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Risk Weighted Capital Regulation and Government Debt

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Risk Weighted Capital Regulation and Government Debt

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Abstract

Microprudential capital requirements are designed to reduce the excessive risk taking of banks. If banks are required to use more equity funding for risky assets they invest more funds into safe assets. This paper analyzes a government that simultaneously regulates the banking sector and borrows from it. I argue that a government may have the incentive to use capital requirements to alleviate its budget burden. The risk weights for risky assets may be placed relatively too high compared to the risk weight on government bonds. This could have a negative impact on welfare. The supply of loans for the risky sector shrinks, which may have a negative impact on long term growth. Moreover, the government may be tempted to increase its debt level due to better funding conditions, which increases the risk of a future sovereign debt crisis. A short term focused government may be tempted to neglect the risk and, thereby, may introduce systemic risk in the banking sector.

Keywords: Capital Requirement Regulation; Government Debt

JEL: G21; G28; G32

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1. Introduction

The recent financial crisis and the resulting economic crises have illustrated the vulnerability of the banking sector and its negative externalities on real sector development. One main cause of the vulnerability of the banking sector is that banks are partly shielded against the downside risk of their investments by explicit insurance of their deposit liabilities and implicit insurance in the form of government support. The main instrument that is used to prevent banks from taking excessive risk is risk sensitive capital requirement regulation. Optimal regulation reduces the risk shifting of banks and can implement the optimal risk allocation. However, a government may face an inherent conflict of interest when setting the risk weights for bank assets. On the one hand, governments regulate banks to limit their exposure to risk and the related negative externalities of such risk. On the other hand, banks are also a source of financing government debt as pointed out by Calomiris and Haber (2011).

This paper analyzes the inherent conflict of interest and the possible implications for optimal capital requirement regulation and discusses possible welfare implications. Based on a simple model, it is shown that a government which simultaneously regulates the banks and borrows from them, may have the incentive to overregulate risky investments compared to safe investments if those safe investments are government bonds. The interesting point made here is that the government can influence its budget indirectly via risk weighted capital regulation and, thus, may circumvent the monetary policy monopoly of the central bank. This calls into question whether or not governments should be entitled with setting the optimal risk weights for capital requirement regulation.

If government bonds are indeed safe, the overregulation of risky assets may not decrease overall welfare. However, if the risk of government default increases due to its indebtedness, a limitedly liable government can have the incentive to neglect this risk partially, participating in risk shifting on its own. This might result in increased systemic risk and a vulnerable government, with detrimental effects on welfare.

The idea that the financial sector is a potential source of easy resources for a government to finance its debt has been already discussed by McKinnon (1973). He defines financial repression as a set of policies, laws, regulation, taxes, distortions, qualitative and quantitative restrictions, and controls that are imposed by governments, which do not allow financial intermediaries to be active at their full technological potential. This point abstracts from the optimal degree of regulation in banking that is justified by the existence of moral hazard and other market failures. Financial repression considers any policy that goes beyond the regulation that deals with the negative externalities of financial markets. Roubini and Sala-i Martin (1992) conclude that regulation in the form of financial repression tends to reduce financial intermediation from its optimal level, and thereby has negative effects on the long term growth of the economy.

However, to the author's knowledge, the government's incentives for a biased setting of risk weights in capital requirements has not yet been discussed, and it is the goal of this paper to close this gap.

In the aftermath of the financial crisis, strengthening capital requirement regulation became the major concern of regulators. The goal of recent regulatory reforms, such as the third Basel Accord, is to increase the quantity and the quality of the equity base, which banks use to refund their investments. However, the discussion of the risk weights for bank assets has been of limited concern.

The impact of banking capital regulation on the portfolio composition of banks is well studied. The Basel I accord was criticized for applying too broad risk weights among assets. By searching for yield, the banks have the incentive to reshuffle their portfolios to the highest risk assets with accordingly higher returns within one risk class. The Basel II and III changes and enhancements aim to reduce this regulatory arbitrage. The broad risk classes for capital requirements were amended according to external ratings under the standard approach. As in Basel II, the Basel III agreement sets a zero risk weight to AAA-AA- rated governments while loan assets require a significantly higher risk weight. Moreover, the new Basel accord expects large and sophisticated banks to implement the IRB approach, which requires an individual assessment of government risk. However, the recommendations of the Basel agreements are not binding for national government regulators. In fact, when the European Union implemented the Basel II approach in the form of the Capital Requirement Directive[1], a zero risk weight for sovereign bonds of the European Union members, regardless of their risk rating, was sustained under the standardized approach.[2]

[1]Basel II was implemented into European law by DIRECTIVE 2006/48/EC, Article 89(1)(d), which was amended by the Directive 2009/111/EC. The zero risk weight exception for Member States is still valid.

[2]"Exposures to Member States' central governments and central banks denominated and funded in the domestic currency of that central government and central bank shall be assigned a risk weight of 0 %." (Directive 2006/48/EC, Annex VI, Part1(4))

Moreover, the European directive allows for the IRB approach the permanent partial use rules, according to which, the IRB approach can be applied to corporate exposures, whereas the risk weight applied to the member state government exposures remains zero.[3]

The comparatively low risk weight for government bonds can certainly be justified with very low observed government defaults. However, the recent government debt crisis and the continuous deterioration of government risk ratings casts doubts on this certainty. This reluctancy to implement the risk sensitive amendments made by the Basel II approach may serve as anecdotal evidence of the tendency to privilege government bonds. This biased regulation had a detrimental effect in the aftermath of the financial crisis. Jablecki (2012, p.6) summarizes this effect as follows "[...] by imposing a zero risk weight on all EU sovereign exposures - irrespective of the governments' fiscal conditions' - the CRD [Capital Requirement Directive] encouraged banks to load up on debt issued by the most risky euro-area governments, reducing the yields that these governments would have had to pay creditors otherwise".

Brunnermeier et al. (2011) present a detailed discussion on how the over-investment of banks in government debt has created a "vicious circle" in which a doubt on the government's safety creates a crisis in those banks' safety which have invested heavily in government bonds. The stressed banks in turn need to be supported by the government, which increases government debt further eroding the government's solvency.

Both effects have been supported with empirical evidence. Reinhart and

[3]The EU-wide Stress Test Aggregate Report of the European Banking Authority (2011) revealed that only 36 out of 90 banks applied the IRB approach to sovereign debt.

Rogoff (2011) find empirical evidence that a systemic banking crisis increases the probability of a subsequent government debt crisis. Borensztein and Panizza (2009) find support that the occurrence of a sovereign debt crisis increases the probability of a banking crisis.

Observing this diabolic loop in the current sovereign debt crisis, the question arises: Why does a regulator have the incentive to indirectly subsidize government debt with unbalanced relative risk weights for capital requirement regulation?

Livshits and Schoors (2009) present a simple model and some empirical evidence of a Russian data set that a government may not have the right incentive to include sovereign risk in prudential regulation as this could lower the cost of financing the debt and may postpone the sovereign default.

In contrast, this paper argues that a regulator may have an incentive to increase the relative risk weight for risky assets beyond the optimal point if the government does is not prone to default risk.

The goal of a financial regulator without any fiscal interest is modeled as in Tirole (1994), according to which the regulator represents the interest of the depositors and intervenes in the case of a banker's insolvency by guaranteeing outstanding debt to depositors in exchange for control rights of the bank. This view leads to a narrow goal of the regulator, who is not concerned with maximizing social welfare but is, instead, interested in minimizing the negative externality of banks' excessive risk taking.

Moreover, in contrast to the narrow goal of the regulator, this paper also allows the government regulator to pursue the additional goal of current budget maximization. This is a very simplified approach to a government's objective, but it is commonly used in public choice theory.[4] Introducing a more sophisticated objective function of the government, would however, not change the basic results as long as the government has an incentive to increase its debt above the level that would result from microprudential regulation. By setting excessively high risk weights on risky assets, such as loans to entrepreneurs, banks' funds are channeled into safe assets, such as government bonds. Assuming that equity funding is costly to the banker a higher risk weight on assets increases the marginal costs and thereby channels more funds into less weighted assets. Hence, for a given market size and funds available, higher risk weights for risky assets create higher demand for low risk assets.

The paper proceeds as follows: in chapter two, a simple model of banker's risk shifting is introduced and it is shown how an optimal capital requirement for risky assets can reduce or eliminate this risk shifting. By extending the objective function of the regulator for short term consumption, the regulator with fiscal interests is introduced and his regulatory choice is compared with the optimal regulation. In chapter 3, the welfare implications are briefly discussed. Chapter 4 concludes.

[4]The argument goes back to Niskanen (1971) who introduces a model in which politicians' preferences are directly linked to an increase in their bureau's budget. The budget maximizer as one extreme and also the mixed incentives of a government are commonly used in the analysis of public choice e.g. Haucap and Kirstein (2003) discuss four types of a government: a welfare maximizer, a Leviathan that is only interested in budget maximization, an industry friendly government and a green government in order to analyze the optimal pricing of pollution permits. The two latter types of governments have mixed incentives of the two extremes. I follow their approach by discussing the extreme case of a not fiscally interested and a fully interested government, a Leviathan, and any mixed incentives in between the two cases.

2. The Model

Consider an economy with two dates $t = 1, 2$. Agents make their decisions at $t = 1$ and returns are realized at $t = 2$. The economy is populated with four different types of agents: bankers, households, borrowers, and a government regulator.

2.1. The Bankers

There is a continuum of bank owner-managers[5] , normalized to one, which are risk neutral and receive an endowment $W = 1$ in $t = 0$.

I assume that bank owner-managers, which I call from here on simply bankers, have the unique skill to profitably provide loans L to borrowers. The assumption that only bankers are able to profitably provide loans to borrowers reflects the incomplete market paradigm for financial markets. In particular, I assume that the loan market is segmented such that risky borrowers cannot borrow directly from households. This market friction constitutes one of the raison d'être for banks.[6] Due to their unique skills to screen and monitor borrowers, banks facilitate access to funding to profitable investment projects that could not be carried out otherwise because borrowers lack access to financial markets.[7] However, to keep the model simple, the

[5]The bank owner-manager may also reflect a consortium of a mass of shareholders and a delegated manager if the manager's interests are aligned with the shareholders and there is no conflict of interest among shareholders.

[6]Freixas and Rochet (2008) offer a comprehensive overview on the incomplete market paradigm for financial markets. They argue that banks play an important role in improving the efficient allocation of capital by: 1) Offering liquidity and payment services, 2) transforming assets, 3) managing risks, and 4) processing information and monitoring borrowers (Freixas and Rochet, 2008, p.2).

[7]This is a simplification, since established firms with a good reputation and collateral obviously have access to direct financial market funding. A vast literature deals with the

costly monitoring and screening effort by banks that is necessary for loans to be profitable is not explicitly modeled.

In order to invest in loan assets, banks can attract insured deposits from households at a risk insensitive deposit rate r_D. Moreover, I assume that there is a deposit insurance risk premium, that is fixed and normalized to zero. For brevity, I define $R_D = 1+r_D$ to be the gross repayment on deposits. Since depositors are insured, the deposit repayment is not contingent on the riskiness of a bankers investment, and deposits take the form of a simple debt contract. Combined with the deposit insurance, the simple debt contract structure creates incentives for excessive risk taking, since banks are at least partly shielded from the downside risk of their risky investments.[8]

Bank owners are assumed to maximize their consumption over the two periods. In order to introduce a private cost of equity capital to the banker I assume that in contrast to households the owners are impatient, i.e. they discount their consumption at $t = 2$ with a discount factor $1/\rho$ where I assume that $\rho > R_S$, with $R_S = 1 + r_S$ the gross repayment on safe assets, i.e., government bonds. The factor ρ, thereby may be interpreted as $\rho = 1+i$ with i being the individual discount rate. The assumption $\rho > R_S$ thus implies that $i \geq r_S$, the banker's individual discount rate is higher than the

reasons for the coexistence of market and bank debt. For a good overview, see Freixas and Rochet (2008). Most prominent is the discussion of the role of banks as delegated monitors that screen borrowers as discussed by Broecker (1990), prevent Moral Hazard as most prominently discussed by Holmström and Tirole (1997), and are able to punish borrowers as discussed e.g. by Diamond (1984). For simplicity, this paper neglects the coexistence of market and bank debt and only focuses on firms that lack access to financial markets.

[8]As Merton (1974) pointed out, deposit insurance creates an option value that banks can exploit by risk shifting.

safe interest rate on government bonds.[9] The assumption reflects the idea of the CAP-Model that the return on an assets increases with the riskiness compared to the market risk. However, while the CAPM is based on the assumption of risk-averse investors, this simple model includes a premium on equity based on impatience in consumption. Therefore, the risk-neutral banker behaves as if he was risk-averse and the investment of equity in the risky bank is privately costly to the banker but not to the society. Moreover, as shown later, debt financing is partly subsidized by a deposit insurance, and thus inside equity funding is comparably more costly to the banker, because depositors do not require to be compensated for the risk of default of the bank.

To keep the model simple, I assume that banks have a constrained capacity to invest. In particular, I assume that a bank's optimal balance sheet size is fixed and normalized to unity.[10] Denote with x the proportion a banker invests into safe assets and with $1 - x$ the proportion of investment in risky

[9] A government could also be allowed to go bankrupt. In this case, also the deposits become risky, since in case of government default, depositors receive nothing. However, deposits remain the least risky investment with the same risk of default as the "safe" investment which is the government bond as they are both repaid as long as the government is solvent.

[10] Consider otherwise, that banks can also choose the optimal balance sheet size. Since we will consider decreasing returns to investments in risky assets, the balance sheet size itself is a function of the banker's optimal investment decision. To see this, consider assume that the management of a bank yields a convex cost function of the bank's balance sheet size S, i.e., $C(S) = \frac{S^2}{\theta 2}$. A single banker chooses the proportion of investments in safe assets x and the balance sheet size. With decreasing returns to the investment in risky loans, the return of investments is a function of x. Denote the utility of the banker as $U = p(R(x))S - C(S)$, then the optimal balance sheet size is determined by $S = \theta p(R(x))$. This would considerably complicate the analysis without changing the main implications that are sought to be analyzed. Since this paper does not aim at discussing the optimal size of banks, the balance sheet size is, therefore, assumed to be exogenous.

loan assets.

2.2. The Households

Furthermore, consider a continuum of households, normalized to one, also with an endowment of $W = 1$ at the beginning of $t = 1$. Households are assumed to be risk-neutral and maximize their consumption at date $t = 2$.[11] The assumption that households cannot consume in $t = 1$ is a simple way to create the need to safe money. Due to a lack of monitoring and screening skills, households can not directly invest their endowment in risky assets. In order to be able to consume in $t = 2$ households, thus, either invest their endowments in government bonds or as insured deposits. Because all banks together may, at the maximum, borrow an aggregate amount of 1 from households in the form of deposits, and the depositors aggregate endowment is $W = 1$, the depositors have no market power and will be willing to deposit their endowment at the bank as long as $R_D \geq R_S$ since both assets have the same risk, i.e., are safe assets in the basic setting. However, as discussed later, the government overtakes the outstanding debt of a banker in case of banker's insolvency and therefore insures the deposits. As a result, even if the government is not safe, deposits have the same risk level as government bonds. Assuming that the households will provide the maximum endowment possible to banks if $R_D = R_S$, it becomes clear, that banks will have to pay $R := R_D = R_S$ to the depositors in order to raise deposits.[12]

[11] This assumption abstracts from the usual liquidity insurance problem of depositors. However, with a known proportion of impatient and patient households, the result would remain unchanged.

[12] The assumption of households preference for deposits is an epsilon argument, i.e., if they are indifferent, banks only need to pay an ϵ more than government bonds. However,

2.3. The Borrowers

There is a continuum of penniless borrowers that receive loans L from the banker, which they invest into a project that returns B with a positive probability p, and zero otherwise. I assume that the projects to which borrowers have access are profitable, i.e., I assume that $p \cdot B > \rho$. Intuitively, the expected gross return from risky projects is assumed to be higher than the private opportunity cost of bankers to invest in those returns. The investment in risky projects is therefore socially desirable.

The returns of investment projects are assumed to be perfectly uncorrelated. Due to a lack of collateral and transparency, borrowers can not get direct funding from households but need to apply for loans from specialized banks. The bank loan is a simple debt contract that limits the liability of the borrower, therefore, the banker receives the repayment on the loan R_L only in case of success.[13] The profit from an investment in the borrower's risky project is the expected net return minus a cost function that is convex in the loan amount, i.e., the investment in the risky project. In particular, I assume the explicit form of the cost function to be $\frac{d}{2}L^2$. Therefore, I can write the expected profit of a risky project as $\Pi^F = p\left((B - R_L)L - \frac{d}{2} \cdot L^2\right) + (1-p)\left(-\frac{d}{2}L^2\right)$. The loan repayment is decreasing in aggregated investment, i.e., the indirect loan demand is assumed to be a decreasing function of overall investment. To understand the intuition, consider a representative penniless borrower, who faces the following

the preference can also be motivated by liquidity and service arguments such as access to ATM and electronic payment systems.

[13]Again, $R_L = 1 + r_L$ is for brevity the gross repayment which consists of the loan interest rate r_L plus one.

utility function:

$$U^F(L) = \max\{\Pi^F; 0\} \cdot (1-\tau) \tag{1}$$

In case of success, the borrower makes a profit of which he has to pay a tax τ to the government. In order to maximize its utility, the representative borrower demands a loan amount $L^* = \text{argmax } U^F(L)$. Because he is limited liable, the utility of a penniless borrower can only be non-negative, a strictly positive demand for loans exists for small loan repayments. In particular, the first partial derivative with respect to L is either negative, such that $L^* = 0$ or the optimal loan demand derived from the first order condition is given by $L^* = \frac{B-R_L}{d}$. The optimal loan demand is decreasing in the loan repayment. Considering that each banker invests a total amount of 1 into assets, such that x is the amount the banker invests in government bonds, and $L = 1 - x$ is the share that is invested into risky loans. Therefore, the indirect demand function for bank loans can be written as

$$R_L = B - d(1-x) \tag{2}$$

Here, B can be interpreted as the reservation price, the maximum loan interest payment borrowers are able to pay. In particular, strategic interaction among banks is neglected because it would not change the general result of this model.

2.4. The Government Regulator

In regulating the bankers, the government regulator that has no fiscal interest has the goal of reducing the excessive risk taking of banks via adequate risk weighted capital requirements. The regulator aims at internalizing the negative externalities of the deposit insurance without aiming at maximizing overall welfare. The idea is, that when the banker does not bear the full cost of funding its investment due to the deposit insurance on deposit funding, he will invest too much of his funds into risky loans. In particular, the unregulated limitedly liable banker will invest more in risky loans than he would if he was fully liable for his outstanding debt. In particular, the investment in safe assets of a fully liable bank x^* is greater than the investment of a limitedly liable bank $x^* > \hat{x}$. As in the real world, the regulator can not directly regulate the asset portfolio composition of a banker's investment, which would be the first best solution. This could be justified by a lack of information on the specific asset characteristics, that is only known by the banker.

However, the regulator can indirectly influence the portfolio composition by setting regulating the liability side of the bank's balance sheet. In order to do so, the regulator forces the bankers to refund a share of their risky investments with privately costly equity, i.e., he puts a relative risk weighted capital requirement Δ on risky loan assets. The relative risk weight Δ makes investments into risky loans relatively more costly to the banker than investments in safe government bonds, and therefore decreases the investment in risky assets and increases the investments in safe assets. In other words, the banker's investment in safe assets $\hat{x}(\Delta)$ is an increasing function of the relative risk weight Δ^*. In this way, the regulator can force the banker to invest exactly the same amount of funds into risky assets as the banker would invest when he was fully liable, i.e., first best investment amount. In order to force banks to internalize the cost of their risk shifting, the regulator implements the risk weighted capital requirement for risky assets that disciplines banks to behave as if they were fully liable such that $\hat{x}(\Delta^*) = x^*$

However, as discussed above, the government regulator also borrows from the banks, which can influence his optimal decisions. Therefore, it is assumed that the government has no endowments in $t = 1$ but receives tax income $\tau \cdot U^F$ in $t = 2$ from successful borrowers.

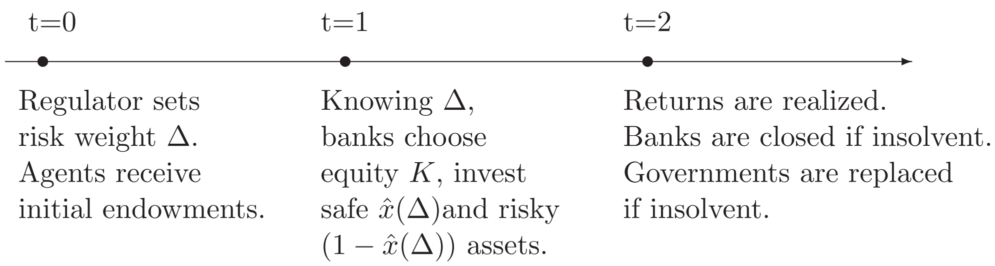
In order to be able to repay current debt and provide public goods as well as bailing out the liabilities of defaulted banks, the government issues government bonds as safe assets in $t = 1$ with the promise of a fixed gross repayment of R_S in $t = 2$. In order to guarantee interior solutions, I assume that $p \cdot (B - d) < R_S$. This assumption implies that due to the increasing cost of conducting risky projects, i.e., the decreasing returns from risky investments, the gross return from risky investments if all funds are channeled into it is lower than the return on safe investments. In other words, it is socially not optimal to invest all funds into the risky projects of borrowers. Moreover, this implies that $p \cdot (B - d) < \rho$: it is not optimal to invest the aggregate banker's endowment into risky assets. Together with the earlier assumption of profitable initial investments $p \cdot B > \rho$ the assumption above secures that it is neither optimal to invest all funds in safe nor risky assets, but in a portfolio of both assets.

The government's objective when borrowing is to maximize its budget, which is reflected as the objective to maximize current consumption. Depending on the focus of the government regulator, the goal of budget maximization enters the regulator's objective function with weighting factor ϕ measuring the fiscal interest of a government regulator. In the basic model, it is assumed that government bonds are indeed safe, i.e. that the government regulator receives an endowment in $t = 2$ that enables him to pay back the bond obligations.

2.5. Decisions and Timing

The timing is as follows: the households and bankers receive their initial endowments and the regulator decides on the optimal relative risk weight for risky assets compared to safe assets Δ as a minimum capital requirement regulation. After the agents received their endowments, the bankers collect funds from depositors, decide to invest inside equity, invest deposits and equity into assets, and consume the residual in $t = 1$. In $t = 2$, the bankers receive the returns from their successful asset investments. If they are solvent, they repay their debt to depositors and consume any profits. If insolvent, the bank is closed and the banker's outstanding debt is cleared by the deposit insurance, which is covered the government in this model. Because the banker consumes the part of his endowment, which he does not invest as equity, he is penniless in $t = 2$ and, thus, also limitedly liable. In case of bank default, the banker receives a payoff of zero, while equity that was invested in $t = 1$ is sunk.

Figure 1: The Timeline of the Decisions Taken



3. The Banker's Investment Decision

3.1. The First Best Investment

As a benchmark, I first discuss the optimal investment choice of bankers in the absence of externalities and without regulation. Therefore, consider a world, where a banker is fully liable. After receiving his endowment in $t = 1$, the representative banker has to decide how much to invest of its own endowment as inside equity investment K. The banker borrows the residual $1 - K$ as deposits from households at the promised repayment R_D. He then invests the deposits and own equity in a portfolio of a share x of safe government bonds with repayment R_S and in a share $(1 - x)$ of loan asset with repayment $R_L(x)$. In the benchmark, the banker is fully liable to repay the deposit liability even if his asset investments default.

The banker then chooses K, and respectively $D = 1 - K$ and the asset portfolio composition x to maximize his expected intertemporal consumption. As he is impatient he discounts the expected future consumption in time $t = 2$.

$$E(U^{fl}(K, x)) = c_1 + \frac{1}{\rho} \cdot E(c_2) \tag{3}$$

$$s.t.$$

$$c_1 = W - K$$

$$E(c_2) = p\,(xR_S + (1 - x)R_L(x) - (1 - K)R_D) + (1 - p)\,(R_S x - (1 - K)R_D)$$

Because of the full liability, the consumption of the banker can be negative in $t = 2$. In particular, it will be negative when the bank invests no own equity as shown in the following lemma.

Lemma 1. *If the risky loan investment defaults, the banker's consumption* c_2 *is negative when he proportion of equity investment is smaller than the* *investment in risky assets.*

Proof. With probability $(1-p)$, the loan asset investment defaults and the banker receives $(R_S x - (1-K)R_D)$. As discussed above, the deposit rate is driven down to $R = R_D = R_S$, which implies $R(x-1-K)$ such that consumption becomes negative whenever $1-x > K$. □

This follows from the zero profit of the safe investment, which does not create a buffer against losses. The partial derivative of the expected future consumption with respect to equity investment K is:

$$\frac{\partial E(U^{fl})}{\partial K} = -1 + \frac{1}{\rho} \cdot R_D \tag{4}$$

As discussed above, the deposit rate is driven down to $R = R_D = R_S$. Under the assumption that $\rho > R_S$ the right hand side of equation (4) is negative, such that even a fully liable banker chooses to leverage his portfolio with deposits as much as possible.

Lemma 2. *A fully liable banker invests no inside equity but all deposits into a portfolio with* $(1-x^*) = \frac{B-\frac{R}{p}}{2d}$ *risky loan assets and* x^* *government bonds.*

Proof. Because $\frac{\partial E(U^{fl})}{\partial K} < 0$ the banker optimally chooses to invest no inside equity. With $K = 0$ the partial derivative of the expected consumption function with respect to x becomes:

$$\frac{\partial E(U^{fl})}{\partial x} = p(R - R_L(x) + (1-x)R_L'(x)) + (1-p)R \stackrel{!}{=} 0.$$

Solving the first order condition for the optimal investment into risky loan assets $1-x^*$ yields $(1-x^*) = \frac{B-\frac{R}{p}}{2d}$ □

Intuitively, the optimal portfolio decision equalizes the marginal profit of the safe investment, which is zero, with the marginal profits of the risky investment.

I now introduce the economic problem that the banker is only limitedly liable, i.e., after he consumed his initial endowment, he cannot made liable if the asset returns from his investment portfolio fall short of his liabilities to depositors. In other words, from now on, I exclude the possibility of negative consumption.

3.2. The Banker's Investment Decision without Regulation

If the banker is limitedly liable, his future consumption can be at minimum zero. He therefore wants to maximize the following expected utility function.

$$E(U^{ltd}(K,x)) = c_1 + \frac{1}{\rho} \cdot E(c_2) \tag{5}$$

$$s.t.$$

$$c_1 = W - K$$

$$E(c_2) = \max\{p\,(xR_S + (1-x)R_L(x) - (1-K)R_D)$$
$$+(1-p)\,(R_S x - (1-K)R_D)\,;0\}$$

Lemma 3. *The unregulated banker prefers to consume all his endowments in $t = 1$ and borrow $D = 1$ from insured depositors.*

Proof. The right hand side of first order partial derivative with respect to inside equity investments is negative in each case, i.e., $\frac{\partial E(U^{ltd})}{\partial K} = -1 < 0$ if $E(c_2) = 0$ and $\frac{\partial E(U^{ltd})}{\partial K} = -1 + \frac{1}{\rho} \cdot R_D < 0$, otherwise. Therefore, the unregulated bank will always prefer to consume all its endowments in $t = 1$. □

With $K = 0$, the profit from bank investment is never positive, if the loan investment fails. Therefore, the first order condition with respect to the optimal portfolio choice variable x becomes

$$\frac{\partial E(U^{ltd})}{\partial x} = \frac{1}{\rho} \cdot p\,[R - R_L(x) + (1-x)R_L'(x)] \stackrel{!}{=} 0 \tag{6}$$

The marginal benefit from investing in the loan asset should equal the marginal benefit from investing in the safe asset, which is zero. Using the linear indirect demand function, the optimal investment of an unregulated bank into risky assets is

$$(1 - \hat{x}) = \frac{B - R}{2d} \tag{7}$$

Lemma 4. *A Limitedly liable banker takes excessive risk in the form of higher loan asset investments compared to optimal investment with full liability.*

Proof. Consider from Lemma 2 the optimal investment of a fully liable bank: $(1 - x^*) = \frac{1}{2}\frac{B - \frac{R}{p}}{d}$. For any positive default probability of risky assets $p < 1$, it holds that $\frac{R}{p} > R$ such that $(1 - x^*) < (1 - \hat{x})$ or $x^* > \hat{x}$ a fully liable banker invests more funds into safe assets and less into risky assets. □

3.3. The Banker's Investment Decision with Regulation

A risk weighted capital requirement in this model is reflected by a relative risk weight for risky loans compared to safe loans: $K \geq (1 - x) \cdot \Delta$. The relative risk weight $\Delta \in [0, 1]$ is a stark simplification of the granulated capital requirements of the Basel II and III accords but covers in essence the main mechanisms of the influence of risk weights on the portfolio choice of bankers.

A more realistic approach to Basel II would be a capital requirement $K \geq (w_S \cdot x + w_L(1 - x))\delta$, where δ is the unweighted percentage, i.e, 8 % of assets under Basel II, w_S is the risk weight for safe assets and w_L is the risk weight for risky assets. A zero risk weight for safe assets immediately results in $w_L \cdot \delta$, which corresponds to the Δ in the simplified approach. With a nonzero risk weight for safe assets the requirement can be written as $K \geq (w_S \cdot \delta + (w_L - w_S)\delta(1 - x))$. In this case, the optimal portfolio decision of the banker will not only be influenced by the overall size of the capital requirement but also by the relative risk weight, i.e., the decision is influenced by $(w_L - w_S)\delta$. This relative risk weight is also captured by the simplified Δ above. If the Δ corresponds to the relative risk weight $(w_L - w_S)\delta$ it is noteworthy that Δ can be increased by a higher risk weight for risky assets as well as by a lower risk weight for safe assets, respectively. This implies that a correct risk weight for risky loan assets but a comparatively too low risk weight for the safer asset, such as government bonds, is also reflected in a higher Δ.

The inside equity investment of the banker must at least equal a percentage Δ of its risky loan investment. As discussed above, a banker prefers consumption over investing inside equity, hence, the minimum equity requirement that the regulator sets will be a binding constraint to the bankers optimal investment decision $K = (1 - x) \cdot \Delta$. Inserting the binding requirement into equation (5) yields the regulated banker's objective function.

$$E(U^{reg}(x)) = c_1 + \frac{1}{\rho} \cdot E(c_2) \tag{8}$$

$$s.t.$$

$$c_1 = W - (1 - x) \cdot \Delta$$

$$E(c_2) = \max\{p\,(xR_S + (1 - x)R_L(x) - (1 - (1 - x) \cdot \Delta)R_D)$$
$$+(1 - p)\,(R_S x - (1 - K)R_D)\,; 0\}$$

Lemma 5. *For a relative risk weighted capital requirement $\Delta < 1$, the regulated banker does not make positive profits when his assets default.*

Proof. Recall from Lemma 1 that a banker defaults when his assets default whenever $(1 - x) > K$. Substitution of the binding relative risk weighted capital requirement $K = (1-x) \cdot \Delta$ gives $(1-x) > (1-x) \cdot \Delta$, such that the banker defaults whenever $\Delta < 1$. $\square$

In the case of $\Delta = 1$, the banker is forced to refund 100% of his assets with equity, such that he cannot default. However, this extreme regulation implies that the banker looses his role as a financial intermediary and is therefore excluded from the analysis.[14]

Lemma 5 shows that a regulated limited liable banker, i.e., a banker that is regulated with $\Delta < 1$ expects future consumption to be $E(c_2) = p\,(xR_S + (1-x)R_L(x) - (1-(1-x)\cdot\Delta)R_D)$ because with probability $1-p$ the bank makes negative profits such that the banker receives zero. This leads to the first order condition for the optimal portfolio choice variable x of

$$\frac{\partial E(U^{reg})}{\partial x} = \Delta + \frac{1}{\rho} \cdot p\left[(1-\Delta)R - R_L(x) + (1-x)R_L'(x)\right] \overset{!}{=} 0 \qquad (9)$$

Solving for the optimal portfolio investment gives the optimal investment in risky assets as a function of the regulation Δ:

$$(1 - \hat{x}(\Delta)) = \frac{B - \frac{\Delta\rho}{p} - (1-\Delta)R}{2d} \qquad (10)$$

It is straightforward to show that the investment choice of the representative bank into safe assets is increasing in the risk weight for risky assets: Note,

[14] Corresponding to the discussion above, Δ reflects the difference of risky and safe risk weights times the general capital requirement, i.e, $(w_L - w_S)\delta$. The risk weight w_L for a corporate may be above 100% , e.g. claims on corporations are assigned with a risk weight of up to 150% under the Standard Approach when the corporation rated below BB^-. However, even with a zero risk weight $w_S = 0$ the difference $(w_L - w_S)$ is multiplied by the general capital requirement δ, i.e., 8% under Basel II and up to 13 % under Basel III such that even under the higher requirements of Basel III it is feasible to assume that $\Delta < 1$.

that if the banker is not allowed to receive funds from depositors but has to refund his investment with equity only, i.e., $\Delta = 1$, the optimal investment of the regulated banker would be lower than the first best investment, due to the high opportunity cost of equity investment. In the other extreme case, when $\Delta = 0$ the banker's investment choice equals equation (7), the unregulated case.

Moreover, the partial derivative of the optimal safe investment choice with respect to the capital requirement regulation is positive:

$$\frac{\partial \hat{x}(\Delta)}{\partial \Delta} = \frac{1}{2} \frac{\rho - pR}{pd} > 0 \tag{11}$$

A higher risk weight for loan assets reduces investment in risky assets and increases investment in government bonds.

3.4. The Optimal Risk Weight of a Regulator without Fiscal Interest

Under the assumption that the regulator cannot regulate the asset side of the bank but only the liability side, the first best outcome cannot be implemented.[15] However, the regulator can force the bankers to internalize the cost of their excessive risk taking with the help of minimum capital requirement. The regulator thereby takes the investment decision $\hat{x}(\Delta)$ of bankers as given. To force the banker to internalize the full cost of his investment decision the regulator sets a Δ^* such that the regulated banker

[15] Actually, regulation under the Basel accords concentrates on liabilities of the bank rather than the regulation of assets: The main reason for this focus is the asymmetric information on the asset characteristics. As banks are specialized in evaluating the risk and return characteristics of their assets it is difficult, if not impossible, for a regulator to determine the optimal asset portfolio composition. However, anticipating that the incentives of bankers are disturbed by their limited liability, the regulator can correct these incentives by requiring the banker to invest sufficient equity funds.

implements $\hat{x}(\Delta^*) = x^*$. Formally, he sets $\Delta^* = \text{argmax}\{E(U^{fl}(x(\Delta))\}$ such that the Δ^* chosen fulfill the first order condition of the fully liable banker with reaction function $\hat{x}(\Delta)$.

Proposition 1. *The regulator without fiscal interest sets an optimal capital requirement risk weight for loan assets that balances the banker's benefit from limited liability with the private opportunity costs of investing equity*

$$\Delta^* = \frac{R \cdot (1-p)}{\rho - pR}.$$

Proof. The first order condition is

$$p(R - B + 2d(1 - x(\Delta)) + (1-p)R \stackrel{!}{=} 0.$$

Using equation (10) and solving for Δ yields the Δ^* for which it is true that $1 - \hat{x}(\Delta^*) = 1 - x^*$, i.e.:

$$(1 - \hat{x}(\Delta^*)) = \frac{B - \frac{\Delta\rho}{p} - (1-\Delta)R}{2d} = \frac{pB - pR - \Delta(\rho - pR)}{2dp}$$

Inserting $\Delta^* = \frac{R \cdot (1-p)}{\rho - pR}$ and using Lemma 2 yields:

$$\frac{pB - pR - R(1-p)}{2dp} = \frac{B - \frac{R}{p}}{2d} = (1 - x^*)$$

□

It is worth noting that the optimal capital requirement risk weight, and hence the demand for safe assets, is increasing in the risk less government bond rate R.

3.5. A Regulator with Fiscal Interests

This section analyzes how a regulator sets the capital requirement when he also has fiscal interests. In other words, I assume that the regulator gains some utility from forcing banks to integrate the negative externality of their investment. However, the regulator also gains utility from maximizing his current budget and, thus, wants banks and households to invest in government bonds. I focus on a short term oriented regulator that only values current consumption in $t = 1$. In particular, I assume that, besides regulating the banking sector, the government regulator wants to maximize his budget in $t = 1$.[16]

Requiring banks to refund their investments with inside equity in this model has two effects on: Firstly, the bank internalizes the risk and, therefore, invests less in loan assets compared to the unregulated decision. Secondly, the inside equity crowds out deposit investments of households. Since households have access to the sovereign debt market, those households that can not deposit their savings at a bank invest their savings in government bonds.

A regulator with fiscal interests then wants to maximize the weighted sum of utility he gets from setting Δ^* and the utility from his current budget $\hat{x}(\Delta) + (1 - \hat{x}(\Delta))\Delta$. The current budget consists of two terms, where the first term is the direct investment in government bonds from banks as a function of capital regulation and the second term the increased investment from households that cannot deposit their savings at banks due to the capital requirement. Both terms are increasing in the capital requirement, though the second term at a decreasing rate, since banks invest less in risky loans to minimize their private cost of capital requirements. Denote with $\Gamma(\Delta, \phi)$

[16] The weight that a government regulator puts on budget maximization can also be interpreted as a measure for the necessity to raise new debt in order to server outstanding debt. This is not explicitly modeled in this simple static model, but the intuition would be, that a government with high outstanding debt from earlier periods would have a greater interest to maximize its budget than a government that has low outstanding debt.

the utility of a regulator with fiscal interest, where the government regulator weights the goal of current budget maximization with ϕ and the achievement on his goal of optimal regulation with $(1-\phi)$.

$$\hat{\Delta}(\phi) = \text{argmax}\{(1-\phi)E(U^{fl}(x(\Delta)) + \phi\,[\hat{x} + (1-\hat{x})\cdot\Delta]\} \tag{12}$$

If $\phi = 0$, the regulator has no fiscal interest and sets the optimal capital requirement, i.e., $\hat{\Delta}(0) = \Delta^*$. However, if $\phi > 0$, the government regulator sets a capital requirement strictly greater than the optimal regulation.

Proposition 2. *A regulator with fiscal interests sets a higher relative risk weighted capital requirement on risky loan assets than a regulator without fiscal interests.*

Proof. The first order condition can be solved for Delta:

$$\Delta = \frac{p\,(1-\phi)\,(1-p)\,R^2 + (((2-\rho)\,\phi + \rho) - \rho\,(1-\phi))\,R - \phi\,(\rho + pB)}{(\rho - pR)\,(p\,(1-\phi)\,R + (\rho-2)\,\phi - \rho)}$$

The second partial derivative with respect to Δ is negative:

$$-\frac{1}{2}\,\frac{(1-\phi)\,(\rho-pR)^2}{pd} - \frac{\phi\,(\rho - pR)}{pd} < 0$$

The partial derivative of the optimal regulation with respect to ϕ is positive:

$$\frac{\partial\Delta}{\partial\phi} = \frac{pB - R + \rho - R}{((1-\phi)\,\rho - p\,(1-\phi)\,R + 2\,\phi)^2} > 0$$

Here the basic assumptions are used, i.e. that $pB > \rho$ and $\rho \geq R$. The higher ϕ, i.e., the more interested the regulator is in current budget maximization, the higher he sets the relative risk weighted capital requirement for risky loan assets. □

To get an intuition, consider the case where $\phi = 1$, the case of a Leviathan regulator that is only interested in maximizing his budget in $t = 1$. In this case, the first order condition can be summarized to the following condition:

$$\Delta = \min\left[\frac{1}{2}\left(1 + \frac{p(B-R)}{\rho - pR}\right), 1\right] = 1$$

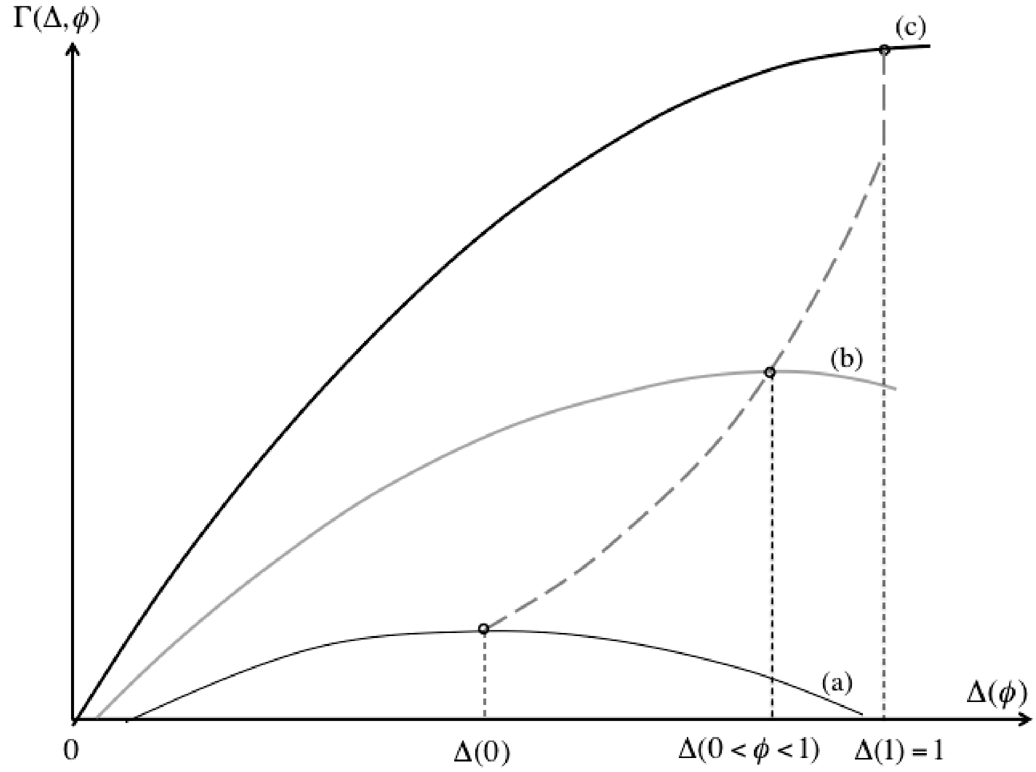
For the basic assumptions $pB > \rho$ and $\rho > R$, the first term is strictly greater than one, such that a Leviathan regulator would always choose the corner solution and sets the relative risk weighted capital requirement for risky loans equal to one.

In contrast, a regulator without fiscal interest sets a capital requirement strictly smaller than one, i.e. $\Delta^* < 1$ for $\rho > R$.

Moreover, as shown in the proof of Proposition 2, the capital requirement set by the regulator is strictly increasing in his fiscal interest ϕ, when the expected return from loan investment outweighs the banker's private cost of capital. The more a regulator is fiscally interested, i.e, the more he values current budget maximization (higher ϕ), the higher he sets the relative risk weight for loan assets, deviating from the optimal risk weight, i.e.: $\frac{\partial\Delta(\phi,R)}{\partial\phi} > 0$. Thereby, the regulator channels funds from bankers and households to investments in government bonds.

Figure 2 illustrates three different types of the government regulator. The thin black line, labeled (a), depicts the regulator's utility without any fiscal interest. He will set the risk weight for risky loan assets as described in Proposition 1. The thin grey line, labeled (b), illustrates the case of a partly fiscally interested regulator. The maximum of his utility function is reached at a higher relative risk weight for risky loan assets. The bold black line, labeled (c), depicts the utility of a regulator that is only concerned with fiscal interests, i.e., that only derives utility from current consumption. Such

Figure 2: The Regulator's Utility as a function of Δ and ϕ



a Leviathan optimally chooses a corner solution where he sets the risk weight as high as possible, which would be equal to full inside equity funding in our model framework. The dashed grey line depicts all feasible utility maximizing $\Delta(\phi)$ for $\phi \in [0, 1]$. A higher regulator's interest results in a higher overall utility level because in this simple setting the budget maximization adds utility to the utility gained from optimal regulation.

Basically, the regulator can implement any bank investment portfolio decision in the interval $[\hat{x}(0), \hat{x}(1)]$by setting a certain Δ. In other words, the risk weight decision directly influences how much the banking sector invests in safe assets $\hat{x}$. It is easy to verify that $x(\Delta(0)) < x(\Delta(\phi))$ for $\Delta(\phi) > \Delta(0)$, because x is linearly increasing in Δ. The benevolent regulator channels less funds into government bonds than the regulator with fiscal interests.

4. Welfare Considerations

The goal of optimal regulation to internalize the cost of risk shifting to the bank's optimal portfolio choice does not necessarily coincide with the welfare maximizing regulation of the banking sector. In particular, with no additional social cost of bank default, the regulation of banks in this simple model would be welfare decreasing. To see this, consider the welfare generated in terms of consumption.

In $t = 1$, the endowment of households is invested in banks and government bonds depending on the regulation. Banks consume $W - K$ and the government consumes K. The net welfare effect is zero, since higher regulation just shifts consumption from banks to the government regulator.

In $t = 2$, the productive return from the risky projects $\Pi^F(1 - \hat{x}(\Delta))$ is generated and split between the banks and the firms in terms of the loan interest rate. The residual profit of borrowers is shared between the successful entrepreneurs and the government according to the tax rate. Households receive and consume R, either from successful banks or the government in case of bank default. The government pays back its obligations to banks and households. Hence, the net welfare Y generated is the net profit from successful entrepreneurs $Y = (1 - x(\Delta)) \cdot p(B - \frac{d}{2}(1 - x(\Delta)))$.

Without any social cost of bank default, the net impact of investment in government bonds is a reduction in welfare. In particular, the capital regulation that maximizes the net profit from successful entrepreneurs is:

$$\Delta^Y = argmax(1 - \hat{x}(\Delta)) \cdot p(B - \frac{d}{2}(1 - \hat{x}(\Delta))) = -\frac{p(B + R)}{\rho - pR} < 0 \qquad (13)$$

Therefore, any capital regulation $\Delta > 0$ reduces welfare, because it reduces investment into the productive but risky sector. However, as the recent financial crisis has illustrated, bank failures are costly because of the contagion to other solvent banks, the disappearance of know how and private information on borrowers, as well as the disturbance of trust, financing, and payment flows. I assume that these costs are linear to the bank failure, though as the last crisis has shown, the costs could very well be convex, i.e. the more banks fail the higher are the marginal costs to society. Introducing these social costs s proportional to the banks that default, the welfare function can be written as

$$Y = (1 - x(\Delta)) \cdot p(B - \frac{d}{2}(1 - x(\Delta)) - s(1 - p) \cdot (1 - x(\Delta)) \qquad (14)$$

Proposition 3. *With moderate social cost of bank default, a fiscally interested capital regulation harms social welfare.*

The detailed proof can be found in the Appendix A. The intuition is that, with moderate social cost associated with bank default, i.e. $s \in \left[0, \frac{1}{2}\left(\frac{B+R}{1-p} + R\right)\right]$, setting a capital regulation $\Delta(\phi) > \Delta^*$ strictly reduces welfare. However, if the social costs are very high, i.e. $s > \frac{1}{2}\left(\frac{B+R}{1-p} + R\right)$ welfare can be increased by fiscally interested regulation. However, a regulator with high fiscal interest may not consider the constraint of government solvency and, therefore, may risk the detrimental welfare consequences of a sovereign default.

5. Discussion

The paper argues that a government regulator, who simultaneously regulates the banking sector and borrows from it, may have the incentive to increase risk weights for risky loan assets beyond the optimal level in order to ease its own debt financing. In particular, the government regulator may have an incentive to overregulate risky assets compared to safe assets. This incentive to overregulate is particularly interesting, since the most prominent international guidelines for prudential capital regulation, the Basel accords, only provide standards for minimum capital requirements but not for maximum requirements. Therefore, the Basel agreements leave room to overregulate classes of assets compared to less risky assets. By overregulating the risky assets, the government regulator can indirectly increase the demand for government bonds, thereby undermining the separation of monetary and fiscal policy.

Likewise, biased risk weighted capital regulation may be implemented in the form of underregulated safe assets compared to risky assets. If risky assets receive a fair risk weight that indeed reflects the fundamental risk of the asset, the government with fiscal interest may have an incentive to relatively underregulated the government bond compared to the risky asset. Anecdotal evidence may be found in the implementation of the Basel II agreement into European law. Deviating from the recommendations of Basel II, the Capital Requirement Directive imposed a zero-risk weight on all EU sovereign bonds. Arguably this lowest possible risk weight encouraged European banks to invest massively in these EU bonds because irrespective of the individual sovereign risk, the bank could invest without any additional equity requirement. In times of low interest rates but rare equity, the cheap borrowed capital was, therefore, channeled into EU government bonds.

In each of the two theoretical cases, biased capital ratios increase the demand for government bonds. This eases government spending and thus circumvents the monetary policy monopoly of an independent institution as the central bank. In other words, through risk weighted capital regulations, governments can indirectly influence their refunding conditions. Moreover, reduced cost of government debt may increase government spending. The increase in current government debt may jeopardize the government's solvency of tomorrow. However, if the yield on government bonds does not (fully) reflect the riskiness of the government regulator, this higher risk is not (fully) taken into account by the regulator with fiscal interests. This result points to an additional problem in the Eurozone, where government bond yields did not fully reflect the individual risk of each Eurozone member state. Besides the direct incentive to increase government debt due to cheap financing, the government regulator has the incentive to introduce biased regulation, thereby forcing banks to increase their investments in government bonds.

This could lead to an additional problem. Due to the excessive investment in government bonds, all banks are more correlated. If the government bonds can default, the systemic risk in the banking sector increases. If the financial distress of the regulator results in a systemic crisis of the banking sector, the feedback effect on the government through the safety net can drive the government and its banking sector into an insolvency circle.

The policy implications of the presented analysis are threefold: In the aftermath of the financial crisis, the reformers in the Basel Committee focused on the size and quality of the regulatory equity. In addition, anticyclical equity buffers are introduced. However, the calibration of the risk weights barely changed and the standards of implementation and supervision are no component of the reforms. This focus on the fine-tuning of the risk weighted capital regulation overlooks incentive problems regarding the national and supranational implementation of the Basel Accords. The problem of upwards biased capital adequacy regulation may be encountered by a simple maximum leverage ratio as discussed in the Basel III reform.

Moreover, the analysis suggests the equity regulation should be delegated to an independent authority because it has the power to indirectly influence monetary policy. For example, the delegation of regulatory policy, especially the imposition of risk weights, to an independent institution like the central bank could avoid the inherent conflict of interest. Finally, the analysis suggests that higher indebted governments have a higher incentive to bias capital regulation. In the process of international harmonization of banking regulation, the harmonization of maximum government debt levels may also alleviate the adverse incentives of governments to bias the regulation.

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Appendix A. Proof of Proposition 3

Proof. In $t = 1$, banks consume

$$W - K$$

Households invest

$$-W$$

The government consumes

$$x + K$$

and borrowers receive

$$1 - x$$

The net welfare is

$$W - K - W + x + K + 1 - x = 1.$$

In $t = 2$, banks consume

$$p(xR + (1 - x)R_L - (1 - K)R)$$

Households receive $p(1 - K)R$ from successful banks and $(1 - p)(1 - K)R$ from the government, taking over the liabilities from defaulting banks

$$p(1 - K)R + (1 - p)(1 - K)R + KR = R$$

The government receives tax income and pays pxr to banks or depositors in case of default, pays $(1-p)(1-K)R - KR$

$$\tau \cdot p(1-x)(B - R_L - \frac{d}{2}(1-x)) - pxR - (1-p)(1-K)R$$

and borrowers receive

$$(1-\tau) \cdot p(1-x)(B - R_L - \frac{d}{2}(1-x))$$

The intertemporal net welfareis

$$Y := 1 + p(1-\hat{x}(\Delta))(B - \frac{d}{2}(1-\hat{x}(\Delta))).$$

Using equation (10) the net welfare can be expressed in terms of the capital requirement:

$$1 + \left(\frac{1}{2} \frac{B\left(p(B-R) - \Delta(\rho - pR)\right)}{pd} - \frac{1}{8} \frac{\left(p(B-R) - \Delta(\rho - pR)\right)^2}{dp^2} \right) p$$

The first order condition with respect to Δ is

$$-\frac{1}{4} \frac{\left(p(B-R) - \Delta(\rho - pR)\right)(\rho - pR)}{dp^2} p \overset{!}{=} \frac{1}{2} \frac{B\left(\rho - pR\right)}{pd}$$

Solving for delta gives:

$$\Delta^W = -\frac{pB + pR}{\rho - pR} < 0$$

Introducing the social cost of bank default, the social welfare function becomes

$$Y^s := 1 + p(1-x)(B - \frac{d}{2}(1-x)) - s(1-p)(1-x)$$

Solving the first order condition for Δ gives:

$$\Delta^W(s) = \frac{2(1-p)s - p\left(B + R\right)}{\rho - pR}$$

The welfare optimal $\Delta^W(s)$ is between 0 and 1 for $s \in \left[\frac{B+R}{2(1-p)}, \frac{(\rho-pR)+(B+R)}{2(1-p)}\right]$. For $s = \frac{(\rho-pR)+R(1-p)}{2(1-p)}$, the welfare optimal Δ equals the benevolent regulator's choice. Therefore, for $s \leq \frac{(\rho-pR)+R(1-p)}{2(1-p)}$, the welfare is decreasing if the regulator has fiscal interests and sets a risk weighted capital regulation that is higher than the regulation that internalizes the risk shifting of limitedly liable banks. $\square$

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