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CREDIT SUPPLY, FLIGHT TO QUALITY AND EVERGREENING: AN ANALYSIS OF BANK-FIRM RELATIONSHIPS AFTER LEHMAN

by Ugo Albertazzi* and Domenico J. Marchetti*

Abstract

This paper analyzes the effects of the financial crisis on credit supply by using highly detailed data on bank-firm relationships in Italy after Lehman's collapse. We control for firms' unobservable characteristics, such as credit demand and borrowers' risk, by exploiting multiple lending. We find evidence of a contraction of credit supply, associated to low bank capitalization and scarce liquidity. The ability of borrowers to compensate through substitution across banks appears to have been limited. We also document that larger less-capitalized banks reallocated loans away from riskier firms, contributing to credit pro-cyclicality. Such 'flight to quality' has not occurred for smaller less-capitalized banks. We argue that this may have reflected, among other things, evergreening practices. We provide corroborating evidence based on data on borrowers' productivity and interest rates at bank-firm level.

JEL Classification: E44, E51, G21, G34, L16.
Keywords: credit supply, bank capital, flight to quality, evergreening.

Contents

* Bank of Italy, Economics, Research and International Relations.

1 Introduction[1]

Since the start of the recent financial crisis there has been an intense debate on whether banks had become abnormally reluctant to grant loans to the economy, particularly to firms. The debate has attracted not only economists but politicians and the public opinion at large, for its important implications. A contraction of credit supply can be particularly harmful during a period of weak economic activity as firms' liquidity buffers are low and a dramatic cutback in their investment spending may exacerbate the dampening effects of the recession on production and employment.

One important factor which may lead to a contraction in credit supply is related to the difficulties that banks encounter on the liability side of their balance sheet and, in particular, in maintaining an adequate level of capital, be it connected with prudential regulation or market discipline. Worries intensified after the collapse of Lehman Brothers when credit growth fell dramatically in all developed economies.

However, despite the intense debate and the massive interventions by public authorities, conclusive evidence of a capital-related contraction of credit supply is still unavailable.[2] In particular, the need of controlling effectively for developments in credit demand makes the identification of changes in credit supply quite difficult (e.g., Udell, 2009).

An additional subtlety is that credit supply, or more generally banks' willingness to lend to a given firm, may diminish because of an increase in perceived risk and for other good reasons. Basic corporate finance principles suggest that some rationing in financial markets arises as a second best device to face incentive issues: as entrepreneurs should maintain a sufficient stake on firm's return, their debt capacity is limited by their own resources.

[1]The views in this paper are those of the authors only and do not necessarily reflect those of the Bank of Italy. Helpful comments were received from Paolo Angelini, Matteo Bugamelli, Riccardo De Bonis, Eugenio Gaiotti, Simon Gilchrist, Luigi Guiso, Giorgio Gobbi, Francesca Lotti, Paolo Mistrulli, Fabio Panetta, Diego Rodriguez de la Palenzuela, Carmelo Salleo, Fabiano Schivardi, Alessandro Secchi, Enrico Sette and seminar participants at Bank of Italy, EIEF, University of Bologna, the 2009 NBER Summer Institute, the 2009 CEPR-Bank of Finland-Cass Business School conference on "Credit crunch and the macroeconomy" and the 2010 CEPR-University of Tilburg conference on "Procyclicality and financial regulation". Responsability for any error is entirely our own. E-mail: ugo.albertazzi@bancaditalia.it; domenico.marchetti@bancaditalia.it.

[2]At an earlier stage of the crisis, when credit growth was decreasing but still robust, some disputed the existence of a credit supply restriction at all (Chari et al., 2008).

Disentangling these sources of supply contraction from that associated to capital constraints is difficult, as all typically get exacerbated during crises.

Previous studies have tried to overcome these difficulties in several ways but, due to data limitation, could not properly control for loan demand. Peek and Rosengren (1995), using US bank-level data, document a stronger contraction of credit by less-capitalized banks during the 1990-91 recession. Although highly suggestive, this evidence is not fully persuasive given that differences in bank capital are likely to be associated with differences in borrowers quality, so that differences in credit growth may just reflect differences in firms' conditions rather than in banks' conditions. More structural evidence with bank-level data is supplied by Peek and Rosengren (2000), who show that losses in Japan prompted US subsidiaries of Japanese banks to cut back credit in US. Woo (2003), based on Japanese data, documents a stronger contraction of credit by less-capitalized banks in 1997, when government and regulator's indulgence towards banks ceased. A similar approach, based on information on loan rejection rates over the current financial crisis, is followed by Puri, Rocholl and Steffen (2009), who find that German saving banks affiliated with Landesbanken heavily exposed to subprime lending reduced acceptance rates by more than other saving banks.[3]

In this work we provide robust evidence of a capital-related contraction of credit supply, by using highly detailed data on bank-firm relationships after Lehman's collapse, based on a representative sample of Italian firms. The main feature of our empirical analysis is that we control for firm's specific risk and credit demand by exploiting the widespread use in Italy of multiple lenders (Detragiache et al., 2000), which allows us to use fixed effects capturing all unobservable firm's characteristics.[4,5] The period analyzed is

[3] Other papers try to exploit firm or sectoral level data, but cannot distinguish 'pure' from other supply factors. Dell'Ariccia et al. (2008) identify loan supply factors by exploiting sectoral differences in dependence on the banking sector; Borensztein and Lee (2002) have used information at the firm-level and proxied credit demand with some observable balance sheet items (e.g., net investment and cash-flow). Perhaps most convincingly, Jiménez et al. (2009) go one step further by analyzing individual bank-firm relationships in Spain until December 2008; they show that, responding to the same borrower's loan application, undercapitalized banks were more likely to reject it.

[4] Note that this is different from having firm-specific fixed effects in a standard panel set-up with repeated cross sections, since in that environment fixed effects would capture all time invariant unobservable features which clearly cannot include (time varying) credit demand.

[5] Unlike Jiménez et al. (2009), who also consider individual bank-firm relationships, we

the six-month period after Lehman's failure (September 2008-March 2009), when the financial crisis erupted and credit growth collapsed dramatically everywhere (in Italy the 3-month growth of credit to firms fell from 8% to 1%, on a annualized basis; the dynamics of loans has stagnated since then, in Italy as in the rest of the Euro area and the other major economies; see Figure 1). This is also when, according to evidence based on bank survey data, credit supply effects were more pronounced.[6]

In the investigation of the restrictions to credit supply, Italy is an interesting case to study for two main reasons. It is a bank-based economy so that distortions in credit supply may possibly bring a sizable impact;[7] more generally, because of common economic and banking features, the analysis of credit developments in Italy can help to shed light on developments in continental Europe at large. Moreover, because of the data requirements of banking supervision, a unique dataset is available for the Italian economy, which includes timely information on outstanding loans at bank-firm level.

We also investigate if the capital-related contraction of credit supply had a diversified impact across firms, in particular according to borrower's risk. There are several reasons why it may be so. For instance, the higher risk-sensitiveness of Basle II capital requirements may induce a bias toward less risky borrowers. Other mechanisms, such as evergreening, may work in the opposite direction. According to the latter notion (dubbed also forbearance lending, unnatural selection or zombie lending), less-capitalized banks may delay the recognition of losses on their credit portfolio by rolling over loans to high-risk borrowers, in order not to further impair their reported capital and profitability (Peek and Rosengren, 2005).

Unnatural selection in credit allocation has been largely documented with regard to the long-lasting Japanese stagnation of the nineties, to which it contributed in several ways (Caballero et al., 2008). Several observers have emphasized the similarities with the current financial crisis (e.g., Hoshi and

look at credit dynamics rather than loan rejections. There are many reasons why loan rejection rates may not merely reflect lending policies. For instance, if there is a cost associated to the decision to apply for a loan, then the expectation of a tighter (looser) lending policy may discourage (encourage) applicants (one obvious cost is related to the possibility that a bank may get some information on previous rejections by the other lenders, as it happens in Italy).

[6] See Del Giovane et al. (2010).

[7] At the end of 2008, the ratio of total bank credit to nominal GDP amounted to 60% in US, compared to 112% in Italy (140 in the euro area as a whole, higher than in Italy mainly because of the low level of Italian households' indebtedness).

Kashyap, 2008; Kobayashi, 2008). It is therefore natural to ask if those credit market inefficiencies could take place in other economies beyond the Japanese one. Indeed, the introduction in 2008 of Basle II standards, with their more procyclical capital requirements, may have contributed world-wide to the increasing difficulties faced by troubled banks to maintain an adequate capitalization.[8]

We find substantial differences across lenders in the nexus between poor bank capitalization and the attitude towards borrower's risk. In particular, we show that larger less-capitalized banks reallocated loans away from riskier borrowers. Such 'flight to quality' has not occurred for smaller less-capitalized banks. This finding is consistent with evergreening but also with other explanations (for example, with smaller banks being less affected by Basle II risk-sensitive capital requirements). We provide evidence suggestive that evergreening did play a role by using data on borrowers' productivity and interest rates at bank-firm level.

Our contribution to the literature is three-fold. We provide robust evidence of a capital-related contraction of credit supply. As to evergreening, our analysis represents the first attempt to our knowledge to study this issue beyond the case of Japan. Furthermore, this paper improves in the way impaired borrowers are identified. While previous contributions have mainly focused on balance sheet indicators of borrowers' quality, we consider also information on firm's economic fundamentals and competitiveness (based on TFP measures). Crucially, this allows us to disentangle short-termist lending patterns such as evergreening from the opposite phenomenon of 'patience' (namely the extension of credit to economically sound firms which undergo temporary financial difficulties and appear risky). Altogether, we show that an excessive generalized credit tightening and the extension of 'cheap' credit to selected (risky) borrowers, both induced by low bank capitalization, may well coexist.[9]

The remainder of the paper is organized as follows. The next section presents a simple model where capital constraints are introduced into a standard model of borrowing capacity. Section 3 describes the data. Section 4 presents the main evidence of bank capital effects on credit supply. Section 5 analyzes the heterogeneity of credit supply restrictions across firms

[8] See e.g. Panetta et al. (2009).

[9] It has been already shown for transition economies that credit supply restriction and soft budget constraint are not mutually exclusive (Berglöf and Roland, 1997).

and banks, in particular with respect to the borrower's risk. Section 6 investigates the role of relationship lending. Finally, Section 7 draws some conclusions.

2 The Analytical Framework

In this section we slightly extend a basic corporate finance model of borrowing capacity in order to illustrate the theoretical underpinnings of our empirical analysis. We show how our estimations can identify two interrelated but distinct mechanisms, namely a capital-related contraction of credit supply and efficient credit rationing.

Let's consider an economy populated by N entrepreneurs, indexed by i, each endowed with a risky investment project. The expected return depends on the behavior of the entrepreneur which is not contractable. The investment is profitable only if the entrepreneur behaves correctly (for example by exerting adequate effort); should he misbehave, he would enjoy some private benefits. Each entrepreneur is endowed with an amount of cash (or equity) equal to A_i.[10]

If the total investment required by the project, I_i, is larger than A_i, the entrepreneur can borrow the difference $(I_i - A_i)$ from a bank.

As the behavior of the entrepreneur cannot be determined by contractual provisions, he will choose an adequate level of effort in equilibrium only if it is convenient for him to do so (in other words, if the incentive compatibility constraint is satisfied). A standard result is that, for this to be the case, the borrower should keep a sufficient stake in the investment's returns; more precisely, under quite general conditions it can be shown that there exists a multiplier $k_i>1$ such that I_i in equilibrium is equal to:

$$I_i' = \min(A_i k_i, I_i^*) \tag{1}$$

where I_i^* is the optimal level of investment (the first-best solution, where all agency frictions are ruled out by assumption). With some approximation, I_i^* can be thought of as loan demand.

The intuition is that, whenever $I_i^*>A_i k_i$, there is some rationing $(I_i^* - A_i k_i)$, and its extent is related to the severity of the agency costs (k_i is a decreasing

[10] More generally, A_i can be interepreted as a measure of balance sheet conditions; a high A_i characterizes a firm with a relatively small debt or relatively high levels of cash, equity or fixed capital which can be used as collateral.

function of the private benefits that the entrepreneur enjoys by misbehaving).[11]

Let's consider now the presence of a (binding) capital constraint. Excluding by assumption the uninteresting case where $I_i^* < A_i$, the capital constraint can be written as:

$$\sum_{i=1}^{N} (I_i - A_i) \leq \gamma C \tag{2}$$

where C, bank capital, and γ are positive and exogenously given (the left hand side is total lending by the bank). This constraint may be interpreted as representing either the prudential capital regulation ($\gamma = 1/0.08$) or more generally the market discipline which limits the bank's access to financial markets (for the same reasons outlined above for a generic firm). The solution is readily obtained by assuming so called-type I rationing, namely that lending to each individual borrower is reduced proportionally to the level such that constraint (2) is satisfied with an equality.[12] With this simplifying hypothesis, lending to firm i, denoted as L_i'' to distinguish it from the unconstrained level L_i', is equal to:

$$L_i'' = L_i' (\gamma C / L^*) = A_i (k_i - 1) (\gamma C / L') \tag{3}$$

with $L' = \sum_{i=1,...,N} L_i'$. Two remarks are in order. First, since $L_i'' < L_i'$, total rationing imposed on a firm is larger when capital constraints are binding. This additional source of rationing is exactly what the empirical analysis reported in Section 5 is aimed at measuring. The welfare implications of the two types of rationing are quite different. If banks granted more credit than L_i', they would determine a misalignment of firms' incentives; on the contrary, if banks granted more credit than L_i'' then firm's incentives would still be preserved.

One difficulty in isolating the two sources of rationing is that they are likely to move together: when business activity slows down, firms are likely to undergo an erosion of equity and possibly face harsher agency frictions, implying a lower L_i'; similarly, the rationing brought by the erosion of bank equity is likely to raise during recessions, when banks tend to suffer higher credit losses.

[11] For more details on the notion of equity multiplier see, for example, Tirole (2006).

[12] The opposite case of type II rationing — i.e., some borrowers within a homogeneous group receive credit while others do not — is discussed below.

The rationale of our empirical strategy is suggested by the simple comparison of the two solutions L_i' and L_i''. With no shortage of bank capital, lending to a given firm just reflects its characteristics, such as its equity A_i and agency costs k_i. In the alternative case where $\gamma C < \sum_{i=1}^{N} A_i (k_i - 1)$, lending to a firm is also influenced by lender's characteristics, in particular its capitalization C. Taking logs of (3) leads to the regression equation:

$$\ln (L_{i,j}) = \beta_0 + \beta_1 \ln (A_i (k_i - 1)) + \beta_2 \ln (C_j) + \varepsilon_{i,j} \tag{4}$$

where $\beta_0 = \ln \left(\gamma / \left(\sum_{i=1,...,N} A_i (k_i - 1) \right) \right)$ and $\varepsilon_{i,j}$ is an error term. The notation $L_{i,j}$ stands for loans extended to firm i by bank j. The null hypothesis of no (capital-related) credit supply restrictions is $H_0 : \beta_2 = 0$, against the alternative $H_1 : \beta_2 > 0$.

By introducing the index j for banks we implicitly dropped the assumption of the existence of a unique bank; this is done not only for the sake of realism, but also for introducing an important methodological feature of our analysis. In principle, estimating (4) requires detailed information not just on balance sheet items A_i but also on variables, such as the agency costs k_i, which are hardly observable. Notwithstanding, supposing that there is availability of information on loan dynamics at bank-firm level, an unbiased estimation of the coefficient β_2 can be obtained by using standard panel data techniques.

The model assumption of bank capital exogeneity needs some clarification. Banks do actively adjust their own capital endowment, presumably by also taking into account current and expected loan demand. However, as documented by the empirical literature, the adjustment of bank capital is not necessarily frictionless (indeed, our test of capital-related restriction of credit supply can be seen as a test of capital exogeneity).[13] Broadly speaking, the ability to raise (outside) equity capital is influenced by factors similar to those affecting the ability to raise debt capital, for both non financial firms and banks.[14]

Finally, it is worth mentioning that there are two potential aspects of a

[13] Barakova and Carey (2001) show that it takes 1.6 years for banks to restore their capital after becoming under-capitalized. The adjustment is possibly even slower according to Barnea and Kim (2008).

[14] More specifically, Kashyap and Stein (2004) emphasize that (i) equity issues increase the value of existing debt, thus generating an externality in favor of debtholders and harming existing shareholders; (ii) equity issues may signal forthcoming losses.

capital-related contraction of credit supply which are neglected in the above model but will be investigated in the empirical section. One is the possibility that a firm which is rationed by a bank with shortage of capital can compensate by borrowing more from another bank which has an excess of capital. The aggregate effect on credit supply of a shortage of bank capital is thus affected by the ability of firms to substitute across lenders. A second aspect is the possible heterogeneity across firms in the impact of credit supply restrictions. This heterogeneity may arise for several reasons. First, depending on firms' production technology, it could be less costly to sacrifice only some borrowers instead of reducing somewhat the credit to all. Also, banks' lending decisions may be affected by the presence of long-lasting relationships. Third, banks subject to risk-sensitive capital requirements, as with Basel II, might decide to reallocate their loan portfolio towards less risky borrowers in order to save on scarce capital. Moreover, quite to the opposite direction, bankers may protect riskier borrowers in order to postpone the accounting of credit losses (evergreening). In Section 5 we will investigate the heterogeneity of lending to risky borrowers across different types of less-capitalized banks.

3 Data

3.1 Data definition

We use data on outstanding loans extended by Italian banks to a representative sample of Italian firms in manufacturing and services, merged with data on corresponding bank and firm variables. The data on credit flows refer to the period September 2008-March 2009; the data on bank variables refer to September 2008, those on firm characteristics to 2007 averages. Overall, the dataset includes roughly 19,000 observations on bank-firm relationships, which refer to outstanding loans extended by roughly 500 banks to almost 2,500 non-financial firms (on average, therefore, firms in our sample borrow from 8 different banks).

Our dependent variable is the change in outstanding loans extended by bank b to firm i, divided by the firm's total assets at the beginning of the period. We preferred to use this variable rather than the rate of growth of loans because in many cases the amount of credit at bank-firm level at the beginning of the period (September 2008) or at the end (March 2009)

was negligible, resulting in a disproportionate number of observations with, respectively, a huge positive rate of growth or a rate of growth equal to -100% (see Table 1, first row).

Table 1
Descriptive statistics of dependent variable (percent)

Variable (bank-firm level)	Percentiles						
	1st	10th	25th	median	75th	90th	99th
Rate of growth of credit	-100	-100	-63.6	-10.9	16.4	117.5	23,039
Change of credit over firm's assets	-11.6	-2.6	-0.7	0.0	.5	2.6	12.4

Rather than dropping large tails of the distribution of such dependent variable, which in all likelihood would have resulted in the elimination of observations with the most interesting information content for our purposes, we chose to divide the change in credit by firm's total assets. This normalization should not alter the information content of the data, while delivering a variable with a much smoother distribution (see Table 1, second row). This is therefore the main dependent variable that we use throughout this paper (however, regressions with the rate of growth as dependent variable were also run, for the sake of robustness; see Tables A3 and A8 in Appendix II).

The risk of firm's default is measured by Zscore, an indicator of the probability of default of a given firm, which is computed annually by the Company Accounts Data Service (CADS) on balance sheet variables (the methodology is described by Altman, 1968, and Altman et al., 1994). It takes values from 1 to 9. Firms with Zscore value between 1 and 3 are considered 'low risk' by CADS, those in the 4-6 range are considered 'medium risk', and those in the 7-9 range are considered 'high risk'; the latter firms are more likely to default within the next two years.

Productivity is computed for each firm as the log-level of (gross output) Solow Residual, tfp_i:

$$tfp_i = \ln y_i - (\alpha_L \cdot \ln \_l_i + \alpha_K \cdot \ln \_k_i + \alpha_M \cdot \ln \_m_i) \ , \tag{5}$$

where $\ln \_y_i$, $\ln \_l_i$, $\ln \_k_i$ and $\ln \_m_i$ are the logarithms of, respectively, firm's gross output, hours, capital and intermediate inputs, all measured in real terms, and the α's are the revenue shares of each input.[15] Since the level

[15] Gross-output measures of total factor productivity, whenever data are available, are preferable to value-added measures, because of the reduced-form nature of the latter,

of productivity may vary widely across sectors, we computed for each firm its difference relative to the sectoral median, to allow for comparison across sectors.

Further details on the definition of variables and descriptive statistics can be found in Appendix I.

3.2 Data sources

There are four main sources of data: data on outstanding loans come from the Credit Register; balance-sheet data on bank variables are drawn from the Banking Supervision Register at the Bank of Italy; data on firms' inputs and output (used to measure productivity) and other firm characteristics come from the Bank of Italy annual Survey of Industrial and Service Firms and from the Company Accounts Data Service (CADS).

The Credit Register data are collected by a special unit of the Bank of Italy (*Centrale dei Rischi*) and contain detailed information on virtually all individual loans extended in Italy (see Appendix I).

The Survey of Industrial and Service Firms (SISF) is carried out annually by the Bank of Italy. The data are of very high quality, being collected by officials of the local branches of the Bank of Italy, who often have a long-standing work relationship with the firm's management. The Company Accounts Data Service (CADS - *Centrale dei Bilanci*) is the most important source of balance sheet data on Italian firms. It covers about 30,000 firms and is compiled by a consortium that includes the Bank of Italy and all major Italian commercial banks.

4 Evidence of capital-related contraction of credit supply

4.1 The main results

The core of this paper is the investigation of bank-firm relationships over the period September 2008-March 2009. This period coincides with the aftermath of Lehman's bankruptcy, when the growth of credit came to a substan-

which may induce potential model misspecification and omitted variable bias when used in regressions (see Basu and Fernald, 1997; for an analysis of these TFP measures with a dataset similar to that used in this work, see Marchetti and Nucci, 2006).

tial halt (for the median firm in our sample, outstanding loans contracted in nominal terms by an annualized 1.6%).

Consistently with the model introduced in Section 2, the basic regression for testing the hypothesis of a capital-related contraction of credit supply is the following:

$$\Delta cred_{b,i} = \alpha + \beta_1 \cdot low\_cap_b + \eta_i + u_{b,i} \tag{6}$$

where $\Delta cred_{b,i}$ is the change in outstanding loans extended by bank b to firm i between (end) September 2008 and (end) March 2009, divided by firm i's total assets in September 2008; low_cap_b is a dummy variable for less-capitalized banks; η_i is a firm-specific fixed-effect and $u_{b,i}$ is the regression residual. More precisely, low_cap_b is equal to 1 for banks whose total (risk-weighted) capital ratio is lower than 10%. The latter value is that recommended by the Bank of Italy, and — although the official Basle II regulatory threshold is 8% — it appears to be perceived by the market as the relevant benchmark; moreover, it roughly coincides with the 25th percentile (10.5%) of the sample distribution, and therefore is a useful reference value also in statistical terms.[16]

Equation (6) includes firm-specific fixed-effects; this key feature allows us to control for firm's credit demand as well as any other firm's characteristic. Regression results are reported in Table 2, first column. The estimated coefficient of low_cap_b is negative and highly significant, leading to a clear rejection of the null hypothesis that a capital-related contraction of credit supply did not occur. We also investigated the role of other balance sheet indicators of banks' funding difficulties — beyond those associated to regulatory requirements — such as the liquidity ratio. We thus included the dummy variable $high\_liq_b$ for banks whose liquidity ratio (i.e., cash and securities other than shares, divided by total assets) is higher that the sample median (12.1%). Results are reported in Table 2, second column. The supply of credit by more liquid banks has been significantly higher, while the estimated coefficient of low_cap_b remains negative and highly significant.

We also considered, mainly as controls, three variables related to different aspects of bank organization, possibly relevant during the crisis: $large_b$ is a dummy for banks belonging to the major five banking groups (which overall extend roughly half of total loans to non-financial firms, and accounted for

[16] The use of a dummy for lowly-capitalized bank is aimed at capturing possible non-linearities, since bank capital affects credit supply only when capital constraints are binding.

most of the credit slowdown); $scoring\_bank_b$ is a dummy, based on survey data, which is equal to 1 for banks whose use of scoring schemes in lending decisions is reported to be either "important" or "very important", and 0 for banks that report to make little or no use of credit scoring; $coop_b$ is a dummy variable for cooperative banks, which are subject to a specific regulatory regime and have been shown in the literature to focus on relationship lending (e.g., Angelini et al., 1998).

Results of the extended model are reported in Table 2, third column. The effect of bank capital and liquidity is strenghtened, despite the high significance of the estimated coefficient for $large_b$.[17] Overall, these results show that the findings for low_cap_b previously commented are not due to possible correlation between low bank capitalization and other banking features, such as the fact of belonging to a major banking group or the reliance on credit scores in lending decisions.[18]

The contraction of loan supply by less-capitalized banks has been significant in both statistical and economic terms. The (asset-normalized) change in credit extended by less-capitalized banks is about two percentage points lower (in annual terms) compared to that of other banks. It can be estimated that, on an annual basis, this corresponds to roughly 0.7% of the stock of outstanding loans to firms (measured in September 2008); analogously, the effect through liquidity constraints, captured by the coefficient of $high\_liq_b$, corresponds to roughly 0.6% of the stock. Overall, therefore, 'pure' supply effects related to banks' balance-sheet conditions amounted to more than 1% of total credit to firms.

Our interpretation of the results is corroborated by looking at loan supply developments in the pre-crisis period. In particular, for comparison purposes, we considered the latest six-month period spanning from September to March before the beginning of the turmoil (August 2007), that is September 2006-March 2007, and estimated again the extended model with the corresponding

[17] This finding, as we will see, is not specific to the period under investigation and is possibly related to the ongoing recomposition of market shares in the Italian credit market following the consolidation process of the sector in first half of the 2000's.

[18] The coefficient of $scoring\_bank_b$ is positive and significant, contrary to the common conjecture that a heavy use of credit scores would weigh negatively on lending decisions during a recession accompanied by a financial crisis. However, the procyclical implications of credit scoring on loan developments deserve a deeper analysis, which is beyond the scope of this paper. Similar considerations can be done with regard to the estimate of the coefficient of $coop_b$, which is typically interpreted as a proxy of relationship lending.

data. The results are reported in Table 2, fourth column: as expected, at normal times the supply of credit is not affected by bank capitalization (or liquidity, for that matter). Overall, the evidence reported for the pre-crisis period strongly confirms the interpretation of our results as evidence of a capital-related contraction of credit supply.

4.2 Robustness

The results proved extremely robust along several dimensions. First, they are substantially unchanged if the original dependent variable is replaced by the rate of growth of loans (Table A3 in Appendix II). Second, the results proved robust to the choice of the threshold value for the definition of low_cap_b (low_cap_b was set equal to 1 for banks whose capital ratio is lower than the sample median, i.e. 13.0; Table A4). A third set of robustness checks was related to the definition of credit: we considered granted rather than utilized credit (Table A5).

A further robustness exercise was related to the level at which the capital ratio is computed (individual banks vs. group). Regulatory requirements concern both unconsolidated capital ratios and consolidated ones. Throughout this paper we chose to use unconsolidated ratios, in order to exploit the heterogeneity of behavior and conditions across banks belonging to the same group. For example, the literature on internal capital markets shows that agency frictions among individual firms within industrial or banking groups generates relationships which tend to be similar to those observed among independent market participants (e.g., Shin and Stultz, 1998). Moreover, consolidated balance sheet data are not available at quarterly frequency, so that we should use capital ratios computed on either June or December 2008; given that capital levels were changing during the period of interest, this could bring noise in the data. At any rate, consolidated and unconsolidated capital ratios exhibit an extremely high level of correlation in June 2008 (.87). A final advantage, on statistical grounds, is the much greater variability and granularity of unconsolidated capital ratios.[19] This notwithstanding, for robustness purposes (for example, bank supervision activity tend to focus on consolidated parameters), we regressed our dependent variable (computed with consolidated loan data) on low_cap_b computed based on consolidated

[19] The banks of the five major groups (15% of our dataset) account for roughly 60% of total bank-firm observations; over all those observations the consolidated capital ratio spans across 5 different values included in a very narrow range (9.1-10.4).

capital ratios and the corresponding distribution. The estimated coefficient remains negative and highly significant (see Table A6).

A final robustness exercise was related to the accounting impact of securitizations on loans data. The data on outstanding loans used throughout the paper do not include securitized loans. In principle this seems appropriate since typically a bank, by securitizing a loan, sells on the market the loan itself, transfering on third parties the corresponding risk of credit. The loan supply of that bank to the given firm decreases by the corresponding amount. However, in practice, in the period being considered most securitizations were so-called retained-securitizations, whose only purpose was to create securities to be used as collateral in the Eurosystem's refinancing operations but which did not imply any transfer of risk to third parties. In such cases the loan supply at the bank-firm level can be considered unchanged. We therefore adjusted loan data for the effect of securitizations, by re-including loans which were securitized during the period of interest into the stock of outstanding bank-firm loans at the end of March 2009. The results are shown in Table A7 and are virtually unchanged.

A full discussion of all robustness exercises is provided in Appendix II.

4.3 Substitution across banks

We also tried to investigate if and to what extent borrowers were able to compensate the contraction of credit supplied by less-capitalized banks by increasing loans from other banks. In principle, in the extreme case of perfect and timely substitution the credit supply restrictions by capital-constrained banks would have no effects on production and employment, and there would be merely a recomposition of credit flows within the banking sector.

For each firm in our dataset we thus computed the change of loans extended by all highly-capitalized banks (i.e., banks with capital ratio $\geq 10\%$) and regressed it on the change of loans extended by all other banks (defined as $cred\_lowcap_i$). If substitution were perfect and this were the only factor driving the relationship being estimated, we expect a coefficient equal to -1; incomplete substitution would correspond to a coefficient between -1 and 0; a coefficient not statistically different from 0 would imply no substitution, while a positive and significant coefficient would signal complementarity between loans from the two bank categories. As it is not possible to include fixed effects, we included in the regression controls for the main firms' characteristics (i.e. risk of default, size, economic sector and region) to capture other factors

which might potentially affect the relationship between the dependent variable and the regressor. Results (with and without controls) are reported in Table 3, first and second columns. The estimated coefficient of $cred\_lowcap_i$ is negative and highly significant, with an absolute size much lower than one, thus suggesting that some substitution did take place, but was rather limited (namely, the increase in loans from highly-capitalized banks appears to have compensated on average only around 30% of the decrease of loans from less-capitalized banks).

Estimating the same regression in the pre-crisis period (September 2006-March 2007) broadly confirms this interpretation of the results. We expect that at normal times, with no credit supply restrictions, the scope for substitution is smaller, if any at all; indeed, the estimated coefficient of $cred\_lowcap_i$ in the comparable pre-crisis period is much smaller in size and with lower statistical significance (Table 3, third column).

Considering again the after-Lehman period, we also found some evidence that the number of lenders affected borrowers' ability to substitute across banks, as one would expect. We computed a new dummy variable, $few\_lenders_i$, for firms that have less than 4 lenders (roughly 38% of the total; the 25th percentile of the distribution is 3). The results are reported in Table 3, fourth column; for the latter category of firms, the estimated coefficient of $cred\_lowcap_i$ is much smaller in size and not statistically significant, whereas for firms that borrow from at least 4 lenders the estimate is highly significant and very similar in size to that previously commented.

5 Flight to quality and evergreening

5.1 Heterogeneity of credit supply restrictions across firms

We now turn to the investigation of a specific aspect of the contraction of credit supply, namely the occurrence of a flight to quality away from risky borrowers and its heterogeneity across banks.

We start by analyzing whether and how the (capital-related) credit supply restriction was differentiated across firm's types. We considered four main firm's characteristics, namely size, export propensity, risk of default and productivity. The corresponding variables were interacted with low_cap_b, first each at a time and then all together; results are reported in Table 4. The

contraction of loan supply from less-capitalized banks was significantly more pronounced for smaller firms (i.e., firms with less than 50 employees, identified by the dummy $small\_f_i$). As to export propensity, there is no evidence that exporting firms (identified by the dummy $export_i$) were hit more severely by credit supply restrictions.[20] With regard to productivity, there is no evidence that more productive firms have been shielded from the contraction of credit supply (tfp_i is the firm's Solow residual, sectorally de-meaned). Finally, and most interestingly for our purposes, there is some evidence that credit supply restrictions have been stronger for riskier firms ($high\_risk_i$ is a dummy for firms whose Zscore is in the 7-9 range).

The evidence found for $low\_cap_b \cdot small\_f_i$ and $low\_cap_b \cdot high\_risk_i$ reminds the notion of the flight to quality described by Bernanke et al. (1996), based on the role of agency costs. Notice however that our findings are slightly different, as in our analysis agency costs are captured by firm-specific fixed effects. The estimated coefficient of $low\_cap_b \cdot small\_f_i$ and that of $low\_cap_b \cdot high\_risk_i$ capture an additional impact on lending to smaller or riskier firms, specific to poor bank capitalization, which is not related to differences in agency costs compared to other borrowers. One possible factor underlying this form of flight to quality linked to bank capital, as mentioned in Section 2, is the effect of the higher risk-sensitiveness of Basel II capital requirements. Other factors potentially relevant include evergreening and 'patience'. The different mechanisms imply differences in lending patterns across banks, according to size and organization.

5.2 Flight to quality: Heterogeneity across banks

A first dimension to be investigated is bank size. In the Italian banking sector — as in most developed banking sectors world-wide — small, local banks coexist with large, multi-national banking groups. The differences in bank's organization and decision-making are likely to potentially affect the attitude towards borrower's risk. For example, with regard to evergreening, providing 'cheap' credit to a borrower with high risk of default, in order to postpone credit losses, is presumable easier for a smaller bank where discretion in lending decisions is higher and the weight of credit scoring is lower than for a

[20] Given that these firms have been harshly hit by the collapse of world demand, this is an interesting finding since it reveals that concerns that 'short-termist' banks might possibly reduce credit to these firms, which represent the dynamic and healthy core of the Italian productive system, seem unfounded.

larger bank, where lending decisions are based on more automatic procedures. Indeed, by introducing bank size into our analysis of lending patterns to risky borrowers, a clear difference emerges. Consider the following regression:

$$\begin{aligned} \Delta cred_{b,i} \;=\; & \alpha + \beta_1 \cdot low\_cap_b + \beta_2 \cdot (low\_cap_b \cdot high\_risk_i) \\ & + \beta_3 \cdot [low\_cap_b \cdot high\_risk_i \cdot (1 - large_b)] + \beta_4 \cdot large_b \\ & + \eta_i + \varepsilon_{b,i} \ . \end{aligned} \tag{7}$$

The results are reported in Table 5, second column. Given the specification of this model — namely the presence of the triple interaction term $low\_cap_b \cdot high\_risk_i \cdot (1 - large_b)$ — the coefficient of $low\_cap_b \cdot high\_risk_i$ captures the flight to quality effect (i.e. the reallocation of credit away from riskier borrowers) for larger banks alone. Such coefficient is negative and highly significant; interestingly, thus, the evidence of a reallocation away from riskier borrowers is much stronger for larger banks (both in size and statistical significance) than for the average less-capitalized bank (Table 5, first column).[21] On the other hand, the coefficient of $low\_cap_b \cdot high\_risk_i \cdot (1 - large_b)$ is positive and highly significant, showing that the lending pattern to riskier borrowers by smaller less-capitalized banks is significantly different from that of larger banks — namely, the flight to quality of smaller banks is lower compared to that of larger banks. Moreover, for such smaller (less-capitalized) banks there is no evidence altogether of flight to quality, since the total reallocation effect towards riskier borrowers by such banks is given by $\widehat{\beta_2} + \widehat{\beta_3}$, which is non-negative.[22] Importantly, all the results are robust to the inclusion in the regression of all double interactions among the variables in the equation (Table 5, third column).[23]

As anticipated throughout the paper, there are at least three possible

[21] The first column of Table 5 reports again, for comparison purposes, the regression presented in Table 4, fourth column.

[22] In mathematical terms, it can be readily seen that, for smaller banks (i.e. those for which $large_b$=0), $\partial \frac{\partial \text{ change of loans}}{\partial \text{ low\_cap}} / \partial \text{ high\_risk} = \widehat{\beta_2} + \widehat{\beta_3}$. Indeed, based on this regression there is evidence of flight *to risk* for smaller banks, since $\widehat{\beta_2} + \widehat{\beta_3}$=0.504, with the hypothesis of $\widehat{\beta_2} + \widehat{\beta_3} = 0$ being rejected at 1% statistical level (F-statistic=13.38, with p-value .000).

[23] The positive coefficient for $low\_cap_b \cdot (1 - large_b)$ signals that the effect of capital on lending is more important for larger banks. This may reflect different ownership patterns (which may interfere with banks' ability to promptly adjust their capital) or more careful monitoring by market participants on larger and listed banks.

explanations for the finding that, in striking difference with larger less-capitalized banks, smaller ones have not reallocated their credit away from riskier borrowers after Lehman.

One explanation is that, compared to larger banks, smaller ones are less affected by the new Basle II risk-sensitive capital requirements and did not reallocate at all their loan portfolio in order to save on scarce capital. Another potential explanation is evergreening, on the ground that, as already mentioned, any reallocation of credit in favor of borrowers with a bad credit score — finalized to avoid or postpone the realization of losses — is presumably easier in the case of smaller banks. A third possible explanation is that smaller banks have better (soft) information on riskier borrowers, compared to that of larger banks; this would allow smaller banks to keep funding borrowers with bad credit scores that have good economic fundamentals and are just undergoing temporary financial difficulties. In such case, the lack of 'flight from risk' by smaller banks would be evidence of virtuous 'patience', as opposed to the suboptimal myopia (short-termism) of larger banks.[24]

As to the first explanation, when the adoption of Basle II will be completed, some technical aspects of the new capital requirements will indeed presumably deliver a higher risk-sensitiveness by larger banks (which are more likely to adopt the 'internal rating system'). However, the implementation has been gradual and, in the period under consideration, was still partial.[25] It appears therefore unlikely that the differences documented above are entirely justified by the effect of Basle II regulation. While the latter effect may be an interesting issue for future research, in the rest of this section we conduct other exercises aimed at disentangling the 'evergreening' explanation from that based on 'patience'.

[24] This interpretation, however, seems inconsistent with the negative and significant coefficient for $(1 - large_b) \cdot high\_risk_i$, which suggests that the lenience of smaller lenders towards risky borrowers is specific to the lowly capitalized smaller intermediaries.

[25] The sensitivity of new capital requirements to the risk of individual borrowers is maximized under the 'internal ratings-based' (IRB) approach, which is typically chosen by larger banks. Under the alternative system ('standardized' approach), all borrowers that are not rated by the rating agencies are given the same weight in the computation of capital requirements, regardless of the actual individual risk profile. The share of loans covered by the IRB system in the period September 2008-March 2009 for the few (large and small) banks which adopted it varied between roughly 40 and 70%.

5.3 Corroborating the 'evergreening' explanation

As just argued, the findings of Table 5, second and third column, might reflect 'patience' by smaller less-capitalized banks — as opposed to myopia of larger banks — instead of evergreening. Indeed, this is a general limitation of all balance sheet indicators of borrowers' quality that are used in the evergreening literature, arising from the fact that they do not take into any account firms' future prospects.[26] Thus, by using these measures, it is not possible to distinguish true forbearance lending from efficient debt restructuring, whereby a non myopic lender helps a borrower, who is currently distressed but whose expected profitability is potentially high, go through temporary difficulties. The latter would be typically the case of a firm which got involved in substantial restructuring, funded by debt, thanks to which it is regaining its competitiveness.[27]

A simple but rather powerful method to discriminate between the two alternative explanations is integrating the information of (financially-focused) balance sheet indicators with that of indicators which are, arguably, better proxies of the firm's economic fundamentals and competitiveness, and therefore more forward-looking measures of its economic prospects, such as productivity.

We therefore replicated the regressions reported in Table 5 by replacing $high\_risk_i$ with a proxy for bad (impaired) borrowers, imp_bor_i, which is equal to 1 if $high\_risk_i$=1 and, at the same time, the firm's Solow residual, sectorally de-meaned, is lower than the sample median. After having identified bad borrowers in this way, any evidence of reallocation

[26] An alternative approach to the identification of impaired borrowers has been adopted by Caballero et al. (2008). In that paper, bad borrowers are identified as those receiving an interest rate subsidy, which in turn is identified by comparing, for any firm and year in the sample, total interest expenses with an estimated lower bound. As it is not based on indicators of current performances, this approach offers the main advantage of being inherently more forward-looking. Another more forward-looking measure adopted is stock returns, as in Peek and Rosengren (2005). The main limitation in this case is that such information can be obtained only for listed firms, which tend to be only large firms. Also, one could argue that during crises stock prices are not as efficiently determined as in normal times.

[27] There is specific evidence that this factor may have been relevant in our context. Bugamelli et al. (2008) document, by analyzing a dataset including our sample of firms, that substantive firms' restructuring occurred in the Italian manufacturing and services sectors in the last decade, as a response to the introduction of the euro and the need to face global competition.

of credit towards them (or weaker reallocation away from them) can be hardly interpreted as evidence of 'patience'. The results with imp_bor_i are reported in Table 6 (whose structure replicates that of Table 5; they strongly confirm, and possibly strengthen, previous evidence. The 'flight from bad borrowers' by larger banks, captured by the estimated coefficient of $low\_cap_b \cdot imp\_bor_i$ in columns 2-3, has intensified (the size of the coefficient has roughly doubled compared to that of Table 5). The coefficient of $low\_cap_b \cdot imp\_bor_i \cdot (1 - large_b)$, which captures the difference of behavior between smaller and larger banks, has remained positive and highly significant; if anything, its size appears sharply increased as well. Overall, again, there is no evidence of 'flight from bad borrowers' by smaller banks (i.e. the hypothesis of $\widehat{\beta_2}+\widehat{\beta_3}=0$ cannot be rejected).[28]

Notice that the findings documented in Table 6, columns 2-3, lend support to the explanation based on evergreening also vis-à-vis that based on Basle II regulations. In fact, if the lack of flight to quality for smaller banks (documented in Table 5) were justified only by the differential impact of new capital requirements, adding borrowers' productivity into the analysis should leave the results broadly unchanged, since the rating methods used under the IRB approach typically focus on balance sheet variables (such as those summarized in Zscore), and do not take into account measures of firms' productivity and competitiveness. If anything, the use of imp_bor_i instead of $high\_risk_i$ should attenuate the observed difference between large and small banks, since, in the absence of evergreening, small banks should reallocate their credit away from the 'bad borrowers' identified by imp_bor_i even if that does not give them the full advantages, in terms of lower risk-weighted capital ratios, brought by Basle II and enjoyed by larger banks. As we saw, on the contrary, the observed difference between larger and smaller banks widened.

Going back to the comparison between the 'evergreening' and the 'pa-

[28] A further robustness exercise is the following. Since the aim is that of investigating the extension of credit to risky borrowers for the purpose of avoiding losses on pre-existing loans, it is appropriate to include, among the borrowers which may potentially benefit from evergreening, only firms which, at the beginning of the period being considered (i.e., September 2008), were actively borrowing from a given bank. To this purpose, we estimated the regressions reported in Table 6 after dropping the bank/firm observations associated to firms with imp_bor_i =1 and no outstanding loans from a given bank. After doing so, the dummy imp_bor_i identifies (only and all) the potential recipients of 'evergreening' loans. Results are substantially unchanged; they are reported in Table A7 in Appendix II.

tience' explanations, another way of testing the hypothesis that loans to riskier borrowers might actually represent good profit opportunities — with smaller less-capitalized banks being in a better position to detect them — is by looking at interest rate developments at the bank-firm level. This is feasible since have information on average nominal interest rates for each bank-firm relationship over the same period. The rationale for looking at interest rates is that 'genuine' loans (i.e. non associated to evergreening) to riskier but profitable borrowers should be associated to higher interest rates.

Quite to contrary, interest rates on the loans extended by smaller less-capitalized banks to riskier borrowers turned out not to be statistically different from those on other loans. See Table 7, which for simplicity replicates the structure of Tables 5, with the dependent variable being replaced by interest rates at bank-firm level (average over the period of interest). For our purposes, we do not need to provide a structural interpretation of all the parameters in the regression; we simply notice that the estimated coefficient of $low\_cap_b \cdot high\_risk_i \cdot (1 - large_b)$ is clearly not statistically different from zero (Table 7, second and third column).

5.4 The role of credit scoring

We have provided evidence corroborating the interpretation of our findings based on forbearance lending. When initially putting forward this hypothesis, we mentioned that one reason why evergreening might be easier for smaller banks is the lower weight of credit scoring techniques. It seems natural, therefore, to re-estimate previous regressions after replacing $(1 - large_b)$ with $(1 - scoring\_bank)$. The results are documented in the fourth and fifth column of, respectively, Tables 5, 6 and 7 (which replicate the second and third column of the corresponding table). The findings clearly confirm those obtained with $(1 - large_b)$. Namely, banks which rely extensively on credit scoring did reallocate credit away from risky (bad) borrowers, while the others did not (Tables 5 and 6). For the sake of comparing the explanatory power of $(1 - large_b)$ with that of $(1 - scoring\_bank)$ in capturing the allegedly 'evergreening' effect, we also included all regressors in the same equation. The results, reported in the sixth column of, respectively, Tables 5 and 6, show that the estimated coefficient of $[low\_cap_b \cdot high\_risk_i \cdot (1 - large_b)]$ maintains its high statistical significance, unlike that of $[low\_cap_b \cdot high\_risk_i \cdot (1 -$

$scoring\_bank$)].[29] This suggests that the weight of credit scoring has been only one of the factors underlying our findings; additional factors associated to bank's size played a role, presumably related to organizational aspects. For example, the relevance of agency costs in major groups, documented in the literature (e.g., Stein, 2002), might induce a tendency to centralize decision processes and permanently limit the autonomy of local loan officer, possibly making evergreening more difficult.

6 Credit supply restrictions and relationship lending

Finally, we investigated whether and how the capital-related contraction of credit supply documented in Section 4 is affected by the intensity of bank-firms relationships. We did so by including in the main regressions the share of credit that a given firm receives from a given bank, $cred\_share_{b,i}$, alone and interacted with low_cap_b. The results for the model without and with controls are reported, respectively, in the first and second columns of Table 8. The estimated coefficients of $low\_cap_b \cdot cred\_share_{b,i}$ and $cred\_share_{b,i}$ are both negative and statistically significant.[30] Overall, therefore, we find no evidence that the capital-related contraction of credit supply has been attenuated by intense bank-firms relationships, or, more in general, that credit supply during the turmoil has been positively affected by relationship lending.[31] This is consistent with the finding by Peek and Rosengren (2005) that, during the 'lost decade' in Japan, main banks were less likely to increase lending compared to other banks.

Notice, however, that our analytical framework is not best suited for an analysis of relationship lending, which is not the aim of this paper. First, the non negligible category of firms borrowing from a single lender — for which relationship lending is most valuable — is excluded by our analysis,

[29] As to Table 7, there is some evidence that the estimated coefficient of $low\_cap_b \cdot high\_risk_i \cdot (1 - scoring\_bank_b)$ is even negative and statistically significant, showing that interest rates on the loans extended to riskier borrowers by lowly-capitalized banks which make little use of scoring techniques are lower than those on other loans.

[30] Similar evidence has been obtained by analyzing credit flows to smaller firms, that typically benefit more from relationship lending (Table 8, third column).

[31] Substantially similar results have been obtained by using as dependant variable the rate of growth of loans (see Table A8).

based on the use of firm-level fixed effects which requires lenders' multiplicity. Moreover, for the firms included in our analysis some of the effects of lending relationships might be captured by the fixed effects. For example, the presence of a main bank may provide some kind of 'certification' allowing other intermediaries to lend to the same firm, at lower interest rates, while saving on monitoring costs.[32]

We also investigated the link between the intensity of bank-firm relationships and the lending patterns towards risky borrowers. We run the main regressions reported in Table 6 after including $cred\_share_{b,i}$, respectively alone and interacted with $[low\_cap_b \cdot imp\_bor_i \cdot (1 - large_b)]$ and $[low\_cap_b \cdot imp\_bor_i \cdot (1 - scoring\_bank_b)]$. The results are reported in Table 9; there is no evidence that the (supposedly) 'evergreening' effect is either strengthened or weakened by relationship lending.

7 Conclusions

In this paper we have presented evidence of a contraction of credit supply, associated to low bank capitalization and scarce liquidity, over the 6-month period following Lehman's bankruptcy.

We have shown that the dampening effect on credit supply of less-capitalized banks has been quite sizeable; moreover, we offered some evidence that the ability of borrowers to substitute loans from less-capitalized banks with loans from the other banks has been limited, and almost nil in the case of firms that borrow from few lenders.

By analyzing the impact of the credit supply restrictions across firm's types, we also found that larger less-capitalized banks have reallocated their credit away from riskier firms. Quite strikingly, this 'flight to quality' has not been observed for smaller less-capitalized banks.

A first explanation for this dichotomy hinges on the potentially different impact of Basle II capital regulations on larger vs. smaller banks; however, the implementation of the new, more risk-sensitive capital requirements was still partial during the period of interest, and it appears unlikely to entirely

[32] See Casolaro and Mistrulli (2008). In general, an analysis of the role of relationship lending cannot neglect firms' bank-invariant characteristics. De Mitri et al. (2009) conduct an analysis along these lines based on Italian firm-level data (that include our sample); they find a positive link between several measures of relationship lending and firms' credit availability after Lehman.

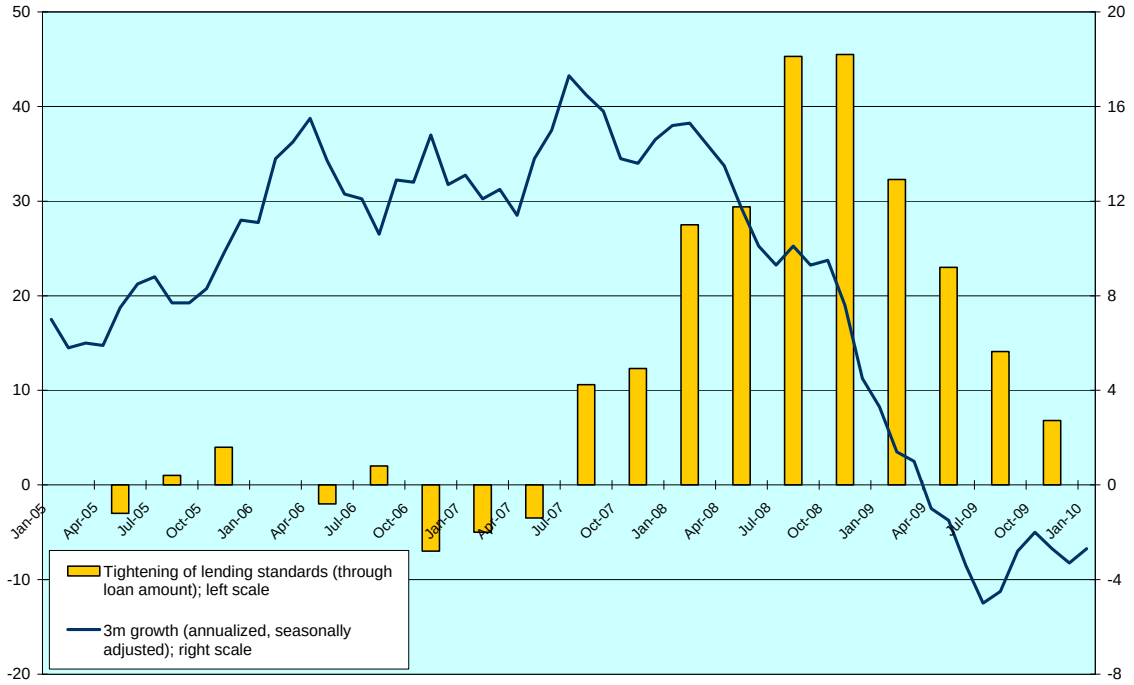
justify the difference in the observed 'flight to quality'. Another potential explanation hinges on evergreening. The rational is that evergreening is arguably easier for smaller banks, whose lending decision processes are more flexible and less constrained by credit scores, than for larger banks. A third potential explanation is 'patience' by smaller banks, in the sense described in this paper. In order to disentangle between the latest two explanations we used data on borrowers' productivity and interest rates at bank-firm level. This evidence suggests that some evergreening did take place.

Overall, this paper innovates by combining two separate strands of the literature on bank capital and lending supply, namely those on capital-related contractions of credit supply and evergreening. Our results indicate that pressure on bank capital may induce, simultaneously, two opposite lending biases. A generalized excessive tightening and some excessive loosening of credit policies towards risky borrowers (evergreening) may represent two different faces of banks' response to capital constraints.

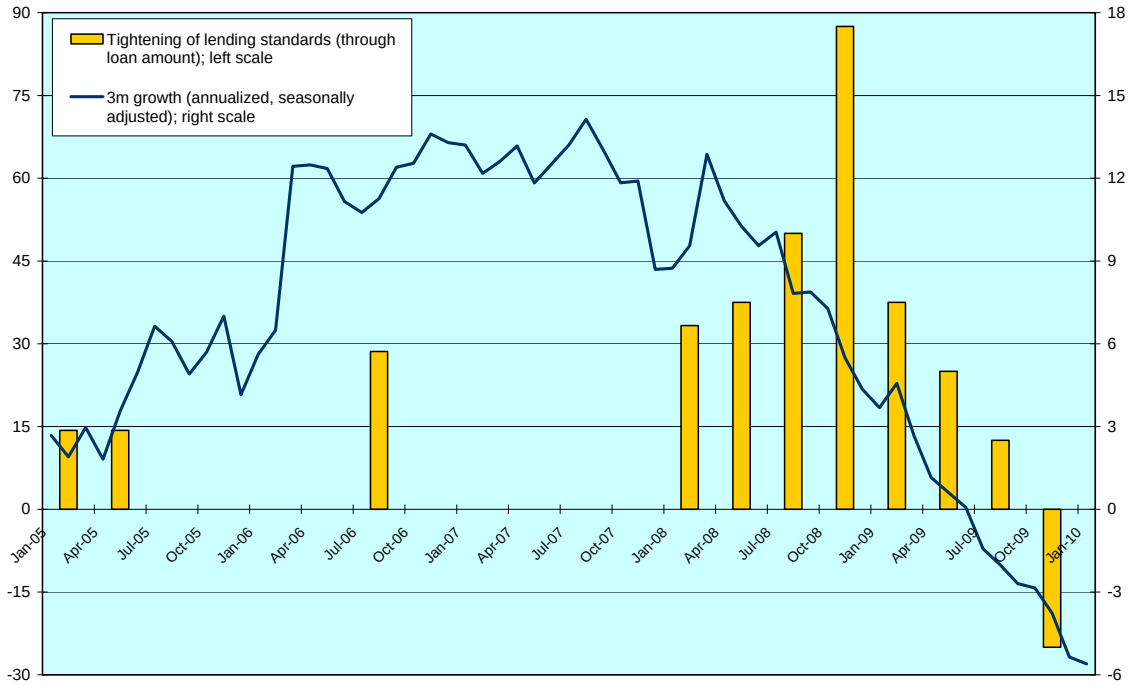
Figure 1

Loans to non financial corporations and lending standards

Euro area



Italy



Source: Bank of Italy and European Central Bank

Note: The lending standards indicator is based on the data of the Eurosystem's quarterly Bank Lending Survey. It represents the tightening of lending conditions, with respect to previous quarter, implemented through reductions of the amount of the extended loans or granted credit line (net percentage).

Table 2

Testing for Credit Supply Restrictions

Dep. variable: Change of loans over firm's assets

Bank variables	(1)	(2)	(3)	(4) Pre-crisis
Low_cap$_b$	-.835***	-.867***	-1.086***	.036
	(.066)	(.067)	(.076)	(.047)
High_liq$_b$	-	.447***	.560***	-.078
	-	(.084)	(.144)	(.096)
Large$_b$	-	-	-.142***	-.090*
	-	-	(.045)	(.049)
Scoring_bank$_b$	-	-	.219**	.105
	-	-	(.088)	(.072)
Coop$_b$	-	-	-.439*	-.003
	-	-	(.137)	(.130)
No. firms	2,558	2,558	2,546	2,358
No. obs.	19,576	19,576	17,596	16,602

Note: Fixed effect (firm-level) estimation with data at the bank-firm level. Each column corresponds to a regression. The dependent variable is the change of loans from individual banks over the period September 2008-March 2009, normalized to firm's assets; regressors data refer to September 2008. In column 4, the dependent variable is defined over the period September 2006-March 2007, and regressors data refer to September 2006. Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level).

*Significant at the 10-percent level; **significant at the 5-percent level; ***significant at the 1-percent level.

Table 3
Substitution across Banks
Dep. variable: Change of loans from highly-capitalized banks over firm's assets

Firm variables	(1)	(2)	(3)	(4)
			Pre-crisis	
Cred_lowcap$_i$	-.306***	-.297***	-.096*	-
	(.067)	(.070)	(.051)	-
Cred_lowcap$_i$ · (1-Few_lenders$_i$)	-	-	-	-.316***
	-	-	-	(.083)
Cred_lowcap$_i$ · Few_lenders$_i$	-	-	-	-.166
	-	-	-	(.107)
Few_lenders$_i$	-	-	-	-.753**
	-	-	-	(.360)
Credit risk dummies	No	Yes	Yes	Yes
Size dummies	No	Yes	Yes	Yes
Sectoral dummies	No	Yes	Yes	Yes
Regional dummies	No	Yes	Yes	Yes
No. firms/obs.	2,558	2,452	2,371	2,452

Note: OLS estimation with firm-level data. Each column corresponds to a regression. In columns 1-2 and 4, the dependent variable is the change of loans from highly-capitalized banks, normalized to firm's assets, defined over the period September 2008-March 2009, and regressors data refer to September 2008; in column 3 the dependent variable is defined over the period September 2006-March 2007 and regressors data refer to September 2006. Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). Credit risk dummies identify firms whose Zscore value is between, respectively, 1 and 3 ('low risk'), 4 and 6 ('medium risk') and 7 and 9 ('high risk') . Size dummies identify four categories of firms: 20-50 employees, 51-200 employees, 201-1000 employees, over 1000 employees. Sector dummies refer to 2-digit sectors. Regional dummies refer to four macro-regions: North-West, North-East, Center and South.

*Significant at the 10-percent level; **significant at the 5-percent level; ***significant at the 1-percent level.

Table 4
Heterogeneity of Credit Supply Restrictions across Firms
Dep. variable: Change of loans over firm's assets

Bank and firm variables	(1)	(2)	(3)	(4)	(5)
Low_cap_b	-.744***	-.799***	-.964***	-.808***	-1.032***
	(.069)	(.143)	(.116)	(.074)	(.201)
$Low\_cap_b \cdot Small\_f_i$	-.384**	-	-	-	-.460**
	(.180)	-	-	-	(.211)
$Low\_cap_b \cdot Export_i$	-	-.050	-	-	.011
	-	(.161)	-	-	(.186)
$Low\_cap_b \cdot Tfp_i$	-	-	.227	-	.191
	-	-	(.138)	-	(.157)
$Low\_cap_b \cdot High\_risk_i$	-	-	-	-.194	-.367*
	-	-	-	(.168)	(.190)
$High\_liq_b$	-	-	-	-	.583***
	-	-	-	-	(.145)
$Large_b$	-	-	-	-	-.145***
	-	-	-	-	(.045)
$Scoring\_bank_b$	-	-	-	-	.195**
	-	-	-	-	(.089)
$Coop_b$	-	-	-	-	-.441***
	-	-	-	-	(.138)
No. firms	2,558	2,558	2,558	2,452	2,440
No. obs.	19,576	19,576	19,576	18,981	17,074

Note: Fixed effect (firm-level) estimation with data at the bank-firm level. Each column corresponds to a regression. The dependent variable is the change of loans from individual banks, normalized to firm's assets, defined over the period September 2008-March 2009. Regressors data refer to, respectively, September 2008 for bank variables and 2007 averages for firm variables. Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). $Small\_f_i$ is a dummy for firms with less than 50 employees; $export_i$ is a dummy for exporting firms (roughly 70% of the total); $high\_risk_i$ is a dummy for firms with high risk of default (as signalled by a Zscore value between 7 and 9), and tfp_i is a dummy for firms whose total factor productivity (demeaned at sectoral level) is higher than the median.

*Significant at the 10-percent level; **significant at the 5-percent level; ***significant at the 1-percent level.

Table 5
Flight to Quality: Heterogeneity across Banks
Dep. variable: Change of loans over firm's assets

Bank and firm variables	(1)	(2)	(3)	(4)	(5)	(6)
Low_cap$_b$	-.808***	-.805***	-1.259***	-.994***	-1.042***	-1.551***
	(.074)	(.074)	(.107)	(.083)	(.088)	(.120)
Low_cap$_b$ · High_risk$_i$	-.194	-.639***	-.483*	-.458**	-.462**	-.729**
	(.168)	(.222)	(.263)	(.197)	(.206)	(.294)
Low_cap$_b$ · High_risk$_i$	-	1.143***	.669**	-	-	.712**
· (1-Large$_b$)	-	(.203)	(.304)	-	-	(.340)
Large$_b$	-	-.162***	.118**	-	-	.314***
	-	(.043)	(.061)	-	-	(.069)
High_risk$_i$ · (1-Large$_b$)	-	-	-.447***	-	-	-.540***
	-	-	(.142)	-	-	(.151)
Low_cap$_b$ · (1-Large$_b$)	-	-	1.197***	-	-	1.563***
	-	-	(.131)	-	-	(.149)
Low_cap$_b$ · High_risk$_i$	-	-	-	1.253***	1.061**	.606
· (1-Scoring_bank$_b$)	-	-	-	(.327)	(.467)	(.455)
Scoring_bank$_b$	-	-	-	.187**	.270***	.101
	-	-	-	(.084)	(.097)	(.100)
High_risk$_i$ · (1-Scoring_bank$_b$)	-	-	-	-	-.427	-.142
	-	-	-	-	(.297)	(.291)
Low_cap$_b$ · (1-Scoring_bank$_b$)	-	-	-	-	.681***	-.135
	-	-	-	-	(.196)	(.200)
No. firms	2,452	2,452	2,452	2,440	2,440	2,440
No. obs.	18,981	18,981	18,981	17,074	17,074	17,074

Note: Fixed effect (firm-level) estimation with data at the bank-firm level. Each column corresponds to a regression. Variables and estimation period are as defined in Table 4; high_risk$_i$ is a dummy for firms whose Zscore is in the 7-9 range. Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). * Significant at the 10-percent level; ** 5-percent level; *** 1-percent level.

Table 6
Corroborating the 'Evergreening' Explanation
Dep. variable: Change of loans over firm's assets

Bank and firm variables	(1)	(2)	(3)	(4)	(5)	(6)
Low_cap$_b$	-.792***	-.789***	-1.256***	-.995***	-1.057***	-1.574***
	(.068)	(.068)	(.100)	(.077)	(.082)	(.112)
Low_cap$_b$ · Imp_bor$_i$	-.671**	-1.266***	-1.158***	-.992***	-.947***	-1.423***
	(.277)	(.360)	(.413)	(.330)	(.342)	(.462)
Low_cap$_b$ · Imp_bor$_i$	-	1.676***	1.402***	-	-	1.657***
· (1-Large$_b$)	-	(.346)	(.486)	-	-	(.569)
Large$_b$	-	-.197***	.158***	-	-	.360***
	-	(.040)	(.057)	-	-	(.064)
Imp_bor$_i$ · (1-Large$_b$)	-	-	-.589***	-	-	-.710***
	-	-	(.213)	-	-	(.233)
Low_cap$_b$ · (1-Large$_b$)	-	-	1.212***	-	-	1.564***
	-	-	(.121)	-	-	(.137)
Low_cap$_b$ · Imp_bor$_i$	-	-	-	1.292***	.645	-.350
· (1-Scoring_bank$_b$)	-	-	-	(.380)	(.564)	(.563)
Scoring_bank$_b$	-	-	-	.145*	.346***	.154
	-	-	-	(.083)	(.099)	(.100)
Imp_bor$_i$ · (1-Scoring_bank$_b$)	-	-	-	-	.003	.446
	-	-	-	-	(.338)	(.321)
Low_cap$_b$ · (1-Scoring_bank$_b$)	-	-	-	-	.836***	.009
	-	-	-	-	(.189)	(.190)
No. firms	2,452	2,452	2,452	2,440	2,440	2,440
No. obs.	18,981	18,981	18,981	17,074	17,074	17,074

Note: Fixed effect (firm-level) estimation with data at the bank-firm level. Each column corresponds to a regression. Variables and estimation period are as defined in Table 4; imp_bor$_i$ is a dummy for firms whose Zscore is in the 7-9 range and whose productivity (sectorally de-meaned) is lower than the sample median. Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). * Significant at the 10-percent level; ** 5-percent level; *** 1-percent level.

Table 7
Evergreening: Robustness on Interest Rates
Dep. variable: Interest rates at the bank-firm level

Bank and firm variables	(1)	(2)	(3)	(4)	(5)	(6)
Low_cap$_b$	.035	.032	.044	.038	.022	.070*
	(.028)	(.028)	(.036)	(.029)	(.030)	(.037)
Low_cap$_b$ · Imp_bor$_i$	-.049	-.063	-.110	.078	.067	-.041
	(.095)	(.105)	(.119)	(.104)	(.105)	(.129)
Low_cap$_b$ · Imp_bor$_i$	-	.034	.151	-	-	.274
· (1-Large$_b$)	-	(.162)	(.194)	-	-	(.205)
Large$_b$	-	-.036	-.049	-	-	-.070*
	-	(.027)	(.035)	-	-	(.038)
Imp_bor$_i$ · (1-Large$_b$)	-	-	-.101	-	-	-.082
	-	-	(.123)	-	-	(.133)
Low_cap$_b$ · (1-Large$_b$)	-	-	-.029	-	-	-.131**
	-	-	(.056)	-	-	(.059)
Low_cap$_b$ · Imp_bor$_i$	-	-	-	-.484**	-.347	-.480*
· (1-Scoring_bank$_b$)	-	-	-	(.190)	(.256)	(.265)
Scoring_bank$_b$	-	-	-	-.020	.018	.059
	-	-	-	(.047)	(.055)	(.056)
Imp_bor$_i$ · (1-Scoring_bank$_b$)	-	-	-	-	-.302*	-.253
	-	-	-	-	(.165)	(.175)
Low_cap$_b$ · (1-Scoring_bank$_b$)	-	-	-	-	.184*	.251**
	-	-	-	-	(.107)	(.111)
No. firms	2,286	2,286	2,286	2,267	2,267	2,267
No. obs.	13,373	13,373	13,373	12,763	12,763	12,763

Note: Fixed effect (firm-level) estimation with data at the bank-firm level. Each column corresponds to a regression. Variables and estimation period are as defined in Table 4; imp_bor$_i$ is a dummy for firms whose Zscore is in the 7-9 range and whose productivity (sectorally de-meaned) is lower than the sample median. Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). * Significant at the 10-percent level; ** 5-percent level; *** 1-percent level.

Table 8
Credit Supply Restrictions and Relationship Lending
Dep. variable: Change of loans over firm's assets

Bank and firm variables	(1)	(2)	(3)
Low_cap_b	-.656***	-.785***	-.799***
	(.073)	(.083)	(.084)
$\text{Low\_cap}_b \cdot \text{Cred\_share}_{b,i}$	-.019**	-.030***	-.026***
	(.008)	(.008)	(.010)
$\text{Cred\_share}_{b,i}$	-.031***	-.028***	-.025***
	(.004)	(.004)	(.005)
High_liq_b	-	.434***	.431***
	-	(.127)	(.128)
Large_b	-	-.227***	-.228***
	-	(.049)	(.049)
Scoring_bank_b	-	.113	.112
	-	(.088)	(.088)
Coop_b	-	-.451*	-.447***
	-	(.140)	(.140)
$\text{Low\_cap}_b \cdot \text{Cred\_share}_{b,i} \cdot \text{Small\_f}_i$	-	-	-.007
	-	-	(.014)
$\text{Cred\_share}_{b,i} \cdot \text{Small\_f}_i$	-	-	-.012
	-	-	(.008)
No. firms	2,552	2,536	2,536
No. obs.	18,378	16,501	16,501

Note: Fixed effect (firm-level) estimation with data at the bank-firm level. Each column corresponds to a regression. Variables and estimation period are as defined in Table 4. Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). *Significant at the 10-percent level; **significant at the 5-percent level; ***significant at the 1-percent level.

Table 9
Evergreening and Relationship Lending
Dep. variable: Change of loans over firm's assets

Bank and firm variables	(1)	(2)	(3)
Low_cap_b	-1.307*** (.091)	-1.117*** (.076)	-1.645*** (.103)
$Low\_cap_b \cdot Imp\_bor_i$	-1.042*** (.400)	-.875*** (.331)	-1.298*** (.445)
$Cred\_share_{b,i}$	-.038*** (.004)	-.039*** (.004)	-.039*** (.004)
$Large_b$	.094 (.058)	-	.296*** (.065)
$Imp\_bor_i \cdot (1\text{-}Large_b)$	-.358 (.230)	-	-.506 (.264)
$Low\_cap_b \cdot (1\text{-}Large_b)$	1.233*** (.115)	-	1.583*** (.133)
$Low\_cap_b \cdot Imp\_bor_i \cdot (1\text{-}Large_b)$	.961* (.524)	-	1.526** (.650)
$Low\_cap_b \cdot Imp\_bor_i$	.025 (.023)	-	-.008 (.031)
$\cdot (1\text{-}Large_b) \cdot Cred\_share_{b,i}$			
$Scoring\_bank_b$	-	.296*** (.099)	.150 (.100)
$Imp\_bor_i \cdot (1\text{-}Scoring\_bank_b)$	-	.218 (.352)	.540 (.345)
$Low\_cap_b \cdot (1\text{-}Scoring\_bank_b)$	-	1.053* (.194)	1.053* (.194)
$Low\_cap_b \cdot Imp\_bor_i \cdot (1\text{-}Scoring\_bank_b)$	-	.142 (.700)	-1.072 (.830)
$Low\_cap_b \cdot Imp\_bor_i$	-	.031 (.020)	.050 (.038)
$\cdot (1\text{-}Scoring\_bank_b) \cdot Cred\_share_{b,i}$			
No. firms	2,444	2,426	2,426
No. obs.	17,612	15,830	15,830

Note: Fixed effect (firm-level) estimation with data at the bank-firm level. Each column corresponds to a regression. Variables and estimation period are as defined in Table 6. Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). * Significant at the 10-percent level; ** 5-percent level; *** 1-percent level.

A Appendix I: Data sources, definition of variables and some descriptive statistics

Bank and credit variables. Data on outstanding loans come from the Italian National Credit Register, maintained at the Bank of Italy. For each borrower, banks have to report to the Register, on a monthly basis, the amount of each loan, respectively granted and utilized, for all loans exceeding a given threshold.[33] The sample of banks is given by the set of intermediaries reporting a positive amount of credit utilized or extended to at least one firm in the sample of firms on either end-September 2008 or end-March 2009 or at both dates. Data on banks' balance sheets refer to the end of September 2008. Summary statistics on the variables are reported in Table A1. Total assets are expressed in millions of euros. The capital ratio is computed as the ratio of total capital to risk-weighted assets and is expressed in percentage points. The numerator of the liquidity ratio is the sum of the amount of cash and securities other than shares, the denominator is total assets. Net interbank liabilities are expressed as a ratio of total assets. The figures for the five major banking groups refer to the set of banks belonging to the five largest banking holding companies. The data for cooperative firms (*BCC*) refer to small local cooperative banks subject to a specific regulatory regime.

Firm variables. Data on employment and hours, labor compensation, investment and capital stock are drawn from the Survey of Industrial and Service Firms (SISF), carried out annually by the Bank of Italy. Data on gross production, purchases of intermediate goods and inventories of finished goods are drawn from the Company Accounts Data Service (CADS - *Centrale dei Bilanci*). Total factor productivity (on a gross-output basis) is computed as follows. Gross output is measured as the value of firm-level production (source: CADS) deflated by the sectoral output deflator computed by ISTAT (the National Statistical Institute). Employment is the firm-level average number of employees over the year (source: SIM); firm-level man-hours include overtime hours (source: SIM). Intermediate inputs are measured as firm-level net purchases of intermediate goods of energy, materials and business services (source: CADS), deflated by the corresponding industry deflator computed by ISTAT. Investment is firm-level total fixed investment in build-

[33] The threshold was equal to euro 75,000 until December 2008 and was then reduced to euro 30,000.

ings, machinery and equipment and vehicles, plus investment in software and patents, (source: SIM), deflated by the industry's ISTAT investment deflator. Capital is the beginning-of-period stock of capital equipment and non-residential buildings at 1997 prices. To compute it, we applied the perpetual inventory method backwards by using firm-level investment data from SIM and industry depreciation rates from ISTAT. The benchmark information is that on the capital stock in 1997 (valued at replacement cost), which was collected by a special section of the SIM Survey conducted for that year. The capital deflator is the industry capital deflator computed by ISTAT. Descriptive statistics on selected firm variables are reported in the Table A2.

Table A1
Summary statistics of bank variables
(percent, unless otherwise indicated)

Five largest banking groups (62 banks)	25th pctile	median	75th pctile	mean
Total assets (milions euro)	2436	10553	24716	30427
Capital ratio	8.9	10.2	12.6	12.1
Liquidity ratio	4.9	6.5	8.3	7.3
All banks (488 banks)				
Total assets (milions euro)	288	716	2384	6073
Capital ratio	10.5	13.0	16.8	15.0
Liquidity ratio	6.5	11.2	17.1	12.3

Source: Banking Supervision Register; data refer to September 2008.

Table A2
Summary statistics of firm variables
(percent, unless otherwise indicated)

Variable	25th pctile	median	75th pctile	mean
Number of employees (units)	45	93	233	357
Real gross output growth	-3.8	3.1	10.9	4.2
TFP growth	-1.6	.6	3.0	.7
TFP level (log-difference from sectoral median)	-12.7	5.1	18.8	.4
Labor revenue-share	9.6	15.5	22.9	18.4
Capital revenue-share	4.7	8.1	12.8	10.0
Materials revenue-share	64.0	74.8	83.1	71.6

Source: SIM and CADS; data refer to 2007.

A Appendix II: Robustness

This section briefly documents a number of robustness exercises conducted on the results presented in Section 4 and 5, all of which have been referred to in the main text.

A first set of exercises investigated the robustness, along four different dimensions, of the evidence of credit supply restrictions reported in Table 2. We replaced the original dependent variable with the rate of growth of loans; results are reported in Table A3 (extreme values of the dependent variable were eliminated by dropping the top and bottom 5% of the distribution).[34] We computed low_cap_b based on the median capital ratio (13.0) as threshold, instead of the 25th percentile; see Table A4 (the size of the coefficient is lower, as expected, since the number of banks involved in the estimation of the effect has doubled, and includes banks with relatively high capital ratios). We changed the definition of credit, by replacing, in the original dependent variable, outstanding loans with total credit lines (utilized and non-utilized); see Table A5 (it may be argued that this is a preferable indicator of credit supply, since their level is chosen mainly by banks, whereas short-term developments of outstanding loans may also reflect the choice of firms, that can increase or decrease the degree of utilization of existing credit lines). We run the baseline regression with consolidated data (both the dependent variable and the regressor low_cap_b); see Table A6. We also adjusted loan data for the accounting effect of securitizations, by re-including loans securitized from October 2008 to March 2009 into the stock of outstanding bank-firm loans at March 2009 (see the Section 4.2 for a discussion of the rationale); see Table A7.

A second set of exercises investigated the robustness (with respect to the

[34] This robustness check is important since our choice of the dependent variable might potentially affect the identification of firm-specific effects within our model. Consider, for example, what would happen if "weak" (undercapitalized) banks were specialized, before the crisis, in "weak" firms (most hardly hit by the crisis). Given the definition of our benchmark dependent variable (i.e., *absolute* changes in credit), the values of such variable might be of a different order of magnitude across banks exposed to a different degree towards a given firm or category of firms, and in principle our firm-specific fixed-effects might fall short of fully capturing demand effects. In such case, the observations related to the banks more exposed to "weak" firms (associated to the largest absolute changes in credit) might possibly drive the estimate of the coefficient of low_cap_b. Results with the rate of growth of loans as dependent variable rule out this potential explanation of our results.

dataset) of the evidence on evergreening reported in Table 6. We included, among the borrowers which may potentially benefit from evergreening, only firms which, at the beginning of the period being considered, were actively borrowing from a given bank. To this purpose, we estimated the regressions reported in Table 6 after dropping the (few) observations associated to firms with imp_bor_i =1 and no outstanding loans by a given bank at September 2008. By doing so, the dummy imp_bor_i identifies (only and all) the potential recipients of 'evergreening' loans. See Table A8.

Finally, we checked the robustness of the evidence on relationship lending with respect to the definition of the dependent variable; namely, we replicated the evidence reported in Table 8 after replacing the original dependent variable with the rate of growth of loans. See Table A9.

Table A3
Credit Supply Restrictions: Robustness on the dependent variable (rate of growth)

Dep. variable: Rate of growth of loans

Bank variables	(1)	(2)	(3)	(4) Pre-crisis
Low_cap$_b$	-9.123***	-9.025***	-7.572***	-2.406
	(1.552)	(1.606)	(1.754)	(1.550)
High_liq$_b$	-	-.856	7.786**	-2.273
	-	(2.396)	(3.473)	(3.872)
Large$_b$	-	-	4.302**	-2.753*
	-	-	(1.766)	(1.631)
Scoring_bank$_b$	-	-	9.091***	4.285***
	-	-	(2.612)	(2.898)
Coop$_b$	-	-	-8.498**	8.189
	-	-	(3.811)	(6.426)
No. firms	2,205	2,205	2,165	2,028
No. obs.	11,008	11,008	9,964	10,541

Note: Fixed effect (firm-level) estimation with data at the bank-firm level. Each column corresponds to a regression. The dependent variable is the rate of growth of loans from individual banks over the period September 2008-March 2009; regressors data refer to September 2008. In column 4, the dependent variable is defined over the period September 2006-March 2007, and regressors data refer to September 2006. In all regressions, extreme values of the dependent variable were eliminated by dropping the top and bottom 5% of the distribution. Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). *Significant at the 10-percent level; **significant at the 5-percent level; ***significant at the 1-percent level.

Table A4
Credit Supply Restrictions: Robustness on the threshold for capital ratio (median)

Dep. variable: Change of loans over firm's assets

Bank variables	(1)	(2)	(3)	(4) Pre-crisis
Low_cap$_b$	-.463***	-.459***	-.422***	.059
	(.065)	(.065)	(.069)	(.051)
High_liq$_b$	-	.257***	.299**	-.071
	-	(.081)	(.144)	(.096)
Large$_b$	-	-	-.240***	-.087*
	-	-	(.045)	(.049)
Scoring_bank$_b$	-	-	.189**	.101
	-	-	(.086)	(.072)
Coop$_b$	-	-	-.249*	-.005
	-	-	(.133)	(.130)
No. firms	2,558	2,558	2,546	2,358
No. obs.	19,576	19,576	17,596	16,602

Note: Fixed effect (firm-level) estimation with data at the bank-firm level. Each column corresponds to a regression. The dependent variable is the rate of growth of loans from individual banks over the period September 2008-March 2009, normalized to firm's assets; regressors data refer to September 2008. In column 4, the dependent variable is defined over the period September 2006-March 2007, and regressors data refer to September 2006. Low_cap$_b$ is a dummy for banks whose capital ratio is lower than the sample median (13.0). Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). *Significant at the 10-percent level; **significant at the 5-percent level; ***significant at the 1-percent level.

Table A5
Credit Supply Restrictions: Robustness on the definition of credit (granted credit)
Dep. variable: Change of total credit lines over firm's assets

Bank variables	(1)	(2)	(3)	(4) Pre-crisis
Low_cap$_b$	-1.758***	-1.821***	-2.235***	.009
	(.093)	(.095)	(.107)	(.055)
Hig_liq$_b$	-	.872***	.989***	.004
	-	(.129)	(.233)	(.105)
Large$_b$	-	-	-.229***	-.059
	-	-	(.054)	(.057)
Scoring_bank$_b$	-	-	.336***	.289***
	-	-	(.101)	(.086)
Coop$_b$	-	-	-.786***	-.057
	-	-	(.164)	(.143)
No. firms	2,530	2,530	2,518	2,325
No. obs.	19,333	19,333	17,371	16,439

Note: Fixed effect (firm-level) estimation with data at the bank-firm level. Each column corresponds to a regression. The dependent variable is the change of total credit lines (utilized and not-utilized) from individual banks over the period September 2008-March 2009, normalized to firm's assets; regressors data refer to September 2008. In column 4, the dependent variable is defined over the period September 2006-March 2007, and regressors data refer to September 2006. Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). *Significant at the 10-percent level; **significant at the 5-percent level; ***significant at the 1-percent level.

Table A6
Credit Supply Restrictions: Robustness with respect to consolidated bank data
Dep. variable: Change of loans (consolidated) over firm's assets

Bank variables (consolidated)	Definition of less-capitalized banks: Threshold on the consolidated capital ratio:	
	25th percentile (i.e., 11.0)	Median (i.e., 13.2)
Low_cap_cons$_b$	-.213***	-.209**
	(.080)	(.099)
No. firms	2,557	2,557
No. obs.	14,890	14,890

Note: Fixed effect (firm-level) estimation with data consolidated at the banking group level. Each column corresponds to a regression. The dependent variable is the rate of growth of loans from banking groups (or individual banks, in the case of banks which do not belong to groups) over the period September 2008-March 2009, normalized to firm's assets; regressor data refer to September 2008. Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). *Significant at the 10-percent level; **significant at the 5-percent level; ***significant at the 1-percent level.

Table A7
Credit Supply Restrictions: Robustness with respect to the accounting effect of securitizations

Dep. variable: Change of loans over firm's assets

Bank variables	(1)	(2)	(3)
Low_cap$_b$	-.819***	-.851***	-1.069***
	(.065)	(.067)	(.075)
High_liq$_b$	-	.436***	.550***
	-	(.084)	(.144)
Large$_b$	-	-	-.137***
	-	-	(.045)
Scoring_bank$_b$	-	-	.212**
	-	-	(.087)
Coop$_b$	-	-	-.441***
	-	-	(.137)
No. firms	2,558	2,558	2,546
No. obs.	19,578	19,578	17,596

Note: Fixed effect (firm-level) estimation with data at the bank-firm level. Each column corresponds to a regression. The dependent variable is the change of loans from individual banks over the period September 2008-March 2009, normalized to firm's assets; regressors data refer to September 2008. Loan data include securitized loans. Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). *Significant at the 10-percent level; **significant at the 5-percent level; ***significant at the 1-percent level.

Table A8
Evergreening:
Robustness with respect to the dataset
Dep. variable: Change of loans over firm's assets

Bank and firm variables	(1)	(2)	(3)	(4)	(5)	(6)
Low_cap$_b$	-.818***	-.814***	-1.287***	-1.020***	-1.085***	-1.605***
	(.068)	(.068)	(.100)	(.077)	(.082)	(.112)
Low_cap$_b$ · Imp_bor$_i$	-.642**	-1.302***	-1.078***	-.973***	-.898***	-1.318***
	(.271)	(.347)	(.405)	(.325)	(.337)	(.452)
Low_cap$_b$ · Imp_bor$_i$	-	1.836***	1.228**	-	-	1.406**
· (1-Large$_b$)	-	(.347)	(.491)	-	-	(.576)
Large$_b$	-	-.236***	.143**	-	-	.349***
	-	(.041)	(.057)	-	-	(.065)
Imp_bor$_i$ · (1-Large$_b$)	-	-	-.249	-	-	-.408
	-	-	(.232)	-	-	(.267)
Low_cap$_b$ · (1-Large$_b$)	-	-	1.231***	-	-	1.584***
	-	-	(.121)	-	-	(.138)
Low_cap$_b$ · Imp_bor$_i$	-	-	-	1.646***	.686	-.201
· (1-Scoring_bank$_b$)	-	-	-	(.436)	(.604)	(.641)
Scoring_bank$_b$	-	-	-	.115	.339***	.154
	-	-	-	(.084)	(.100)	(.102)
Imp_bor$_i$ · (1-Scoring_bank$_b$)	-	-	-	-	.326	.576*
	-	-	-	-	(.343)	(.336)
Low_cap$_b$ · (1-Scoring_bank$_b$)	-	-	-	-	.862***	.025
	-	-	-	-	(.191)	(.193)
No. firms	2,444	2,444	2,444	2,428	2,428	2,428
No. obs.	18,565	18,565	18,565	16,703	16,703	16,703

Note: Fixed effect (firm-level) estimation with data at the bank-firm level. Each column corresponds to a regression. Variables and estimation period are as defined in Table 6. Observations with Zscore$\geq$7 and no reported outstanding loans at September 2008 are dropped from the sample. Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). * Significant at the 10-percent level; ** 5-percent level; *** 1-percent level.

Table A9
Credit Supply Restrictions and Relationship Lending: Robustness on the dependent variable

Dep. variable: Rate of growth of loans

Bank and firm variables	(1)	(2)	(3)
Low_cap_b	-13.149***	-9.183***	-9.164***
	(2.204)	(2.503)	(2.514)
$Low\_cap_b \cdot Cred\_share_{b,i}$	.326***	.112	.094
	(.124)	(.144)	(.167)
$Cred\_share_{b,i}$	-.541***	-.576***	-.534***
	(.076)	(.080)	(.094)
$High\_liq_b$	-	7.355**	7.401**
	-	(3.454)	(3.457)
$Large_b$	-	5.190***	5.180***
	-	(1.773)	(1.774)
$Scoring\_bank_b$	-	9.269***	9.271***
	-	(2.618)	(2.617)
$Coop_b$	-	-8.694**	-8.700**
	-	(3.788)	(3.785)
$Low\_cap_b \cdot Cred\_share_{b,i} \cdot Small\_f_i$	-	-	.054
	-	-	(.209)
$Cred\_share_{b,i} \cdot Small\_f_i$	-	-	-.144
	-	-	(.163)
No. firms	2,205	2,165	2,165
No. obs.	11,008	9,964	9,964

Note: Fixed effect (firm-level) estimation with data at the bank-firm level. Each column corresponds to a regression. The dependent variable is the rate of growth of loans over the period September 2008-March 2009; regressors data refer to September 2008. Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). *Significant at the 10-percent level; **significant at the 5-percent level; ***significant at the 1-percent level.

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