Bank capital and equity investment regulations

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Abstract

This paper uses an intermediation model to study the efficiency and welfare implications of both banks’ minimum required capital-asset ratio and the regulation that limits, and in some countries forbids, banks’ investments in the equity of nonfinancial firms. There are two sources of moral hazard in the model: one between the bank and the provider of deposit insurance, and the other between the bank and an entrepreneur who demands funds to finance an investment project. Among other things, the paper shows that capital regulation improves the bank’s stability and can also be Pareto-improving. Equity regulation is never Pareto-improving and does not increase the bank’s stability. © 1999 Elsevier Science B.V. All rights reserved.

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1. Introduction

The risk-shifting effect caused by deposit insurance, when the insurance premium does not reflect a bank’s risk, has long been recognized. 1 None-
theless, regulators have maintained the general features of the deposit insurance contract offered to banks. They have, however, introduced a wide range of restrictions on banks’ activities designed to limit their incentive and ability to choose portfolios of risky assets. Although these restrictions vary between countries, there are some common patterns, such as the regulations on banks’ capital and the regulations on the association between banking and commerce.

The 1987 Basle Accord on Capital Standards, reached by the G10 countries, and the 1993 introduction by the European Community of the Banks’ Own Funds and the Solvency Ratio Directives, both in line with the Basle Accord, were the main regulations that implemented the international harmonization of capital requirements. These regulations require banks to observe a minimum capital–asset ratio, where assets are weighted according to their risks.

The regulations on the association between banking and commerce have not driven the same international coordination. Nevertheless, there are some common patterns between countries both on the regulations on nonfinancial firms’ ownership of banks and on the regulations on banks’ ownership of nonfinancial firms. The former frequently limit the share of a bank’s capital that a firm can own. The latter usually limit a bank’s investment in the equity of a firm to a certain percentage of the bank’s capital, but their most common feature is the limit they impose on a bank’s investment in the equity of a firm to a certain percentage of either the firm’s capital or its voting rights. For example, this limit is 50% in Norway; 25% in Portugal; 10% in Canada and Finland; and 5% in Belgium, Japan, the Netherlands, and Sweden. Germany and Switzerland are examples of countries where banks are not subject to that form of regulation. As a result, banks in these countries can be the sole owners of nonfinancial firms.

In the US, banks are generally not allowed to invest in the equity of nonfinancial firms. Such investments can be made by bank holding companies provided that they do not represent more than 5% of a firm’s voting shares. The US Congress, however, in its current attempt to pass legislation repealing the Glass–Steagall Act, in order to allow commercial banks to reenter the investment banking business, is also considering proposals for relaxing the sep-

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2 Buser et al. (1981) suggest that the deposit insurance provider deliberately charges a subsidized risk-insensitive insurance premium to entice banks to submit themselves voluntarily to the regulatory dominion it controls.

3 See Cordell and King (1992) for a presentation of the Basle Accord.

4 See Pecchioli (1987), Schuijer (1992) or Barth et al. (1997) for a description of the regulations on the association between banking and commerce in several countries.

5 See Santos (1998) for a discussion of the association between banking and commerce throughout American history.
aration between banking and commerce. These proposals would continue to prohibit banks to invest in the equity of nonfinancial firms but they would relax the current regulation governing bank holding companies’ investments in the equity of these firms.

The objective of this paper is to compare the efficiency and welfare implications of both the regulation on banks’ capital and the regulation that limits banks’ investment in the equity of a firm to a certain percentage of that firm’s capital. The paper also studies the impact of these regulations on banks’ stability and on the contracts they use to finance firms. These issues are studied in an intermediation model where banks are the only source of external funds to firms. There are two sources of moral hazard in the model. One is in the relationship between the bank and the provider of deposit insurance. The other is in the relationship between the bank and the entrepreneur who demands funding to finance an investment project. Furthermore, because one of the regulations studied here involves banks’ investments in equity, the project held by the entrepreneur is designed so that the optimal financing contract can be replicated by a combination of debt and equity contracts.

In the model adopted in this paper, the bank chooses its capital structure and the contract it uses to finance the entrepreneur. As a result, the risk-shifting effect due to deposit insurance is translated here not in the bank’s decision to finance risky instead of safe investment projects, as is common in the literature, but in its choice of a financing contract that motivates the entrepreneur to adopt a riskier behavior, which in turn increases the risk to the bank’s assets. As we will see, the bank accomplishes this objective by increasing the relative importance of the debt portion of the financing contract. Using this framework, the paper shows that an increase in the bank’s minimum required capital–asset ratio increases the bank’s stability and it can be Pareto-improving. The paper also shows that the regulation which limits the bank’s investment in equity to a certain percentage of the firm’s capital does not increase the bank’s stability and is not Pareto-improving.

Although many authors have studied the importance of the bank capital regulation along several dimensions, including its effectiveness controlling banks’ incentive to undertake risk because of deposit insurance, they have done so in frameworks where banks can hold only debt securities and simply choose among borrowing firms of varying risk. Examples of this research are Kahane (1977), Koehn and Santomero (1980), Kim and Santomero (1988), Furlong and Keeley (1989), Keeley and Furlong (1990), Rochet (1992), Campbell et al. (1992), Giammarino et al. (1993) and Besanko and Kanatas (1996). The present paper extends that research in two directions. First, it allows the bank to use equity in addition to debt to finance a firm. Second, it studies how this change in the set of financial instruments available to the bank affects its portfolio risk, by looking at how the design of the contract
the bank uses to finance the firm affects this firm’s incentive to undertake risk.

The literature on the regulation of banks’ equity positions in nonfinancial firms, although not as vast as that on bank capital regulation, has already addressed several issues. For example, Pozdena (1991), Kim (1992), and John et al. (1994) study how the borrowing firm’s incentive changes when the financier uses equity in addition to debt to fund that firm. Rajan (1992) focuses on the role that the financier’s equity stake plays on the financier’s credibility when it underwrites the firm’s securities. James (1995) and Berlin et al. (1996) focus on the importance played by the Financier’s equity investment in a firm that is in financial distress. This paper is closer to the literature that has studied the effects on the borrowing firm’s incentives when the financier uses equity in addition to debt to fund the firm. The paper extends that literature by conducting the study in a framework where debt and equity are optimal contracts and where funding is provided by a bank in the presence of deposit insurance rather than by a nonbank financier, that is, an agent that has no deposits in his capital structure. Among other things, this allows for a study of the moral hazard caused by deposit insurance when banks are allowed to take equity positions in the firms to which they also extend loans. In addition, because the paper studies the regulation on bank capital and that on banks’ investments in the equity of nonfinancial firms in the same framework, it also allows for a comparison of the effectiveness of these regulations in limiting the bank’s risk-shifting incentive caused by deposit insurance.

The remainder of the paper is organized proceeds as follows. Section 2 introduces the model, characterizes the first- and second-best solutions, and shows the optimality of debt and equity contracts. Section 3 studies the capital and equity investment regulations. Final remarks are presented in Section 4, followed by two appendices, one containing the proofs and the other a numerical example.

2. The model

There are four players in the model adopted here: An entrepreneur, a bank, the provider of deposit insurance and the depositors. The crucial features of the model are the nature of the relationships between the bank and the entrepreneur on the one hand, and between the bank and the deposit insurance provider on the other hand. The former relationship is characterized by a principal–agent problem, where the bank is the principal and the entrepreneur the agent. The moral hazard in this relationship is generated by the dependence of the project’s expected return on the entrepreneur’s effort, which is not observable. The key feature of the latter relationship is the usual moral hazard
resulting from the flat rate deposit insurance premium that the insurer charges the bank. The assumptions of the model are as follows:

**Assumption 1.** There is a risk-neutral entrepreneur with an investment project, but without the necessary funds to finance it. At the beginning of the period, the project requires a fixed investment equal to $I$, and produces at the end of the period the outcome $y_j$ with probability $p_j$, $\forall j \in \{0, 1, 2, \ldots, n\}$, with $y_0 = 0$ and $0 < y_1 < y_2 < \cdots < y_n$. In addition, the project produces a nonassignable rent, $x_j$, which is captured by the entrepreneur when the project is successful, that is, $x_0 = 0$. The nonassignable rent is an affine function of the project’s outcomes, that is, $x_j = \phi + \delta y_j$, $\forall j \in \{1, 2, \ldots, n\}$, with $\phi > 0$ and $\delta \geq 0$. The banker observes the project’s outcome at no cost and he knows the value of the nonassignable rent.

The nonassignable rent can be interpreted, for example, as the enhancement of the agent’s reputation due to the project’s success, which he can then report in order to obtain funding for other projects. It can also be interpreted, in accordance with Diamond (1991) and O’Hara (1993), as the benefit obtained by the agent for being in control of the firm.

The probability distribution of the project’s returns depends on the entrepreneur’s effort and effort is costly. In modeling these relationships, if one were to take the entrepreneur’s effort as the choice variable, then one would need to specify a functional relationship between the probability distribution and the effort, and to define a cost function with effort as an argument. I use instead, the approach where the choice variables are the probabilities themselves. Because the entrepreneur incurs a certain cost for each probability distribution he chooses, the cost function depends on the probabilities $\{p_1, p_2, \ldots, p_n\}$ with $p_0 = 1 - \sum_{j=1}^{n} p_j$. The main advantage of this approach is that it avoids some of the technical difficulties that frequently appear when solving a principal-agent problem. In addition, the choice of a cost function that is strictly convex and strictly increasing in its arguments makes it possible to use convex programming theory in solving the model. Because of this, I use the cost function $C(p) = \frac{1}{2} \sum_{j=1}^{n} a_j p_j^2$, with $p = \{p_1, p_2, \ldots, p_n\}$ and $a_j > 0$.

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6 As we will see, in the model adopted here the bank implements its risk-shifting policy by changing the contract it uses to finance the entrepreneur in a way that motivates him to increase the risk of the project. If the entrepreneur were assumed to be risk averse instead of risk neutral, it would be more difficult for the bank to implement that policy. Nonetheless, the bank’s incentive to do so would still remain in place because it is driven by the flat rate deposit insurance premium.

7 See Holmström (1979) for a discussion of the advantages of this approach.
Assumption 2. There is a risk-neutral banker.\(^8\) The opportunity cost of the bank’s capital, \(r\), is larger than the risk-free interest rate, \(i\), because of, for example, a tax on the bank’s profits. In accordance with the existing bank capital regulation, the bank must satisfy a minimum capital–asset ratio, where the assets are weighted according to their risk, that is, \(K \geq \theta I\), where \(K\) is the bank’s capital and \(\theta\) is the minimum required capital–asset ratio.\(^9\)

The measurement and implementation problems that arise with the asymmetry of information existing between banks and the deposit insurance provider regarding banks’ assets are the reasons usually presented to justify why the insurer charges banks a flat rather than a risk linked premium. The administration of a risk related premium imposes greater informational demands than that of a flat premium. Furthermore, even if the insurer were able to collect the necessary information to determine the risk of a bank’s portfolio of assets, for example through audits and examinations, the costs of doing so might be prohibitive. The insurer could avoid these problems by designing an incentive-compatible, risk-sensitive deposit insurance pricing scheme, but there are important hurdles to the development of such a scheme and it has been shown that its implementation is possible only under some restricted conditions.\(^10\)

Chan et al. (1992) motivate a risk-insensitive deposit insurance premium by assuming that the bank’s assets cannot be observed and verified ex post by the insurance provider. The insurer can only observe whether it has to settle depositors’ claims. Because of this, the insurer charges the bank a flat rate premium per unit of deposits the bank holds. That premium is defined so that the insurer breaks even. In the current model, I adopt the same assumptions to justify why the insurance provider charges the bank an insurance premium that is not linked to the risk of the bank’s assets.

Assumption 3. Depositors are risk averse. They are willing to supply any amount of deposits, provided they are paid the risk-free interest rate.

\(^8\) See Flannery (1989) for a discussion of the risk neutrality assumption in the banking literature. If the banker were assumed to be risk averse instead, this would reduce the risk-shifting effect caused by the mispricing of deposit insurance. Nevertheless, the subsidy associated with the flat rate premium would still increase the banker’s incentive to undertake risk.

\(^9\) Under the Basle Accord, a bank’s capital has to be equal or larger than 4% of the risk-weighted assets. To compute the risk-weighted assets the bank assigns its assets to one of four categories of credit risk exposure: 0%, 20%, 50% and 100%. For example, cash is assigned to the first category while loans to commercial and industrial firms and investments in equity of nonfinancial firms are assigned to the last category. Thus, given the assets held by the bank in this model, \(\theta\) would be equal to 0.04.

\(^10\) See Chan et al. (1992) for an analysis of the feasibility of an incentive-compatible, risk-sensitive deposit insurance premium.
Finally, I assume the conditions necessary to guarantee that the entrepreneur cannot eliminate the project’s risk of failure, $0 < p_0 < 1$, and that the feasibility conditions hold, $0 < p_j < 1$, $\forall j \in \{1, 2, \ldots, n\}$.

2.1. The first-best outcome

The first-best outcome would be the solution to the model if there were no moral hazard, or if the entrepreneur had enough funds to finance the project. In both cases, this outcome would be the solution to the following problem:

$$\max_p \Pi^b_E = \sum_{j=1}^n p_j (y_j + x_j) - C(p) - I(1 + r)$$

s.t. $p.e \leq 1$, $p \geq 0$,

where $\Pi^b_E$ is the entrepreneur’s first-best profits and $e$ is a vector of ones.

Because the objective function is $C^2$ and strictly concave in $p$, and the feasible set is convex and compact, we are in the presence of a convex programming problem. In this case, we know there is a unique optimum and that the Kuhn–Tucker conditions are necessary and sufficient for a solution. Given that by assumption the entrepreneur is not able to eliminate the risk of failure of the project, the first-best outcome is

$$p^b_0 = 1 - \sum_{j=1}^n p^b_j, \quad p^b_j = \frac{y_j + \phi + \delta y_j}{a_j}, \quad \forall j \in \{1, 2, \ldots, n\}.$$ 

2.2. The second–best outcome

When the entrepreneur gets the necessary funds to finance his project from an outside source (in this model, a bank), the following question can be raised: What are the characteristics of the optimal contract that will rule their relationship? Given that the effort chosen by the entrepreneur is not observable, and that at the beginning of the period the bank will supply a fixed amount of funds, then the only thing left to be defined by the contract is the payment that the entrepreneur will make to the bank at the end of the period. This payment will be contingent on the observable information at that time, that is, the outcome of the project. The rent captured by the entrepreneur when the project is successful because, by assumption, it is nonassignable, cannot be contracted on.

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11 Because I want to study the case where the bank funds the firm rather than that where it owns the firm, I rule out the possibility of the bank buying the project and then offering the entrepreneur a compensation scheme to run it.
Let \( r_j \) be the payment required by the bank contingent on the outcome \( y_j \). Due to the limited liability condition, we have \( r_0 = 0 \), because \( y_0 = 0 \), and \( r_j \leq y_j, \forall j \in \{1, 2, \ldots, n\} \). Based on this definition, the contract between the two parties can be written as \((I, r)\), where \( I \) is the fixed amount of funds supplied by the bank and \( r \) is the vector of (nonnegative) contingent payments made by the entrepreneur. The optimal contract and the bank’s optimal capital structure are given by the solution to the following problem:

\[
\max_{r, K} \quad \Pi_E = \sum_{j=1}^{n} p_j (y_j + x_j - r_j) - C(p)
\]

s.t.
\[
y_j - r_j + x_j - a_j p_j = 0 \quad \forall j \in \{1, 2, \ldots, n\},
\]
\[
0 \leq r_j \leq y_j \quad \forall j \in \{1, 2, \ldots, n\},
\]
\[
K + B = I, \quad K \geq 0 I,
\]
\[
\sum_{j=0}^{n} p_j \max \left\{0, r_j - QB \right\} - K(1 + r) \geq \Pi_B,
\]

where \( B \) is the bank’s deposits and \( \Pi_B \) is the profits demanded by the bank to finance the project. \( \Pi_B \) can take any value between zero (representing the case where the entrepreneur captures the project’s entire surplus) and \( \Pi_B^{\max} \) (representing the case where the bank captures the project’s surplus). The \( n \) linear constraints included in that problem are the entrepreneur’s incentive constraints when \( r_j \leq y_j \). They are the first-order conditions to the following problem:

\[
\max_{p} \quad \Pi_G = \sum_{j=1}^{n} p_j (y_j + x_j - r_j) - C(p)
\]

s.t.
\[
p_e \leq 1,
\]
\[
p \geq 0,
\]

where \( r_j \) is the payment demanded by the bank. Recall that \( r_0 = 0 \) because the project’s outcome in state 0 is equal to 0, \( y_0 = 0 \). The importance of these constraints results from the impossibility of observing the entrepreneur’s effort, which determines \( p \). Through them the bank motivates the entrepreneur to choose (voluntarily) the proper effort (probability distribution).

Finally, \( Q \equiv \left\lceil (1 + i) + q \right\rceil \), where \( q \) is the flat rate deposit insurance premium that the insurer charges the banker per unit of deposits in his capital structure. As we will see, and as it happens in other models that have studied the moral hazard caused by deposit insurance, the flat rate premium leads to risk shifting. The difference here, however, is that the bank increases the risk of its assets not by choosing to fund a risky project from a pool of projects of varying risk, but instead by altering the contract that it uses to fund the entrepreneur in such a way that it motivates him to increase the risk of his project. In doing so, the bank takes into account that in motivating the entrepreneur to choose a riskier project it reduces his incentives to exert effort, which in turn affects the project expected return when it is successful. This explains why, despite the existence of
a flat rate insurance premium, the bank still does not maximize the risk of its assets.

Because the insurer charges the bank a flat rate premium, the banker chooses his capital structure and the contract he is going to use to finance the entrepreneur taking that premium as given. Once these decisions have been made, the flat premium is replaced with the fair price of deposit insurance, \( q^* \), so that the insurer breaks even. In state 0, the bank fails because it receives no income from the entrepreneur. Therefore, in that state the bank pays nothing to the insurer and the insurer is asked to settle depositors’ claims equal to \( B^*(1+i) \). In the other states, the bank is solvent and, as a result, it pays the insurer \( qB^* \). Given that the bank fails with probability \( p^*_0 \) and is solvent with probability \( (1 - p^*_0) \), the insurer breaks even when it charges the bank a premium per unit of deposits equal to \( (p^*_0/(1 - p^*_0))(1 + i) \).

In order to simplify the notation, from this point on the results will be presented for the case where \( n = 3 \), that is, for the case where there are four states. The project produces a zero outcome in state 0 and positive outcomes in the other three states, \( y_1 < y_2 < y_3 \).

**Proposition 1.** The optimal contract to the problem defined here is \((I, r^*)\), where

\[
\begin{align*}
    r^*_0 &= 0, \\
    r^*_j &= (y_j + \phi + \delta y_j)(1 - f(\mu^*)) + Q^* B^* f(\mu^*) \quad \forall j \in \{1, 2, 3\},
\end{align*}
\]

with: First, \( Q^* \equiv [(1+i) + q^*] \) and \( q^* \) is the equilibrium insurance premium. Second, \( f(\mu^*) = (1 - \mu^*)/(1 - 2\mu^*) \) and \( \mu^* \) is the Lagrange multiplier associated with the bank’s participation constraint. Finally, the bank’s capital structure is

\[
K^* = 0I, \quad B^* = (1 - 0)I.
\]

See Appendix A for a sketch of the proof of this proposition, the equilibrium insurance premium, \( q^* \), and the Lagrange multiplier, \( \mu^* \).

According to Proposition 1, the banker chooses the minimum capital–asset ratio allowed by the capital regulation. This result is a consequence of the assumption that capital is more expensive than deposits. With respect to the optimal contract presented in that proposition, its form is better understood when that contract is specified in terms of the financial instruments known in the corporate finance literature. Suppose the bank uses debt and/or equity to finance the investment project. Then the new contract can be written as \((I, x, d)\), where \( I \) is, as before, the fixed amount of funds supplied by the bank to the entrepreneur, \( x \) is the proportion of the firm’s capital held by the bank, \( (1 - x) \) is the proportion held by the firm’s entrepreneur, and \( d \) is the face value of debt borrowed by the firm. As usual, I assume that equityholders are the residual claimants and that they are protected by limited liability.
Proposition 2. The optimal contract for the problem presented here can be replicated by a unique combination of debt and equity, that is, by the contract $(I, x^*, d^*)$, where

$$x^* = (1 + \delta)[1 - f(\mu^*)],$$

$$d^* = \frac{Q^*B^* + \phi[1 - f(\mu^*)]}{1 - (1 + \delta)[1 - f(\mu^*)]},$$

and $Q^*$, $B^*$, and $f(\mu^*)$ are equal to the values defined in Proposition 1.

See Appendix A for proof of this proposition.

Proposition 2 shows that the optimal contract for the problem defined here can be spanned by a (unique) combination of debt and equity, which proves the optimality of these financial instruments in that model. Furthermore, it is possible to show that this optimality holds regardless of the number of states where the project produces a positive outcome. 12

The size of the entrepreneur’s stake in the firm is important in the model presented here because it determines the entrepreneur’s incentive to exert effort, which in turn affects the firm’s prospects. This contrasts with the justification for the entrepreneur’s stake in the firm in the model of Leland and Pyle (1977). In their model, the size of that stake is important because it is the device used by the entrepreneur to signal the uninformed lenders the quality of the project that he needs to finance.

Looking at the contract defined in Proposition 2, we see that the financial instruments used by the bank to finance the firm (debt and equity) depend on the bank’s capital structure (mix of deposits and capital). In other words, the moral hazard created by deposit insurance eliminates the known result of the separation between the bank’s asset composition and its capital structure. 13

The nature of the relationship existing between the two sides of the bank’s balance sheet and its impact on the firm’s capital structure will be explained in Section 3.1.

Proposition 2 also shows that the ability to span the optimal contract with a combination of debt and equity contracts still holds when the nonassignable rent that the entrepreneur receives when the project is successful, $x_j$, does not depend on the project’s outcome, that is, when $\delta = 0$, which implies that $x_j = \phi, \forall j \in \{1, 2, 3\}$. Because this simplifies the notation, I assume from now on the nonassignable rent to be constant and equal to $\phi$. 14

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12 See Santos (1997) for the proof of this result and an explanation of why a combination of debt and equity spans the optimal contract in this model.

13 See Klein (1971), Hart and Jaffee (1974), Szegö (1980) and Sealey (1985) for a discussion on the separation of the bank’s asset composition from its capital structure.
Using the results in Proposition 1, it is possible to compute the second-best probability distribution, \((p_0^*, p_1^*, p_2^*, p_3^*)\), where
\[
p_0^* = 1 - \sum_{j=1}^{n} p_j^*,
\]
\[
p_j^* = \frac{(y + \phi - Q^B)}{a_j} f(\mu^*) \quad \forall j \in \{1, 2, 3\}.
\]
Comparing these results with the first-best outcome, we observe that, due to both sources of moral hazard existing in the model, the entrepreneur now chooses a lower level of effort leading to a reduction in the probability of success of the project, \(p_j^* < p_j^b\), \(\forall j \in \{1, 2, 3\}\). As a result, the project’s probability of failure is now larger than the equivalent first-best value, \(p_0^* > p_0^b\).

3. Bank capital and equity investment regulations

As mentioned above, the efficiency costs of the two sources of moral hazard existing in the model are translated in a lower level of effort chosen by the entrepreneur, implying a higher probability of failure for the project. The efficiency costs caused by the moral hazard existing in the bank-entrepreneur relationship are originated by a problem of asymmetry of information, which cannot be alleviated by regulation. But what about the efficiency costs originated by the moral hazard due to the flat rate deposit insurance premium? Is it possible to reduce them through regulation? This is the subject of the remainder of the paper. In particular, two pieces of regulation are addressed here: banks’ minimum capital–asset ratio requirement, and the regulation that limits banks’ investments in the equity of nonfinancial firms to a certain proportion of the firms’ capital.

Looking at the results in Proposition 1, we see that the revenue of the optimal contract depends on how the project surplus is shared by the entrepreneur and the bank (\(\mu^*\) depends on \(\Pi_B\), the profits demanded by the bank to finance the project). At one extreme, we have the case where the bank makes zero profits, that is, \(\Pi_B = 0\), and the entrepreneur receives the entire surplus of the project. At the other extreme, we have the case where the bank receives the surplus of the project, that is, \(\Pi_B = \Pi_B^{max}\), and the entrepreneur makes at least the minimum he requires to undertake the project, which by assumption is zero.

Before we move to the analysis of the regulations in each of the two cases described above, it is important to take into account the following observation. Using the entrepreneur’s incentive constraints, it is possible to rewrite the entrepreneur’s profits as \(\Pi_E = \frac{1}{2} \sum_{j=1}^{3} a_j p_j^2\). Given that it is not optimal for the
bank to motivate the entrepreneur to choose $p_j = 0, \forall j \in \{1, 2, 3\}$ (because in this case the bank would receive no revenue from the entrepreneur), then when the bank receives the surplus from the project, the entrepreneur’s participation constraint will not be binding, that is, $\Pi_E > 0$. As a result, the optimal contract and the bank’s optimal capital structure will be given by the solution to the problem that maximizes the bank’s profits subject to the entrepreneur’s incentive constraints, the bank’s budget constraint and the capital regulation requirement. It is possible to show that the solution to this problem is given by the results in Propositions 1 and 2 when $\mu^* = -\infty$, which implies in the limit $f(\mu^*) = 1/2$.

Because the assumption that the bank gets the surplus of the project simplifies the problem studied here – in particular, it allows the finding of closed-form solutions for all of the variables, which are easy to work with – in the next two subsections the regulations are studied for that case. In Appendix B, the same regulations are studied for the case where the entrepreneur receives all of the project’s surplus, but this time using a numerical example. As we will see, the major conclusions regarding the impact of both regulations do not depend on who captures the surplus of the project.

3.1. Bank capital regulation

Most of the literature that has studied the risk-shifting effect due to the flat rate deposit insurance premium has done so in settings where banks can use only debt contracts to finance firms. As a result, that effect is usually manifested in the bank’s decision to finance risky instead of safe investment projects. This paper extends that literature by studying the risk shifting effect in a setting where banks can choose multiple contracts – debt and equity – to finance firms. Under these circumstances, the risk-shifting effect is implemented through a different channel. It is manifested in the bank’s adjustment of the debt and equity components of the contract it uses to finance the entrepreneur in a way that motivates him to adopt a riskier behavior, which in turn implies an increase in the risk of the bank’s assets. Thus, even if banks do not change their portfolio of customers, they can still take advantage of the deposit insurance subsidy by changing the way they do business with their current customers.

What is the impact of the capital regulation in that setting? If there were no moral hazard due to deposit insurance, the bank’s profits would be

$$\Pi_B = \frac{1}{4} \sum_{j=1}^{3} \frac{(y_j + \phi)^2}{a_j} - [(1 - \theta)(1 + i) + \theta(1 + r)] I. \quad (1)$$

In this case, given that the bank’s asset composition is independent from its capital structure, an increase in the minimum required capital–asset ratio, $\theta$, does not affect the contract used by the bank. As such, it does not reduce the
inefficiency in the model that results from the moral hazard that is due to the asymmetry of information existing between the bank and the entrepreneur. However, since this policy forces the bank to substitute capital for deposits (that is, it forces the bank to use relatively more of its most expensive source of funding – capital), it makes bank funding more expensive, thus reducing the bank’s profits.

When we consider the moral hazard caused by deposit insurance, the bank’s profits in equilibrium are

\[ \Pi_B^e = \frac{W(q^*(\theta))}{4} - \theta I(1 + r). \]  

(2)

Comparing Eq. (1) with Eq. (2), we see that now an increase in the minimum required capital–asset ratio will have quite different implications.

**Proposition 3.** An increase in the bank’s minimum required capital–asset ratio leads to an improvement in the bank’s stability (because its probability of failure decreases), and, within a certain range, it might be Pareto-improving.

See Appendix A for proof of this proposition.

The results in Proposition 3 can be explained in the following way: When the minimum required capital–asset ratio is increased, forcing the bank to substitute capital for deposits, there is an increase in the value of what the banker has at stake in case of bankruptcy. As a result, in order to minimize its costs in case of failure (the loss of the banker’s capital), the bank adjusts the financing contract in a way that it motivates the entrepreneur to make the investment project safer. In the present model this is implemented through a reduction in the relative importance of the component of that contract that is more effective in determining the entrepreneur’s risk incentives. The bank reduces the relative importance (value) of the financial instrument that is more risk-motivating – debt.

The reduction in the payments demanded to the entrepreneur explains the increase in both his profits and his effort. This, in turn, explains the reduction in the project’s probability of failure and in the bank’s risk of failure. Finally, the increase in the bank’s stability implies a reduction in the equilibrium insurance premium. If the savings resulting from this reduction outweigh the costs imposed on the bank, because it must substitute capital for deposits, then an increase in the minimum capital–asset ratio also implies an increase in the bank’s profits (this relationship is clear in the proof to Proposition 3). Note, however, that because the reduction in the equilibrium insurance premium due to increases in the minimum capital–asset ratio occurs at a decreasing rate, after a certain level of capital has been reached, further increases in the capital requirement will imply a decrease in the bank’s profits.
In sum, the results unveiled here show that capital regulation can be used to reduce the moral hazard costs that arise with deposit insurance. An increase in the bank’s minimum required capital–asset ratio leads to an improvement in the bank’s stability. This result accords with the findings of Furlong and Keeley (1989) and Keeley and Furlong (1990) but it is in opposition to those found by Koehn and Santomero (1980), Kim and Santomero (1988) and Rochet (1992). The model adopted in the current paper is rather different from the models adopted by these researchers. The novelty of the model is in the fact that the risk-shifting effect caused by deposit insurance is not translated in the bank’s decision to finance risky instead of safe investment projects, but in its choice of a financing contract that motivates the entrepreneur to adopt a riskier behavior, which in turn increases the risk of the bank’s assets. That linkage explains why the moral hazard due to deposit insurance makes the bank’s asset composition dependent on its capital structure, thus invalidating the usual separation result. In that framework, an increase in the required capital–asset ratio leads the bank to adjust the financing contract it uses to fund the entrepreneur in such a way that it motivates him to make the project safer in order to reduce the bank’s risk of failure. This is accomplished through a reduction of the relative importance of that part of the financing contract that is more risk-motivating – debt.

3.2. Bank equity investment regulation

As explained in the introduction, in some countries banks are not allowed to invest in the equity of nonfinancial firms. In the countries where banks are allowed to do so, they are frequently subject to a regulation limiting each of these investments in terms of either the firm’s capital or its voting rights. An argument often used to justify this form of regulation is that it limits the bank’s involvement with each firm, reducing the bank’s exposure to any major disturbances caused by a firm’s bankruptcy and thus improving the bank’s stability. A problem with this argument is that it does not take into account that limiting the bank’s ability to finance a firm through an equity contract also forces the bank to use a different financial instrument to supply the funds needed by the firm. This alternative instrument may prove more effective than equity in motivating the firm to choose a risky investment, in which case the gains resulting from the bank’s lessening its stake in the firm’s capital may be outweighed by the costs of using the alternative financial instrument.

In a procedure similar to that adopted for studying the capital regulation, this subsection studies the implications – for the model’s efficiency and for the bank’s stability – of introducing a limit on the bank’s equity investment defined in terms of the firm’s capital. Suppose that the bank is not allowed to hold more than \( \bar{\alpha} \) percent of the firm’s capital, with \( \bar{\alpha} < \alpha^* \). \( \bar{\alpha} \) is equal to zero in countries where banks are not allowed to invest in nonfinancial firms’ equity.
Proposition 4. The introduction of a limit on the bank’s investment in equity, defined in terms of the firm’s capital, does not improve the bank’s stability, and it is not Pareto-improving.

See Appendix A for proof of this proposition.

The results associated with the introduction of the limit on the bank’s investment in equity are better understood if the following two effects of this form of regulation are considered: First, because in this model equity is one of the optimal financial instruments used by the bank to finance the firm, restricting its use creates in itself a distortion, which explains why such regulation is not Pareto-improving.

Second, as is well documented, the flat rate deposit insurance premium motivates the bank to increase its portfolio risk. In the present model, as we saw before, the bank accomplishes this objective by using relatively more debt because, of the financial instruments it uses, debt is the most effective in motivating the borrower to increase the risk of its investment project, which in turn increases the risk of the bank’s portfolio of assets. Given this result and the fact that the equity regulation being studied here forces the bank to substitute debt for equity in the financing contract, it becomes clear why such regulation does not improve the bank’s stability. The gains in stability that might result from reducing the bank’s stake in the capital of the firm are offset, and in some cases outweighed (see the proof to Proposition 4 for a characterization of these cases), by the risk effect of the additional debt that the regulation forces the bank to use in order to finance the firm.

The results unveiled here about the regulation on banks’ investments in the equity of nonfinancial firms are substantially different from those obtained in Section 3.1 regarding the capital regulation. The fundamental reason for such a difference is that by increasing what the banker has at stake in case of bankruptcy, capital regulation decreases his incentive to take advantage of the deposit insurance subsidy. However, the form of equity regulation addressed here not only lacks this effect, but it also creates a distortion against one of the optimal financial instruments (equity) used by the bank to finance the firm, which also happens to be the instrument that is less risk-motivating.

In sum, it is clear from that set of results that the regulation on banks’ equity investments is not Pareto-improving and, contrary to what is usually claimed, does not improve the banks’ stability. These results accord with those found by the literature that has studied the effects on the borrowing firm’s risk-taking incentives when the financier uses equity in addition to debt to fund the firm (Pozdena, 1991; Kim, 1992; John et al. (1994)). That literature, however, assumes that funding is provided by a nonbank financier, that is, an agent that has no deposits in his capital structure. By considering the case where funding is provided by a bank in the presence of deposit insurance, the findings of this paper show that allowing banks to undertake equity positions in the firms to
which they extend loans does not increase the moral hazard problem that arise with deposit insurance. 14

4. Final remarks

The literature that has studied the capital regulation when there is moral hazard due to deposit insurance has used frameworks where banks are allowed to hold only debt contracts and to choose among borrowing firms of varying risk. This paper extends that literature by allowing the bank to use equity in addition to debt to finance firms, and by studying how this affects the incentives of the borrowing firm and thus the risk of the bank’s portfolio of assets.

That literature usually identifies the risk-shifting effect due to deposit insurance with banks’ decision to finance risky instead of safe investment projects. In the model adopted here, this effect is manifested in the bank’s adjustment of the financing contract it uses in a way that motivates the firm to adopt a riskier behavior, which in turn increases the risk of the bank’s assets. Thus, the firm’s capital structure is influenced by the conditions under which the bank operates – namely, the existence of deposit insurance and the presence of regulations. Under these circumstances, an increase in the minimum required capital–asset ratio reduces the bank’s incentives to motivate risky behavior by the firm to which it supplies funds. As a result, it reduces the bank’s risk of failure and it can be Pareto-improving.

The paper also studies the regulation that limits banks’ investments in nonfinancial firms in a framework where the firm is financed by a bank in the presence of deposit insurance. Introducing a limit on one of the optimal financial instruments a bank uses to finance a firm not only creates a distortion against this instrument, but it also forces the bank to use alternative contracts in order to finance the firm. This is what happens when firms depend largely on banks to raise external funds, and when the regulation limits banks’ equity investments to a certain percentage of the firms’ capital. In the model presented here, this type of regulation is not Pareto-improving, and it does not improve

14 Boyd et al. (1997) reach the opposite conclusion. As the authors acknowledge, they use a model rather different than mine. Key to their finding is the assumption that the bank can benefit as an equityholder of the nonfinancial firm, but not as a debtholder, from the entrepreneur’s behavior associated with the moral hazard problem embedded in the model. They focus on bank’s monitoring to control the moral hazard problem while I focus on the incentives driven by the debt and equity contracts. In addition, in their model banks fund a firm with a loan or by taking an equity position, but not through a combination of both. In contrast, in the model of this paper the bank’s optimal funding decision is to take an equity position in the firm to which it extends the loan.
the bank’s stability. By limiting the bank’s ability to use equity, the regulator forces the bank to use more debt in order to channel the necessary funds to the firm. This offsets the effects of the reduction of the bank’s stake in the capital of the firm and, in some cases, it might even create the perverse effect of increasing the bank’s risk of failure because debt, as we saw, is the financial instrument that the bank prefers to use to motivate the firm to increase the risk of its investment project.

Comparing the effects of both regulations, it becomes clear that, among other things, capital regulation is a more efficient tool to control the moral hazard caused by deposit insurance than prohibiting banks’ investments in the equity of the firms to which they extend loans. How robust are these results? Conducting the analysis in a framework where both debt and equity are optimal contracts introduced certain limitations based on the design of the project held by the entrepreneur. Nonetheless, most of the results hold regardless of who captures the surplus of the project, the bank or the entrepreneur. In addition, the results concur both with a segment of the literature on bank capital regulation and with the literature that has studied a firm’s risk-taking incentive when the financier takes an equity position in the firm to which he extended a loan. It remains a topic for future research to study the impact of equity investment regulations when firms have access to other sources of external finance, particularly to the capital markets, and when banks hold equity positions in the firms to which they extend loans, both for incentive reasons and for the control rights associated with the ownership of these securities.

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Appendix A. Proofs of Propositions

A.1. Proof of Proposition 1

For a given value of the insurance premium, $q$, the problem defined here can be solved through the following steps. First, because of the assumption that capital is more expensive than deposits, we know that the bank chooses the minimum required capital, that is, $K^* = \theta I$. Based on this and on the bank’s budget constraint, we know its demand for deposits, $B^* = (1 - \theta)I$. Second, using that information and the entrepreneur’s incentive constraints, we can rewrite both the bank’s and the entrepreneur’s profits in the probabilities. Third, from the first-order conditions to that problem, we can find the optimal probabilities $p_1^*, p_2^*, p_3^*$. Since this is a convex problem, there is no need to consider the second-order conditions. Fourth, using the values of $p_j^*$, through the entrepreneur’s incentive constraints, it is possible to find $r_j^*$, and through the definition of the fair insurance premium, it is possible to derive the second-degree equation in $q^*$, $V_2 q^{*2} + V_1 q^* + V_0 = 0$, where

$$V_0 \equiv (1 + i)\{a_1 a_2 a_3 - [(a_1 a_2 y_3 + a_1 a_3 y_2 + a_2 a_3 y_1)(1 + \delta)
+ A\phi - AB^*(1 + i)]\},$$

$$V_1 \equiv \{AB^*(1 + i) - [(a_1 a_2 y_3 + a_1 a_3 y_2 + a_2 a_3 y_1)(1 + \delta)
+ A\phi - AB^*(1 + i)]\},$$

$$V_2 \equiv AB^* f(\mu^*),$$

$$A \equiv a_1 a_2 + a_1 a_3 + a_2 a_3, \quad \mu^* = \frac{1}{2} - \frac{1}{2} \left(\frac{W(q^*)}{W(q^*) - 4[K^*(1 + r) + \Pi_B]}\right)^{1/2}$$

and

$$W(q^*) \equiv \sum_{j=1}^{3} \frac{(y_j + \phi + \delta y_j - Q^* B^*)^2}{a_j}.$$

Note that $V_0 > 0$ because of the conditions imposed by the first-best solution to the model, $V_2 > 0$, and $V_1 \geq 0$. In order to have an equilibrium with $q^* > 0$, we need to have $V_1 < 0$. In this case, the equilibrium insurance premium is the smaller root to the second-degree equation referred to above, because this root Pareto dominates the larger one. Hence, the equilibrium insurance premium is

$$q^* = \frac{-V_1 - (V_1^2 - 4V_0 V_2)^{1/2}}{2V_2}. \quad (A.1)$$
A.2. Proof of Proposition 2

Taking into account the equityholders’ limited liability condition, this proposition can be shown through a spanning argument. For a given percentage of the firm’s capital held by the bank, $z$, and a given face value of debt, $d$, the entrepreneur must solve the following problem:

$$
\max_p \quad \Pi_E = \sum_{j=1}^{3} p_j \left[ (1 - z)(y_j - d) + x_j \right] - C(p) \\
\text{s.t.} \quad p.e \leq 1, \\
p \geq 0.
$$

This is a convex programming problem, so the usual results apply. For the case where $p_j > 0$ the incentive constraints are

$$(1 - z)(y_j - d) + x_j - a_j p_j = 0 \quad \forall j \in \{1, 2, 3\}. \tag{A.2}$$

If there exists a feasible combination of $z$ and $d$ that motivates the entrepreneur, through his incentive constraints, to choose the second-best probability distribution $p^*$, and if such a combination generates the same revenue to the bank as $r^*$ does, then it must be the solution to the bank’s problem, which proves that the optimal contract can be spanned by a combination of debt and equity.

From the incentive constraints and the second-best probability distribution $p^*$, it is possible to find $z^*$ and $d^*$. If these values are feasible, then the last thing left to be shown is that the combination $(z^*, d^*)$ generates the same revenue to the bank as $r^*$ does. This is apparent immediately once we recognize that $z(y_j - d) + d = r_j$, and we take into account the equityholders’ limited liability condition in order to explain why in state 0 (the state where the project’s outcome is equal to zero), the bank in its position as debtholder receives no payment from the firm’s equityholders.

A.3. Proof of Proposition 3

Given that an increase in the bank’s minimum required capital–asset ratio implies a reduction in the equilibrium insurance premium, $q^*$, defined in Eq. (A.1), it is straightforward to show that the probabilities of the project’s positive outcomes rise when $\theta$ is increased. This in turn implies an increase in the entrepreneur’s profits, $\Pi_E^*$, and a decrease in the project’s probability of failure, $p_0^*$. The impact of the capital regulation on the bank’s profits in equilibrium, $(\Pi_B^*)$, is given by

$$
\frac{d\Pi_B^*(\theta)}{d\theta} = -(1 - p_0^*)B^* \frac{dq^*(\theta)}{d\theta} - (r - i)I. \tag{A.3}
$$
From here we see what happens to the bank’s profits when there is an increase in the minimum required capital–asset ratio. This increase imposes a cost on the bank because it forces the bank to use relatively more of its most expensive source of funding – capital [note that \( r > i \) by Assumption 2]. But it also implies a positive effect for the bank – the reduction of the moral-hazard costs caused by deposit insurance, which is given by \( dq^*(\theta)/d\theta < 0 \). Whether the bank’s profits increase with that policy depends on the relative magnitude of these two effects.

\[ A.4. \text{ Proof of Proposition 4} \]

One way of showing the results in this proposition is to derive all endogenous variables as functions of \( \alpha \), and then study the impact on these variables of a reduction in \( \alpha \).

The problem that the bank must solve is

\[
\begin{align*}
\max_{\alpha,d,K} \quad & \sum_{j=0}^{3} p_j \max \left\{ 0, [\alpha(y_j - d) + d - QB] \right\} - K(1+r) \\
\text{s.t.} \quad & (1-\alpha)(y_j - d) + \phi - a_j p_j = 0 \quad \forall j \in \{1,2,3\}, \\
& 0 \leq \alpha < 1, \quad 0 \leq d \leq y_1, \\
& K + B = I, \quad K \geq 0I.
\end{align*}
\]

There is no need to consider the entrepreneur’s participation constraint because, as previously explained, this constraint is not binding when the bank captures the project’s surplus. We already know that the bank’s capital structure is \( K^* = 0I \) and \( B^* = (1 - \theta)I \). In order to find the endogenous variables as functions of \( \alpha \), the bank’s problem is solved in two steps. In the first step, the optimal value of \( d \) is determined taking \( \alpha \) and \( q \) as given. In the second step, the first-order condition of the first step is substituted in the bank’s problem so that the optimal value of \( \alpha \) can be computed.

The first-order condition of the first step is

\[
d^* = \frac{(a_1a_2y_3 + a_1a_3y_2 + a_2a_3y_1)(1 - 2\alpha) + A\phi + AQB^*}{2A(1 - \alpha)}.
\]

(A.4)

Using Eq. (A.4) and the entrepreneur’s incentive constraints, one can compute the project’s probability of failure, the entrepreneur’s profits and the bank’s profits, all as functions of \( \alpha \). They are

\[
p_0^* = 1 - \frac{a_1a_2y_3 + a_1a_3y_2 + a_2a_3y_1 + A\phi - AQB^*}{2a_1a_2a_3},
\]

(A.5)
\[ \Pi_E(x) = \frac{1}{8a_1a_2a_3A} (E_0 + E_1x + E_2x^2), \]  
\[ \Pi_B(x) = \frac{1}{4a_1a_2a_3A} (B_0 + B_1x + B_2x^2) - K^*(1 + r), \]

where

\[ E_0 \equiv [a_1a_2y_3 + a_1a_3y_2 + a_2a_3y_1 + A(\phi - QB^*)]^2 \]
\[ + 4a_1a_2a_3 \left[ a_1(y_3 - y_2)^2 + a_2(y_3 - y_1)^2 + a_3(y_2 - y_1)^2 \right], \]

\[ E_1 \equiv -\frac{1}{2} E_2 \text{ and } E_2 \equiv 4a_1a_2a_3[a_1(y_3 - y_2)^2 + a_2(y_3 - y_1)^2 + a_3(y_2 - y_1)^2], \]

\[ B_0 \equiv [a_1a_2y_3 + a_1a_3y_2 + a_2a_3y_1 + A\phi - AQ^*]^2, \quad B_1 \equiv -B_2, \]

and

\[ B_2 \equiv -4a_1a_2a_3 \left[ a_1(y_3 - y_2)^2 + a_2(y_3 - y_1)^2 + a_3(y_2 - y_1)^2 \right]. \]

Note that for the case considered here, that is, when \( d^* \leq y_1 \), the bank’s probability of failure, \( p_0^* \), does not depend on \( x \). Under these circumstances, the introduction of a limit on bank’s investment in equity does not affect the bank’s probability of failure and, as a result, has no impact on the equilibrium insurance premium. With respect to the entrepreneur’s profits, because they are a decreasing, strictly convex function of \( x \) in the relevant range (that is, when \( x \leq x^* \)), the equity investment regulation implies an increase in the value of this function. Finally, regarding the bank’s profits, because they are an increasing, strictly concave function of \( x \) in the relevant range (with its maximum, as expected, at the point where \( x = x^* \)), the introduction of the equity limit implies a reduction in the value of this function.

The results derived so far in this proof assume that the optimal value of \( d \), determined by Eq. (A.4) for a given maximum equity that the bank can hold, \( \bar{x} \), is smaller than \( y_1 \). However, because there is an inverse relationship between \( d \) and \( \bar{x} \), depending on the parameters of the model, it is possible that for small values of \( x \) the optimal value of \( d \) becomes larger than \( y_1 \), that is, there is an additional state where the firm goes bankrupt. As a result, the entrepreneur chooses to put forth no effort in this state implying an increase in the project’s probability of failure. Under these circumstances, the introduction of the equity regulation will imply a reduction in the entrepreneur’s profits and will have the perverse effect of increasing the bank’s risk of failure.
Appendix B. Numerical example

This appendix studies the capital and equity investment regulations for the case where the entrepreneur captures the entire surplus of the project and the bank makes zero profits from funding it. This study is conducted using a numerical example for the reasons discussed in Section 3. The parameters chosen for the numerical example are

\[ y_1 = 1.0, \quad a_1 = 3.7, \quad i = 0.02, \]
\[ y_2 = 1.2, \quad a_2 = 3.8, \quad r = 0.03, \]
\[ y_3 = 1.3, \quad a_3 = 3.9, \quad I = 0.3, \]
\[ \phi = 0.1, \quad \delta = 0. \]

The first-best solution to the model with these parameters is

\[ p_{fb}^{0} = 0.002, \quad p_{fb}^{1} = 0.297, \]
\[ p_{fb}^{2} = 0.342, \quad p_{fb}^{3} = 0.359, \]
\[ \Pi_{E}^{fb} = 0.328. \]

The results for the bank’s capital and equity investment regulations, when the entrepreneur captures the surplus of the project and the bank gets zero profits from funding it are presented in the next two subsections. For the case of capital regulation (Section B.1), the equilibrium is given by the results in Propositions 1 and 2, with \( \Pi_{B} = 0 \). The equilibrium values for some of the variables are plotted as functions of \( \theta \), the minimum required capital–asset ratio. The impact of an increase in the capital regulation is given by the variation in those variables when \( \theta \) is increased. Note that, as it happened when the bank captured the surplus of the project, an increase in the minimum required capital–asset ratio implies a reduction in the bank’s risk of failure, and it may also imply an increase in the entrepreneur’s profits, in which case it is Pareto-improving.

With respect to the equity investment regulation (Section B.2), the equilibrium for each given value of \( \bar{x} \) (the maximum stake of the firm’s capital that the bank can hold) is determined by the face value of debt that the bank has to charge the firm, given the bank’s zero-profit condition. The equilibrium values for some of the variables are plotted as functions of \( \bar{x} \) for the range of the numerical example where this limit is binding, that is, for \( \bar{x} < x^* \). The impact of the equity investment regulation is given by comparing the second-best solution to the model with the values of these variables associated with a given value of \( \bar{x} \). Again, as it happened when the bank captured the surplus of the project, this regulation is not Pareto-improving and it does not increase the bank’s stability.
In sum, comparing the effects unveiled here with the results in Propositions 3 and 4, we see that regardless of who captures the surplus of the project, the bank or the entrepreneur, capital regulation improves the bank’s stability and can be Pareto-improving while the equity investment regulation is not Pareto-improving and it does not improve the bank’s stability.

**B.1. Results of the capital regulation**

See Figure 1.

![Graphs showing the results of the capital regulation](image)

**Fig. 1.**
B.2. Results of the equity investment regulation

See Figure 2.

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