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Credit Availability in the Crisis: Which Role for Public Financial Institutions?*

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In this paper we develop a moral hazard model to investigate whether and how public financial institutions can mitigate a credit crunch problem caused by the financial crisis. Public institutions provide instruments that work to reduce the financial capital cost of private banks. This facilitates the access to credit, but may induce borrowers to invest in bad projects. We find that stimulating competition among banks is welfare-enhancing in that it disciplines borrowers. Alternatively, a concentrated banking sector can increase welfare through monitoring, provided that public intervention in the form of credit guarantees does not undermine the incentive to monitor.

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1. INTRODUCTION

Historical evidence supports the idea that asymmetric information plays a central role in banking crises (see, *e.g.*, Calomiris and Gorton, 1991, and Mishkin, 1991). In this theoretical paper, we investigate the role that public financial institutions can play in their attempt to mitigate moral hazard problems between lenders and Small and Medium Enterprises (SMEs henceforth) in periods of crisis.

The recent turmoil of the global financial system has been generated by a multiplicity of factors, among which the failure of national and international regulation systems. The proliferation of new financial tools catered to investors' demand for higher return, but they turned out to be riskier than they initially appeared. Financial regulation proved to be limited in scope and failed to keep up with financial innovation. The system collapsed, banks became reluctant to grant loans, and many creditworthy investors were denied access to credit. The crisis rapidly spread from the financial markets to the real economy, thus exacerbating the effects of the slowdown.

Since then, economists and policy-makers have agreed on the necessity to revamp the scope of financial regulation and improve the provision of liquidity. In the aftermath of the crisis participants in G7, G8 and G20 meetings called for urgent reforms. In particular, they proposed to enhance liquidity and funding through traditional and newly created instruments. Co-funding, credit guarantees, and deposit insurance are typical examples of government intervention in support of lending activity.

In the US, since its creation in 1953, the Small Business Administration (SBA) actively engages in provision of direct loans and bank loan guarantees to SMEs, particularly affected by the shortage of liquidity.[1] Deposit insurance schemes were rare before 1980, found mainly in the US, Canada, and some Latin American countries. Following financial crises in the 1970s through the 1990s, they were gradually adopted by most European and Asian countries as well. In the EU, the European Investment Bank Group (EIBG), established in 2000 to bring the European Investment Bank (EIB) and the European Investment Fund (EIF) under the same umbrella, aims at helping innovative SMEs to get access to credit mainly through the disbursement of loans and the provision of guarantees.

However, there is no consensus about exactly which recovery program should be implemented (see Philippon and Skreta, 2012, for a discussion on this topic). Accordingly, the aim of this paper is not to propose specific measures. Rather, we first show that government interventions generally

[1] Hancock *et al.* (2007) provided evidence that loans guaranteed by the SBA between 1990 and 2000 were less affected by adverse economic shocks than non-guaranteed loans. Craig *et al.* (2007), using a panel data set of SBA-Guaranteed lending, found a positive and significant relationship between the level of SBA-Guaranteed lending and future income growth in local markets where targeted SMEs operate.

result in a reduction of financial capital costs. Then, we study how this affects credit squeeze problems due to firms' moral hazard.

Since the seminal contribution of Stiglitz and Weiss (1981), the problem of credit rationing, which occurs when investors have less information about the risk of an investment than entrepreneurs, has been extensively studied. A wide range of literature has been developed on the basis of this adverse selection model. Cho (1986) argued that the problem disappears if investors use equity instead of debt. Yet, Myers and Majluf (1984) and Greenwald et al. (1984) showed that equity markets could have rationing too. Other contributions suggested to solve the credit rationing by offering more complicated financial contracts (see, *e.g.*, Brennan and Kraus, 1987). DeMeza and Webb (1987) integrated these various approaches and concluded that rationing disappears if investors use appropriate financial instruments. However, they do not allow for asymmetric information for both expected returns and risks. On the contrary, Hellmann and Stiglitz (2000) studied such a case and showed that credit and equity rationing may indeed occur.

However, in many real economic situations the implementation of optimal contractual schemes may be extremely difficult. Public support initiatives facilitating the access to credit are highly advocated, especially in periods of crisis. Innes (1991) focused on government credit policy in financial markets where quality of the projects' return distribution is private information of the entrepreneurs. He showed that the government can increase social welfare by offering subsidized debt contracts. Williamson (1994) and Wang and Williamson (1998) considered public intervention that alleviates information asymmetries caused by costly state verification. More recently, Minelli and Modica (2009), Tirole (2012) and Philippon and Skreta (2012) provided new issues on optimal government intervention in credit markets with hidden information.

In this paper we present a model of financing in which difficult access to credit is due to moral hazard, rather than adverse selection. We build on Holmström and Tirole (1997) and consider a wealthless SME that needs funding to invest in a project whose stochastic outcome depends upon the firm's costly and unobservable effort. We analyze two alternative scenarios, respectively without or with the intervention of a public financial institution. In the first scenario the firm applies to a local bank and can be induced to behave only in exchange for an informational rent. However, this is not profitable for the bank. Due to the crisis, the project proposed by the firm yields low expected returns relative to the total (informational plus actual) cost of funding. The loan is therefore denied and a credit crunch problem occurs. In the second scenario the loan application is addressed to an intermediary bank supported by the public financial institution. The latter favours the lending process by co-funding the investment project, and/or providing guarantees to the bank in the event of the project's failure.[2] It is the impact of the anti-crisis measures on the capital cost that is crucial for our analysis, not which specific measure is adopted. Even so, we limit our attention to these instruments for two reasons. First, they are widely employed.[3] Second, our targets are SMEs. As pointed out, *e.g.*, by Gersl and Hlavacek (2007), the problem of insufficient financial resources for big investment projects is occasionally addressed by guarantees and subsidies. Most of the time, in fact, government support is dedicated to the creation of favorable conditions for foreign direct investment.

We show that the intervention of the public institution helps agents overcome credit crunch by reducing the cost of raising capital for the bank.[4] This virtuous effect is already well known in empirical literature. Lelarge *et al.* (2010), for example, present evidence that the French government loan guarantee program (Sofaris) effectively helped young French firms to get financed. At the same time, they remark that guaranteed firms are more likely to adopt risky strategies.[5] We capture this side-effect by accounting for the different degrees of competition faced by the bank and by showing that public interventions in highly concentrated banking sectors may induce borrowers to shirk. Boyd and De Nicoló (2005) argue that competition in the loan market lowers interest rates, thus reducing the risk-taking incentives of the borrowers. The main novelty of our analysis consists of highlighting the crucial role played by the banking industry structure in affecting the outcome of the public initiative.[6]

Our findings may also explain the occurrence of sluggish economic recovery in the aftermath of a financial crisis. In a recent contribution, Reinhart and Reinhart (2010) looked at fifteen post-World War II financial crises

[2]Based on the functioning of the most relevant public financial institutions, we argue that direct funding to the SME is not convenient due to prohibitive transaction costs. The European Investment Bank Group, for example, explicitly states that: "Small and medium-scale ventures and smaller-scale infrastructure projects are financed by credit lines to regional banks who better understand the local marketplace" (EIB website: "Intermediated Loans"). In the US, the SBA does not grant direct loans (with the exception of Disaster Relief Loans). Instead, loans are provided through banks, credit unions and other lenders that have established a partnership with the SBA.

[3]See Gudger (1998) for a survey on credit guarantees and subsidies around the world. Uesugi et al. (2010) examine Japan's Special Credit Guarantee Program for Financial Stability, under which Japanese SMEs received government-sponsored credit guarantees between 1998 and 2001.

[4]A similar result is found by Arping et al. (2010) who develop a thoretical model with both moral hazard and adverse selection.

[5]Also deposit insurance schemes may indirectly induce moral hazard. According to Demirgüç-Kunt and Detragiache (2002), countries with ill-designed deposit insurance systems have a higher probability of experiencing a banking crisis.

[6]The EIBG, for example, is concerned with this problem. Indeed, it aims at stimulating competition among the intermediaries so as to pass on to SMEs the generous credit conditions offered to intermediary banks.

in advanced and emerging economies. They also investigated three global crises that occurred in the 1930s, the 1970s, and the latest financial crisis. They concluded that GDP growth is significantly lower in the ten-year period following a crisis when compared to the decade that preceded it.[7]

The second part of the paper is devoted to the analysis of bank monitoring. The crucial role of banks as monitors has been widely recognized in the financial intermediation literature since Diamond (1984) and James (1987). Interestingly, we find that the welfare-reducing outcome arising in a concentrated banking sector after the public intervention can be mitigated through monitoring. Yet, the level of guarantees should not exceed a threshold value, above which the bank's incentive to monitor turns out to be dampened. This consequence is well known in banking literature. Rajan and Winton (1995), *e.g.*, argue that highly collateralized loans may decrease the intensity of monitoring because the lender's claim is almost fully secured regardless of the borrower's business conditions.

The remainder of the paper is organized as follows. The formal model is laid out in Section 2. Sections 3 and 4 consider the two scenarios described above, without and with the intervention of the financial institution, respectively. In Section 5 we extend the analysis by taking into account the monitoring option. Section 6 discusses the robustness of the results and concludes the paper.

2. THE BASIC MODEL

The framework of this section builds upon Fedele et al. (2013). A wealthless firm needs funding to implement a business based on two alternative risky projects. Project i, $i = H, L$, yields a per-unit-of-investment return a with probability $p_i \in (0, 1)$ and 0 otherwise. It also requires a nontransferable effort, whose per-unit-of-investment monetary equivalent disutility is denoted by c_i. Moreover, we let $c_H = c > 0 = c_L$ and $p_H > p_L$. Project H entails a bigger effort cost than project L, but succeeds with higher probability.

The financial contracting game begins when the firm applies for a bank loan, the amount of which is normalized to one. The bank designs a proposal, then the firm decides whether or not to accept it. After the loan is granted the firm chooses between projects H and L, *i.e.* it decides whether to exert an extra effort cost $\Delta c \equiv c_H - c_L = c$, thereby increasing the success probability by $\Delta p \equiv p_H - p_L$, or to shirk. This choice is assumed

[7]In the aftermath of the crisis, Federal Reserve Chairman Ben Bernanke told the Congress that "even after a recovery gets underway, the rate of growth of real economic activity is likely to remain below its longer-run potential for a while" (B. S. Bernanke, "The Economic Outlook", statement before the Joint Economic Committee, U.S. Congress, 2009 May 5th).

to be hidden, thus giving rise to a moral hazard problem. Finally, returns accrue and the firm repays the bank. The firm's outside option is zero.

We examine two alternative scenarios to show how the availability of credit can be affected by a public financial institution. In the first one, the firm resorts to a local bank (LB, henceforth) to obtain the unit of capital. In the second one, the loan application is directed to an intermediary bank (IB, henceforth) supported by a public financial institution (PFI, henceforth).[8] The PFI is supposed to operate on a nonprofit basis given its public status.[9] The IB determines the fraction $\alpha \in [0, 1]$ of the unit of capital to be lent directly to the firm, while demanding from the PFI *(i)* the remaining amount $(1-\alpha)$, and *(ii)* guarantees $W \geq 0$ against the project's failure. The firm, banks, either local or intermediary, and PFI are all supposed to be risk-neutral.

The different contractual features characterizing the two scenarios are described as follows.

(i) When resorting to the LB, the firm is offered a contract which specifies the share that each party receives when the project's outcome is positive. The firm's expected share is

$$u_i \equiv p_i (a - r) - c_i, \tag{1}$$

where r is the amount to be repaid by the firm to the LB, while the bank's expected share is

$$v_i \equiv p_i r - \rho, \tag{2}$$

where ρ represents the bank's unitary cost of raising money.[10] Summing up (1) and (2) gives the expected welfare (or surplus) s_i when project i is implemented:

$$s_i \equiv p_i a - c_i - \rho. \tag{3}$$

(ii) When the firm applies to the intermediary bank the amount to be repaid is denoted by R. Hence, the firm's expected share is

$$U_i \equiv p_i (a - R) - c_i. \tag{4}$$

The IB's share is

$$p_i R + (1 - p_i) W - \gamma - (1 - \alpha) \Gamma - \alpha \eta (W). \tag{5}$$

[8]According to the discussion reported in the Introduction, we assume that the PFI cannot lend directly to the firm due to high transaction costs.

[9]This hypothesis has its roots in the real world. In the EU, *e.g.*, the EIB is ruled on a non-profit maximizing basis in accordance with its general commitment towards the integration, development and economic and social cohesion of the EU Member States.

[10]As effort cost c is privately borne by the firm and the project yields only one positive outcome, our loan arrangement can be interpreted both as a debt and an equity contract.

Finally, the PFI's one amounts to

$$Z_i \equiv (1-\alpha)\,\Gamma - (1-p_i)\,W + \gamma - (1-\alpha)\,\phi. \tag{6}$$

Expressions (5) and (6) show the way we model guarantee provision and co-funding by the PFI. On one hand, the IB pays a monetary amount γ in exchange for guarantee W received from the PFI only if the firm's project fails (with probability $1-p_i$). On the other hand, $(1-\alpha)$ is the amount of co-funding provided by the PFI to the IB to finance the firm's project. Γ is the unitary gross remuneration the IB owes to the PFI in return for the capital borrowed. Finally, parameter ϕ represents the PFI's unitary cost of raising money, while $\eta\,(W)$ is the IB's corresponding cost, which depends on W and whose functional form is specified below.[11]

The sums of (4), (5) and (6) yield the expected welfare when project i is implemented after the PFI's intervention:

$$p_i a - c_i - \alpha\eta(W) - (1-\alpha)\phi. \tag{7}$$

Banks and the PFI raise money from outside investors, for example, bondholders and depositors who, differently from the other agents in our framework, are supposed to be risk-averse. In this scenario a better credit rating enables an institution to get funding at a lower cost. We assume that the PFI has an out-of-the-model, wider, and more diversified asset portfolio than the banks. Thus, it enjoys a triple-A credit rating compared to a worse evaluation for the latter. This is why the financial capital unitary cost is supposed to be lower for the PFI:[12]

$$\phi < \rho. \tag{8}$$

Finally, we specify the functional form of $\eta\,(W)$, the IB's unitary cost of raising money. Guarantee W insures the IB against the credit risk arising

[11] The EIF, *e.g.*, supplies guarantees through different instruments, among which the Credit Enhancement-Securitisation, that enables intermediary banks to transfer part of their portfolio's risk. More exactly, securitization works like an insurance for loans, as the credit exposure attached to every loan is transferred from banks to the EIF through the issue of notes (called "asset backed-securities") on the capital market. The banks have to pay the EIF a fee for the protection, and in case of default the latter pays the loss. The beneficial role of the EIF in the securitization transactions is supported by different studies (*e.g.*, Robinson 2009, Janda 2008, ÖIR-Managementdienste GmbH 2007, European Commission 2007 and AMTE Final Report 2006).

[12] The PFI may also rely on governments, which offer cheaper financial capital than private investors. In the European context, the EIB's capital is subscribed by EU member States. Moreover, the EIB raises resources through bond-issues and other debt instruments. The EIB's "firm shareholder support, [...] strong capital base, exceptional asset quality, conservative risk management and [...] sound funding strategy" constitute the reasons for its constant triple-A credit rating, assigned by Moody's, Standard and Poor's, and Fitch (see EIB website: "About the EIB").

from financing the firm's project. This is important even though the IB is risk-neutral, for its utility is indirectly affected by the degree of insurance. Indeed, outside investors are risk-averse. Therefore, they require returns that increase with volatility of the IB's investments. If the IB collects a fraction $\alpha > 0$, the higher $W\,(\leq R)$, the lower the volatility, as captured by per-unit-of-investment variance

$$p_i\,(1-p_i)\,(W-R)^2\,. \tag{9}$$

In turn, the lower the returns demanded by the investors, *ceteris paribus*. Accordingly, we suppose that cost $\eta\,(W)$ is decreasing in W. When the IB is fully insured, $W = R$, volatility is nil for any R. In this case, we let $\eta\,(W)$ be equal to ϕ, the same cost borne by the highly credit rated PFI.[13] In symbols:

$$\alpha\eta\,(W) = \begin{cases} \alpha f\,(W) > \alpha\phi & \text{if } 0 \leq W < R \\ \alpha\phi & \text{if } W = R \end{cases} \tag{10}$$

with $f'\,(W) < 0$. It is worth remarking here that guarantees play no role in reducing the funding cost if the IB relies entirely on the PFI to finance the project, $\alpha = 0$. This is due to the idea that the bank does not have to raise money from outside risk-averse investors. Without loss of generality, we assume that no guarantees are demanded by the IB, *i.e.* $W = 0$, if $\alpha = 0$.

3. THE LOCAL BANK: WHEN THE CREDIT MARKET IS LEFT ALONE

In this section we consider the scenario in which the PFI does not intervene and only local banks are available in the credit market. The timing of the game is as follows:

1. At $t = 0$, first the firm applies for the loan; then the LB designs a loan proposal. Finally, the firm decides whether or not to accept it.
2. Between $t = 0$ and $t = 1$, the firm chooses between projects H and L.
3. At $t = 1$ returns accrue and the firm repays the bank.

Before proceeding, we assume that the total expected surplus s_i is positive if and only if the firm behaves:

$$s_H \equiv p_H a - c - \rho > 0 > s_L \equiv p_L a - \rho. \tag{11}$$

[13] Here we make the implicit simplifying assumption that funding costs ϕ, $\eta\,(W)$ and ρ are independent of R and r: this is without loss of generality, as we argue extensively in Section 6.

Throughout the paper, we refer to project H (resp. L) as the good (resp. bad) project. Accordingly, the LB is forced to induce the firm not to shirk. Otherwise, the expected outcome of the project would not meet the former's participation constraint. In symbols, the LB must choose r such that the firm's incentive compatibility constraint holds:

$$u_H \equiv p_H (a - r) - c \geq u_L \equiv p_L (a - r) \Leftrightarrow r \leq a - \frac{c}{\Delta p}. \qquad (12)$$

The firm behaves only for relatively low values of r, in which case the negative effect of the effort disutility on u_i is outdone by the positive effect of the increased success probability. At the same time the amount r cannot be too low, otherwise the LB, whose share v_H increases with r, finds it not profitable to lend. Accordingly, the LB's participation constraint has to be satisfied:

$$v_H \equiv p_H r - \rho \geq 0 \Leftrightarrow r \geq \frac{\rho}{p_H}. \qquad (13)$$

We allow the maximum expected share that the LB can receive, without jeopardizing the firm's incentive to behave, to be lower than the funding cost ρ:

$$p_H \left(a - \frac{c}{\Delta p} \right) < \rho. \qquad (14)$$

The above inequality is likely to hold in a period of crisis, where the expected return a is low relatively to both the effort disutility c and the cost of funding ρ. Condition (14) can be rewritten as $a - c/\Delta p < \rho/p_H$, which implies that (12) and (13) can not simultaneously hold. It follows that the loan can not be granted. When (12) holds, then (13) does not, meaning that the bank can not break even on the loan. By contrast, if (13) holds, then (12) does not, with the effect that the firm does not behave and, again, the bank is unable to meet its participation constraint.

We can summarize the result of this section in:

PROPOSITION 1. *Under condition* (14)*, the loan is not granted and the resulting welfare is nil when the firm applies to the local bank.*

As argued above, condition (14) is likely to hold in a period of crisis. In such a scenario, the loan is refused as the firm can not be properly motivated to implement a creditworthy project.

4. THE INTERMEDIARY BANK SUPPORTED BY THE PUBLIC FINANCIAL INSTITUTION

In this section we study the case in which the firm resorts to the IB, supported by the PFI through the provision of co-funding and guarantees. The timing of the game is as follows:

1. At $t = 0$ the firm applies for the loan. The IB first demands co-funding and guarantees to the PFI, and then designs a loan proposal. Finally, the firm decides whether or not to accept it.
2. Between $t = 0$ and $t = 1$, the firm chooses between projects H and L.
3. At $t = 1$ returns accrue, the firm repays the IB, which in turn repays the PFI.

We first determine the amount of co-funding and guarantees demanded by the IB. For ease of exposition, we consider separately the two activities carried out by the PFI, as if it was divided into two sub-units, one focused on the provision of co-funding and the other specialized in the supply of guarantees.[14] Expression (6) splits then into $Z' \equiv (1-\alpha)\,\Gamma - (1-\alpha)\,\phi$ and $Z_i'' \equiv \gamma - (1-p_i)\,W$. We recall that the lending activity is ruled by the PFI on a nonprofit basis. It follows that unitary price Γ of co-funding and price γ of guarantees are determined through the break-even conditions $Z' = 0 \Leftrightarrow \Gamma = \phi$ and $Z_i'' = 0 \Leftrightarrow \gamma_i = (1-p_i)\,W$.

According to the latter condition, equality price of guarantees γ_i depends on the firm's project choice. This aspect deserves a careful explanation. The firm's choice is hidden, hence noncontractible. Yet, the PFI can set γ contingent upon the amount R charged by the IB for R is verifiable in our framework. More exactly, the PFI correctly anticipates that the firm will behave if and only if the following incentive compatibility condition holds:

$$U_H \geq U_L \Leftrightarrow R \leq a - \frac{c}{\Delta p}. \tag{15}$$

Inequality (15) is equivalent to (12). At $t = 0$, the PFI and the IB agree upon γ_H if R does not exceed $a - c/\Delta p$, and they agree upon γ_L otherwise. After that, the PFI observes the loan contract between the IB and the firm. Finally, at $t = 1$, the LB pays γ_i to the PFI. Notice that $\gamma_L > \gamma_H$ if $W > 0$: misbehavior by the firm increases the credit risk faced by the PFI when a positive amount of guarantees is put up, hence the latter is forced to charge a higher γ in order to break-even.

Plugging $\Gamma = \phi$ and $\gamma_i = (1-p_i)\,W$ into the IB's share (5) yields:

$$p_i R - \alpha\eta\,(W) - (1-\alpha)\,\phi. \tag{16}$$

[14] This is consistent, for example, with the separation between the EIB and the EIF, as we described in the Introduction.

The above expression increases with W according to (10): $W = R$ is then the amount of guarantees demanded by the IB, in which case the optimal quantity of co-funding is any amount less than 1. Here the two instruments are perfect substitutes for the IB because they both reduce the cost of capital to ϕ and their prices are driven bythe PFI's break-even conditions. This is not true if $W < R$. In this case (16) decreases with α and the demand for co-funding is maximum, $\alpha = 0$. According to the reasoning developed at the end of Section 2, the demand for guarantees is instead nil.

Assuming that the PFI has enough resources to satisfy the demand for guarantees and/or co-funding, then the IB's share (16) can be rewritten, after substituting $\eta(R) = \phi$ or $\alpha = 0$, as

$$p_i R - \phi, \tag{17}$$

where $i = H$ (or L) if $R \leq$ (or $>$) $a - c/\Delta p$. Comparing the above value to (2), one can straightforwardly deduce that the positive effect of the PFI's intervention consists of lowering to $\phi < \rho$ the bank's cost of raising funds. The excellent credit rating enjoyed by the PFI is transmitted to the IB.

Focusing on the IB's share (17) helps clarify a key aspect of our analysis. Suppose $W = R$, then the IB is fully insured against the project's failure. One should therefore expect no incentive to induce the firm to behave. Nevertheless, by inspecting (17) , one can easily check that the IB's share, depending on p_i, is negatively affected by the firm's choice of the bad project L. This is not surprising. If the firm does not behave and the IB is fully insured, it is the credit risk faced by the PFI that increases. Yet, the monetary burden deriving from such an increment is transferred to the IB through the extra-price $\gamma_L - \gamma_H = \Delta p R$.

Before proceeding, we denote with S_i the total expected surplus (7) after substituting the optimal levels of guarantees ($W = R$) or co-funding ($\alpha = 0$). We also assume that S_i remains positive, even though the firm does not behave, because of the reduced cost of financing following the PFI's intervention:

$$S_H \equiv p_H a - c - \phi > S_L \equiv p_L a - \phi > 0. \tag{18}$$

Given these premises, we are able to study the IB's problem, starting from its participation constraint:

$$p_i R - \phi \geq 0 \Leftrightarrow R \geq \frac{\phi}{p_i}. \tag{19}$$

It is worth remarking that $\phi/p_L > \phi/p_H$: if the firm decides to shirk the project succeeds with lower probability. Hence, the minimum R must rise, otherwise the IB would incur a loss. The firm's project choice is instead driven by condition (15).

We assume that the maximum IB's share that is compatible with the firm's incentive compatibility constraint (15) is higher than the reduced cost of capital, thanks to the PFI's intervention:

$$p_H \left(a - \frac{c}{\Delta p} \right) > \phi. \tag{20}$$

It follows that, differently from the scenario with the LB, ϕ/p_H is strictly lower than $a - c/\Delta p$, with the effect that any R belonging to interval $[\phi/p_H, a - c/\Delta p]$ ensure both IB's participation and firm's choice of a good project. Moreover, also higher R, even if violating (15) and thus inducing the firm not to behave, could be compatible with IB's participation since $S_L > 0$ according to (18).

Here the equilibrium value of R turns out to be crucial to give some insights on the IB's lending decision and the firm's project choice. Such a value depends on the bargaining power between the parties, which is in turn affected by the degree of competition faced by the IB. We consider two polar environments. When the IB competes *à la* Bertrand (and all banks are symmetric), R is chosen to maximize the firm's share U_i. Otherwise, the firm applies to a rival bank. In this case, it is the firm that makes a take-it-or-leave-it offer to the bank. In the opposite situation of monopolistic IB, the bank has full bargaining power and sets the amount R to maximize its own share.

(i) Focus first on a competitive IB, in which case R is set at its lowest value $R = \phi/p_i$. Substituting ϕ/p_i into U_i yields S_i. When the IB breaks even on the loan, the firm gets the entire surplus S_i. Since $\phi/p_H < \phi/p_L$, the equilibrium amount of R is ϕ/p_H. Indeed, any higher value would be undercut by rival banks and any lower one would not satisfy the banks' participation constraint. Finally, the firm ends up with S_H since it behaves.

(ii) Consider now the monopolistic scenario, where the bank sets the amount R to maximize its own share $p_i R - \phi$, subject to the firm's incentive compatibility and participation constraints: $U_i \geq U_{-i}$, with $-i = L, H$, and $U_i \geq 0$, respectively. The optimal value of R will be selected between $a - c/\Delta p$, the maximum R compatible with the firm's choice of project H, and a, the maximum R compatible with the firm's participation when it shirks. When selecting $R = a - c/\Delta p$ the bank ends up with $p_H (a - c/\Delta p) - \phi$ and the firm with $p_L c/\Delta p$. On the contrary, by setting $R = a$ the former gets $p_L a - \phi$, while the latter zero. The monopolistic IB's choice of R depends on the comparison between $p_H (a - c/\Delta p) - \phi$ and $S_L \equiv p_L a - \phi$. Note that

$$p_H (a - c/\Delta p) - \phi \geq p_L a - \phi \Leftrightarrow a \geq p_H c/ (\Delta p)^2 .$$

We are now able to sum up the main findings of this section:

PROPOSITION 2. *Under condition* (20), *the loan is granted when the firm applies to the intermediary bank supported by the financial institution. The resulting welfare depends on the degree of competition faced by the bank. With Bertrand competition, welfare is* S_H. *With monopoly, welfare is either* S_H, *if* $a \geq p_H c / (\Delta p)^2$, *or* S_L, *if* $a < p_H c / (\Delta p)^2$.

The intervention of the PFI lowers the bank's cost of raising funds and turns out to represent a powerful device to soften credit crunch problems in periods of recession, where projects' returns are low relative to informational and funding costs, as captured by condition (14). However, such an intervention may give rise to a negative side-effect. Since the decrease in the cost of financing outweighs the negative effect on the project's success probability due to low effort, *i.e.* $S_L > 0$, the PFI's intervention may prompt firms to invest in bad projects. This occurs when the IB is monopolistic and $a < p_H c / (\Delta p)^2$, in which case the surplus amounts to S_L instead of $S_H > S_L$.

As argued above, the presence of guarantees does not directly affect the incentive for the IB to control the firm's behavior. Yet, our model captures in an indirect way a socially detrimental effect caused by the PFI's intervention. This finding offers a potential theoretical explanation for the sluggish economic growth, frequently observed after a financial crisis which triggers interventions by governments and central banks addressed to improve the access to credit for cash-poor firms. Nonetheless, such a side-effect is shown to dim when intermediary banks operate in a competitive environment. The resulting downward trend of the equilibrium interest rates charged on loans may induce firms to behave. Building on this result, an important policy indication can be derived. Any public financial institution which aims at promoting economic growth after a crisis not only should support the banking sector through, *e.g.*, provision of co-funding and guarantees, but also stimulate competition. Indeed, only competitive intermediary banks are induced to pass on to the final beneficiary the favorable credit conditions proposed by the public financial institution, thus preventing firms from investing in bad projects.

In conclusion, we collect for ease of exposition the parametric conditions driving the results of Sections 3 and 4, *i.e.* those appearing in (11), (14), (18) and (20):

$$p_H a - c > \rho > \max\left\{p_H\left(a - \frac{c}{\Delta p}\right), p_L a\right\} \geq \min\left\{p_H\left(a - \frac{c}{\Delta p}\right), p_L a\right\} > \phi. \tag{21}$$

5. MONITORING

In this section we extend our analysis by considering the possibility for the banks (either LB or IB) to monitor the firm between $t = 0$ and $t = 1$, *i.e.* after the contract is signed but before returns accrue. We then study how this additional option affects our previous findings.

When carrying out the monitoring activity, the banks aim at acquiring information on the firm's behavior through, for instance, inspection of balance sheet position and management. This entails a cost which is assumed to be fixed and denoted by $m > 0$.[15] In conformity with the moral hazard framework introduced in Section 2, we assume that the monitoring effort can not be observed by the PFI. Monitoring is assumed to make the agent's behavior perfectly observable. If project L is chosen, this is detected with probability one and the firm is imposed a punishment whose monetary equivalent is denoted by b. We analyze separately the case of local and intermediary banks.

5.1. The Local Bank Case

When the LB decides to monitor, the moral hazard issue softens as the firm has less incentive to shirk. For ease of exposition, but with no loss of generality, we assume that monitoring eliminates the moral hazard problem. This requires that the firm's incentive compatibility condition (12), which rewrites as

$$p_H (a - r) - c \geq p_L (a - r) - b \tag{22}$$

according to the design of monitoring, holds for any r compatible with the firm's participation

$$p_H (a - r) - c \geq 0 \Leftrightarrow r \leq a - \frac{c}{p_H}. \tag{23}$$

Solving (22) by b yields $b \geq c - \Delta p (a - r)$. If punishment in case of shirking is high enough, then a monitored firm always behaves. It is worth remarking that $c - \Delta p (a - r)$ increases with r: a higher r strengthens the moral hazard problem, in which case a harsher punishment is needed to induce the firm to behave. Yet, r can not exceed $(a - c/p_H)$. Substituting such a value into $c - \Delta p (a - r)$ gives $p_L c/p_H$. We hence suppose

$$b = \frac{p_L}{p_H} c, \tag{24}$$

so that (22) holds for any $r \leq a - c/p_H$.

[15]One can think of the time spent by the banks to directly monitor the behavior of the firm, parameter m thereby representing the opportunity cost of not devoting that time to other productive activities.

If monitoring takes place, then the LB correctly anticipates that the firm will choose project H given (22) and (24). The LB has solely to focus on the firm's participation constraint (23). At the same time, the LB's share (2) rewrites as $p_H r - \rho - m$. Therefore, its new participation constraint is

$$r \geq \frac{\rho + m}{p_H}. \tag{25}$$

In line with condition (14), we let the maximum expected share that the LB can receive when monitoring without jeopardizing the firm's participation, to be lower than the funding cost ρ:

$$p_H \left(a - \frac{c}{p_H} \right) - m < \rho \Leftrightarrow m > p_H a - c - \rho. \tag{26}$$

Again, the above inequality is likely to hold in a period of crisis, where the expected return a is low relatively to costs m, c, and ρ. Condition (26) can be rewritten as $a - c/p_H < (\rho + m)/p_H$, which implies that (23) and (25) can not simultaneously hold. As a consequence, the loan is not granted.

We can wrap up the above findings as follows.

Proposition 3. *Under condition* (26)*, the credit crunch problem highlighted in Proposition 1 is not overcome, even when a monitoring technology is available to the local bank.*

Monitoring by the LB eliminates the moral hazard problem and this might ameliorate the credit market conditions. However, the crisis scenario captured by inequality (26) makes monitoring relatively expensive, with the effect that the access to credit for cash-poor firms remains difficult in the absence of public intervention.

5.2. The Intermediary Bank Case

We focus now on case of the intermediary bank, by first computing the amount of co-funding and guarantees demanded by the IB. In the absence of monitoring (see Section 4) the break-even price of guarantees depends on the firm's project choice, $\gamma_i = (1 - p_i) W$. Here, the PFI cannot observe either the IB's monitoring choice or the firm's project choice. Yet, it is able to set γ contingent upon R and the amount of guarantees W demanded by the IB, which are both verifiable. The mechanism is as follows.

(a) Suppose first that $R \leq a - c/\Delta p$, with $a - c/\Delta p < a - c/p_H$. In such a case, the PFI correctly anticipates that the firm will participate and behave in both cases: with monitoring, thanks to (22), (23), and (24); without monitoring, due to (15). The price of guarantees is then set equal

to $\gamma_H = (1 - p_H) W$. Substituting $i = H$ and $\gamma_H = (1 - p_H) W$ into (5) yields

$$p_H R - (1 - \alpha) \Gamma - \alpha\eta (W) - m$$

when the IB decides to monitor, thus bearing the cost m. On the contrary, in absence of monitoring, it yields

$$p_H R - (1 - \alpha) \Gamma - \alpha\eta (W). \tag{27}$$

The latter expression is clearly higher, hence the PFI infers that no monitoring will occur.

(b) Assume now that $R > a - c/\Delta p$. Here the firm behaves only when monitored, hence the PFI is not able to anticipate the firm's behavior and make γ contingent on it. Yet, the PFI can correctly compute that the IB obtains

$$p_H R + (1 - p_H) W - \gamma - (1 - \alpha) \Gamma - \alpha\eta (W) - m \tag{28}$$

when monitoring and

$$p_L R + (1 - p_L) W - \gamma - (1 - \alpha) \Gamma - \alpha\eta (W) \tag{29}$$

when not monitoring. The former value is higher if and only if

$$W \leq R - \frac{m}{\Delta p}. \tag{30}$$

As a consequence, when observing $R > a - c/\Delta p$, the PFI knows that monitoring will occur if and only if the demand for guarantees W does not exceed the amount $R - m/\Delta p$.[16] In this case guarantees are priced at γ_H as the PFI knows that the firm will behave. By contrast, if $W > R - m/\Delta p$, then the unmonitored firm does not behave and the price of guarantees rises to γ_L.

We are now able to compute the demand for co-funding and guarantees as a function of R and W. If $R \leq a - c/\Delta p$, we can substitute the break-even price of co-funding, $\Gamma = \phi$, into (27) and get $p_H R - (1 - \alpha) \phi - \alpha\eta (W)$: such a value decreases with $\eta (W)$ and α according to (10). This situation is equivalent to the case studied in Section 4: full insurance $W = R$ or maximum co-funding $\alpha = 0$ are optimal solutions for the IB, whose deriving share is

$$p_H R - \phi. \tag{31}$$

[16] This is a standard result, as we argued in the Introduction. As pertinent examples, in the EU the EIF sets limits to the provision of guarantee support in order to avoid opportunistic behaviors by the partner banks, while in the US the SBA guarantee is usually in the range of 50 to 85 percent of the loan amount.

The same conclusion can be drawn if $R > a - c/\Delta p$ and $W > R - m/\Delta p$, in which case the optimal IB's share is

$$p_L R - \phi, \tag{32}$$

after substituting $\Gamma = \phi$, $\gamma_L = (1 - p_L) W$ and $W = R$ (or $\alpha = 0$) into (29). Finally, if $R > a - c/\Delta p$, but $W \leq R - m/\Delta p$, then (28) rewrites as $p_H R - (1 - \alpha)\phi - \alpha\eta(W) - m$, after substituting $\gamma_H = (1 - p_H) W$. Such a value is maximum for $\alpha = 0$, since $\eta(W) > \phi$ according to (10) and (30), and equals

$$p_H R - \phi - m \tag{33}$$

according to the reasoning developed at the end of Section 2. Because of this, the demand for guarantees is instead nought.[17]

If monitoring takes place, the IB's new participation constraint is therefore

$$p_H R - \phi - m \geq 0 \Leftrightarrow R \geq \frac{\phi + m}{p_H},$$

while the firm's participation condition is given by $R \leq a - c/p_H$. In line with condition (20), we suppose that the IB's after-monitoring maximum expected share compatible with the firm's participation is higher than funding cost ϕ:

$$p_H \left(a - \frac{c}{p_H} \right) - m > \phi \Leftrightarrow m < p_H a - c - \phi. \tag{34}$$

It follows that, differently from the scenario with the LB, $(\phi + m)/p_H$ is strictly lower than $a - c/p_H$, with the effect that any R belonging to interval $[(\phi + m)/p_H, a - c/p_H]$ ensure both the IB's participation and the firm's choice of good project after monitoring.

Following the analysis of Section 4, we consider two polar degrees of competition faced by the IB to study its equilibrium choices concerning R and monitoring, and the firm's project selection.

(i) When the bank competes *à la* Bertrand, the lowest level of R that is compatible with the IB's participation and monitoring is $R = (\phi + m)/p_H$. Yet, $\phi/p_H < (\phi + m)/p_H$. Hence, $(\phi + m)/p_H$ can not be an equilibrium because it would be undercut by rival banks who decide not to monitor.

[17] In this particular case, the IB acts as a channel for public funding: its only contribution is to provide monitoring, which may increase the project's expected value. This aspect is well known in the banking literature: see, *e.g.*, Boot and Thakor (2000) and Allen et al. (2011), *inter alii*, who argue that bank monitoring helps improve firm performance.

The only equilibrium amount of R is ϕ/p_H, for which the competitive IB does not monitor. Otherwise, its participation constraint would be violated whilst the firm behaves, since $\phi/p_H < a - c/\Delta p$.

(ii) When the IB is monopolistic, the optimal value of R is $a - c/p_H$, the maximum R compatible with the monitored firm's participation. Substituting $R = a - c/p_H$ into (33) yields

$$p_H \left(a - \frac{c}{p_H} \right) - m - \phi,$$

which is positive given (34).

The above value must be compared to the IB's optimal share with no monitoring. Such a share is given by $\max \{ p_H (a - c/\Delta p) - \phi, p_L a - \phi \}$, where the former expression is (31) after substituting $R = a - c/\Delta p$ and the latter is (32) with $R = a$.

Focus first on interval $a \geq p_H c/(\Delta p)^2 \Leftrightarrow p_H (a - c/\Delta p) - \phi \geq p_L a - \phi$, for which the monopolistic IB, when not monitoring, induces the firm to behave and the deriving welfare is S_H (see Proposition 2). Yet, the bank prefers to monitor if and only if

$$m \leq \frac{p_L}{\Delta p} c, \tag{35}$$

where (35) is the solution to $p_H (a - c/p_H) - m - \phi \geq p_H (a - c/\Delta p) - \phi$. When (35) holds, the monitoring option, implemented at equilibrium by the monopolistic IB, turns out to be socially wasteful, in that it shrinks welfare from S_H to $S_H - m$.

Consider now region $a < p_H c/(\Delta p)^2$, for which the monopolistic IB, when not monitoring, opts for the welfare-reducing choice to induce the firm to shirk and ends up with S_L (see again Proposition 2). Monitoring can overcome this situation if and only if

$$m \leq \Delta p a - c, \tag{36}$$

where (36) is the solution to $p_H (a - c/p_H) - m - \phi \geq p_L a - \phi$.[18] In this case the monopolistic IB ends up with a higher share when monitoring and inducing the choice of the good project than when not monitoring and inducing the choice of the bad project. More interestingly, such a choice is welfare improving as $S_H - m \geq S_L$ under condition (36).

[18]Under conditions (21) both $p_L c/\Delta p$ and $\Delta p a - c$ are strictly higher than the lower bound on m implied by (26) and strictly lower than the upper bound required by (34). This ensures that intervals (35), (36) and their complementary ones are all nonempty.

Finally, substituting $R = a - c/p_H$, into the RHS of (30) yields

$$a - \frac{c}{p_H} - \frac{m}{\Delta p},$$

which is strictly positive when the monopolistic IB decides to monitor, *i.e.* when $a \geq p_H c/(\Delta p)^2$ and $m \leq p_L c/\Delta p$, or $a < p_H c/(\Delta p)^2$ and $m \leq \Delta pa - c$. Condition (30) is therefore met given that the demand for guarantees is nil.

We sum up the above findings as:

PROPOSITION 4. *Under condition* (34)*, the intermediary bank may find it profitable to implement monitoring only in a regime of monopoly. In such a case, welfare is reduced from S_H to $S_H - m$ if $a \geq p_H c/(\Delta p)^2$ and $m \leq p_L c/\Delta p$, while it increases from S_L to $S_H - m$ if $a < p_H c/(\Delta p)^2$ and $m \leq \Delta pa - c$.*

Monitoring is not a viable option for a competitive IB because the deriving high share granted to the firm is a cheaper way to mitigate the moral hazard problem.[19] On the contrary, a relatively efficient monitoring technology (*i.e.* conditions (35) and (36) met) implemented by a monopolistic IB turns out to be welfare-reducing if $a \geq p_H c/(\Delta p)^2$ and welfare-enhancing when the opposite holds.

In our framework, the monitoring technology becomes effective only after the intervention of the PFI, given (26) and (34). This may represent a useful tool to promote economic growth, when a particularly severe crisis (captured by condition $a < p_H c/(\Delta p)^2$, which implies return a low relatively to effort cost c) would otherwise prompt firms to invest in bad project, as highlighted by Proposition 2. Yet, this strategy produces an opposite and negative effect on welfare when the crisis is less severe, *i.e.* when condition $a \geq p_H c/(\Delta p)^2$ holds.

6. CONCLUDING REMARKS

Discussion of the results. Before summing up our findings, we owe a discussion of an aspect that could be problematic to our analysis. Throughout the paper, we have implicitly supposed that funding costs ϕ, $\eta(W)$ and ρ are independent of R of r (see Footnote 13). This is a simplifying assumption since the latter values affect positively the volatility of the banks'

[19]A similar result is found by Allen et al. (2011) who show that competition in the banking sector may hinder the monitoring activity in the absence of public intervention, which takes the form of deposit insurance in their model.

returns (see, *e.g.*, formula (9) for any $W < R$). Yet, our hypothesis is without loss of generality for two reasons.

First, the equilibrium funding cost for the IB is ϕ, either because the loan is fully guaranteed ($W = R$), or because the IB relies entirely on the PFI to finance the project ($\alpha = 0$). Cost ϕ is correctly supposed to be independent of R for in the former case variance is nil for any R, whilst in the latter case money is not raised by the IB.[20]

Second, if we assumed cost ρ to be increasing in r, the only effect would be a potential trade-off for the LB when choosing the equilibrium level of r. Nonetheless, a trade-off is already captured by the firm's moral hazard. LB's shares increase in r, but relatively high values of r violate the incentive compatibility condition (12), thus reducing the bank's expected returns.

Conclusion. The recent crisis of the global financial system has generated a wide debate on the necessity of public financial institutions to play an active role in enhancing credit availability. In this paper we have demonstrated how nonprofit top-credit-rated public financial institutions providing additional credit and guarantees to intermediary banks can mitigate the effects of informational problems between lenders and borrowers. This is crucial in periods of crisis, where trust between economic actors has to be re-established.

In addition, we have demonstrated that a competitive banking sector is a sufficient condition to allow the financing of good projects after public intervention. In the presence of a monopolistic bank, on the contrary, worse projects receive funds when the conjuncture is particularly negative. This may contribute to explain the slow recovery that often follows a period of financial crisis. In the final part of the paper we have considered the possibility for lenders to resort to costly monitoring. Interestingly, we have found that a highly concentrated banking sector is a necessary condition for monitoring to be implemented in the presence of public support. In this case welfare can be augmented, provided that credit guarantee level is sufficiently low.

Focusing on the European context, recent reforms and new measures taken by the EIBG confirm the validity of the message conveyed in our contribution. After the dramatic deterioration of the situation on the financial markets and the expansion of the economic crisis, the EIBG reinforced its skills with "anti-crisis measures". In particular, it deployed exceptional resources in support of SMEs and increased its volume target. As a consequence, more than 120000 SMEs received support in 2011. According to the EIB Group Report on Activities supporting SMEs 2011, allocations of

[20]When $\alpha = 0$, money is entirely provided by the PFI: yet, its funding cost ϕ is assumed not to be affected by R since the PFI mainly relies on an out-of-the-model wide and diversified asset portfolio, as argued in Section 2.

loans for SMEs reached the record amount of EUR 14.5 billion, 25% higher than 2010.[21] As for guarantees, through commitments of more than EUR 1.5 billion, EUR 7.6 billion of loans to SMEs were stimulated, covering more than 50 000 new SMEs. Finally,

> "According to its Operational Plan for 2012 – 2014, the Bank plans to increase its financing activity for SMEs and MidCaps during 2012 to EUR 11 billion of signatures. As a result SMEs will form an increasing proportion of the Bank's activity – 22% in 2012 against a share of 15-18% historically." (EIB Group Report on Activities supporting SMEs 2011)

According to our paper, public support might allow to overcome the credit crunch problem. On top of that, a liberalized banking sector may help a quicker recovery of the economy by inducing the borrowers to operate correctly in the implementation phase of the project. Future empirical research might test our prediction on the effectiveness of the public intervention relying on cross-national data at banking sector level.

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[21] Intermediated loans via banks continued to be EIB's core SME instrument, with EUR 10.5 billion signed in 2011. This reinforces the choice adopted in our paper, where we focus on such a loan agreement.

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