Relationship and Transaction Lending in a Crisis

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Abstract

We study how relationship lending and transaction lending vary over the business cycle. We develop a model in which relationship banks gather information on their borrowers, which allows them to provide loans for profitable firms during a crisis. Due to the services they provide, operating costs of relationship-banks are higher than those of transaction-banks. In our model, where relationship-banks compete with transaction-banks, a key result is that relationship-banks charge a higher intermediation spread in normal times, but offer continuation-lending at more favorable terms than transaction banks to profitable firms in a crisis. Using detailed credit register information for Italian banks before and after the Lehman Brothers' default, we are able to study how relationship and transaction-banks responded to the crisis and we test existing theories of relationship banking. Our empirical analysis confirms the basic prediction of the model that relationship banks charged a higher spread before the crisis, offered more favorable continuation-lending terms in response to the crisis, and suffered fewer defaults, thus confirming the informational advantage of relationship banking.

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1 Introduction[1]

How do banks help their corporate borrowers through a crisis? Beyond providing loans to firms, commercial banks have long been thought to play a larger role than simply screening loan applicants one transaction at a time. By building a relationship with the firms they lend to, banks also play a continuing role of managing firms' financial needs as they arise, whether in response to new investment opportunities or to a crisis. What determines whether a bank and a firm build a long-term relation, or whether they simply engage in a market transaction? And, how do relationship and transaction lending differ in a crisis? Our knowledge so far is still limited. To quote Allen Berger, "What we think we know about small versus large banks (...) in small business lending may not be true and we know even less about them during financial crises".[2] We address these questions from both a theoretical and empirical perspective.

Existing theories of relationship banking typically do not allow for aggregate shocks and crises. Thus, we expand the relationship lending model of Bolton and Freixas (2006) by introducing an aggregate shock along idiosyncratic cash-flow risk for non-financial corporations. In the expanded model firms differ in their exposure to the aggregate shock and therefore may have different demands for the financial flexibility provided by relationship banking. To be able to bring the model to the data we introduce a further critical modification to the Bolton and Freixas model by allowing firms to borrow from multiple banks on either a transaction or relationship basis.[3]

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[2] Keynote address, Indiana Review of Finance Conference, Dec. 2012.

[3] The Bolton and Freixas (2006) model of relationship banking considers firms' choice of the optimal mix of financing between a long-term banking relationship and funding through a corporate bond issue. Most firms in practice are too small to be able to tap

The main predictions from the theoretical analysis are four. First, the firms relying on a banking relation are better able to weather a crisis and are less likely to default than firms relying only on transaction lending, even though the underlying cash flow risk of firms borrowing from an $R-$bank is higher than that of firms relying only on $T-$banking. Second, the firms relying on $R-$banks are prepared to pay higher borrowing costs on their relationship loans in normal times in order to secure better continuation financing terms in a crisis. Interest rates on $R-$loans are countercyclical: they are higher than interest rates on $T-$loans in normal times and lower in crisis times. Third, firms will generally seek a mix of relationship lending (or, for short, $R-$banking) and transaction lending (or $T-$banking). Fourth, relationship banks need a capital buffer to be used in order to preserve the lending relationship in bad times.

We test these predictions by looking at bank lending to firms in Italy before and after the Lehman Brother's default. Following Detragiache, Garella and Guiso (2000), we use the extremely detailed credit registry information on corporate lending by Italian banks, which allows us to track Italian firms' borrowing behavior before and after the crisis of 2008-09 at the individual firm and bank level. The empirical analysis confirms the predictions of the model. In particular, that relationship banks charged a higher spread before the crisis, offered more favorable continuation-lending terms in response to the crisis, and suffered fewer defaults, thus confirming the informational and financial flexibility advantage of relationship banking.

Our study is the first to consider how relationship lending responds to a crisis in a comprehensive way both from a theoretical and an empirical perspective. Our sample covers loan contracts by a total of 179 Italian banks to more than 72.000 firms over the time period ranging from 2007 to 2010, with the collapse of Lehman Brothers marking the transition to the crisis. The degree of detail of our data goes far beyond what has been available in previous studies of relationship banking. For example, one of the most important existing studies by Petersen and Rajan (1994) only has data on firms' balance sheets and on characteristics of their loans, without additional

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the corporate bond market, and the choice between issuing a corporate bond or borrowing from a bank is not really relevant to them. However, as we know from Detragiache, Garella and Guiso (2000) these firms do have a choice between multiple sources of bank lending (see also Bolton and Scharfstein, 1996; Houston and James, 1996; Farinha and Santos, 2002).

specific information on the banks firms are borrowing from.[4] As a result they cannot control for bank specific characteristics. We are able to do so for both bank and firm characteristics, since we observe each bank-firm relationship. More importantly, by focusing on multiple lender situations we can run estimates with both bank and firm fixed effects, thus controlling for observable and unobservable supply and demand factors. We are therefore able to precisely uncover the effects of bank-firm relationship characteristics on lending. It turns out that our results differ significantly depending on whether we include or exclude these fixed effects, revealing that the lack of detailed information on each loan may lead to biases if, as one may expect, the heterogeneity of banks (small, regional, large, mutuals,...) maps into different lending behaviors that only bank fixed effects can identify. Also, unlike the vast majority of existing empirical studies, our database includes detailed information on interest rates for each loan. This allows us to investigate bank interest rate determination in good and bad times in a direct way, without relying on any assumptions.[5]

Overall, our study suggests that relationship banking plays an important role in dampening the effects of negative shocks following a crisis. The firms that rely on relationship banks are less likely to default on their loans and are better able to withstand the crisis thanks to the more favorable continuation lending terms they can get from $R-$banks. These findings suggest that the focus of Basel III on core capital and the introduction of countercyclical capital buffers could enhance the role of $R-$banks in crises and reduce the risk of a major credit crunch especially for the firms that choose to rely on

[4]They have a dummy variable taking the value 1 if the loan has been granted by a bank and 0 if granted by another financial institution, but they do not have information on which bank has granted the loan and they do not have balance sheet information on the bank.

[5]In one related paper Gambacorta and Mistrulli (2014) investigate whether bank and lender-borrower relationship characteristics had an impact on the transmission of the Lehman default shock by analysing *changes* in bank lending rates over the period 2008:Q3-2010:Q1. Bonaccorsi di Patti and Sette (2012) take a similar approach over the period 2007:Q2-2008:Q4, while Gobbi and Sette (2014) consider 2008:Q3-2009:Q3. Albertazzi and Marchetti (2010) and De Mitri et al. (2010) complement the previous studies by investigating the effect of the financial crisis on *lending growth*. In this paper, we focus instead on the *level* of lending rates and the quantity of credit (instead than their respective changes). Moreover, we analyse the behaviour of relationship and transactional banks by comparing bank prices and quantities both in "normal" times and in a crisis. Although our results are not perfectly comparable, they are consistent with the above cited papers.

$R-$banks.

Related Literature: Relationship banking can take different forms, and most of the existing literature emphasizes benefits from a long-term banking relation to borrowers that are different from the financial flexiblity benefits that we model. The first models on relationship banking portray the relation between the bank and the firm in terms of an early phase during which the bank acquires information about the borrower, and a later phase during which it exploits its *information monopoly* position (Sharpe 1990). While these first-generation models provide an analytical framework describing how the long-term relation between a bank and a firm might play out, they do not consider a firm's choice between transaction lending and relationship banking, and which types of firms are likely to prefer one form of borrowing over the other. They also do not allow for any firm bargaining power at the default and renegotiation stage, as we do following Diamond and Rajan (2000, 2001, and 2005).

The second-generation papers of relationship banking that consider this question and that have been put to the data focus on three different and interconnected roles for an $R-$bank: insurance, monitoring and screening. A first strand of studies focuses on the (implicit) insurance role of $R-$banks against the risk of changes in future credit terms (Berger and Udell, 1992; Berlin and Mester 1999); a second strand focuses on the monitoring role of $R-$banks (Holmstrom and Tirole 1997, Boot and Thakor 2000, Hauswald and Marquez 2006); and a third strand plays up the greater screening abilities of new loan applications of $R-$banks due to their access to both hard and soft information about the firm (Agarwal and Hauswald 2010, Puri et al. 2010). Our theory is closest to a fourth strand which emphasizes the $R-$banks' ability to learn about changes in the borrower's creditworthiness, and to adapt lending terms to the evolving circumstances the firm finds itself in (Rajan, 1992 and Von Thadden, 1995). Interestingly, these four different strands have somewhat different empirical predictions. Overall, our empirical results suggest that only the predictions of the fourth strand of theories are fully confirmed in our data. While papers based on ex-ante screening predict that $R-$banks have lower loan delinquency rates than $T-$banks, only the fourth strand of theories predicts that $T-$banks raise loan interest rates more than $R-$banks in crisis times.

The structure of the paper is the following. In section 2 we describe the theoretical model of $T-$banking and $R-$banking and in section 3 the combination of the two forms of funding by firms. In section 4 we compare the firm's benefits from pure $T-$banking with the ones of mixed finance, and the implication for the capital buffers the banks have to hold. In section 5 we describe the database and we test the model's predictions. Section 6 compares our results with those derived by other types of theories of relationship banking. The last section concludes.

2 The model

We consider the financing choices of a firm that may be more or less exposed to business-cycle risk. The firm may borrow from a bank offering relationship-lending services, an $R-$bank, or from a bank offering only transaction services, a $T-$bank. As we explain in greater detail below, $R-$banks have higher intermediation costs than $T-$banks, $\rho_R > \rho_T$, because they have to hold more equity capital against the expectation of more future roll-over lending. We shall assume that the banking sector is competitive, at least ex ante, before a firm is locked into a relationship with an $R-$bank. Therefore, in equilibrium each bank just breaks even and makes zero supra-normal profits. We consider in turn, 100% $T-$ bank lending, 100% $R-$bank lending, and finally a combination of R and $T-$bank lending.

2.1 The Firm's Investment and Financial Options

The firm's manager-owners have no cash but have an investment project that requires an initial outlay of $I = 1$ at date $t = 0$ to be obtained through external funding. If the project is successful at time $t = 1$, it returns V^H. If it fails, it is either liquidated, in which case it produces V^L at time $t = 1$, or it is continued in which case the project's return depends on the firm's type, H or L. For the sake of simplicity, we assume that the probability of success of a firm is independent of its type. An $H-$firm's expected second period cash flow is V^H, while it is zero for an $L-$firm. The probability that a firm is successful at time $t = 1$ is observable, and the proportion of $H-$firms is known. Moreover, both the probability of success and the proportion of $H-$firms change with the business cycle, which we model simply as two distinct states of the world: a good state for *booms* ($S = G$) and a bad state for *recessions* ($S = B$). Figure 1 illustrates the different possible returns of the project depending on the bank's decision to liquidate or to roll over the unsuccessful firm at time $t = 1$.[6]

We denote the firms' probability of success at $t = 1$ as p_S, with $p_G > p_B \geq 0$. We further simplify our model by making the idiosyncratic high (V^H) and low (0) returns of firms at time $t = 2$ independent of the business cycle; only the population of $H-$firms, which we denote by ν_S will be sensitive to the business cycle. Finally, recession states ($S = B$) occur with probability θ and boom states ($S = G$) occur with the complementary probability $(1 - \theta)$.

The prior probability (at time $t = 0$) that a firm is of type H is denoted by ν. This probability belief evolves to respectively ν_B in the recession state and ν_G in the boom state at time $t = 1$, with $\nu_B < \nu_G$. The conditional probability of a firm being of type H knowing it has defaulted in time $t = 1$ will be denoted by

$$\overline{\nu} \equiv \frac{(1-\theta)(1-p_G)\nu_G + \theta(1-p_B)\nu_B}{(1-p)}.$$

As in Bolton and Freixas (2006), we assume that the firm's type is private information at time $t = 0$ and that neither R nor T banks are able to identify the firm's type at $t = 0$. At time $t = 1$ however, $R-$banks are able to observe the firm's type perfectly by paying a monitoring cost $m > 0$, while $T-$banks continue to remain ignorant about the firm's type (or future prospects).

Firms differ in the observable probability of success $p = \theta p_B + (1 - \theta)p_G$. For the sake of simplicity we take $p_G = p_B + \Delta$ and assume that p_G is *uniformly* distributed on the interval $[\Delta, 1]$, so that p_B is $U \sim [0, 1 - \Delta]$ and p is $U \sim [(1 - \theta)\Delta, 1 - \theta\Delta]$. Note that for every p there is a unique pair (p_B, p_G) so that all our variables are well defined.

Firms can choose to finance their project either through a *transaction bank* or through a *relationship bank* (or a combination of transaction and relationship loans). To keep the corporate financing side of the model as simple as possible, we do not allow firms to issue equity. The main distinguishing features of the two forms of lending are the following:

[6] A model with potentially infinitely-lived firms subject to periodic cash-flow shocks and that distinguishes between the value to the firm and to society of being identified as an H-type, would be a better representation of actual phenomena. In a simplified way our model can be reinterpreted so that the value of β takes already into account this long run impact on the firms' reputation. Still, a systematic analysis of intertemporal effects would require tracking the balance sheets for both the firm and of two types of banks as state variables of the respective value functions and would lead to an extremely complex model.

1. **Transaction banking**: a transaction loan specifies a gross repayment $r_T(p)$ at $t = 1$. If the firm does not repay, the bank has the right to liquidate the firm and obtains V^L. But the bank can also offer to roll over the firm's debt against a promise to repay $r_T^S(p_S)$ at time $t = 2$. This promise $r_T^S(p_S)$ must, of course, be lower than the firm's expected second period pledgeable cash flow, which is V^H for an $H-$firm and zero for an $L-$firm. Thus, if the transaction bank's belief ν_S that it is dealing with an $H-$firm is high enough, so that

   $$r_T^S(p_S) \leq \nu_S V^H,$$

   the firm can continue to period $t = 2$ even when it is unable to repay its debt $r_T(p)$ at $t = 1$. If the bank chooses not to roll over the firm's debt, it obtains the liquidation value of the firm's assets V^L at $t = 1$.

   The market for transaction loans at time $t = 1$ is competitive and since no bank has an informational advantage on the credit risk of the firm the roll-over terms $r_T^S(p_S)$ are set competitively. Consequently, if gross interest rates are normalized to 1, competition in the $T-$banking industry implies that

   $$\nu_S r_T^S(p_S) = r_T(p), \tag{1}$$

   (when the project fails at time $t = 1$ the firm has no cash flow available towards repayment of $r_T(p)$; it therefore must roll over the entire loan to be able to continue to date $t = 2$).

   For simplicity, we will assume that in the boom state an unsuccessful firm will always be able to get a loan to roll over its debt $r_T(p)$:

   $$\frac{r_T(p)}{\nu_G} \leq V^H. \tag{2}$$

   A sufficient condition for this inequality to hold is that it is satisfied for $p_G = \Delta$.[7]

   By the same token, in a recession state firms with a high probability of success will be able to roll over their debt $r_T(p)$ if ν_B is such that

   $$\frac{r_T(p)}{\nu_B} \leq V^H, \tag{3}$$

[7] Note that the condition is not necessary as in equilibrium some firms with low p may not be granted credit at time $t = 0$ anyway.

This will occur only for values of p_B above some threshold $\hat{p}_B$ for which condition (3) holds with equality, a condition that, under our assumptions, is equivalent to $p \geq \widehat{p}$, where $\widehat{p} = \hat{p}_B + (1-\theta)\Delta$. In other words, for low probabilities of success $p < \widehat{p}$, an unsuccessful firm at $t = 1$ in the recession state will simply be liquidated, and the bank then receives V^L, and for higher probabilities of success, $p \geq \widehat{p}$ (or $p_B \geq \hat{p}_B$) an unsuccessful firm at $t = 1$ in the recession state will be able to roll over its debt. Figure 2 illustrates the different contingencies for the case $p_B \geq \hat{p}_B$.

2. **Relationship banking**: Under relationship banking the bank incurs a monitoring cost $m > 0$ per unit of debt,[8] which allows the bank to identify the type of the firm perfectly in period 1. A bank loan in period 0 specifies a repayment $r_R(p)$ in period 1 that has to compensate the bank for its higher funding costs $\rho_R > \rho_T$.

   The higher cost of funding is due to the need of holding higher amounts of capital that are required in anticipation of future roll-overs. It can be shown, by an argument along the lines of Bolton and Freixas (2006), that as the R-banks are financing riskier firms, even if, on average their interest rates will cover the losses, they need additional capital. In addition R-banks refinance H-firms and they do so by supplying lending to those firms that do not receive a roll-over from $T-$banks. As a consequence, they also need more capital because of capital requirements due to the expansion of lending to $H-$firms.

   If the firm is unsuccessful at $t = 1$ the relationship bank will be able to extend a loan to all the firms it has identified as $H-$firms and then determines a second period repayment obligation of r_R^1. As the bank is the only one to know the firm's type, there is a bilateral negotiation over the terms r_R^1 between the firm and the bank. We let the firm's bargaining power be $(1-\beta)$ so that the outcome of this bargaining process is $r_R^1 = \beta V^H$ and the $H-$firm's surplus from negotiations is $(1-\beta)V^H$.

In sum, the basic difference between transaction lending and relationship

[8] Alternatively, the monitoring cost could be a fixed cost per firm, and the cost would be imposed on the proportion ν of good firms in equilibrium. This alternative formulation would not alter our results.

lending is that transaction banks have lower funding costs at time $t = 0$ but at time $t = 1$ the firm's debt may be rolled over at *dilutive* terms if the transaction bank's beliefs that it is facing an $H-$firm ν_B are too pessimistic. Moreover, the riskiest firms with $p < \widehat{p}$ will not be able to roll over their debts with a transaction bank in the recession state. Relationship banking instead offers higher cost loans initially against greater roll-over security but only for $H-$firms.

3 Equilibrium Funding

Our set up allow us to determine the structure of funding and interest rates at time $t = 1$ and $t = 2$ under alternative combinations of transaction and relationship loans. We will consider successively the cases of pure transaction loans, pure relationship loans, and a combination of the two types of loans. We assume for simplicity that the intermediation cost of dealing with a bank, whether $T-$bank or $R-$bank is entirely 'capitalized' in period 0 and reflected in the respective costs of funds, ρ_T and ρ_R. We will assume as in Bolton and Freixas (2000, 2006) that $H-$firms move first and $L-$firms second. The latter have no choice but to imitate $H-$firms by pooling with them, for otherwise they would perfectly reveal their type and receive no funding.

Transaction Banking: Suppose that the firm funds itself entirely through transaction loans. Then the following proposition characterizes equilibrium interest rates and funding under transaction loans.

Proposition 1: *Under $T-$banking, firms characterized by $p \geq \widehat{p}$ are never liquidated and pay an interest rate*

$$r_T^S = \frac{1}{\nu_S}$$

on their rolled over loans.

For firms with $p < \widehat{p}$ there is no loan roll-over in recessions, and the roll-over of debts in booms is granted at the equilibrium repayment promise:

$$r_T^G = \frac{1}{\nu_G}.$$

The equilibrium lending terms in period 0 *are then:*

$$r_T(p) \quad = \quad 1 + \rho_T \text{ for } p \geq \widehat{p}. \tag{4}$$

$$r_T(p) \quad = \quad \frac{1 + \rho_T - \theta(1 - p_B)V^L}{\theta p_B + 1 - \theta} \text{for } p < \widehat{p}.$$

Proof: See Appendix A. ■

Relationship Banking: Consider now the other polar case of exclusive lending from an $R-$bank. The equilibrium interest rates and funding dynamics are then given in the following proposition.

Proposition 2: *Under relationship-banking there is always a debt roll-over for $H-$firms at equilibrium terms*

$$r_R^1 = \beta V^H.$$

The equilibrium repayment terms in period 0 *are then given by:*

$$r_R(p) = \frac{1 + \rho_R - (1 - p)[(1 - \overline{\nu})V^L + \overline{\nu}(1 - m)\beta V^H]}{\theta p_B + (1 - \theta)p_G}. \tag{5}$$

Proof: See Appendix A. ■

Combining T and $R-$banking: In the previous two cases of either pure T banking or pure $R-$banking the structure of lending is independent of the firm's type. When we turn to the combination of T and $R-$banking, the firms' choice might signal their type. As mentioned this implies that the $L-$firms will have no choice but to mimick the $H-$firms.

Given that transaction loans are less costly ($\rho_T < \rho_R$) it makes sense for a firm to rely as much as possible on lending by $T-$banks. However, there is a limit on how much a firm can borrow from $T-$banks, if it wants to be able to rely on the more efficient debt restructuring services of $R-$banks. The limit comes from the existence of a debt overhang problem if the firms are overindebt with $T-$banks.

To see this, let L_R and L_T denote the loans granted by respectively $R-$banks and by $T-$banks at $t = 0$, with $L_R + L_T = 1$. Also, let r_R^{RT} and r_T^{RT} denote the corresponding repayment terms under each type of loan. When a firm has multiple loans an immediate question arises: what is the seniority structure of these loans? As is common in multiple bank lender situations, we shall assume that $R-$bank loans and $T-$bank loans are *pari passu* in the event of default. Under this assumption, the following proposition holds:

Proposition 3: *The optimal loan structure for $H-$firms is to maximize the amount of transactional loans subject to satisfying the relationship lender's incentive to roll over the loans at $t = 1$.*

The firm borrows:

$$L_T = \frac{(p + (1-p)\overline{\nu})\left[\beta V^H(1-m) - V^L\right]}{1 + \rho_T - V^L}. \tag{6}$$

in the form of a transaction loan, and $(1 - L_T)$ from an $R-$bank at $t = 0$ at the following lending terms:

$$r_T^{RT} = \frac{(1+\rho_T) - (1-p)(1-\overline{\nu})V^L}{p + (1-p)\overline{\nu}}, \tag{7}$$

and,

$$r_R^{RT} = \frac{1}{p}\left[(1+\rho_R) - \frac{(1-p)V^L}{(1-L_T)}\right]. \tag{8}$$

At time $t = 1$ both transaction and relationship-loans issued by $H-$ firms are rolled over by the R-bank. Neither loan issued by an $L-$ firm is rolled over.

Proof: See Appendix A. ■

As intuition suggests: *i)* pure relationship lending is dominated under our assumptions; and *ii)* if the bank has access to securitization or other forms of funding to obtain funds on the same terms as $T-$banks, then it can combine the two.

Note finally that, as $T-$loans are less expensive, a relatively safe firm (with a high p) may still be better off borrowing only from $T-$banks and taking the risk that with a small probability it won't be restructured in bad times. We turn to the choice of optimal mixed borrowing versus 100% $T-$financing in the next section.

4 Optimal funding choice

When would a firm choose mixed financing over 100% $T-$financing? To answer this question we need to consider the net benefit to an $H-$firm from choosing a combination of R and $T-$bank borrowing over 100% $T-$bank borrowing. We will make the following plausible simplifying assumptions in order to focus on the most interesting parameter region and limit the number of different cases to consider:

Assumption A1: Both $(\rho_R - \rho_T)$ and m are small enough.

Assumption A2: $\beta V^H - V^L$ is not too large so that it satisfies:

$$\beta V^H - V^L < \min\left\{ \frac{(1+\rho_T)[\frac{(1-\theta)}{\nu_G} + \frac{\theta}{\nu_B} - 1]}{(1 - [(1-\theta)\nu_G + \theta\nu_B])}, \frac{\theta(1-p_B)(V^H - V^L)}{(1-p)(1-\overline{\nu})} \right\}$$

These two conditions essentially guarantee that relationship banking has an advantage over transaction banking. For this to be true, it must be the case that: First, the intermediation cost of relationship banks is not too large relative to that of transaction banks. Assumption A1 guarantees that this is the case. Second, the cost of rolling over a loan with the $R-$bank should not be too high. This means that the $R-$bank should have a bounded ex post information monopoly power. This is guaranteed by assumption A2.

To simplify notation and obtain relatively simple analytical expressions, we shall also assume that $V^H > \frac{r_T(p)}{\nu_B}$. The last inequality further implies that $V^H > \frac{r_T(p)}{\nu_G}$, as $\nu_G > \nu_B$, so that the firm's debts will be rolled over by the $T-$bank in both *boom* and *bust* states of nature. Note that when this is the case the transaction loan is perfectly safe, so that $r_T(p) = 1 + \rho_T$, as in equation (4).

We denote by $\Delta\Pi(p) = \Pi^T(p) - \Pi^{RT}(p)$ the difference in expected payoffs for an $H-$firm from choosing 100% $T-$financing over choosing a combination of T and $R-$loans and establish the following proposition.

Proposition 4: *Under assumptions A1 and A2, the equilibrium funding in the economy will correspond to one of the three following configurations:*

1. $\Delta\Pi(p_{\min}) \equiv \Delta\Pi((1-\theta)\Delta) > 0$*: monitoring costs are excessively high and all firms prefer* 100% *transactional banking.*

2. $\Delta\Pi(p_{\max}) \equiv \Delta\Pi(1-\theta\Delta) > 0$ *and* $\Delta\Pi(p_{\min}) \equiv \Delta\Pi((1-\theta)\Delta) < 0$*: Safe firms choose pure* $T-$*banking and riskier firms choose a combination of* $T-$*banking and R-banking.*

3. $\Delta\Pi(p_{\max}) \equiv \Delta\Pi(1-\theta\Delta) < 0$*: all firms choose a combination of* $T-$*banking and* $R-$*banking.*

Proof: See Appendix A. ■

We are primarily interested in the second case, where we have coexistence of 100% $T-$banking by the safest firms along with other firms combining $T-$Banking and $R-$banking. Notice, that under assumptions A1 and A2, it is possible to write

$$\begin{aligned}\Delta\Pi((1-\theta)\Delta) &= (\rho_R-\rho_T)(1-L_T^*)+(1-(1-\theta)\Delta)\left[\overline{\nu}m\beta V^H\right] \\ &\quad +\theta\Delta(1+\rho_T)+(1-(1-\theta)\Delta)(1-\overline{\nu})(\beta V^H-V^L) \\ &\quad -(1+\rho_T)[\frac{(1-\theta)(1-\Delta)}{\nu_G}+\frac{\theta}{\nu_B}] \end{aligned} \tag{9}$$

and

$$\begin{aligned}\Delta\Pi(1-\theta\Delta) &= (1+\rho_R)-(\rho_R-\rho_T)L_T^*-\theta\Delta\left[\overline{\nu}(1-m)\beta V^H+(1-\overline{\nu})V^L\right] \\ &\quad -(1-\theta\Delta)(1+\rho_T)+\theta\Delta\beta V^H \\ &\quad -(1+\rho_T)[\frac{\theta\Delta}{\nu_B}]. \end{aligned} \tag{10}$$

Under assumption A1 $(\rho_R-\rho_T)$ and m are small, so that a sufficient condition to obtain $\Delta\Pi(1-\theta\Delta)>0$ is to have $\theta\Delta$ sufficiently close to zero. Indeed, then we have:

$$\Delta\Pi(1-\theta\Delta)\approx(\rho_R-\rho_T)(1-L_T^*)>0$$

To summarize the testable hypotheses coming from our theoretical model are the following:

1 $R-$banks are better able than $T-$banks at learning firms' type. In a crisis, the rate of default on firms financed through transaction loans will be higher than the rate on firms financed by $R-$banks.

2 $R-$banks charge higher lending rates in good times on the loans they roll over, but in bad times they lower rates to help their best clients through the crisis. $R-$banks increase their supply of lending (relative to $T-$banks) in bad times.

3 It exists a critical threshold for the probability of success in bad time $\hat{p}_B$ such that for any $p_B \geq \hat{p}_B$ firms prefer pure transactional banking and for any $p_B < \hat{p}_B$ firms prefer to combine the maximum of transactional banking and the minimal amount of relationship banking.

4 Banks need a capital buffer to be used in order to preserve the lending relationship in bad times. This implies that the capital buffer of an $R-$bank (which makes additional loans to good firms in distress) will have to be higher than the one of a $T-$bank. This is consistent with $R-$banks quoting higher interest rates in normal times.

5 Data and empirical findings

We now turn to the empirical investigation of relationship banking over the business cycle. A key test we are interested in is whether $R-$banks charge higher lending rates in good times and lower rates in bad times to help their best clients through the crisis, and, similarly, whether $T-$banks offer cheaper loans in good times but roll over fewer loans in bad times. Another related prediction from our theoretical analysis we test is whether we observe lower delinquency rates in bad times for $R-$banks that roll over their loans. To test these predictions, we proceed in two steps. First we analyze how firms' default probability in bad times is influenced by the fact that the loan is granted by an $R-$bank or a $T-$bank. Second, we analyze (and compare) lending and bank interest rate setting in good times and bad times. Our dataset comes from the Italian Credit Register (CR) maintained by the Bank of Italy and other sources.

The first challenge we face is to identify two separate periods that represent the two states of the world in the model. Our approach is to distinguish and compare bank-firm relationships prior to and after the Lehman Brothers' default (in September 2008), the event typically used to mark the beginning of the global financial crisis in other studies (e.g. Schularick and Taylor, 2011).

Our unique dataset covers a significant sample of Italian banks and firms. There are at least four advantages in focusing on Italy. First, from Italy's perspective the global financial crisis was largely an unexpected (exogenous) event, which had a sizable impact especially on small and medium-sized firms that are highly dependent on bank financing. Second, although Italian banks have been hit by the financial crisis, systemic stability has not been endangered and government intervention has been negligible in comparison to other countries (Panetta et al. 2009). We do not consider the time-period beyond 2011, as it is affected by the effects of the European Sovereign debt crisis. Third, multiple lending is a long-standing characteristic of the bank-firm relationship in Italy (Foglia et al. 1998, Detragiache et al. 2000). And fourth, the detailed data available for Italy allow us to test the main hypotheses of the theoretical model without making strong assumptions. Mainly, the availability of data at the bank-firm level on both quantity and prices allows us to overcome major identification problems encountered by the existing bank-lending-channel literature in disentangling loan demand from loan supply shifts (see e.g. Kashyap and Stein, 1995; 2000).

The visual inspection of bank lending and interest rate dynamics in Figure 3 helps us to select two periods that can be considered good and bad times: We select the second quarter of 2007 as a good time-period when lending reached a peak and the interest rate spread applied on credit lines levelled to a minimum (see the green circles in panels (a) and (b) of Figure 3). We take the bad time-period to be the first quarter of 2010, which is characterized by a contraction in bank lending to firms and a very high intermediation spread (see the red circles in panels (a) and (b) of Figure 3). The selection of these two time-periods is also consistent with alternative indicators such as real GDP and stock market capitalization (see panel (c) in Figure 3).

Our second challenge is to distinguish between $T-$banks and $R-$banks. One of the distinguishing characteristics of $R-$banks in our theory and other relationship-banking models (Boot 2000; Berger and Udell 2006) is that $R-$banks gather information about the firms they lend to on an ongoing basis, to be able to provide the flexible financing their client firms value. Thus, the measure of relationship banking we focus on is the informational distance between lenders and borrowers.[9] The empirical banking literature has established that greater geographical distance between a bank and a firm affects the ability of the bank to gather soft information (that is, information that is difficult to codify), which in turn undermines the bank's ability to act as a relationship lender (see Berger et al. 2005, Agarwal and Hauswald 2010).

The theoretical banking literature argues that greater geographical distance plausibly increases monitoring costs and diminishes the ability of banks to gather and communicate soft information. In particular, it is argued that loan officers who are typically charged with gathering this kind of information and to pass it through the bank's hierarchical layers will face higher costs.[10] Stein (2002) has shown that when the production of soft information is decentralized, incentives to gather it crucially depends on the ability of the agent to convey information to the principal. Cremer, Garicano and Prat (2007) have also argued that distance may affect the transmission of information within banks (i.e. the ability of branch loan officers to harden soft information), since bank headquarters may be less able to interpret the information they receive from distant branch loan officers than from closer ones. They show that there is a trade-off between the efficiency of communication and the breadth of activities covered by an organization, so that communication is more difficult when headquarters and branches are farther apart.

We therefore divide $R-$banks and $T-$banks by the geographical distance between the lending banks' headquarters and firm headquarters, which we take as a simple proxy for informational distance.[11] More precisely, we introduce two dummy variables: for an $R-$bank, the first variable is equal to 1 if firm k is headquartered in the same province where bank j has its headquarters; for a $T-$bank, the second variable is equal to 1 when the first variable (for the $R-$bank) is equal to 0. This way a bank can act both as

[9] There is not a clear consensus in the literature on the way relationship characteristics are identified. In Appendix C, we have checked the robustness of the results using alternative measures for relationship lending.

[10] Soft information it is gathered through repeated interaction with the borrower and then it requires proximity. Banks in order to save on transportation costs delegate the production of soft information to branch loan officers since they are those within bank organizations which are the closest to borrowers. Alternatively, one can consider the geographical distance between bank branches and firms' headquarters. However, Degryse and Ongena (2005) find that this measure has little relation to informational asymmetries.

[11] Accordingly, branches of foreign banks are treated as $T-$banks.

an $R-$bank for a firm headquartered in the same province and as a $T-$bank for firms that are far away.

Our third challenge is to measure credit risk and to distinguish this measure from asymmetric information. One basic assumption of our theoretical framework is that ex ante all banks know that some firms are more risky than others. The objective measure of a firm's credit risk shared ex ante by all banks is given by $(1-p)$ in our model and by a firm's $Z-$score in our empirical analysis. The $Z-$score, thus, is our measure of a firm's ex-ante probability of default.[12] The $Z-$scores can be mapped into four levels of risk: 1) safe; 2) solvent; 3) vulnerable; and 4) risky. Measuring asymmetric information and the role of relationship banks in gathering additional information is more complex. Obviously, no contemporaneous variable could possibly reflect soft information that is private to the firm and the relationship bank. Consequently, it is only ex post that a variable could reflect the skills of relationship banks in refinancing the good firms and liquidating the bad ones. Relationship banks' superior soft information must imply that firms who are able to roll over their loans from a relationship bank must on average have lower rates of default. This is why in order to distinguish $H-$firms from $L-$firms we look at the realization of defaults.

Table 1 gives some basic information on the dataset after having dropped outliers (for more information see the data Appendix B). The database includes around 75,000 firms tracked before and after the crisis (a total of around 185,000 bank-firm observations). The table is divided horizontally into three panels: i) all firms, ii) $H-$firms (i.e. firms that have not defaulted during the financial crisis) and iii) $L-$firms (i.e. firms that have defaulted on at least one of their loans). In the rows we divide bank-firm relationships into: i) pure relationship lending: firms which have business relationship with $R-$banks only; ii) mixed banking relationship: firms which have business relationships with both $R-$banks and $T-$banks; iii) pure transactional lending: firms which have business relationship with $T-$banks only.

Several clear patterns emerge. First, cases where firms have only relationships with $R-$banks (10% of the cases) or $T-$banks (44% of the cases) are numerous but the majority of firms borrow from both kinds of banks (46%). Second, the percentage of defaulted firms that received lending only from

[12] The Z-score is an indicator of the probability of default which is computed annually by CERVED (see http://www.cerved.com/xportal/web/eng/aboutCerved/aboutCerved.jsp) on balance sheet variables. The methodology is described in Altman et al. (1994).

$T-$banks is relatively high (64% of the total). Third, in the case of pure $R-$banking, or combined RT $-$banking, firms experience a lower increase in the spread in the crisis. Fourth, $R-$banking is associated with a higher level of bank equity-capital ratios, so that $R-$banks have a buffer against contingencies in bad times. Their equity-capital slack depends on the business cycle and is depleted in bad times. Interestingly, the size of the average $T-$bank is four times that of the average $R-$bank (100 vs 25 billions). This is in line with Stein (2002) who points out that the internal management problem of very large intermediaries may induce these banks to rely solely on hard information in order to align the incentives of the local managers with headquarters.

These patterns are broadly in line with the predictions of our theoretical model. However, these findings can only be suggestive as the bank-lending relationship is influenced not only by firms' types but also by other factors (sectors of a firm's activity, the firm's age and location, bank-specific characteristics, etc.), which we have not yet controlled for in the descriptive sample statistics reported in Table 1.

5.1 Hypothesis 1: $R-$banks have better information than $T-$banks about firms' credit risk

To verify whether $R-$banks are better able to learn firms' types than $T-$banks we look at the relationship between the probability that a firm k defaults and the firm's relative share of *transactional vs relationship* financing. If $R-$banks have superior information than $T-$banks in a crisis then the rate of default of firms financed through transaction loans will be higher than for firms financed by $R-$banks.

Our baseline cross-sectional equation estimates the marginal probability of default of firm k in the six quarters that follow the Lehman Brothers collapse (2008:q3-2010:q1) as a function of the share of loans of firm k from a $T-$bank in 2008:q2. In particular, we estimate the following marginal probit model:

$$MP(\textit{Firm k's default=1}) = \alpha + \zeta + \pi(T - share)_k + \varepsilon_k \qquad (11)$$

where α and ζ are, respectively, vectors of bank and industry-fixed effects and $(T - share)_k$ is the pre-crisis proportion of transactional loans (in value) for firm k. The results reported in Table 2 indicate that a firm with more

$T-$bank loans has a higher probability of default.[13] This marginal effect increases with the share of $T-$bank financing and reaches a maximum of around 0.3% when $(T - share)_k$ is equal to 1. This effect is not only statistically significant but also important from an economic point of view, as the average default rate for the whole sample in the period of investigation was around 1%. This finding is robust to enriching the set of controls with additional firm-specific characteristics (see panel II in Table 2) or to calculating the proportion of transactional loans in terms of the number of banks that finance firm k instead of by the size of outstanding loans (see panel III in Table 2).

5.2 Hypotheses 2: 2a) $R-$banks charge higher rates in good times and lower rates in bad times. 2b) $R-$banks increase their supply of lending (relative to $T-$banks) in bad times.

In the second step of our analysis we investigate bank lending and price setting over the business cycle. Our focus on multiple lending relations at the firm level allows us to solve potential identification issues, by including both bank and firm fixed effects in the econometric model. In particular, the inclusion of fixed effects allows us to control for all (observable and unobservable)

[13] In principle the reliability of this test may be biased by the possible presence of "evergreening", a practice aimed at postponing the reporting of losses on the balance sheet. Albertazzi and Marchetti (2010) find some evidence of "evergreening" practices in Italy in the period 2008:Q3-2009:Q1, although limited to small banks. We think that evergreening is less of a concern in our case for three reasons.

First, evergreening is a process that by nature cannot postpone the reporting of losses for a too long time. In our paper, we consider the period 2008:Q3-2010:Q1 that is 18 months after Lehmann's default and therefore there is a higher probability that banks have reported losses.

Second, there is no theoretical background to argue that evergreening can explain the difference we document between T-banks and R-banks. Both kinds of banks may have a similar incentive to postpone the reporting of losses to temporarily inflate stock prices and profitability.

Third, in the case that R-banks have more incentive to evergreen loans the definition of default used in the paper limits the problem. In particular, we consider a firm as in default when at least one of the loans extended is reported to the credit register as a defaulted one ("the flag is up when at least one bank reports the client as bad"). This means that a R-bank cannot effectively postpone the loss simply because a T-banks will report it.

time-invariant bank and borrower characteristics, and to identify in a precise way the effects of bank-firm relationships on the interest rate charged and the loan amount.

We estimate two cross-sectional equations: one for the interest rate ($r_{j,k}$) applied by bank j on the credit line of firm k, and the other for the logarithm of outstanding loans by bank j in real terms ($L_{j,k}$) on total credit lines to firm k:

$$r_{j,k} = \nu + \beta + \gamma T\text{-bank}_{j,k} + \varepsilon_{j,k}, \tag{12}$$

$$L_{j,k} = \delta + \phi + \mu T\text{-bank}_{j,k} + \varepsilon_{j,k}, \tag{13}$$

where ν and δ are bank-fixed effects and β and ϕ are firm-fixed effects.[14] Both equations are estimated over good times (2007:q2) and bad times (2010:q1).

The results are reported in Table 3.[15] In line with the predictions of the model, the coefficients show that $T-$banks (compared to $R-$banks) provide loans at a cheaper rate in good times and at a higher rate in bad times (see columns I and II). The difference between the two coefficients $\gamma_B - \gamma_G = .123 - (-.081) = .204^{***}$ is statistically significant. As for loan quantities, other things being equal, $T-$banks always provide on average a lower amount of lending, especially in bad times (see columns III and IV). In this case the difference $\mu_G - \mu_B = -.313 - (-.275) = -0.038^{**}$ indicates that, other

[14]It is worth stressing that the analysis of interest rates applied on credit lines is particularly useful for our purposes for two reasons. First, these loans are highly standardized among banks and therefore comparing the cost of credit among firms is not affected by unobservable (to the econometrician) loan-contract-specific covenants. Second, overdraft facilities are loans granted neither for some specific purpose, as is the case for mortgages, nor on the basis of a specific transaction, as is the case for advances against trade credit receivables. As a consequence, according to Berger and Udell (1995) the pricing of these loans is highly associated with the borrower-lender relationship, thus providing us with a better tool for testing the role of lending relationships in bank interest rate setting.

[15]Following Albertazzi and Marchetti (2010) and Hale and Santos (2009) we cluster standard errors ($\varepsilon_{j,k}$) at the firm level in those regressions that include bank fixed effects. Vice versa in those regressions that include specific firm fixed effects (but no bank fixed effects) we cluster standard errors at the bank group level. In this way we are able to control for the fact that, due to the presence of an internal capital market, probably financial conditions of each bank in the group is not independent of one another. For a general discussion on different approaches used to estimating standard errors in finance panel data sets, see Petersen (2009).

things being equal, $R-$banks increase their supply of loans in bad times. In particular, they supply 4% more loans relatively to $T-$banks.

5.3 Hypothesis 3: Safe firms prefer transactional lending; other firms prefer to combine transactional and relationship banking.

A key prediction of our model is that firms with low underlying cash-flow risk (those with a probability of success in bad times that is greater than $\hat{p}_B$) prefer pure transaction banking, while those with higher cash-flow risk (with $p_B \leq \hat{p}_B$) prefer to combine transaction and relationship banking. To test this prediction we will look for a $Z-$score relation such that firms with a *low* Z score reveal their preference for pure transactional banking and those with a high Z score reveal their preference for combined T and $R-$banking. To this end, equations (12) and (13) are further enriched with interaction terms between bank-types and the $Z-$score in order to explore whether $R-$banks and $T-$banks behave differently with respect to borrowers with a different degree of risk:

$$r_{j,k} = \nu+\theta+\gamma(T-\text{bank})_{j,k}+\gamma_Z(T-\text{bank})_{j,k}*Z+\rho_Z(R-\text{bank})_{j,k}*Z+\Theta X+\varepsilon_{j,k} \tag{14}$$

$$L_{j,k} = \delta+\theta+\mu T-\text{bank}_{j,k}+\mu_Z(T-\text{bank})_{j,k}*Z+\psi_Z(R-\text{bank})_{j,k}*Z+\Phi X+\varepsilon_{j,k} \tag{15}$$

In the above equations we can include only bank fixed effects, as the interaction terms between bank type and $Z-$scores (a linear combination that is invariant for each firm) prevent us from including firm-fixed effects. For this reason we also enrich the set of controls by including a complete set of industry-province dummies (θ) and a vector X with a number of firm-specific characteristics. In particular X now contains:

- a dummy US>GR that takes the value of 1 for those firms that have used their credit lines for an amount greater than the value granted by the bank, and zero elsewhere;
- a dummy that takes the value of 1 if the firm is a limited liability corporation, and zero elsewhere (LTD);

- a dummy that takes the value of 1 for firms with less than 20 employees (SMALL_FIRM), and zero elsewhere; this dummy aims to control for the fact that small firms do not issue bonds as larger firms may do;
- the length of the borrower's credit history (CREDIT HISTORY) measured by the number of years elapsed since the first time a borrower was reported to the Credit Register. This variable tells us how much information has been shared among lenders through the Credit Register over time and is a proxy for firms' reputation acquisition.

The results are reported in Table 4. Firms that use their credit lines for an amount greater than the value granted by the bank have to pay a higher spread that increases in bad times. Repeated interaction with the banking system also has an effect on bank interest rate setting and loan supply. The variable CREDIT_HISTORY, representing the number of years elapsed since the first time a borrower was reported to the Credit Register, is negatively (positively) correlated with rates applied to credit lines (amount of outstanding loans). Firms organized as limited liability corporations (LTD corporations) are less opaque and pay a lower spread. Other things being equals, LTD corporations also need less bank lending because they have access to other sources of funds.

The graphical representation of the interaction terms between bank-types and the $Z-$score is reported in Figure 4. The upper panels (a) and (b) describes the effects on the interest rate, the bottom panels (c) and (d) those on the logarithm of real loans. The graphs on the left illustrate the pre-Lehman period, while those on the right represent the post-Lehman period. In each graph the horizontal axis reports the $Z-$score, where Z goes from 1 (safe firm) to 4 (risky firm). Transaction banking ($T-$banks) is indicated with a dotted line and relationship banking ($R-$banks) with a solid line.

The visual inspection of all graphs shows that both interest rates and loan size are positively correlated with the $Z-$score. The positive correlation between risk and bank financing probably reflects the fact that risky firms have a limited access to market financing. As one would expect, the interest rate increases with credit risk.

In line with the predictions of our model, the cost of credit of transactional lending is always lower than relationship banking in good times: the dotted line is always below the solid one for all $Z-$scores (see panel (a) of Figure 4). This pattern is reversed in bad times (panel (b)) when banks with a strong lending relationship ($R-$banks) offer lower rates to *risky* firms (those with a $Z-$score greater than 1). And, as predicted by our model, it is always cheaper for safe firms to use transactional banking because they obtain always a lower rate from $T-$banks. Moreover the two bottom panels of Figure 4 highlight that the roll-over effects of $R-$banks on lending is mostly present for *risky* firms, while $safe$ firms always obtain a greater level of financing from $T-$banks whether in good or bad times (the dotted line is always above the solid line for $Z = 1$ both in panel (c) and panel (d)).

5.4 Hypothesis 4: $R-$banks need capital buffers to be used to preserve the lending relationship in bad times

A final prediction of our model is that $R-$banks have a higher equity capital buffer than $T-$banks in good times so as to support the lending relationship in bad times. To test this prediction we focus on bank capital endowments: Since $T-$banks have a lower incentive of making additional loans to firms in distress in bad times, we should observe that these banks hold a lower equity-capital buffer against contingencies relative to $R-$banks prior to the crisis. In particular, we estimate the following cross-sectional equation on our sample of 179 banks:

$$CAP_j = z + \tau(T - share)_j + \Psi Y + \Phi B + \varepsilon_j, \qquad (16)$$

where the dependent variable CAP_j is the regulatory capital-to-risk-weighted-assets of bank j in 2008:q2 (prior to the Lehman collapse), the variable $(T - share)_j$ is the proportion of transaction loans (in value) for bank j, z is a set of bank-zone dummies, Y a set of bank-specific controls, and B a set of bank credit portfolio-specific controls. Bank specific characteristics include not only bank size and liquidity ratio (liquid assets over total assets), but also the retail ratio between deposits and total bank funding (excluding capital). We also include the log of the number of provinces in which each banks supply loans. This control is helpful because banks with loans concentrated in their home provinces are more exposed to provincial risk than banks whose loans are spread over other provinces. All explanatory variables are taken in 2008:q1 in order to tackle endogeneity problems. The results reported in Table 5 indicate that, indipendently of the model specification chosen, a pure $T-$bank that has a credit portfolio composed exclusively of transaction loans

($T - share_j = 1$) have a capital buffer more than 3 percentage points lower than a pure $R-$bank, whose portfolio is composed exclusively of relationship loans ($T - share_j = 0$).

Finally, we also test the effects of bank capital endowments on interest rates and lending. We thus include in our baseline equations (12) and (13), the regulatory capital-to-risk weighted assets ratio (CAP, lagged one period to mitigate endogeneity problems), a set of bank-zone dummies (z), and other bank-specific controls (Y):

$$r_{j,k} = \beta + z + \gamma(T - \text{bank})_{j,k} + \nu CAP_j + \Psi Y + \varepsilon_{j,k} \tag{17}$$

$$L_{j,k} = \phi + z + \mu(T - \text{bank})_{j,k} + \lambda CAP_j + \Xi Y + \varepsilon_{j,k} \tag{18}$$

The vector Y contains in particular the dummy $US > GR$, described above, and:

- a dummy for mutual banks ($MUTUAL$), which are subject to a special regulatory regime (Angelini et al., 1998);
- a dummy equal to 1 if a bank belongs to a group and 0 elsewhere;
- a dummy equal to 1 if a bank has received government assistance and 0 elsewhere.

The results reported in Table 6 indicate that banks with larger capital ratios are better able to protect the lending relationship with their clients. Well-capitalized banks have a higher capacity to insulate their credit portfolio from the effects of an economic downturn by granting a higher amount of lending at a lower interest rate. To get a sense of the economic impact of the above-mentioned results, during a downturn a bank with a capital ratio 5 percentage points greater with respect to another one supplies 5% more loans at an interest rate 20 basis points lower. This result on the effects of bank capital is in line with the bank lending channel literature which indicates that well-capitalized banks are better able to protect their clients in the event of a monetary policy shock (Kishan and Opiela, 2000; Gambacorta and Mistrulli, 2004).

Interestingly, the positive effect of bank capital in protecting the lending relationship is more important for $R-$banks than for $T-$banks. This can be tested by replacing νCAP in equation (17) with

$$\upsilon_T(T - bank) * CAP + \upsilon_R(R - bank) * CAP$$

and λCAP in equation (18) with

$$\lambda_T(T - bank) * CAP + \lambda_R(R - bank) * CAP.$$

In particular, the coefficients υ_T and υ_R take the values of -0.038*** (s.e. 0.010) and -0.054*** (s.e. 0.008), respectively, and are statistically different. A similar result is obtained in the lending equation, where λ_T and λ_R take the values of 0.006* (s.e. 0.003) and 0.025*** respectively, and are statistically different from one another. This means that during a downturn an $R-$bank (resp. $T-$bank) with a capital ratio 5 percentage points greater than another $R-$bank supplies 12% more loans at an interest rate 27 basis points lower (resp. 3% more loans and 19 basis points lower rates for a $T-$bank).

5.5 Robustness checks

We have checked the robustness of our results in several ways.[16] We have: (1) included in the baseline regressions an additional measure of relationship banking, namely a dummy for the "main bank"; (2) tested for alternative definitions of the relationship dummy $R-$bank; (3) considered all subsidiaries of foreign banks as $T-$banks; (4) estimated equations on a subset of "new firms". In all cases results are very similar.

One distinctive feature of our dataset is that, by focusing on multiple lending, we can run estimates with both bank and firm fixed effects, thus controlling for observable and unobservable supply and demand factors. In this way we are able to clearly identify the effects of bank-firm relationship characteristics on lending, not biased by the omission of some variables that may affect credit conditions. To highlight this point we have re-run all the models without bank and firm fixed effects. The new set of results (not reported for the sake of brevity but available from the authors upon request) indicates that $T-$bank coefficients are often different and may even change sign in one third of the cases. In particular, when we do not introduce fixed-effects, $T-$banks are shown to supply relatively more lending but at higher prices. This is an important observation, as it clearly shows that not

[16] For more details see Appendix C.

controlling for all unobservable bank and firm characteristics biases results; in particular, the benefits of relationship lending tend to be overestimated on prices and underestimated on quantities.

The bias can be seen by comparing Figure 4 (illustrating the results of the models with fixed effects reported in Table 4) with Figure 5 (illustrating results of the same models but without fixed effects). In Figure 5 the dotted line for $T-$banks moves upwards relative to Figure 4. In other words, $T-$banks supply relatively more loans and charge higher interest rates when fixed effects are dropped compared with the case when they are added to the estimated equation.

This last finding is consistent with the way we identify transaction and relationship banking, as one would expect to see this sign for the bias if $R-$banks are better able than $T-$banks to gather soft information, and consequently better able to discriminate good and bad borrowers. Indeed, consider two firms that have the same $Z-$score but one is, in reality, riskier than the other. According to our model, $R-$banks are better able to discriminate between the two while $T-$banks are not. This happens because $T-$banks use only hard information (incorporated in the $Z-$scores) while $R-$banks rely on both hard and soft information. If this is true then the riskiest firm would prefer to ask $T-$banks for a loan since these banks are less able to distinguish good from bad borrowers. As a consequence, the riskiest firm will in theory get better price conditions and a larger amount of credit compared to the situation where $T-$banks are able to evaluate firms' credit risk correctly. Of course, $T-$banks are perfectly aware that the bank-firm matching is not random and that their applicant pool is on average riskier than that of $R-$banks. As a consequence, $T-$banks will charge higher interest rates, anticipating that they will tend to make more mistakes in their loan restructuring choices compared to $R-$banks. In other words, $T-$banks know that they will tend to lend "too much" and this is exactly what we observe in Figure 5, where we are not controlling for this endogenous matching. In contrast, when we use fixed effects we can control for the fact that bank-firm matching is not random by comparing $R-$banks' and $T-$banks' behavior keeping constant and homogenous the level of default risk between banks' types. It is only in this last situation that we are able to compare $R-$banks with $T-$banks perfectly, since then the interest rate spread between these two types of banks (and their different lending behavior) only reflects their different roles in the credit market. In sum, the interest spread between $R-$banks and $T-$banks in good times reported in Figure 4 (using fixed effects) is an unbiased measure of the premium that firms pay in order to get a loan restructuring in bad times.

6 Comparing different theories of relationship banking

The relationship banking literature distinguishes between different benefits from a long-term banking relation. Except for Berlin and Mester (1999) the other theories do not explicitly consider how relationship lending would evolve over the business cycle. Nevertheless it is instructive to briefly compare our findings with the likely predictions of the other main theories.

We have identified four different strands of relationship banking theories, which differ in their predictions of default rates, cost of credit, and credit availability over the business cycle. A first strand emphasizes the role of $R-$Banks in providing (implicit) insurance to firms towards future access to credit and future credit terms (Berger and Udell 1992, Berlin and Mester 1999). According to this (implicit) insurance theory, $R-$banks do not have better knowledge about firms' types and therefore they should experience similar default rates (in crisis times) to those of $T-$banks. Although Berlin and Mester find that banks funded more heavily with core deposits provide more loan-rate smoothing in response to exogenous changes in aggregate, it does not follow from this finding that the firms with the lowest credit risk choose this loan-rate smoothing service.

A second strand underscores the *monitoring* role of $R-$banks (Holmstrom and Tirole 1997, Boot and Thakor 2000, Hauswald and Marquez 2006). According to the monitoring theory, only firms with low equity capital choose a monitored bank loan from an $R-$bank, while firms with sufficient cash (or collateral) choose cheaper loans from a $T-$bank. By this theory adverse selection is a minor issue, and monitoring is simply a way to limit the firm's interim moral hazard problems. Although these monitoring theories do not make any explict predictions on default rates in a crisis, it seems plausible that these theories would predict higher probabilities of default in bad times for firms borrowing from $R-$banks.

A third strand plays up the greater *ex-ante screening* abilities (of new loan applications) of R-banks due to their access to both hard and soft information about the firm (Agarwal and Hauswald 2010, Puri et al. 2010).

A plausible prediction of these ex-ante screening theories would seem to be that $R-$banks have lower default rates in crisis times than $T-$banks. Another plausible prediction is that $R-$banks would benefit from an ex-post monopoly of information both in good and bad times, thus charging higher lending rates than $T-$banks in both states on the loans they roll over.

A fourth strand of relationship banking theories, on which our model builds, emphasizes (soft) information acquisition about borrowers' types over time. This role is closer to the one emphasized in the original contributions by Sharpe (1990), Rajan(1992) and Von Thadden (1995). This strand of theories puts the $R-$bank in the position of offering continuation lending terms that are better adapted to the specific circumstances in which the firm may find itself in the future. This line of theories predicts that $R-$banks charge higher lending rates in good times on the loans they roll over, and lower rates in bad times to help their best clients through the crisis. In contrast, $T-$banks offer cheaper loans in good times but roll over fewer loans in bad times. Also, according to this theory we should observe lower delinquency rates in bad times for $R-$banks that roll over their loans.

As a first step in the comparison among these different theoretical models, we focus on the relationship between the probability for a firm k to go into default and the composition of its *transactional* vs *relationship* financing. From our test of Proposition 1 (see equation 11) we find that $T-$banks exhibit higher default rates in bad times. This finding is consistent with the predictions of our theory as well the third strand of theories based on *ex-ante screening*. For example, we get results similar to those in Agarwal and Hauswald (2010) that distinguish between screened and unscreened loans. However, we can go one step forward by checking if the mechanism at work is pure *ex-ante screening* or banks learns about changes in borrower's creditworthiness and adapt lending terms to the evolving circumstances the firm finds itself in.

In particular, the comparison of interest rates of $R-$banks and $T-$banks in good times and in bad times provides additional insights into the likely benefits of relationship banking. In particular, our findings that $R-$banks charge higher rates than $T-$banks in good times and vice-versa in bad times are only consistent with the prediction of our theory.[17] Importantly, we

[17]The finding that transaction loans carry lower rates than relationship loans before the crisis, but higher rates during the crisis may in principle also be consistent with other models. For example, in a screening model, uninformed banks will charge higher rates as credit conditions worsen because this increase the Winner's Curse Effect (Rajan,1992); on

do not observe an ex-post monopoly of information for $R-$banks such that $R-$banks always charge higher rates than $T-$banks on the loans they roll over.

7 Conclusion

The theoretical approach we suggest, which emphasizes the idea that relationship lending allows banks to learn firms' types and therefore help them in bad times, provides predictions on relative rates of default in a crisis, the behavior of interest rates, and the amount of equity capital of relationship banks that the our data broadly supports. Our empirical analysis thus provides further guidance on what relationship-lending achieves in the real economy. We have found that relationship banking is an important mitigating factor of crises. By helping profitable firms to retain access to credit in times of crisis relationship banks dampen the effects of a credit crunch. However, the role relationship banks can play in a crisis is limited by the amount of excess equity capital they are able to hold in anticipation of a crisis. Banks entering the crisis with a larger equity capital cushion are able to perform their relationship banking role more effectively. These results are consistent with other empirical findings for Italy (see, amongst others, Albertazzi and Marchetti (2010) and De Mitri et al. (2010)).

Our analysis suggests that if more firms could be induced to seek a long-term banking relation, and if relationship banks could be induced to hold a bigger equity capital buffer in anticipation of a crisis, the effects of crises on corporate investment and economic activity would be smaller. However, aggressive competition by less well capitalized and lower-cost transaction banks is undermining access to relationship banking. As these banks compete more aggressively more firms will switch away from $R-$banks and take a chance that they will not be exposed to a crisis. And the more firms switch the higher the costs of $R-$banks. Overall, the fiercer competition by $T-$banks contributes to magnifying the amplitude of the business cycle and the procyclical effects of bank capital regulations.

the other hand, this premium may be small in normal times and the uninformed banks' rate may be lower because these banks do not sustain the cost of screening. However, such theoretical model is not able to explain why informed (relationship) banks *reduce* the level of their rates in a crisis.

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Figure 1

Average firm cash flows in state S

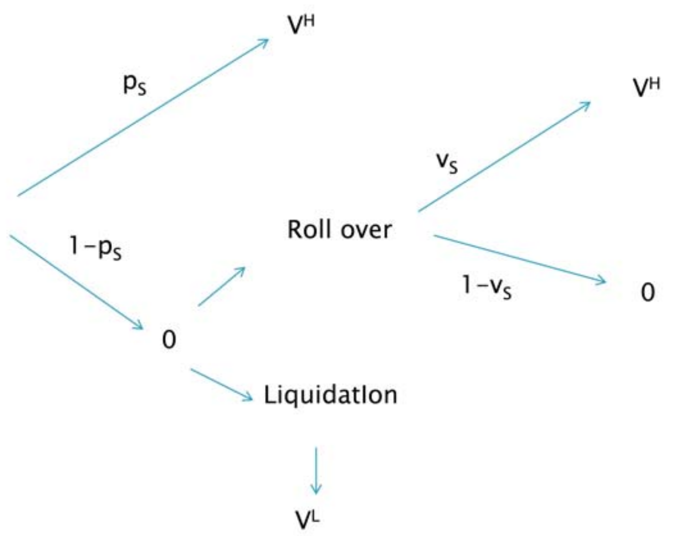


Figure 2

100% Transactional Banks Payoff

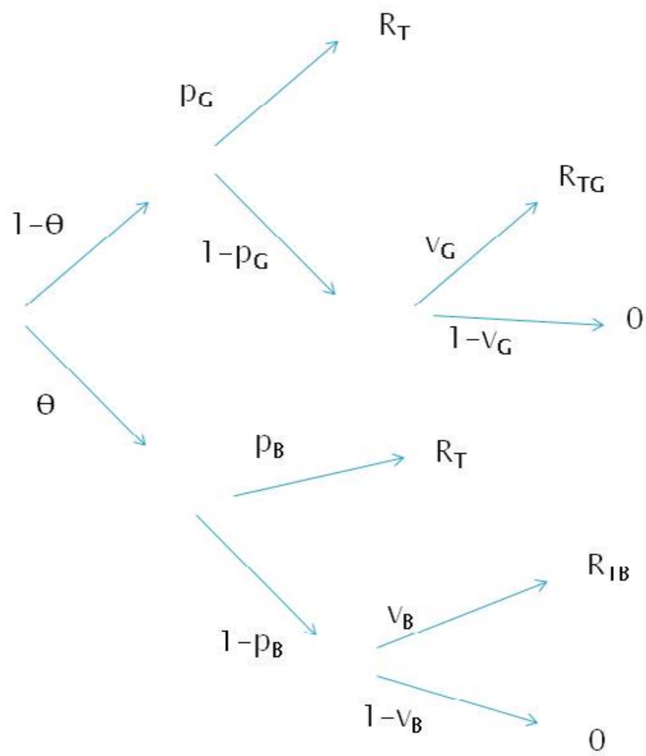
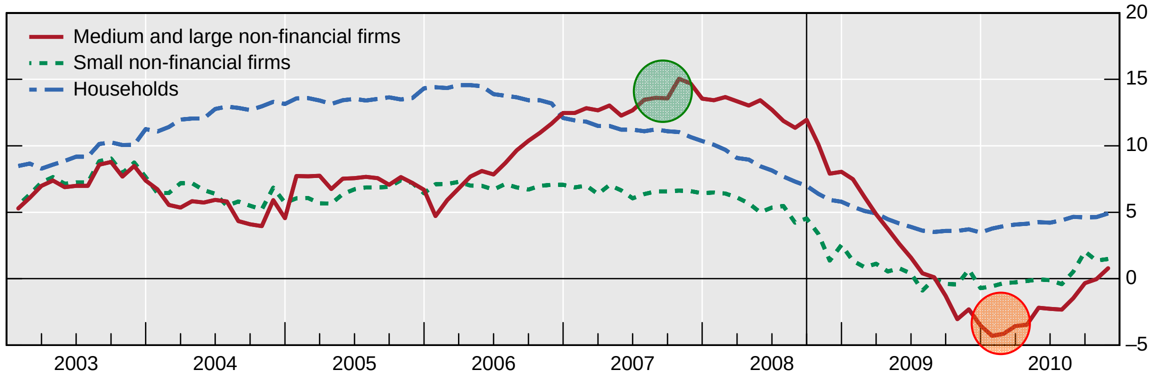


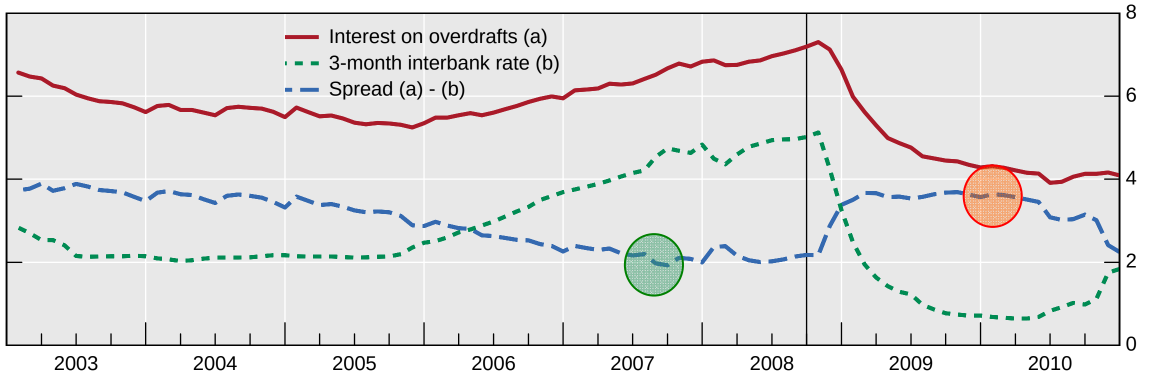
Figure 3

Bank lending, interest rates and the business cycle in Italy

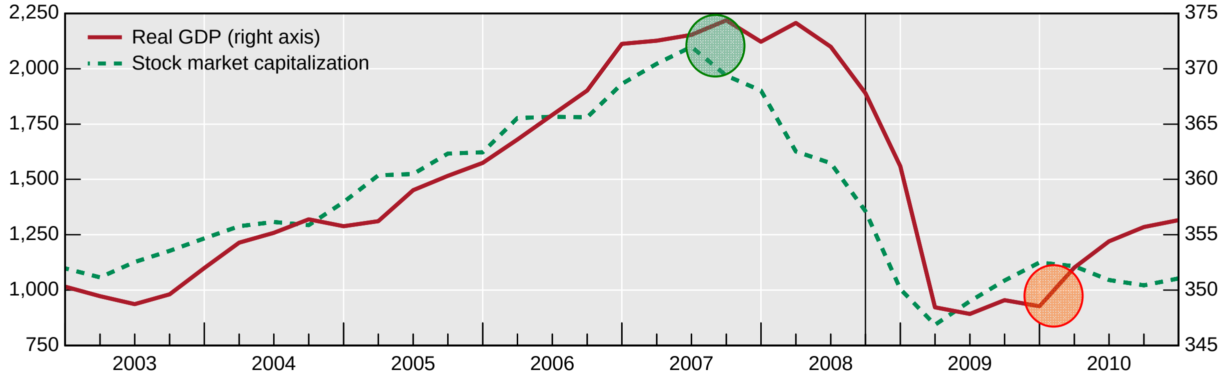
(a) Bank lending to the private sector[1, 2]



(b) Interest rate on overdraft and interbank rate[1, 3]



(c) Real GDP and stock market capitalization[4, 5]



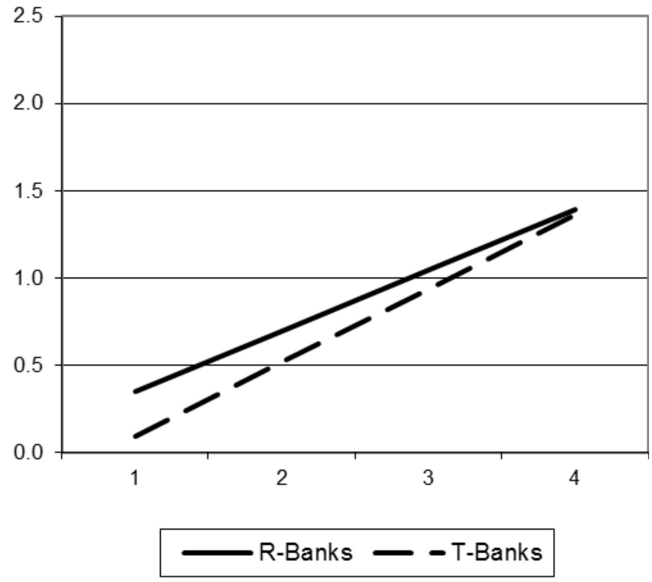
Notes. The vertical line indicates Lehman's default. [1] Monthly data. [2] Annual growth rates. Bad loans are excluded. The series are corrected for the impact of securitization activity. [3] Percentage points. Current account overdrafts are expressed in euro. [4] Quarterly data. [5] Real GDP in billions of euro. Stock market capitalization refers to the COMIT Globale Index, 31 Dec. 1972 = 100.

Sources: Bank of Italy; Bloomberg.

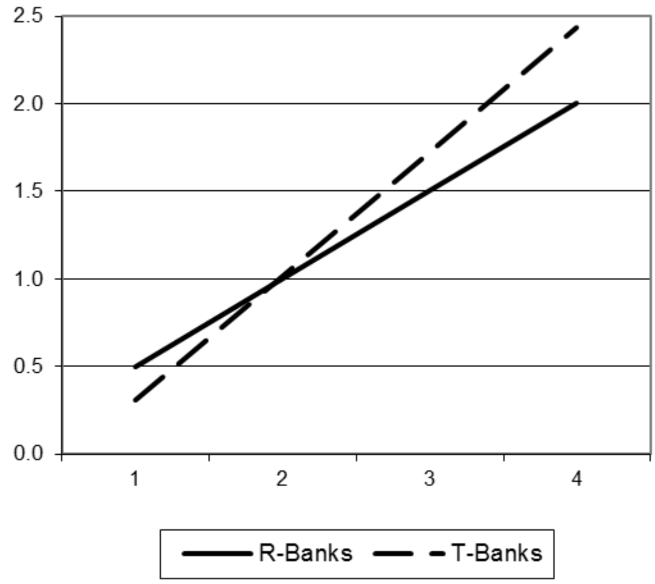
Figure 4

Lending supply and interest rate setting by banks' type and state of the world[1]

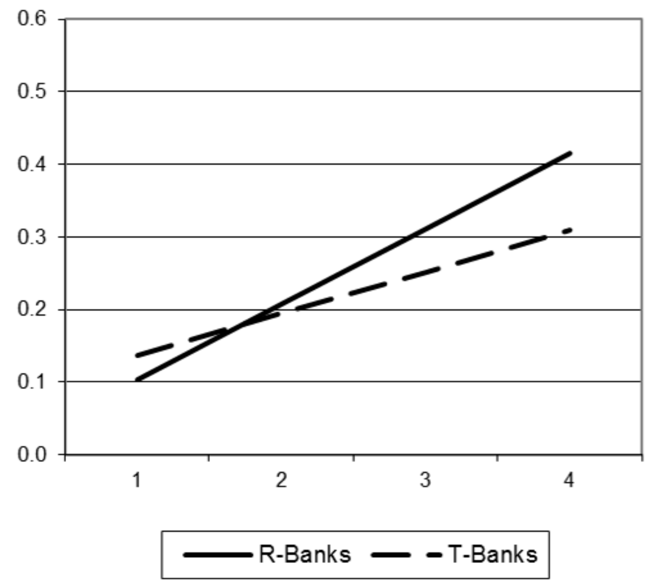
(a1) Interest rate: good times (2007:q2)



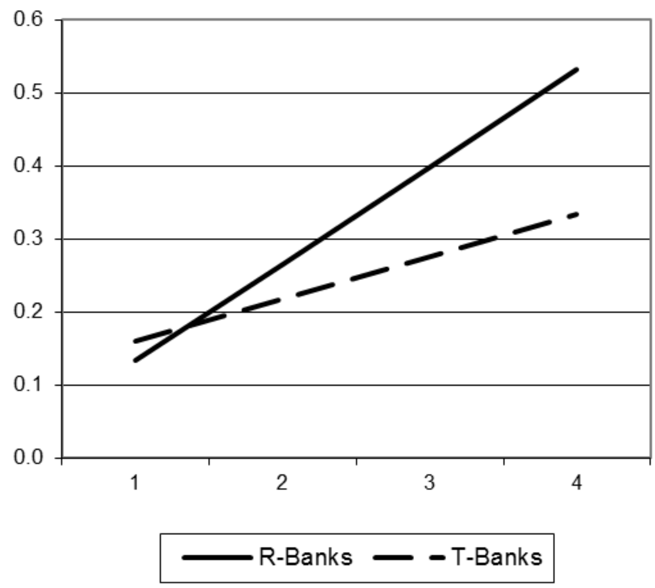
(a2) Interest rate: bad times (2010:q1)



(b1) Lending: good times (2007:q2)



(b2) Lending: bad times (2010:q1)

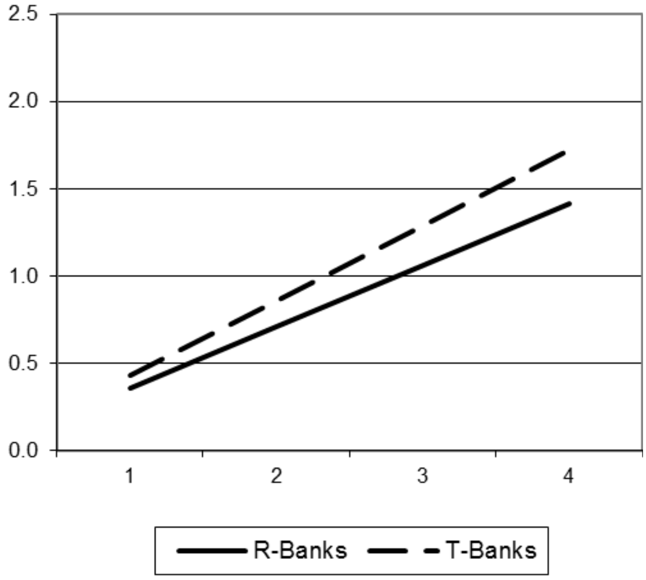


[1] This figure reports a graphical representation of the results in Table 4. The horizontal axis of each graph reports the Z-score, an indicator of the probability of default of firms. These scores can be mapped into four levels of risk: 1) safe; 2) solvent; 3) vulnerable; 4) risky. The vertical axis of graphs (a1) and (a2) indicate the level of the interest rate applied by the two bank types on credit lines to the 4 different kinds of firms; those of graphs (b1) and (b2) report the log of lending in real terms supplied by the two bank types.

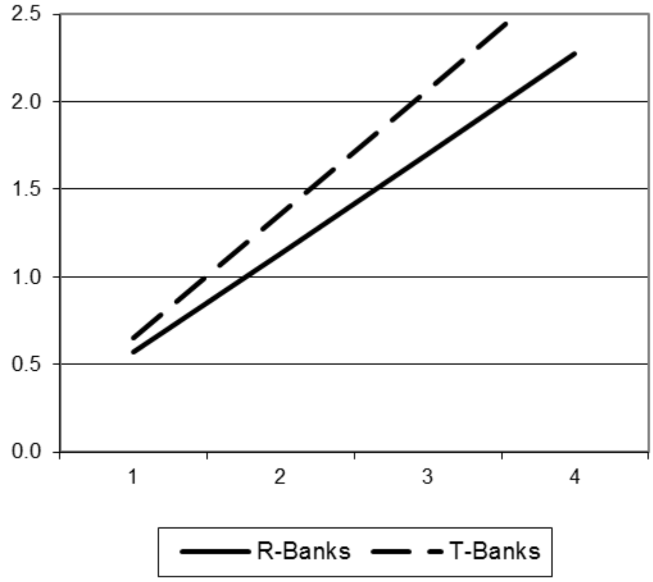
Figure 5

Graphical analysis of the results in Table 5 without fixed effects[1]

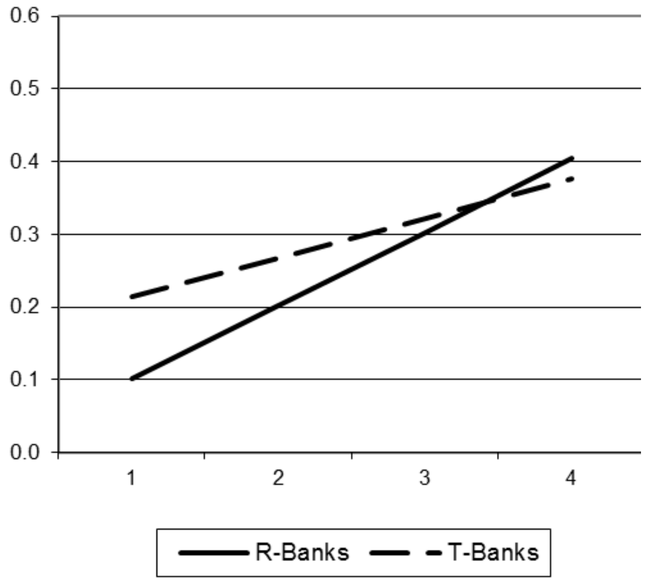
(a1) Interest rate: good times (2007:q2)



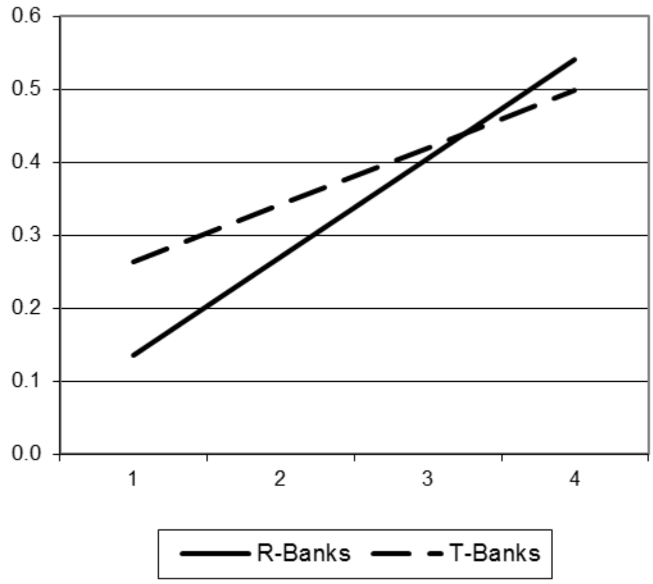
(a2) Interest rate: bad times (2010:q1)



(b1) Lending: good times (2007:q2)



(b2) Lending: bad times (2010:q1)



[1] This figure reports a graphical representation of the results obtained re-running the same models reported in Table 4 without fixed effects. The horizontal axis of each graph reports the Z-score, an indicator of the probability of default of firms. These scores can be mapped into four levels of risk: 1) safe; 2) solvent; 3) vulnerable; 4) risky. The vertical axis of graphs (a1) and (a2) indicate the level of the interest rate applied by the two bank types on credit lines to the 4 different kinds of firms; those of graphs (b1) and (b2) report the log of lending in real terms supplied by the two bank types.

Table 1 Descriptive statistics. Bank-firm relationship

Bank-firm loan types	Obs.	%	Spread good time (2007:q2) (a)	Spread bad time (2010:q1) (b)	(b) -(a)	Log Loans good time (2007:q2) (c)	Log Loans bad time (2010:q1) (d)	(d) -(c)	Capital to asset ratio (2007:q2) (e)	Capital to asset ratio (2010:q1) (f)	(f)-(e)
					ALL FIRMS						
i) Relationship only	18693	10.1%	4.3	6.2	1.9	7.74	7.73	-0.011	9.103	8.794	-0.31
ii) Both types	84598	45.8%	4.5	6.7	2.2	7.96	8.00	0.036	8.843	8.743	-0.10
iii) Transactional only	81604	44.1%	4.8	7.1	2.3	7.78	7.81	0.029	8.547	8.793	0.25
Total	184895	100.0%	4.6	6.8	2.2	7.86	7.89	0.028	8.739	8.770	0.03
					H-FIRMS						
i) Relationship only	18489	10.1%	4.2	6.2	1.9	7.74	7.73	-0.006	9.096	8.79	-0.30
ii) Both types	84129	45.9%	4.5	6.7	2.2	7.95	7.99	0.039	8.543	8.56	0.02
iii) Transactional only	80493	44.0%	4.8	7.1	2.3	7.77	7.80	0.032	8.842	8.79	-0.05
Total	183111	100.0%	4.6	6.8	2.2	7.85	7.88	0.031	8.730	8.69	-0.04
					L-FIRMS						
i) Relationship only	206	11.6%	6.0	9.0	3.0	8.07	7.90	-0.169	8.98	8.70	-0.28
ii) Both types	439	24.6%	5.9	9.4	3.5	8.54	8.33	-0.207	8.949	9.04	0.09
iii) Transactional only	1139	63.8%	6.3	9.7	3.5	8.17	8.06	-0.113	8.648	8.88	0.24
Total	1784	100.0%	6.2	9.6	3.4	8.25	8.11	-0.143	8.760	8.90	0.14

Note: L-Firms are those that went into default in the period 2008:q3-2010:q1, H-Firms are the remaining ones.

Table 2 Effect of Bank-firm relationship on the marginal probability of a firm's default

Dependent variable: P($default_k$=1)	(I) Baseline equation		(II) Firm specific characteristics		(III) Alternative Weight	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
T-share (in value)	0.0032	***	0.0029	***		
	(0.0008)		*(0.0007)*			
T-share (number of banks)					0.0028	***
					(0.0007)	
Z			0.0051	***	0.0051	***
			(0.0005)		*(0.0001)*	
LTD			-0.0002		-0.0002	
			(0.0018)		*(0.0018)*	
Small firm			-0.0021		-0.0021	
			(0.0034)		*(0.0034)*	
CREDIT_HISTORY			-0.0002	***	-0.0001	***
			(0.0000)		*(0.0000)*	
Bank fixed effects	Yes		Yes		Yes	
Industry-province dummies	Yes		Yes		Yes	
Number of obs.	72,489		72,489		72,489	
Pseudo R^2	0.1273		0.1395		0.1397	

The models estimate the marginal probability for a firm k to go into default in the period 2008:q3-2010:q1. All explanatory variables are evaluated at 2008:q2, prior Lehman's default. The variable T- Share indicates the proportion of loans that firm k has borrowed from a transactional bank. We report the share both in loan value and in terms of number of T-banks. Parameter estimates are reported with robust standard errors in brackets (cluster at individual bank level). The symbols *, **, and *** represent significance levels of 10%, 5%, and 1% respectively. Coefficients for industry-province dummies and bank fixed effects are not reported.

Table 3 T-banking and R-banking in good times and bad times

Variables	Interest rate good time (2007:q2) (I)	Interest rate bad time (2010:q1) (II)	Log Loans good time (2007:q2) (III)	Log Loans bad time (2010:q1) (IV)
T-Bank	-0.0805***	0.1227***	-0.2753***	-0.3129***
	(0.0174)	(0.0210)	(0.0123)	(0.0110)
Bank fixed effects	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes
Number of obs.	184,859	184,859	184,859	184,859
Adjusted R-squared	0.529	0.585	0.426	0.473

Notes: The models in column (I) and (III) are estimated in 2007:q2; those in columns (II) and (IV) in 2010:q1. The dummy T-Bank takes the value of 1 if the loan is granted by a transactional bank. The coefficients represent the difference relative to relationship banking (R-banks). Parameter estimates are reported with robust standard errors in brackets (cluster at individual firm level). The symbols *, **, and *** represent significance levels of 10%, 5%, and 1% respectively. Coefficients for fixed effects are not reported.

Table 4 Comparing T-banking, R-banking and firms' quality

Variables	Interest rate good time (2007:q2) (I)	Interest rate bad time (2010:q1) (II)	Log Loans good time (2007:q2) (III)	Log Loans bad time (2010:q1) (IV)
T-Bank	-0.3309***	-0.3977***	0.0795*	0.1023**
	(0.0604)	(0.0737)	(0.0393)	(0.0413)
R-Bank*Z	0.3479***	0.5016***	0.1036***	0.1329***
	(0.0148)	(0.0178)	(0.0115)	(0.0096)
T-Bank*Z	0.4238***	0.7076***	0.0575***	0.0577***
	(0.0119)	(0.0151)	(0.0092)	(0.0062)
US>GR	0.8825***	1.5181***	0.6887***	0.5667***
	(0.0193)	(0.0192)	(0.0093)	(0.0075)
LTD	-0.3697***	-0.3760***	-0.0603*	-0.0796***
	(0.0453)	(0.0561)	(0.0330)	(0.0213)
Small firm	-0.0854	0.2037	-0.3993***	-0.4688***
	(0.2295)	(0.2463)	(0.0968)	(0.0784)
CREDIT_HISTORY	-0.0475***	-0.0619***	0.0460***	0.0404***
	(0.0020)	(0.0023)	(0.0013)	(0.0009)
Bank fixed effects	yes	yes	yes	yes
Firm fixed effects	no	no	no	no
Industry-province dummies	yes	yes	yes	yes
Number of obs.	184,859	184,859	184,859	184,859
Adjusted R-squared	0.1776	0.2065	0.0865	0.0857

Notes: The models in column (I) and (III) are estimated in 2007:q2; those in columns (II) and (IV) in 2010:q1. The dummy T-Bank takes the value of 1 if the loan is granted by a transactional bank. The coefficients represent the difference relative to relationship banking (R-banks). Parameter estimates are reported with robust standard errors in brackets (cluster at individual bank level). The symbols *, **, and *** represent significance levels of 10%, 5%, and 1% respectively. Coefficients for industry-province dummies and fixed effects are not reported.

Table 5 Capital endowment and bank type

Variables	Baseline model (I)	Bank-specific characteristics (II)	Firm-specific characteristics (III)	Financially constrained firms (IV)
T-share	-3.839*** (0.890)	-2.992** (1.344)	-3.154** (1.307)	-3.231** (1.308)
Bank size		0.181 (0.402)	0.038 (0.390)	0.068 (0.375)
Bank liquidity ratio		-0.015 (0.018)	-0.010 (0.019)	-0.003 (0.018)
Retail ratio		0.054*** (0.018)	0.030* (0.017)	0.029* (0.017)
Number of provinces in which each bank operates (logs)		-0.601 (0.725)	-0.149 (0.741)	-0.071 (0.727)
Proportion of small firms in the bank's credit portfolio			6.239 (4.158)	6.008 (4.062)
Proportion of LTD firms in the bank's credit portfolio			-2.693 (3.942)	-2.273 (3.889)
Average Z-score of the bank's credit portfolio			-1.7139 (2.440)	-1.388 (2.538)
Proportion of financially constrained firms (US>GR)				5.328 (6.668)
Bank zone dummies	yes	yes	yes	yes
Number of obs.	179	179	179	179
Adjusted R-squared	0.130	0.185	0.217	0.218

Notes: The dependent variable is the regulatory capital/risk-weighted asset ratio at 2008:q2 prior to Lehman's default. The variable T-share represents the proportion of transactional loans (in value) for bank j. It takes the value from 0 (pure R-bank) to 1 (pure T-bank). All bank-specific characteristics and credit portfolio characteristic are at 2008:q1. Parameter estimates are reported with robust standard errors in brackets (cluster at individual bank level). The symbols *, **, and *** represent significance levels of 10%, 5%, and 1% respectively. Coefficients for bank zone dummies are not reported.

Table 6 Lending relationship and bank-capital

Variables	Interest rate good time (2007:q2) (I)	Interest rate bad time (2010:q1) (II)	Log Loans good time (2007:q2) (III)	Log Loans bad time (2010:q1) (IV)
T-Bank	-0.0792**	0.1940**	-0.1625***	-0.2208***
	(0.0402)	(0.0734)	(0.0282)	(0.0289)
CAP	0.0096	-0.0426***	-0.0112	0.0113**
	(0.0185)	(0.0123)	(0.0086)	(0.0052)
US>GR	0.1881***	0.1611***	0.5315***	0.1403***
	(0.0228)	(0.0430)	(0.0174)	(0.0193)
MUTUAL	-0.7812***	-1.0057***	0.0573	0.0569
	(0.1284)	(0.1066)	(0.0378)	(0.0523)
Bank group and rescue dummies	yes	yes	yes	yes
Bank zone dummies	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes
Number of obs.	184,859	184,859	184,859	184,859
Adjusted R-squared	0.4856	0.5433	0.4161	0.4530

Notes: The models in column (I) and (III) are estimated in 2007:q2; those in columns (II) and (IV) in 2010:q1. The dummy T-Bank takes the value of 1 if the loan is granted by a transactional bank. The coefficients represent the difference relative to relationship banking (R-banks). Parameter estimates are reported with robust standard errors in brackets (cluster at individual bank group level). The symbols *, **, and *** represent significance levels of 10%, 5%, and 1% respectively. Coefficients for dummies and firm fixed effects are not reported.

Appendix A. Mathematical proofs

Proof of Proposition 1

We shall characterize the equilibrium lending terms and loan refinancing using backwards induction. These lending terms and roll-over decisions will depend on whether we are considering a safe firm for which condition (**??**) holds ($p \geq \widehat{p}$) or a risky firm ($p < \widehat{p}$).

- If the project is successful, firms are able to repay their loan out of their cash flow V^H. This occurs with probability p_S. In this case the firm continues to period 2 and gets V^H if it is an $H-$firm.

- If the project fails at time $t = 1$, firms with $p \geq \widehat{p}$ will be able to roll over their debts. Their debt will then be rolled over against a promised repayment of $r_T^S(p_S)$ that reflects state of nature S. When with $p \geq \widehat{p}$, $H-$firms are able to make sufficiently high promised expected repayments $\nu_B r_T^B(p_B)$ even in the recession state, so that for these firms we have $r_T(p)$ given by the break-even condition:

$$r_T(p) = 1 + \rho_T.$$

- If, instead $p < \widehat{p}$, liquidation occurs in state B if the firm is not successful, which happens with probability $\theta(1 - p_B)$. The gross interest rate $r_T(p)$ is then given by the break even condition:

$$[p + (1-\theta)(1-p_G)]\, r_T(p) + \theta(1-p_B)V^L = 1 + \rho_T.$$

Proof of Proposition 2

$H-$firms are then able to secure new lending at gross interest rate $r_R^1 = \beta V^H$ in both recession and boom states. Under these conditions, the first period gross interest rate $r_R(p)$ is given by the break-even condition:

$$p r_R(p) + (1-p)[\overline{\nu}(1-m)\beta V^H + (1-\overline{\nu})V^L] = 1 + \rho_R,$$

where[1]

$$\overline{\nu} \equiv \frac{(1-\theta)(1-p_G)\nu_G + \theta(1-p_B)\nu_B}{(1-p)}$$

[1] We assume again that the intermediation cost of dealing with an $R-$bank is entirely 'capitalized' in period 0.

Proof of Proposition 3

If $R-$banks have no incentive to roll over the firm's joint debts of $H-$firms, then the benefits of combining the two types of debt are lost and the firm would be better off with 100% $T-$bank financing. Consequently, the combinations of the two types of debt, L_R and L_T, is of interest only in so far as the $R-$bank has an incentive to use its information to restructure the debts of unsuccessful $H-$firms.

This means that combining both types of debts only makes sense if the following constraint is satisfied:

$$\beta V^H(1-m) - r_T^{RT} L_T \geq L_R V^L. \tag{1}$$

The LHS represents what the $R-$bank obtains by rolling over all the period $t = 1$ debts of an unsuccessful $H-$firm. When there is a combination of $T-$debt and $R-$debt, a roll-over requires not only that the $R-$bank extends a new loan to allow the firm to repay r_R^{RT} at $t = 1$, but also that it extends a loan to allow the firm to repay r_T^{RT} to the $T-$bank. As a result, the $R-$bank can hope to get only $\beta V^H(1-m) - r_T^{RT} L_T$ by rolling over an unsuccessful $H-$firm's debts. This amount must be greater than what the $R-$bank can get by liquidating the firm at $t = 1$, namely $L_R V^L$.

$T-$banks know that if they are lending to an $H-$firm their claim will be paid back by the $R-$bank, provided the above condition (1) is met. So they will obtain the par value, r_T^{RT} for sure if they lend to an $H-$firm and a fraction L_T of the residual value V^L if, instead the firm is an $L-$firm. The corresponding rate is therefore:

$$r_T^{RT} = \frac{(1+\rho_T) - (1-p)(1-\overline{\nu})V^L}{p + (1-p)\overline{\nu}}. \tag{2}$$

As intuition suggests, constraint (1) holds only if the amount of $T-$bank debt the firm takes on is below some threshold. To establish this, note that replacing $L_R = 1 - L_T$ condition (1) can be rewritten as:

$$\beta(1-m)V^H - V^L \geq L_T(r_T^{RT} - V^L). \tag{3}$$

Substituting for r_T^{RT} we obtain that the following maximum amount of transaction lending is consistent with efficient restructuring:

$$L_T \left[\frac{(1+\rho_T) - (1-p)(1-\overline{\nu})V^L}{p + (1-p)\overline{\nu}} - V^L \right] \leq \beta V^H(1-m) - V^L, \tag{4}$$

which simplifies to:

$$L_T \left[\frac{(1+\rho_T) - V^L}{p + (1-p)\overline{\nu}} \right] \leq \beta V^H (1-m) - V^L \tag{5}$$

Implying that:

$$L_T \leq \frac{(p + (1-p)\overline{\nu}) \left[\beta V^H (1-m) - V^L \right]}{1 + \rho_T - V^L}.$$

As the firm optimally chooses the amounts L_T and L_R, it will choose the combination that maximizes Π^{RT}, which is equivalent to minimizing the total funding cost ϕ

$$\phi = p\ r_R^{RT}(p)(1 - L_T) + p\ r_T^{RT} L_T$$

under the constraint (1) that guarantees that the $R-$bank has an incentive to restructure $H-$firms.

The expression for ϕ can be simplified by using the break even constraint for the $R-$bank, which is given by:

$$\begin{aligned} & p\ r_R^{RT}(1 - L_T) + \\ & (1-p) \left[\overline{\nu}((1-m)\beta V^H - r_T^{RT} L_T) + (1-\overline{\nu})(1-L_T)V^L \right] \\ & = (1+\rho_R)(1 - L_T) \end{aligned} \tag{6}$$

or,

$$p\ r_R^{RT}(1 - L_T) =$$
$$(1+\rho_R)(1-L_T) - (1-p) \left[\overline{\nu}((1-m)\beta V^H - r_T^{RT} L_T) + (1-\overline{\nu})(1-L_T)V^L \right]$$

Collecting terms in L_T on the right hand side we then get:

$$\begin{aligned} & p\ r_R^{RT}(1 - L_T) = \\ & L_T[-(1+\rho_R) + (1-p)(\overline{\nu} r_T^{RT} + (1-\overline{\nu})V^L)] + (1+\rho_R) \\ & -(1-p) \left[\overline{\nu}(1-m)\beta V^H + (1-\overline{\nu})V^L \right] \end{aligned} \tag{7}$$

Replacing $pr_R^{RT}(1 - L_T)$ by its value in (7) and ignoring constant factors we thus obtain the equivalent funding cost minimization problem :

$$\min_{L_T} [-(1+\rho_R) + ((1-p)\overline{\nu} + p) r_T^{RT} + (1-p)(1-\overline{\nu})V^L)] L_T$$

But notice that the coefficient

$$[-(1+\rho_R)+((1-p)\overline{\nu}+p)r_T^{RT}+(1-p)(1-\overline{\nu})V^L)]>0$$

as r_T^{RT} satisfies

$$((1-p)\overline{\nu}+p)r_T^{RT}+(1-p)(1-\overline{\nu})V^L=1+\rho_T$$

and $\rho_R>\rho_T$.

Consequently the condition (1) is always binding. This allows to replace L_T in (6) leading to:

$$pr_R^{RT}(1-L_T)+(1-p)V^L=(1+\rho_R)(1-L_T) \tag{8}$$

thus obtaining the expression for r_R^{RT}.

Proof of Proposition 4

Let $\Delta\Pi=\Pi^T-\Pi^{RT}$ denote the difference in expected payoffs for an $H-$firm from choosing 100% $T-$financing over mixed financing, where

$$\Pi^T=p(2V^H-r_T(p))+(1-\theta)(1-p_G)(V^H-\frac{r_T(p)}{\nu_G})+\theta(1-p_B)(V^H-\frac{r_T(p)}{\nu_B})$$

for $p\geq\widehat{p}$, where $r_T(p)=1+\rho_T$ and

$$\Pi^T=p(2V^H-r_T(p))+(1-\theta)(1-p_G)(V^H-\frac{r_T(p)}{\nu_G})$$

for $p<\widehat{p}$, where

$$r_T(p)=\frac{1+\rho_T-\theta(1-p_B)V^L}{\theta p_B+1-\theta}$$

and,

$$\Pi^{RT}=p(2V^H-r_R^{RT}(p)(1-L_T)-r_T^{RT}(p)L_T)+(1-p)(1-\beta)V^H$$

- Consider first the case $p\geq\widehat{p}$

  Combining these expressions $\Delta\Pi$ can be written as follows:

$$\begin{aligned}\Delta\Pi(p) \quad = \quad & p(r_R^{RT}(p)(1-L_T)+r_T^{RT}(p)L_T-r_T(p)) \\ & +(1-\theta)(1-p_G)[\beta V^H-\frac{r_T(p)}{\nu_G}]+ \\ & +\theta(1-p_B)(\beta V^H-\frac{r_T(p)}{\nu_B})\end{aligned} \tag{9}$$

The first term,

$$p(r_R^{RT}(1-L_T)+r_T^{RT}(p)L_T)-r_T(p)),$$

reflects the difference in the costs of funding when the firm is successful, which occurs with probability p. The other terms measure the difference for a non successful firm between the benefits of relationship banking and those of transactional banking.

To simplify the expression for $\Delta\Pi(p)$ let

$$\Sigma \equiv p[r_R^{RT}(p)(1-L_T)+r_T^{RT}(p)L_T]$$

From the break even condition (6) we then obtain that

$$\begin{aligned}\Sigma &= (1+\rho_R)(1-L_T)+(1-p)\overline{\nu}\; r_T^{RT}(p)L_T \\ &\quad +p\; r_T^{RT}(p)L_T-(1-p)\left[\overline{\nu}(1-m)\beta V^H+(1-\overline{\nu})(1-L_T)V^L\right]\end{aligned}$$

Substituting for

$$r_T^{RT}=\frac{(1+\rho_T)-(1-p)(1-\overline{\nu})V^L}{p+(1-p)\overline{\nu}}$$

the above expression simplifies to:

$$\Sigma=(1+\rho_R)-(\rho_R-\rho_T)L_T-(1-p)\left[\overline{\nu}(1-m)\beta V^H+(1-\overline{\nu})(1-L_T)V^L\right]-(1-p)(1-\overline{\nu})L_TV^L \tag{10}$$

Substituting for Σ in $\Delta\Pi(p)$ we obtain:

$$\begin{aligned}\Delta\Pi(p) &= \Sigma-p\; r_T(p)+(1-\theta)(1-p_G)[(1-\beta)V^H-\frac{r_T(p)}{\nu_G}]+ \\ &\quad \theta(1-p_B)\left[\beta)V^H-\frac{r_T(p)}{\nu_B}\right]\end{aligned}$$

we obtain:

$$
\begin{aligned}
\Delta\Pi(p) \quad &= \quad (1+\rho_R) - (\rho_R - \rho_T)L_T^* - \qquad (11) \\
&\quad (1-p)\left[\overline{\nu}(1-m)\beta V^H + (1-\overline{\nu})V^L\right] - p(1+\rho_T) + (1-p)\beta V^H \\
&\quad -(1+\rho_T)[\frac{(1-\theta)(1-p_G)}{\nu_G} + \frac{\theta(1-p_B)}{\nu_B}]
\end{aligned}
$$

Differentiating with respect to p_B and noting that

$$
\frac{dp_G}{dp_B} = \frac{dp}{dp_B} = 1
$$

and that:

$$
\frac{dL_T^*}{dp} = \frac{(1-\overline{\nu})\left[\beta V^H(1-m) - V^L\right]}{1+\rho_T}
$$

$$
\begin{aligned}
\frac{d\Delta\Pi(p)}{dp_B} \quad &= \quad -(\rho_R - \rho_T)\frac{dL_T^*}{dp_B} - \frac{d(1-p)\overline{\nu}}{dp_B}\left[(1-m)\beta V^H - V_L\right] \qquad (12) \\
&\quad +V_L - (1+\rho_T) - \beta_M V^H \\
&\quad +(1+\rho_T)[\frac{(1-\theta)}{\nu_G} + \frac{\theta}{\nu_B}]
\end{aligned}
$$

Using

$$
\frac{d(1-p)\overline{\nu}}{dp_B} = -\left[(1-\theta)\nu_G + \theta\nu_B\right]
$$

and

$$
\frac{dL_T^*}{dp_B} = \frac{\left[(1-m)\beta V^H - V^L\right]}{1+\rho_T}(1 - [(1-\theta)\nu_G + \theta\nu_B])
$$

we further obtain:

$$\frac{d\Delta\Pi(p)}{dp_B} = -(\rho_R - \rho_T)\frac{\left[(1-m)\beta V^H - V^L\right]}{1+\rho_T}(1 - [(1-\theta)\nu_G + \theta\nu_B]) \tag{13}$$
$$+ [(1-\theta)\nu_G + \theta\nu_B]\left[(1-m)\beta V^H - V^L\right]$$
$$+V^L - (1+\rho_T) - \beta V^H$$
$$+(1+\rho_T)[\frac{(1-\theta)}{\nu_G} + \frac{\theta}{\nu_B}]$$

Or, equivalently,

$$\frac{d\Delta\Pi(p)}{dp_B} = -(\rho_R - \rho_T)\frac{\left[(1-m)\beta V^H - V^L\right]}{1+\rho_T}(1 - [(1-\theta)\nu_G + \theta\nu_B]) \tag{14}$$
$$- [(1-\theta)\nu_G + \theta\nu_B]\, m\beta V^H$$
$$-(\beta V^H - V^L)(1 - [(1-\theta)\nu_G + \theta\nu_B])$$
$$+(1+\rho_T)[\frac{(1-\theta)}{\nu_G} + \frac{\theta}{\nu_B} - 1]$$

Now, under assumption **A1** the first two terms are negligeable, while under assumption **A2** the last two terms are positive, leading to $\frac{d\Delta\Pi(p)}{dp_B} > 0$.

- Next, consider the case $p < \widehat{p}$.

Proceeding as before, $\Delta\Pi$ can be written as follows:

$$\begin{aligned}\Delta\Pi(p) &= p(r_R^{RT}(p)(1-L_T) + r_T^{RT}(p)L_T - r_T(p)) \\ &+(1-\theta)(1-p_G)[\beta V^H - \frac{r_T(p)}{\nu_G}] + \\ &-\theta(1-p_B)(1-\beta)V^H\end{aligned} \tag{15}$$

We will simply show that A1 and A2 are sufficient conditions for $\Delta\Pi(p) < 0$

The first term,

$$p(r_R(p)(1-L_T)+r_T^{RT}(p)L_T)-r_T(p)),$$

reflects the difference in the costs of repaying the loan when the firm is successful, which occurs with probability p. The other terms measure the difference for a non successful firm between the benefits of relationship banking and those of transactional banking.

To simplify the expression for $\Delta\Pi(p)$ let

$$\Sigma \equiv p[r_R^{RT}(p)(1-L_T)+r_T^{RT}(p)L_T]$$

From the break even condition (6) we then obtain that

$$\begin{aligned}\Sigma &= (1+\rho_R)(1-L_T)+(1-p)\overline{\nu}r_T^{RT}(p)L_T \\ &\quad +p\ r_T^{RT}(p)L_T-(1-p)\left[\overline{\nu}(1-m)\beta V^H+(1-\overline{\nu})(1-L_T)V^L\right]\end{aligned}$$

Substituting for

$$r_T^{RT}=\frac{(1+\rho_T)-(1-p)(1-\overline{\nu})V^L}{p+(1-p)\overline{\nu}}$$

the above expression simplifies to:

$$\Sigma=(1+\rho_R)-(\rho_R-\rho_T)L_T-(1-p)\left[\overline{\nu}(1-m)\beta V^H+(1-\overline{\nu})V^L\right] \quad (16)$$

Substituting for Σ in $\Delta\Pi(p)$ we obtain:

$$\begin{aligned}\Delta\Pi(p) &= \Sigma-p\ r_T(p)+(1-\theta)(1-p_G)[(\beta V^H-\frac{r_T(p)}{\nu_G}]+ \\ &\quad -\theta(1-p_B)\left[(1-\beta)V^H\right]\end{aligned}$$

As $\nu_G<1$, the expression $p\ r_T(p)+(1-\theta)(1-p_G)\frac{r_T(p)}{\nu_G}$ has a lower bound $\Gamma=r_T(p)\left[p+(1-\theta)(1-p_G)\right]$

but $p+(1-\theta)(1-p_G)=\theta p_B+1-\theta$, so that replacing $r_T(p)$ we obtain $\Gamma=1+\rho_T-\theta(1-p_B)V^L$

As a consequence, we obtain

$$\begin{aligned}\Delta\Pi(p) &< \Sigma - \Gamma + (1-\theta)(1-p_G)\beta V^H + \\ &-\theta(1-p_B)\left[(1-\beta)V^H\right]\end{aligned}$$

which after replacement of Σ and Γ leads to

$$\begin{aligned}\Delta\Pi(p) &< (\rho_R - \rho_T)(1-L_T^*) \\ &-(1-p)\left[\overline{\nu}(1-m)\beta V^H + (1-\overline{\nu})V^L\right] + (1-p)\beta V^H \\ &+\theta(1-p_B)V^L - \theta(1-p_B)V^H\end{aligned} \tag{17}$$

Rearranging terms this expression becomes:

$$\begin{aligned}\Delta\Pi(p) &< (\rho_R - \rho_T)(1-L_T^*) + (1-p)m\beta V^H \\ &-(1-p)\left[\overline{\nu}\beta V^H + (1-\overline{\nu})V^L\right] + (1-p)\beta V^H \\ &-\theta(1-p_B)(V^H - V^L)\end{aligned} \tag{18}$$

that is

$$\begin{aligned}\Delta\Pi(p) &< (\rho_R - \rho_T)(1-L_T^*) + (1-p)m\beta V^H \\ &+(1-p)(1-\overline{\nu})\left[\beta V^H - V^L\right] \\ &-\theta(1-p_B)(V^H - V^L)\end{aligned} \tag{19}$$

Under A1 the first two terms are small. Under A2 $\left[\beta V^H - V^L\right]$ is also small so that the last term dominates and $\Delta\Pi(p) < 0$.

Appendix B. Technical details regarding the data

We construct the database by matching four different sources.

i) The Credit Register (CR) containing detailed information on all loan contracts granted to each borrower (i.e. the amount lent, the type of loan contract, the tax code of the borrower).

ii) The Bank of Italy Loan Interest Rate Survey, including information on interest rates charged on each loan reported to the CR and granted by a sample of more than 200 Italian banks; this sample accounts for more than 80% of loans to non-financial firms and is highly representative of the universe of Italian banks in terms of bank size, category and location. We investigate overdraft facilities (credit lines) for three main reasons. First, this kind of lending represents the main liquidity management tool for firms – especially the small ones (with fewer than 20 employees) that are prevalent in Italy – which cannot afford more sophisticated instruments. Second, since these loans are highly standardized among banks, comparing the cost of credit among firms is not affected by unobservable (to the econometrician) loan-contract-specific covenants. Third, overdraft facilities are loans granted neither for some specific purpose, as is the case for mortgages, nor on the basis of a specific transaction, as is the case for advances against trade credit receivables (Berger and Udell, 1995).

iii) The Supervisory Reports of the Bank of Italy, from which we obtain the bank-specific characteristics (size, liquidity, capitalization, funding structure). Importantly, for all the banks in the sample, we obtain information on the credit concentration of the local credit market in June 2008. We compute Herfindahl indexes for each province (similar to counties in the US) using the data on loans granted by banks.

iv) The CERVED database, which includes balance sheet information on about 500,000 companies, mostly privately owned. Balance sheet data are taken at $t-1$. This is important since credit decisions in t on how to set firms' interest rates on credit lines are based on balance sheet information that has typically a lag.[2]

We match these four sources obtaining a dataset of bank-firm lending re-

[2] For more information, see http://www.cerved.com/xportal/web/eng/aboutCerved/aboutCerved.jsp. The methodology for the calculation of the $Z-$score, computed annually by CERVED, is provided in Altman et al. (1994).

lationships. In the paper we focus on multiple lending by selecting those firms which have a credit line with at least two Italian banks in June 2008. This limits the analysis to 216,000 observations. However, around 80% of Italian non-financial firms have multiple lending relationships, so this selection does not limit our study from a macroeconomic point of view.

We clean outliers from the data, cutting the top and bottom fifth percentile of the distribution of the dependent variables we use in the regression. An observation has been defined as an outlier if it lies within the top or bottom fifth percentile of the distribution of the dependent variables ($r_{j,k}$ and $L_{j,k}$). After these steps our sample reduces to around 185,000 observations (75,000 firms), which we use for the empirical analysis. The following tables gives some basic information on the main variables used in the regressions.

Figure 1: Table B1 Summary statistics for firms

Z score in 2008:Q4	**Obs.**	**T-bank (1)**	**Credit History (2)**	**LTD**	**Log Loans**	**Spread 2007:Q2 (3)**	**Spread 2010:Q1 (3)**
1=Safe	4,045	0.68	10.92	0.991	7.48	3.81	5.38
2=Solvent	7,968	0.69	10.36	0.995	7.65	3.94	5.65
3=Vulnerable	67,614	0.71	10.33	0.981	7.89	4.39	6.33
4=Risky	106,697	0.72	9.35	0.963	7.91	4.88	7.33
Total	186,324	0.72	9.78	0.971	7.88	4.64	6.86

Note: (1) Share of loans that is granted by a bank that has its headquarter outside the same province where the firm has its headquarter. (2) Number of years elapsed since the first time a borrower was reported to the Credit register. (2) Interest rate on credit lines minus one month interbank rate.

Figure 2: Table B2 Summary statistics for banks

Variables	Obs	Mean	Std. Dev.	Min	Max
T-share	179	0.449	0.280	0.000	1.000
Bank size (log Total Assets)	179	8.121	1.329	6.037	12.992
Bank liquidity ratio (1)	179	25.760	15.780	3.239	89.341
Capital ratio (2)	179	8.600	3.278	0.015	18.817
Mutual bank (dummy)	179	0.263	0.441	0.000	1.000
Rescued bank	179	0.028	0.165	0.000	1.000
Average Z-score of the bank's credit portfolio	179	3.441	0.158	2.500	4.000
Proportion od LTD firms in the bank's credit portfolio	179	0.664	0.148	0.000	1.000
Proportion of small firms in the bank's credit portfolio	179	0.285	0.136	0.000	1.000
Proportion of financially constrained firms	179	0.130	0.050	0.000	0.333
Number of provinces in which each bank operates (logs)	179	3.747	0.684	1.386	4.700

Note: All bank-specific and credit portfolio characteristics are at 2008:q1. (1) Cash and securities over total assets. (2) Regulatory capital/risk-weighted asset at 2008:q2, prior to Lehman's default.

Appendix C. Robustness checks

We have checked the robustness of the results in several ways.

(1) *Main bank*. As there is not a clear consensus on the way relationship characteristics are identified, we have tested the robustness of the results by including in the baseline regressions an additional measure of relationship banking, namely a dummy for the "main bank". This dummy typically captures "incentive to monitor" effects or "skin in the game" effects. In particular, we have first calculated the share of loans granted by each bank to the firm and constructed two variables: i) the highest share of lending granted by the main bank ($Maxsh$); ii) a dummy ($Main$) that is equal to one if that bank grants the highest share of lending to the firm. However, as in several cases many banks had a pretty low and similar share of total lending, we have decided to consider as "main bank" only those fi-

nancial intermediaries that granted not only the highest share but also at least one quarter of the total loans.

We have therefore modified equations (11)-(13) for the marginal probit model, the interest rate ($r_{j,k}$) and outstanding loans in real terms ($L_{j,k}$) in the following way:

$$MP(\textit{Firm k's default}=\textit{1}) = \alpha+\zeta+\pi T-share_k+\lambda Maxsh_k+\kappa(T-share_k*Maxsh_k)+\varepsilon_k \tag{11'}$$

$$r_{j,k} = \nu+\beta+\gamma T-bank_{j,k}+\varpi Main_{j,k}+\iota(T-bank_{j,k}*Main_{j,k})+\varepsilon_{j,k} \tag{12'}$$

$$L_{j,k} = \delta+\phi+\mu T-bank_{j,k}+\tau Main_{j,k}+\delta(T-bank_{j,k}*Main_{j,k})+\varepsilon_{j,k} \tag{13'}$$

where α, ν and δ are bank-fixed effects, ζ is a vector of industry fixed effects, β and ϕ are firm-fixed effects.

The results reported in Table C1.1 indicates that the highest the share of loan granted to a firm the lower is the probability that the firm goes into default. At the same time, the effect of transactional loans on default probability is still in place and similar in magnitude with respect to that in Table 3. In particular, the probability for a firm to go into default increases with the share of $T-$bank financing and reach the maximum of around 0.4% when $T-share_k$ is equal to 1. This result remains pretty stable by enriching the set of controls with additional firm-specific characteristics (see panel II in Table C1) or by calculating the proportion of transactional loans $T-share_k$ not in value but in terms of the number of banks that finance firm k (see panel III in Table C1).

The main results of our work remain also with respect to the two cross-sectional equations (12') and (13'). In line with the predictions of the model, Table C2 indicates that $T-$banks (compared to $R-$banks) provide loans at a cheaper rate in good time and at a higher rate in bad time (see columns I and II). As for loan quantities, other things being equal, T-banks always provide on average a lower amount of lending, especially in bad times (see columns III and IV). Interestingly, we find that a bank with a high share of lending to a given firm tends to grant *always* lower interest rates and to further reduce the cost of credit by more in time of crisis. However, we also find that the main bank reduce the amount of loans in a crisis. This finding is consistent with the result in Gambacorta and Mistrulli (2013) and may be interpreted as the effect of more bank risk aversion and a greater need to diversify credit risk following the crisis.

(2) *Region instead than province.* One possible objection to the definition used for the relationship dummy $R-$bank is that considering the bank and the firm as "close" only if both have headquarter in the same province could be too restrictive. For example, banks may be able to get soft information, i.e. information that is difficult to codify, which is a crucial aspect of lending relationships, also if they are headquartered inside the same region where the firm has is main seat.

We have therefore replicated the results of Table 3 and Table 4 in the main text by using a different definition for relationship and transaction banks. In particular, the $R-$bank dummy is equal to 1 if firm k is headquartered in the same region (instead than the province) where bank j has its headquarters; $T-$bank is equal to 1 if $R-$bank=0. Results reported in Tables C3 and C4 are very similar to those in the main text. Interestingly, the absolute values of coefficients are slightly reduced pointing to the fact that informational asymmetries increase with functional distance.

(3) *All foreign banks are T-banks.* In the paper we divide $R-$banks and $T-$banks according to the distance between the lending bank headquarters (at the single bank level, not at the group level) and firm headquarters. This raises some questions for foreign banks (subsidiaries and branches of foreign banks). Following this definition, branches of foreign banks are always $T-$banks. This classification is correct because lending strategic decisions are typically taken by the bank's headquarter located outside Italy.

However, these loans have not a big weigh in the database and represent only 0.04% of the cases. On the contrary, subsidiaries of foreign banks are treated as the Italian banks. This hypothesis seems plausible as these banks have legal autonomy and are subject to Italian regulation. However, to test the robustness of the results we have therefore replicated the estimations reported in Table 3 and Table 4 by imposing that all foreign bank headquartered in Italy and with legal autonomy (around 7% of observations) are $T-$banks. This means that the $T-$bank dummy is equal to 1 if firm k is not headquartered in the same province where bank j has its headquarters or bank j is a foreign bank; $R-$bank is equal to 1 if $T-$bank$=0$. Even in this robustness test results are very similar to the baseline case (see Tables C5 and C6).

(4) *New firms.* One of the main hypothesis of the model is that at $t = 0$ no bank can distinguish firms' type. To make the empirical part closer to the theoretical one we have therefore estimated equations (2)-(3) on a subset of around 6,000 "new firms", that entered the credit register in the period 2005:Q2:2007:Q2. The results are qualitatively very similar to that obtained from the baseline equations (see Tables C7 and C8).

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