverse shocks turns to zero. So the estimates suggest that financial constraints bind mainly in bad times.

Finally, we test whether having a single bank allows reducing financial constraints in these periods. We introduce an interaction term with both a dummy for adverse cash flow shocks and a dummy for a single bank relationship. The results indicate that the number of bank relationships is irrelevant for

the degree of financial constraints, both in periods of normal cash flow fluctuations and in periods of adverse liquidity shocks. So our results indicate that firms with a single bank relationship do not face stronger financial constraints than firms with multiple bank relationships, both in periods of normal cash flow fluctuations and in periods of adverse cash flow shocks[13].

Table 6 - Estimates of the investment equation with cash flow-capital ratio

	coef	tstat		coef	tstat		coef	tstat		coef	tstat	
constant	0.04	2.69	***	0.04	2.22	**	0.08	4.02	***	0.12	3.05	***
I_{it-1}/K_{it-2}	0.07	2.40	**	0.06	2.34	**	0.06	1.79	*	0.09	1.57	+
Δy_{it}	0.22	0.81		0.21	0.81		0.20	0.64		0.37	1.15	
Δy_{it-1}	0.06	1.94	**	0.05	1.91	*	0.05	1.64	*	0.05	1.42	
CF_{it}/K_{it-1}	0.19	2.96	***	0.22	3.78	***	0.00	-0.03		-0.11	-0.83	
$D_{bad}.CF_{it}/K_{t-1}$							0.29	2.60	***	0.45	2.39	**
$D_1.CF_{it}/K_{it-1}$				-0.10	-1.04					0.21	1.12	
$D_1.D_{bad}.CF_{it}/K_{it-1}$										-0.37	-0.82	
$(y-k)_{it-2}$	0.00	-0.49		0.00	-0.65		0.00	0.33		0.00	0.35	
D_{bad}							-0.05	-1.60	+	-0.22	-1.64	*
D_1				0.03	1.18					-0.17	-1.47	
$D_1.D_{bad}$										0.66	1.45	
		p-value			p-value			p-value			p-value	
Sargan	37.08	0.21		35.61	0.22		30.75	0.43		19.90	0.80	
m_1	-7.97	0.00		-8.09	0.00		-8.26	0.00		-4.31	0.00	
m_2	-0,61	0,54		-0,57	0,57		-0,37	0,71		1,10	0,27	

Second step system GMM estimates with Windmeijer (2000) 's corrected t-stat Second step Sargan. All estimations include time dummies. As to the difference equation, we use Arellano-Bond instrument matrix for I_{t-1}/K_{t-2} to I_{t-2}/K_{t-3}, stacked Δy_{t-1}, Δy_{t-2}, CF_{t-1}/K_{t-2}, CF_{t-2}/K_{t-3}, $(y_{t-1}-k_{t-1})$ $(y_{t-2}-k_{t-2})$ As to the level equation, we use Arellano-Bond instrument matrix for $\Delta I_t/K_{t-1}$, $\Delta\Delta y_t$, $\Delta(y_{t-1}-k_{t-1})$, D_{bad} is a dummy that is equal to 1 when $\Delta(CF/K)$ is below the first quartile. D_1 is a dummy that is equal to 1 if the firm has a single bank relationship
*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level

We find that the number of bank relationship does not affect the degree of financial constraints, either in normal times or in case of adverse liquidity shocks, for the firms in our sample. This contrasts with previous findings that bank relationships allow to smooth financial constraints (see,

13 The interaction term between D_1 and D_{bad} may be insignificant for two reasons. First, only 4% of the observations relate to firms with a single bank relationship in periods of adverse cash flow shocks (by construction 25% of the observations experience adverse cash flow shocks, and 15% of the firms have a single bank relationship). Second, the lack of significance may reflect heterogeneity across firms with a single bank relationship. Having a single bank may reflect the strategic choice of a firm with sufficient financing from other sources (own funds, equity ...). Alternatively, firms may be restricted to a single bank due to financial constraints. These two cases will of course have very different implications for financial constraints, so that the coefficient turns insignificant The next sections indeed highlight two opposite cases in how firms adjust their financing in response to the adverse liquidity shock (some firms can compensate for the liquidity drop through increased (bank) debt, while some others experience a reduction in external credit in addition to the adverse cash flow shock).

for instance, Elston, 1998, Garcia-Marco and Ocafia, 1999, Hoshi et al, 1991[14]). Further, contrary to Suzuki and Wright (1985), Elsas and Krahnen (1998), Berlin and Mester (1998), we do find no evidence that bank relationships allows the firm to escape financial constraints in exceptional times[15].

5. How do firms manage periods of adverse liquidity shocks as a function of bank relationships

The results in the above section show that financial constraints bind in periods of adverse cash flow shocks, but reveal no difference in cash flow sensitivity of investment between firms with a single versus multiple bank relationships. We now examine in more detail how firm's investment and financing respond to adverse cash flow shocks as a function of bank relationships. In line with the above results we expect little difference between firms with a single versus firms with multiple bank relationships.

In the analysis we make a distinction between firms that increase bank debt following the adverse shock and firms that decrease bank debt. Extra financing should be associated with higher investment, irrespective of bank relationships. Also, if net trade debt is a substitute for bank debt, one should expect net trade debt to increase when bank debt decreases and vice versa, again irrespective of bank relationships.

Our main focus is on testing whether firms with a single versus firms with multiple bank relationships obtain different amount of credit at times of adverse cash flow shocks, *conditional on either increasing bank debt or decreasing bank debt*. Table 7 reports the median value of the changes in bank debt, trade debt and investment over the absolute value of the change in cash flow, in periods of adverse cash flow shocks. The absolute value of the change in cash flow signifies the amount of loss in liquidity and is used to standardize the changes in bank debt, trade debt and investment. Table 7 also reports indicators such as size (total assets), profitability as measured by

14 Hoshi et al (1991) find that investment of Japanese firms belonging to a keiretsu is less sensitive to liquidity. Elston (1998) shows that, in Germany, the cash flow sensitivity of investment is lower for firms in which banks have a high direct equity stake. Garcia-Macro and Ocafia (1999) show that the neoclassical model, without financing constraints, holds for Spanish firms in which banks have a high ownership, while it fails to represent the other firms.

15 Suzuki and Wright (1985) argue that in Japan keiretsu members benefit from rescue operations from banks of the group that reduce their bankruptcy risk. Elsas and Krishnan (1998) show that house banks provide liquidity insurance to their clients. They increase their credit to their clients when they experience a (small) unexpected drop in credit rating, while, on the contrary, other banks will reduce their credit to firms. Also, Berlin and Mester (1998) argue that, in case of interest rate shocks, banks may smooth interest rate fluctuations for clients with which they maintain strong relationships, and even reallocate their credits towards them.

profits over assets, and debt ratios the beginning of the period, i.e. just before the adverse cash flow shock. We first use a Chi-squared test of significant differences in the medians.

Table 7 - Median change in debt and investment over the absolute value of cash flow change in case of large negative cash flow shocks

	Δ(bank debt)				**Δ(bank debt)>0**				**Δ(bank debt)<0**			
	>0	<0	X^2		1 bank	>1 bank	X^2		1 bank	>1 bank	X^2	
# obs	690	718			107	583			152	566		
changes in financing and expenditures over the absolute value of the change in cash flow												
Δ(bank debt)/| ΔCF|	0.893	-0.644	1353	***	0.508	0.924	2.49		-0.695	-0.641	0.03	
Δ(net trade debt)/| ΔCF|	-0.114	0.141	9.56	***	-0.011	-0.141	0.90		0.067	0.153	0.83	
Δ(bankdebt+nettrade debt)/| ΔCF|	0.807	-0.631	198.1	***	0.672	0.815	0.28		-0.689	-0.604	0.53	
Δ(investment)/|CF|	-0.080	-0.201	12.38	***	-0.032	-0.086	0.28		-0.216	-0.198	0.13	
initial values (t-1)												
assets (million euros)	8.951	7.583	7.11	***	4.943	9.501	10.63	***	5.974	8.037	6.54	**
profits/assets	0.135	0.140	1.14		0.134	0.136	0.01		0.142	0.140	0.00	
credit lines/assets	0.144	0.117	11.64	***	0.097	0.154	12.05	***	0.066	0.131	26.17	***
leverage	1.661	1.537	1.64		1.846	1.601	3.99	**	1.265	1.611	5.64	**
Net trade debt/assets	-0.081	-0.093	1.92		-0.106	-0.077	1.87		-0.088	-0.094	0.13	
bank debt/assets	0.133	0.172	13.14	***	0.076	0.141	3.99	**	0.160	0.175	0.13	

X^2 is a Chi-squared test of differences in the medians
* significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level
1408 observations

A first finding is that following an adverse cash flow shock, approximately one half of the periods (690), firms benefit from an increase in bank debt while the other half of the periods (718) firms experience a reduction in bank credit, which reduces the available finance further. Firms that experience a cut in bank debt significantly increase debt from their trade partners (a median increase of 0.14 as a fraction of the drop in cash flow). Likewise firms that increase bank debt reduce their reliance on trade debt significantly (a median drop of 0.11 as a fraction of the drop in cash flow). The substitution of bank debt by trade debt indicates that the financing behaviour in times of adverse cash flow shocks is at least partially explained by supply of credit by banks rather than simply a demand reaction by firms. Indeed if trade debt is more expensive than bank debt as suggested by Petersen and Rajan (1994), the substitution behaviour evidenced here can be explained by rationing of bank debt during adverse cash flow shocks. Firms that benefit from increases in bank lending, obtain extra credit that compensate for 89 percents of the reduction in cash flow. Still, they cut investment by 0.08 of the reduction in cash flow. Firms that, in addition to the liquidity shortfall experience reductions in bank credit and do not compensate for this through a

sufficiently high increase in trade debt, so that the total amount of credit diminishes, reduce their investment spending by a much higher 0.20. What distinguishes the groups that increase and decrease bank lending is their size and initial bank lending. Firms that benefit from a compensation in bank debt following the large negative cash flow shock are significantly larger and have a significantly lower initial bank debt over assets ratio. This is consistent with banks being more willing to lend to larger firms and firms with initially low leverage, especially in periods of adverse shocks.

The last columns of Table 7 reveal that there are no significant differences between firms with a single bank relationship and firms with multiple bank relationships with respect to the size of changes in bank debt and trade debt and investment following an adverse cash flow shock. The amount of extra credit (or credit cuts) is of the same order of magnitude whether the firm has a single bank or multiple banks relationships. Note that firms may look for additional banks in order to compensate for the liquidity shortage[16]. Results in Table 7 consider the *current number of bank relationships*; so if firms that have a single bank before the cash flow shock augment their number of bank relationships, they will be characterised as having multiple bank relationships.

The significant cash flow sensitivity and the substitution of bank debt by trade debt during times of adverse cash flow shocks indicate that financial constraints bind. Having a single or multiple bank relationships however does not seems to affect the degree of financial constraints. In case of adverse liquidity shocks, larger firms and firms with initially lower bank-debt over assets ratio (partly) compensate the cash flow shortfall through extra bank credit. Smaller firms and firms with higher initial bank debt experience a reduction in external finance in addition to the cash flow drop. They also cut their investment spending more severely. There is no significant difference between firms with a single and multiple bank relationships in the increase in debt following an adverse liquidity shock, conditional on obtaining extra credit. The next section examines more precisely what determines the probability of obtaining extra bank debt, in the spirit of Cole (1998). We specifically examine how this probability is modified by the occurrence of large negative cash flow shocks, and by the number of bank relationships.

16 This is supported by a Probit estimation on the probability of going from one to multiple bank relationships. The results presented in Table A.3 in the appendix suggest that firms opt to multiple bank relationships when sales and investment are stronger, and also when they experience a large negative cash flow shock.

6. What explain the probability of obtaining extra bank debt in periods of adverse cash flow shocks

The main question we are interested in is whether single bank relationship firms significantly change their probability of obtaining extra credit in bad times. If a single bank relationship is important during bad times, one would expect that credit would be more often granted during those bad times. We use a probit estimation to estimate the probability of obtaining extra bank debt along the lines of Cole (1988) during normal times versus times of adverse cash flow shocks. Our explanatory variables are firm's size, initial level of bank debt over assets, initial cash flow over assets, the initial level of credit lines over assets and a dummy for a single bank relationship. We also include time dummies and industry dummies. Table A.4 in appendix reports the estimation of the Probit model with random effects; the coefficient are of the same order of magnitude. We expect larger firms to have a higher probability to obtain extra credit, as banks should be more willing to lend to large firms with low leverage. We expect a higher cash flow over assets to reduce the probability of obtaining extra credit, since more liquid firms should have less need for extra credit. Bank credit has an ambiguous effect. As Cole 1988) argue, increasing credit to a firm allows the bank to acquire additional information about the firm; it may therefore facilitate access to additional credit. On the other hand, it augments leverage, which tends to reduce access to extra finance. Therefore, bank debt over assets may have an ambiguous effect on the probability of obtaining extra bank debt. This is not the case for credit lines, since they do not induce an increase in leverage (as long as they are not utilised), so only the first effect may be at play. Consequently, we expect that higher credit lines have a positive impact on the probability of obtaining extra bank debt. And we test formally if during adverse cash flow shocks single bank firms have a different probability of obtaining extra credit.

Table 8 - Probit model : Probability of obtaining extra bank debt in normal times and during periods of adverse cash flow shocks

Dependent variable: D(∆bank>0). All equations include time and industry dummies

		entire period				**bad times**			**entire period**	
	marginal	coef.	std err		marginal	coef.	std err		marginal	coef.	std err	
$size_{it-1}$	0.01	0,04	0,02	**	0.02	0.05	0.03	*	0,01	0,03	0,02	**
bank debt/A_{it-1}	-0.38	-0,97	0,11	***	-0.49	-1.27	0.23	***	-0,35	-0,90	0,12	***
credit lines/A_{it-1}	0.21	0,53	0,10	***	0.27	0.69	0.22	***	0,19	0,48	0,12	***
CF_{it-1}/A_{it-1}	-0.22	-0,57	0,23	***	-0.55	-1.42	0.44	***	-0,17	-0,45	0,27	*
D_1	-0.06	-0,15	0,05	***	-0.08	-0.22	0.09	**	-0,05	-0,14	0,05	***
D_{bad}*$size_{it-1}$									0,01	0,01	0,01	**
D_{bad}*bank debt/A_{it-1}									-0,10	-0,26	0,25	
D_{bad}*credit lines/A_{it-1}									0,08	0,20	0,24	
D_{bad}*CF_{it-1}/A_{it-1}									-0,29	-0,74	0,48	
D_{bad}*D_1									-0,02	-0,05	0,10	
Log L		-4017				-931				-4013		
# obs		5956				1408				5956		

D_1 is a dummy that is equal to 1 if the firm has a single bank relationship
D_{bad} is a dummy that is equal to 1 when ∆(CF/K) is below the first quartile
marginal : Marginal effects are computed for firms with multiple bank relationship in 2002 in the food industry
* significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level

Our first regression shows that over all periods (both normal and bad times), the probability of obtaining extra bank debt is higher for larger firms with lower bank debt over assets ratio, higher credit lines, confirming the earlier results. In addition, the probability of obtaining extra bank debt is higher for firms with lower cash flow. Also firms with a single bank relationship have a lower probability to obtain bank credit. This is consistent with the evidence given in Table 1 that for firms with a single bank relationship, banks are not their most important source of finance (they have lower bank debt in percentage of their total assets). This contrasts with the finding of Cole (1998) that firms with multiple sources of financial services have a lower probability of receiving credit.

In the second regression the results indicate that during adverse cash flow shocks period, the same results hold. Large firms with low leverage and higher credit lines are more likely to obtain credit. Although it is possible that firms that are larger and have less bank credit endogenously demand more credit in normal times and during adverse cash flow shocks, a more likely interpretation is that in general, banks are more willing to extend their credit to firms that are larger and that are not too highly bank indebted. Finally, firms with a single bank relationship have a lower probability of obtaining extra bank debt in bad times, controlling for size and initial liquidity.

In principle times of adverse cash flow shocks should be times where extra credit is demanded. A priori the increase in demand should not be different for single bank and multiple bank relationship firms. If single bank relationship firms are better shielded from adverse cash flow shocks by their bank than multiple bank relationship firms, one should expect that the probability of obtaining extra bank debt for single bank relationship firms to go up during adverse cash flow shocks. We test whether the probability *changes* during times of adverse cash flow shocks compared to normal times. Our findings are in column (3). The only factor that significantly increases the probability of obtaining extra credit in bad times versus normal times is size. Larger firms are more likely to obtain extra credit. We interpret this as consistent with larger firms facing less asymmetric information problems during adverse cash flow shocks. Single bank relationship firms do not show a different probability of obtaining credit during times of adverse cash flow shocks. So size and not bank relationships seem to matter in times of adverse cash flow shocks.

7. Conclusion

This paper examines how firms do adjust their investment and financing in periods of adverse liquidity shocks, and whether having a single versus multiple bank relationships influences investment and financing outcomes. We analyse these questions for a sample of medium and large firms over the period 1997-2002.

Our results may be summarised as follows. First, interpreting differences in the cash flow sensitivity of investment as differences in the degree of financial constraints (following Fazzari et al, 1988), we identify periods where financial constraints become binding as periods of large negative cash flow shocks. We find that the number of bank relationships does not influence the degree of financial constraints the firm faces.

Second, we provide evidence that, in some case, firms may compensate for this thanks to increased lending from their creditors. In particular, firms that benefit from additional bank credit reduce their investment spending by a much lower extent. However, in some other cases, the negative effect of these events on firm's investment is reinforced when lenders cut their credit to firms. This forces firms to reduce their investment spending strongly. The number of bank relationships has no significant effect on the amount of debt received, conditional on obtaining additional credit.

Third, our Probit regressions suggest that the probability of obtaining extra bank debt is higher for larger firms, for firms with lower bank debt to assets ratio and for firms that can rely on several banks. In case of adverse liquidity shocks, the probability of obtaining extra bank debt is lower, and

banks may be more reluctant to provide additional credit to smaller and more levered firms, but having a single bank does not modify the probability of obtaining extra bank debt as compared to normal business fluctuations.

All in all, we find no strong evidence that the number of bank relationships influence investment and financing decisions. Having a single bank relationship does not affect the degree of financial constraints. Investment behaviour is identical for firms with a single bank and firms with multiple bank relationships. This holds in normal times as well as in periods of adverse liquidity shocks. Having a single bank relationship reduces the probability of obtaining increases in bank credit, but the probability for single bank firms is not lower in bad times When financial constraints bind, in periods of adverse liquidity shocks, they obtain the same amount of bank debt as firms with multiple bank relationships (conditional on the probability of obtaining extra bank credit). In addition, they may turn to trade debt. In case of adverse liquidity shocks, what really impedes investment in these periods is when firms cumulate a drop in cash flow and a contraction of external bank credit. The second depends more on the size and initial leverage of the firm than on the number of bank relationships.

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Appendix

Data appendix

The main variables of our analysis are defined as follow. Output is defined by turnover. Cash flow is defined as the sum of net profits, depreciation, changes in investment grants, changes in provisions and deferred taxes, amounts written off on stocks and contracts on progress and on trade debt, and adjusted for relevant financial charges. We use value added and investment prices to obtain real series.

For the construction of the capital stock, we distinguish between five different types of capital goods: (1) land and buildings, (2) plant and machinery, (3) furniture and motor vehicles, (4) leasing, and (5) other. For each of these capital goods and each sector we construct the capital stock in the following way. We use the perpetual inventory method to construct the real capital stock, i.e.:

$$\overline{K_t} = \overline{K_{t-1}} .(1-\delta) + p_t.I_t/p_t$$

We use the industry-specific price index of investment goods provided by the National Accounts, in which the price index at 1995 is equal to one. Nominal investment is the sum of several factors, each of which is deflated by the investment price index of the time at which the investment was made. In particular, the acquisition of tangible assets in the current year is deflated by current prices, but sales and the disposal of old capital are deflated by the prices related to the age of this capital.[17] The initial nominal capital stock at historical prices in t is equal to the sum of all acquisitions of new capital minus (accumulated) depreciation over the entire history of the firm up to t-1. The real initial capital stock is obtained by deflating the initial nominal capital stock with investment prices related to the age of the capital stock.[18] We construct depreciation rates by sector and type of capital good, based on the lifetimes of the capital goods reported in the National Accounts.

We define bank relationship across the range of all bank products. Firm i has a relationship with bank j in period t, if bank j provides credit or short-term facilities or collateral to firm I in year t. Developing a bank relationship through some bank products may facilitate access to (long-term) credit when necessary. In addition, although the natural way to finance fixed investment is through long-term debt or equity issues, it appears that some firms have no long-term debt at all, and

17 The average age of sold and used capital is estimated from the annual accounts information on depreciation. Details will be provided by the authors on request.

18 This is again inferred from annual accounts information on depreciation.

finance their investment through other sources. This is another reason to consider a broader range of products that long-term credit alone. We therefore think the relevant definition of bank relationship should cover all types of bank products, long-term credit, short-term credit, credit lines, collateral, ….

The data is trimmed as follow. We focus on profit maximising firms, that is we exclude foreign and public companies and non-profit associations. We consider only annual accounts going from January to December in order to ensure consistency with price indexes (constructed over the entire year) and consistency between units[19]. We also exclude a couple of observations that concerned firms that lose a bank relationship due to a bank merger; this concerns only 1% of the original sample. I/K, CF/K, □y Y/K and financial ratios are trimmed by P5-P95 year by year. For estimation purposes, we retain only firms that exist for at least 7 consecutive years

Determinants of the probability of a single vs. multiple bank relationship

Table A.1. reports the Maximum Likelihood estimates of a Probit model for having a single multiple bank relationships. The first column reports the estimates with time dummies and no random effects. The second takes into account individual heterogeneity by including random effects. The results show that firms that are larger and with less cash flow tend to have multiple bank relationships rather than a single one. They are also characterised by higher bank credit over total assets, both in the form of bank debt and in the form of credit lines.

Table A.1 - Probit model for multiple bank relationships

Dependent variable:D(>,ıbanks) 7207observations. All equations include time dummies								
	no random effects				with random effects $\upsilon_i \sim N(0,\sigma_\upsilon^2)$			
	coef	std	p-value		coef	std	p-value	
I_{it-1}/K_{it-1}	-0.31	0.10	0.00	***	-0.39	0.27	0.16	
$size_{it}$	0.47	0.04	0.00	***	0.45	0.00	0.00	***
CF_{it}/K_{it-1}	-0.30	0.05	0.00	***	-0.58	0.16	0.00	***
credit $lines_{it}/K_{it-1}$	0.22	0.03	0.00	***	0.67	0.33	0.04	**
bank $debt/assets_{it}$	0.50	0.20	0.01	***	0.36	0.45	0.43	
$\sigma\upsilon^2$					16.29	0.45	0.00	***
Log L	-3445.06				-2121.15			

* significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level

19 In some cases annual accounts refer to only a part of the year (for seasonal activities for example). In some other case, the period covered is spanned over several years. For instance in 1997 a firm reports for the period August 1996 to July 1997.If, for the future she wants to report for the period from January to December. Then in 1998, she will report from August 1997 to December 1998.

Predictive power of cash flow for future sales growth

Table A.2. below reports simple forecasting models for future sales growth, along the lines of Bond et al. (2003). The aim is to test whether our finding of a positive cash flow coefficient in the investment equation (1) is due to cash flow proxying for future profits rather than to financial constraints. We estimate an autoregressive model for sales growth, through least squares with time and industry dummies as well as with the system GMM estimator (as in the investment equation). There is no robust evidence that cash flow is predictor of future sales growth. This suggests that we may be confident on our interpretation that an excessive sensitivity of investment to cash flow is an indication of financial constraints.

Table A.2 - Predictive power of cash flow for future sales growth

Dependent variable: Δy.. All equations include time dummies

	LS with time and industry dummies			LS with time and industry dummies			SGMM estimation			SGMM estimation		
Parameter	coef.	std err		coef.	std err		coef.	std err		coef.	std err	
C	0.051	11.91	***	0.061	7.24	***	0.050	10.12	***	0.037	4.12	***
I_{it-1}/K_{it-2}	0.060	5.24	***	0.046	4.11	***	0.016	1.21		0.019	1.08	
I_{it-2}/K_{it-3}				0.036	3.60	***				0.017	1.06	
Δy_{it-1}	-0.010	-0.65		-0.060	-3.86	***	-0.068	-3.38	***	-0.076	-2.87	***
Δy_{it-2}				0.001	0.06					-0.025	-1.03	
CF_{it-1}/K_{it-2}	-0.008	-1.70	*	0.001	0.14		0.017	1.56		0.033	1.44	
CF_{it-2}/K_{it-3}				-0.004	-0.59					0.029	2.21	**
								p-value			p-value	
Sargan							39.739	0.04		30.252	0.14	
m_1							-20.321	0.00		-19.587	0.00	
m_2							-1.970	0.05		-1.510	0.13	

* significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level

Determinants of the probability of going from a single to multiple bank relationship

Table A.3. reports the Maximum Likelihood estimates of a Probit model for having a single vs. multiple bank relationships. The first column reports the estimates with time dummies and no random effects. The second takes into account individual heterogeneity by including random effects. The results show that are larger and with less cash flow tend to have multiple bank relationships rather than a single one. They are also characterised by higher bank credit over total assets, both in the form of bank debt and in the form of credit lines.

Table A.3 - Probit model for changes from 1 to multiple bank relationships

Dependent variable:D(>.ıbanks) 7207observations. All equations include time dummies												
	no random effects			no random effects			with random effects $\upsilon_i \sim N(0,\sigma_\upsilon^2)$			with random effects $\upsilon_i \sim N(0,\sigma_\upsilon^2)$		
Parameter	coef.	std err		coef.	std err		coef.	std err		coef.	std err	
Δy_{it}	0.53	0.24	**	0.62	0.24	***	0.53	0.24	**	0.62	0.24	***
$\Delta(CF_{it}/K_{it-1})$	-0.32	0.10	***	-0.15	0.12		-0.32	0.10	***	-0.15	0.12	
I_{it-1}/K_{it-1}	0.44	0.14	***	0.40	0.14	***	0.44	0.14	***	0.40	0.14	***
$size_{it-1}$	-0.16	0.03	***	-0.16	0.03	***	-0.16	0.03	***	-0.16	0.03	***
D_{bad}				0.24	0.08	***				0.24	0.08	***
Log L	-862.9			-858.1			0.00	0.00	***	0.00	0.00	***

* significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level

Estimates of the probit model for the probability of an increase in bank debt, with random effects

Table A.4. reports the Maximum Likelihood estimates of the Probit model of section VI, with time dummies and random effects. The coefficients are of the same order of magnitude as in Table 8. As before, having a single bank relationship reduces the probability of receiving extra bank debt.

Table A.4 - Probability of obtaining extra bank debt in normal times and during periods of adverse cash flow shocks

Dependent variable: D(Δbank>0) 1408 observations. Probit model with time dummies and random effects $\upsilon i \sim N(0,\sigma\upsilon^2)$									
	adverse cash flow shocks			normal times					
	coef.	std err		coef.	std err		coef.	std err	
$size_{it-1}$	0.07	0.03	**	0.04	0.02	**	0,03	0,02	*
bank debt/A_{it-1}	-1.28	0.26	***	-1.36	0.14	***	-1,27	0,15	***
credit lines/A_{it-1}	0.74	0.23	***	0.64	0.12	***	0,60	0,13	***
CF_{it-1}/A_{it-1}	-1.26	0.44	***	-0.60	0.25	**	-0,45	0,30	
D_1	-0.21	0.10	**	-0.18	0.05	***	-0,17	0,06	***
D_{bad}*$size_{it-1}$							0,01	0,01	**
D_{bad}*bank debt/A_{it-1}							-0,36	0,27	
D_{bad}*credit lines/A_{it-1}							0,18	0,26	
D_{bad}*CF_{it-1}/A_{it-1}							-0,67	0,51	
D_{bad}*D_1							-0,08	0,11	
$\sigma\upsilon^2$	0.12	0.10		0.18	0.03	***	0,18	0,03	***
Log L	-942			-4001			-3997		
# obs	1408			5956			5956		

D_1 is a dummy that is equal to 1 if the firm has a single bank relationship
D_{bad} is a dummy that is equal to 1 when Δ(CF/K) is below the first quartile

* significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level

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