# Does credit crunch investment down?

## New evidence on the real effects of the bank-lending channel

**Abstract**

We quantify the real effects of the bank lending channel exploiting the dramatic liquidity drought in interbank markets that followed the 2007 financial crisis as a source of variation in credit supply. Using a large sample of matched firm-bank data from Italy, we find that banks pre-crisis exposure to interbank markets negatively predicts subsequent credit supply and has a significant, negative direct impact on firms investment. Our estimates imply that investment expenditure in the sample would have been more than 20% higher, had the interbank market not collapsed. Using exposure as an instrument, we quantify the sensitivity of investment to bank credit. We calculate that investment expenditure at the average firm would have increased by around 30 cents per additional euro of available credit in the aftermath of the crisis. We also find that credit shocks more generally affect the firm's value added, employment and input purchases, and that they propagate through firms' trade credit chains.

# 1 Introduction

The 2007-2008 financial crisis has been followed by the deepest recession since the 1930s, with most developed countries experiencing, in particular, a dramatic drop in private investment. Because it followed a series of major shocks to banks' liquidity, the fall in investment has often been traced back to a supply-driven contraction of credit (a "credit crunch"), during which intermediaries proved unable to mitigate the consequences of liquidity shortages on lending conditions (the so-called "bank lending channel", BLC).

However, the actual relevance of the BLC for firm investment and, more generally, the sensitivity of investment to bank credit remain largely unexplored empirically. Quantifying these magnitudes requires credibly isolating supply- from (firm-specific) demand-determinants of credit growth on one hand, and disentangling the role of credit from that of alternative (observed and unobserved) drivers of investment on the other. Moreover, identification necessitates detailed information on both bank-firm relationships and banks' and firms' balance sheets.

In this paper we exploit the dramatic liquidity drought in interbank markets that followed the 2007 and 2008 financial shocks (owing to the subprime mortgage crisis and to Lehman's default, respectively) as credit supply curve shifters. Drawing on a large matched firm-bank dataset from Italy, we first show that banks that were highly exposed to interbank borrowing before the crisis subsequently tightened credit conditions (as measured by credit quantities) more than other banks (Iyer et al. 2013 found the same in the case of Portugal).

We then assess the consequences of deteriorating credit conditions for firm outcomes. First, we quantify the direct effect of the bank shock on capital accumulation during the Great Recession computing the fraction of the aggregate drop in investment traceable to the interbank market collapse. Using the shock as an instrumental variable, we then estimate the sensitivity of firm investment to bank credit availability. Finally, we extend the analysis beyond capital looking at other inputs (such as employment and intermediate goods purchases) and at output (value added) thus shedding light on the more general consequences of deteriorated credit market conditions for firm activity.

Our work draws on a unique dataset combining firm-bank matched data from the Italian Credit Register (CR) with balance-sheet information available for around 30,000 non-financial firms (and for all their lenders). Credit Register data are essential for the analysis: they allow us to recover all existing bank-firm relationships and the corresponding amount of credit that flows over time. We use lenders' reliance on interbank funding before the crisis as a measure of *bank exposure* to the shock, and its credit-share weighted average at the firm level as a measure of *firm exposure* to the shock. Identification hinges on the assumption that exposure to the shock is uncorrelated with any unobserved determinant of the credit market or investment outcomes.

The data allow us to test the validity of such assumption in a number of ways. First, we show that firm exposure is not correlated with credit growth or capital accumulation before the financial crisis (neither in previous recession periods nor in normal times). Firm exposure is also uncorrelated with pre-crisis observable firm- (and bank-) characteristics that plausibly affected the credit market or investment outcomes after the shock (e.g., measures of firm riskiness and profitability). Third, our core estimates are unaffected when we account for proxies of unobserved firms' growth opportunities during the crisis (i.e., their short-term expectations of investment elicited just before the crisis, and an estimate of firm demand for credit obtained from a within-firm model of credit growth). Finally, within-firm credit regressions suggest that bank exposure is uncorrelated with unobserved determinants of firm credit demand, which corroborates the idea that the matching of banks and borrowers is as good as random.

Our results show that the real effects of negative supply shocks in the credit market are sizable. Reduced-form regressions of investment on firm exposure imply that, had the interbank market not collapsed in 2007, the total investment expenditure in the four subsequent years would have been more than 20% higher than observed. The impact of the shock proved to be stronger among small and young firms as well as those with a high dependence on bank credit. Interestingly, however, we do not find that banks selectively reduced credit on the basis of those firm characteristics. Taken together, these results suggest that financially vulnerable firms face greater difficulties in tapping alternative sources of finance to compensate for a given fall in bank credit.

The analysis more generally show that firm investment decisions are highly sensitive to bank credit availability. Our baseline estimate implies that a 10 percentage point fall in credit growth triggers, on average, a 2.6 percentage points fall in the investment rate. Back-of-the-envelope calculations based on a range of alternative estimates suggest that investment expenditure at the average firm would have increased by 25-35 cents per additional euro of available credit during the Great Recession.

Looking beyond investment, we find that the shock to bank credit more generally induced a significant downsizing of firm's activity, as measured by value added (the value of production less the cost of inputs), employment, labor costs, and intermediate input expenditure. For example, we estimate that firms facing a 10 percentage point fall in the growth rate of credit between 2006 and 2010 lowered value added and employment growth by nearly 2.6 and 1.8 percentage points, respectively. Hence, the 2007 bank shock exacerbated the subsequent recession. Our reduced-form estimates in fact imply that it accounted for around half of the aggregate drop in value added observed in the sample between 2006 and 2010 (which amounted to nearly 5% in real terms).

Finally, we find evidence that the direct effects of the credit crunch may have been amplified through firms' trade credit chains, as predicted by the theoretical model of Kiyotaki and Moore (2004). Indeed, according to our estimates, a firm facing a 10 percentage point decrease in bank credit growth will in turn lower the growth rate of trade credit to its customers by almost 4 percentage points.

Our findings make several contributions to the literature. Recent studies use credit register data to estimate the effect of shocks to bank liquidity on credit supply. Iyer et al. (2013) show that Portuguese banks that relied more on interbank borrowing before the 2007 crisis tightened credit supply more than other banks. Khwaja and Mian (2008) and Schnabl (2012) estimate the consequences of liquidity shocks hitting Pakistani and Peruvian banks, respectively. While none of these studies look beyond credit, we provide comprehensive evidence on the consequences of bank shocks on the real economy.

Previous studies on the real effects of credit supply shocks either employ aggregate data (Peek and Rosengren 2000) or focus on samples of publicly listed firms (Gan 2007a, 2007b, Almeida et al. 2012, Amiti and Weinstein 2013, Campello et al. 2010, Chava and Purnandaram 2011, Duchin et al. 2010). Both approaches have limitations.

The use of aggregate data does not allow to fully distinguish whether the estimated effect is driven by firms' or consumers' responses to the shock. Moreover, convincing measurement of the real effects of the BLC should first ascertain that individual firms are affected by changes in credit supply, controlling for factors affecting credit demand. Focusing on publicly listed firms, on the other hand, only captures a limited portion of aggregate investment, employment or value added. Moreover, listed firms are likely to provide a biased portrait of the real impact of the BLC, which is presumably stronger for small firms (e.g., due to limited availability of alternative sources of external finance), as confirmed by our analysis.

A notable exception is the contemporaneous work by Balduzzi et al. (2014) who also study the impact of financial shocks on investment and employment using a representative sample of approximately 3,000 Italian firms. We complement and extend their findings by looking at a larger sample and a broader set of outcomes. Importantly, access to loan-level information for each bank-firm relationship allows us to precisely assess the relevance of the financial shock as a source of variation in bank credit supply, as well as the sensitivity of firm activity to credit availability.

Few very recent papers use detailed loan-level data to provide evidence of the real effects of credit shocks. Chodorow-Reich (2014) finds that U.S. bank exposure to the Lehman default had a sizable impact on employment for medium and small firms. He focuses on a sample of about 2,000 medium-sized and large firms, and restricts to syndicated loans, which represent an important but small segment of the credit market. We add to his results using more comprehensive credit register data, by focusing on a larger sample that includes a significant fraction of small firms, and by looking at a wider set of real outcomes (most notably investment). Our broader focus on firms' outcomes distinguishes our study from the ongoing work of Bentolila et al. (2014), who also use credit register data to estimate the employment consequences of the recent financial crisis in Spain. They find that firms attached to weak banks (those eventually bailed-out by the Spanish government) suffered a larger drop in employment than firms attached to stronger banks. Finally, Paravisini et al. (2015) study the impact of the 1998 Russian crisis on exports by Peruvian firms. They find that export decisions are sensitive to credit supply, but that the specific shock only explains a small fraction of the aggregate fall in Peruvian exports. We extend their findings by looking at the effect of credit shocks on investment, employment, and the whole scale of firm activity. Moreover, we do not restrict our analysis to the sub-sample of exporting firms, which are typically more productive than the average firm. Coupled with the plausibly higher intensity of the shock, this may explain why we instead find that the interbank market crisis had a large impact on firm activity and accounts for a significant fraction of the overall drop in investment in Italy during the last recession.

## 2 The interbank market freeze as a shock to bank lending

The relevance of bank shocks for credit availability has long been acknowledged in the literature. According to the Bank Lending Channel (BLC) theory, bank shocks matter because, in particular, they impact banks external finance premium, and this is reflected in the cost and availability of funds to bank-dependent borrowers.[1] Indeed, in a simple model of credit supply, banks' optimal level of lending equates the expected return on the loans to the cost of its funding. When hit by a, say, negative shock to one source of external finance that cannot be compensated by tapping into other sources, banks shift the supply of loans inward.

Recent empirical studies estimate the strength of the BLC exploiting the 2007 freeze of the interbank market (Ivashina and Scharfstein 2010, Bonaccorsi di Patti and Sette 2012, Iyer et al. 2013, Kapan and Minoiu 2013). The underlying idea is that, because interbank deposits represent banks' marginal source of funding, their price affects banks' external finance premium. If the shock to interbank funding cannot be fully compensated by other sources of finance, banks with higher exposure to the interbank market should tighten credit conditions relatively more than less exposed banks.[2]

The cost of interbank funding increased significantly during the 2007-2008 financial crisis. As Figure 1 shows, starting in the second half of 2007 the price of unsecured inter-

[1]Several authors argue that, because today non-reservable liabilities represent a large fraction of banks' loanable funds, intermediaries pay an external finance premium, just as non-financial firms. The premium reflects the credit risks associated with uninsured lending or the perceived creditworthiness of the institution (Kashyap and Stein 1995, Bernanke and Gertler 1995, Stein 1998 and Bernanke 2007).

[2]A further reason why an interbank market freeze has the potential to affect credit conditions is that it significantly increases banks' expected cost of absorbing negative liquidity shocks, making it more difficult for exposed banks to roll over their wholesale deposits. According to Cornett et al. (2011), this may have induced banks to substitute illiquid assets, such as loans, with more liquid assets, such as securities.

bank deposits in Europe ("Euribor") sharply increased relative to secured deposits ("Eurepo"). The volume of unsecured interbank deposits also contracted markedly (Brunnermeier 2009; see Figure 2 for the case of the Italian market). Importantly, the volume and price of secured interbank deposits followed similar patterns during the crisis, because of the general reduction in the quality of collateral, and the lowered banks' propensity to lend (Gorton and Metrick 2010). In this context, switching to other sources of finance proved extremely difficult: the cost of issuing bonds rose sharply, while the rapidity of the shock and the subsequent recession did not allow banks to raise retail deposits quickly enough (Brunnermeier 2009).[3] As a matter of fact, many of the studies mentioned above confirm that the shock had sizable consequences on subsequent credit flows.

While affecting most European countries, the interbank market freeze seems particularly well-suited to identify the effects of credit shortages in the case of Italy. First, the shock there was particularly severe. As Figure 2 shows, the average daily volume of interbank deposits negotiated yearly on the e-MID market had topped 20 billion Euros in 2006, when interbank funding represented a large share of total assets of the average bank (12.3%). Transactions began to shrink starting in July 2007 and plummeted in the two subsequent years, reaching 4.7 billion by the end of 2010.

Second, in Italy the interbank market collapse was not amplified by concurrent

[3] Importantly, interbank markets did not return to their pre-crisis levels even after the ECB liquidity injections (Bank of Italy 2009). Indeed, as we show in Section 5.1, we do not find evidence that the strength of the effect of pre-crisis exposure to the interbank market on subsequent credit growth weakened after 2008 (when the ECB introduced the fixed rate tender procedure with full allotment, which allowed banks to obtain unlimited liquidity at a fixed rate in return for collateral. See ECB (2009) for a further description of these measures). This result is common to other papers looking at the consequences of recent liquidity shocks for credit and has been interpreted as evidence of liquidity hoarding (Acharya and Merrouche 2013, Cornett et al 2011, Brunetti et al. 2011).

shocks in other key asset markets. In fact, the balance sheets of Italian banks were only marginally affected by losses due to holdings of "toxic" assets (Asset Backed Securities, Collateralized Debt Obligations, etc.), or to off-balance sheet exposure to Special Purpose Vehicles or Lehman's liabilities (Bank of Italy 2009).

Moreover, Italy did not experience a real estate bubble (Nobili and Zollino 2012). This implies that Italian banks did not suffer much from losses on mortgages, households were not hit by adverse wealth effects, and firms were not harmed by reductions in commercial property prices, which may decrease their collateral.

The balance sheets of Italian banks were affected by a relevant, though subsequent, shock which may act as a confounding factor: the European sovereign debt crisis starting in the summer of 2011. Therefore, our empirical analysis will focus on a time window ending in 2010.

As a final remark, note that, in practice, there are several possible channels through which an increase in banks cost of funds can translate into worsened credit conditions to borrowers. For example, banks might pass on the higher cost to their clients offering the same quantities of credit at higher prices. Alternatively, if they fear that increasing prices would induce adverse selection (as emphasized by Stiglitz and Weiss, 1981) banks could react rationing credit quantities. We do not aim at assessing the relative importance of these (or other) channels. Following the empirical BLC literature, we will mainly track changes in credit market conditions through changes in credit quantities, which are precisely measured in the Credit Register. In section 7.2, we will briefly consider whether the credit supply tightening also affected the available measures of interest rates charged on credit.

**Preliminary evidence.** Figure 3 provides prima facie evidence on the patterns of credit and investment flows around the collapse of the interbank market. It focuses on firms, distinguishing those with above-and below-median exposure to the shock. The left panel of Figure 3 plots the percentage change in the total outstanding credit for the two groups of firms relative to 2006. The graph shows that before the crisis (i.e., from 2002 to 2006) credit flows followed very similar patterns across the two groups. Starting in 2007, however, credit to high-exposure firms began to grow at significantly lower rates relative to low-exposure firms. The right panel plots total yearly net investment rate (as a ratio of total assets in 2001) by firms in the same groups (see Figure A1 for a similar plot using the cumulative net investment rate). As in the case of credit, the two lines overlap until 2006, but diverge starting from 2007, when investment expenditure by high-exposure firms decreases significantly more relative to low-exposure firms.

Although these patterns are only suggestive, as equilibrium outcomes reflect both supply and demand determinants, they are consistent with the idea that exposure to the interbank market shock influenced the dynamics of credit and investment during the crisis. The next section describes our approach to identify and quantify these effects.

# 3 Empirical strategy

Assessing the consequences of the interbank market collapse on real outcomes involves two steps. First, we need to show that bank exposure to the shock induced significant changes in the subsequent supply of credit to firms. The second step involves quantifying the consequences of the credit tightening for firm real outcomes, starting from investment (capital accumulation).

Identification hinges on the assumption that exposure to the interbank market is not correlated with any unobserved determinants of credit market or real outcomes. This would not be the case if, for example, firms with low growth opportunities tended to borrow from high-exposure banks. This section will discuss these issues in turn.

### 3.1 Assessing the strength of the Bank Lending Channel

Khwaja and Mian (2008) pioneered a simple approach to identify the impact of a bank liquidity shock on credit supply while accounting for observed and unobserved determinants of credit demand. When a panel of matched bank-firm data is available, the methodology consists in comparing *within*-borrower variation in the growth rate of credit from banks with different exposure to the shock. The estimating equation is as follows:

$$\frac{\Delta C_{ij}}{C_{ij,2006}} = \alpha + \beta B_j + d_i + \varepsilon_{ij} \tag{1}$$

where the dependent variable is the growth rate of credit granted to firm $i$ by bank $j$ after the shock (including both drawn and undrawn credit), $B_j$ is bank $j$ exposure to the shock (henceforth "Bank Exposure") measured in 2006, and the fixed effect $d_i$ captures firm-specific determinants of credit flows, which is usually interpreted as a measure of credit demand.[4] A negative estimate of $\beta$ in model (1) indicates that high-exposure

[4]Credit growth is computed as the percentage growth rate of total outstanding credit (committed credit) $C_{ij,t}$ in a bank-firm relationship: $\hat{C}_{ij} = \frac{C_{ij,2010}}{C_{i,2006}} - 1$. Using percent changes has two main advantages over the log-difference approximation ($\hat{C}_{ij} \approx \log C_{ij,2010} - \log C_{ij,2006}$). First, it allows

banks reduced lending more relative to low-exposure banks, even looking at the *same* borrower. Hence, the strength of the BLC is estimated upon controlling for any firm characteristics that may affect credit market outcomes.

The within-firm specification (1), however, does not allow assessing the impact of the bank shock on the (percentage) growth rate of *total* credit ($\Delta C_i/C_{i,2006}$), because that includes credit flows from both existing *and* new relationships (the extensive margin). If the latter represent an important margin of adjustment, the overall strength of the BLC should rather be estimated using the related between-firm (i.e., cross sectional) equation:

$$\frac{\Delta C_i}{C_{i,2006}} = \bar{\alpha} + \bar{\beta}\bar{B}_i + d_i + \bar{\varepsilon}_i \tag{2}$$

where $\bar{B}_i = \sum_j w_{ij} * B_j$ (referred to as "Firm Exposure") is the weighted average of Bank Exposure computed across the firm's lenders ($B_j$), with weights $w_{ij}$ equal to the share of credit granted by each lender $j$ on December 31st, 2006.

In the cross-sectional model (2) the firm-specific demand shock $d_i$ cannot be absorbed. Thus, a simple OLS estimate of $\bar{\beta}$ would be biased if Firm Exposure is correlated with credit demand. It turns out, however, that one can exploit the within-firm specification (1) to correct for the potential bias in (2). This can be achieved in two equivalent ways: either with a numerical correction that exploits the difference between estimates of $\beta$ in (1) obtained from OLS and fixed-effect models ($\beta_{OLS} - \beta_{FE}$), as in

accounting for terminated relationships (i.e., the cases in which $C_{ij,2010} = 0$). Second, it is more precise, given the wide range of variation in credit growth at the bank-firm level. In practice, as we show in Table A1 of the Appendix, our core estimates would have been similar had we used log-differences.

Jimenez et al. (2010) or by including estimates of $d_i$ from (1) in equation (2), as in Bonaccorsi di Patti and Sette (2012). In the remainder of the paper we focus on the latter approach, which eases inference both in (2) and in the 2SLS model (4) described below. We provide a formal proof and an empirical test of the equivalence of the two approaches in Appendix A3.

Jimenez et al. (2010) also propose a direct test of the relevance of biases arising from the endogenous matching between firms and banks (the main threat to identification in this context) exploiting model (1). They argue that if unobservable firm characteristics that affect the credit relationship were systematically correlated with exposure, the above mentioned difference ($\beta_{OLS} - \beta_{FE}$) should be sizable, reflecting the omitted variables. Consistently, one should estimate a substantial correlation between exposure and the estimated $d_i$. As we will show in Section 5.1, this is not the case in our data, suggesting that Bank Exposure to the shock is uncorrelated with unobserved determinants of credit demand.

### 3.2 Impact on capital accumulation

In examining the consequences of credit supply tightening on investment, we have two main objectives. The first is to quantify the contribution of the negative bank shock to the aggregate fall in capital accumulation between 2006 and 2010 (the first phase of the recent Italian recession). To achieve that, we estimate the reduced-form effect of firm exposure to the shock ($\bar{B}_i$) on a measure of firm *cumulative net* investment over the same time interval:

$$\frac{CI_i}{K_{i,2006}} = \pi + \lambda \bar{B}_{i,2006} + X_i \Phi + \epsilon_i \quad (3)$$

where $CI_i = \sum_t I_{i,t},\ t = 2007...2010$ is the sum of net investment flows after the shock, normalized by beginning-of-period assets, as customary in the empirical investment literature.[5] The matrix of controls $X_i$ includes sector and province fixed-effects; a set of commonly used proxies for firm growth opportunities and frictions to capital accumulation, measured before the shock (these will be detailed in Section 5.2); and the vector of firm-specific credit demand parameters ($\hat{d}_i$) estimated in (1).

Conditional on Firm Exposure being exogenous to firm investment decisions (an assumption we discuss below), estimates of $\lambda$ can be used to infer the *aggregate* impact of the bank shock on capital accumulation among firms in the sample (see Section 5.2 for calculation details).

Our second objective is to quantify the sensitivity of firm capital accumulation to the availability of bank credit. This is obtained by estimating a two-stage regression of cumulative firm investment on the contemporaneous flow of bank credit ($c_i$), using Firm Exposure ($\bar{B}_i$) as an instrument for credit growth in the first stage:

$$\frac{CI_i}{K_{i,2006}} = \pi + \theta \frac{\Delta C_i}{C_{i,2006}} + X_i \Phi + \epsilon_i \quad (4)$$

[5]Focusing on net investment (defined as the gross investment expenditure net of divestment) allows us to better measure the change in the firm's stock of capital over the period of interest. However, our results would have not been affected, had we used gross investment, as shown in Table A2. Note also that our results would be equivalent (except for a constant), had we used (e.g., Gan 2007b) the *average* investment rate computed over the same period: $\bar{IR}_i = 1/4 * (CI_i/K_{i,2006})$. Following Duchin et al. (2010) investment is normalized by total firm assets ($K_{i,06}$).

$$\frac{\Delta C_i}{C_{i,2006}} = \alpha + \chi \bar{B}_i + X_i \Pi + \epsilon_{it} \tag{5}$$

Conditional on the validity of Firm Exposure as an instrument, $\theta$ measures the percentage point variation in the investment rate of firms facing a 1 percentage point fall in the growth rate of credit.[6] This parameter can be used to infer by how much would investment expenditure by a representative firm increase per each additional euro of available credit: $\Delta CI_i = \theta * K_{i,2006}/C_{i,2006}$, where $C_{i,2006}$ is the amount of the total outstanding credit at firm $i$ (see Section 5.2).

While the emphasis here is on firm investment, the same equations can be used to assess the relevance of the BLC on other production inputs (such as employment and expenditure on intermediate goods) and on the firm's value added. This part of the analysis will be presented in Section 7.3.

**Identification issues.**

Identification of the real consequences of the BLC requires Firm Exposure $\bar{B}_i$ to be correlated with credit growth but unrelated to any other determinant of firm investment following the shock. The first condition can be directly checked by looking at the size and significance of $\chi$ in the first stage regression (5). However, the assumption that Firm Exposure is as good as randomly assigned to firms (the exclusion restriction) can only be indirectly assessed.

In Section 6, we report a comprehensive set of tests supporting the validity of this

[6] Note that adopting this specification allows us to interpret equation (3) as the reduced-form expression (the so called *intention-to-treat*, or ITT, effect) of the two-stage model. Moreover, note that the first stage (5) is ultimately the between-firm credit growth model (2) augmented with the matrix $X_i$ of firm characteristics.

assumption. In particular, we show that (consistently with Figure 3) Firm Exposure was uncorrelated with credit growth and capital accumulation before the onset of the crisis (Section 6.1), notably during previous recession episodes (Section 6.2).[7] Moreover, Firm Exposure is not correlated with unobservable firm characteristics, as captured by firm fixed-effects ($\hat{d}_i$) estimated in (1), or with self-reported, pre-crisis growth expectations by firms (Section 6.3). We also show that pre-crisis observable firm and bank characteristics are balanced across the distribution of Firm Exposure (Section 6.4). Finally, Sections 6.5 and 6.7 test the robustness of our results to a range of checks of the empirical specification and the selection of the sample.

Note that, because our measure of exposure to the shock is time-invariant, our analysis (as most other empirical works on the BLC) exploits cross-sectional rather than longitudinal variation.[8] However, we can still estimate a difference-in-difference model comparing *changes* in credit and investment flows across firms with different exposure to the shock, before and after the shock. Similarly, we can characterize the time pattern of the impact of the shock by estimating several cross-sectional models with different time-spans (from 2006 to 2007, 2008, and 2009). The results from these extensions are discussed at the end of Section 6.7.

[7] In Table A3 we also show that Bank Exposure $B_j$ had no effect on credit growth before the crisis, controlling for firm unobserved heterogeneity as in model (1).

[8] The latter would require finding a convincingly exogenous time-varying measure of banks' exposure to the interbank market shock. This seems unlikely in our context. For example, interacting Firm Exposure with the time-varying Euribor-Eurepo spread (or its US counterpart, the LIBOS-OIS spread) would not help, because the spread dynamics reflect the conditions of banks, or market expectations on the evolution of economic activity. These are, in fact, likely to be correlated with firms' investment opportunities.

## 4 Data

Our analysis draws on a high-quality, matched bank-firm dataset containing detailed information on credit relationships and balance sheets both before and after the financial crisis. The final dataset is obtained by combining three main sources which are briefly illustrated in this section (a more detailed description can be found in Appendix A5.1).

The first source is the Italian Credit Register (CR) administered by the Bank of Italy and collecting individual data on borrowers with total exposure (debt and guarantees) above 75,000 euros towards banks operating in Italy. For each firm-bank pair, we recover the end-of-year total outstanding credit granted (including both drawn and undrawn credit).

We match CR with the Company Accounts Data System (CADS), administered by CervedGroup. This matching yields a sample of 38,797 non-financial incorporated firms active in 2006, for which we observe detailed balance-sheet information. It is the largest sample of Italian firms for which data on investment flows are available. In 2006, net revenues by sampled firms accounted for more than 75% of total revenues.

Finally, data on bank characteristics are sourced from the consolidated balance-sheet data submitted by banks to the Bank of Italy through the Supervisory Reports. These data allow, in particular, to compute the exposure of each bank to the interbank market as of December 2006 (Bank Exposure). Specifically, Bank Exposure is obtained as the ratio between interbank liabilities (including repos with other banks, but excluding those with the ECB) and total bank assets (Iyer et al. 2013, Bonaccorsi di Patti and Sette

2012, Kapan and Minoiu 2013). Branches of foreign banks are excluded from the sample, because true external interbank funding cannot be distinguished from transfers of funds from the headquarters in their case.

To obtain our baseline sample, we select all credit relationships between Italian banks and CADS firms. To estimate firm credit demand in model (1), we restrict the analysis to firms that had obtained loans from at least two banks as of December 2006. Because multiple banking is very common in Italy, also among small firms (Detragiache et al. 2000, Gobbi and Sette 2013), single-bank firms amount to just 8.25% of the original sample. Further details on data construction are provided in Appendix A5.2. Overall, the sample includes 31,047 firms whose characteristics are summarized in Table 1.

As discussed in Section 3.2, our main outcome variable is the firm's cumulative net investment rate, obtained as the sum of investment expenditure (net of divestments) between 2007 and 2010, normalized by the value of firm assets in 2006. Credit growth is measured as the percent change in the total outstanding credit granted to each firm between December 2006 and December 2010. Other dependent variables listed in Table 1 are used in the extensions of Section 7.3. All independent variables are measured as of December 2006 (see Appendix A5.2 for details on their construction). Sampled firms are on average small: median assets are 1.9 million euros (approximately 2.5 million US Dollars at 2006 exchange rates), and almost entirely not listed.[9] Approximately 53% of firms operate in manufacturing, 45% in the tertiary sector, and 2% in agriculture. Construction firms are excluded.

[9] In Italy, as of December 2006, only 248 firms were listed.

# 5 Results

## 5.1 Interbank market exposure and credit supply

Table 2 reports our findings on the credit growth models presented in Section 3.1. Columns 1 to 3 focus on the impact of Bank Exposure (the interbank liabilities-to-assets ratio in 2006, $B_j$) on credit growth at the bank-firm level. The coefficient reported in the first column refers to a simplified version of model (1), excluding the firm fixed effects $d_i$. These are included in the second specification, thus absorbing any potential bias induced by the endogenous matching between firms and banks. Both estimates point to a negative and statistically significant effect of the shock, implying that a 10 percentage point increase in Bank Exposure lowered the credit growth by about 7 percentage points between 2006 and 2010. As discussed in Section 3.1, the two point estimates being almost identical is very reassuring in terms of identification. Intuitively, if relevant unobserved characteristics of borrowers were correlated with Bank Exposure, one would expect the point estimates to change across the two specifications to reflect the omitted variables.

In column 3, we include further controls for bank characteristics that proxy for potentially confounding factors in the transmission of the financial shock. Following Iyer et al. (2013), these include bank liquidity, capital ratio, loan charge-offs, ROA, and size (all measured as of December 2006).[10] The effect of Bank Exposure on credit supply

[10]Iyer et al. (2013) argue that the liquidity ratio (cash and government bonds to total assets) captures banks' capacity to absorb liquidity shocks; capital (equity to total assets) and ROA (net profits to total assets) capture banks' ability to take risk and to absorb future losses; and loan charge-offs (relative to total assets) measures whether banks are already absorbing losses on their loan portfolio (Santos, 2011).

remains negative and significant (if anything, it becomes larger) suggesting that Bank Exposure is not capturing any of these characteristics.

Columns 4 to 6 show estimates of the between firm equation (model 2), looking at the impact of Firm Exposure ($\bar{B}_i$, measured in 2006) on total credit growth between 2006 and 2010. The specification in column 4 only accounts for industry (2 digit Ateco) and province fixed-effects, while that in column 5 also includes the firm-specific fixed-effect estimated in model (1). As in the case of the within-firm specification, the inclusion of a control for credit demand does not affect the results.[11] The between-firm estimates, which are very similar in magnitude to the within-firm estimates, imply that a 10 percentage point increase in Firm Exposure lowered total credit growth by 7.6-7.9 percentage points. This result is unaffected (if anything, it becomes larger) by the inclusion of bank and firm controls (column 6).[12]

Taken together, the evidence from the two credit growth models reported in Table 2 indicates the following: i) Bank Exposure had a significant effect on the supply of credit to firms; ii) this remains true when accounting for unobservable determinants of credit demand (which show no correlation with the exposure measures), supporting the validity of the identification assumptions; and iii) the effects of Bank and Firm Exposure are numerically very similar, suggesting that firms were unable to compensate for the fall in credit from high-exposure banks.[13] In Appendix A4, we provide more direct evidence

[11] Indeed, the estimated firm fixed-effects are essentially uncorrelated with Bank Exposure (with a correlation coefficient of 0.005).

[12] Bank controls include the same variables used in column 3, averaged at the firm level using each bank's credit share in 2006 as weights. Firm controls are those included in the investment model discussed in Section 5.2: a second-order polynomial in firm assets, the 2006 investment rate, sales-to-assets, cash-holdings to assets, ROA, drawn-to-granted credit ratio, and leverage.

[13] The effect of Firm Exposure is somewhat larger in absolute value than that of Bank Exposure.

on the impact of the shock on credit substitution. Our results show that high-exposure firms were able to switch to borrowing from low-exposure banks only to a limited extent. The stickiness of borrower-lender relationships may result from the need to circumvent information asymmetries about the credit worthiness of the borrowers establishing long-term, continuous interactions (the so-called "relationship lending", see Chodorow Reich, 2014, for a recent discussion).

## 5.2 Firm Exposure and capital accumulation

### 5.2.1 Reduced form estimates: the BLC and the drop in investment

We start from estimating the reduced-form impact of Firm Exposure on cumulative investment (model 3) and quantifying the aggregate impact of the interbank shock on subsequent capital accumulation in the sample. Table 3 reports the results obtained including different sets of covariates. The baseline specification used in column 1 only accounts for sector and province fixed-effects. The estimated coefficient is negative and significant at the 1% level and implies that a 10 percentage point increase in Firm Exposure lowers the investment rate by 1.8 percentage points (approximately 11% of its average value). Column 2 introduces the firm fixed effect retrieved from equation (1). This control has a positive and significant coefficient, consistent with its capturing firm-level determinants of credit demand (as productivity or customer demand shocks); the estimated effect of Firm Exposure however is unaffected. In columns 3-5, we in-

The difference is marginal, however, both in statistical and in economic terms (it amounts to 0.02-0.03 percentage points, less than 0.1% of a standard deviation of credit growth). The difference in the point estimates may be driven by measurement error (Paravisini et al. 2015), which is likely to affect the firm-bank variable (Bank Exposure) more than its average at the firm-level (Firm Exposure).

clude a quadratic in assets (to account for potentially non-linear effects of firm size on investment), and test the robustness of our findings to alternative sets of controls, corresponding to different investment equations developed in the literature. In particular, column 3 shows estimates of a standard investment-accelerator model (Bernanke et al. 1999), accounting for the growth rate of sales and for lagged values of the investment rate. Column 4 shows estimates of a model including a second-order polynomial of the sales-to-assets ratio, as in Gala and Gomes (2013). Finally, column 5 (our preferred specification) shows estimates of a model that proxies Tobin's Q using Returns-On-Assets (Asker et al., 2013), and includes the cash-holdings to assets ratio and firm leverage to account for financial frictions. It also includes the ratio of drawn credit to granted credit, an additional indicator of financial needs usually unavailable in empirical analyses, that we compute from CR data. In all the different specifications the estimated effect of the BLC remains remarkably stable.

**Aggregate implications**. The above estimates can help assess the aggregate impact of the bank shock on capital accumulation by firms in the sample.This requires estimating the aggregate loss in investment due to the shock, and then expressing it in terms of the total investment by sampled firms.[14]

For each firm $i$, we first define the predicted drop in the investment rate ($IR_i =$

[14]The validity of this exercise relies on two assumptions (Chodorow-Reich, 2014). First, the total (aggregate) effect equals the sum of the direct effects on each individual firm (partial equilibrium hypothesis). Second, banks would not have lowered lending during the crisis, had they not had any interbank liabilities at the onset (the unconstrained at the top assumption). This aggregation abstracts from general equilibrium effects (e.g., the fact that in equilibrium some final demand may shift from high- to low-exposure firms). Chodorow-Reich (2014) calibrates a model showing that, for plausible parameter values, the partial equilibrium effects do not substantially overstate the importance of the credit supply channel for employment in general equilibrium.

$CI_i/K_{i,2006}$) relative to a counterfactual in which the interbank market did not collapse: $\Delta\iota_i = \hat{IR}_i^{FIT} - \hat{IR}_i^{CFT} = \hat{\lambda} \times \bar{B}_i$ where $\hat{\lambda}$ is the (negative) parameter estimated in (3) and $\bar{B}_i$ is the average exposure of firm $i$ (all the other variables in the regression specification maintain their actual value). The counterfactual assumes that firm exposure would have had no effect on investment ($\hat{\lambda}$=0). Next, we compute the overall loss in investment expenditure by aggregating this predicted value across sample firms: $CI_{LOSS} = \sum K_{i,2006} * \Delta\iota_i$. Finally, we obtain the estimated percentage loss in investment due to the shock as follows: *Investment loss due to shock* $= \frac{CI_{LOSS}}{CI_{OBS}}$, where $CI_{OBS} = \sum CI_i$ is the observed investment expenditure across all firms over the period.

Using our preferred estimate of $\lambda$ (column 5 of Table 3), we estimate that the percentage loss in the cumulative net investment due to the bank shock equals 23.7% of the aggregate investment by sampled firms in 2007-2010. This suggests that in 2010, the aggregate stock of capital in the sample could have been nearly one fourth higher than that observed, had the interbank market not collapsed. For reference, in 2007-10, the investment rate of sampled firms (measured with respect to beginning-of-period total assets) had fallen by more than one-third (36.2%) relative to the 2003-6 period. Our estimates imply that this fall could have been contained to around one-fifth (21.1%), implying approximately 27.6 billion euros of additional investments over the 2007-10 period. Thus, the impact of the credit shock was not only statistically significant, but also economically relevant.[15]

[15] As we will show in Section 6.6 the impact of exposure on investment ($\hat{\lambda}$) would be only slightly lower if estimated assuming that relevant confounds are time invariant and can be absorbed by firm-specific fixed-effect. This alternative estimate would imply that the bank shock induced a loss in investment by sampled firms of around 21% (as opposed to 23.7%) of the observed aggregate.

### 5.2.2 IV estimates: the sensitivity of investment to bank credit

We now turn to estimate the sensitivity of investment to bank credit. For this purpose, we use Firm Exposure as an instrument for credit growth, and estimate model (4) via 2SLS, as described in Section 3.2. We include all the covariates of our preferred specification (column 5 of Table 3).

Table 4 summarizes our baseline findings. The first-stage results, reported in column 1, confirm that Firm Exposure is a strong instrument for credit growth (with an F-statistic in excess of 64), showing a negative and highly significant coefficient. The second-stage (IV) results point to a statistically significant and economically relevant effect of credit on investment. The coefficient in column 2 implies that, on average, a 10 percentage point fall in the growth rate of credit induces firms to lower their investment rate by 2.6 percentage points.

Finally, column 3 reports OLS estimates of the same model. OLS estimates are likely to be biased in this context, but the direction of the bias is a priori ambiguous. It would be upwards if, for example, high investment firms also had high demand for credit (reverse causality). However, if high loan demand was rather stemming from weaker firms trying to cushion a fall in revenues, the parameter of interest may be under-estimated.[16]

The IV coefficient shown in column 2 can be used to infer by how much one additional euro of credit would raise the investment expenditure in a representative firm

[16]OLS being downward biased is consistent, for example, with the idea that economic downturns reduce both investment prospects and cash-flows, so that more severely affected firms also require more external funding to finance working capital. A downward bias has been detected by the trade literature on the effects of credit on export (Paravisini et al. 2015) and employment (Chodorow-Reich, 2014).

(the sensitivity of firm investment to bank credit). Our results imply that the predicted investment rate at firm $i$ is: $\frac{\hat{CI}_{i,t}}{K_{i,2006}} = 0.26 * \frac{\Delta Cr_i}{Cr_{i,2006}}$. One additional euro of available credit would therefore induce the firm to raise investment expenditure over the period by $\Delta\hat{CI}_i = 0.26 * K_{i,2006}/Cr_{i,2006}$, that is 34.6 cents if the value of the $K/Cr$ ratio equals that of the firm with median investment rate. Note that based on the alternative estimation approach discussed in section 6.6 which allows accounting for firm-specific fixed-effect, but restricts to a smaller sample of firms the extra investment expenditure would be lower (around 25 cents).

These figures are on the medium end of the range of available estimates of the investment-cash flow sensitivity, a conceptually similar parameter that has attracted a lot of attention in the corporate finance literature (since the seminal paper by Fazzari et al., 1988).[17]

Interestingly, our estimates are also larger than those obtained by Amiti and Weinstein (2013), who quantify the sensitivity of investment to credit using Japanese data. The difference may be due to several factors, including different degrees of external finance dependence among firms in the underlying samples.[18]

[17]Using data from the US, Fazzari et al. (1988) find that firms' investment expenditure increases from 23 (for uncontrainted firms) to 46 (for constrained firms) cents per additional unit of available cash. Subsequent studies extending the analysis to different countries and estimation methods provide estimates ranging from 16 (Almeida and Campello 2007) to 17-24 (Gilchrist and Himmelberg, 1995). Bond et al. (2003) find values ranging from 8 in France to 20 in Germany and 50 in the UK (all expressed as cents per unit of cash).

[18]Amiti and Weinstein (2013) focus on a sample of listed firms only, while we look at a large pool of mostly small- and medium-sized firms, for which bank credit is more relevant. Listed firms proved less responsive to changes in access to bank credit even during the recent financial crisis (Asker et al., 2013).

# 6 Robustness checks

This section presents a set of tests aimed at supporting our identification assumptions. We will refer to the reduced-form impact of Firm Exposure on investment as ITT ("Intention to Treat", or model 3); to our core credit growth regression as FS ("First Stage" or model 5); and to the estimated impact of credit on real outcomes as IV (model 4).

## 6.1 Pre-crisis common trend in credit and investment

We begin by showing that Firm Exposure (measured in 2006) is not correlated with the patterns of credit and capital accumulation across firms measured *before* the financial crisis. If this was the case, our estimates may just be capturing different pre-crisis trends in these variables.

Table 5 reports the estimated impacts of Firm Exposure when credit growth (in Panel A) and investment rates (Panel B) are measured on a yearly basis.[19] The coefficients estimated between 2002 and 2006 are largely non-significant and display no regular pattern in either case, suggesting no systematic pre-crisis differences in credit or investment flows by firms with different exposure to the subsequent shock.

The table also highlights the timing of the effect of the 2007 shock on both variables. Credit flows to high exposure firms decline relative to low exposure firms already in 2007. Interestingly, the negative impact on investment rates only unfolds in 2008 (it becomes

[19]The coefficients in Panel A are obtained estimating model 5 with credit flows computed relative to the previous year. In Panel B we estimate model 3 using yearly investment expenditure. Both variables are normalized to 2001 values of credit and assets. The sample is restricted to firms observed both in 2001 and 2006.

statistically significant since 2009).[20]

### 6.2 Placebo test: early 2000s recession

Further threats to identification arise if high exposure banks tend to lend to firms that happen to be more vulnerable during downturns. We address this issue exploiting the early 2000s recession episode, which was *not* characterized by any shock to the interbank market.[21] The idea is that, if vulnerable firms systematically borrow from high-exposure banks, then Firm Exposure should be correlated with credit market outcomes or investment decisions even during the previous recession episode.

We replicate our core specifications estimating the impact of Firm Exposure on credit growth and cumulative investment (our baseline FS and ITT models, 5 and 3) in 2000-2003. Columns 1 and 2 of Table 6 show that exposure measured before the recession (in 1999) was unrelated to either outcome during the subsequent downturn. Replicating both exercises with Firm Exposure measured in 2006 yields to similar results, pointing to no systematic relationship between firms' vulnerability during recessions and their propensity to borrow from high exposure banks.[22]

[20]The lagged response of investments can be partly explained by accounting rules. Indeed, according to Italian standards, investment expenditure is recorded only when the purchased good or property becomes available for production. Hence, the 2007 data would not promptly reflect the slowdown in investment purchases later that year in presence of delivery or construction lags (as those discussed by Abel and Blanchard, 1988, for example). By the same token, they would include investments that become available for production by year-end and yet had been purchased based on pre-crisis credit conditions.

[21]Italian GDP growth sharply declined in 2001 and 2002, eventually becoming negative in the first two quarters of 2003. Data constraints prevent us to look at earlier recession episodes (occurred in the early 1980s and early 1990s). In those years the interbank and the credit market differed markedly with respect to our period of analysis, as the banking sector was largely state owned until 1992.

[22]As we will show in Section 6.4, in fact, all available measures of firm vulnerability (and of their growth potential) look balanced across the distribution of Exposure before the shock.

### 6.3 Controlling for pre-crisis investment expectations

A fundamental challenge when estimating firm-level investment equations is that growth opportunities, a plausible driver of investment decisions, are usually unobserved. As in most empirical investment literature, our estimates of Section 5.2 can only indirectly account for firm's investment opportunities through observable proxies (Gala and Gomes, 2013). Here we provide more direct evidence by exploiting firm-level information on the expectations of future investment obtained from the Bank of Italy Survey of Industrial and Service Firms (SISF).

SISF is a panel representative survey administered to approximately 3,000 Italian firms (with at least 20 employees), designed to obtain firm-level information on investments, employment and production. One of its peculiar features is a set of question that directly elicit expectations on future investment and demand (Guiso and Parigi 1999). In particular, SISF collects information both on the actual level of investment in the year before the survey and on its expected levels at the end of the survey year. Crucially for our analysis, it is always administered in April. Hence, the 2007 wave contains firms' self-reported expectations on the growth rate of investment elicited *just before* the onset of the global financial crisis. Accordingly, we compute a measure of the expected investment rate (defined as the ratio between expected investment in 2007 to actual assets in 2006) and use it as a proxy of growth opportunities measured before the crisis.

This measure allows us to perform several important tests, summarized in Table 7. We first show that expected investment is not significantly correlated with Firm

Exposure (column 1).[23] Note that because of the sample size of the SISF dataset, of panel attrition and of our focus on manufacturing and services firms only, the final dataset only includes 1,360 firms. Despite the much lower sample size, the reduced-form impact of Firm Exposure on investment (ITT, reported in column 2) is remarkably similar to our baseline results in Table 3 ($-0.279$ vs. $-0.224$). More importantly, this estimate is not affected by augmenting the model with investment expectations, which in turn accurately forecast the actual investment rate (column 3). This suggests that growth opportunities may not be a relevant concern in our main regression, conditioning on observables. Finally, adding investment expectations to the IV model (4) does not alter our baseline findings either. The coefficient in column 4 implies that a 10 percentage point fall in credit growth lowers the investment rate by approximately 2 percentage points (compared to 2.6 points in the baseline estimate of Table 4).

### 6.4 Balance of observable characteristics

Our core identification assumption requires the exogeneity of Firm Exposure with respect to *unobserved* firm characteristics. Supportive evidence exploiting the firm-specific fixed-effects from within-firm credit growth regression was discussed in Section 5.1. Table 8 focuses on the balancing of several firm-level variables across the distribution of Firm Exposure. These variables are meant to capture unobserved growth opportunities, firms vulnerability to aggregate shocks and other characteristics that affect demand for

[23]We do find, however, that the expected investment rate positively predicts the estimated credit demand $d_i$. Indeed, a 1 percentage point increase in the expected investment rate is significantly associated with a 1 percentage point increase in estimated credit demand (see Table A4 in the Appendix). This provides indirect evidence on the quality of both variables.

credit and investment. The absence of systematic correlation between such observables and Firm Exposure would also support the assumption that the latter is orthogonal to other unobserved determinants of credit market or real outcomes. Following Imbens and Wooldridge (2009), we test for the balancing of covariates computing the normalized difference between each quartile average and the average in the other three quartiles (reported in parenthesis).[24] As a rule of thumb, the authors suggest that a normalized difference smaller than 0.25 should not raise concerns about the covariate being imbalanced.

The first two rows in Table 8 show the average investment rate in the firm (2-digit) industry and province, respectively (both dimensions are absorbed by industry- and province-level fixed-effects in our empirical specification). Firms in the top quartile of exposure to the credit shock belong to industries that experienced an average yearly investment rate of 4.03% after the interbank market collapse, compared with an average investment rate of 4.00% in the industries of the least exposed firms. Similarly, high- and low-exposure firms operated in provinces that had very similar rates of accumulation after the shock. Hence, our estimates are unlikely to be driven by high exposure banks disproportionately lending to industries or areas experiencing particularly low opportunities of investment after the shock.

Other observable firm-level proxies of growth opportunities, measured before the cri-

[24]The normalized difference should be preferred to the t-statistic to test the balancing of covariates, because its results do not depend on sample size and sample size does not affect the bias in estimated coefficients (see Imbens and Wooldridge 2009, for a more thorough discussion). In Appendix A2 we provide additional evidence using alternative two-group partitioning of the sample. Specifically, we assign firms to treatment and control groups based on their exposure to the shock being (i) above and below the median exposure, and (ii) in the top vs. the bottom quartile of Exposure. In both cases the results confirm that firm observables are well-balanced across the distribution of Firm Exposure.

sis (end of 2006) also prove to be balanced along the distribution of exposure. These include pre-crisis investment rates, the ratio of cash holdings to assets (a measure of growth opportunities according to Kaplan and Zingales 1997), profitability (Return on Assets) and firm sales. In fact, the first three variables suggest that investment opportunities were slightly higher for more exposed firms, which would imply that, if anything, we may be underestimating the impact of credit supply shocks.

Next, we focus on measures of borrower riskiness. The first is credit rating, an indicator of the firm's likelihood of default (the Altman Z-Score) within two years.[25] Its average value is very similar across the quartiles of the distribution of Exposure (if anything, the least exposed firms are evaluated as slightly riskier). Other commonly used proxies for firm riskiness include debt maturity (here, captured by the share of short term debt), leverage and the share of secured debt (here, the share of collateralized loans). Even in this case, differences over the distribution of Firm Exposure are small both economically and statistically (and would, again, suggest that riskier firms tend to have lower Exposure). The intensity in the usage of available credit (measured by the used-to-granted credit ratio and capturing short term credit demand) is also balanced across the distribution of Firm Exposure.

Finally, the Table also considers bank characteristics (averaged at the firm level using 2006 credit shares as weights). We focus on bank size, the Tier 1 capital ratio, return on assets, and loan charge-offs. Three such variables look unbalanced, featuring values of the normalized difference larger than one-fourth in at least one quartile. In particular,

[25]Produced by CADS, the Altman Z-Score takes integer values ranging from 1 (the safest firm) to 9 (the firm most likely to default) and is used by all major banks to assess credit risk.

high-exposure firms tend to borrow from larger, more capitalized and more profitable banks, suggesting a positive correlation between exposure and commonly used proxies of financial strength. In the following section, we test whether these imbalances represent a concern for our analysis using propensity score techniques.

### 6.5 Propensity score weighting

Several approaches have been proposed to assess the relevance of biases associated with differences in observed covariates. Here we apply the correction method recommended by Imbens and Wooldridge (2009) , replicating our core regressions while weighting each observation based on its propensity score (see the Supplementary appendix A2 for more details on this methodology and further implementations).

To this purpose we identify firms with higher-than-median Exposure, and estimate the propensity score of assignment to this group (the treated) conditional on a set of observable characteristics including those used in the baseline specification of Section 5 and, importantly, the measures of bank characteristics that proved unbalanced in Table 8.[26] As shown in the Appendix, the methodology (which matches treated firms with the closest firms in the control group) is able to balance the covariates distributions across the two sub-samples.

We then re-run our baseline investment regressions using the inverse of the estimated propensity score to weight the units (firms) in order to eliminate biases associated with

[26] We also tried an alternative specification and estimated the propensity score of assignment to the top quartile (the treated) and bottom quartile (the control) of the Exposure distribution. The results were unaffected. See Appendix A2 for details.

unbalanced covariates (see Imbens and Wooldridge, 2009).[27] Tables A10 and A11 in the Appendix show that both the reduced form impact of exposure on investment (the ITT) and the sensitivity of investment to credit (the IV) remain remarkably close to the baseline results values discussed in Section 5.2. This suggests that the possible unbalancing of bank characteristics is unlikely to bias our results.

### 6.6 Difference-in-differences approach

An alternative approach to assess the relevance of firm heterogeneity in investment opportunities is to assume this is time-invariant and can therefore be absorbed by firm fixed-effects. We checked the robustness of our findings to this alternative identification assumption replicating the analysis in a Difference-in-differences setting. Specifically, we regressed within-firm differences in outcomes measured before and after the shock (2003-2006 and 2007-2010, respectively) on Firm Exposure measured in 2006. Table A6 in the Appendix reports the results obtained looking at cumulative investment (cols. 1 and 2) and credit growth (cols. 3 and 4), considering for each dependent variable the two first specifications of Table 3. For reference, it also reports the results obtained running the corresponding cross sectional specification on the same sample.[28]

The estimated impact of exposure on investment (the ITT) obtained absorbing firm-fixed effects is only slightly (around 10%) lower than the corresponding cross sectional

[27]Intuitively, the weighting creates a synthetic sample in which the distribution of covariates is independent of treatment assignment.

[28]To assure comparability with the baseline regressions of Section 5.2 we focus on continuing firms (which therefore have to be observed every year between 2001 and 2010) and restrict to those having at least two bank relationships at the beginning of each sub-period. The number of firms used in the panel estimation is therefore lower than it was in the cross section regressions.

estimates, while the first stage is, if anything, slightly stronger.The fact that the point estimates remain similar to our baseline cross-sectional model when using a difference-in-differences specification provides reassuring evidence that firm unobserved heterogeneity is not significantly biasing our results.

### 6.7 Additional robustness checks

Table A5 in the Appendix tests the robustness of our core findings to the inclusion of additional controls and to changes in the definition of the dependent variable. We focus on the estimated effect of Firm Exposure on investment (ITT, or model 3) and on the sensitivity of investment to credit (IV, or model 4). Both coefficients prove to be robust to these additional checks.

First, we adopt a more flexible specification for aggregate shocks, allowing for a full interaction between the industry *and* province fixed effect. In principle, the additive structure of the province and industry fixed effects in our baseline model may upwardly bias our estimates if low-exposure banks are better able to identify industry profitability at the province level. Second, we include a set of "main bank" fixed effects, indicating the bank with the highest share of lending to the firm as of December 2006, to control for potential unobserved bank characteristics. In this specification, identification stems from differences in exposure of (and shares of credit from) the remaining banks (it is, therefore, rather demanding on the data). In column 3 we restrict the analysis to bank-firm relationships longer than 3 years, to check whether Firm Exposure captures banks' under-accumulating soft information on their clients (as would be the case if high-exposure banks were less likely to rely on relationship lending). To the extent that duration correlates with firm quality, this test also helps address potential bias from firm heterogeneity.

In the remaining columns we apply different treatments of extreme values of the dependent variable. As discussed in Section 4, in our baseline analysis this was winsorized at the (top) 5%. Lowering this threshold to 2.5% and 1%, or trimming outliers does not affect the results.

Finally, as anticipated in Section (3) our main results are unaffected changing the definition of credit growth (i.e. using log-differences as opposed to percentage changes, Table A1) or of investment (using gross as opposed to net investment, Table A2).

# 7 Extensions

## 7.1 Heterogeneity

While we have so far estimated average coefficients, the strength of the effect of bank shocks on real outcomes is likely to vary with firm characteristics. Heterogeneity may stem from two different channels. On the one hand, banks may selectively lower credit availability. On the other hand, firms may differ in their ability to substitute bank credit with other sources of finance. Unlike most of the literature, which focuses on the reduced form impact of bank shocks on firm outcomes, our detailed matched bank-firm data allow us to quantify the relative strength of each channel.

Table 9 presents the results obtained when the impact of Firm Exposure is allowed to vary by firm characteristics in the credit and the investment regression (results are reported in odd and even columns, respectively). We focus on a set of firm traits that have been shown to matter for either of the two channels (or both): firm age and size, firm dependence on external finance, and level of local financial development. For each dimension, the sample is split into two sub-groups of firms with high and low values of the variable (see the table notes for details).

The results in odd columns of Table 9 do not provide any support to the idea that banks lowered credit availability selectively, discriminating along any of the above-mentioned dimensions. A different picture, though, emerges when looking at the reduced form impact of Firm Exposure on investment.

Results in column 2 shows that this was significantly stronger among small firms, whose investment rate fell by approximately 40% more than for large firms facing the same cut in credit. Similar evidence is obtained in the case of young firm (column 4). These results confirm that size and age are important observable dimensions to identify firms whose activity is more likely to be constrained by bank credit availability.

Focusing on measures of bank dependence more directly highlights the importance of other sources of finance to attenuate the impact of the credit supply shock. In column 6 firms are split according to the share of bank debt in overall firm debt. Highly dependent firms had to cut their investment twice as much as firms with greater access to alternative forms of debt. Column 8 complements this evidence looking at cash holdings as potential substitute for bank debt. Results show that holding large amounts of cash (relative to total assets) more than halved the negative impact of the shock. Finally, column 10 suggests that firms in less financially developed areas (we used the indicator developed by Guiso et al. 2004) had more difficulties in compensating the fall in bank credit. The coefficient is only marginally significant, though, indicating that geographic heterogeneity is somehow less relevant than the previous firm-level dimensions.

### 7.2 The effects on interest rates

Thus far, we have focused on the consequences of the shock on the quantity of credit. However, an inward shift of credit supply may also increase its price (i.e., interest rates).

Most empirical papers on the BLC do not deal with this issue due to data constraints: Credit Registers typically do not contain information on interest rates. The Italian register represents an exception as it reports the interest rates charged to individual firms by a large sample of intermediaries (approximately 100 Italian banks). The impact of the BLC on the price of credit can therefore be estimated using the within-firm specification (1) with the change in interest rates between 2006 and 2010 as dependent variable. This amounts to test whether the same firm borrowing from two different banks experienced a larger increase in interest rates by the relatively more exposed one.[29]

Table 10 reports the results obtained looking at two different credit aggregates. First, we focus on overdraft facilities (revolving credit lines) which allow a more precise mea-

[29] Appendix A6 contains a detailed description of the data and of the methodology used to compute the interest rates used in the analysis. Two important limitations should be remarked. First, the information on interest rates is only available for a sub-set of banks, accounting for a large but still partial fraction of the loan market (approximately 80%, see Panetta et al. 2009). Moreover, interest rates can be computed only for the fraction of credit drawn, not for the larger amount of credit granted. These issues imply a significant drop in sample size relative to the corresponding within-firm quantity regression in Table 2. The sample is in fact restricted to firms having at least two credit relationships from banks reporting information on interest rates *and* actually drawing credit from both.

surement of the price charged at the time of observation as they do not have a specified maturity (Panetta et al. 2009). Then we look at total credit (aggregating credit lines, term loans, and loans backed by receivables). Results from the baseline specification show that Bank Exposure has no statistically significant effect on either interest rate measure (see columns 1 and 3). Augmenting the model with banks' observable characteristics and with the level of the interest rate charged in 2006 (columns 2 and 4) does not change this conclusion.[30]

Other studies based on Credit Register data fount that, while affecting the quantity of credit supplied a bank shock may have no statistically significant impact on the average price charged (Khwaja-Mian 2008 and Bentolila et al. 2014). Theoretically, this result is usually rationalized on the basis of concerns about the adverse selection effects of higher interest rates, which are particularly strong during a crisis (Stiglitz and Weiss, 1981).[31] Yet, these findings need not be exclusively explained in terms of credit rationing. A highly elasitc credit demand curve, for example, would imply that even a small increase in the interest rate offered (possibly too small to be captured by our regressions) induces large falls in observed quantities. Alternatively, we might fail to detect a significant effect on credit prices simply because our interest rate data are not accurate or numerous enough.

[30]The results are unchanged even if we restrict to the subset of firms with the highest rate of credit utilization, a proxy for credit demand rigidity.

[31]Studies that focus on syndicated loans, as Chodorow-Reich (2014) or Santos (2011), do find a positive effect of bank shocks on interest rates. One potential explanation for the discrepancy with Credit Register-based evidence is that syndicated loan data usually cover only larger firms, for which Stiglitz-Weiss-type of adverse selection concerns may be less relevant. Another is that interest rates may be better measured since syndicated loan data allow controlling for maturity and collateral.

### 7.3 Bank credit and firm activity

Our findings so far indicate that the 2007 credit supply shock had sizable consequences on firm investment. Do these findings extend to other production inputs? And to what extent did the credit shock ultimately affect firm production? This last section thoroughly exploits our balance sheet data to address these relevant, though largely unexplored issues.[32]

We start by looking at the consequences of the credit shock on production inputs, focusing on employment (dependent workers), labor costs (total wage bill), and expenditure on intermediate goods. Next, we consider its impact on firms' value added (obtained subtracting the cost of inputs from the value of production) and conclude with insights on trade credit chains. For each outcome, we first estimate the reduced form impact of the credit supply shock (ITT) by regressing its 2006-2010 growth rate on Firm Exposure (as in model 3). These estimates help informing about the aggregate effect of the shock on relevant economic variables (as employment and value added). We also replicated our 2SLS estimates (model 5) with Firm Exposure as the instrument.

The corresponding results, reported in the three panels of Table 11, indicate that the credit supply shift had sizable impacts across all dimensions of firm activity. For example, the results in column 1, panel A imply that a 10 percentage point increase in Firm Exposure lowered the growth rate of employment by 1.8 percentage points between 2006 and 2010. For reference, the median firm in the sample experienced a contraction

[32]While the impact of a credit shock on employment has been studied by Chodorow-Reich (2014), Bentolila et al. (2014), and Balduzzi et al. (2014), to the best of our knowledge this is the first paper looking at other inputs and outcomes (value added, intermediate inputs, and trade credits).

in employment of around 1.7%.[33] Interestingly, the impact of credit supply shifts on firm output is estimated to be higher than that on inputs. The results in column 4 imply that a 10 percentage point increase in Firm Exposure to the bank credit shock lowered the growth rate of value added by 2.2 percentage points. Note that these findings were not a priori obvious: while firms investment can be expected to respond to financial or liquidity shocks, these do not necessarily impact short-run production.

We also find evidence that employment is highly sensitive to the availability of bank credit (panel B). For example, we estimate that firms facing a 10 percentage point drop in credit growth between 2006 and 2010 lowered the growth rate of employment by 1.76 percentage points over the same period. The corresponding estimates on the cost of labor (column 2) and on the purchase of intermediate inputs (column 3) are very similar. On the other hand, the impact of an analogous credit fall on value added growth turns out to be slightly larger (2.6 percentage points).

Finally, we look at firms as providers of trade credit to customers, i.e., as part of a credit chain (Kiyotaki and Moore 2004).[34] Evidence that an initial shock to bank credit propagates through the network of inter-firm trade credit would in fact highlight an important amplification mechanism of liquidity shortages. Our estimates, shown in column 5 of Table 11, indicate that firms borrowing from banks that were more affected by the crisis grant less trade credit to their customers. More specifically, our results

[33]The number of employees is unfortunately *not* a compulsory entry in balance sheet data as those in CADS, and therefore presents several missing values. This explains why the sample size falls by around one-third. Moreover, firms are not required to provide any information on hours worked, which prevents us from extending the analysis to the intensive margin of the labor input.

[34]See also Garcia-Appendini and Montoriol-Garriga (2013) for evidence on the effect of the 2007-2008 crisis on trade credit.

imply that a firm facing a 10 percentage point reduction in bank credit growth reduces the growth rate of trade credit by 3.8 percentage points.[35]

**Aggregate implied effects.**

As in the case of capital accumulation, the coefficients estimated in panel A can help inform about the aggregate consequences of the financial shock. In particular, we used them to infer the employment and value added losses between 2006 and 2010.[36]

In 2010, the value added produced by firms in the sample was 4.9% lower, in real terms, than at the end of 2006. Based on the estimates in column 4 of panel A the worsened credit market conditions contributed to more than half (51.2%) of this fall. In other words, absent the bank shock the drop in aggregate value added would have shrunk to -2.4%. This suggests that the credit crunch substantially contributed to the Great Recession in Italy.

Between 2006 and 2010, on the other hand, the number of employees in the sample fell by 1.1%. This figure only refers to employees headcounts and is therefore likely to underestimate the true impact of the crisis on the labor input.[37] Our estimates imply

[35] The negative effect on trade credit may be explained by firm downsizing inducing a drop in sales. To test for this possibility, we use the growth rate of trade credit relative to sales as a dependent variable. We still obtain a significant positive coefficient indicating that a negative credit shock reduces the firms'propensity to provide credit to their customers.

[36] The underlying analysis projects the growth rate of each outcome ($\hat{Z}_i = \frac{Z_{i,2010}}{Z_{i,2006}} - 1$ ) on Firm Exposure $\bar{B}_{i,06}$ and on a set of other controls. As in the case of capital accumulation, the estimated impact of Firm Exposure can be used to compute the difference between the fitted and the counterfactual (i.e., "no-shock") growth rates of $Z_i$: $\Delta\omega_i = (\hat{Z}_i^{FIT} - \hat{Z}_i^{CFT}) = \hat{\theta} \times \bar{B}_{i,2006}$, where $\hat{\theta}$ is the (negative) parameter estimated in panel A. It follows that the total loss in the end-of-period value of $Z$ due to the credit shock is $\Delta Z_{10}^{LOSS} = \sum_i \Delta\omega_i * Z_{i,2006}$. This can be compared with the observed change in $Z$ over the period ($\Delta Z_{2010}^{OBS} = \sum_i (Z_{i,2010} - Z_{i,2006})$) to obtain the percentage loss in $Z$ due to the shock: $Percentage\ loss\ in\ Z\ due\ to\ shock = \Delta Z_{2010}^{OBS} / \Delta Z_{2010}^{LOSS}$

[37] Unfortunately, balance sheet data do not capture other important margins of adjustment such as changes in the number of hours worked, or the layoff of atypical workers. For reference, National Accounts data indicate that, while the fall in the number of employees in private non-agricultural industries was limited (-0.62%), the number of hours worked fell by 3.45%.

that employment would have been 12% higher absent the shock, only slightly attenuating the actual fall to approximately 1%.

## 8 Conclusions

In this paper we provide new evidence on the consequences of the 2007-2008 credit crunch on firm activity. We exploit a large sample of Italian firms, for which we observe loan-level data on all loans made by each Italian bank and balance-sheet data, both before and during the crisis. Identification exploits the variation in bank reliance on the interbank market at the end of 2006, leading to different bank exposure to the liquidity shock generated by the sudden freeze of that market starting in July 2007. The negative shock to bank liquidity significantly deteriorated credit conditions: high-exposure banks tightened credit supply more than low-exposure banks even when looking at the same borrower (i.e., accounting for firm-specific determinants of credit).

Our core results suggest that in the absence of the negative supply shock in the credit market, total investment expenditure in 2007-2010 would have been almost 24% higher than that observed. More generally, our findings suggest that lower credit availability has very relevant, negative consequences for a range of other firm outcomes, such as value added, employment and expenditure in intermediate inputs. Finally, we also find evidence that the initial shock to bank credit gets amplified through trade credit chains.

Interestingly, while the credit tightening was homogeneous across firms, investment fell by a much larger amount among smaller and younger firms, and those with higher bank dependence. This is important to inform policy on the transmission of bank shocks:

firms that are unable to substitute bank credit with other sources of internal or external finance are more likely to suffer its consequences.

Our findings also have a direct relevance for the current policy debate about the business model of banks. While being very effective in normal times, a high exposure to volatile sources of funding such as the interbank market may represent an important source of contagion during financial crises. Precautionary measures aimed at assuring that banks hold sufficient levels of liquidity (such as the Net Stable Funding Ratio criterion envisaged in the Basel III regulatory framework) may help in dampening the transmission of shocks from financial markets to the real sector. More generally, our results suggest that, in financially-driven recessions, policies focusing on improving banks liquidity position and confidence in financial markets should be prioritized.

## 9 References


Abel, A. and O. Blanchard (1988), Investment and Sales: Some Empirical Evidence, in textitDynamic Econometric Modelling, W. Barnett, E. Berndt and Halbert White Eds., Cambridge University Press.

Acharya, V. and O. Merrouche (2013), Precautionary Hoarding of Liquidity and Interbank Markets: Evidence from the Sub-prime Crisis, Review of Finance, 17(1), 107-160.

Almeida, H. and M. Campello (2007), Financial constraints, asset tangibility, and corporate investments. The Review of Financial Studies, 20(5), 1429-1460.

Almeida, H., Campello, M., Laranjeira, B. and S. Weisbenner (2012), Corporate Debt Maturity and the Real Effects of the 2007 Credit Crisis. Critical Finance Review 1.1, 3-58.

Amiti, M and D. Weinstein (2013), How Much do Bank Shocks Affect Investment? Evidence from Matched Bank-Firm Loan Data, NBER Working Papers 18890.

Asker, J., J. Farre-Mensa, and A. Ljungqvist (2013), Corporate Investments and Stock Market Listing: a Puzzle?, ECGI - Finance Working Paper.

Balduzzi P., E. Brancati and F. Schiantarelli (2014), Financial Markets, Banks' Cost of Funding, and Firms' Decisions: Lessons from Two Crises. Boston College Working Paper 824

Bank of Italy (2009), Annual Report, Rome, Italy.

Bentolila, S., M. Jansen, G. Jimenez, and S. Ruano (2014), When Credit Dries Up: Job

Losses in the Great Recession, mimeo, Bank of Spain.

Bernanke, B.S. (2007), Global Imbalances: Recent Developments and Prospects. Bundesbank Lecture. Berlin, Germany.

Bernanke, B.S. and M.L. Gertler (1995), Inside the Black Box: the Credit Channel of Monetary Policy Transmission. Journal of Economic Perspectives, 9(4), 27-48.

Bernanke, B.S., M.L. Gertler, and S. Gilchrist (1999), The Financial Accelerator in a Quantitative Business Cycle Framework, Handbook of Macroeconomics, 1(C), 1341-1393.

Bonaccorsi di Patti, E. and E. Sette (2012), Bank Balance Sheets and the Transmission of Financial Shocks to Borrowers: Evidence from the 2007-2008 Crisis. Bank of Italy Working Papers, No. 848.

Bond, S., J.A. Elston, J. Mairesse and B. Mulkay (2003), Financial Factors and Investment in Belgium, France, Germany, and the United Kingdom: A Comparison Using Company Panel Data, The Review of Economics and Statistics, 85(1), 153-165.

Brunetti, C., M. di Filippo, and J.H. Harris (2011), Effects of Central Bank Intervention on the Interbank Market During the Subprime Crisis, Review of Financial Studies, 24(6), 2053-2083.

Brunnermeier, M. (2009), Deciphering the Liquidity and Credit Crunch 2007-2008, Journal of Economic Perspectives, vol. 23(1), pages 77-100, Winter.

Campello, M., JR Graham, and CR Harvey (2010), The Real Effects of Financial Constraints: Evidence from a Financial Crisis. Journal of Financial Economics, 97(3), 470-487.

Chava, S. and A. Purnanandam (2011), The Effect of Banking Crisis on Bank-dependent Borrowers, Journal of Financial Economics, 99, 1, 116-135.

Chodorow-Reich, G. (2014), The Employment Effects of Credit Market Disruptions: Firm-level Evidence from the 2008-09 Financial Crisis, Quarterly Journal of Economics, forthcoming.

Cornett, M., McNutt, J., Strahan P., and H. Tehranian (2011), Liquidity Risk Management and Credit Supply in the Financial Crisis, Journal of Financial Economics, 101, 297-312.

Detragiache, E., P. Garella, and L. Guiso (2000), Multiple Versus Single Bank Relationships: Theory and Evidence. Journal of Finance, 55(3), 1133-1161.

Duchin, R., Ozbas, O. and B. Sensoy (2010), Costly External Finance, Corporate Investment, and the Subprime Mortgage Credit Crisis, Journal of Financial Economics 97, 418-435.

ECB (2009), Monthly Bulletin, July, 75-89.

Fazzari, S., Hubbard, G. and B. Petersen (1988), Financing Constraints and Corporate Investment, Brookings Papers on Economic Activity, Economic Studies Program, The Brookings Institution, vol. 19(1), pages 141-206.

Gaiotti, E. (2013), Credit Availability and Investment: Lessons from the Great Recession, European Economic Review, 59, 212-227.

Gala, V. and J.F. Gomes (2013), Beyond Q: Investments Without Asset Prices, AFA 2013 San Diego Meetings Paper.

Gan, J. (2007a), Collateral, Debt Capacity, and Corporate Investments: Evidence from a Natural Experiment. Journal of Financial Economics, 85(3), 709-734.

Gan, J. (2007b), The Real Effects of Asset Market Bubbles: Loan- and Firm-Level Evidence of a Lending Channel. Review of Financial Studies 20, 1941-1973.

Garcia-Appendini, E. and J. Montoriol-Garriga (2013), Firms as Liquidity Providers: Evidence from the 2007-2008 Financial Crisis, Journal of Financial Economics, 109(1), 272-291.

Gilchrist, S., C. Himmelberg, (1995), Evidence on the role of cash flow for investment," Journal of Monetary Economics, 36(3), 541-572.

Gobbi, G. and E. Sette (2013), Do Firms Benefit from Concentrating their Borrowing? Evidence from the Great Recession, Review of Finance, 18(2), 527-560.

Gorton, G. and A. Metrick (2010), Securitized Banking and the Run on Repo, NBER Chapters, in: Market Institutions and Financial Market Risk National Bureau of Economic Research.

Guiso, L. and G. Parigi (1999), Investment and demand uncertainty, Quarterly Journal of Economics, 114(1), 185-227.

Guiso, L., P. Sapienza and L.Zingales (2004), Does Local Financial Development Matter?, The Quarterly Journal of Economics, 119(3), 929-969.

Imbens, G., J. Wooldridge (2009), Recent Developments in the Econometrics of Program Evaluation, Journal of Economic Literature, 47(1), 5-86.

Iyer, R., S. Lopes, JL Peydrò, and A. Schoar (2013), Interbank Liquidity Crunch and the Firm Credit Crunch: Evidence from the 2007-2009 Crisis, Review of Financial Studies, forthcoming.

Ivashina, V. and D. Scharfstein (2010), Bank Lending During the Financial Crisis of 2008, Journal of Financial Economics, 97(3), 319-338.

Jimenez, G., A. Mian, JL Peydrò, and J. Saurina (2010), Local Versus Aggregate Lending Channels: The Effects of Securitization on Corporate Credit Supply in Spain. NBER Working Papers, No. 16595.

Kapan, T. and C. Minoiu (2013), Balance Sheet Strength and Bank Lending During the Global Financial Crisis, IMF Working Papers, No. 13/102.

Kaplan, S. and L. Zingales (1997), Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints?, The Quarterly Journal of Economics, 112 (1): 169-215.

Kashyap, A. and J. Stein (1995), The Impact of Monetary Policy on Bank Balance Sheets, Carnegie-Rochester Conference Series on Public Policy, 1995, 42, 151-195.

Kashyap, A.K. and J.C. Stein (2000), What do a Million Observations on Banks Say About the Transmission of Monetary Policy?, American Economic Review, 90(3), 407-428.

Khwaja, AJ and A. Mian (2008), Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market. American Economic Review, 98(4), 1413-1442.

Kiyotaki N. and J. Moore (2004), Credit Chains. ESE Discussion Papers, 2004-03.

Lamont, O. (1997), Cash Flow and Investment: Evidence from Internal Capital Markets. Journal of Finance, 52, 83-109.

Nobili, A. and F. Zollino (2012), A Structural Model for the Housing and Credit Markets in Italy, Bank of Italy Working Papers, No. 887.

Panetta, F., F. Schivardi and M. Shum (2009), Do Mergers Improve Information? Evidence from the Loan Market. Journal of Money, Credit and Banking, 41, 673-709.

Paravisini, D., V. Rappoport, P. Schnabl, and D. Wolfenzon (2015), Dissecting the Effect of Credit Supply on Trade: Evidence from Matched Credit-Export Data, Review of Economic Studies, 82(1), 333-359.

Peek, J. and E. Rosengren (2000), Collateral Damage: Effects of the Japanese Bank Crisis on Real Activity in the United States. American Economic Review, 90, 30-45.

Santos, J. (2011), Bank loan pricing following the subprime crisis, Review of Financial Studies, 24(6), 1916-1943.

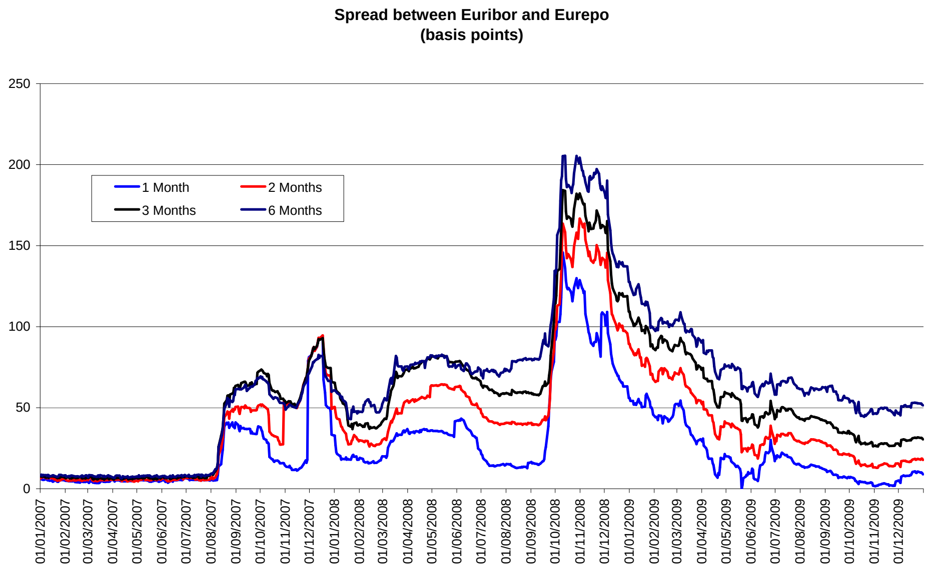
Schnabl, P. (2012), The International Transmission of Bank Liquidity Shocks: Evidence from an Emerging Market. Journal of Finance, 67, 897-932.

Stein, J. (1998), An Adverse-Selection Model of Bank Asset and Liability Management with Implications for the Transmission of Monetary Policy. RAND Journal of Economics, 29 466-486.

Stiglitz, J. and A. Weiss (1981), Credit Rationing in Markets with Imperfect Information, American Economic Review, 71(3), 393-410.

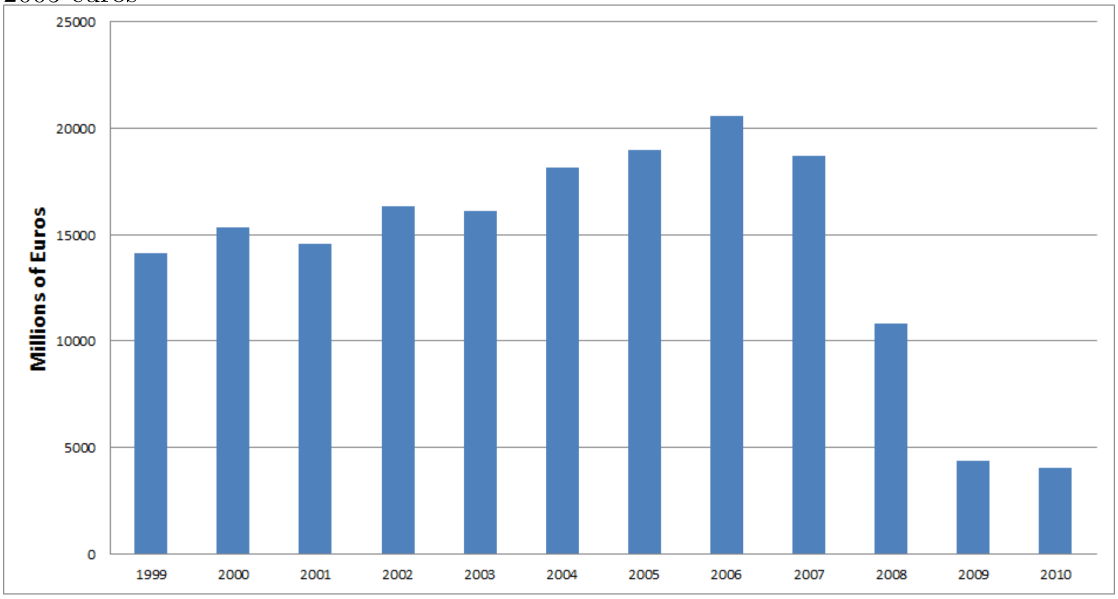
## 10 Figures and Tables

Figure 1: The spread between unsecured and secured lending



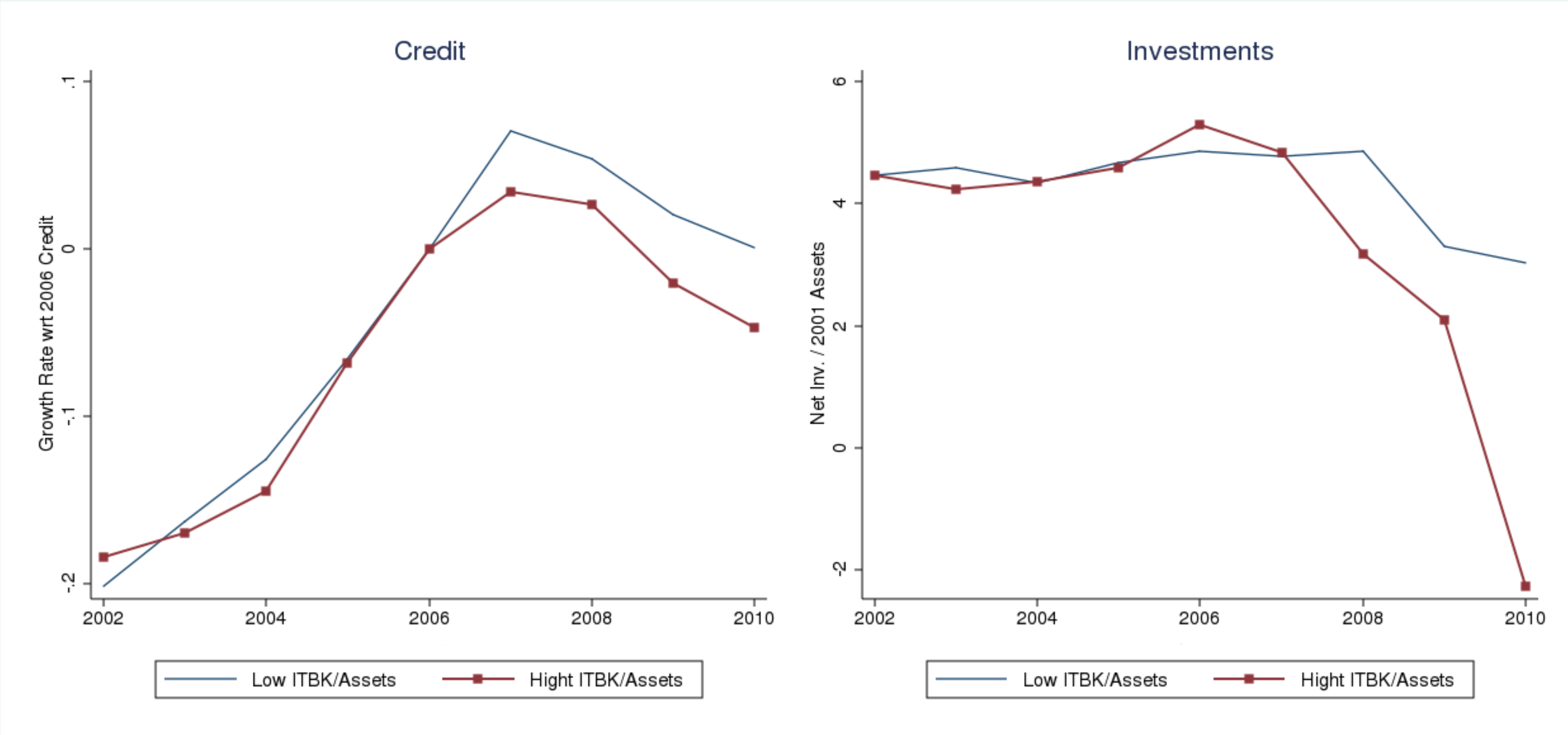

*Notes:* The figure plots the 2007-2009 dynamics of the spread between unsecured ("Euribor") and secured ("Eurepo") interbank lending in Euros at different time horizons. Source: European Central Bank.

Figure 2: Total interbank daily deposits of Italian banks (e-MID market) in constant 2005 euros




*Notes:* The figure shows the evolution of total interbank daily deposits between 1999 and 2010 on the electronic market for Interbank Deposits (eMID). Source: Bank of Italy.

Figure 3: Growth rate of credit granted and yearly investment rate of firms borrowing from high and low exposure banks.




*Notes:* The figure plots the percentage change in total outstanding credit granted relative to 2006 (left panel) and total yearly net investment as a ratio of total assets in 2001 (right panel) for two groups of firms. Those with above- and below- median Firm Exposure (as measured by the credit-weighted average at the firm-level of bank's interbank-to-assets ratio in 2006). Figures are computed on the basis of firms which were granted credit from at least two bank relationships in 2006, and that did not report missing credit or investment data over the period 2001-2010 (corresponding to the sample used in column 9 of Table 5). See Section 3.1 for a precise definition of the variables used here. Sources: Italian Credit Register, Supervisory Reports, and Company Accounts Data System.

Table 1: Descriptive Statistics

| | Mean | St.Dev. | Median | Min | Max | Obs. |
|---|---|---|---|---|---|---|
| **Dependent Variables** | | | | | | |
| $I/K$ (%) | 16.44 | 18.65 | 9.64 | -3.24 | 66.72 | 31047 |
| Credit Growth (%) | 13.76 | 61.44 | 3.77 | -100 | 180.82 | 31047 |
| Growth of Sales (%) | .12 | 12.92 | -.03 | -1.57 | 1734 | 29249 |
| Growth of Value Added (%) | 3.67 | 43.26 | .46 | -99.99 | 134.68 | 27811 |
| Growth of Employees (%) | -4.10 | 24.50 | -1.71 | -99.94 | 45.45 | 27190 |
| Growth of Labor Cost (%) | 10.49 | 34.45 | 10.77 | -99.97 | 104.99 | 28852 |
| Growth of Interm. Exp. (%) | -6.36 | 33.96 | -6.47 | -99.92 | 80.36 | 28690 |
| Growth of Trade Credits (%) | 1.81 | 45.42 | -1.83 | -99.99 | 139.63 | 27509 |
| **Independent Variables** | | | | | | |
| $\bar{B}$ (%) | 11.81 | 3.43 | 11.91 | 0 | 55.62 | 31047 |
| Total Assets (000) | 21714.55 | 773370.38 | 1908 | 0.01 | 105902600 | 31047 |
| ROA | 6.27 | 7.27 | 5.09 | -26.59 | 40.27 | 31047 |
| Cash Holdings/Assets (%) | 6.201 | 9.519 | 2.134 | 0 | 48.742 | 31047 |
| Sales/Assets | 1.55 | .95 | 1.33 | 0 | 6.30 | 31047 |
| Investment Rate 2006 | 4.01 | 8.27 | 2.02 | -249.96 | 42.35 | 31047 |
| Leverage | 9.64 | 14.61 | 5.09 | 1.12 | 103.31 | 31047 |
| Drawn/Granted Credit | 48.21 | 27.036 | 50.27 | 0 | 108.13 | 31047 |
| Expected 1-Year Inv. Rate in 2006 | 3.66 | 3.79 | 2.35 | 0 | 14.10 | 1360 |

*Notes:* Table entries are the relevant statistics computed for firms in the bank-firm matched sample. Firm balance sheet data are from the company account Data system (CADS). Credit data are from the Italian Credit Register. Bank balance sheet data are from the Supervisory Reports submitted by banks to the Bank of Italy. The expected investment rate is from the SISF sample. The symbol (000) denotes variables expressed thousands of euros. The minimum of the distribution of firm assets is 0, but it indicates firms assets worth less than 500 euros, thus rounded at 0.

Table 2: The Effect of Banks' Exposure to the Interbank Market on Credit Growth - Within- and Between-Firms Estimates

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Within-firm estimates | | | Between-firm estimates | | |
| Bank Exposure | -0.712*** | -0.740*** | -0.849*** | | | |
| | (0.239) | (0.237) | (0.282) | | | |
| Firm Exposure | | | | -0.761*** | -0.787*** | -0.855*** |
| | | | | (0.207) | (0.193) | (0.103) |
| Firm FE | N | Y | Y | N | N | N |
| Credit Demand | N | N | N | N | Y | Y |
| Sector FE | N | N | N | Y | Y | Y |
| Province FE | N | N | N | Y | Y | Y |
| Controls | N | N | Y | N | N | Y |
| No. of Obs. | 151690 | 151690 | 151476 | 31047 | 31047 | 31047 |
| No. of Firms | 31047 | 31047 | 31047 | 31047 | 31047 | 31047 |

*Notes:* The dependent variable in columns 1, 2, and 3 is the credit growth within a bank-firm pair between 2006 and 2010. Credit growth is measured as the percentage change in total credit granted (credit commitments) within the pair (i.e., aggregating multiple loans of a firm from the same bank). Bank Exposure is the ratio of interbank funding to total assets at the bank-level. The dependent variable in columns 4, 5, and 6 is the average growth of total credit granted to a firm between 2006 and 2010. Firm Exposure is the firm-level average of Bank Exposure weighted by the share of total credit granted to the firm by each bank. Credit data are from the Italian Credit Register. Column 3 replicates the estimate in column 2 adding bank observable characteristics (liquidity, capital ratio, ROA, loan chargeoffs, and total assets). Column 6 replicates the estimate in column 5 including the same set of bank characteristics averaged at the firm level. Credit demand are the firm-level dummies estimated in the regression in column 2. Heteroskedasticity robust standard errors clustered at the bank level (columns 1-3) and at the main bank and sector levels (column 4-6) in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 3: The effect of Firm Exposure on the Investment Rate

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Firm Exposure | -0.185*** | -0.194*** | -0.198*** | -0.202*** | -0.224*** |
| | (0.061) | (0.062) | (0.053) | (0.053) | (0.052) |
| Credit Demand | | 0.084*** | 0.081*** | 0.080*** | 0.078*** |
| | | (0.004) | (0.003) | (0.003) | (0.003) |
| Assets (billions) | | | -1.879** | -1.899*** | -1.979*** |
| | | | (0.737) | (0.694) | (0.746) |
| Assets Squared | | | 0.023** | 0.023** | 0.024** |
| | | | (0.009) | (0.009) | (0.010) |
| Sales Growth | | | -0.019*** | | |
| | | | (0.004) | | |
| Investment Rate Lagged | | | 0.413*** | 0.402*** | 0.398*** |
| | | | (0.027) | (0.025) | (0.026) |
| Sales/Assets | | | | -0.076 | -0.329 |
| | | | | (0.788) | (0.221) |
| Sales/Assets Squared | | | | -0.007 | |
| | | | | (0.124) | |
| Roa | | | | | 0.116*** |
| | | | | | (0.022) |
| Cash-Holdings/Assets | | | | | 0.345 |
| | | | | | (1.476) |
| Leverage | | | | | -0.035*** |
| | | | | | (0.008) |
| Drawn/Granted | | | | | -0.019*** |
| | | | | | (0.007) |
| Sector FE | Y | Y | Y | Y | Y |
| Province FE | Y | Y | Y | Y | Y |
| No. of Obs. | 31047 | 31047 | 31027 | 31047 | 31047 |

*Notes:* The dependent variable is the cumulative (2007-2010) firm-level investment rate, obtained as the ratio between overall investment in the four years and the value of total assets in 2006. Firm Exposure measures the average exposure of firms to the interbank market shock. For each firm, it is obtained as the weighted average of Bank Exposure (the ratio of interbank funding to the bank total assets, measured in 2006) of all banks lending to the firm, using each bank share of total credit to the firm as weights. Credit demand are the firm-level dummies estimated in the credit regression (1), see Table 2. Other firm-level controls are sourced from balance sheets (see table 1). Data are from the Italian Credit Register, from Supervisory Reports, and from the Company Accounts Data System. Heteroskedasticity robust standard errors clustered at the main bank and sector levels in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 4: The Sensitivity of Investment to Credit Growth

| | (1)<br>FS | (2)<br>IV | (3)<br>OLS |
|---|---|---|---|
| Firm Exposure | -0.855*** | | |
| | (0.103) | | |
| Credit Growth | | 0.263*** | 0.082*** |
| | | (0.054) | (0.006) |
| Controls | Y | Y | Y |
| Sector FE | Y | Y | Y |
| Province FE | Y | Y | Y |
| No. of Obs. | 31047 | 31047 | 31047 |
| F-Statistics | 64.23 | | |

*Notes:* The dependent variable is the cumulative (2007-2010) firm-level investment rate. Credit Growth is the percentage change in total credit granted (credit commitments) to each firm between 2006 and 2010. In column 1, Credit Growth is instrumented with Firm Exposure. Firm Exposure measures the average exposure of firms to the interbank market shock. For each firm, it is obtained as the weighted average of Bank Exposure (the ratio of interbank funding to the bank total assets, measured in 2006) of all banks lending to the firm, using each bank share of total credit to the firm as weights. Data are from the Italian Credit Register, from Supervisory Reports, and from the Company Accounts Data System. Controls include assets, squared assets, credit demand (the firm-level dummies estimated in the credit regression (1), see Table 2), ROA, cash-holdings over assets, sales over assets, the investment rate, the ratio of drawn to granted credit, and firm leverage all measured as of December 2006. Heteroskedasticity robust standard errors clustered at the main bank and sector levels in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Common Trend Analysis

| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|
| First-Stage - *Dep. Var. Credit Growth since 2001* | | | | | | | | | |
| Firm Exposure in 2006 | -0.077 | 0.000 | -0.008 | 0.006 | 0.123 | -0.178** | -0.104** | -0.218** | -0.142*** |
| | (0.062) | (0.082) | (0.064) | (0.087) | (0.098) | (0.08) | (0.04) | (0.084) | (0.05) |
| Intention-to-Treat - *Dep. Var.: Cumulative Investment Rate since 2001* | | | | | | | | | |
| Firm Exposure in 2006 | -0.008 | -0.006 | -0.014 | -0.005 | 0.032 | 0.017 | -0.057 | -0.033*** | -0.143* |
| | (0.018) | (0.012) | (0.017) | (0.022) | (0.021) | (0.021) | (0.047) | (0.012) | (0.077) |
| Province FE | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Sector FE | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| No. of Obs. | 25778 | 25778 | 25778 | 25778 | 25778 | 24885 | 23982 | 22681 | 21646 |

*Notes:* The dependent variable in the top panel is the difference in the stock of credit granted (credit commitments) between the beginning and the end of the year indicated at the top of each column (the net flow of credit in the period), normalized by the stock of credit granted as of 2001. The dependent variable in the bottom panel is the net investment in the year indicated at the top of each column (the flow of investment in the period), normalized by assets as of 2001. The sample includes firms that are active in both 2006 (to observe Firm Exposure as of December 2006) and in 2001 (to observe firm assets as of December 2001). All regressions include assets, squared assets, ROA, cash-holdings over assets, sales over assets, the investment rate in 2006, the ratio of drawn to granted credit, and firm leverage. Variables are deflated using the deflator of investment (for manufacturing, services, and construction) from the Italian National Statistics (ISTAT). Standard errors in parentheses are robust to serial correlation at the sector and main-bank levels; *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Placebo Analysis - Early 2000s Recession

| | (1) FS | (2) ITT | (3) FS | (4) ITT |
|---|---|---|---|---|
| Firm Exposure in 1999 | 0.001 | -0.070 | | |
| | (0.003) | (0.063) | | |
| Firm Exposure in 2006 | | | -0.001 | 0.012 |
| | | | (0.03) | (0.071) |
| Province FE | Y | Y | Y | Y |
| Sector FE | Y | Y | Y | Y |
| No. of Obs. | 27877 | 27877 | 25558 | 25558 |

*Notes:* The dependent variables in columns 1 and 3 (FS) is the growth rate of credit granted (credit commitments) between December 1999 and December 2003. The dependent variable in columns 2 and 4 (ITT) is the cumulative net investment rate between December 1999 and December 2003, normalized by assets as of December 1999. All regressions include assets, squared assets, ROA, cash-holdings over assets, sales over assets, the investment rate, firm leverage, the ratio of drawn to granted credit, all measured as of December 1999. Standard errors in parentheses are robust to serial correlation at the sector and main-bank levels; *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Accounting for Investment Expectations

| | (1) | (2) ITT | (3) ITT | (4) IV |
|---|---|---|---|---|
| Dependent variable is: | Investment Expectations | Investment Rate (SISF) | | |
| Firm Exposure | -0.009 | -0.279** | -0.263** | |
| | (0.030) | (0.136) | (0.120) | |
| Credit Growth | | | | 0.199** |
| | | | | (0.095) |
| Exp. Investment Rate | | | 1.004*** | 0.920*** |
| | | | (0.075) | (0.129) |
| Controls | Y | Y | Y | Y |
| Sector FE | Y | Y | Y | Y |
| Province FE | Y | Y | Y | Y |
| No. of Obs. | 1360 | 1360 | 1360 | 1360 |
| F-Statistics | | | | 11.425 |

*Notes:* The dependent variable in (1) is the expected investment rate between 2006 and 2007; the dependent variable in (2) to (4) is the cumulative (2007-2010) firm-level investment rate. Credit Growth is the percentage change in total credit granted (credit commitments) to each firm between 2006 and 2010. Firm Exposure measures the average exposure of firms to the interbank market shock. For each firm, it is obtained as the weighted average of Bank Exposure (the ratio of interbank funding to the bank total assets, measured in 2006) of all banks lending to the firm, using each bank share of total credit to the firm as weights. Data are from the Italian Credit Register, from Supervisory Reports, and from the Bank of Italy Survey of Investment of industrial firms (SISF). Controls include assets, squared assets, credit demand (the firm-level dummies estimated in the credit regression (1), see Table 2), ROA, cash-holdings over assets, sales over assets, the investment rate, firm leverage, the ratio of drawn to granted credit, all measured as of December 2006. Heteroskedasticity robust standard errors clustered at the main bank and sector levels in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Balancing of Observable characteristics

| | $1^{st}$ Quartile | $2^{nd}$ Quartile | $3^{rd}$ Quartile | $4^{th}$ Quartile | St.Dev. |
|---|---|---|---|---|---|
| Sector-Level Inv.Rate | 4 | 4 | 4.01 | 4.03 | 1.3 |
| | (-.01) | (-.01) | (.00) | (.02) | |
| Province-Level Inv.Rate | 4.1 | 3.99 | 3.97 | 3.99 | .66 |
| | (.12) | (-.03) | (-.06) | (-.03) | |
| Credit Demand | 11.48 | 13.02 | 13.61 | 12.98 | 47.94 |
| | (-.03) | (.00) | (.02) | (.00) | |
| Inv. Rate in 2006 | 4.1 | 4.05 | 3.8 | 4.09 | 8.279 |
| | (.01) | (.00) | (-.02) | (.01) | |
| Assets | 17.56 | 19.51 | 31.11 | 56.69 | 672.67 |
| | (-.02) | (-.02) | (.00) | (.03) | |
| Cash Holdings/Assets | .07 | .06 | .06 | .07 | .09 |
| | (.02) | (-.05) | (-.04) | (.07) | |
| Sales / Assets | 1.68 | 1.52 | 1.5 | 1.52 | .96 |
| | (.12) | (-.03) | (-.06) | (-.04) | |
| Roa | 6.19 | 6.01 | 6.2 | 6.69 | 7.28 |
| | (-.01) | (-.03) | (-.01) | (.05) | |
| Leverage | 11.41 | 9.84 | 9.02 | 8.33 | 14.61 |
| | (.11) | (.01) | (-.04) | (-.09) | |
| Z-Score | 4.58 | 4.67 | 4.59 | 4.29 | 1.8 |
| | (.03) | (.07) | (.03) | (-.13) | |
| Drawn/Granted | 47.81 | 49.33 | 49.51 | 46.22 | 27.04 |
| | (-.01) | (.04) | (.05) | (-.07) | |
| Average Bank Capital | 8.02 | 7.03 | 6.98 | 7.57 | 1.44 |
| | (.39) | (-.26) | (-.31) | (.11) | |
| Average Bank Size | 11.97 | 12.59 | 12.82 | 12.73 | .66 |
| | (-.84) | (.10) | (.47) | (.30) | |
| Average Bank Roa | .89 | .96 | 1.02 | 1.00 | .17 |
| | (-.44) | (-.06) | (.30) | (.19) | |
| Average Bank Loan Charge-offs | .54 | .59 | .59 | .560 | .12 |
| | (-.22) | (.13) | (.19) | (-.08) | |

*Notes:* For each variable the four columns report averages values computed by quartile of Firm Exposure. Figures in parentheses are normalized differences (the difference between the quartile average and the average of the other three quartiles, normalized by the square root of the sum of the corresponding variances). The last column shows the standard deviations of the distribution of each variable. The first two rows report the average investment rate in borrower's industry (2-digit ATECO) and in the province where the borrower is established. Firm balance sheet data are from the company account Data system (CADS). Credit data are from the Italian Credit Register. Bank balance sheet data are from the Supervisory Reports submitted by banks to the Bank of Italy, and are computed as credit-weighted averages at the firm-level.

Table 9: Heterogeneity in the Effects of Exposure and Credit Growth on Investment

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Firm Size | | Firm Age | | Bank Debt ratio | | Cash-Holdings ratio | | Local Fin. Development | |
| | $D_i$ = small | | $D_i$ = young | | $D_i$ =high | | $D_i$ =low | | $D_i$ =low | |
| | FS | ITT | FS | ITT | FS | ITT | FS | ITT | FS | ITT |
| Exposure | -0.851*** | -0.120** | -0.802*** | -0.207*** | -0.768*** | -0.164*** | -0.969*** | -0.138** | -0.612** | -0.159 |
| | (0.106) | (0.0515) | (0.102) | (0.0607) | (0.134) | (0.0564) | (0.100) | (0.0562) | (0.289) | (0.117) |
| Exposure × $D_i$ | 0.0943 | -0.0806** | -0.203 | -0.100* | -0.198 | -0.139*** | 0.176 | -0.163*** | -0.276 | -0.0746 |
| | (0.123) | (0.0398) | (0.162) | (0.0540) | (0.198) | (0.0415) | (0.191) | (0.0471) | (0.270) | (0.119) |
| Controls | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Province FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Sector FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| No. of Obs. | 31047 | 31047 | 30926 | 30926 | 31047 | 31047 | 30215 | 30215 | 31047 | 31047 |

*Notes:* The table reports results of model [check]:

$$Y_i = \rho_0 + \rho_1 \bar{B}_{i,2006} + \rho_2 \bar{B}_{i,2006} \times D_i + \rho_3 D_i + X_i \rho_4 + \epsilon_i \quad (6)$$

where $Y_i$ is the growth rate of credit in columns labelled FS (First-Stage), and the investment rate in columns labelled ITT (Intention-To-Treat). $\bar{B}_{i,2006}$ is Firm Exposure in 2006, and $D_i$ is a heterogeneity dummy. In columns 1 and 2, it equals 1 if the firm has lower-than-median size. In columns 3-4, it identifies young firms (< 10 years old). In columns 5-6 it is equal to 1 for firms with lower-than-median share of bank debts over total debts, and for those with lower-than-median cash-holdings relative to total assets in columns 7-8. Finally, in columns 9-10, it is equal to 1 for firms localized in less financially developed regions, as defined by Guiso et al. (2004). Whenever $D_i$ varies at the regional level (columns 9-10), coefficient $\rho_3$ is not identified because of collinearity with province fixed effects. Data are from the Italian Credit Register, from Supervisory Reports, and from the Company Accounts Data System. Controls include assets, squared assets, credit demand (the firm-level dummies estimated in the credit regression (1), see Table 2), ROA, cash-holdings over assets, sales over assets, the investment rate, firm leverage, and the share of drawn credit, all measured in 2006. Heteroskedasticity robust standard errors clustered at the sector and main-bank levels; *** p<0.01, ** p<0.05, * p<0.1.

Table 10: The Effect of Bank Exposure on Interest Rates

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Credit Lines | | Total Credit | |
| Bank Exposure | 0.018 | -0.036 | -0.025 | -0.011 |
| | (0.061) | (0.087) | (0.017) | (0.014) |
| Firm FE | Y | Y | Y | Y |
| Bank Controls | N | Y | N | Y |
| No. of Obs. | 64154 | 64154 | 93542 | 93542 |
| No. of Firms | 21531 | 21531 | 28024 | 28024 |

*Notes:* The dependent variable is column 1 and 2 is the change in the interest rate on credit lines, charged in each firm-bank relationship. The dependent variable in column 3 and 4 is the change in the interest rate on total credit charged in each firm-bank relationships. Estimates shown in column 2 and 4 include bank-level controls: capital ratio, liquidity ratio, ROA, loan charge-offs, bank size. All specifications include a firm fixed-effect. Heteroskedasticity robust standard errors clustered at the bank level; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 11: The Sensitivity of Alternative Firm-level Outcomes to Credit Growth

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Dependent variable is: | No. of Employees | Labour Cost | Interm. Expend. | Value Added | Trade Credit |
| Panel A: ITT | | | | | |
| Exposure | -0.181*** | -0.175*** | -0.142*** | -0.221*** | -0.331*** |
| | (0.066) | (0.054) | (0.055) | (0.076) | (0.093) |
| Implied Effect | -0.116 | -0.089 | -0.129 | -0.019 | -0.067 |
| Panel B: FS | | | | | |
| Exposure | -0.969*** | -0.888*** | -0.854*** | -0.863*** | -0.855*** |
| | (0.115) | (0.097) | (0.092) | (0.092) | (0.093) |
| Panel C: IV | | | | | |
| Credit Growth | 0.176*** | 0.197*** | 0.166*** | 0.256*** | 0.387*** |
| | (0.061) | (0.048) | (0.051) | (0.076) | (0.073) |
| F-test on Excl. Instr. | 69.289 | 80.999 | 83.841 | 86.442 | 82.928 |
| Controls | Y | Y | Y | Y | Y |
| Province FE | Y | Y | Y | Y | Y |
| Sector FE | Y | Y | Y | Y | Y |
| No. of Obs. | 19097 | 30371 | 30201 | 29275 | 28957 |

*Notes:* The dependent variable is the cumulative (2007-2010) growth rate of the variables indicated in each column. Credit Growth is the percentage change in total credit granted (credit commitments) to each firm between 2006 and 2010. Firm Exposure measures the average exposure of firms to the interbank market shock. For each firm, it is obtained as the weighted average of Bank Exposure (the ratio of interbank funding to the bank total assets, measured in 2006) of all banks lending to the firm, using each bank share of total credit to the firm as weights. Data are from the Italian Credit Register, from Supervisory Reports, and from the Company Accounts Data System. Controls include assets, squared assets, credit demand (the firm-level dummies estimated in the credit regression (1), see Table 2), ROA, cash-holdings over assets, sales over assets, and the investment rate, all measured in 2006. Heteroskedasticity robust standard errors clustered at the main bank and sector levels in parentheses; *** p<0.01, ** p<0.05, * p<0.1.