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INTERNATIONALES ET DU DÉVELOPPEMENT

GRADUATE INSTITUTE OF INTERNATIONAL
AND DEVELOPMENT STUDIES

Graduate Institute of International and Development Studies
Working Paper No: 14/2012

Countercyclical Capital Regulation and Bank Ownership Structure

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JEL Classification: E60, G28, G32
Keywords: macroprudential policy, bank regulation, insider-outsider, bank shareholding

*The current version of this research paper was completed during the last months of my PhD studies at The Graduate Institute | Geneva. I wish to thank Cédric Tille; this version benefited from his comments and suggestions. Remaining mistakes are to be attributed solely to me.

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1 Introduction

After a decade of criticism against the banking regulation in place and the occurrence of a disruptive crisis in the major economies around the world, policymakers have decided to modify and improve the rules of the game. A priority is the better management of the bank capital, which regulators want to achieve passing from the criticized procyclical Basel II Accords to a set of countercyclical restrictions (Basel III). The countercyclicality should instill a taste for prudent behaviour, inducing the build-up of sufficient bank capital to contain the effects of negative shocks.

The goal of this paper is to address one aspect of this logic, that is, the likely impact of countercyclical capital requirements on the ownership structure of banks. Specifically, I consider the traditional separation between inside and outside shareholders, in order to understand how the enforcement of countercyclical requirements affects the willingness of bank owners to share revenues and costs under different economic conditions.

This question is grounded on some recent findings that suggest that banking regulation is not the unique and foremost determinant of bank capital. According to the empirical analysis of Gropp and Heider (2010), the agency problems typical of bank governance have been the key factors driving the banking capitalization over the previous decades. Boyd and Hakenes (2009) argue that, under certain conditions, an increase in capital requirements can lead the inside banker to make less prudent choices, because she can loot[1] part of the income of the bank at the damage of outside shareholders. Gale (2010) shows that, if there is disagreement between agents with different propensities to risk, higher capital requirements can justify risk-shifting. And Laeven and Levine (2009) find that banks with more concentrated ownership tend to have more volatile assets (and return on assets), although their book leverage may seem satisfactory from a prudential policy perspective.

All these ideas come at a time in which the macro-finance literature is thinking about the stabilization properties of the old and new capital rules[2]. In addition, the literature on bank governance has looked at a generic tightening of capital requirements, while regulators are talking about a set of restrictions that become automatically tighter in positive phases of the cycle (and milder in negative phases). So here I analyze the relationship insider-outsider into a dynamic context characterized by countercyclical capital requirements. The scope is pretty much self-contained, in the sense that for the time being I look at the specific risk-sharing mechanism between classes of equity and do not

[1] See Akerlof and Romer (1994).

[2] See, for instance, Angeloni and Faia (2011), Christensen, Meh and Moran (2011), and Repullo and Suarez (2012).

attempt at any definitive conclusion on general equilibrium effects and on risk-taking.

A justification for proceeding this way is that research on the issuance of outside equity in macro-dynamic models is still in its infancy, even in models with banking. Gertler, Kiyotaki and Queralto (2012) are a notable and interesting exception in this sense, but risk-sharing and countercyclical policy is not part of their analysis. To study the relationship insiders-outsiders, I thus adopt an alternative characterization of outside equity, which is part of my contribution.

In our framework, the insider is an impatient consumer and the representative of the unique class of agents that are in charge for running the bank. In addition, the objectives of inside and outside owners are not perfectly aligned, as insiders derive utility benefits from controlling the bank and may divert a share of the total bank dividends. However, diversion is costly and the bank must comply with binding capital requirements that adjust to the state of the economy. In particular, the agency costs of earnings diversion are proportionally increasing in the share of the bank equity that is owned by outsiders. This can capture the idea that outsiders, aware of their informational disadvantage and interested in the dividends of the bank, exercise some monitoring, which grows in strength with the size of their ownership share (Shleifer and Vishny, 1986). Deposits are instead fully insured.

The ownership structure of the bank can change in response to shocks, in the sense that the share of bank capital owned by outsiders can increase or decrease with changes in the prevailing state of the economy. The mechanism that underlies the modifications in the ownership structure is based on the fact that the share of capital owned by outsiders influences: the benefit of meeting the regulatory capital requirements (i.e., the shadow value of total bank equity), the distribution of expected dividends across all of the claimants and the intensity of the disagreement (the agency costs of diversion) between these claimants.

The first step is the determination of a well-defined (stationary) equilibrium in which capital requirements are effectively binding and outside shareholding is possible. This is required by the fact that meeting binding capital requirements depends on the ownership share of outsiders and, thus, on the agency costs between bank owners. Then, we study the dynamic link between outside shareholding and capital requirements that vary countercyclically. The link is established by the optimal demand for assets and that for deposits by insiders, and is negative. At the basis of the negative relationship, there is the fact that a given share of outside ownership today corresponds to a specific distribution of earnings and to specific costs of diversion in the future. So in case of a positive shock and an automatic increase in the capital requirement, the most direct way to build capital and secure a substantial portion of the expected increase in future dividends (and maybe private benefits) is for insiders to increase relatively more their ownership share. Risk-sharing with outsiders falls. The opposite effects take instead place in case of negative shocks.

The same mechanism is, by definition, not in place if capital requirements are risk-insensitive (Basel I). It does not work either with procyclical capital regulation (Basel II) because banks are not seemingly forced to counteract the build up of risk in good times nor to recapitalize after bad shocks.

To further clarify the properties of the model and its key implications, we discuss an illustrative numerical example using a standard parametrization. Ultimately, the main message of our analysis - that there is a negative relationship between outside shareholding and countercyclical capital requirements - is complementary to the recent findings on bank governance. If ownership concentration and disagreement between claimants can drive risk-taking in case of tight financial policy, then it is important to acknowledge that positive shocks lead to higher capital requirements and, in turn, these, may restrain risk-sharing between bank owners. But clearly this is a very modest statement for various reasons. First, the mechanism that we find here requires further research. Second, there could be other relevant mechanisms. There is increasing attention for the substitution between debt and equity during the cycle, but generally this research focuses on non-financial corporations[3], and even in this case results are mixed (Covas and Den Haan, 2011). Finally, the model is very basic in all the respects that do not pertain to the relationship insiders-outsiders, so it is not a typical general equilibrium macroeconomic framework.

The rest of this paper is structured as follows. The next section is devoted to the relationship between this work and the existing literature. Section 3 presents the model, whose properties are then studied in section 4. The relationship between countercyclical capital regulation and outside shareholding is the object of section 5, and in the subsequent section 6 I discuss some numerical results. A brief discussion (section 7) and a conclusion (section 8) close the paper.

2 Related Literature

As said, our work relates to some recent contributions on the conduct of the bank and capital regulation: Boyd and Hakenes (2009), Gale (2010), Gropp and Heider (2010) and Levine and Laeven (2009). All these works look at the relationship insiders-outsiders, with the only exception of Gale (2010). But the latter makes the important point that the reaction of banks to tighter capital

[3]See, for instance, Jermann and Quadrini (2009) and Korajczyk and Levy (2003), Levy and Hennessy (2007).

regulation depends on the misalignment between the objectives of different claimants to the profits of the bank. He considers the interaction between a non-stakeholder manager and the bank owners. We instead borrow his idea of possible disagreements between bank claimants and apply it to a context in which also the manager is a shareholder. The misalignment between objectives arises from the fact that insiders derive utility from private benefits of control.

The literature contains, at least, two approaches for treating the agency costs arising from the extraction of private benefits. The first approach is to impose a financial contract. This contract may determine how the realized revenues are distributed among the different claimants, in order to deter the extraction of private benefits and to incentivise the needed monitoring that prevents it (Holmstrom and Tirole, 1997). Alternatively, the contract may impose to the insider to keep a stake that is at least sufficient to cover the costs of diversion (Levy and Hennessy, 2007). The second approach is the one where some diversion may or may not occur depending on the level of investors' protection (Albuquerque and Wang, 2008; Shleifer and Wolfenzon, 2003). We draw more insights from this second approach in order to have a flexible model, as we attempt to endogenize the risk-sharing between owners. Yet, our framework is quite well related to the one built by Levy and Hennessy (2007).

There are important works in macro-finance that account for bankers' moral hazard and for the issues affecting the relationship between inside and outside owners. In Brunnermeier and Sannikov (2012) there is separation between inside and outside shares of dividends, but these shares are constant. In addition, Brunnermeier and Sannikov's model is more comprehensive than the one developed here and addresses a completely different question (endogenous risk in non-linearized macroeconomic dynamics). Meh and Moran (2010) introduce moral hazard to study the behaviour of bank capital. However, they use the moral hazard framework *à la* Holmstrom and Tirole, focusing on the relationship between entrepreneur, bank and debtholders in order to derive market-based constraints on leverage. Gertler, Kiyotaki and Queralto (2012) make instead one of the first proposals (if not the first) to model the issuance of outside equity in a dynamic macroeconomic model; their model is about financial risk and unconventional monetary policy. Yet, apart from the different objective, their work differs from mine in the way the outside equity is modeled. While they think of a banker that divides the *total revenues* between her own net worth, outside equity and debt, I emphasize the fact that insiders must share with outsiders the *profits* that remain after deducting the flow of interests due to depositors from the total revenues.

The strand of the macro-financial literature with which our work is more strongly connected is however represented by the research on the cyclical properties of banking regulation. The cyclicality arises from the fact that, starting with Basel II, banks are required to compute their capitalization *weighting* their assets for the corresponding level of risk, and these risk-weights are state-contingent. Danielsson, Zigrand and Shin (2004) present a model with these features, which is used to study the endogeneity of the agents' risk aversion in presence of multiple assets and procyclical leverage restrictions. Also de Walque, Pierrard and Rouabah (2010) consider risk-weighted assets. An alternative, which is at the center of the current policy debate, is the idea that capital requirements should follow a leading indicator-variable: the credit-to-GDP ratio (Borio and Drehmann, 2009; Borio, Drehmann and Tsatsaronis, 2011) or simply GDP (Repullo and Saurina, 2011). There are already models encompassing this idea (Angelini, Neri and Panetta, 2011; Angeloni and Faia, 2012; Elizalde and Repullo, 2007; Christensen, Meh and Moran, 2011; Covas and Fujita, 2010; Repullo and Suarez, 2012), and I follow them because in the framework developed here there is a single bank asset. Specifically, my approach is closer to the third and fourth of the just mentioned papers, since all the other works address the question of the *voluntary* build-up of capital buffers which is not at stake here. But taken together, those studies help us understand the impact of bank runs on macroeconomic performance, the difference between procyclicality and countercyclicality and the interaction between monetary policy and macroprudential policy in the attempt to pursue economic stabilization.

3 Model

3.1 Setup

Consider an economy populated by two groups of agents, each of which has unit mass. One group of agents is represented by the patient consumers, who build up savings and invest them through the banking system. These *outside* funds are allocated into bank deposits and an outside share of the bank capital (i.e., outside equity). The other group of agents is made of impatient households, who are the *inside* shareholders that de facto run the bank. On each date, insiders demand deposits and supply outside equity and, with the resources so obtained, decide the asset size of the balance sheet of the bank. The balance sheet is structured as follows:

Assets	**Liabilities**	
loans	deposits	
l	d	
	equity capital	
	e	
	inside	outside
	$e - e_o$	e_o

Being managers and majority shareholders, insiders have full control over the size of l and the demand for d. On the other hand, outsiders are mainly interested in dividends and capital gains, which they cannot influence *ex ante*. A simple case of moral hazard arises because insiders can engage in some earnings diversion at the expense of the outside shareholders. But this diversion is costly, and the costs increase with the size of the bank owned by outsiders.

There is no scope for risk-sharing between bank owners and its depositors because deposits are fully guaranteed by the government. In case of losses, insiders receive enough transfers from the deposit insurance scheme. Given these transfers, at any time t shareholders can pay the contractual rate promised on the preceding date, R_{t-1}, so depositors do not need to worry. For simplicity, we think of the insurance premium as being implicit in R_{t-1}.

The state of the economy is determined by a forcing process binding two consecutive states together, subject to exogenous shocks. We refer to a standard log-linear process: $\varsigma_t = \varsigma_{t-1}^{\rho} \exp(\varepsilon_t)$ with ε_t being an i.i.d. innovation.

3.2 Outsiders

Outsiders are typical infinitely-lived consumers, who discount the future at a rate β. They plan their consumption stream across subsequent dates in accordance with their budget constraint: given the income available at time t, outsiders choose how much to consume, c_t^o, how many shares of bank capital to purchase, $e_{o,t}^o$, and, finally, how much to save in the form of deposits, d_t^o. Therefore, the dynamic problem of the representative agent is standard:

$$V^o\left(d_{t-1}^o, e_{o,t-1}^o, \varsigma_t\right) = \max_{c_t^o, e_{o,t}^o, d_t^o, s_t^o} \left\{u\left(c_t^o\right) + \beta E_t V^o\left(d_t^o, e_{o,t}^o, \varsigma_{t+1}\right)\right\} \quad (1)$$

$$\text{s.t.} \quad c_t^o + q_t e_{o,t}^o + d_t^o + T_t \leq w + R_{t-1} d_{t-1}^o + \left(q_t + \Pi_t\right) e_{o,t-1}^o \quad (2)$$

where q_t is the market price of outside equity, Π_t are the corresponding dividends, T_t is a lump-sum tax levied on this class of agents and w is an exogenous endowment. Since outsiders do not formally run the bank, they do not directly influence the size of the bank capital and, thus, the realized dividends[4]. Of course, this informational disadvantage gives rise to some agency costs, but for "contractual reasons" these costs are ultimately paid by insiders.

Given the solution of the problem (1)-(2), the supply of deposits and the demand for equity must respectively satisfy the following conditions:

$$d_t^o \quad : \quad 1 = E_t \Lambda_{t,t+1}^o R_t \tag{3}$$

$$e_{o,t}^o \quad : \quad q_t = E_t \Lambda_{t,t+1}^o \left(q_{t+1} + \Pi_{t+1}\right) \tag{4}$$

where $\Lambda_{t,t+1}^o = \beta u'\left(c_{t+1}^o\right)/u'\left(c_t^o\right)$ is outside agents' discount factor. The first condition indicates that the marginal cost of depositing one unit of savings today must be equal to the expected future revenues from such deposits, the guaranteed return R_t. The second condition defines the value that outsiders attribute to purchasing today one unit of bank capital at price q_t in order to maybe resell it at price q_{t+1} and to receive dividends Π_{t+1} on the future date.

3.3 Insiders (Bankers)

3.3.1 Characterization of Agency Costs and Bank Assets

Insiders run the bank, so they can be interchangeably called bankers. The activity of the representative agent in this group is to manage the bank capital e_t, deciding how much to invest in the asset l_t (loans), using her reinvested wealth, deposits d_t^b and outside equity $e_{o,t}^b$. These decisions must satisfy three constraints: a flow-of-fund constraint, a balance sheet constraint and a capital requirement constraint. Respectively, these three constraints are as follows:

$$c_t^b + e_t + T_t \leq \underbrace{w + \Pi_t\left(e_{t-1} - e_{o,t-1}^b\right) - q_t e_{o,t-1}^b}_{\text{net reinvested income}} + \underbrace{q_t e_{o,t}^b}_{\text{equities issued in } t} + tr_t \tag{5}$$

$$l_t \leq e_t + d_t^b \tag{6}$$

$$e_t \geq \vartheta_t l_t \tag{7}$$

where T_t are the lump-sum taxes levied on insiders, w is an exogenous endowment, tr_t are the transfers received from the deposit insurance scheme and ϑ_t is a capital requirement that adjust to

[4] See Levy and Hennessy (2007) for a similar consideration, as implied by the equilibrium conditions of their model.

the state of the economy (see below). Since she runs the bank, the insider knows and influences the amount of bank dividends Π_t, which equal the total amount of profits per unit of invested capital: $\Pi_t = \left(r(\varsigma_t) l_{t-1} - R_{t-1} d^b_{t-1}\right)/e_{t-1}$. The loan rate $r(\varsigma_t)$ is the stochastic component of these dividends, and it is fully determined by the exogenous state variable ς_t.

Definition 1 *On any date t, the state variable determines the income generated by each unit of loans financed in $t-1$. So the rate of return on bank assets is*

$$r(\varsigma_t) \equiv (1 - \Omega(\varsigma_t))\, a = \underbrace{a}_{\text{safe part}} - \underbrace{\Omega(\varsigma_t)\, a}_{\text{risky part}} \qquad \text{with } a > 1,\ \Omega'(\cdot) < 0$$

In the stationary equilibrium $\Omega(\bar{\varsigma}) \neq 0$ but investment projects are economically profitable: $1 < \bar{R} < r(\bar{\varsigma})$.

Definition 1 draws from the recent attempts to introduce default in dynamic macro models and assume that the return on assets $r(\varsigma_t)$ is affected by some exogenous losses. In absence of losses, the bank assets would repay a constant gross return a. But in presence of risk, a fraction $\Omega(\varsigma_t)$ of this return must be "written-off" (Van den Heuvel, 2009) because, on any given date, the repayment rate on loans is less than 100 percent (de Walque, Pierrard and Rouabah, 2010). Of course, $\Omega(\varsigma_t)$ decreases in good times, increases in bad times and satisfies the standard condition that it is attractive to invest in the risky asset (at least, in the steady state).

The insider does not have the same objectives as the outside owners. She can in fact size some private benefits, diverting a fraction of the bank earnings (Shleifer and Wolfenzon, 2003; Albuquerque and Wang, 2008). These benefits have utility value, which is a simple but neat way to express the fact that the benefits of control are not used in any profitable way and cannot thus be subjected to the capital requirement constraint (7). The period objective function of the representative banker is

$$u\left[c^b_t + B_t \Pi_t (e_{t-1} - \psi e_{o,t-1})\right] = v\left(c^b_t\right) + B_t \Pi_t (e_{t-1} - \psi e_{o,t-1}) \quad \text{with } B_t = B v'\left(C^b_t\right) \tag{8}$$

This function shows that insiders attribute value not only to consumption c^b_t, but also to the total dividends of the bank. These dividends can be "diverted" to accrue some utility benefit B_t, before distributing the realized earnings across all classes of equity (in proportion to their share). However, this diversion imposes a cost $\psi e_{o,t-1}$, which depends on the amount of bank equity in the hands of the outsiders. Given the parameter $\psi > 0$, the costs of diversion increase with the amount of dividends due to (and subtracted from) outsiders. This simple assumption is meant to capture the tension between different claimants on the bank equity, taking into account the *value of large minority shareholders* (Shleifer and Vishny, 1986). The interpretation is that the agency costs of diversion increase with the size of minority shareholding, because outsiders have increasing resources and incentives to monitor the insiders while their ownership share gets bigger and bigger.

The form of the utility function (8) is inspired to the textbook analyses of the agency problems under asymmetric information[5] and to the characterization of the households' utility function suggested by Aiyagari and Gertler (1999). In their model, households are non-expert traders and face a non-pecuniary cost for selecting which assets to purchase. We instead consider a utility benefit B_t and follow them to characterize the time-variation of B_t, which is useful for the dynamics of the system. Specifically, given a constant $B > 0$, the benefits follow the marginal utility of consumption of the average banker, and this consumption (denoted by C_t^b) is taken as given by each single agent within the group.

3.3.2 Bankers' Programming Problem

Let us consider equilibria where the bank invests all of its capital and the balance sheet constraint (6) binds at all times:

$$e_t = l_t - d_t^b \tag{6'}$$

The insider has an incentive to borrow outside funds and can never self-finance the bank asset l_t because she is more impatient than the outsider. Following Carlstrom and Fuerst (1997), we model this heterogeneity in a simple way, assuming that the representative insider discounts future consumption at rate $x\beta$, where the constant $x \in (0, 1)$.

Under (6'), bank dividends become

$$\Pi_t = \frac{r(\varsigma_t)\, l_{t-1} - R_{t-1} d_{t-1}^b}{l_{t-1} - d_{t-1}^b} \tag{9}$$

[5] Some insights are drawn from the textbook formalization of the factors that increase or decrease the utility of firm managers, in presence of moral hazard due to hidden information (e.g., Mas-Colell, Whinston and Green, 1995, chapter 14).

so the constraints (5), (7) and the utility (8) give rise to the following dynamic problem:

$$V^b\left(d^b_{t-1}, l_{t-1}, e^b_{o,t-1}, \varsigma_t\right) = \max_{c^b_t, d^b_t, e^b_{o,t}, l_t} \Big\{ \upsilon\left(c^b_t\right) + B_t\Big(r\left(\varsigma_t\right) l_{t-1} - R_{t-1} d^b_{t-1} - \psi \Pi_t e_{o,t-1}\Big) + \left(x\beta\right) E_t V^b\left(d^b_t, l_t, e^b_{o,t}, \varsigma_{t+1}\right)\Big\} \quad (10)$$

$$\text{s.t.} \quad c^b_t + l_t + T_t - tr_t \leq w + r\left(\varsigma_t\right) l_{t-1} - R_{t-1} d^b_{t-1} - \Pi_t e^b_{o,t-1} + d^b_t + q_t\left(e^b_{o,t} - e^b_{o,t-1}\right) \quad (11)$$

$$l_t - d^b_t \geq \vartheta_t l_t \quad (12)$$

The full derivation of the optimality conditions is carried out in two steps. First, the straightforward derivation of the optimal demand for deposit, the optimal demand for bank assets (supply of loans) and the optimal supply of outside equity, respectively, yields

$$d^b_t \;:\; \upsilon'\left(c^b_t\right) - \mu_t = \left(x\beta\right) E_t\left[\upsilon'\left(c^b_{t+1}\right)\left(R_t + \frac{\partial \Pi_{t+1}}{\partial d^b_t} e^b_{o,t}\right) + B_{t+1}\left(R_t + \psi \frac{\partial \Pi_{t+1}}{\partial d^b_t} e^b_{o,t}\right)\right] \quad (13)$$

$$l_t \;:\; \upsilon'\left(c^b_t\right) - \mu_t\left(1 - \vartheta_t\right) = \left(x\beta\right) E_t\left[\upsilon'\left(c^b_{t+1}\right)\left(r\left(\varsigma_{t+1}\right) - \frac{\partial \Pi_{t+1}}{\partial l_t} e^b_{o,t}\right) + B_{t+1}\left(r\left(\varsigma_{t+1}\right) - \psi \frac{\partial \Pi_{t+1}}{\partial l_t} e^b_{o,t}\right)\right] \quad (14)$$

$$e^b_{o,t} \;:\; \upsilon'\left(c^b_t\right) q_t = \left(x\beta\right) E_t \upsilon'\left(c^b_{t+1}\right)\left[\left(q_{t+1} + \Pi_{t+1}\right) + \psi B_{t+1} \Pi_{t+1}\right] \quad (15)$$

where μ_t is the shadow value of *total* bank equity (Kashyap and Stein, 2004) *to* the insider. Equations 13-15 show clearly that insiders' decisions are affected by three factors: a) financial regulation, which enters into the demand for deposits and the supply of loans through μ_t and ϑ_t; b) risk sharing with outsiders, which influences the expected cost of deposits and the expected return on assets through $\frac{\partial \Pi_{t+1}}{\partial d^b_t} e^b_{o,t}$ (the share of dividends promised to outsiders); c) agency problems, that are present in all the conditions because of the benefits B_{t+1} and the cost of earnings diversion parameter ψ.

In the second step, I make use of three definitions: a) expression (9) for bank dividends; b) the expression for B_{t+1}, accounting as usual for the fact that in equilibrium $c^b_t = C^b_t$; c) the definition of the share of outside equity (Definition 2 below).

Definition 2 *Outside equity is a share $s \in (0, 1)$ of the bank capital, so outsiders are entitled to the corresponding fraction of realized dividends and bankers keep the remaining fraction. Depending on* *whether we are considering outsiders demand for equity (e_o^o) or insiders' supply of it (e_o^b), we can always write $s^i = e_o^i / \left(l - d^i\right)$, where $i = o, b$.*

Therefore, (13)-(15) reduce to the following three equations:

$$d_t^b \quad : \quad 1 = E_t \Lambda_{t,t+1} \left[1 - s_t^b + B\left(1 - \psi s_t^b\right)\right] R_t + \frac{\mu_t}{\upsilon'\left(c_t^b\right)} \tag{16}$$

$$l_t \quad : \quad 1 = E_t \Lambda_{t,t+1}^b \left[1 - s_t^b + B\left(1 - \psi s_t^b\right)\right] r\left(\varsigma_{t+1}\right) + \frac{\mu_t}{\upsilon'\left(c_t^b\right)} \left(1 - \vartheta_t\right) \tag{17}$$

$$e_{o,t}^b \quad : \quad q_t = E_t \Lambda_{t,t+1}^b \left[q_{t+1} + \Pi_{t+1}\left(1 + \psi B\right)\right] \tag{18}$$

where $E_t \Lambda_{t,t+1}^b = (x\beta) E_t \upsilon'\left(c_{t+1}^b\right) / \upsilon'\left(c_t^b\right)$ is the insider's stochastic discount factor and the shadow value of bank capital is weighted by $\upsilon'\left(c_t^b\right)$. For the sake of brevity, I shall continue to refer to $\mu_t / \upsilon'\left(c_t^b\right)$ simply as shadow value of bank capital (to the insider). According to (16), the benefit of receiving an additional unit of savings from depositors must be equal to the expected future cost of this marginal deposit. The cost is given by the predetermined rate of return R_t and by the shadow price $\mu_t / \upsilon'\left(c_t^b\right)$; the latter is a consequence of financial regulation. Risk-sharing with outsiders and the corresponding agency issues enter through the two terms in square brackets: $\left[1 - s_t^b + B\left(1 - \psi s_t^b\right)\right]$. The first term shows that, since insiders are entitled to a share $1 - s_t^b$ of dividends, they care for the future costs of deposits only proportionally to this share. On the other hand, the term $B\left(1 - \psi s_t^b\right)$ shows that the cost of deposits is affected by the disagreement between bank owners and by the agency costs that this disagreement generates.

Equation 17, which governs the supply of loans, can be interpreted in a similar vein. The difference is that now the terms $\left[1 - s_t^b + B\left(1 - \psi s_t^b\right)\right]$ affect the expected return on bank assets $r\left(\varsigma_{t+1}\right)$ and that the shadow premium $\mu_t / \upsilon'\left(c_t^b\right)$ is limited by the level of capital currently required by the government, ϑ_t. Finally, (18) is an almost standard pricing equation, except for the effect of the costs of diversion. These costs translate into costs of outside equity, and the insider accounts for this fact. For each unit of outside equity, the insider does not simply promise to the outsider the corresponding share of bank dividends Π_{t+1}, but $(1 + \psi B)$ times that amount.

3.4 Government

In this economy the main role of the government is to regulate the banking system, guaranteeing bank deposits and imposing the time-varying capital requirement ϑ_t.

The structure of the deposit insurance is as follows. Banks pay a premium which is implicit in the riskless return on deposits R_{t-1}. This premium entitles the bank (specifically, the bankers) to a transfer tr_t from the deposit insurance scheme. Apart from a constant component, tr_c, the transfer is state-contingent and depends on the fraction of losses $\Omega(\varsigma_t)$ incurred by the bank:

$$tr_t = tr_c + \Omega(\varsigma_t) R_{t-1} d_{t-1}^b \tag{19}$$

Therefore, transfers are very small in positive states when losses are low, but they tend to increase in negative states. Plugging (19) into the insider's budget constraint (11), one can easily see that deposits would have been exposed to risk had the deposit insurance been absent.

Given (19), government expenditures are

$$g_t = g_c + tr_t$$

where again g_c is an exogenous constant. And the government budget constraint is simply

$$2T_t = g_t \tag{20}$$

because the government levies lump-sum taxes on both patient and impatient consumers.

Considering now the dynamics of the capital requirement, we model it as a simple log-linear function of the behaviour of the state variable around its stationary equilibrium value:

$$\vartheta_t = \bar{\vartheta} \left(\frac{\varsigma_t}{\bar{\varsigma}} \right)^{\gamma} \tag{21}$$

where $\bar{\vartheta} > 0$. The cyclical properties of this requirement are governed by the parameter γ, in particular by its sign. Capital restrictions are risk-insensitive (as in Basel I) only if $\gamma = 0$; otherwise, they are risk-sensitive. If $\gamma < 0$, the system is procyclical (Basel II), in the sense that ϑ_t decreases when $\varsigma_t > \bar{\varsigma}$ and increases in the opposite case. So banks are not forced to build-up capital in case of positive shocks (or to recapitalize after a bad shock has passed); but they are induced to do exactly the reverse. In contrast, those incentives are present when $\gamma > 0$ and the capital requirement is countercyclical (Basel III). In this case, banks should increase their capital exactly when a positive shock brings ς_t above its trend value, can lower it when the economy receives a negative shock but should also converge back to steady state once the effects of the latter shock have faded. The following analysis focuses mainly on this last case of countercyclical requirements.

In terms of modeling, (21) does not specify which leading indicator the government follows to calibrate the capital requirement to the state of the economy. This is coherent with the small-scale structure of the macroeconomic framework at hand; this approach is close to that adopted by Covas and Fujita (2010). However, since here the state variable ς_t is basically the unique driver of economic dynamics, (21) is a reasonable approximation of a requirement that is calibrated on a leading variable[6].

3.5 Market Clearing

The model is closed by the market clearing conditions for deposits, outside equities and the consumption good. The first two conditions are

$$d_t^o = d_t^b \tag{22}$$

$$e_{o,t}^o = e_{o,t}^b \left(\Longleftrightarrow s_t^o = s_t^b \right) \tag{23}$$

where (23) is connected with definition 2. The satisfaction of (22)-(23) implies that also the market for goods clears:

$$\underbrace{c_t^o + c_t^b + g + l_t}_{\text{aggregate demand}} = \underbrace{2w + r\left(\varsigma_t\right) l_{t-1}}_{\text{aggregate supply}} \tag{24}$$

This shows one side of my approach. Earnings diversion and its costs affect insiders' utility function (8) but not the aggregate of the economy (24). In fact, I simply focus on the relationship insiders-outsiders, not on the real effects of asymmetric information in bank governance.

Therefore, the equilibrium is a vector of allocations $(c_t^o, c_t^b, e_{ot}^o, e_{ot}^b, d_t^o, d_t^b, l_t)$ and a vector of prices (R_t, q_t, μ_t) that satisfy the optimality conditions for all agents (equations 2-4, 11-12, 16-18) and

[6] In order to capture the contingent risk affecting the bank capital, models and policy analyses have recently connected the capital requirement to two key indicators: credit-to-GDP in deviation from its trend and output gap (or GDP growth).

Given definition 1 and the clearing condition (24), in our model the deviation of the credit-to-GDP ratio from its trend can be written as

$$\frac{l_t}{2w + \left(1 - \Omega\left(\varsigma_t\right)\right) a l_{t-1}} - \frac{\bar{l}}{2w + \left(1 - \Omega\left(\bar{\varsigma}\right)\right) a \bar{l}}$$

which is obviously *positively* related to the risk of losses with respect to trend, $\Omega\left(\varsigma_t\right)/\Omega\left(\bar{\varsigma}\right)$. During adverse states, this ratio increases imposing either tighter restrictions - if the policy measures are procyclical - or milder ones - if the measures are countercyclical.

A similar argument can be made for the second of the most recently proposed indicators: GDP. Here the deviation of GDP from its steady state value can be captured by the following expression:

$$\frac{2w + \left(1 - \Omega\left(\varsigma_t\right)\right) l_{t-1}}{2w + \left(1 - \Omega\left(\bar{\varsigma}\right)\right) \bar{l}}$$

This ratio is *inversely* related to $\Omega\left(\varsigma_t\right)/\Omega\left(\bar{\varsigma}\right)$ much in the same way as ϑ_t reacts to $\varsigma_t/\bar{\varsigma}$ in the current framework (through equation 21).

that guarantee that all markets clear (equations 22-24). Given the equilibrium allocations, also the remaining variables are defined: Π_t from (9), tr_t from (19) and T_t from (20).

4 Properties

4.1 The Shadow Value of Bank Capital

As in models with heterogeneous agents and some constraints on borrowing or leverage, the shadow price attached to these constraints is determined by the fact that different types of agents have different time preferences over lifetime consumption. However, in the current framework insiders are subject to binding capital requirements and, simultaneously, issue outside equity; therefore, the difference between time preferences is not the unique determinant of shadow prices.

The borrowing limit is implicit in the capital requirement constraint (12), and the shadow price attached to it is determined by the demand and supply of deposits (eq. 3 and 16). Putting these optimality conditions together, we find that

$$\frac{\mu_t}{\upsilon'\left(c_t^b\right)} = \underbrace{\frac{E_t\Lambda_{t,t+1}^o - E_t\Lambda_{t,t+1}^b}{E_t\Lambda_{t,t+1}^o}}_{\text{different time preferences}} - \underbrace{\frac{E_t\Lambda_{t,t+1}^b}{E_t\Lambda_{t,t+1}^o}\left[B\left(1-\psi s_t^b\right) - s_t^b\right]}_{\text{relationship insider-outsider}} \tag{25}$$

This expression shows that the shadow value of total bank equity is influenced by two components. The first component is the standard difference between pricing kernels, as outsiders are patient while insiders are impatient: $E_t\Lambda_{t,t+1}^o - E_t\Lambda_{t,t+1}^b > 0$.

The second component is instead specific to the relationship between insiders and outsiders. And this factor can be itself separated into two sub-factors. On one side, there is the simple risk sharing component, s_t^b, that shows up because bank owners share both the revenues and the costs of the banking activity. So the insider is aware of the fact that her share of the bank equity is not the only capital that backs the repayment of deposits. On the other side, (25) indicates that $\mu_t/\upsilon'\left(c_t^b\right)$ is affected by the agency problems of asymmetric information, $B\left(1-\psi s_t^b\right)$. In particular, the insider accounts for the fact that the costs of diversion increase with the ownership share of outsiders. Indeed, the overall effect of s_t^b on $\mu_t/\upsilon'\left(c_t^b\right)$ is positive:

$$\frac{\partial\left(\frac{\mu_t}{\upsilon'\left(c_t^b\right)}\right)}{\partial s_t^b} = (1+\psi B)\frac{E_t\Lambda_{t,t+1}^b}{E_t\Lambda_{t,t+1}^o} > 0 \tag{26}$$

It is often argued that equity is costly to the bank, and that it is especially difficult to raise fresh capital on the market. Coherently, (26) suggests that the costs connected with the issuance of outside equity (see equation 18) must affect the shadow price $\mu_t/\upsilon'\left(c_t^b\right)$.

4.2 The Price of Outside Equity

The difference between discount factors has implications not only for the shadow value of *total* bank equity, but also for the price that the representative of each group of agents attributes to an *outside share* of bank equity.

Outsiders' demand function (eq. 4) and insiders' supply schedule (eq. 15) show that, in equilibrium, both types of agents value outside equity at the same price q_t because insiders face some costs for issuing fresh capital. The costs of diversion make up for the fact that, at present, insiders prefer to consume more than any other minority shareholder. In particular, the cost of diversion suggests that the pricing function of each group of owners must satisfy a constant relationship:

$$\psi B = \frac{E_t\left(\Lambda_{t,t+1}^o - \Lambda_{t,t+1}^b\right)\left(q_{t+1} + \Pi_{t+1}\right)}{E_t \Lambda_{t,t+1}^b \Pi_{t+1}} \tag{27}$$

Of course, the fact that this relationship is constant is a convenient simplification that could be overcome with a more complex model.

More interestingly, (27) indicates that the costs of diversion correct for the fact that insiders and outsiders look differently at bank dividends. Insiders are leveraged and most importantly do not have exactly the same objectives as the minority shareholders. While the former can accrue private benefits of control, the latter do not run the bank but are interested in the realized dividends. Therefore, ψB is equal to the ratio between the cash flows on outside equity discounted by outsiders' pricing kernel relative to insiders' one, $E_t\left(\Lambda_{t,t+1}^o - \Lambda_{t,t+1}^b\right)\left(q_{t+1} + \Pi_{t+1}\right)$, and the discounted dividend payments generated by the costs of diversion, $E_t \Lambda_{t,t+1}^b \Pi_{t+1}$.

4.3 Existence of a Stationary Equilibrium

Our analysis concerns bankers that comply with the capital requirement imposed by the government and are willing to issue some outside equity. This means that, in equilibrium, the shadow value of total equity (25) must be positive and outsiders must own a positive fraction of the bank. And these two requirements must hold also in the stationary equilibrium in order to study the local dynamics around it.

Let us denote stationary values with variables surmounted by a bar. Since the cost of diversion equilibrates the pricing equations of heterogeneous owners, in the stationary equilibrium the cost parameter ψ is a function of other parameters. From (4) and (18) follows that

$$\psi = \frac{1-x}{x(1-\beta)B} \tag{28}$$

which is always positive for any preference parameter $x, \beta \in (0,1)$ and for any benefit of diversion parameter $B > 0$. This result confirms that, as in equation (27), the cost of diversion is a reflection of both the differences between time preferences (insiders discount the future at rate $x\beta < \beta$) and the issues posed by asymmetric information (which allow insiders to extract some benefits B). Since the total *unitary* cost of diversion equals ψB, ψ is mechanically inversely related to B. Under (28), an equilibrium exists in the sense of the following lemma.

Lemma 3 *Given the demand functions for deposits (16), that for bank assets (17) and the market clearing condition (23), the outside ownership share is*

$$\bar{s} = \frac{(1+B)\,x\beta\left[r(\bar{\varsigma}) - \bar{R}\left(1-\bar{\vartheta}\right)\right] - \bar{\vartheta}}{(1+\psi B)\,x\beta\left[r(\bar{\varsigma}) - \bar{R}\left(1-\bar{\vartheta}\right)\right]} \tag{29}$$

At the same time, an equilibrium with binding capital requirements exists if the shadow cost of capital (25) is $\bar{\mu}/v'\left(\bar{c}^b\right) > 0$. *Conditional on solution (29) for* $\bar{s}$, *such an equilibrium with binding capital restrictions always exists in the present model because the risky asset is sufficiently attractive by Definition 1:* $r(\bar{\varsigma}) > \bar{R}$. *This equilibrium is such that the outside share of bank equity is well-defined (i.e.,* $\bar{s} \in (0,1)$*) if and only if*

$$r(\bar{\varsigma}) - \bar{R} \in \bar{\vartheta}\left(\frac{1-x(1+B)}{x\beta(1+B)}, \frac{1-\beta-Bx(1-\beta)+x(1-x)}{\beta\left[x(1-\beta)B-(1-x)\right]}\right) \tag{30}$$

Since $\bar{s}$ *increases with* B *to curb earnings diversion, (30) defines an economically meaningful range of values whenever, given a choice for* $x, \beta \in (0,1)$,

$$B \in \left(\frac{1-x}{x(1-\beta)}, \frac{1-\beta+x(1-x)}{x(1-\beta)}\right)$$

Proof. See appendix. ■

According to (29), $\bar{s}$ is determined by the discounted profitability of the bank assets ($x\beta\left(r(\bar{\varsigma}) - \bar{R}\right)$), by the capital requirement and its impact on the cost of debt ($\bar{\vartheta}, R\bar{\vartheta}$) and by the disagreement between bank owners and the related costs $(B, \psi B)$. In particular, $\bar{s}$ depends on the trade-off between the profitability of the bank assets under regulation (the term $(1+B)\,x\beta\left[r(\bar{\varsigma}) - \bar{R}\left(1-\bar{\vartheta}\right)\right]$) and the capital requirement itself (the parameter $\bar{\vartheta}$). If $\bar{\vartheta}$ is so high to eliminate all the expected profits from running the bank, then there is no possibility of an agreement between insiders and outsiders for any positive share of the bank capital ($\bar{s}$ would equal 0). We can rule out this possibility as an uninteresting situation. Of course, once we rule out the case of $\bar{s} = 0$, the bank profits that the insider seeks to earn in order to manage the bank are affected by asymmetric information (and the consequent opportunity that they have to extract some benefits B).

However, the distortion created by B is mitigated by the costs of diversion, as $\bar{s}$ increases with B. Intuitively, if insiders manifest that they accrue high utility benefits from diversion, then the model suggest that outside shareholding should be correspondingly high to mitigate the related agency problems (and keep diversion from happening). Given (25), (28) and (29), this mechanism actually involves three quantities at once, and (30) sets the conditions for an equilibrium that has economic and logic sense. In the simple numerical example below, I show that these conditions are not at all restrictive and are satisfied by standard parameter values.

To clarify further, we can draw a comparison between the mechanism at work here (for which $\bar{s}$ must increase in order to contain the extraction of benefits B) and the insights from financial contracting. There are, at least, two contracting schemes to take into account. One is the framework in which entrepreneurs may choose worse projects in order to accrue private benefits (Holmstrom and Tirole, 1997; Meh and Moran, 2010). In this case, incentive compatibility implies that

$$\text{entrepreneur's payoff} \;\propto\; \text{private benefits}$$

The other framework is the one where earnings diversion is completely avoided because insiders have sufficient skin in the game (e.g., Levy and Hennessy, 2007):

$$\text{insider's ownership share} \;\geq\; \text{cost of diversion}$$

Overall, these two approaches suggest that either the insiders' share of earnings or her ownership share is exogenously fixed. In our case, these two shares decrease (in the stationary equilibrium) if the tendency to extract benefits increases. This is not the same mechanism proposed by those two contracts (especially, that by Levy and Hennessy, 2007). In this sense, the present framework is closer to the studies on corporate governance in presence of imperfect investor protection. Since the costs of diversion increase with the size of outside shareholding (Shleifer and Wolfenzon, 1986), the steady state value $\bar{s}$ can be thought of as replacing the investor protection parameter used by that literature on corporate governance. This is the mechanism that underlies the shifts in the ownership structure once dynamics is brought back into the model.

5 Capital Regulation and Ownership Structure

The focus of this section is the supply of outside equity (and s_t^b), yet by market clearing (equation 23) the results below have general effects on the entire model economy.

5.1 A Generic Increase in the Capital Requirement

As the previous section already makes it clear, the outside ownership share s_t^b is determined by the two optimality conditions for deposits and bank assets (16)-(17). By standard arbitrage, these two demand functions can be equalized in equilibrium, and this implies that insiders make their efficient choices by trading off the return on assets with the cost of debt. More conveniently, the two relationships can be combined so as to eliminate the shadow cost of capital. Writing (16) as in (25), I get

$$\begin{aligned} 1 &= E_t \Lambda_{t,t+1}^b \left[1 - s_t^b + B\left(1 - \psi s_t^b\right)\right] r\left(\varsigma_{t+1}\right) \\ &\quad + \left\{1 - E_t \Lambda_{t,t+1}^b \left[1 - s_t^b + B\left(1 - \psi s_t^b\right)\right] R_t\right\} \left(1 - \vartheta_t\right) \end{aligned}$$

which can be solved for s_t^b as a function of ϑ_t, given the predetermined value of R_t, the (exogenously) realized return on assets $r\left(\varsigma_{t+1}\right)$ and the endogenous pricing kernel $\Lambda_{t,t+1}^b$:

$$s_t^b = \frac{1+B}{1+\psi B} - \frac{\vartheta_t}{\left(1+\psi B\right) E_t \Lambda_{t,t+1}^b \left[r\left(\varsigma_{t+1}\right) - R_t\left(1-\vartheta_t\right)\right]}$$

Using this expression, one can determine what happens if the government raises ϑ_t at any time t by a marginal unit, abstracting for the moment from the cyclical properties of the capital requirement (21). The answer is provided by the following result:

$$\frac{\partial s_t^b}{\partial \vartheta_t} = -\frac{\mu_t / \upsilon'\left(c_t^b\right)}{\left(1+\psi B\right) \underbrace{E_t \Lambda_{t,t+1}^b \left[r\left(\varsigma_{t+1}\right) - R_t\left(1-\vartheta_t\right)\right]}_{\text{expected earnings to share under regulation}}} \tag{31}$$

where the fact that the numerator of this differential equals $\mu_t / \upsilon'\left(c_t^b\right)$ is shown in the appendix. The differential carries a negative sign, and, since in equilibrium $\mu_t / \upsilon'\left(c_t^b\right) > 0$, the negative sign can be confirmed or reverted only by the denominator. Apart from the multiplicative constant $1+\psi B$, the denominator of (31) shows that the reaction of the supply of outside equity by insiders (and thus of s_t^b) to the increase in the capital requirement depends on the expected payoff that the bank can earn in the future (given how regulation itself constrains borrowing). In practice, the deposit rate is predetermined, so that the expectation of future profits or losses is dominated by the expected return on bank assets.

Case 1. The economy is hit by a positive shock: $\varsigma_{t+1} = \varsigma_t^{\rho} > \bar{\varsigma}$. Since the economic conditions are favourable, actual and future expected losses are low, implying that the bank will probably make high profits and $E_t \Lambda_{t,t+1}^b \left[r\left(\varsigma_{t+1}\right) - R_t \left(1-\vartheta_t\right)\right] > 0$. Given (31), this means that $\frac{\partial s_t^b}{\partial \vartheta_t} < 0$.

Case 2. The economy is hit by a negative shock: $\varsigma_{t+1} = \varsigma_t^{\rho} < \bar{\varsigma}$. In such a case, the repayment rate on loans decreases and is expected to be low in the future. In principle the return on assets could be lower than the safe rate paid on deposits, yet (31) shows that the capital requirement can have compensating effects because it restrains the access to deposits. This implies that $E_t \Lambda_{t,t+1}^b \left[r\left(\varsigma_{t+1}\right) - R_t \left(1-\vartheta_t\right)\right] \gtreqless 0$ and $\frac{\partial s_t^b}{\partial \vartheta_t} \lesseqgtr 0$, depending on the realized level of the return on assets $r\left(\varsigma_{t+1}\right)$. Nonetheless, we can expect that if the fall of this variable is not too large, $\frac{\partial s_t^b}{\partial \vartheta_t} < 0$. On the other hand, if the negative shock lowers $r\left(\varsigma_{t+1}\right)$ markedly, then the bank may cease to exist. But the closure/failure of a bank is not explicitly modeled here.

To summarize, (31) suggests that there is a negative relationship between risk sharing among bank owners and capital regulation. Since there are asymmetric roles in the bank governance, tightening the capital requirement may generally exacerbate the relationship between bank owners because s_t^b determines how profits and losses will be shared in the future. Building capital when times are good, may well lead to a reduction of s_t^b because expected profits are high, which makes it easier to build capital itself and, for insiders, to accrue a large share of future gains and private benefits. The reaction of s_t^b is instead more ambiguous when times are not good, as by definition insiders are losing part of their net worth and need to trust more on outside funds in order to recapitalize the bank after the shock.

5.2 The (Counter)cyclicality of Capital Restrictions

Although (31) shows how s_t^b reacts to ϑ_t and that this relationship is affected by the state of the economy, capital requirements are themselves state-dependent as equation 21 indicates. In particular, for $\gamma > 0$ capital regulation is countercyclical, in the sense that ϑ_t increases in good times and decreases in less favourable economic conditions.

To study how these cyclical properties can affect the relationship between s_t^b and ϑ_t, let us take a linear approximation of the demand for deposits and asset by insiders (equations 16-17) around the stationary equilibrium defined above:

$$d_t^b \quad : \quad \widehat{\upsilon'\left(c_t^b\right)} + \xi_{sd}\hat{s}_t^b - \xi_\mu \hat{\mu}_t + \xi_R \hat{R}_t = \xi_R E_t \widehat{\upsilon'\left(c_{t+1}^b\right)}$$

$$l_t \quad : \quad \widehat{\upsilon'\left(c_t^b\right)} + \xi_{sl}\hat{s}_t^b - \xi_\mu \left(1-\bar{\vartheta}\right)\hat{\mu}_t + \xi_\mu \hat{\vartheta}_t = \xi_r E_t \left(\widehat{\upsilon'\left(c_{t+1}^b\right)} + \widehat{r\left(\varsigma_{t+1}\right)}\right)$$

where a hat over the variables is the standard notation for the value of variables in deviation from the stationary equilibrium and the coefficients of the linearization are: $\xi_{sd} = x\beta\left(1+\psi B\right)\bar{R}$, $\xi_R = x\beta\left[1-\bar{s}+B\left(1-\psi\bar{s}\right)\right]\bar{R}$, $\xi_{sl} = x\beta\left(1+\psi B\right)r\left(\bar{\varsigma}\right)$, $\xi_r = x\beta\left[1-\bar{s}+B\left(1-\psi\bar{s}\right)\right]r\left(\bar{\varsigma}\right)$, $\xi_\mu = \bar{\mu}/\upsilon'\left(\bar{c}^b\right)$. Combined, these two relations imply the following dynamic expression for $\hat{s}_t^b$:

$$\xi_s \hat{s}_t^b = \xi_{rR} E_t \widehat{\upsilon'\left(c_{t+1}^b\right)} + \xi_r\left(1-\bar{\vartheta}\right)\widehat{r\left(\varsigma_{t+1}\right)} - \xi_R \hat{R}_t - \bar{\vartheta}\widehat{\upsilon'\left(c_t^b\right)} - \xi_\mu \hat{\vartheta}_t \tag{32}$$

where $\xi_s = x\beta\left(1+\psi B\right)\left(r\left(\bar{\varsigma}\right)-\bar{R}\right)$ and $\xi_{rR} = \xi_r - \xi_R\left(1-\bar{\vartheta}\right)$.

Then, normalizing $\bar{\varsigma} = 1$, equation 21 suggests that the first order dynamics of the capital requirement are governed by the reaction of the government to the current state of the economy: $\hat{\vartheta}_t = \gamma\hat{\varsigma}_t$. Plugging this into (32), we finally get the following relation:

$$\xi_s \hat{s}_t^b = \xi_{rR} E_t \widehat{\upsilon'\left(c_{t+1}^b\right)} + \xi_r E_t \widehat{r\left(\varsigma_{t+1}\right)} - \xi_R\left(1-\bar{\vartheta}\right)\hat{R}_t - \bar{\vartheta}\widehat{\upsilon'\left(c_t^b\right)} \quad \underbrace{-\gamma\xi_\mu\hat{\varsigma}_t}_{\gamma>0:\ \text{negative effect}} \tag{33}$$

Equation 33 suggests a direct result. First, note that - given Definition 1, the properties of the stationary equilibrium (Lemma 3) and the values of the parameters - equation 32 confirms that the relationship between $\hat{s}_t^b$ and $\hat{\vartheta}_t$ is negative, as seen in the previous section. Formally, since $\xi_s, \xi_\mu > 0$, $-\xi_\mu/\xi_s < 0$. Then, (33) shows that this negative relationship characterizes countercyclical prudential policy measures because in such a case the capital requirement is an increasing function of the current state of the economy ($\gamma > 0$). So the indirect effect of a shock to $\hat{\varsigma}_t$ *acting through* $\hat{\vartheta}_t$ is $-\gamma\xi_\mu/\xi_s < 0$, and actually the magnitude of this reaction is determined by how strongly capital requirement adjusts to the prevailing economic conditions ($|\gamma|$).

Other things being equal, the implication of this result is that countercyclical capital restrictions lead to a reduction in the outside ownership share ($\hat{s}_t^b < 0$) when economic conditions are good ($\hat{\varsigma}_t > 0$) and to an increase in the same share ($\hat{s}_t^b > 0$) when the economic conditions worsen

($\hat{\varsigma}_t < 0$). Simultaneously, countercyclicality means that banks are supposed to build up capital during favourable states and that they can use it to cover the heightened losses typical of the bad states. This means that, due to the structure of bank governance, the cyclical variations in bank capital are accompanied by a change in the ownership composition. Insiders will prefer to reinvest dividends (and gain some benefits) in good times, while they are more logically forced to rely on outside owners in order to recapitalize after bad shocks.

Of course, the negative link between countercyclical restrictions and outside shareholding could be compensated by other reactions present in the model (equations 2-4, 11-12, 16-20, 22-24) and acting through the other variables that influence $\hat{s}_t^b$ in (33): $\widehat{\upsilon'\left(c_{t+1}^b\right)}$, $\widehat{r\left(\varsigma_{t+1}\right)}$, $\hat{R}_t$ and $\widehat{\upsilon'\left(c_t^b\right)}$. However, this compensating effect is hardly strong enough for reasonable starting values of outside shareholding, since all of the coefficients attached to these four variables are small for sufficiently high values of $\bar{s}$:

$$\begin{aligned} \frac{\partial \xi_{rR}}{\partial \bar{s}} &= -x\beta\left(1+\psi B\right)\left(r\left(\bar{\varsigma}\right)-\bar{R}\right) < 0 \\ \frac{\partial \xi_{r}}{\partial \bar{s}} &= -x\beta\left(1+\psi B\right) r\left(\bar{\varsigma}\right) < 0 \\ \frac{\partial \xi_{R}}{\partial \bar{s}} &= -x\left(1+\psi B\right) < 0 \end{aligned}$$

In contrast, the linearization coefficient attached to the capital requirement is $\xi_\mu > 0$, and - if anything - it increases with $\bar{s}$:

$$\frac{\partial \xi_{\mu}}{\partial \bar{s}} = x\left(1+\psi B\right) > 0$$

where this result is suggested by the steady state equivalent of (25). That is, the empirical evidence (Levine and Laeven, 2009) suggests that outside bank shareholding is around 70-80 percent of total equity capital (emerging markets) or more (advanced economies). In such a case, the stationary equilibrium features a substantial shadow value of bank capital, which constitutes ξ_μ and implies that countercyclical restrictions have a non-trivial effect. On the other hand, any other competing effect in (33) tends to be small because such values of $\bar{s}$ tend to be associated with small coefficients ξ_{rR}, ξ_r, ξ_R. We prefer to clarify this conclusion further with the simple numerical example that follows.

Lastly, (32)-(33) show quite clearly that the considerations made here apply only to countercyclical restrictions. A risk-insensitive regime (such as the original Basel I) features a capital requirement that is flat over time and cannot by definition affect $\hat{s}_t^b$: formally $\gamma = 0$, and the last term disappears from (33). A procyclical policy measure (such as the Basel II Accords that countries are currently modifying) implies instead that regulatory costs and agency costs affecting the bank governance go hand-in-hand: since in this case $\gamma < 0$, the effect on $\hat{s}_t^b$ is $-\gamma\xi_\mu/\xi_s > 0$. This does not at all mean to say that other forms of banking regulation are better than countercyclical policy measures. The problems created by procyclical requirements are well known (Covas and Fujita, 2010; Kashyap and Stein, 2004; Repullo and Suarez, 2012). The idea is instead that, since countercyclical restrictions lead banks to increase capital when times are good while procyclical restriction would imply the opposite, in those times the former (but not the latter) can interfere with the agency issues typical of corporate governance. Then, how much the mechanism that underlies this conclusion - the sharing of gains and losses proposed by (31) - works becomes a question for the empirical literature on the cyclical properties of debt and equity finance.

6 A Illustrative Numerical Example

The purpose of this numerical example is simply to illustrate the properties and the implications of the analytical framework developed in this paper. The connection between the quantitative predictions of the model and the data are instead beyond the scope of the current analysis.

6.1 Parameters and Steady State

The parameter values and the functional forms used for the numerical exercise are, respectively, reported in Tables 1 and 2. At the beginning of the economy, agents are endowed with an asset $\bar{l}$ which we normalized to 1. The exogenous endowment $w < 1$, satisfying the assumption that insiders cannot self-finance the project[7]. The riskless return on deposits is 1.04, implying that outsiders' discount factor is $\beta = 0.96015$. The parameter x is chosen in such a way that the discount factor of the impatient consumers is roughly 0.03 lower than β.

The exogenous state variable is a standard log-linear AR(1), which is subject to i.i.d. shocks and has persistence $\rho = 0.85$. There is no need to specify the variance of the shock σ_{ε}, since the following application focuses on unitary shocks and avoid making too many assumptions about the process describing the bank losses.

Given this exogenous variable, the behaviour of the capital requirement is characterized by the level of capitalization that the government wants the bank to maintain in the stationary equilibrium and to how strongly this capitalization level should react in case of shocks. I select $\bar{\vartheta} = 0.07$ and $\gamma = 0.3054$.

[7] The choice of the other two constants, tr_c and g_c, is more justified by numerical convenience.

In this way, ϑ_t rises to about 9.5 percent in response to a positive one-unit-impulse in the exogenous state and decreases to roughly 5 percent in the aftermath of a negative shock. This range of values is consistent with the fact that the conservatory buffer and the countercyclical buffer - which are part of the Basel III Accords - impose capital restrictions on banks whose total equity is between 4.5 and 9.5 percent of risk-weighted assets (Basel Commission on Banking Supervision, 2010a).

Definition 1 shows that the return on assets is fully driven by the percentage of non-performing loans $\Omega(\varsigma_t)$. Let us consider a simple but convenient isoelastic loss: $\bar{\Omega}(\varsigma_t)^k$. According to de Walque et al. (2010), the repayment rate obtained from quarterly U.S. data is roughly equal to 95 percent[8]. So I set $\overline{\Omega}$ to about 2.5 percent per annum[9]. Dynamically, losses are smaller than 1 percent in good states and, at most, about 6 percent in bad states.

Setting $a = 1.07$, this specification of the non-performing bank assets implies that the return on assets is 1.0429. Therefore, the difference between the return on assets and that on deposits is 0.0029, which is reported in the first-column (upper part) of Table 3. This table shows the properties of the model, in terms of satisfaction of Lemma 3. This poses the conditions for which, given the agency costs of bank governance, capital restrictions are binding and, simultaneously, outside shareholding $\bar{s}$ is positive. This analysis is carried out for different starting values of outside shareholding $\bar{s}$. The various values for $\bar{s}$ are obtained endogenously calibrating the parameter B: as equations 28-30 show, the three parameter ψ, $\bar{s}$ and $\bar{\mu}/\upsilon'\left(\bar{c}^b\right)$ are connected with each other for a given value of B.

Increasing B leads to higher values of $\bar{s}$, which is consequential to the fact that the costs of diversion depend on the size of outside shareholding. So the higher the tendency to divert earnings, the higher must be the costs that keep this from happening. Indeed, we consider 5 values (14, 47.5, 70, 80 and 90 percent) and find that, going from the lowest to the highest of these values, the insider must pay ever increasing agency costs. The costs of diversion are as small as 0.0091 only when the bank is basically all in the hands of the insider and outsiders only own 14 percent of the total equity. However, in this case Lemma 3 is not satisfied, as the last two columns of the upper part of the table show. The model suggests that, given our choice for the preference parameters x, β, $\bar{s} = 0.14$ is not an economically reasonable situation, which can be interpreted in the sense that $\bar{s}$ is not high enough to curb earnings diversion and insiders and outsiders do not agree in equilibrium[10].

[8] See also Repullo and Suarez (2012).

[9] It would be possible to assume linear losses instead of the non-linear function. Yet, results would not change markedly.

[10] The case of $\overline{s} = 0.14$ not only is at odds with Lemma 3, but it also implies a range of values for $r(\overline{\varsigma}) - \overline{R}$ that amounts to an absurd (the upper bond is lower than the lower bound). However, this is of course a consequence of the parameter values chosen for x, β and can thus change over different parametrization.

At higher levels of $\bar{s}$, condition (30) is satisfied, but the range of values progressively narrows down. The logic behind this narrowing down is that a situation in which outside shareholding $\bar{s} > 1$ is economically meaningless as much as it is the previous case of very small $\bar{s}$ (and any case of negative $\bar{s}$). Anyway, the bottom part of the table shows that the presence of outside owners raises the shadow value of bank capital to the insider above what the simple difference between time-preference $(1-x)$ would imply. This confirms the positive relationship between $\mu/v'\left(c^b\right)$ and s^b found previously (equations 25-26). With $\bar{s} > 0$, the shadow cost of bank capital is $\mu_t/v'\left(c_t^b\right) = 0.0387$, while it equals 0.032 if we set $\bar{s} = 0$. And interestingly, since equations 28-30 indicate that - for given B - the parameters ψ, $\bar{s}$ and $\bar{\mu}/v'\left(\bar{c}^b\right)$ must be consistent with one another, $\bar{\mu}/v'\left(\bar{c}^b\right)$ stays constant while $\bar{s}$ moves between 0 and 1.

6.2 Reaction to Shocks

The analytical results of the previous section suggest that countercyclical capital requirements imply a negative relationship between the willingness of insiders to share risk with outsiders and the state of the economy. This is true for sufficiently high values of $\bar{s}$. Here we study this relationship considering unit impulses in ς_t.

Figure 1 shows what happens after a positive shock, considering the highest three values for $\bar{s}$ (0.7, 0.8, 0.9), which are consistent with the evidence discussed by Laeven and Levine (2009). The positive shock brings to a reduction in the ratio of non-performing assets and an increase in the capital requirement. Since the regulatory restrictions are binding, insiders react reducing the bank leverage as much as needed to cope with the new requirement and build capital. However, the need to increase the total capitalization of the bank puts some pressures on the relationship between insiders and outsiders. As a result, there is a shift in the ownership composition of the bank. Although some new outside equities is issued, the most of the increase in bank capital remains in the hands of the insider. So *relatively* to the increase in total equity, there is a decrease in the share that is owned by outsiders and s_t falls.

The logic is that, since losses have temporarily decreased, agents expect the return on assets to be high in the future dates. But the higher the share of outside shareholding, the greater the fraction of the increased dividends that in the future must be transferred outside the bank and the greater the agency costs. To restrain these consequences, the supply of outside equity increases less than proportionally to the increase in total equity and s_t falls. The reduction in s_t is more pronounced, the higher $\bar{s}$ because, as Table 3 shows, the costs of diversion increase with $\bar{s}$. Interestingly, also the shadow value of bank capital falls by more, the higher the values of $\bar{s}$. This is justified by the fact that equation 25 establishes a positive relationship between outside shareholding and the shadow value of bank capital. More intuitively, this result is consistent with the fact that, since the bank is improving his capitalization, the marginal benefit of having an additional unit of it must fall.

The type of adjustment set into motion by negative shocks is exactly the opposite. As Figure 2 shows, a negative shock worsens the economic conditions and makes it harder for banks to keep high levels of equity. Thus the capital requirement decreases and equity can be substituted with debt in order to satisfy constraint (12) on leverage. Since the negative shock is associated with a higher fraction of non-performing assets, the insider has lower internal funds to invest and needs relatively more outside equity to recapitalize the bank so long as the bank capital converges back to equilibrium. And since the post-shock capitalization of the bank is low, the marginal value of an additional unit of bank equity goes up.

All in all, Figures 1 and 2 provide support to result (33), which shows a negative relationship between countercyclical requirements and outside bank ownership. Equation 31 additionally suggests that, under bad shocks, this negative relationship could be reverted by heightened losses, especially if bank defaults were possible. The model developed here rules out this possibility of defaults by assumption, and the impulse responses continue to show a negative link between s_t and ϑ_t. This means that, if it is possible that adverse economic conditions encourage risk-sharing between bank owners, the shock needed to generate such a positive link should have far worse economic consequences than those in Figure 2.

Seemingly, given the parameters used here, also the effects that could in principle compensate the negative relationship between s_t and ϑ_t are not at work. In particular, there is no compensation if Lemma 3 is satisfied. Figure 3 shows that outside shareholding can behave at odds with Figures 1-2 (increasing in positive states and decreasing in negative ones) only if the stationary fraction of equity held by outsiders is $\bar{s} = 0.14$, which is the case of this numerical example that fails to satisfy Lemma 3 (table 3). For comparison, the graph reports again the behaviour of the model for one of the situation considered above ($\bar{s} = 0.8$).

Lastly, Figures 5-6 show that the results of this numerical example are robust to the specific function used to model the losses $\Omega(\varsigma_t)$ and that all the considerations made before only apply to countercyclical capital restrictions. Figure 4 is obtained using the linear loss function $\Omega(\varsigma_t) = \Omega_U(1 - k\varsigma_t)$, where Ω_U and k are chosen to have the same steady state return on bank assets ($r(\bar{\varsigma}) = 1.0429$) and similar dynamic properties as before. Once again, a positive shock raises the capital requirement but reduces the ownership share of outsiders, while the reverse is true for negative shocks.

Figure 5 shows instead what happens if one considers a simple example of procyclical capital restrictions, in which the size of the reaction of ϑ_t to the exogenous state is the same as that used to study the countercyclical case (i.e., $\gamma_{procyclical} = -0.3054$). In this case, a positive (negative) shock leads to a lower (higher) capital requirement but also to higher (lower) s_t. In fact, in good times procyclical banking policies allow banks to substitute debt for equity. With lower capitalization and favourable economic conditions, the asymmetric information problems that affect the relationship insider-outsider bite less. As a result, the bank reduces its total equity, and the inside owner is less constrained to hold a sufficiently high fraction of the bank equity to solve the asymmetric information issues; s_t can increase. The opposite is instead what happens under bad economic conditions.

7 Brief Discussion

The analysis of the previous sections is inspired to the recent contributions on the role of bank governance as an important determinant of how banks react to the enforcement and the tightening of capital requirements (Boyd and Hakenes, 2009; Gale, 2010; Gropp and Heider, 2010; Laeven and Levine, 2009). These studies show that an increase in capital requirements induces less prudent choices by bankers if there is disagreement between different claimants on bank profits and ownership concentration. Given these findings, the present work simply attempts to disentangle the impact of countercyclical capital restrictions on the inside-outside composition of bank governance. The results suggest that the impact is negative, so for instance risk-sharing between bank owners worsens in those good states in which capital requirements are high. It follows that, if the disagreement between owners and the increased concentration of ownership leads to more risk-taking, then the negative relationship that is found in this paper may be an aspect to consider for successful prudential regulation.

This would imply considering bank governance in the design of time-varying restrictions on capital. There is growing literature on the need for taxes on borrowing (Lorenzoni, 2008; Bianchi and Mendoza, 2011; Jeanne and Korinek, 2011; and Korinek, 2011), and the recent Basel Accords rely on restrictions on the distribution of earnings[11]. The model developed here suggests that any of these restrictions may not work as originally thought if they apply equally to all the bank owners, simply because the bank owners have different roles and objectives in the conduction of the bank. From

[11] See Basel Commission on Banking Supervision (2010a).

this viewpoint, a sort of subsidy to the issuance of outside equity (recalling the proposal by Gertler, Kiyotaki and Queralto, 2012) could be a good way to extend the prudential policy measures and deal with the heterogeneity between bank owners.

Clearly, the framework built in this paper is simple and merely shows that there is a negative link between risk-sharing and countercyclical properties on banking regulations. The problems that this relationship can create and the way to fix them are to be studied further in the future. Furthermore, the dynamics of the model still abstract from many features, especially from the relationship between entrepreneurs and banks, capital accumulation and more standard drivers of the business cycle (e.g., productivity shocks).

8 Conclusions

In this paper, I build a small macroeconomic model where bank insiders receive external funds by outside shareholders and depositors. The repayment of deposits is guaranteed by the government, while the distribution of dividends is affected by asymmetric information that introduces the possibility of earnings diversion by insiders.

Therefore, since in such a situation outside shareholders have an incentive to monitor, the costs of diversion are assumed to be proportional to the share of the bank owned by outsiders. And this share changes endogenously in reaction to shocks, at the same time as the capital requirement automatically adjusts to the shock. The two variables are connected through the demand for assets and the demand for deposits by inside bankers, and the main consequence is that countercyclical variations in the capital requirement and changes in the ownership structure move into opposite directions.

The negative relationship arises from the sharing of dividends between insiders and outsiders and from the related intensity of the agency costs that keep insiders from extracting private benefits. For example, the model suggests that, in case of a positive shock, the extent of risk-sharing between bank owners falls because insiders want to be entitled to a larger fraction of the expected future profits and to contain the costs of diversion.

The scope of the analysis is specific and contained. Yet, the agency costs characterizing the bank ownership structure are important to determine the success of the new countercyclical capital restrictions, probably as much as they did decades ago in case of financial deregulation (Saunders, Strock and Travlos, 1990). What drives the incentives of banks to keep a certain level of capitalization is still to be clarified, and this lack of clarity can be for instance found in the consideration made by Acharya et al. (2009). As they observe, even in the aftermath of the 2007-09 crisis when banks had to build up capital, there was the tendency to compensate the tightened regulation with poor quality instruments in the place of common equity.

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Appendix

A Proof of Lemma 3

Since there is a unique equilibrium price of outside equities, inside and outside shareholders must value them at the same price $\bar{q}$. Hence, the pricing functions (4) and (18) imply that the cost of diversion parameter is

$$\psi = \frac{1-x}{x\left(1-\beta\right)B} \tag{A1}$$

Hence, $\psi > 0$ for any values attributed to $x, \beta \in (0,1)$ and to $B > 0$. And given these two preference parameters, ψ is governed by B.

The stationary equilibrium value of outside shareholding $\bar{s}$ is instead given by the steady state counterpart of equations (16)-(17), which is

$$1 = x\beta\left[1-\bar{s}^b+B\left(1-\psi\bar{s}^b\right)\right]\bar{R}+\frac{\bar{\mu}}{\upsilon'\left(\bar{c}^b\right)} \tag{A2}$$

$$1 = x\beta\left[1-\bar{s}^b+B\left(1-\psi\bar{s}^b\right)\right]r\left(\bar{\varsigma}\right)+\frac{\bar{\mu}}{\upsilon'\left(\bar{c}^b\right)}\left(1-\bar{\vartheta}\right) \tag{A3}$$

Combining these two equations in order to eliminate $\bar{\mu}/\upsilon'\left(\bar{c}^b\right)$, I get

$$\bar{s} = \frac{\left(1+B\right)x\beta\left[r\left(\bar{\varsigma}\right)-\bar{R}\left(1-\bar{\vartheta}\right)\right]-\bar{\vartheta}}{\left(1+\psi B\right)x\beta\left[r\left(\bar{\varsigma}\right)-\bar{R}\left(1-\bar{\vartheta}\right)\right]} \tag{A4}$$

where I have dropped the superscript b because, by market clearing (condition 23)

$$\bar{s}^o = \bar{s}^b \equiv \bar{s}$$

The conditions that guarantee that $\bar{s} \in (0,1)$ are found as follows. To start with, according to Definition 1, projects are profitable in the sense that $r\left(\bar{\varsigma}\right) > \bar{R}$. This means that, for any small $\bar{\vartheta} \in (0,1)$,

$$r\left(\bar{\varsigma}\right)-\bar{R}\left(1-\bar{\vartheta}\right) > 0 \tag{A5}$$

at both the numerator and the denominator of (A4). Bearing this in mind, $\bar{s} > 0$ if and only if

$$\left(1+B\right)x\beta\left[r\left(\bar{\varsigma}\right)-\bar{R}\left(1-\bar{\vartheta}\right)\right]-\bar{\vartheta} > 0$$

Using the fact that $\bar{R} = 1/\beta$ (equation 3), this inequality reduces to the following condition

$$r\left(\bar{\varsigma}\right)-\bar{R} > \frac{\bar{\vartheta}\left[1-x\left(1+B\right)\right]}{x\beta\left(1+B\right)} \tag{A6}$$

On the other hand, $\bar{s} < 1$ if and only if

$$(1+B)\, x\beta \left[r(\bar{\varsigma}) - \bar{R}\left(1-\bar{\vartheta}\right)\right] - \bar{\vartheta} < (1+\psi B)\, x\beta \left[r(\bar{\varsigma}) - \bar{R}\left(1-\bar{\vartheta}\right)\right]$$

Simplifying and using expression (A1) for ψ, this inequality leads to

$$\left(B - \frac{1-x}{x(1-\beta)}\right) x\beta \left[r(\bar{\varsigma}) - \bar{R}\left(1-\bar{\vartheta}\right)\right] < \bar{\vartheta}$$

which yields this second condition:

$$r(\bar{\varsigma}) - \bar{R} < \frac{\bar{\vartheta}\left[1-\beta - Bx(1-\beta) + x(1-x)\right]}{\beta\left[x(1-\beta)B - (1-x)\right]} \tag{A7}$$

It is now possible to use (A4) to determine the shadow cost of bank capital from (A2). Substituting, using $\bar{R} = 1/\beta$ and simplifying, I get

$$\frac{\bar{\mu}}{\upsilon'(\bar{c}^b)} = 1 - x - x\left[B - (1+\psi B)\frac{(1+B)\, x\beta\left[r(\bar{\varsigma}) - \bar{R}\left(1-\bar{\vartheta}\right)\right] - \bar{\vartheta}}{(1+\psi B)\, x\beta\left[r(\bar{\varsigma}) - \bar{R}\left(1-\bar{\vartheta}\right)\right]}\right]$$

Denoting $\Phi = x\beta\left[r(\bar{\varsigma}) - \bar{R}\left(1-\bar{\vartheta}\right)\right]$, this expression is equivalent to

$$\frac{(1-x)(1+\psi B)\Phi - xB(1+\psi B)\Phi + x(1+\psi B)(1+B)\Phi - x(1+\psi B)\bar{\vartheta}}{(1+\psi B)\Phi}$$

implying that

$$\frac{\bar{\mu}}{\upsilon'(\bar{c}^b)} = \frac{x\beta\left[r(\bar{\varsigma}) - \bar{R}\left(1-\bar{\vartheta}\right)\right] - x\bar{\vartheta}}{x\beta\left[r(\bar{\varsigma}) - \bar{R}\left(1-\bar{\vartheta}\right)\right]} \tag{A8}$$

Therefore, since by (A5) $x\beta\left[r(\bar{\varsigma}) - \bar{R}\left(1-\bar{\vartheta}\right)\right] > 0$, the shadow value of bank capital is positive and capital requirements impose binding restrictions if and only if the numerator of (A8) is positive:

$$x\beta\left[r(\bar{\varsigma}) - \bar{R}\left(1-\bar{\vartheta}\right)\right] - x\bar{\vartheta} > 0$$

which reduces to

$$r(\bar{\varsigma}) - \bar{R} > 0 \tag{A9}$$

and this condition is always satisfied by Definition 1.

Given this result, conditions (A6) and (A7) can be put together; as a consequence, in an equilibrium with binding capital requirements, insiders and outsiders agree on a positive amount of outside equity such that $\bar{s} \in (0,1)$ whenever

$$r(\bar{\varsigma}) - \bar{R} \in \bar{\vartheta}\left(\underbrace{\frac{1-x(1+B)}{x\beta(1+B)}}_{Lower}, \underbrace{\frac{1-\beta-Bx(1-\beta)+x(1-x)}{\beta\left[x(1-\beta)B-(1-x)\right]}}_{Upper}\right) \tag{A10}$$

For a given small $\bar{\vartheta}$, this range of values depends on the preference parameters $x, \beta \in (0,1)$ and on the benefit of diversion parameter $B > 0$. So (A10) is an economically meaningful set if these parameters satisfy the following three conditions

$$\begin{aligned} Lower &= \frac{1 - x(1+B)}{x\beta(1+B)} \gtrless 0 \qquad (A11)\\ Upper &= \frac{1 - \beta - Bx(1-\beta) + x(1-x)}{\beta[x(1-\beta)B - (1-x)]} > 0 \qquad (A12)\\ Lower &< Upper \qquad (A13)\end{aligned}$$

Clearly, the third condition is somewhat redundant, as it is automatically satisfied if (A11)-(A12) hold.

Let us start with the second of these two, (A12). This condition is satisfied if both its numerator and its denominator have the same sign:

$$\begin{aligned} 1 - \beta - Bx(1-\beta) + x(1-x) &\gtrless 0 \qquad (A14)\\ \beta[x(1-\beta)B - (1-x)] &\gtrless 0 \qquad (A15)\end{aligned}$$

Putting restrictions on B, the numerator (A14) yields

$$\frac{1 - \beta + x(1-x)}{x(1-\beta)} \gtrless B \qquad (A16)$$

while the denominator (A15) yields

$$B \gtrless \frac{1-x}{x(1-\beta)} \qquad (A17)$$

Then, considering (A14) and (A15) together, it can be shown that

$$\frac{1-x}{x(1-\beta)} < \frac{1 - \beta + x(1-x)}{x(1-\beta)}$$

because

$$0 < -\beta + 2x - x^2$$

where this inequality holds true because both roots of x are positive ($x_{1,2} = 1 \mp \sqrt[2]{1-\beta}$). And this result brings to the conclusion that, given $x\beta \in (0,1)$, (A12) applies for any

$$B \in \left(\frac{1-x}{x(1-\beta)}, \frac{1 - \beta + x(1-x)}{x(1-\beta)} \right) \qquad (A18)$$

so $Upper > 0$.

Finally, it can be shown that, if B is chosen this way, also (A11) and (A13) are satisfied; that is, $0 \lesseqgtr Lower < Upper$. Indeed, since $x\beta(1+B) > 0$, $Lower \gtrless 0$ if and only if

$$\underbrace{\frac{1}{x} - 1}_{<1} \gtrless B$$

and the expression on the left hand side of this inequality is smaller than the lower bound in (A18). Formally:

$$\begin{aligned} \frac{1}{x} - 1 &< \frac{1-x}{x(1-\beta)} \\ -\beta - x + x\beta &< -x \\ x &< 1 \end{aligned}$$

which is always true.

B Proof of Differential 31

There are two ways to prove that the (31) takes the expression used in the text. One is to simultaneously solve for the shadow value of capital $\mu_t/\upsilon'\left(c_t^b\right)$ and outside shareholding s_t, which is the approach we use above to prove Lemma 3. The other is to solve for s_t twice, once explicitly and once implicitly, compute the differential $\partial s_t^b/\partial\vartheta_t$ in both cases and infer from the results so obtained. This second route is more straightforward, so I pursue it here.

First, consider the explicit solution for s_t. As main text points out, combining (16) and (17) so as to eliminate $\mu_t/\upsilon'\left(c_t^b\right)$ yields

$$s_t^{EX} = \frac{1+B}{1+\psi B} - \frac{\vartheta_t}{(1+\psi B)\, E_t\Lambda_{t,t+1}^b \left[r(\varsigma_{t+1}) - R_t(1-\vartheta_t)\right]} \tag{A19}$$

The link between s_t^{EX} and ϑ_t is given by

$$\frac{\partial s_t^{EX}}{\partial\vartheta_t} = -\frac{E_t\Lambda_{t,t+1}^b\left(r(\varsigma_{t+1}) - R_t\right)}{(1+\psi B)\left\{E_t\Lambda_{t,t+1}^b\left[r(\varsigma_{t+1}) - R_t(1-\vartheta_t)\right]\right\}^2} \tag{A20}$$

Second, consider an implicit solution for s_t. Again, combine (16) and (17) as in the text, but this time treating the resulting expression as an implicit function of s_t. Formally,

$$\begin{aligned} 1 &= E_t\Lambda_{t,t+1}^b\left[1 - s_t^{IM} + B\left(1 - \psi s_t^{IM}\right)\right] r(\varsigma_{t+1}) \\ &\quad + \left\{1 - E_t\Lambda_{t,t+1}^b\left[1 - s_t^{IM} + B\left(1 - \psi s_t^{IM}\right)\right] R_t\right\}(1-\vartheta_t) \end{aligned}$$

which leads to the following implicit function

$$f\left(s_t^{IM}\right)=\vartheta_t-E_t\Lambda_{t,t+1}^b\left[1-s_t^{IM}+B\left(1-\psi s_t^{IM}\right)\right]\left[r\left(\varsigma_{t+1}\right)-R_t\left(1-\vartheta_t\right)\right]$$

The link between s_t^{IM} and ϑ_t is given by

$$\frac{\partial s_t^{IM}}{\partial\vartheta_t}=-\frac{1-E_t\Lambda_{t,t+1}^b\left[1-s_t^{IM}+B\left(1-\psi s_t^{IM}\right)\right]R_t}{\left(1+\psi B\right)E_t\Lambda_{t,t+1}^b\left[r\left(\varsigma_{t+1}\right)-R_t\left(1-\vartheta_t\right)\right]}$$

And since equation (16) suggests that

$$\frac{\mu_t}{\upsilon'\left(c_t^b\right)}=1-E_t\Lambda_{t,t+1}^b\left[1-s_t^{IM}+B\left(1-\psi s_t^{IM}\right)\right]R_t>0 \tag{A22}$$

I obtain

$$\frac{\partial s_t^{IM}}{\partial\vartheta_t}=-\frac{\mu_t/\upsilon'\left(c_t^b\right)}{\left(1+\psi B\right)E_t\Lambda_{t,t+1}^b\left[r\left(\varsigma_{t+1}\right)-R_t\left(1-\vartheta_t\right)\right]} \tag{A23}$$

Since (A20) and (A23) are fundamentally the same object, they can be equalized. As a consequence, once an explicit value for s_t is available, the shadow value of bank capital must be

$$\frac{\mu_t}{\upsilon'\left(c_t^b\right)}=\frac{E_t\Lambda_{t,t+1}^b\left(r\left(\varsigma_{t+1}\right)-R_t\right)}{E_t\Lambda_{t,t+1}^b\left[r\left(\varsigma_{t+1}\right)-R_t\left(1-\vartheta_t\right)\right]} \tag{A24}$$

Note that (A24) and (A22) (which is the same thing as equation 25 in the text) are alternative ways to express the same equilibrium quantity. Equation 25 (or equivalently A22) suggests that the shadow value of bank capital satisfies (3) and (16) for a still to be defined s_t. On the other hand, (A24) shows the expression for $\mu_t/\upsilon'\left(c_t^b\right)$ that satisfies (3), (16) and also (17), once s_t has been computed explicitly.

Graphs and Tables

Table 1. Parameter Values

Parameter		Value
$\bar{l}$	(normalized) bank asset	1
$\bar{R}$	rate of interest on deposits	1.04
x	difference between discount factors	0.968
a	safe component of the risky return	1.07
$\overline{\Omega}$	stationary value of the fraction of losses	0.0253
k	parameter of the $\Omega(\varsigma_t)$ function	-0.999
$\bar{\vartheta}$	steady state capital requirement	0.07
γ	sensitivity of ϑ_t to changes in the state	0.3054
σ	risk aversion coefficient	2
ρ	persistence of the state variable	0.85
$\bar{\varsigma}$	stationary value of the state variable	1
w	exogenous endowment	0.875
g_c	constant component of government spending	0.35
tr_c	constant component of government transfers	0.45

Table 2. Functional Forms

Type of Process	Specification Used
exogenous state	$\varsigma_t = \varsigma_{t-1}^{\rho} \exp(\varepsilon_t)$
i.i.d. shock	$\varepsilon_t \sim N\left(0, \sigma_{\varepsilon}^2\right)$
utility function of agent $i = o, b$	$\left(c_t^i\right)^{1-\sigma} / (1-\sigma)$
fraction of losses on bank assets	$\Omega(\varsigma_t) = \bar{\Omega}(\varsigma_t)^k$
capital requirement	$\vartheta_t = \bar{\vartheta}(\varsigma_t/\bar{\varsigma})^{\gamma}$

Table 3. Stationary Equilibrium: Existence and Related Costs

$r(\bar{\varsigma}) - \bar{R}$	Outside Ownership	Range for $r(\bar{\varsigma}) - \bar{R}$	Is Lemma 3 Satisfied?
0.0029	14%	[-0.0128, -0.1937]	No
0.0029	47.5 %	[-0.0327, 4.2857]	Yes
0.0029	70%	[-0.0400, 0.0949]	Yes
0.0029	80%	[-0.0425, 0.0450]	Yes
0.0029	90%	[-0.0446, 0.0177]	Yes

Outside Ownership	Cost of Diversion	Shadow Value of Bank Capital	
		With Outside Owners	Without Outside Owners $(1-x)$
14%	0.0091	0.0387	0.0320
47.5 %	0.0309	0.0387	0.0320
70%	0.0456	0.0387	0.0320
80%	0.0521	0.0387	0.0320
90%	0.0586	0.0387	0.0320

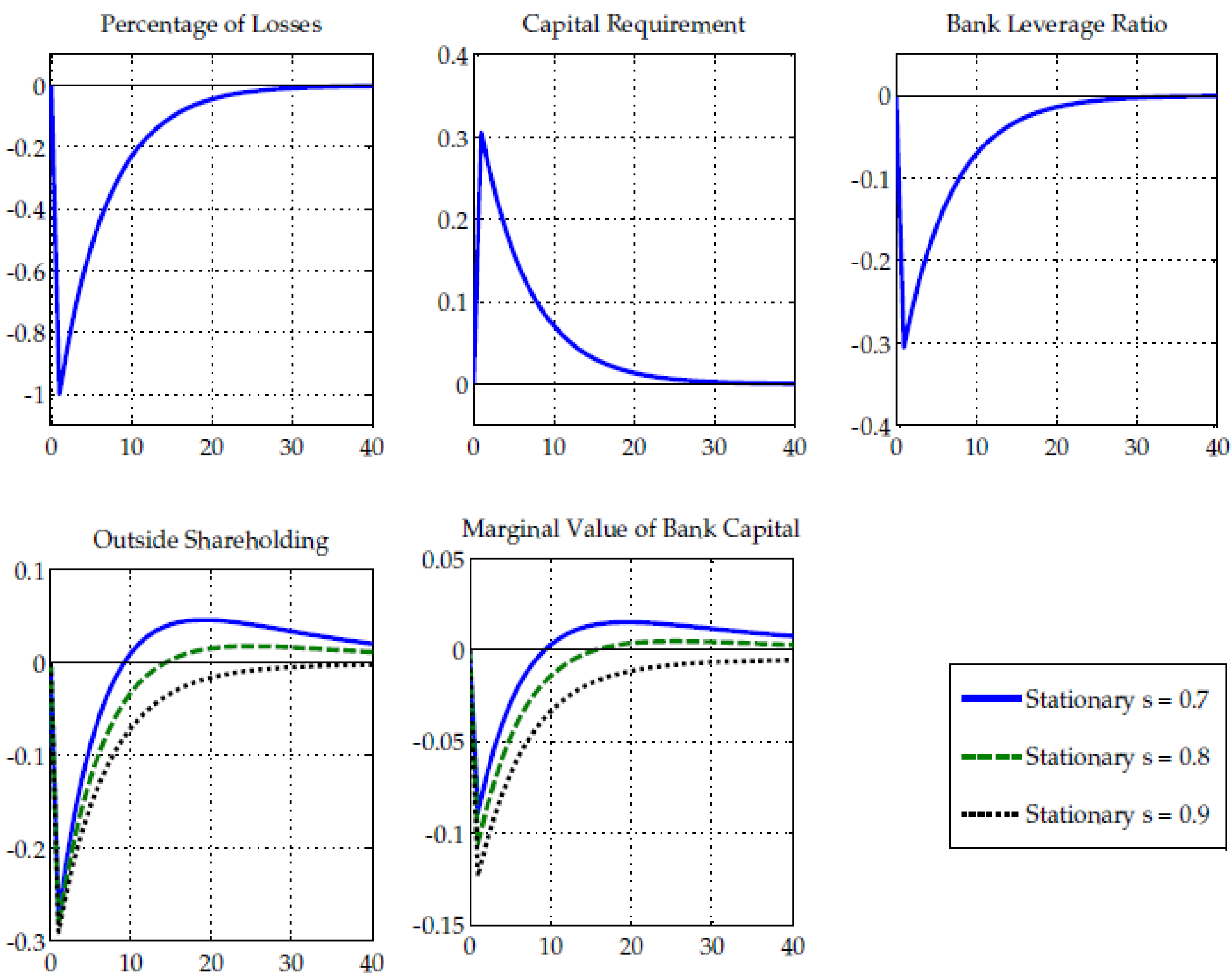

Figure 1: The effect of a positive shock under countercyclical requirements

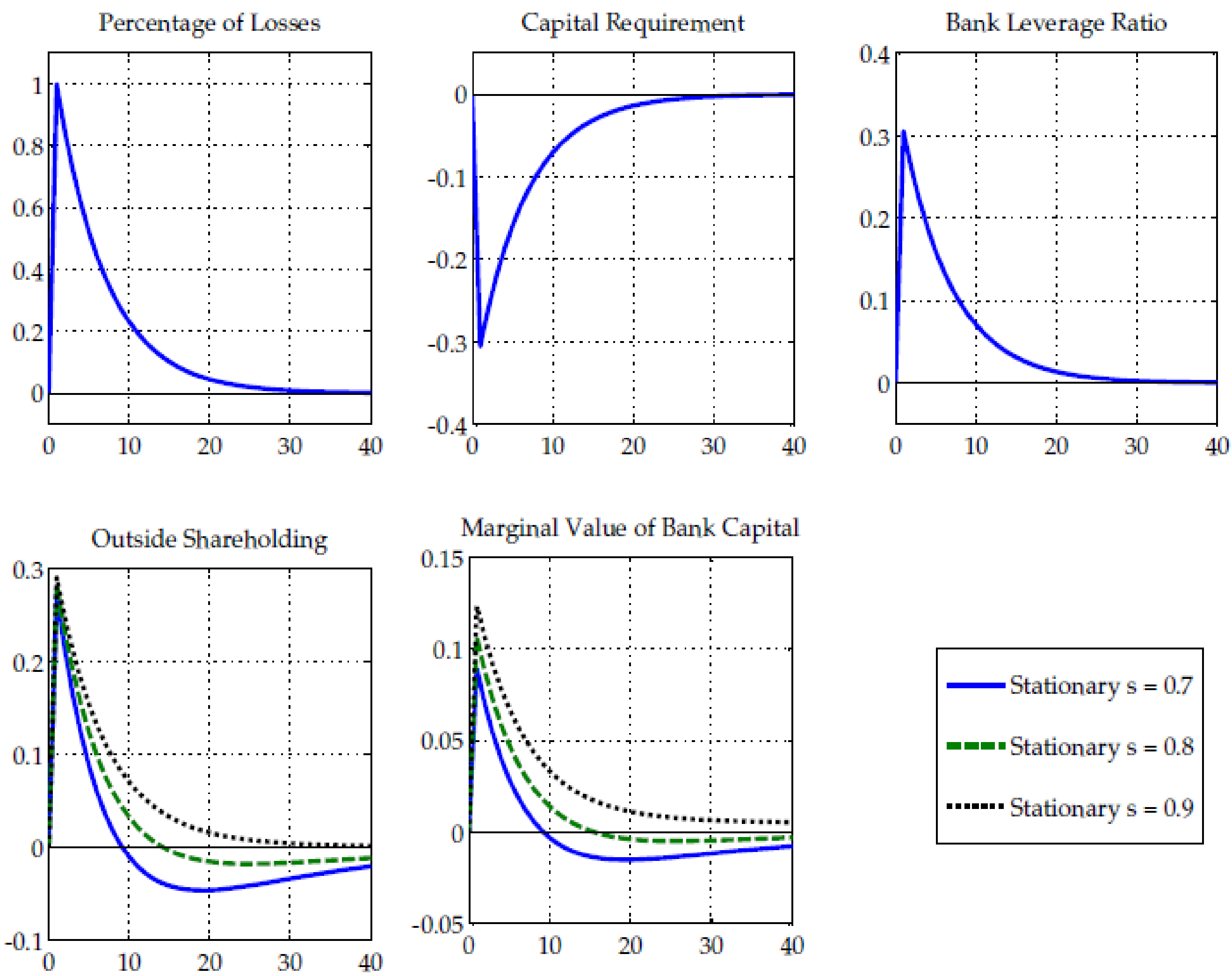

Figure 2: The effect of a negative shock under countercyclical requirements

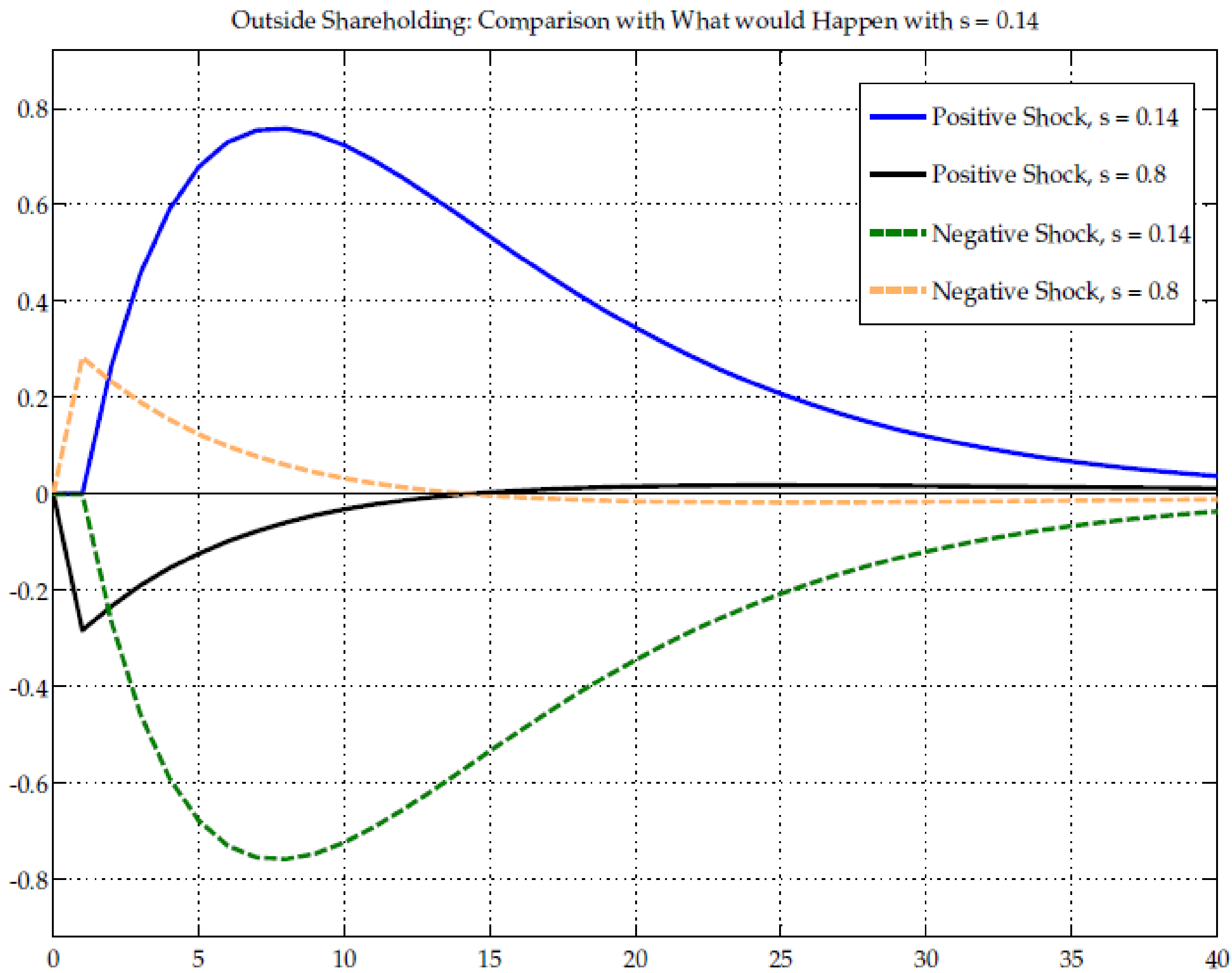

Figure 3: Countercyclical regulation: the case of low outsiders' ownership in the steady state

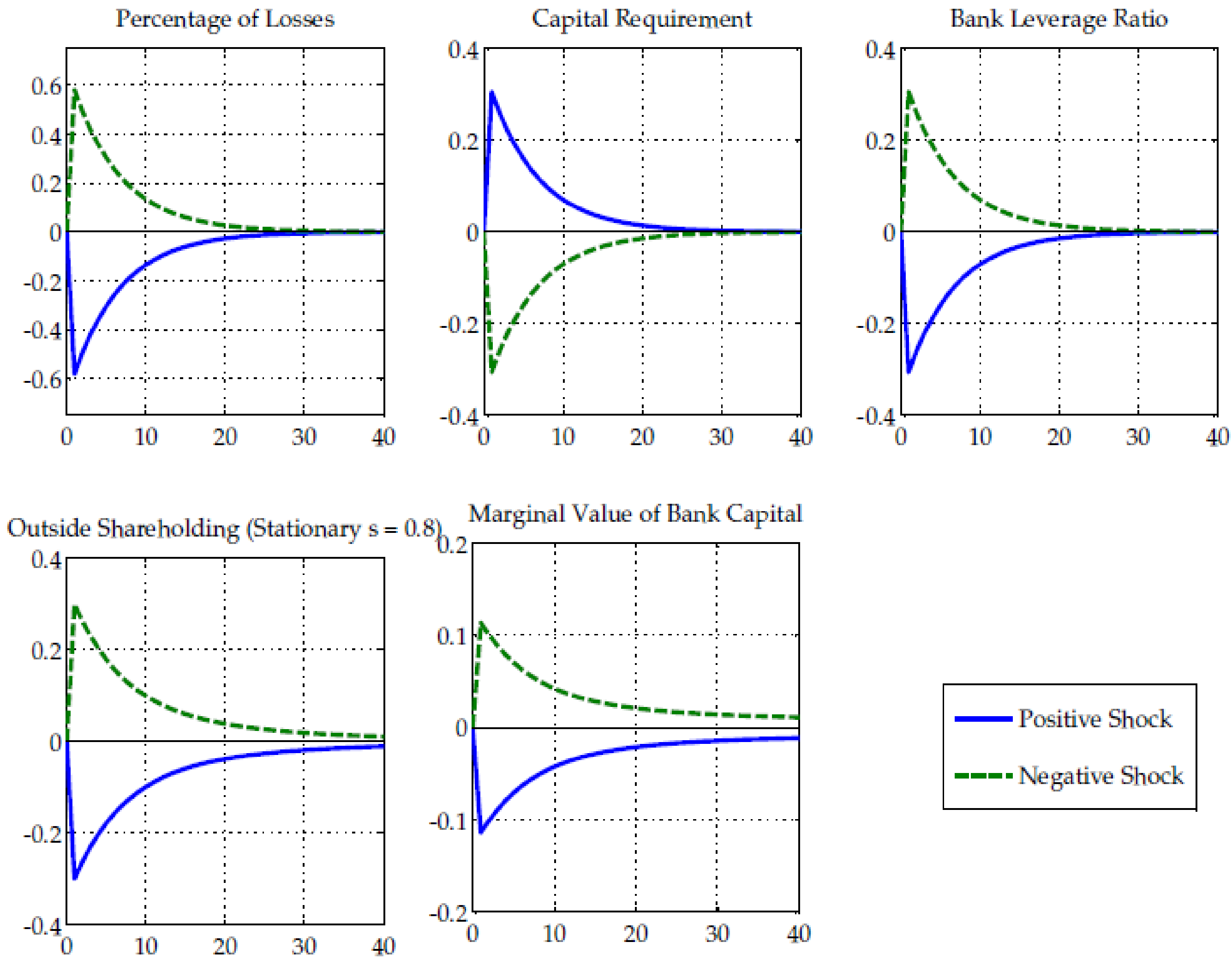

Figure 4: Robustness: the effect of countercyclicality when the loss function is $\Omega(\varsigma_t) = \Omega_U (1 - k\varsigma_t)$, with $\Omega_U = 0.071$, $k = 0.3672$ and $a = 1.092$

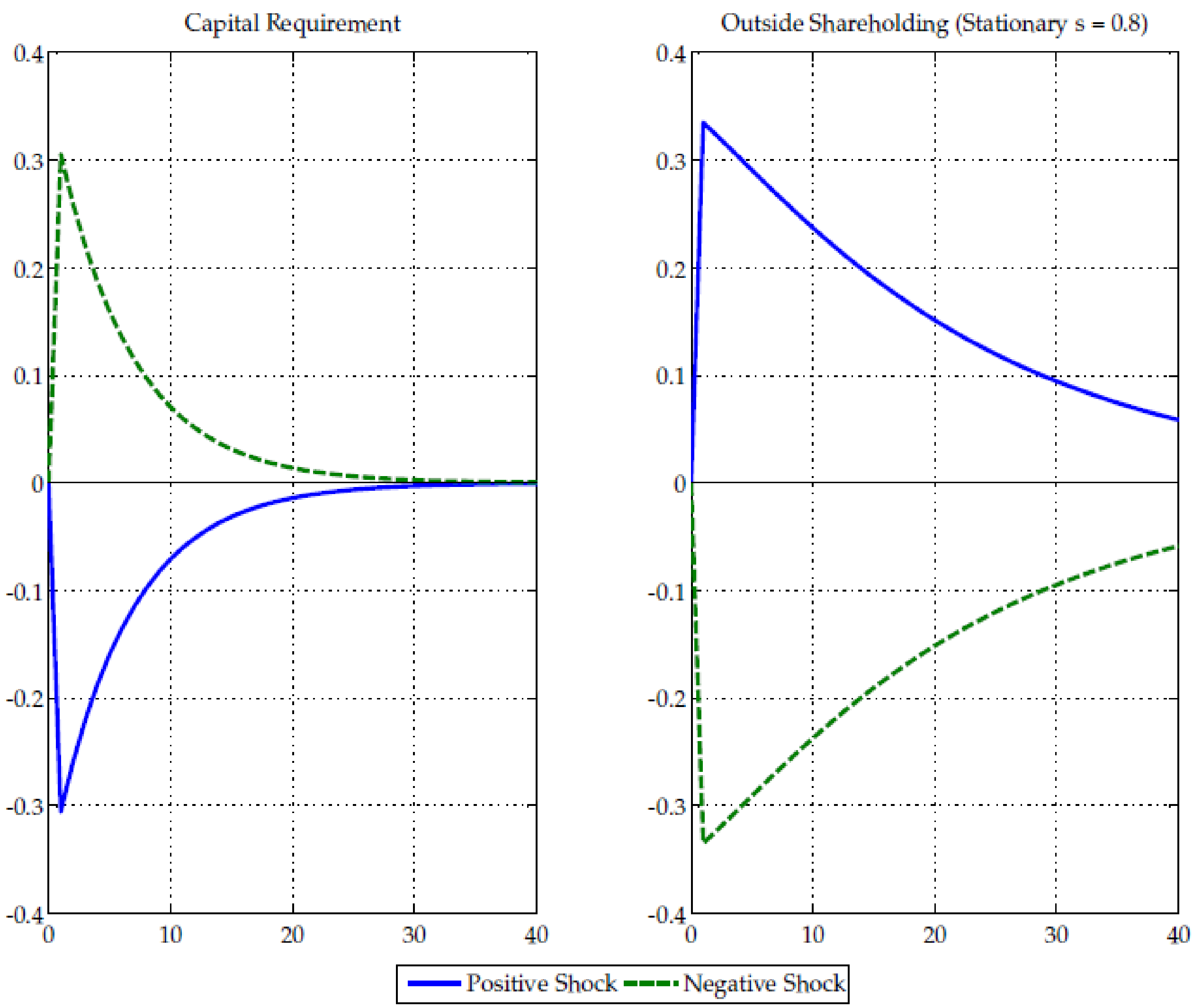

Figure 5: An example with procyclical capital requirements: $\gamma = 0.3054$