Competition between Bank Regulators*

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Abstract

This paper examines competition between bank regulators in open economies. We use a model where credit demand of firms is endogenous and show any tendency for downward competition in regulation policy is limited by the effect of regulation on profits of nonfinancial firms. Moreover, perfect mobility on loans and deposit markets fully eliminates the incentives of regulators to set bank regulation at inefficient low levels.

JEL classification: D8, H0

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1 Introduction

Globalization and its effects on fiscal policy has been a long standing issue both in policy discussions and in academic debates. Today there is a widespread fear that governments choose to reduce taxes on internationally mobile tax bases and thereby expenditures in a game of competition between fiscal systems, even under the assumptions that governments act in the best interest of their citizens.[1] But globalization has not only made tax competition very fierce, it also has led to increasing competition between private institutions. Recently market integration has been most visible with respect to capital markets (see Haufler, 2001, and Sinn, 2003b). The result is increased international competition between financial institutions, in particular between publicly regulated banks.

In analogy to a possible outcome of fiscal competition the perception is that downward competition in banking regulation might result. Therefore, our paper builds on the seminal contribution of Stiglitz and Weiss (1981) to provide a more detailed look at the issue of international regulatory competition in banking regulation. The topic has received only limited attention in the literature, the exception being Sinn (2003a).[2]

It is well understood by now that banks do not necessarily have an interest in holding reserves. Following Stiglitz and Weiss (1981) banks are faced with a heterogeneous distribution of borrowers and cannot perfectly discriminate between them, hence they are confronted with a moral hazard problem. This creates an incentive in each of banks to follow more risky investment strategies because each perceives that the risk of banking can be shifted to depositors by means of reduced holding of reserves. However, since all banks are following this strategy, the result is an increase in the interest rate depositors are willing to accept on the capital market. Bank profits are lowered and marginal productivity of capital investment in firms rises above the social opportunity costs of capital. As a consequence, capital adequacy requirements would be useful from an aggregate point of view. A central result in Sinn's analysis is, however, that the regulatory agency in an open economy does not have an incentive to increase capital adequacy requirements because any such increase would tend to reduce the volume of capital investment in domestic banks. As a result, the analogue to the underprovision hypothesis

[1] In Mintz and Tulkens (1986) tax competition may also result in excessive taxation of a mobile tax base, leading to an overprovision of a public good. However, the less-than-optimal level of public good provision has received much more attention. See, e.g., Christiansen, Hagen, and Sandmo (1994), Edwards and Keen (1996) and Sinn (1997). Edwards and Keen also contrast the view of government as a maximizer of residents' welfare with the opposing one of governments as revenue maximizers.

[2] Freixas and Rochet (1997) offer a most comprehensive discussion of the literature on financial intermediation.

in the fiscal competition literature – downward competition in banking regulation – may result from globalization of financial markets. The present paper rationalizes this view. But we also show in a model extension with endogenous demand for loans that efficient use of capital adequacy requirements can be established under much weaker assumptions than the previous analysis suggests. Indeed, minimum capital requirements are widely implemented throughout the world and are heavily used in the international Capital Accords, known as Basel I and Basel II.

However, we cannot rule out any possibility for inefficiently low capital adequacy requirements. Moreover, efficient use of regulatory instruments requires that the regulator is able to collect a great amount of information. Against this background a policy relevant and intellectually challenging question to ask is which relevant private institutions are able to establish an efficient allocation, even in the absence of regulatory policy? The present paper also provides answers to this question in a separate subsection. The starting point is based on the perception that bank depositors are not in a position to control the operations of international banks. In addition, national regulators who defend their nation's interests are not willing to control the activities of domestic banks. Hence, excessive risk taking by banks must be eliminated by some other institution. This institution is not a hypothetical one. It exists if one takes the model of international competition serious.

The essence of international competition is that the internationalization of markets changes the economic environment for national policies. Previous literature considered the case where the market for deposits is international, but the market for loans is assumed to be national. Taking the model of international competition serious, implies, however, a symmetric treatment of both markets. This distinction between models is not a semantic one. We show that the problem of international regulatory competition vanishes if the problem is taken seriously. International competition exactly eliminates the rents within the banking sector that have the potential to create inefficient regulatory competition. The reason is that the creation of an international market for loans reduces bank profits in our model, which, in turn, eliminates the motives for excessive risk taking.

The paper proceeds as follows. The following section develops the model. Section 3 discusses the policy outcome in the two scenarios mentioned above. Section 4 concludes.

2 The Model

To discuss the competition between bank regulators consider a set of identical countries $i = 1, \ldots, N$ which are linked through perfect capital mobility. Each of the identical economies are assumed to be small in the sense that each takes the international price for capital as given. Any country is inhabited by a representative individual who supplies financial capital to the banking industry. Banks lend capital to private firms, which produce a homogeneous good using capital as input.

Regulator and markets Even in this simple economy the flows of real and financial capital imply a complicated net of transactions. For the purpose of this paper we assume in line with most of the literature on fiscal policy in open economies that the individual in the country under consideration have unlimited options for their worldwide financial investment (as in, e.g., Sinn, 2003a). The existence of an international market for financial capital then ensures that financial capital is allocated to the country where the return per unit of financial capital is highest, implying equalization of interest rates for savings worldwide. With regard to the banking industry we assume the existence of a representative bank within each country. We consider a situation where national regulators have limited power in the sense that they can only impose restrictions on the behavior of banks residing within the country, but not on banks residing abroad. Regulators require banks to hold a certain amount of equity capital, $\overline{C}_i$, in government bonds, which yield a secure interest rate s. Figure 1 describes the structure of institutions on capital markets. Arrows indicate the direction of capital flows.

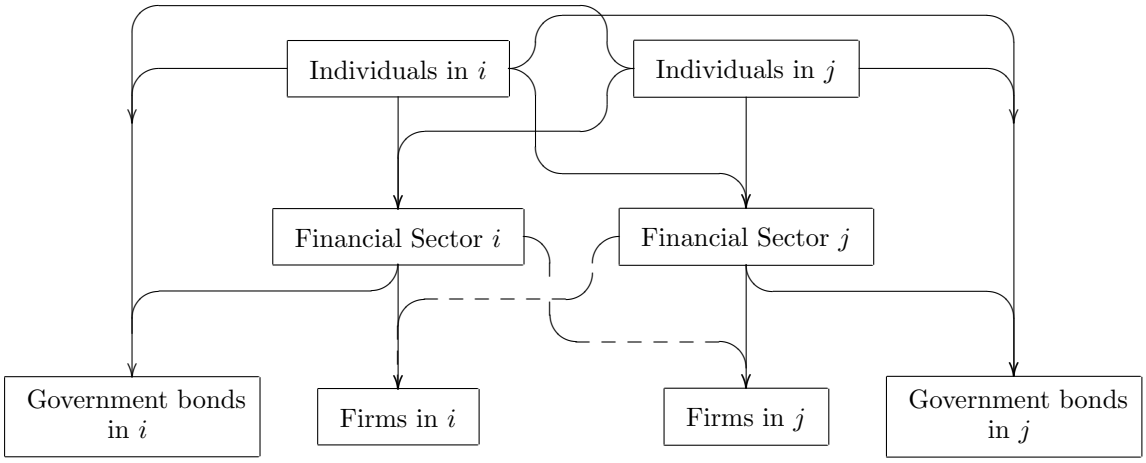

Figure 1: Institutional structure of regulatory competition.

We consider an economic environment where residents in country i may either invest in riskless government bonds in any country or invest in the financial sector in any country. Additionally, they can fund financial institutions with equity capital. Household investors need these financial institutions to channel their funds to firms. Financial institutions, called 'banks' in the following to have a simple wording, have unlimited access to government bonds and to firms in country i. Banks choose the funds they supply to domestic firms. However, the options of banks to provide funding to foreign firms might be limited, as indicated by the dashed lines in figure 1. We will discuss the implications of both scenarios on optimal regulator policy in the following section.

Firms There are n firms with limited liability in each country. Firms' owners are risk neutral and profits from business activity may be shared between domestic and foreign residents. Each of firms borrows one unit of capital from the banking industry. Firms within an arbitrarily chosen country i differ in their productivity a_i. Being unable to observe a_i, the banking industry cannot discriminate among firms. The banking industry offers the same contract to firms, in which all firms have to repay an amount fixed by the bank. Let the continuous random variable a_i be distributed according to the cumulative distribution function $p(a_i \geq \tilde{a}_i) : [0, n] \rightarrow [0, 1]$ and the probability density function $f(n)$. Denote costs per unit of capital for i-firms by $\tilde{a}_i$. Assuming that initial equity capital in firms is zero, expected profit of a firm in country i is obtained from

$$E(\pi_i) = p(a_i)(a_i - \tilde{a}_i) + (1 - p(a_i)) \max\{0 - \tilde{a}_i, 0\}. \tag{1}$$

Inspection of (1) shows that the marginal firm is characterized by $a_i = \tilde{a}_i$. Since projects are indivisible, the total demand for loans is given by the number of firms with productivities of at least $\tilde{a}_i$. Denote by $l_i^d = \int_{\tilde{a}_i}^{n} 1\, da_i$ total investment demand of i-firms for a given productivity $\tilde{a}_i$. Expected profits of firms in country i are

$$E(\Pi_i) = \int_{\tilde{a}_i}^{n} p(a_i) \cdot (a_i - \tilde{a}_i)\, da_i. \tag{2}$$

Households The representative individual is risk-neutral and endowed with a capital good. The individual has access to an international market for financial capital and allocates savings between banks or government bonds and banks' stocks at home, and banks or government bonds and banks' stocks abroad to maximize expected income. Perfect capital mobility will eliminate any difference between countries in effective re-

turns from all types of investment. Let s be the riskless return from internationally traded government bonds and x the return to stocks. As households are risk neutral, they do not demand a risk premium on equity capital. Furthermore, we assume there is no moral hazard between bank managers and banks' owners. Thus, arbitrage ensures the return to stocks being equal to the return of riskless government bonds in expected values, $E[x] = s$. Hence, for decision making bank managers calculate with cost of equity capital of s. Let r denote the return in bonds offered by banks. Anticipating the result to be derived below that banks choose to minimize equity capital, we may already note here that r is a risky return in a situation where bank liability is limited because of lax regulatory policy. In contrast, $r = s$ holds in the case where the minimum equity requirement imposed by the regulator in each country is such that equity capital always suffices to repay households.

We may now give a detailed description of household behavior. We consider the case where household investors are unable to differentiate countries by the imposed level of regulation and therefore cannot monitor the risk of banks at a given location. This assumption makes the problem of international competition in banking regulation economically interesting. It clearly mirrors the costs of collecting country-specific information that households have to bear. Households can, however, use an indirect indicator for the riskiness of banks, which is the average risk of banks in market equilibrium. This is an internationally representative bank's probability that firms funded are profitable. The representative bank's loan portfolio fails otherwise. Furthermore, the repayment to households per unit of deposit is smaller than one, $\overline{C}_i/l_i^s < 1$, in cases where investment of banks in firms fails to be successful, if the equity capital of a bank, $\overline{C}_i$, does not meet the level of bank loans given to firms, l_i^s.

Households choose their portfolio by comparing the expected return from savings deposits with the rate of return obtained from investment in government bonds. Arbitrage opportunities are exhausted once the return per unit of capital in riskless government bonds equals the expected return to capital investment in banks.

$$(1+r)\,\overline{p}(q_i) + (1-\overline{p}(q_i))\,\min\left\{(1+r), (1+s)\frac{\overline{C}_i}{l_i^s(q_i)}\right\} = (1+s), \tag{3}$$

where q_i denotes the market return for loans offered to i-firms and $\overline{p}$ is the average probability of bank survival. Note that $(1+r)$ depends solely on this average probability and is independent of the choice of q_i by the banking sector in a single country. The reason is that, according to our assumptions, households cannot monitor the country-

specific riskiness of banks and demand the same market return for their deposits in each country.

The expected income of an individual residing in country i, out of bank bonds, is

$$E(u_i) = \overline{p}(q_i)(1+r)(e_i^i + e_i^j) + (1-\overline{p}(q_i)) \min \left\{ (1+r), (1+s)\frac{\overline{C}_i}{l_i^s(q_i)} \right\} (e_i^i + e_i^j), \quad (4)$$

where e_i^i is the capital allocated to banks in country i and e_i^j denotes capital investment in the banking sector abroad, $e_i = e_i^i + e_i^j$.[3]

Banks Banks maximize expected profits. Each can finance business loans to firms using savings deposits, and by equity capital. We assume that the banks are informed about the distribution of productivities in the firm sector, but have limited information about the productivity of a single firm. Moreover, all firms are assumed to have the same amount of collateral, which therefore cannot be used as a screening device. Being unable to observe the firm-specific a_i, the banking sector cannot use productivities as a screening device. To rationalize a positive level of bank profits let us assume that, in each country i, there is one, monopolistic bank.[4]

To characterize the behavior each of banks let us denote by C_i the capital the bank located in country i has at the beginning of the period. Banking regulation forces banks to hold a minimum level of this capital, $\overline{C}_i$, in government bonds. We denote by c_i^b the voluntary investment in domestic government bonds exceeding $\overline{C}_i$ and by c_i^f the part of capital used for loans offered to firms. Thus:

$$C_i = \overline{C}_i + c_i^b + c_i^f. \quad (5)$$

The loans, l_i^s, supplied by banks must be financed either from equity capital, c_i^f, from savings deposits from households residing at home, e_i^i, or abroad, e_j^i. Hence,

$$l_i^s = c_i^f + e_i^i + e_j^i.$$

If bank's investment in firms turns out to be profitable, then the bank will be able to service the bonds issued, it will receive interest from equity capital, and the value of the

[3]Implicitly we assume at this stage $\overline{p}(q_i) = \overline{p}(q_j)$ and $\frac{\overline{C}_i}{l_i^s(q_i)} = \frac{\overline{C}_j}{l_j^s(q_j)}$. However, this does not restrict our analysis because we assumed countries to be symmetrical.

[4]The main focus of our analysis is on regulatory competition between countries, thus we abstract from more complicated market structures on the country level.

bank, before user costs of capital s, will be $(1+s)(\overline{C}_i+c_i^b)+(1+q_i)(l_i^s)-(1+r)(l_i^s-c_i^f)$. In contrast, if the investment in firms is not profitable, then its value equals $(1+s)(\overline{C}_i+c_i^b)-(1+r)(l_i^s-c_i^f)$ or 0, whichever is higher. We get the average probability of the investment portfolio being successful, $\overline{p}(q_i)$, by summing up the success probabilities of each firm funded and dividing by the number of firms funded by the bank in country i. Since each of firms uses one unit of capital, the number of firms is $l_i^s(q_i)$ and we define:

$$\overline{p}(q_i)=\frac{\int_{q_i}^{n} p(a_i)\,da_i}{l_i^s(q_i)}.$$

Multiplying the possible states of bank value with their probabilities, summing up over all firms and subtracting the end-of-period value of the initial equity capital using (5) gives expected profits of the bank:

$$\begin{aligned}E(B_i)=&\left[(1+s)(\overline{C}_i+c_i^b)+(1+q_i)l_i^s(q_i)-(1+r)(l_i^s(q_i)-c_i^f)\right]\overline{p}(q_i)\\&+\max\left\{(1+s)(\overline{C}_i+c_i^b)-(1+r)(l_i^s(q_i)-c_i^f),0\right\}(1-\overline{p}(q_i))\\&-(1+s)(\overline{C}_i+c_i^b+c_i^f).\end{aligned}\tag{6}$$

The bank maximizes $E(B_i)$ choosing c_i^b, c_i^f and the return for loans to firms, q_i, taking as given r, s and $\overline{C}_i$. To discuss the bank choices we have to differentiate (6) for the three choice variables and to discuss the resulting expression for all possible values of $\overline{C}_i$.

Differentiation of (6) with respect to c_i^b shows that $dE(B_i)/dc_i^b=0$ for all levels of c_i^b, conditional to the requirement that equity always suffices to repay bank lenders. It is this case where the maximum value function in the second line of (6) is not binding. The economic argument for the result is that, for a given c_i^f, the bank is indifferent between all levels of C_i. The reason is that a unit increase in c_i^b causes costs s, which is equal to the return per unit of capital invested in government bonds, as c_i^b is not needed for paying out households in bad states of the world. Consider next the contrasting case where the liability constraint is binding. Inspection of (6) shows that $dE(B_i)/dc_i^b=(1+s)(\overline{p}(q_i)-1)<0$ for all levels of c_i^b. The argument here is that shifting downward risk and losses to households is profitable for a bank with limited liability. The bank invests as little as possible equity capital in government bonds in order to maximize profits, as this equity capital would only increase income of lenders in bad states of the world where the bank fails anyway. In order to simplify the exposition it is therefore sensible

to assume throughout the following discussion that banks will choose to minimize c_i^b.

Turn next to the choice of c_i^f. In the case where the maximum value function in the second line of (6) is not binding we find that

$$\frac{dE(B_i)}{dc_i^f} = (1+r) - (1+s) = 0 \quad \forall c_i^f \qquad \text{since} \qquad r = s. \tag{7}$$

The condition is understood from the observation that bonds issued by banks and government bonds are perfect substitutes in a situation where equity capital always suffices to pay out bank lenders. Hence, banks always have to pay out a rate of return of s to its lenders, independent of refinancing by bonds or equity. In other words, they are indifferent with respect to the preferred level of c_i^f. In case of limited liability the condition for c_i^f becomes

$$\frac{dE(B_i)}{dc_i^f} = (1+r)\overline{p}(q_i) - (1+s). \tag{8}$$

At $\overline{C}_i = 0$, expressions (3) and (8) coincide and the bank is indifferent. At $\overline{C}_i > 0$ we have $(1+r)\overline{p}(q_i) < (1+s)$ from arbitrage condition (3), implying that it is profitable for the bank to reduce equity capital, $dE(B_i)/dc_i^f < 0$. The economic argument behind the result is that the bank finds it advantageous to shift the risk of banking from equity owners to household bank lenders. Even though rational households, anticipating this effect, are demanding an risk adjusted return for their savings deposits, financing firms through savings deposits is cheaper than funding firms via equity as long as only part of the capital deposited in banks is backed by equity capital.

The following lemma summarizes the discussion:

Lemma 1 (Bank equity policy) *Bank equity policy can be characterized as follows: (i) The bank chooses not to use equity for investment in government bonds, $c_i^b = 0$. (ii) The bank finances investment in firms by use of savings deposits, $c_i^f = 0$. (iii) From part one and part two follows: (a) The bank finances loans given to firms by savings deposits, $e_i^i + e_j^i = l_i^s$. (b) The chosen level of equity capital is equal to the minimum level of equity capital required by the regulator, $C_i = \overline{C}_i$.*

We can then use lemma 1 to write the condition for the profit-maximizing choice

of q_i in the case where the bank's equity capital matches the repayment obligation as[5]

$$\frac{dE(B_i)}{dq_i} = l_i^s(q_i)\overline{p}(q_i) - (1+q_i)p(q_i) - (1+r)l_i^{s\prime}, \tag{9}$$

The condition for optimal loan pricing will be

$$\begin{aligned}\frac{dE(B_i)}{dq_i} &= l_i^s(q_i)\overline{p}(q_i) - (1+q_i)p(q_i) - (1+r)l_i^{s\prime} \\ &- \frac{(1+s)C_i - (1+r)l_i^s(q_i)}{l_i^s(q_i)}\, p(q_i) - \frac{(1+s)\overline{p}(q_i)C_i - (1+r)l_i^s(q_i)}{l_i^s(q_i)}\, l_i^{s\prime},\end{aligned} \tag{10}$$

if the limited liability constraint is binding. Inspection of (10) shows that this condition extends (9) by the external effect in the second line. The external effect increases bank profits if the positive effect of limited liability (first term) will dominate the negative effect caused by a potential decrease in the demand for loans when q_i increases (second term). It follows from this argument that $l_i^{s\prime}$ has a strong effect on the the behavior of banks. To evaluate $l_i^{s\prime}$ we have to close the model by including the market clearing condition on the loans market. Two institutional structures are relevant here, and we will discuss both of them in the following.

The market for loans We consider two economic environments which differ in the assumptions on the structure of the loan market. First, consider the case where markets for loans are national, that is the capital flows described by dashed lines in figure 1 are absent. Here, firms only have access to domestic banks to finance real investment because transaction costs are prohibitive. Market clearing on the capital markets for business loans requires that capital supply from banks, l_i^s, equals capital demand from firms, l_i^d, in each country. The domestic price for capital in firms, $\tilde{a}_i$, equals capital costs chosen by banks, q_i. To summarize

Lemma 2 (National market for loans) *In the case where financial choices of firms are limited clearing on the loan markets requires that* $l_i^s = l_i^d = \int_{q_i}^{n} 1\, da_i$.

We note that our focus on a symmetric equilibrium implies $q_i = q_j$. Let us discuss the consequences of a change in the minimum equity on bank policy, given that the markets for loans are national. Observe that lemma 1 holds irrespective of (9)-(10). Assuming that the profit maximum is characterized by an interior solution for q_i we make use

[5]Note that prime might indicate discrete jumps for changes in q_i from lemma 3 below.

of (9), (10) and lemma 2 to obtain

$$\frac{\partial q_i}{\partial \overline{C}_i} = 0 \qquad \text{for} \qquad (1+s)\overline{C}_i - (1+r)l_i^s \geq 0, \tag{11a}$$

$$\frac{\partial q_i}{\partial \overline{C}_i} = -\frac{(1+s)}{d^2E(B_i)/dq_i^2}\frac{\partial \overline{p}(q_i)}{\partial q_i} < 0 \qquad \text{for} \qquad (1+s)\overline{C}_i - (1+r)l_i^s < 0. \tag{11b}$$

The second institutional environment we discuss is one where firms have unlimited access to an international market for loans. Let us postulate that i-firms borrow capital from banks located in country i whenever $q_i \leq q_j$, i.e., they borrow at home also in case of indifference. Firms located in i borrow from banks abroad at $q_i > q_j$. Recall that $l_i^d = \int_{\tilde{a}_i}^n 1\, da_i$ is total investment demand of i-firms. The level of capital borrowed at home is denoted by l_i^{id}, and l_i^{jd} gives the level of capital borrowed abroad, $l_i^d = l_i^{id} + l_i^{jd}$. With this notation we may summarize arbitrage opportunities at a given vector of capital costs as follows

Lemma 3 (International market for loans) *In the case where firms have access to banks abroad market clearing on the loan market requires that* $l_i^s + l_j^s = l_i^d + l_j^d$.
Arbitrage opportunities of firms can then be summarized as follows:

(a) If $q_i \leq q_j \quad \Rightarrow \quad l_i^d = l_i^{id} = \int_{\tilde{a}_i = q_i}^n 1\, da_i \quad \wedge \quad l_i^{jd} = 0,$

(b) If $q_i > q_j \quad \Rightarrow \quad l_i^d = l_i^{jd} = \int_{\tilde{a}_i = q_j}^n 1\, da_i \quad \wedge \quad l_i^{id} = 0.$

Lemma 3 implies $q_i = q_j$ in an equilibrium on the market for loans. We note that this is a property of equilibrium due to perfect capital mobility and it is not a consequence of the assumption of symmetric policy outcomes. To develop the argument we use lemma 3, (10) and (9). Start assuming that expected profits of banks in all countries are positive and consider three cases. (i) The bank in country i sets $q_i > q_j$. Then all i-firms characterized by productivities $q_j \leq a_i$ finance investment by lending from j-banks, j-firms borrow at their home location. (ii) Assume next $q_i < q_j$. As a result, i-banks attract i-firms and the worldwide demand for loans of j-firms with productivities $q_i \leq a_j$. (iii) Assume $q_i = q_j$. In this case firms in each country borrow from banks at their home location.

To sum up cases (i)-(iii), the bank in country i can attract world demand for loans by undercutting its competitors. The positive effect on bank profits in country i from the discrete inflow of capital caused by a reduction of q_i below q_j dominates adverse marginal effects on bank return unless (i) $(q_i - r)l_i^s(q_i)\overline{p}(q_i) = (1+s)\overline{C}_i\,(1-\overline{p}(q_i))$ at $\overline{C}_i < (1+r)l_i^s/(1+s)$, or, (ii), $1+r = (1+q_i)p(q_i)$ at $\overline{C}_i \geq (1+r)l_i^s/(1+s)$.

In both cases expected profits in (6) are zero. Similarly, the bank in country j can attract demand for loans of all firms worldwide with productivities $q_j < a$ by choosing $q_j < q_i$. The positive effect on profits of the discrete capital inflow caused by a reduction of $q_j < q_i$ dominates the second-order losses unless (iii) $(q_j - r)l_j^s(q_j)\overline{p}(q_j) = (1 + s)\overline{C}_j\,(1 - \overline{p}(q_j))$ at $\overline{C}_j < (1 + r)l_j^s/(1 + s)$, or, (iv), $1 + r = (1 + q_j)p(q_j)$ at $\overline{C}_j \geq (1 + r)l_j^s/(1 + s)$.

Given that $q_i = q_j$ and $E(B_i) = E(B_j) = 0$ we can use (10) to derive the structure of q_i and $\overline{C}_i$. We know that (10) becomes negative in the case where $l_i^{s\prime}$ approaches minus infinity. It follows that banks always behave as if they were fully liable. More formally we have, in the situation where liability is limited, that each of banks will set a mark-up $q_i - r$, given by $(q_i - r)l_i^s(q_i)\overline{p}(q_i) = (1 + s)\overline{C}_i\,(1 - \overline{p}(q_i))$. Moreover, we have from the arbitrage condition of household investors (3) that

$$r = \left[l_i^s(q_i)(1 + s - \overline{p}(q_i)) - (1 - \overline{p}(q_i))(1 + s)\overline{C}_i\right] / \left[\overline{p}(q_i)l_i^s(q_i)\right] \tag{12}$$

for the case where liability is limited. Using (12) in the zero-profit condition above gives $(1+q_i)\,\overline{p}(q_i) = 1+s$, which holds for all levels of $\overline{C}_i$. That is, also in the case of full liability. The result, thus, is that competition between banks on the market for loans eliminates any incentives of banks to create externalities on household investors on the market for bank deposits. We may summarize this finding in a first proposition:

Proposition 1 (Allocation with an international market for loans) *The allocation with an international loan market is characterized by* $(1+q_i)\,\overline{p}(q_i) = 1+s$. *Expected profits of banks are zero for all levels of* $\overline{C}_i$.

We are now in the position to characterize the incentives for regulator in country i. This is done in the subsequent section both for lemma 2 and lemma 3.

3 Competition between Regulators

To characterize the outcome of decentralized decision-making, we first need to assume some explicit objective function for the regulator. In particular, assume the regulatory institution in each country maximizes the utility residents derive from their capital investment. This income is composed out of three terms: (i) income from bank deposits, (ii) bank profits and (iii) firms profits. Denote by α the share of i-residents among the people lending to banks in country i, let β be the stake of i-residents in banks in coun-

try i and let γ denote the ownership stake of i-residents in firms located in country i. Then, national welfare can be written as follows:

$$W_i = \alpha E(u_i) + \beta E(B_i) + \gamma E(\Pi_i). \tag{13}$$

In the following we use (13) to discuss the effects of a change in the minimum equity capital requirement on welfare in two scenarios which differ in the assumptions on the economic environment.

3.1 Regulatory competition with a national market for loans

The regulator chooses the minimum equity requirement to maximize (13) realizing that the choice of $\overline{C}_i$ will have economic effects only in the case where liability of the bank is limited.[6] The condition that determines the choice of the policy variable $\overline{C}_i$ in the case where banks have limited liability and lemma 2 applies, reads:

$$\begin{aligned}\frac{dW_i}{d\overline{C}_i} =&(1+s)(\alpha-\beta)\left(1-\overline{p}(q_i)\right)+\alpha\,\overline{p}(q_i)\,(1+r)\,\frac{\partial l_i^s}{\partial q_i}\frac{\partial q_i}{\partial \overline{C}_i}\\ &-\alpha\left((1+s)\overline{C}_i-(1+r)l_i^s\right)\frac{\partial \overline{p}(q_i)}{\partial q_i}\frac{\partial q_i}{\partial \overline{C}_i}-\gamma\int_{\tilde{q}_i}^{n} p(a_i)\,da_i\,\frac{\partial q_i}{\partial \overline{C}_i}\end{aligned} \tag{14}$$

where we used lemma 1, $e_i = l_i^s$ from symmetry and the first-order condition of banks (10) after differentiation of (13) to obtain (14). Denote by C_i^* the level of the minimum equity capital requirement chosen by the regulator.

Equation (14) consists out of four terms. The first one represents the redistribution from bank owners to bank lenders as a consequence of an increase in the equity requirement in an environment where bank liability is limited. The second term captures the fact that households expand their investment in domestic banks, which become less riskier and therefore deliver a higher expected return than government bonds. Third, a higher equity requirement induces banks to take fewer risks and reduces the likelihood of bank failure. The fourth reflects the effect of higher equity requirements on firm profits.

Inspection of (14) shows

Proposition 2 (Regulation with a national loan market) *The minimum equity requirement set by the regulator in an open economy: (i) C_i^* is increasing with the share of residents among bank lenders, α. (ii) C_i^* is decreasing with the ownership stake of*

[6] With full liability of banks a policy change will not have any effect on welfare from (11).

i-residents in i-banks, β. (iii) C_i^* is increasing with the ownership stake of i-residents in i-firms, γ. (iv) The allocation is Pareto efficient only if C_i^* is such that banks are fully liable.

An implication of proposition 2 is that the condition for the optimal minimum equity requirement (14) can in principle be negative for all levels of $\overline{C}_i$, implying that $C_i^* = 0$. Condition (14) is equal to zero at $0 < C_i^* < (1+r)l_i^s/(1+s)$, or condition (14) is positive for all levels of C_i, implying that $C_i^* \geq (1+r)l_i^s/(1+s)$. Results depend on the relative weights of the three potential sources of income that are included in the welfare function.

Proposition 2 also clarifies that international capital flows, cross-ownership of firms and banks are potential sources for lax regulatory policy. If cross-ownership were absent, the regulator in each country would not have any incentive to establish a *laissez-faire* regime in banking policy, which leads to a partial expropriation of household investors, bank owners or firms owners, or all. The result is in line with a main finding in Huizinga and Nielsen (1997) that cross-ownership in firms may lead to overly high tax rates in a model of international tax competition. The result is even closer to a related analysis of Sinn (2003a), who, in a nutshell, concludes that bank regulation is inefficient if there is any at all. The argument of Sinn is that the share of foreign lenders exceeds the share of foreign bank owners, at least in Germany. Given this parameter specification, lax regulation is indeed a possible policy outcome, however, this need not to be the case in our model. The model yields the insight that banking regulation will probably be inefficient, but laxity is not as grave as suggested by models that do not incorporate the change in firm profits that follows a change in regulatory policy. Indeed, a natural case is the one where the adverse effects of lax regulation on profits outweighs the positive effects of lax regulation on the profits of banks.

Proposition 2 rests on the assumption that the loan market is national. A natural question, thus, is whether the laxity in regulatory policy can be overcome by introducing competition on the market for loans. The main result of the following section is that an international market for loans does indeed not eliminate incentives for regulators to engage in regulatory competition, however, this competition does not harm welfare and results in a Pareto-efficient equilibrium.

3.2 Regulatory policies in the presence of an international loan market

Consider an economic environment where lemma (3) applies. This is the case where firms have unlimited options to finance investment on the international loan market. The banking sector in each of countries faces a perfectly elastic demand for capital from firms on the worldwide market for loans. We maintain the assumption that households are only able to observe the average probability of bank survival and household investors still demand a rate of return r from the banking sector in country i for each unit of capital invested from the no-arbitrage condition (3). Assume that banks have limited liability. Thus, (6) can be written as

$$E(B_i) = \left[(1+q_i)\overline{p}(q_i) - (1+r)\overline{p}(q_i) - (1-\overline{p}(q_i))\,(1+s)\frac{\overline{C}_i}{l_i^s(q_i)}\right] l_i^s(q_i). \qquad (15)$$

The first term in squared brackets in (15) is expected revenue per loan, the second includes costs per loan in the good state of the world and the third costs per loan in the bad state. The second and the third together give *expected* costs per loan. Given this economic environment, the regulator chooses the minimum equity requirement to maximize (13). In the following we will characterize this choice.

Consider the symmetric case where $\overline{C}_i = \overline{C}_j$, implying zero profits from Proposition 1. Let us start assuming the regulator in country, say, i increases $\overline{C}_i$ such that $\overline{C}_i > \overline{C}_j$. An increase of q_i above q_j, is not profitable for banks from Lemma 3. The change in $\overline{C}_i$ does not have an effect on costs in the good state of the world because the expenses caused by the increase in the minimum capital requirement are identical to the additional income generated. In the bad state, costs per loan in the banking sector of country i are $(1+s)\overline{C}_i/l_i^s(q_i)$ and revenue is nil. As an implication, *expected* costs per loan $(1+r)\overline{p}(q_i) + (1-\overline{p}(q_i))\,(1+s)\overline{C}_i/l_i^s(q_i)$ are higher than $(1+s)$ from (3) and therefore exceed $(1+q_i)\overline{p}(q_i)$, where the latter term is equal to $1+s$ from Proposition 1. It follows that i-banks leave the market (as banks choose to minimize equity capital from Lemma 1). Firms finance real investment by borrowing from j-banks and households invest their savings in j-banks. To summarize outcomes, an isolated increase in $\overline{C}_i > \overline{C}_j$ leaves banks, households and firms indifferent. Thus the policy change has no effect on welfare for all α, β.

Consider now the situation where country, say, i sets $C_i < C_j$. *Ceteris paribus* this increases $E(B_i)$ since costs per loan in the good state of the world are unchanged

and costs in bad state of the world $(1-\overline{p}(q_i))(1+s)\overline{C}_i/l_i^s(q_i)$ decrease. Therefore, the expected return of capital that household investors receive is smaller that $(1+s)$. We may now check whether a reduction $q_i < q_j$ is profitable for the bank in country i. The reduction of q_i allows to attract world demand for loans from Lemma 3. As a result the market share of j-banks approaches zero and j-banks leave the market from Lemma 1. It follows that the average success probability of investment portfolios of banks world-wide collapses with the success probability of the investment portfolio of the bank in i. Hence, households are able to gather information about the risk structure in the banking sector and will adjust r such that (3) holds. To summarize, the decrease in $q_i < q_j$ reestablishes that the bank in i faces expected costs per loan equal to $(1+s)$ (the sum of the second and the third term in squared bracket in (15)). We may now determine the effect of a decrease in q_i on the first term in (15). Differentiation gives

$$\frac{\partial(1+q_i)\overline{p}(q_i)}{\partial q_i} = \overline{p}(q_i) + (1+q_i)\frac{\partial \overline{p}(q_i)}{\partial q_i} > 0 \text{ since } \frac{\partial \overline{p}(q_i)}{\partial q_i} = -\frac{\overline{p}(q_i)l_i^s + \int_{q_i}^{n} p(a_i)da_i l_i^{s\prime}}{l_i^{s\,2}} > 0,$$

because $l_i^{s\prime} \to -\infty$. A decrease in q_i lowers expected revenue and therefore $(1+q_i)\overline{p}(q_i) < (1+s)$. The expected revenue per loan, $(1+q_i)\overline{p}(q_i)$, is smaller than its costs, $(1+s)$ and expected profits become negative. To summarize, a reduction $q_i < q_j$ is not profitable for the bank in country i. In all cases, an isolated decrease $\overline{C}_i < \overline{C}_j$ redistributes income from households to banks and has no effect on firms. Thus the policy change increases welfare as long $\alpha < \beta$ and reduces welfare if $\alpha > \beta$.

We may then characterize policy in the non-cooperative equilibrium. Assume $\overline{C}_i, \overline{C}_j > 0$. Then the regulator in country i has an incentive to choose $C_i < C_j$ as long as $C_j > 0$, $\alpha < \beta$ and is indifferent otherwise. The regulator in country j has an incentive to set $C_j < C_i$ as long as $C_i > 0$, $\alpha < \beta$ and is indifferent otherwise. It follows that $C_i^* = C_j^* = 0$ is an equilibrium for $\alpha < \beta$, all $C_i^*, C_j^* \geq 0$ are equilibria otherwise.

Proposition 3 (Regulation with an international market for loans) *For an arbitrary ownership stake of i-residents in i-firms, γ, the minimum equity requirement set by the regulator in an open economy C_i^*: (i) is equal to zero if the share of residents among bank lenders, α, is smaller than the ownership stake of i-residents in i-banks, β. (ii) C_i^* is arbitrary if $\alpha \geq \beta$. (iii) The allocation is Pareto-efficient in all cases.*

Proposition 3 has interesting implications and can be interpreted in at least two different directions. First, proposition 3 implies that regulation competition does not harm welfare and regulation itself is not necessary at all, simply because the existence of an

international market for loans implies that banks always do behave as if the regulator has chosen to implement a regime with full regulation. In other words, the international capital market is a perfect substitute for a contract between the bank and households to eliminate moral hazard problems. The international market credibly ties the hands of banks so that they have no incentive to outmanœvre household investors.[7]

Second, the result can be interpreted in the light of the ongoing discussion about the consequences of increased international capital mobility on public policy. The traditional view ist that increasing capital mobility tightens the hands of national governments and leads to strategic interactions and competition between sovereign nations. Such competition often results in suboptimal welfare because each of governments is in a prisoner's dilemma. In our model, profits of banks are non zero without an international capital market for loans. Bank profits are necessarily equal to zero and neither household's utility out of her different investments nor firms profits are affected by regulation competition. For this reason, competition in regulation differs a lot from standard results in tax competition. Our result suggests that it is not the internationalization of capital markets as such which creates adverse effects on the utility of household investors and profits of firms. Instead, national loan markets and the resulting partial internationalization creates market power of banking institutions. In the light of this finding, the best way to maximize welfare is to deepen international market integration.

4 Conclusions

The results of this paper suggest that under specific circumstances the internationalization of capital markets may not be as harmful for countries as previously thought. It is useful to recapitulate some of the main results.

First, the incentives of regulators to use regulatory as a strategic device to expropriate foreign depositors are limited by the negative effect such a policy has on the profits of domestic firms. Second, taking the model of international competition serious implies that the market for loans and the market for deposits should be modeled symmetric. In this case, the outcome with perfect capital mobility, however, gives rise to an equilibrium with efficient decentralized decision-making. The argument behind the latter result is that competition eliminates the incentives of regulators to set bank regulation at

[7] Our result extends to a situation with asymmetric countries as long as one country does not become infinitesimally small. The argument is that our results are driven by the discrete changes in the allocation of loans resulting from marginal changes in the price for loans. Competition will reveal the risk structure in the banking sector as long as such discrete effects are present.

inefficient low levels because competition eliminates potential rents as candidates that make regulatory competition profitable.

Our analysis above has made several simplifying assumptions and we would like to assess the robustness of our results. The analysis is based on the Stiglitz-Weiss model, which does not allow for any sorting mechanism. A number of contributions analyzed the strategy of a bank in a closed economy to use collateral requirements as a sorting device (e.g., Wette, 1983, Bester, 1985, 1987). A main result is that collateral in firms can be used for screening to eliminate adverse selection. Then public intervention is hard to justify. An equivalent result can be obtained if depositors were in a position to induce the bank to the optimal level of equity requirements. This potentially eliminates the moral hazard problem between depositors and banks. Reputational effects may be used as a commitment device (see Boot, Greenbaum, and Thakor, 1993), in which case the conclusion is that public intervention cannot improve welfare.

An important feature of the analysis is that the supply of savings deposits is perfectly elastic at a risk adjusted return rate, based on the return to government bonds, and banks compete in loans provided to firms. In this case, the amount of loans, demanded by firms, increases with lower market returns. Thus, a bank has incentives to undercut its competitors in order to achieve a higher loans volume. This results in lowering the average riskiness of firms' projects and ensures optimality. It is of course possible to perceive other structures. One such structure would be as in Hellmann, Murdock and Stiglitz (2000), where banks compete in acquiring saving deposits, whereas the projects are given. For receiving deposits, a bank has to outbid other banks. Hence, competition leads to higher market returns in bank bonds and households have to pay for these higher returns with greater riskiness, because in equilibrium, banks will finance solely risky projects. Minimum capital requirements are not sufficient to ensure an efficient allocation in this environment. We wish to explore more complicated game structures and to relax some of the assumptions used in this work in future research on open economy politics.

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