Regulatory competition, banks, and the real economy

Inauguraldissertation
zur Erlangung des Grades
Doctor oeconomiae publicae (Dr. oec. publ.)
an der Ludwig-Maximilians-Universität München

vorgelegt von
Ulf Maier

2015

Referent: Prof. Dr. Andreas Haufler
Korreferent: Prof. Dr. Christian Holzner
Promotionsabschlussberatung: 04. November 2015

Acknowledgements

First and foremost, I would like to thank my supervisor, Andreas Haufler. His excellent guidance and inspiration were instrumental to my research. The discussions with him shaped my economic thinking and skills for pursuing academic research. Additionally, I received continuous support during my time at the Seminar for Economic Policy, for which I am very grateful. I am also grateful to Christian Holzner and Kerstin Röder, who offered their support, valuable comments and time, and kindly agreed to join my thesis committee.

Special thanks go to my coauthor of the third chapter, Florian Buck. His cooperation was very inspiring and a source of motivation. I very much enjoyed the time with you.

My time at the chair was made enjoyable by many colleagues. Daphne Alvarez, Christian Bauer, Lisa Essbaumer, Daniel Gietl, Dominika Langenmayr, Mohammed Mardan, Alexandra Semrad, Renate Schwirtz and Davide Suverato, you supported me in every aspect and I am very grateful for that. Because of you, I will always look back to these years with great pleasure.

Ben and Jan, you have been company for me since my first day in Munich and enriched my time since then in many different ways. I really hope that some things will never change.

My time at university would not have been possible without the support of my parents Dagmar and Hans-Georg, my sister Sina, my brother Lukas and my grandmother Lore. I am truely thankful for your encouragement.

Finally, my greatest gratitude goes to Johanna and Luisa - your love and care have been invaluable during the whole process!

Ulf Maier

Munich, November 2015

Contents

List of Figures

Preface

> *We help companies to grow by helping them to raise capital. Companies that grow create wealth. This, in turn, allows people to have jobs that create more wealth and more wealth. It's a virtuous cycle.*
>
> Lloyd Blankfein, chief executive officer of Goldman Sachs, The Sunday Times, November 8, 2009

At first glance, the economic literature can provide support for this assessment. Bank activity is credited with positive effects on economic growth (Levine 2005), the promotion of entrepreneurship (Guiso et al. 2004), the alleviation of poverty (Beck et al. 2007) and the mitigation of volatility in investment and growth (Aghion et al. 2014). This is attributed to the different functions that are performed by banks. Among others, this includes the reduction of transaction costs, the economizing on screening and monitoring costs and the management of liquidity risk. Thus, bank activity can significantly contribute to the efficient allocation of scarce resources.

Within the eurozone, banking supervisory authorities seemed to be confident in the creation of a virtuous cycle when they observed an increase in the total assets on resident bank balance sheets of more than 120% between 1998 and 2008.[1] Considering the revenue of the US finance industry, which experienced a proportional growth in income (Philippon 2015), this assessment was right. In other regard, it proved not to be the case. Rather, the sharp increase of banking activity contributed to a misallocation of financial capital to specific sectors, e.g. housing (European Systemic Risk Board 2014). When interventions were finally implemented, the costs became visible. By the end of 2011, rescue operations targeted at the Euro area banking sector resulted in gross fiscal costs of 3.9% of GDP and an average increase in national public debt of

[1] See ECB data http://sdw.ecb.europa.eu/browse.do?node=bbn137

19.9% (Laeven and Valencia 2012).[2]

Non surprisingly, thus, regulatory policies towards the banking sector have become central in the political debate.[3] Importantly, past experience suggest that the design of the future regulatory framework will be strongly influenced by two factors. Regulatory competition between countries and political considerations within countries. This thesis explicitly accounts for these factors. Thereby, it aims at deriving results that are new to the literature on banking regulation and thus provide help in the explanation and assessment of recent developments in the regulatory framework.

First, with bank capital being highly mobile, national regulatory decisions interdepend. In theory, here, the Basel Committee on Banking Supervision provides a forum for regulatory cooperation between all financially developed countries. However, lacking any sanctioning authority, countries have departed from this global framework.[4] Surprisingly, deviations have been to both directions, undercutting but also reinforcing selected global standards that are determined in the current Basel 3 accord. On the one hand, the United States have already increased the capital standards for their largest banks from 3 to 6 percent.[5] At the same time, a recent assessment of the Bank for International Settlement on the implementation of Basel 3 within the European Union concluded that the overall EU capital regulations were "materially non-compliant" with the Basel 3 framework.[6]

Interestingly, so far, the theoretical literature could only predict a deviation below the cooperative global standard (Sinn 1997, 2003; Dell'Ariccia and Marquez, 2006). However, as shown in chapter 1, this assessment was due to the narrow focus of the existing literature on the profit maximization of a homogenous banking sector. In contrast, once heterogeneous bank quality as well as entrepreneurial and taxpayer concerns are introduced, the analysis shows that it becomes attractive for countries to deviate above the cooperatively set global standards. Following on this, chapter 2 analyzes the interaction between capital standards and resolution procedures in a framework where

[2]Gross fiscal cost consist primarily on bank recapitalizations and asset purchases. While net fiscal costs, e.g. after asset recoveries were significantly lower in some cases, still a large amount of public funds was put at risk during the process.

[3]See Freixas (2010) and Beck (2013) for assessments on the failures of pre-crisis banking regulations and on the implications for the design of the post-crisis regulatory framework.

[4]See BIS 2015 for a report on the adoption of the Basel regulatory framework in all countries that are member of the Basel Committee on Banking Supervision.

[5]See www.federalreserve.gov/newsevents/press/bcreg/20140408a.htm

[6]See www.bis.org/bcbs/publ/d300.pdf

each of these regulatory instruments can be coordinated internationally. Thereby, this chapter shows that the divergence in capital standards between the US and Europe can be explained by their different approaches towards the centralization of resolution mechanisms for resident multinational bank subsidiaries.

Besides international aspects, the distributional effects of regulatory interventions in the banking sector give room to a systematic role of politics. Calomiris and Haber (2014) document this in an impressive way. Providing historical patterns, the authors demonstrate the role of banking regulation in the creation and persistence of rents. Thereby, they show how differences in the size, competitive structure and stability of banking systems are determined by the ability of independent institutions to limit the influence of rent seeking interest groups. Building on these insights, the third chapter of this thesis studies the regulation of banks' sovereign bond holdings. The analysis shows that, by changing a bank's investment policy, the privilege of government bonds creates a financing entry barrier to the private sector that generates rents for wealthy producers and bank owners. It thus creates its own political support by maintaining those rents.

All results of this thesis are derived within a microeconomic framework. Therefore, this thesis builds on previous work about the characteristics of the banking sector and the need for regulatory intervention therein. A specific feature of the banking sector is the existence of a deposit insurance system, which is present in all financially developed countries.[7] The necessity of this system has been well studied in the theoretical literature (Bryant, 1980; Diamond und Dybvig, 1983; Diamond, 1984). Due to the role of banks as a provider of (long-term) credits and guaranteer of (short-term) fund availability, the stability of the banking sector crucially depends on the trust of its customer. Thereby, deposit insurance systems should act as a backstop for negative expectations becoming self-fulfilling and, then, creating negative welfare effects through the liquidation of investment projects. Critically, as shown in the analysis of Acharya and Dreyfuss (1988) and Chan et al. (1992), asymmetric information and timing problems prevent regulation authorities from charging banks with adequate insurance premiums. This in turn provides the incentive for bank owners to take on overly risky projects.[8]

[7]See Demirgüç-Kunt et al 2014 for a global database of deposit insurance arrangements.

[8]Raising this problem to higher power, many authors have shown the spillover effect from the malfunction of single banks to the entire banking sector (Allen and Gale, 2000; Diamond and Rajan, 2005).

Coping with this problem, various regulatory instruments are discussed in the literature. These include, deposit interest rate ceilings (Hellmann et al. 2000), market entry barriers (Cordella and Yeyatti 2002) and supervisory activity (Goodhart and Schoenmaker 1995). However, the main emphasis has been placed on the regulation of the bank funding structure. Here, main contributions emphasize two stabilising effects of capital standards, which determine the amount of equity that the bank has to invest (Rochet, 1992, Dewatripont und Tirole, 1994, Repullo, 2004, Morrison und White, 2005). On the one hand, due to the subordinated status of equity in the order of repayment, higher capital standards increase the capability of banks to take losses before becoming insolvent. At the same time, an increase in capital standards reduces the degree to which bank owners can externalize costs to the deposit insurance system in case of bank default. Consequently, the incentive to choose inefficiently high risk projects is reduced.

All chapters within this thesis depart from the fact that incentives within the banking sector are distorted due to the existence of a deposit insurance system and that regulation authorities can limit the moral hazard behavior by banks through the implementation of capital standards. In the following, I will give a brief overview of the lines of argument developed in each chapter. All chapters are based on self-contained papers which can be read separately. Chapter 1 and 3 are based on co-authored papers.

Chapter 1 studies regulatory competition in the banking sector in a model with three distinct features. First, the model allows for banks that are heterogeneous in their monitoring ability, and hence in their expected profitability. This implies that the least profitable banks will exit the market in response to tougher capital requirements. In turn, this benefits the remaining national banks as loan-taking firms will value the improve in the pool quality of the national banking sector. Second, the model incorporates competitive firms that use bank credit to produce output. This allows the analysis of changes in the consumer surplus that are associated with tightened capital standards. Finally, the model also accounts for the concerns about national public finances by introducing a savings deposit insurance scheme that must be funded by taxpayers in the event of bank failure. The main result of this chapter is that when governments care equally about their banking sectors, consumers and taxpayers, the non-cooperative setting of capital standards will lead to higher levels of capital regulation than is optimal from a cooperative perspective. This result can be explained as follows: higher capital standards in one country shift some of the loan volume to the foreign country, but reduce the aggregate loan volume in the integrated market.

This increases the profits of foreign banks but simultaneously hurts both taxpayers and consumers in the foreign country. At the same time, the selection effect of capital regulation increases the profitability of high-quality banks in the country that imposes the tougher regulation, but it reduces the net increase in profits for the foreign banking sector. On net, the externalities of capital regulation on the foreign country are therefore negative. This chapter is based on unpublished work carried out jointly with Prof. Dr. Andreas Haufler, University of Munich.

Chapter 2 introduces a model where countries compete for the investment of multinational bank subsidiaries. While each country benefits from the investment in normal times, costs arise in case that the subsidiary is hit by a shock and has to default. There exist two regulatory instruments to curb these costs. First, each regulator can impose capital standards for the subsidiary that is resident in its country. However, as this reduces the subsidy from deposit insurance, a unilateral increase will lead to the reallocation of investment to the subsidiary that is located in the other country. Second, each regulation authority can intervene into the operation of its resident subsidiary whenever the probability of default is sufficiently large. Here, national regulators fail to account for the international spillovers that are caused by the reallocation of capital within the multinational bank network in case of unilateral shocks. As an important result, this model shows that moving from a national to a global intervention regime changes the non-cooperative equilibrium of capital standards. The model then analyzes the welfare effect of different intervention regimes. Here, it can define a condition that whenever bank investment is sufficiently profitable and mobile and thus the externality that arises due to non-cooperative capital standards is large, moving from a national resolution regime with too little intervention towards a more centralized intervention regime is welfare decreasing. This result arises due the interdependence of the externalities at different stages within the regulatory framework so that their impact can either be mutually amplified or weakened by unilateral actions.

Chapter 3 analyzes the capital regulation of sovereign bonds in a political economy framework. In this model a monopolist bank can allocate its funds between sovereign bonds and loans to entrepreneurs. Critically, the bank's loan supply is affected by the expectation about its payoff in the case of sovereign default. Capital standards for sovereign bonds affect this optimization. Given the existence of the deposit insurance system, zero capital requirements for sovereign bonds do not incentivize banks to create a buffer that can take losses caused by sovereign default. Then, however, bank owners anticipate that in case of sovereign bond default, the expected return from

loans will not accrue to them but only reduce the cost of the deposit insurance system. Given the fixed costs of funding, this will cause banks to increase the marginal return of each loan and, thus, reduce the total supply of loans. Obviously, this effect is more pronounced if the sovereign bond is perceived to be more risky. Crucially, a subgroup of wealthy producers is not affected by the deterioration in bank funding conditions. For this group, their wealth endowment provides them with collateral to overcome the asymmetric information problem so that they can borrow directly from investors. The model thus shows how the privilege of government bonds in capital regulation causes less lending and thereby creates a financing entry barrier to the private sector. Further, the model illustrates the heterogeneous effects within the production sector. While all producers earn production rents due the financial entry barrier, producers that are dependent on bank loans suffer from artificially high funding costs. Therefore, as an important result, this chapter shows how an inefficient status quo in sovereign bond regulation can affect the composition of the production sector such that the majority of incumbents supports the maintenance of this distortive regulatory framework as an entry barrier for new competitors. This chapter is based on unpublished work carried out jointly with Dr. Florian Buck, University of Munich.

Chapter 1

Regulatory competition in capital standards with selection effects among banks

1.1 Introduction

The regulation of banks, and in particular the setting of capital adequacy standards, is arguably one of the most important policy issues in the aftermath of the financial crisis. In many countries, large, commercial banks needed to be recapitalized with public funds in recent years. In several countries, such as Ireland or Iceland, the public bailout was so massive that it threatened the entire state of public finances. The new Basel III capital standards, which foresee the ratio of core capital to rise to 7 percent of the banks' outstanding loans until 2019, are therefore widely believed to represent a critical step forward in ensuring more resilient banking sectors around the world.[1] At the same time, the higher capital standards are also expected to lead to a consolidation of banking sectors, with smaller or weaker banks having to exit the market.

The financial sectors of many countries have grown dramatically in recent decades and

This chapter is based on joint work with Andreas Haufler.

[1]Thus Mervyn King, then Governor of the Bank of England, noted in October 2010 that "the broad answer to the problem [of finding adequate regulatory tools] is likely to be remarkably simple. Banks should be financed much more heavily by equity rather than short-term debt" (www.bankofengland.co.uk/publications/Documents/speeches/2010/speech455.pdf). Similarly, Timothy Geithner, then U.S. Secretary of the Treasury, emphasized in February 2010 that "first, we are going to make sure that financial firms hold a lot more capital than they did before the crisis" (www.treasury.gov/press-center/press-releases/Pages/tg808.aspx).

represent an important source of value added, highly paid jobs, and - in good times - tax revenue.[2] Therefore, an important concern in policy discussions is that the national setting of higher capital adequacy standards will not distort international competition between the banking sectors of different countries, and maintain a 'level playing field'.

Interestingly, however, it is by no means clear whether individual countries, which may be tempted to pursue 'beggar-thy-neighbor' policies, have an incentive to set their national capital standards above or below that of neighboring jurisdictions. On the one hand is the conventional concern that maintaining low adequacy rules reduces the cost of doing business for domestic banks, thus securing an 'unfair' advantage in the international competition for bank customers. As an example, several critical voices were raised in the United States during 2011 against the new Basel rules, and the implementation of these rules was eventually delayed. This raised concerns among several European policymakers that the United States might eventually refrain from adopting the tighter Basel III standards for its banks.[3]

On the other hand, several countries, such as Switzerland, have enacted capital standards that substantially exceed the Basel rules. Similarly, the United Kingdom announced in May 2012 that it planned to introduce national capital requirements above the Basel standards to protect domestic taxpayers. This announcement also met with resistance from most EU partners, who favored instead a strict harmonization of national capital requirements along the Basel standards.[4] This suggests that there may also be fears of a competitive advantage for banking sectors that operate under capital standards *above* those of their competitors.[5]

This chapter studies regulatory competition in capital standards for the banking sector in a model that incorporates several of the concerns that have featured prominently

[2]Auerbach et al. (2010, Figure 9.5) document the increasing fiscal importance of the financial sector in the United States and the United Kingdom. In both countries, corporate tax revenues from financial corporations made up more than 25% of total corporate tax revenues in 2003, before the financial crisis.

[3]See "Delay seen in implementing U.S. bank capital rules". Reuters, November 9, 2012.

[4]See "European Leaders to weigh new capital requirements for banks", The New York Times, May 1, 2012.

[5]Nevertheless, the United States and the United Kingdom went ahead to implement a regulation of the leverage ratio that differs from the international standard. While the Basel III schedule now foresees a leverage ratio of 3% within the Pillar 1 capital framework becoming effective in 2018 (http://www.bis.org/publ/bcbs270.pdf), the United States will demand an additional buffer of 2% from its largest banks (www.federalreserve.gov/newsevents/press/bcreg/20140408a.htm). In the United Kingdom the leverage ratio of 3% already became effective on July 1, 2014 (http://www.bankofengland.co.uk/pra/Documents/publications/ss/2013/ss313.pdf).

in these recent policy debates. Our model allows for banks that are heterogeneous in their monitoring ability, and hence in their expected profitability. This implies that the least profitable banks will exit the market in response to tougher capital requirements. In this framework, national capital standards cause selection effects, as loan-taking firms anticipate that higher capital standards will drive the least efficient banks from the market and thus improve the pool quality of banks in the regulating country. A second distinguishing feature of our model is that it incorporates the repercussions that changes in the availability and the price of credit have on the real economy. Thus our model incorporates competitive firms that use bank credit to produce output. This allows us to incorporate changes in consumer surplus that are associated with tightened capital standards. Finally, we also incorporate the concerns about national public finances by introducing a savings deposit insurance scheme that must be funded by taxpayers in the event of bank failure.

The main result of our analysis is that when governments care equally about their banking sectors, consumers and taxpayers, the non-cooperative setting of capital standards will lead to *higher* levels of capital regulation than is optimal from a cooperative perspective. In other words, non-cooperative behavior of governments leads to a 'race to the top' in capital regulation.[6] This result, which contradicts the findings in the existing literature (see below), can be explained as follows: higher capital standards in one country shift some of the loan volume to the foreign country, but reduce the aggregate loan volume in the integrated market. This increases the profits of foreign banks but simultaneously hurts both taxpayers and consumers in the foreign country. At the same time, the selection effect of capital regulation increases the profitability of high-quality banks in the country that imposes the tougher regulation, but it reduces the net increase in profits for the foreign banking sector. On net, the externalities of capital regulation on the foreign country are therefore negative.

Our analysis is related to several strands in the existing literature. A first set of papers analyzes the effects of capital regulation on financial institutions (Rochet, 1992; Hellman et al., 2000; Repullo, 2004). This literature stresses that capital regulation increases the risk buffer of banks and curbs risky behaviour. In one of the few contributions that incorporate bank heterogeneity, Morrison and White (2005) show that capital regulation also serves to address adverse selection problems in the banking

[6]This is very different from the issue of tax harmonization, for example, where the concern is almost exclusively about a downward competition of tax rates (see Fuest et al., 2005, for a survey). Where EU-wide legislation exists, as in the field of value-added taxation, only minimum tax rates are therefore stipulated.

sector. Another paper that models bank heterogeneity in a framework with capital regulation is Kopecky and VanHoose (2006). All these models stress that capital regulation is costly for banks. An opposing view is taken by Admati et al. (2010), who argue that higher capital requirements reduce the risk premia incorporated in banks' equity capital, and therefore need not raise the overall financing costs of banks.

The existing literature on regulatory competition in the banking sector stresses the result that nationally set capital standards are inefficiently low from a global welfare perspective. Sinn (1997, 2003) models the competition in regulatory standards as a direct application of the classical lemons problem (Akerlof, 1970), arguing that consumers are unable to discriminate between different levels of regulatory quality. Acharya (2003) models competition between bank regulators that choose both the level of capital requirements and the bailout policy when banks become insolvent. Our approach is closest to Dell'Ariccia and Marquez (2006), where regulators choose nationally optimal capital requirements by trading off the aggregate level of banks' profits against the benefits of financial stability. None of these papers incorporates heterogeneity of banks, nor a benefit to the banking sector that arises from the selection effect of higher capital standards.

A reputation effect that benefits banks is also present in the model of Morrison and White (2009). In their framework, however, the beneficial effect arises from the quality of the regulator, for which capital requirements act as a substitute. Hence, high capital requirements act as a negative signal in their paper, contrary to our approach. Moreover, Morrison and White (2009) do not model international competition between banks and their focus is on the question whether a uniform regulatory standard is beneficial for countries that differ with respect to the quality of their national regulator.

A different channel for cross-border spillover effects of decentralized bank regulation is presented in the empirical papers by Houston et al. (2012) and Ongena et al. (2013). They show that multinational banks that face higher minimum capital requirements in their home country tend to take on higher risk in foreign markets. Further, Carbo-Valverde et al. (2012) demonstrate that cross-border banking mergers can be partly explained by differences in the size and character of safety-net benefits available to banks in individual EU countries. Thus, in this strand of the literature, the spillover effect of national bank regulation is due to the reallocation of cross-border activities by multinational banks. Contrary, in our model, the spillover effect is due to the change in the structure of the national banking sector that affects competition on the international market.

The heterogeneity of banks that we model in this chapter has become an important topic in the recent international trade literature. Buch et al. (2011) show a close empirical link between size, productivity and international activity in the banking sector that is similar to the well-established patterns for the manufacturing sector. Niepmann (2013) develops a model of banking across borders model that is driven by both differences in factor endowments and differences in banking sector efficiency. Finally, the recent public economics literature has stressed the qualitative similarities between regulation and taxation of the financial sector (Keen, 2011). It has also provided first empirical results showing that recent bank levies have been effective in increasing the equity-to-asset ratio of European banks (Devereux et al. 2013).

The remainder of this chapter is set up as follows. Section 1.2 describes the basic model. Section 1.3 analyzes the nationally optimal regulation policy. Section 1.4 derives the outcome of regulatory competition between the two countries. Section 1.5 discusses various extensions of our benchmark model. Section 1.6 concludes.

1.2 The model

1.2.1 Banks

We consider a region of two countries $i \in \{1, 2\}$, which are identical in all respects. Banks in each country extend loans to firms in an integrated regional market. In each country, multiple, heterogeneous banks operate under the authority of a national regulator who imposes capital requirements k_i for all national banks. The number of active banks in each country and the volume of loans given by each bank are endogenous.

Banks differ exogenously in their monitoring skills, which determines the quality q of the individual bank.[7] We assume that the variable q is distributed uniformly in the interval [0,1] and it corresponds to the likelihood that the investment financed by the individual bank's loan is successful. Thus, our model effectively assumes that

[7]See Morrison and White (2005) for a similar assumption. The bank's monitoring decision could also be endogenized by assuming that banks differ exogenously in their monitoring costs and each bank chooses the degree of monitoring optimally, given its cost. See, for example, Dell'Ariccia and Marquez, 2006, for this modeling approach in a setting with homogeneous banks. This however, would complicate our analysis without changing its qualitative results.

the bank's monitoring quality is the critical determinant in the success of firms.[8] Importantly, the exogenous (monitoring) quality q is the individual bank's private information and it is not known by the firm taking a loan from this bank.

There are several ways in which the quality of a bank can improve the payoff to borrowers during the production process. First, due to their repeated interaction with different customers, banks acquire a knowledge that is complementary to that of firms (see Boot and Thakor, 2000). In this sense, q can be interpreted as the general and sector-specific expertise of an individual bank, which directly affects the probability of successful production. Second, during the process of production, firms might face additional random liquidity shocks that could force them to terminate the project. Therefore, firms will optimally protect themselves by demanding lines of credit at their bank (Holmstrom and Tirole, 1998). However, as shown by Boot et al. (1993), the ability of banks to offer these flexible, discretionary financial contracts will depend on the quality of the issuing bank. As a consequence, the probability of successful production will again be a function of bank quality, when q is interpreted as the ability of banks to monitor projects and thus manage the liquidity pool of its portfolio.[9]

Recent financial crises have illustrated the substantial benefits to firms of having long and stable relationships to banks. Firms with stable bank relationships can draw on existing lines of credit (Ivashina and Scharfstein, 2010) and receive favorable credit terms for new loans (Bolton et al., 2013). In the case of insolvency of its bank, a firm loses these relationship-based cost advantages and may face credit constraints from new banks that sharply reduce lending in order to comply with binding capital requirements (Peek and Rosengren, 1997; Popov and Udell, 2012).

Each bank can fund itself either through equity capital, or through external funds, which we take to be saving deposits of individuals. In line with common practice in virtually all developed countries, we assume that the savings deposits are fully insured by the government of the country in which the bank is located. Hence, and importantly for our model, the (expected) costs of bank failures are borne by the taxpayers of the banks' residence country. Being fully insured against failure, depositors demand a competitive return on their savings, which we normalize to unity. In contrast, equity holders may demand a risk premium and the per-unit cost of equity is exogenously

[8]This extreme form of complementarity merely serves to simplify the analysis. The same qualitative results would be obtained when the bank's monitoring quality and the firm's success rate were positively, but not perfectly, correlated.

[9]See Inderst (2013) for a recent analyis where the expected payoff of projects depends on the ability of banks to roll over loans.

given by $\rho \geq 1$.[10]

In our benchmark model we assume that individual banks are not able to signal their quality to firms and the return per unit of loans is the same for all banks in case of success. Therefore, no bank will choose to hold costly equity capital in excess of the minimum level k_i stipulated by the regulator.[11] The expected profits of a bank in country i with quality q that chooses to distribute a total number of l loans are then given by:

$$\pi_i(q,l) = \{q[R_i - (1-k_i)] - k_i\rho\}l - \frac{1}{2}\, bl^2 \ . \tag{1.1}$$

Here R_i is the return per unit of the bank's loan, which depends on the capital standards set by the bank's home country, but not on the individual quality of the bank. From this gross loan rate the bank must deduct the costs of savings deposits $(1-k_i)$, which are paid back by the bank only with its success probability q. The return on the bank loan is zero, if the borrowing firm's risky investment fails. In this case the bank will also go bankrupt and savers will be compensated by payments from the national deposit insurance fund. Equity holders of the bank are residual claimants and receive all profits, less their opportunity costs ρk_i. Finally, the quadratic cost term $(1/2)bl^2$ represents transaction costs that are rising more than proportionally when the bank's level of operation rises. Hence this term limits the scale of operations in each bank.[12]

We assume that all banks are small relative to the overall loan market and hence take R_i as given when choosing l. The optimal loan volume l for each bank is then given by

$$l_i^* = \frac{q\phi_i - k_i\rho}{b} \ , \tag{1.2}$$

where we have defined the short-hand notation

$$\phi_i \equiv R_i - 1 + k_i \tag{1.3}$$

to indicate the bank's return per unit of its loans, net of the funding costs for savings deposits. This term therefore represents the expected increase in the bank's cash flow

[10] Admati et al. (2010) argue that the per-unit cost of equity should be endogenized, and it should fall when the capital requirement is increased. In our model, however, a higher capital requirement will always increase the bank's overall costs of funds, because a higher equity share reduces the value of implicit taxpayer subsidies. Therefore, ignoring the feedback effects of changes in k_i on the per-unit cost of equity capital ρ will not affect our results qualitatively.

[11] This assumption will be relaxed in Section 5, where we assume that imperfect signalling by banks is possible.

[12] See Acharya (2003) for a similar assumption.

when the success probability of a loan increases.

It is clear from (1.2) that the volume of lending for each bank increases in its quality and the loan rate, while it decreases with the amount of capital the bank has to hold. Thus, a better bank is also larger in equilibrium.[13]

Substituting (1.2) in (1.1) determines the optimized profits of a bank of quality q:

$$\pi_i^*(q) = \frac{(q\phi_i - k_i\rho)^2}{2b} \ . \tag{1.4}$$

The equilibrium number of banks in each country is determined by the condition that the cutoff bank with quality $\hat{q}_i$ receives zero expected profits from its operations:

$$\pi(\hat{q}_i) = \hat{q}_i\phi_i - k_i\rho = 0 \ . \tag{1.5}$$

Consequently, only banks with $q_i \geq \hat{q}_i$ will be active in the market. Equation (1.5) shows that capital standards in country i directly affect the quality level $\hat{q}_i$ of the marginal bank, by increasing the cost of capital for all banks. As low-quality banks benefit most from limited liability and cheap deposit funding, they are hit hardest by an increase in capital standards. Without any capital requirements ($k_i = 0$), all banks will be active in the market ($\hat{q}_i = 0$). In contrast, full equity financing of banks ($k_i = 1$) results in $\hat{q}_i = \rho/R_i$. Hence, a necessary condition for a positive number of banks to stay in the market even with full equity financing is that the cost of equity ρ is lower than the equilibrium return on loans R_i. We make this assumption in the following.

It remains to determine the aggregate loan volume of all active banks in country i. We normalize the exogenously given number of potentially entering banks to unity. To arrive at the aggregate loan volume, we integrate over the optimal loan volumes (1.2) of all active banks. This gives

$$L_i = \int_{\hat{q}_i}^{1} l_i(q)dq = \frac{(1-\hat{q}_i)(\phi - k_i\rho)}{2b} = \frac{(1-\hat{q})^2\phi}{2b} \ . \tag{1.6}$$

In the first expression, $(1-\hat{q}_i)$ is the measure of active banks in country i, whereas the

[13]This corresponds to the empirical evidence in Buch et al. (2011). For a sample of more than 2000 German banks, the authors find that bank productivity and bank size are positively correlated, where productivity is measured either as labor productivity (assets/employees), or as the bank-level difference between average revenues and marginal costs.

remaining term on the RHS of (1.6) gives the average loan volume per active bank.[14] The second step in (1.6) then uses (1.5) to simplify the resulting expression.

1.2.2 Firms and consumers

One of the features of our model is that we explicitly incorporate firms that use bank loans to produce consumer goods. In the following sections this will allow us to study the welfare effects of capital standards on banks, taxpayers and consumers.

We assume that there is a large number of identical, potential producers in a final goods market, which do not have any private source of funds. The potential producers compete for credit in an integrated loan market. Each firm that enters the market in equilibrium demands one unit of credit to produce one unit of output. Total output in the integrated market depends on the expected number of successful loans from banks in both countries. Denoting the expected output produced with bank loans from country i by y_i, we get:

$$y \equiv y_i + y_j = \int_{\hat{q}_i}^{1} q_i l_i(q_i) dq_i + \int_{\hat{q}_j}^{1} q_j l_j(q_j) dq_j = L_i \left(\frac{2 + \hat{q}_i}{3} \right) + L_j \left(\frac{2 + \hat{q}_j}{3} \right) . \quad (1.7)$$

It follows from our assumption of a uniform distribution of bank qualities q, and from the fact that high-quality banks supply a larger volume of lending [see eq. (1.2)], that at least two thirds of all loans will lead to successful production, even in the absence of all capital requirements ($\hat{q} = 0$). Obviously this expected success rate increases further, when capital requirements drive the worst banks from the market and $\hat{q} > 0$.

Next we determine the loan rate that firms are willing to pay to banks in the competitive equilibrium. All potential entrants in the final goods sector have to incur a uniform fixed cost c for their projects. Further, as firms can not observe the quality of the contracting bank, they have to form expectations about the average quality of loans distributed by all banks located in country i. We denote this expected success rate of loans originating from banks in country i by q_i^e. If the investment is successful, the firm sells its product in the integrated market for the homogeneous consumer good. This output market is characterized by the inverse demand function $p = A - y$ where A is an indicator of market size. A firm will not repay the loan if its project fails, but the

[14] A comparison with eq. (1.2) shows that this term is the average of the loan volume chosen by the best bank with $q = 1$, and the loan volume of the marginal entering bank with $\hat{q}_i$, which is zero.

fixed cost c has been incurred nevertheless. Thus, allowing for free entry of firms into the output market, the zero profit condition for entering, risk-neutral firms is given by

$$q_i^e(p - R_i) = c \; . \tag{1.8}$$

Equation (1.8) implies that competitive, producing firms make zero profits in the aggregate. Effectively, all (expected) profits are transferred to banks via the loan rate R_i.

To derive the equilibrium loan rate in each country, R_i, we rearrange (1.8) and substitute the inverse demand function $p = A - y$. This gives:

$$R_i = A - \frac{c}{q_i^e} - y = A - \frac{3c}{2 + \hat{q}_i} - y \; \forall \; i, j, i \neq j. \tag{1.9}$$

In the second step of eq. (1.9) we have assumed that firms rationally anticipate the average success rate of loans from country i, which is given by $q_i^e = (2+\hat{q}_i)/3$ from (1.7). Thus the loan price is decreasing in total output and in the amount of fixed costs c. Moreover, (1.9) shows that loan rates are country-specific and depend positively on the expected quality of the banking sector in country i. A higher expected quality of the banking sector reduces each firm's probability of failure and thus raises its willingness to pay for the loan. Hence, in our model, national capital requirements k_i act as a selection mechanism by affecting the pool quality of domestic banks, which in turn affects the price that borrowers are willing to pay for a bank loan from country i. Consequently the price of bank loans differs systematically between the two countries whenever their capital requirements differ, with banks from the country with the higher expected average quality receiving a higher return.

1.2.3 Market equilibrium and welfare

To derive the market equilibrium, we substitute eq. (1.9) into (1.5) and, together with (1.2), into (1.7). This yields a system of three simultaneous equations:

$$\hat{q}_1 \left[A - \frac{3c}{2 + \hat{q}_1} - y - 1 + k_1 \right] = \rho k_1 \tag{1.10}$$

$$\hat{q}_2 \left[A - \frac{3c}{2 + \hat{q}_2} - y - 1 + k_2 \right] = \rho k_2 \tag{1.11}$$

$$y = y_1 + y_2 = \frac{1}{b}\int_{\hat{q}_1}^{1}\left[q^2(A - y - 1 + k_1) - qk_1\rho - q^2\left(\frac{3c}{2+\hat{q}_1}\right)\right]dq + \frac{1}{b}\int_{\hat{q}_2}^{1}\left[q^2(A - y - 1 + k_2) - qk_2\rho - q^2\left(\frac{3c}{2+\hat{q}_2}\right)\right]dq \quad (1.12)$$

Equations (1.10)–(1.12) jointly determine the cutoff qualities of banks, $\hat{q}_1$ and $\hat{q}_2$ and the aggregate output level y, all as functions of the capital requirements imposed by the two countries 1 and 2. These core variables then determine the total level of loans from (1.6) and the loan rate from (1.9).

We consider a national regulator in each country i who sets capital requirements so as to maximize national welfare. The welfare function of country i is given by:

$$W_i = \alpha\Pi_i + \beta T_i + \gamma\frac{S}{2}, \quad \alpha, \beta, \gamma \geq 0. \quad (1.13)$$

Welfare in country i comprises the expected profits of all national banks that are active in the regional market (Π_i). In addition, the regulator considers the expected costs to resident taxpayers when banks fail and depositors must be compensated for their losses through the deposit insurance fund (T_i). Finally, by affecting the supply of loans, capital standards also affect aggregate output and hence consumer surplus. Since the output market is regionally integrated, and the model is symmetric, we allocate one half of the total consumer surplus in the integrated market to each of the two countries ($S/2$).

These components of national welfare can be directly calculated from the equilibrium in the loan market. Total profits in the banking sector of country i are given by aggregating (1.2) over all active banks. This yields

$$\Pi_i = \int_{\hat{q}_i}^{1}\frac{(q\phi - k_i\rho)^2}{2b}\,dq = \frac{(1-\hat{q}_i)\phi_i L_i}{3} = \frac{6by_i^2}{(2+\hat{q}_i)^2(1-\hat{q}_i)}. \quad (1.14)$$

Aggregate profits are the product of of the aggregate loan volume L_i and the net profit per loan, as given by the difference between the gross loan rate R_i and the banks' refinancing cost $1 - k_i + \rho k_i$. In the second step we have used (1.6) and (1.7) to express profits solely as a function of aggregate output $y = y_i + y_j$, and of the common cutoff quality of banks $\hat{q}$.

The expected losses borne by taxpayers in country i are determined by the share of deposit financing, the aggregate loan volume, and the average failure probability of country i's banks. In line with past experience, we thus assume that the costs of bank

failures are fully borne by taxpayers.[15] We abstract from international contagion effects and assume that the losses from failed banks arise only in the country in which the bank is located.[16] Aggregating and using (1.6) and (1.7) in the second step gives

$$T_i = \frac{-(1-k_i)}{b}\int_{\hat{q}_i}^{1}(1-q)(q\phi_i - k_i\rho)dq = \frac{-(1-k_i)(1-\hat{q}_i)L_i}{3} = \frac{-(1-k_i)(1-\hat{q}_i)y_i}{(2+\hat{q}_i)} \tag{1.15}$$

Finally, by affecting aggregate output, capital standards also affect the consumer surplus in the integrated market. The total consumer surplus is

$$S = \frac{1}{2}(A-p)y = \frac{y^2}{2}, \tag{1.16}$$

which is shared equally between the two symmetric countries.

From (1.14)-(1.16) we can thus determine the effects of capital requirements on national and regional welfare, as well as its components.

1.3 Nationally optimal capital standards

1.3.1 Equilibrium in the loan market

In this section we analyze the effects of capital requirements that are set non-cooperatively by the two countries. Thus we are looking for a symmetric Nash equilibrium in the national policy instruments k_i when each country maximizes the welfare of its citizens, as given in (1.13). Appendix A.1 derives the responses of the endogenous variables $\hat{q}_i$, $\hat{q}_j$, y_i and y_j in response to a unilateral increase in country i's capital requirement k_i (where $i \neq j$). These are given by:

$$\frac{\partial \hat{q}_i}{\partial k_i} = \frac{(\rho-\hat{q})[6b(\phi+\tilde{c}\hat{q}) + 2\phi(1-\hat{q}^3)] + \rho(\phi+\tilde{c}\hat{q})(2+\hat{q})(1-\hat{q})^2}{2(\phi+\tilde{c}\hat{q})\Omega} > 0 \tag{1.17}$$

[15] Several countries, such as Germany, are currently building up special funds financed by compulsory bank levies, in order to make the banking sector participate in the costs of bank restructurings. The size of these insurance funds is (still) very small, however. In Germany, for example, the volume of this 'restructuring fund' is only slightly above 1 billion Euro after two years of collecting bank levies, out of a target volume of 70 billion Euro.

[16] See Goodhart and Schoenmaker (2009); Niepmann and Schmidt-Eisenlohr (2013), and Beck and Wagner (2013) for analyses of international regulatory coordination when bank failures in one country have adverse effects on banks in the other country.

$$\frac{\partial \hat{q}_j}{\partial k_i} = \frac{\hat{q}(1-\hat{q})\kappa}{2(\phi + \tilde{c}\hat{q})\Omega} \tag{1.18}$$

$$\frac{\partial y_i}{\partial k_i} = \frac{(1-\hat{q})[6b(\phi + \tilde{c}\hat{q}) + 2\phi(1-\hat{q}^3)]\kappa}{12b(\phi + \tilde{c}\hat{q})\Omega} \tag{1.19}$$

$$\frac{\partial y_j}{\partial k_i} = \frac{-2\phi(1-\hat{q})(1-\hat{q}^3)\kappa}{12b(\phi + \tilde{c}\hat{q})\Omega}, \qquad \frac{\partial y}{\partial k_i} = \frac{(1-\hat{q})\kappa}{2\Omega} \tag{1.20}$$

where we have introduced the short-hand notations

$$\Omega \equiv 3b(\phi + \hat{q}\tilde{c}) + 2\phi(1-\hat{q}^3) > 0, \tag{1.21}$$

$$\kappa = \frac{-6by}{(1-\hat{q}^2)(2+\hat{q})}\left[3(\rho-1)(1+\hat{q}) + (1+2\hat{q})(1-\hat{q})\right] + \tilde{c}(1-\hat{q})(2+\hat{q})\rho. \tag{1.22}$$

and

$$\tilde{c} \equiv \frac{3c}{(2+\hat{q})^2}. \tag{1.23}$$

Equation (1.17) shows that an increase in country i's capital requirements unambiguously raises the quality of the cutoff bank in this country, $\hat{q}_i$. This is due to both the higher cost of equity vis-a-vis savings deposits, and the reduced volume of implicit taxpayer subsidies as a consequence of the higher equity ratio. Hence, by raising the cost of finance for all banks, capital requirements drive the weakest banks in country i from the market.[17]

The remaining effects in (1.18)–(1.20) all depend on the size of κ, as given in (1.22). It is thus critical for our analysis to discuss the effects summarized by κ in detail. As shown in (1.22), the effect of a higher capital requirement on the total level of performing loans can be decomposed in two parts. The first term is unambiguously negative, as capital standards raise the costs of refinancing for all banks. This will drive some banks in country i from the market [eq. (1.17)] and it will also reduce the output of the remaining banks, other things being equal [see eq. (1.2)]. This isolated *cost effect* of higher capital standards will thus reduce loan supply by country i's banks, and hence expected output, other things being equal. The second term involving $\tilde{c}$ is, however, positive. This captures the positive effect of higher capital requirements on the pool quality of banks in country i. The induced rise in $\hat{q}_i$ results in a higher loan rate that firms are willing to pay for loans from banks based in country i, as they face a lower

[17]This effect is thus very similar to models where production taxes or subsidies affect the market entry decision of firms with the highest cost of production (see e.g. Chor 2009). In the same way, capital regulation in our model affects the 'production cost' of banks, and higher costs will drive the banks with the lowest success probability, and hence the lowest expected revenue, from the market.

probability of losing their fixed cost c [see eq. (1.9)]. In the following we will refer to this effect as the *selection effect* of capital standards. In sum, we can therefore not sign κ, in general.

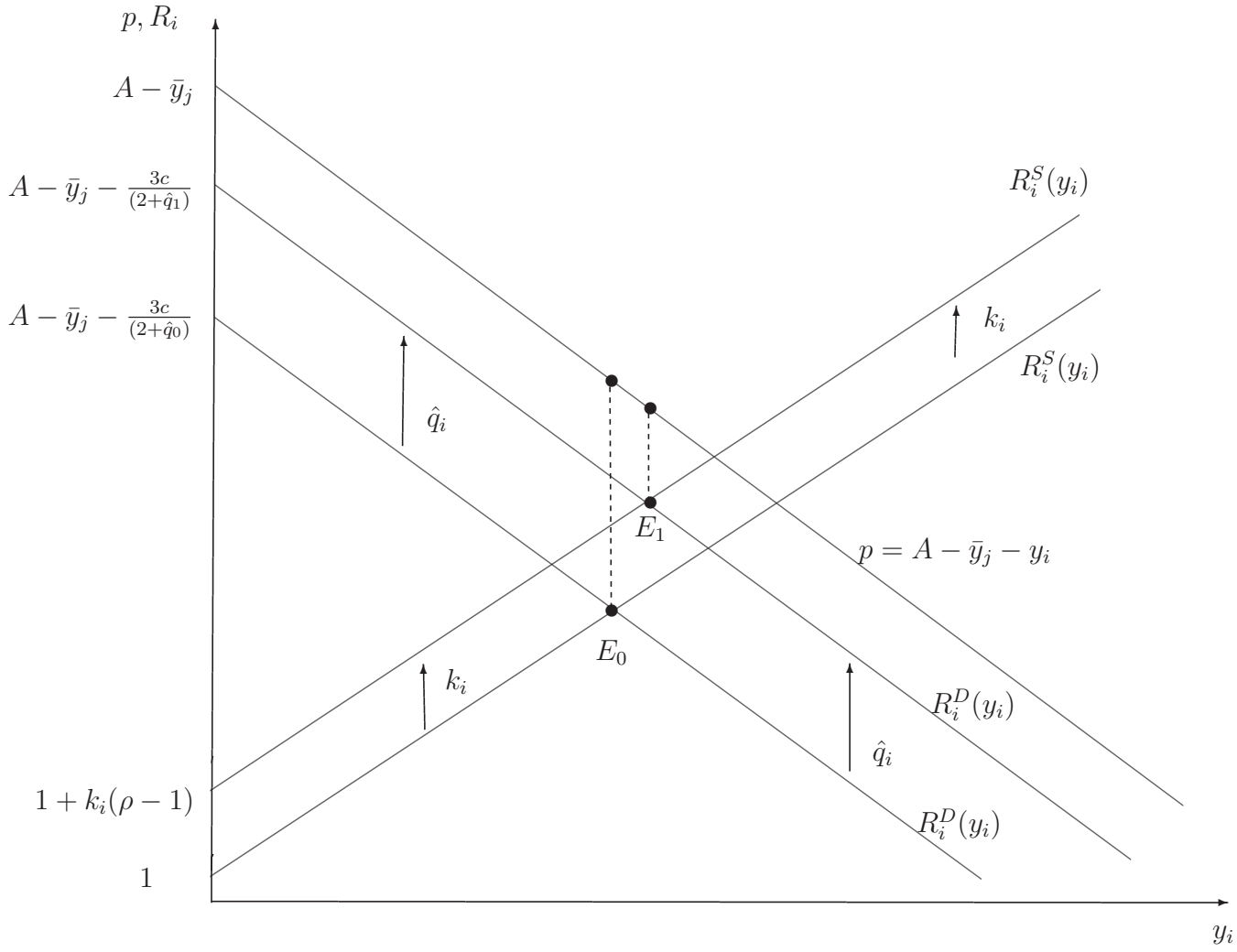
If $\kappa < 0$, and the *cost effect* of higher capital standards in country i dominates the *selection effect*, then output generated from loans by country i's banks falls [eq. (1.19)]. As a result of this fall in output, the output price rises and competitive firms are willing to pay a higher loan rate to banks from country j. This higher profitability will draw additional banks in country j into the market, thus lowering $\hat{q}_j$ [eq. (1.18)]. Moreover, the aggregate loan volume in country j will also rise, and with it the output y_j generated from these loans [eq.(1.20)]. Hence a unilateral increase in country i's capital requirement shifts business from banks in country i to banks in country j. This is the core reason why existing models of cross-country competition in capital standards (Sinn, 1997; Dell'Ariccia and Marquez, 2006) predict *'a race to the bottom'* when capital standards are endogenized.

In our model, it is also possible that the *selection effect* of a higher capital standard dominates the *cost effect* and $\kappa > 0$ holds in (1.22). In this case, the effects of a rise in k_i on the loan volumes of countries i and j and on the critical bank quality in country j are all reversed. In this case, a higher capital standard in country i will boost the aggregate loan supply of banks in country i, as the remaining banks receive a higher loan rate R_i on account of the higher pool quality of banks in country i. If $\kappa > 0$, this increase in the loan volume of higher-quality banks dominates the effect that arises from the reduced number of active banks in country i. The expansion of loans from country i will then reduce the profitability of banks in country j, raising $\hat{q}_j$ and reducing y_j.

The case where introducing a small capital requirement in country i raises this country's aggregate loan supply in equilibrium is shown in Figure 1.1 Eq. (1.6), together with (1.7) yields a (inverse) supply function $R_i^S(y_i)$ that describes the loan rate in country i as a positive function of y_i when the output from loans of country j is held constant. In contrast, eq. (1.9) gives a derived demand $R^D(y)$, where the loan rate is falling in country i's output. The demand function for loans $R_i^D(y_i)$ represents a parallel downward shift of the demand function in the output market, where the change in the vertical intercept is determined by the firms' fixed investment cost c and the average success probability $\hat{q}_i$ [see eq. (1.9)].

In the absence of any capital requirements, the loan supply curve for country i's banks, R_i^S, starts at per-unit refinancing costs of unity. This represents the case of pure deposit finance. A small capital requirement k_i shifts the loan supply curve upward to R_1^S.

Figure 1.1: The effects of a small capital requirement in country i



The associated increase in $\hat{q}_i$ also shifts the loan demand demand curve R_1^D upward, however, by lowering the firms' expected probability of losing their fixed costs. If c is sufficiently large, then the upward shift in the demand curve for country i's loans dominates the shift in the loan supply curve, leading to a higher volume of (successful) loans y_i.

1.3.2 Welfare effects of capital standards

In a second step, we use the effects on the loan market equilibrium variables, as given in (1.17)–(1.20), to determine the effects of the capital standard k_i on country i's welfare.

Totally differentiating (1.13) and (1.14)–(1.16), we get

$$\frac{\partial W_i}{\partial k_i} = \alpha \frac{\partial \Pi_i}{\partial k_i} + \beta \frac{\partial T_i}{\partial k_i} + \frac{\gamma}{2} \frac{\partial S}{\partial k_i} \, ,$$

where

$$\frac{\partial \Pi_i}{\partial k_i} = \frac{18by_i^2\hat{q}_i}{(1-\hat{q}_i)^2(2+\hat{q}_i)^3} \frac{\partial \hat{q}_i}{\partial k_i} + \frac{12by_i}{(1-\hat{q}_i)(2+\hat{q}_i)^2} \frac{\partial y_i}{\partial k_i} \, , \tag{1.24}$$

$$\frac{\partial T_i}{\partial k_i} = \frac{(1-\hat{q}_i)y_i}{(2+\hat{q}_i)} + \frac{3(1-k_i)y_i}{(2+\hat{q}_i)^2} \frac{\partial \hat{q}_i}{\partial k_i} - \frac{(1-k_i)(1-\hat{q}_i)}{(2+\hat{q}_i)} \frac{\partial y_i}{\partial k_i} \, , \tag{1.25}$$

$$\frac{1}{2} \frac{\partial S}{\partial k_i} = y_i \frac{\partial y_i}{\partial k_i} \, . \tag{1.26}$$

We first evaluate equations (1.24)–(1.26) at an initial capital standard of $k_i = 0$. In other words, we ask how welfare in country i is affected by the introduction of a small capital standard k_i. Note that an initial capital standard of $k_i = 0$ implies $\hat{q}_i = 0$ from (1.5). Turning first to the effects on the profits of country i's banking sector in (1.24), the first term in this expression vanishes when $\hat{q}_i = 0$ initially. Hence the effects on bank profits are exclusively determined by the change in the aggregate level of (successful) loans, as given by the second term. Similarly, the change in the volume of successful loans is also critical in determining the change in consumer surplus in the integrated market, as given in (1.26).

The effects on tax revenues in (1.25) are threefold. The first effect gives the direct, positive effect on tax collections (i.e. a reduction in expected subsidy payments) by decreasing the bank's reliance on deposits that are backed by a tax-financed insurance mechanism. Moreover, increasing the critical bank quality $\hat{q}_i$, and hence raising the average success rate of loans, additionally reduces the expected burden on taxpayers

by the second effect. The sign of the third effect is ambiguous, however, as it will depend on the change in the aggregate volume of loans extended by banks in country i, and hence on the sign of κ.

In Appendix A.2 we derive the conditions under which (1.24)–(1.26) are all positive when evaluated at $k_i = 0$ initially and the introduction of a small, capital standard strictly increases welfare in country i. These conditions are given by:

$$\frac{3(2\rho - 1)c}{3\rho - 2} > (A - 1) \tag{1.27}$$

$$\left[\frac{15}{8} + \frac{1}{4b}\right] c < (A - 1). \tag{1.28}$$

The inequality in (1.27) is just the condition for κ to be positive at $k = 0$. Effectively, this requires that the firms' fixed investment costs c must be sufficiently large, relative to the market size parameter A, which determines the profit margin of banks. If condition (1.27) is fulfilled, the *selection effect* of capital standards dominates the *cost effect* when both are evaluated at an initial capital ratio of zero. Inequality (1.28) states, in contrast, that the firms' fixed cost, and hence the induced expansion of bank loans is not so large as to overcompensate the positive first two effects of a small capital standard in (1.25). We can then summarize our results as follows:[18]

Proposition 1.1 *(i) When firms' fixed production costs are sufficiently high, relative to the size of the output market [*(1.27) *holds], then a small capital standard* $k_i > 0$ *raises the aggregate loan volume and aggregate profits of country i's banking sector.*
(ii) If, in addition, the firms' fixed costs c are not overly high, relative to market size [(1.28) *holds], then introducing a small capital requirement benefits banks, consumers and taxpayers in country i simultaneously and country i's welfare is improved for any combination of* $\alpha, \beta, \gamma \geq 0$.

Our model thus shows that in the presence of selection effects, introducing capital standards may be unanimously approved by all agents in a country, even if the regulation is imposed unilaterally. In particular, introducing a small capital standard may be in the overall interest of the country's banking sector when the latter is heterogeneous. By raising the costs of doing business, the capital standard drives the least

[18]Note that (1.27) and (1.27) are not mutually exclusive. For example, if $\rho = 1$ and $b = 2$, both conditions are simultaneously fulfilled when $3c > A - 1 > 2c$.

productive (most risky) banks from the market. High-quality banks will then benefit from the market exit of low-quality banks via a higher loan rate. When firms value the increase in the pool quality of banks sufficiently, as measured in our model by their fixed costs of production c, then the higher profits of infra-marginal banks dominate the profit losses of marginal, low-quality banks. These redistributive effects among heterogeneous banks may explain why large and productive banks do not generally oppose national capital standards, and in some cases even actively advocate them.

We emphasize, however, that Proposition 1.1 is a local result, which holds only for low levels of capital standards. When the capital requirement k_i is continuously increased, κ will fall. To show this, differentiating κ in (1.22) with respect to k_i gives

$$\frac{d\kappa}{dk_i} = \varepsilon \, \frac{\partial \hat{q}_i}{\partial k_i} - \frac{6b[3(\rho-1)(1+\hat{q}) + (1+2\hat{q})(1-\hat{q})]}{(1-\hat{q})^2(2+\hat{q})} \frac{\partial y_i}{\partial k_i}, \tag{1.29}$$

where

$$\varepsilon = \frac{-9\rho c}{(2+\hat{q}^2)} - \frac{6by}{(1-\hat{q})^2(2+\hat{q})^2} \left\{ 3(\rho-1)[5(1+\hat{q}) + 2\hat{q}^2] + (1-\hat{q})(5+2\hat{q}+2\hat{q}^2) \right\} < 0.$$

From the positive effect of k_i on $\hat{q}_i$ in (1.17) we see that the first term in (1.29) is unambiguously negative. Moreover, the second term in (1.29) is also negative when $\kappa > 0$ initially and hence $dy_i/dk_i > 0$ [see eq. (1.19)]. But this is exactly the case of firms' fixed costs being sufficiently large, on which we have focused in Proposition 1.1 (i). Therefore, as long as the value of κ is positive, κ must be unambiguously falling in k .

We can now look at the properties of our model when capital standards are optimally and non-cooperatively chosen in each of the two symmetric countries. Appendix A.3 simplifies (1.24)–(1.26) and gives the first order-condition for the capital standard in each country $i \in \{1, 2\}$:

$$\begin{aligned} \frac{dW_i}{dk_i} =& \alpha \frac{(1-\hat{q})^2\phi}{6b} \left[-3\rho + (2+\hat{q}) \frac{d\phi_i}{dk_i} \right] \\ &+ \beta \left\{ \frac{(1-\hat{q})^3\phi}{6b} + \frac{(1-k)(1-\hat{q})^2}{6b} \left[3\rho - (1+2\hat{q}) \frac{d\phi_i}{dk_i} \right] \right\} \\ &+ \gamma \frac{(1-\hat{q})^3(2+\hat{q})\phi}{2(6b)^2} \left[-3(1+\hat{q})\rho + 2(1+\hat{q}+\hat{q}^2) \left(\frac{d\phi_i}{dk_i} + \frac{d\phi_j}{dk_i} \right) \right] = 0 \, , \end{aligned} \tag{1.30}$$

where

$$\frac{d\phi_i}{dk_i} = \frac{3(1+\hat{q})\rho}{2(1+\hat{q}+\hat{q}^2)} + \frac{6b(\phi+\tilde{c}\hat{q}) + 2\phi(1-\hat{q}^3)\kappa}{(1+\hat{q}+\hat{q}^2)\left[12b(\phi+\tilde{c}\hat{q}) + 8\phi(1-\hat{q}^3)\right](\phi+\tilde{c}\hat{q})} \tag{1.31}$$

$$\frac{d\phi_j}{dk_i} = \frac{-2\phi(1-\hat{q}^3)\kappa}{(1+\hat{q}+\hat{q}^2)\left[12b(\phi+\tilde{c}\hat{q}) + 8\phi(1-\hat{q}^3)\right](\phi+\tilde{c}\hat{q})} \,. \tag{1.32}$$

Not surprisingly, (1.31) and (1.32) show that ϕ, the bank's return per unit of its loans, net of funding costs for saving deposits, is a function of the relative importance of the *selection effect* and the *cost effect*. For $\kappa > 0$, the *selection effect* dominates the *cost effect* and thus increases ϕ_i and decreases ϕ_j. [19]

We can now interpret the first order-condition for the capital standard in each country. Obviously, $d\pi_i/dk_i$, the first term in (1.30) is a positive function of $d\phi_i/dk_i$. An increase in the bank's return per unit of its loans, net of funding costs for saving deposits, mechanically translates into an increase in bank's profit. However, and clearly, this effect can be overcompensated by the increase in funding costs, making the overall effect of an increase in capital standards on bank profits ambiguous.

The effect of an increase in capital standards on the tax revenue in country i is captured in the second term of (1.30). Here $d\phi_i/dk_i$ runs counter to the positive effects of k_i that are due to the lower amount of insured deposits per unit of investment and due to the increase in the quality of the banking pool in country i. The negative effect of $d\phi_i/dk_i$ on T_i can be attributed to the rise in investment that follows from an increase in ϕ_i [see eq. (1.2)], which results in an increase of taxpayer liability in the case of bank default.

The third term in (1.30) measures the effect of an increase in capital standards on consumer surplus in country i. Comparing (1.31) and (1.32), it becomes clear that the effect of κ on $d\phi_i/dk_i$ is always larger than on $d\phi_j/dk_i$. Moreover, substituting (1.31) and (1.32) in (1.30) results in the findings of (1.20), which states that $dy/dk_i > 0$ and thus consumer surplus increases whenever $\kappa > 0$.

To characterize the properties of capital standards that are set at an interior optimum, we can now analyze the value of $d\phi_i/dk_i$ in a symmetric Nash equilibrium. Therefore, we derive $d\phi_i/dk_i$ at $\kappa = 0$ by setting the square bracket in the third term of (1.30), which measures dS_i/dk_i, equal to zero. Then, substituting this value into $d\pi_i/dk_i$

[19] Note that (1.31) and (1.32) further differ due to the fact that ϕ denotes the bank's return per unit of its loans, net of funding costs for saving deposits. Therefore, additionally to κ an increase in k_i decreases the amount and thus the cost for saving deposits per unit of investment in country i, while the amount of saving deposits per unit of investment does not change for banks in country j.

and dT_i/dk_i, we get that both terms are positive at $\kappa = 0$. Combining this result with $d\kappa/dk_i < 0$, we can conclude that when non-cooperative capital standards are optimally set in an interior optimum, it must be true that $\kappa < 0$ holds and hence $dy_i/dk_i < 0$.[20] While this result unambiguously signs dT_i/dk_i and dS_i/dk_i, we are left to determine $d\pi_i/dk_i$ in the Nash equilibrium. Substituting (1.31) in $d\pi_i/dk_i$ shows that even for $\kappa < 0$ it can be true that $d\pi_i/dk_i > 0$. However, analysing dT_i/dk_i and dS_i/dk_i at $d\pi_i/dk_i = 0$, it becomes clear that the negative effect on consumer surplus must receive a relatively high weighting to overcompensate the positive effect on taxpayer losses. More precisely, in Appendix A.3 we show that

$$\gamma < \beta(16b/\rho) \tag{1.33}$$

is a sufficient condition for $d\pi_i/dk_i < 0$ in the non-cooperative policy optimum. We can now summarize our results at that stage in:

Proposition 1.2 *In a symmetric Nash equilibrium where capital standards are at an interior optimum, $0 < k_i^* < 1 \; \forall \; i \in \{1, 2\}$, a marginal increase in the capital standard of country i reduces the loan supply of this country as well as aggregate output, but it increases the loan supply of country j. Further, if the welfare weight on consumer surplus is not overly high [(1.33) holds], then a marginal increase in the capital standard of country i reduces expected profits for the banking sector in country i.*

Proposition 1.2 implies that, in the non-cooperative policy optimum, the *cost effect* of capital standards must dominate the *selection effect*. This in turn shows that, evaluated at the non-cooperative equilibrium, an increase in capital standards reduces consumer surplus in both countries, but it increases tax revenues (i.e. reduces subsidies) for taxpayers for country i. Moreover, it reduces bank profits in country i whenever γ is not overly high.

[20] Theoretically, β could be such that even for $\kappa > 0$ the negative effect of $d\phi_i/dk_i$ on dT_i/dk_i would balance the positive effect on $d\pi_i/dk_i$ and dS_i/dk_i . However, in this case, we would arrive at the corner solution of $k = 1$.

1.4 Are decentralized capital standards set too low?

We now turn to analyzing the efficiency of decentralized regulation policies. Since countries are symmetric in our benchmark model, we can simply define regional welfare as the sum of national welfare levels

$$W_W = W_i + W_j \quad \forall\, i, j \in \{1, 2\}, i \neq j, \tag{1.34}$$

where W_i is given in eq. (1.13). Choosing k_i so as to maximize aggregate welfare (1.34) would imply $\partial W_W/\partial k_i = 0$. The nationally optimal capital standards derived in the previous section are instead chosen so that $\partial W_i/\partial k_i = 0$. Hence, any divergence between nationally and globally optimal capital requirements is shown by the effect of country i's policy variable k_i on the welfare of country j. If $\partial W_j/\partial k_i > 0$, then the capital requirements chosen at the national level are too lax from a regional welfare perspective, as an increase in k_i would generate a positive externality on the welfare of country i. The reverse holds if $\partial W_j/\partial k_i < 0$. In this case the externality on the foreign country is negative and nationally chosen capital requirements are too strict from a regional welfare perspective.

Differentiating W_j with respect to k_i gives (see Appendix A.4):

$$\begin{aligned}\frac{\partial W_j}{\partial k_i} \;=\; & \frac{-\kappa y_j}{2\Omega(\hat{q}\tilde{c}+\phi)(2+\hat{q})}\left\{\frac{6by_j(\alpha-\gamma)}{(1-\hat{q})}\right. \\ & \left. -\frac{\beta(1-k_j)[2(1-\hat{q}^3)+3\hat{q}(1-\hat{q})]}{(2+\hat{q})} - \frac{3\gamma(1-\hat{q})\hat{q}c}{(2+\hat{q})}\right\}. \end{aligned} \tag{1.35}$$

There are three terms in the squared bracket of (1.35). Note that the common multiplier for all these terms is positive because the effects must be evaluated at a negative value of κ in the non-cooperative Nash equilibrium (Proposition 1.2).

The first term in the squared bracket nets out the effect of a higher capital standard in country i on the profits of country j's banks in the absence of a *selection effect* (i.e., for $c = 0$), and the effect on consumer surplus in the output market for the residents of country j. It is seen that if bank profits and consumer surplus are weighed equally in the welfare function of country j (i.e., if $\alpha = \gamma$), then the sum of these effects is exactly zero. To explain why these two externalities just offset each other, note first from the zero profit condition of firms (1.8) that, for given levels of $\hat{q}_j$ and c, the change

in the consumer price p induced by the higher k_i just equals the induced change in the loan rate earned by country j's banks. Moreover, we see from (1.19)–(1.20) that an increase in k_i causes a smaller expansion of (successful) loans in country j, but a larger overall fall in aggregate output y, if banks face relatively high costs of expanding their operations [b is high; see eq. (1.2)]. In this case, however, the profit margin earned by country j's banks is also high, and a given loan expansion therefore increases profits by more [see eq. (1.14)].

Clearly, the fact that these terms are exactly offsetting for $\alpha = \gamma$ is due to the precise specifications of our model. The more general point behind our results is, however, that if the market for bank loans is integrated, the effects of a tougher capital standard in country i on banks vis-a-vis consumers in country j will not only be qualitatively offsetting, but their quantitative importance is also likely to depend on the same underlying market characteristics.

In the case where $\alpha = \gamma$, and the first effect in the squared bracket of (1.35) is thus zero, the net effect of higher capital standards depends on the two effects in the second line of (1.35). Both of these effects are unambiguously negative. The first of these effects gives the change in expected tax subsidies that taxpayers in country j have to pay for their failing banks. Clearly these tax subsidies must increase, because the aggregate size of bank loans rises in country j and the average failure probability also rises, due to the lower cutoff quality of the banking sector in country j [see eq. (1.18)].

Finally, the last effect in (1.35) is also negative. This effect arises from the *selection effect* of capital standards in our model. The higher average quality of loans induced in country i reduces total output, on net, and this has a negative effect on consumer surplus in country j. At the same time, the higher cutoff quality of banks in country i raises the loan rate in country i, but not in country j. Therefore, banks in country j do not benefit from the part of the aggregate output reduction that is induced by a higher level of $\hat{q}_i$. On net, therefore, only the negative effect on consumer surplus remains for country j. We summarize our results in:

Proposition 1.3 *When governments weigh the welfare of banks and consumers equally ($\alpha = \gamma$), then non-cooperatively set capital standards exceed those that maximize aggregate welfare in the union. This 'race to the top' is more pronounced, if (i) the valuation of taxpayers' losses in the government objective function is large (β is high) and (ii) if the 'selection effect' of capital standards is strong (c is large).*

Proposition 1.3 is in direct contrast to the results in the existing literature, which have

found that the non-cooperative setting of capital standards leads to a 'race to the bottom', or to a 'competition of laxity' (see Sinn, 2003; Acharya, 2003; Dell' Ariccia and Marquez, 2006). Effectively, these contributions have focused on the effect that capital requirements have on the profits of national banking sectors. Our model adds two main effects to these existing analyses. First, we incorporate firms that use bank loans to produce final output and we explicitly calculate the costs of bank failures. This allows us to consider more general objective functions where governments set capital standards also with a view on taxpayers and consumers. As we have shown, this leads to additional externalities of capital standards that are *negative* for the neighboring country: higher capital standards can be used to shift risks from domestic to foreign taxpayers and they also negatively affect consumer surplus in the foreign country when loans markets are integrated. In sum, these effects will often overcompensate the positive externality on the foreign banks' profits on which the existing literature has focused.

The second additional aspect in our model arises from the selection effect of capital standards in a model where banks are heterogeneous and individual bank quality is not observable for firms that require funds. In such a setting, capital standards can partly solve the information problem and redistribute profits from low-quality to high-quality banks within the domestic banking sector. At the same time, the cost disadvantage that higher capital requirements imply for the domestic banking sector is reduced, on average, in comparison to a model where such selection effects do not arise. As a consequence, models with homogeneous banks will typically overestimate the positive externalities that higher capital requirements in one country have on the profits of the banking sector in the neighboring jurisdiction.

1.5 Discussion

1.5.1 Foreign ownership of banks

We can easily extend our analysis to allow for the realistic scenario that bank ownership is not limited to national borders. In this case, the welfare function of country j slightly changes to

$$W_j = \alpha \left[\sigma \pi_j + (1-\sigma)\pi_i\right] + \beta T_j + \frac{\gamma}{2} S \,, \tag{1.36}$$

where country j owns a share σ of its own resident banks and a share $(1-\sigma)$ of the banks that are resident in i.

Consequently, compared to section 1.4, two changes occur in the analysis of dW_j/dk_i. First, the positive effect of k_i on the profit of banks that are located in country j becomes less important for the welfare in country j. Second, the consideration of $d\pi_i/dk_i$, which is negative at the non-cooperative policy optimum for $\gamma < \beta(16b/\rho)$, reinforces the negative effect of k_i on welfare in country j which is due to $dT_j/dk_i < 0$ and $dS_j/dki < 0$. Therefore, we can conclude that:

Proposition 1.4 *Foreign ownership of banks increases the negative effect of a unilateral increase in capital standards in country i on welfare in country j.*

Proposition 1.4 tells us that the degree of foreign bank ownership has an unambiguous welfare implication when capital standards are non-cooperatively chosen. This is due to the fact that the positive externality of k_i on π_j enters the welfare function of country j with lower weight, while $d\pi_i/dk_i < 0$ adds to the negative externality of k_i on T_j and S_j, which dominates the overall effect as shown in Proposition 1.3. This result might be especially important for countries with a large presence of foreign bank subsidiaries, e.g. Eastern European countries, where according to Allen et al. (2011) foreign-owned banks provide 90% of the credit to non-bank residents compared to only 30% in other European countries.

1.5.2 Quality signalling of banks

We now depart from our basic model and assume that entrepreneurs are able to interpret the funding structure of banks. More precisely, entrepreneurs anticipate that high quality banks are interested in credibly conveying the information about their quality and that they are thus willing to invest in the costly signal of holding equity above the minimum standard. Thereby, the entrepreneurs take into account that, for a bank with quality q, the marginal cost of changing the funding structure towards more equity is equal to

$$\frac{\partial \pi_i^*(q)}{\partial k} = \frac{q\phi - k\rho}{b}(q - \rho) < 0 \,, \tag{1.37}$$

which follows directly from the first derivative of the banks optimized profit function in eq. (1.4) with respect to k. The cost arises due to the reduction in the share of bank funds that are covered by deposit insurance. Critically, as we can see from (1.37), the marginal cost of raising equity above the minimum standard is a negative function of

bank quality. As the default is most likely for low quality banks, these banks benefit most from the existence of the deposit insurance system.

However, given the complexity of bank balance sheets and the potential costs of screening, it seems hard to imagine that even the smallest differences in the capital holding of banks can be observed and understood by each entrepreneur. Therefore, and to keep the model tractable, we allow for one specific level of equity that is denoted $k_i^h \equiv k_i + \tilde{k}_i$. All banks that choose to hold k_i^h will then be identified as high quality bank ($p = h$), whereas all banks that remain at k_i will be classified as belonging to the low quality pool ($p = l$). This is due to the entrepreneurs' interpretation of the banks' signalling choice according to the following considerations:

$$\tilde{q}_i \left(\phi_i^h - \phi_i^l\right) = \tilde{k}_i \rho \,, \tag{1.38}$$

where

$$\phi_i^p = A - \frac{c}{q_i^{e_p}} - y - 1 + k_i^p \tag{1.39}$$

$$q^{e_p} = \frac{[2\bar{q}^p + \underline{q}^p] l(\bar{q}^p) + [2\underline{q}^p + \bar{q}^p] l(\underline{q}^p)}{3[l(\bar{q}^p) + l(\underline{q}^p)]} \,. \tag{1.40}$$

Entrepreneurs know that the cost of acquiring additional equity is a function of each bank's quality [eq. (1.37)]. Consequently, the entrepreneurs are able to identify the critical quality level $\tilde{q}_i$ at which the bank is just indifferent about investing into the costly signal and issuing additional equity of $\tilde{k}_i$ [eq. (1.38)]. Importantly, the value associated with this signal is determined through $\tilde{q}_i$. This is due to the fact that the loan return will depend on the entrepreneurs assessment of the expected quality of each banking pool [eq. (1.39)]. Therefore, given the benchmark of $\tilde{q}_i$, entrepreneurs infer that all banks with quality $q < \tilde{q}_i$ will prefer to hold only the minimum amount of k_i and be identified as low quality bank, while all banks with $q > \tilde{q}_i$ will choose to signal that they belong to the high quality pool of banks and set k_i^h. The expected quality of each pool [eq. (1.40)] is then calculated as the weighted average of the number of loans issued by the lowest quality bank within the pool ($\underline{q}^l = \hat{q} \,, \underline{q}^h = \tilde{q}$) and issued by the highest quality bank within the pool ($\bar{q}^l = \tilde{q} \,, \bar{q}^h = 1$).[21]

Given this extended setup, we can now again derive the responses of the endogenous

[21] To arrive at eq. (1.40), we first substitute eq. (1.2) in $q^{e_p} = \frac{Y^p}{L^p} = \frac{\int_{\underline{q}^p}^{\bar{q}^p} q l(q) dq}{\int_{\underline{q}^p}^{\bar{q}^p} l(q) dq}$, then solve the integrals, and finally simplify terms.

variables $\hat{q}_i$, $\hat{q}_j$ and y in response to a unilateral increase in the capital requirement of country i, where we assume $dk_i^h = 0$. These are equal to

$$\frac{\partial \hat{q}_i}{\partial k_i} = \frac{\Upsilon_i}{\Omega^s} > 0 \tag{1.41}$$

$$\frac{\partial \hat{q}_j}{\partial k_i} = \frac{\Upsilon_j}{\Omega^s}\kappa^s \tag{1.42}$$

$$\frac{\partial y}{\partial k_i} = \frac{1}{\Omega^s}\kappa^s \ . \tag{1.43}$$

In Appendix A.5 we show that $\Upsilon_i > 0$, $\Upsilon_j > 0$, $\Omega^s > 0$ and that, again, the sign of κ^s is ambiguous and determined through

$$\begin{aligned}\kappa^s = (\tilde{q} - \hat{q}) \{ &- [(2\tilde{q} + \hat{q})(1 - \tilde{q}) + (2\hat{q} + \tilde{q})(1 - \hat{q})] \\ &+ \frac{1}{3}\frac{c}{(q^{e_l})^2}\frac{1}{\phi^l}[2\hat{q}(\tilde{q} + \hat{q})(\rho - 1) + 2\rho\tilde{q}^2 - \tilde{q}\hat{q} - \hat{q}^2]\Big\} \\ &+ \frac{2}{3}\frac{c}{(q^{e_l})^2}\frac{\tilde{q}^3 - \hat{q}^3}{\Lambda}\left[-2(\rho - \tilde{q}) + \frac{1}{3}\frac{c}{(q^{e_l})^2}\frac{\tilde{q}}{\phi^l}\frac{2\hat{q}(\tilde{q} + \hat{q})(\rho - 1) + 2\rho\tilde{q}^2 - \tilde{q}\hat{q} - \hat{q}^2}{\tilde{q}^2 + \tilde{q}\hat{q} + \hat{q}^2}\right] \\ &+ \Gamma\frac{c}{(q^{e_h})^2}\frac{1 - \tilde{q}^3}{\Lambda}\left[-2(\rho - \tilde{q}) + \frac{c}{(q^{e_l})^2}\frac{2}{3}\frac{\rho(\tilde{q} - \hat{q})}{\phi^l}\right]\end{aligned} \tag{1.44}$$

where we have introduced the short-hand notations

$$\Lambda = (\phi^h - \phi^l) - \tilde{q}\left[\frac{2}{3}\frac{c}{(q^{e_l})^2} - \Gamma\frac{c}{(q^{e_h})^2}\right] \overset{!}{>} 0 \tag{1.45}$$

$$\Gamma = \frac{2l_{\tilde{q}}(2l_1 + l_{\tilde{q}})b}{3(l_1 + l_{\tilde{q}})^2 b + \frac{c}{(q^{e_h})^2}(1 - \tilde{q})^2 k^h \rho} > 0 \ . \tag{1.46}$$

Equations (1.41) - (1.44) confirm that the main response functions remain qualitatively unaffected when we extend our basic model and allow for quality signalling by banks. The weakest banks in country i are, again, driven out of the market due to the reduction of implicit taxpayer subsidies [eq. (1.41)]. Further, as in the basic model, the effect of k_i on the number of banks in country j and the total amount of produced output is ambiguous and captured by the term κ^p [eq. (1.42)and (1.43)]. While the first row in eq. (1.44) is similar to κ, which we derived in the basic model [see eq. (1.22)], the terms in the second and third row of eq. (1.44) enter due to the reallocation effects between

the different quality pools within each country.[22] We will now analyze each term in more detail.

Initially, a unilateral increase of capital standards in country i only affects all banks with $q < \tilde{q}_i$. As in the basic model, the loan supply of these banks will change according to the relative strength of the *cost effect* vis-a-vis the *selection effect*. This trade off is captured in the first row of eq. (1.44).

Additionally, however, the expected quality of both bank pools in country i is altered through the change in the willingness of banks to signal their quality. Looking at (1.38), one can see the opposing effects of a marginal increase in k_i on $\tilde{q}_i$. First, the exit of the weakest banks ceteris paribus increases the attractiveness of this pool and thus decreases the incentives of banks to signal their superior quality. Second, and contrary, given the (plausible) assumption of k_i^h remaining constant, an increase in k_i decreases the relative cost of signalling. Interestingly, now, the relative strength of these opposing effects is, again, critically affected by the level of c. Whenever c is relatively large, the positive effect of the increase in $\hat{q}_i$ on q^{e_l} will sharply increase the expected loan return for banks of the low quality pool [see eq. (1.39)]. Thus, in this case, the low quality pool will become relatively more attractive for banks in country i and, consequently, $\tilde{q}_i$ will increase. In contrast, for small values of c, the increase in the expected quality of the low quality pool will be less pronounced compared to the reduction in the relative cost of signalling. Marginally increasing k_i will then decrease $\tilde{q}_i$.

This reallocation process within the banking sector of country i has repercussions on the total output and on the number of banks in country j, which are captured in the second and third row of eq. (1.44). As explained above, whenever c is relatively large, marginally increasing k_i will also raise $\tilde{q}_i$. This in turn increases the expected quality of both bank pools in country i by removing the weakest banks from the high quality pool and increasing the quality of the best bank in the low quality pool. All country i banks that remain in the high quality pool will then increase their loan supply, as follows directly from substituting (1.39) in (1.2). Further, all banks that no longer signal their quality will also increase their supply of loans. This follows from a revealed preference argument. Banks will change their quality pool only if they expect higher profits. These profits, however, can only be generated through an increase in the supply of

[22] Condition (1.45) has to hold, as otherwise we would arrive at $\tilde{q} = 1$. Equation (1.46) measures the effect of a marginal increase in $\tilde{q}$ on the high quality pool. As an increase in $\tilde{q}$ increases ϕ^h, which in turn affects the output and thus the marginal weights of each bank within the pool, this term is more complicated then the effect of $\tilde{q}$ on the low quality pool (2/3), where the output of the lowest quality bank is always zero.

loans [see eqs. (1.2) and eq. (1.4)]. We can summarize these results in

Proposition 1.5 *The responses of $\hat{q}_i$, $\hat{q}_j$ and y to a unilateral increase in k_i remain qualitatively unaffected when we introduce imperfect signalling by banks.*

In section 1.3 we have argued that, given a setup of heterogenous banks that are unable to signal their quality, national banks can benefit from a *selection effect* when the domestic regulator unilaterally increases its capital standard. Our analysis in this section confirms this effect even when banks group themselves into multiple pools to signal their quality. Obviously, all banks in the low quality pool are still directly affected by the increase in the minimum capital standards. However, all banks in the high quality pool will also be affected, indirectly, through the change in the critical quality threshold at which banks opt to signal their superior quality and fund themselves with a higher amount of equity. As we have shown, higher values of c will favor a reallocation of banks such that the expected quality of both quality pools increases. Thus, in this case, banks in both quality pools will benefit from the positive *selection effect* of a marginal increase in the minimum capital standards and increase their loan supply. In contrast, for lower values of c, entrepreneurs will value the exit of worse quality banks less. Therefore, following a unilateral increase in capital standards, the decrease in the relative signalling cost will attract banks around the signalling threshold to enter the high quality pool. Thus, in this case, the marginal increase in capital standard causes a negative *selection effect* for all banks in the high quality pool. This reduces the supply of loans. As in the basic model, this effect will spillover to the banking sector in country j that competes on the integrated loan market. Therefore, the number of banks in country j will decrease whenever the aggregate loan supply from banks in country i increases.

1.6 Conclusion

In a setting with international competition between heterogeneous banks and a taxpayer bailout for failing financial institutions, we have shown that non-cooperative setting of capital adequacy standards leads to a 'race to the top' in capital regulation, in direct contrast to the 'race to the bottom', on which the existing literature has focused. Our model can thus explain why countries such as Switzerland and the United Kingdom, which are characterized by large banking sectors and accordingly a high risk

exposure of national taxpayers, resort to capital adequacy rules that exceed the Basel III standards. At the same time, it also offers a motivation for why many European countries insist on setting *upper* limits on capital standards, along with lower ones.

Chapter 2

Capital standards and resolution procedures for multinational banks

2.1 Introduction

During the recent financial crisis, government responses towards ailing banks were largely driven by the attempt to limit the damage for national taxpayers. However, as the liquidation procedure of Lehman Brothers Holding Inc. (LBHI), the parent company of Lehman Brothers, illustrated, this approach caused serious international contagion effects. While the US authorities refused to support LBHI, they did support the US broker-dealer subsidiary that could be later merged successfully with Barclays Capital. In contrast, the resolution of the remaining subsidiaries that were present in 49 countries was more costly. This was especially due to the high degree of centralization and complexity of the LBHI, that would have made it necessary for the national authorities to cooperate (Claessens et al., 2010). Similar patterns could be observed during the crises of the Icelandic banking system, where banks had established a Europe-wide system of savings accounts that broke down at the onset of the financial crisis (see Benediktsdottir et al., 2011). Further, the large amount of governmental support towards Fortis, a multinational bank with large presence in Belgium, the Netherlands and Luxembourg, was mainly attributed to the lack of cooperation between the national supervisory authorities.[1]

[1]See Claessens et al. (2010) for a study on Fortis and for further cases of cross-border resolution procedures during the recent financial crises.

As a consequence, improvements in the process and the decision about the resolution of multinational banks are high on the political agenda. Proposals include demands for multinational banks to map their line of business into the corporate entities and clarify key interconnections across affiliates (centralized information). Further measures foresee a better collaboration and more rights to intervene for international supervisory colleges (centralized resolution).[2] These measures are expected to lead to a reduction in expected bankruptcy costs of multinational banks.

Interestingly, however, it is by no means clear that this will also decrease the total expected cost for national taxpayers. While coordinated supervision and liquidation can be a reasonable tool to limit the costs of failure for multinational bank once they have occurred, one should also look at the incentives of national regulators to limit the potential social losses of bank failure ex-ante.

This chapter introduces a model where countries compete for the investment of multinational bank subsidiaries. While each country benefits from the investment in normal times, costs arise in case that the subsidiary is hit by a shock and has to default. There exist two regulatory instruments to curb these costs. First, each regulation authority can impose capital standards for the subsidiary that is resident in its country. However, as this reduces the subsidy from deposit insurance, a unilateral increase will lead to the reallocation of investment to the subsidiary that is located in the other country. Second, each regulation authority can intervene into the operation of its resident subsidiary whenever the probability of default is sufficiently large. Here, national regulation authorities fail to account for the international spillovers that are caused by the reallocation of capital within the multinational bank network in case of unilateral shocks.

First, we show that moving from a national to a global intervention regime changes the non-cooperative equilibrium of capital standards. Accounting for the externality at the intervention stage, moving towards a global intervention regime raises the value of one unit of bank investment and thus increases the welfare loss when capital standards are unilaterally increased. Further, when national intervention would be too lax from a global welfare perspective, the increase in safety caused by a more global regime makes it less attractive for each regulation to impose strict capital standards. This result might help to explain why countries like Switzerland, the United Kingdom and the United States, which all host large multinational banks but are not integrated

[2]See Hagan and Vinals (2010), Claessens et al. (2010) and Allen et al. (2011) for discussions on various structures of resolution regimes for multinational banks.

in a multinational intervention regime, have substantially tightened bank capital requirements, while countries within the eurozone have so far not departed from the minimum standard in the Basel 3 framework.

We then analyse the welfare effect of different intervention regimes. Thereby we study the interaction between the anticipation of supervisory decisions, the determination of capital standards and the externalities that are induced without full coordination in both regulatory instruments. We can then define a condition that whenever bank investment is sufficiently profitable and mobile and thus the externality that arises due to non-cooperative capital standards is large, moving towards a more centralized intervention regime is welfare decreasing.

This chapter wants to add to the current policy debate about the strategies in the intervention and resolution of multinational banks. Our analysis is especially important for Europe, where multilateral resolution procedures are aimed at in the new banking union. Most authors support the idea of a more centralized approach (Claessens et al., 2010; Beck and Wagner, 2013). However, until now, the determination of precise intervention criteria and the (partial) transfer of budgetary sovereignty in case of default have impeded the full implementation.[3] This is similar to the harmonization in bank capital standards, where European countries still differ in the application of rules that have to be put in place at the Member state level (Basel Committee on Banking Supervision, 2014). Importantly, as this chapter argues, both initiatives should only be negotiated and agreed upon in a closely coordinated approach. Otherwise, unilateral approaches towards more centralization in the resolution of multinational banks might even prove to be economically harmful.

The analysis in this chapter builds on several strands of the literature. Various authors examined the effects of capital regulation on financial institutions (Rochet, 1992; Hellman et al., 2000; Repullo, 2004). This literature stresses that capital regulation increases the risk buffer of banks and curbs risky behaviour. However, introducing bank mobility, the existing literature shows that capital standards in the non-cooperative equilibrium will be set inefficiently low from a global welfare perspective (Sinn 1997, 2003; Dell'Ariccia and Marquez, 2006). The interaction of capital standards and bailout policies in a framework of international spillovers due to regional bank markets is analyzed in Acharya (2003). The author shows that the convergence of bank capital requirements can amplify the frequency and the amount of bank bailouts when

[3]See "Banking on a new union - The promises and pitfalls of the euro zone's next big idea", The Economist, December 14, 2013.

they are carried out by national authorities.

Different aspects regarding the role of supervision within the regulatory framework have been discussed in the literature. Aghion et al. (1999) and Mitchell (2000) analyse incentive schemes to overcome the information problem between the management of the bank and the supervisory authority. The distribution of supervisory tasks between different institutions, e.g. central bank and deposit insurance fund, is analyzed in the work of Repullo (2000) and Kahn and Santos (2005). The adequacy of different measures of intervention, e.g. liquidation or restructuring, is analyzed in Dewatripont and Freixas (2011). Taking into account the international mobility of banks, several papers discuss the inefficiencies that derive from a decentralized supervision regime. Beck et al. (2013) and Beck and Wagner (2013) analyze the distortions in the intervention decision of host country regulators that are caused by foreign ownership of bank assets, bank equity and bank deposits. Calzolari and Loranth (2011) focus on the effect of the multinational bank's organizational structure on the distortions that arise from national supervision authorities. Goodhart and Schoenmaker (2009) analyze ex-ante burden sharing agreements between hosting nations of multinational banks that can be implemented to overcome the inefficient ex-post negotiations on the recapitalization of failing banks.

The decision for banks to operate multinational is analyzed in Niepmann (2013). Dell'Ariccia and Marquez (2010) analyze the decision of multinational banks between branch-based and subsidiary-based corporate structures. The existence of an internal capital market at multinational banks that allocates capital between capital-scarce and capital-abundant affiliates has been well documented in the empirical literature (see e.g. Cetorelli and Goldberg 2012). More specific, a vast amount of (mostly empirical) literature has analyzed the role of multinational banks during times of financial distress. The findings can be summarized as follows. On the one hand, the internal capital market of multinational banks can play a supportive role for subsidiaries that face idiosyncratic shocks (see e.g. Navaretti et al., 2010). At the same time, the reallocation of funds between affiliates of a multinational bank network might also lead to the propagation of local shocks (see e.g Peek and Rosengren, 1997; De Haas and Van Horen, 2012). In our model, we account for both of these possible outcomes.

The remainder of this chapter is set up as follows. Section 2.2 describes the setup of the model. The basic model is solved by backward induction in section 2.3, while the welfare analysis is carried out in section 2.4. Section 2.5 concludes.

2.2 The model

2.2.1 Bank investment

We consider one representative multinational bank that owns two subsidiaries and has a unique technology of monitoring entrepreneurs. One subsidiary is located in country A while the other subsidiary is resident in country B. Each subsidiary has access to an unlimited amount of domestically raised (insured) deposits at cost of one. In contrast, the supply of bank equity is assumed to be fixed at the level of the multinational bank.[4] The amount of equity at the subsidiary in country A is denoted α. The allocation decision will be analyzed below. Further, we assume that firms do not have any funds of their own so that one unit of loan distributed in country i translates into one unit of investment I_i.

The investment of banks is prone to country specific shocks. Consequently, the return to each unit of bank investment is perfectly correlated within each country and perfectly uncorrelated between both countries. If the shock does not hit country i, each unit of investment leads to the production of one unit of a homogenous consumer good in this country. We assume that both countries are symmetric with respect to the size of the market A and that each national output market is characterized by the inverse demand function $p_i = A - ay_i$. Allowing for free entry of firms that can produce at zero cost, the return of each unit of bank investment in country i in case of successful production is therefore equal to the price on the national output market and given by

$$R_i = A - aI_i \ . \tag{2.1}$$

Obviously, as all profits accrue to the bank subsidiary, R_i is a positive function of the exogenous parameter A and a negative function of total investment in country i. When the investment is successful, the bank subsidiary will be able to repay its depositors and pay out the surplus to the equity holders. Including the surplus to consumers and given that the subsidiary in country i is not hit by a shock, each unit of bank investment

[4]This simplification is often made in the literature, e.g. Dell'Ariccia and Marquez (2006). It represents the notion that bank capital is difficult to raise on short notice. All results would remain qualitatively unaffected if we would instead assume that the bank can raise additional equity but faces higher expected cost than for deposits.

generates

$$v_i = R_i + CS_i = A - \frac{a}{2} I_i \ . \tag{2.2}$$

If, in contrast, country i is hit by a shock, the return of the investment will be zero. Abstracting, for now, from the internal capital market of the multinational bank that reallocates capital between its subsidiaries, the bank subsidiary that is located in country i will not be able to repay its depositors. In this case, the repayment obligations will be shifted to the deposit insurance system. The existence of a deposit insurance system, which equals common practice in virtually all developed countries, can be explained by the prevention of expectation-driven bank runs. These runs would occur due to the possibility for depositors to withdraw their funds at any time. The welfare costs of these bank-runs have been well documented (see e.g. Bryant 1980 and Diamond and Dybvig 1983). Critically, as shown in the analysis of Acharya and Dreyfuss (1988) and Chan et al. (1992) among others, due to asymmetric information and timing problems, it might not be possible to charge banks with fair insurance rates. Experienced difficulties to (fully) recoup the vast amount of financial support from taxpayers during and after the financial crisis confirm this feature of deposit insurance as a subsidy to bank owners. We model this by assuming that the default of the bank subsidiary that is located in country i causes social costs for each unit of investment equal to

$$c^d = c(1 - k_i) \ . \tag{2.3}$$

The exogenous parameter c captures the cost of raising one unit of funds to reimburse depositors. These costs are primarily due to distortions caused by the collection of public funds. Further, as we only allow for two different types of funds, deposits and equity, the amount of insured deposits for each unit of investment is equal to the total investment net of the amount of equity k_i that the subsidiary in country i is required to hold by the national regulation authority.

2.2.2 Bank regulation

In this model, the role for regulation follows from two facts. First, as shown in Eq. (2.3), the default of the bank subsidiary in country i has social costs. Second, due to the limited liability of bank owners and the presence of the deposit insurance system, bank owners have no incentive to curb these costs.

We allow for two regulatory instruments. First, the national regulator in country i can impose capital requirements k_i. This standard determines the amount of equity that the subsidiary in country i has to invest for each unit of loan. Equation (2.3) illustrates the buffer function of capital standards. As an increase in k_i decreases the amount of fixed claims (deposits) for each unit of investment, the expected cost of default decreases in turn. At the same time, however, due to the fixed amount of equity, which we normalize to one, capital standards also limit the total investment of each subsidiary which is given by

$$I_i = \frac{e_i}{k_i} \,, \tag{2.4}$$

where $e_A = \alpha$ is the amount of equity that the multinational bank allocates to the subsidiary in country A, while $e_B = 1 - \alpha$ is the amount of equity at the subsidiary in country B. Below, we will analyze the allocation of equity between both subsidiaries.

Second, we assume that a supervisory authority can intervene into the activity of each bank subsidiary. The modelling approach for this part follows Beck and Wagner (2013). After the investment of each subsidiary but before the realisation of the shock, the supervisory authority will receive a signal indicating the probability λ_i that the investment of the subsidiary in country i will be successful. To simplify, we assume λ_i to be uniformly distributed between $[0, 1]$.[5] Then, for a given intervention threshold $\tilde{\lambda}_i$, which we will derive below, we can differentiate between three scenarios. First, for $\lambda_i < \tilde{\lambda}_i$ and thus with probability $\tilde{\lambda}_i$, the supervisory authority will intervene. We assume that in this scenario the regulator is able to recover the initial investment I_i.[6] Second, given that the supervisory authority will not intervene, the probability that country i will not be hit by a shock is equal to $\frac{1+\tilde{\lambda}_i}{2}$. Consequently, the ex-ante probability of successful investment is equal to $(1 - \tilde{\lambda}_i)\frac{1+\tilde{\lambda}_i}{2} = \frac{1-\tilde{\lambda}_i^2}{2}$. Third, the subsidiary is allowed to continue but then hit by a shock. The ex-ante probability of this scenario is equal to $\frac{(1-\tilde{\lambda}_i)^2}{2}$.

In this model, we are mainly interested in the interaction of capital standards and intervention thresholds in the case that countries do not fully coordinate in the determination of both regulatory instruments. Even in the presence of the Basel 3 Accord, a global regulatory framework, this setting should be a realistic reflection of the current situation. First, the Basel 3 Accord constitutes only a voluntary framework that

[5] While this distribution corresponds to the ex-ante shock probability being equal to 1/2, our results would not be affected qualitatively by different values.

[6] The intervention can take different forms, e.g. assumption of operation involving another bank, and might also incur specific costs. However, as long as these costs are sufficiently small relative to the costs arising after the shock, the same qualitative results would be obtained.

further leaves scope for national evaluations, e.g. with respect to the discretionary surcharge of a 'counter-cyclical buffer' of up to 2.5%. Second, it seems to be widely believed that the capital standards that are specified in the Basel 3 framework are insufficient for large multinational banks.[7] The United States have already introduced a minimum leverage ratio of $5-6\%$ for eight systemically important financial institutions.[8] This level is well above the leverage ratio of 3% that is foreseen under the Basel 3 framework. Similarly, the United Kingdom and Switzerland have also tightened the capital standards for their largest banks above the minimum standards of Basel 3.[9] Therefore, we assume that the capital standards in the first stage of our model are determined non-cooperatively. Starting from this assumption, we are then interested in the evaluation of supervisory regimes that differ with respect to the degree of centralisation.

2.2.3 Internal capital market of the multinational bank

Each affiliate of the multinational bank is organized as a subsidiary. Therefore, it is a locally incorporated stand-alone entity endowed with own capital and protected by limited liability at the affiliate level. Consequently, in the case of financial difficulties at the level of one subsidiary, there would be no legal obligation for the multinational bank to relocate capital between subsidiaries to solve this problem. However, and crucially, there might be other reasons.

The primary reason for the multinational bank to prevent the insolvency of its subsidiaries is reputational. The particular importance of this argument is connected to the characteristic of banking. Due to the illiquidity of its asset side (e.g. loans), the large amount of short-term liabilities and the opaqueness of the financial market, it is of critical importance for each bank to be viewed as trustworthy by all stakeholders (borrowers, investors and regulation authorities). Therefore, the failure of one subsidiary might cause an interruption to the provision of liquidity for all subsidiaries within the bank network and thus amplify the cost for the multinational bank. Further, regulation authorities might also demand the replacement of the bank management following

[7] See www.financialstabilityboard.org/wp-content/uploads/TLAC-Condoc-6-Nov-2014-FINAL.pdf for a consultative document of the Financial Stability Board in response to the G20 St. Petersburg Summit in 2013 that discusses Pillar 1 total loss absorbing capital requirements for systemically important banks and proposes capital standards in the range of $16-20\%$.

[8] see www.federalreserve.gov/newsevents/press/bcreg/20140408a.htm

[9] see www.bankofengland.co.uk/pra/Documents/publications/ss/2013/ss313.pdf and www.admin.ch/opc/de/classified-compilation/20121146/201501010000/952.03.pdf

the default of subsidiaries that are part of the multinational bank network.

As already discussed, the empirical literature shows that due to the reallocation of capital within the multinational bank network, subsidiaries, in contrast to purely domestic banks, can either be more stable or more prone to external shocks. We try to account for both of these possible outcomes by modelling multinational bank behaviour in the following way. In case that either no or both subsidiaries are hit by a shock, no capital reallocation between both subsidiaries will take place. In contrast, whenever only one subsidiary is hit by a shock, the multinational bank can react and reallocate capital to the affected subsidiary. However, as we assume that the shock will take place before the end of the period and thus before the investment in both countries pays off, the subsidiary in the non-affected country has to incur liquidation losses to meet the immediate capital demand. In expected terms, we assume these cost to be smaller than the reputational costs that would arise from a partial default of the subsidiary that is hit by the shock. Consequently, given a unilateral shock, the multinational bank will always decide to liquidate the subsidiary's investment in the non-affected country. To allow for a rich set of possible outcomes, we assume that l, the liquidation loss per unit of investment, is distributed according to the function $h(l)$ that generates positive probabilities for the following three scenarios:

$$\underbrace{\int_0^{l^r} h(l)dl}_{p^r} + \underbrace{\int_{l^r}^{l^c} h(l)dl}_{p^m} + \underbrace{\int_{l^c}^{R} h(l)dl}_{p^c} = 1 \tag{2.5}$$

where

$$l^r = R_i - (1 - k_i) - (1 - k_j) \, , \tag{2.6}$$

$$l^c = R_i - (1 - k_i) \, . \tag{2.7}$$

To illustrate the effect of capital reallocation within the multinational bank, we analyze the different outcomes of the scenario in which the subsidiary in country j is hit by a shock and, thus, the subsidiary in country i liquidates its assets to reallocate capital to the affected subsidiary. First, if the liquidation loss of the subsidiary in country i is sufficiently small ($l \leq l^r$), the multinational bank will be able to reallocate capital to the subsidiary in country j to allow for the repayment of depositors in both countries. Therefore, in this case, the subsidiary in country j that is hit by a shock will be rescued through the internal capital market by funds of the subsidiary in country i. The expected liquidation loss given that $l \leq l^r$ is labeled $\mu^r(l)$. Second, for liquidation

losses within the range of $l^r < l < l^c$, the subsidiary in country i will be able to repay its local depositors but the remaining funds will be too small to further repay the depositors in country j. Consequently, the subsidiary that is located in country j will default, while the subsidiary in country i will remain open. The expected liquidation loss given that $l^r < l < l^c$ is labeled $\mu^m(l)$. Third, if the liquidation loss is sufficiently severe ($l > l^c$), even the subsidiary in country i will not be able to repay its depositors. Thus, in this scenario the shock in country j is contagious in the sense that it triggers the default of the subsidiary in country i that was not hit by a shock. The expected liquidation loss given that $l > l^c$ is labeled $\mu^c(l)$.

Equations (2.5)-(2.7) illustrate the positive welfare effect of an increase in capital standards on the outcome of the internal capital reallocation by the multinational bank. Due to the fact that capital standards define the buffer that can take losses, following an increase in k, each affiliate can withstand greater liquidation losses, which leads to an increase of p_r and a decrease of p_c.[10]

Besides the liquidation costs that are private to the bank owners, additional social costs occur.[11] These costs arise when entrepreneurs depend on the continuous funding of the bank subsidiary and are thus not able to finish their projects, leading to a reduction in consumer surplus. Further costs might be due to the loss of private information between the entrepreneur and the bank following the termination of the relationship. These expected additional liquidation costs are labeled $\mu^e(l)$. Therefore, the total expected social liquidation cost for each unit of investment are given by

$$c^l = p^r \mu^r(l) + p^m \mu^m(l) + p^c \left[\mu^c(l) + c^d\right] + \mu^e(l) \; . \tag{2.8}$$

While the expected cost in the first two terms of (2.8) are private to the bank owners, the expected cost in the third term are only private to the degree that the bank owners stock of equity is depleted. The remaining losses measured in the third term, as well as the losses captured in the fourth term of (2.8) are not internalized by the bank owner. However due to the prevention of the subsidiaries' default whenever $l \leq l^r$, the overall welfare effect of the internal capital reallocation of the multinational bank remains ambiguous.

[10] See Anginer et al., 2014 for a empirical study that analyses the default risk of foreign bank subsidiaries. The authors find a positive effect of equity holding at the subsidiary level on the contagion risk within the multinational bank network.

[11] See Dell'Ariccia et al (2008) and Chor and Manova (2012) for empirical studies that support this assessment.

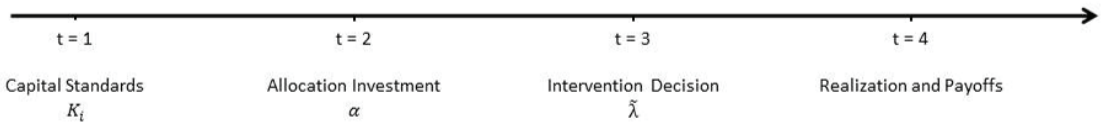


Figure 2.1: The timeline of events

2.2.4 Time structure

The sequence of events in this model is illustrated in figure 2.1. In the first period, regulation authorities in both countries non-cooperatively set capital standards for the subsidiary that is resident in the respective country. In the second period the multinational bank allocates its equity between the subsidiaries in country A and country B. In the third period the supervision authority receives a signal about the success probability of the investment in both countries. It will intervene into the operation of the subsidiary in country i whenever the success probability λ is below the threshold $\tilde{\lambda}_i$. At this stage we analyze the differences between the outcome of a national and a global regime. Between the third and the fourth period each subsidiary, when allowed to continue, can be affected by a shock in its resident country. In case that one of the two subsidiaries is hit by a shock, the subsidiary that is not hit by the shock will liquidate its assets, thereby incurring liquidation losses of l that follow the distribution $h(l)$. Finally, in the fourth period, the payoffs realize. We will solve the model by backward induction.

2.3 Nationally optimal capital standards with different intervention regimes

2.3.1 t=4: Payoffs

For each country, the expected payoff from the activity of the resident subsidiary of the multinational bank depends on the regulatory framework (k and $\tilde{\lambda}$) and on the allocation of capital by the multinational bank (α). The resulting welfare function of

country A is then given by

$$E[WF_A] = \left\{ \tilde{\lambda}_A + \frac{1-\tilde{\lambda}_A^2}{2} \left[v_A - \frac{(1-\tilde{\lambda}_B)^2}{2} c_A^l \right] - \frac{(1-\tilde{\lambda}_A)^2}{2} c_A^d \left[1 - \frac{1-\tilde{\lambda}_B^2}{2} p_A^r \right] - 1 \right\} \frac{\alpha}{k_A} \,. \tag{2.9}$$

The first term in (2.9) measures the expected return from the intervention of the supervisory authority into the investment of the subsidiary in country A. It is equal to $\tilde{\lambda}_A$ due to the fact that the regulator will intervene whenever $\lambda < \tilde{\lambda}_A$ and recover the initial investment of one in this case. The second term in (2.9) captures the expected payoff in case that the subsidiary is allowed to continue and not hit by a shock. Then, whenever the investment is not liquidated early, each unit of investment will yield the social return of v_A [see eq. (2.2)]. In contrast, when the subsidiary in country B is hit by a shock, the welfare in country A will be reduced by the expected liquidation cost c_A^l [see eq. (2.8)]. The expected cost in case that the supervision authority does not intervene and the subsidiary is hit by a shock is given in the third term of (2.9). Here, the return of the bank investment will be zero and the additional default costs c_A^d, which are given in (2.3), will arise, unless the subsidiary will be rescued. This will happen whenever the subsidiary in country B is not hit by a shock and the liquidation losses are sufficiently small. Finally, the last term in (2.9) is equal to the opportunity cost of each unit of investment.

2.3.2 t=3: Supervisory intervention: national vs. global regime

At this stage, the supervisory authority receives a signal about the probability λ_i that the bank investment in country i will be successful. Due to the reallocation of capital by the multinational bank in case that one subsidiary is hit by a shock, the intervention decision in country i affects the expected welfare in country j [see eq. (2.9)]. We want to compare two regimes that differ in the degree that this externality is taken into account. We start with the decision of a national supervisory regime. Therefore, we derive the first order condition of (2.9) with respect to the intervention threshold $\tilde{\lambda}_A$

and get:

$$\frac{\partial WF_A}{\partial \tilde{\lambda}_A} = \left\{ 1 - \tilde{\lambda}_A \left[v_A - \frac{(1-\tilde{\lambda}_B)^2}{2} c_A^l \right] + (1-\tilde{\lambda}_A) c_A^d \left[1 - \frac{1-\tilde{\lambda}_B^2}{2} p_A^r \right] \right\} \frac{\alpha}{k_A} = 0 \tag{2.10}$$

Equation (2.10) shows that a marginal increase in the intervention threshold $\tilde{\lambda}_A$ increases the expected return from intervention (first term) and decreases the expected cost from failure (third term). However, clearly, it also reduces the expected return from successful investment (second term). Therefore, the intervention threshold is chosen relatively low whenever the expected return from successful investment is relatively large, while for large expected costs from failure, the intervention threshold is relatively high.

The ambiguous sign of the interaction term between the intervention threshold in each country is due to the ambiguous welfare effect that follows from the reallocation of capital by the multinational bank. As explained in the previous section, the continuation of the subsidiary in country B will be welfare increasing for country A from an ex-post perspective, whenever the shock unilaterally hits the resident subsidiary. However, it can also be welfare decreasing, whenever only country B is hit by a shock. Whenever the expected cost from liquidation is large, the positive effect of a marginal increase in $\tilde{\lambda}_B$ on the expected return from continuation outweighs the negative effect on the expected cost from continuation that is due to the lower probability of rescue. Therefore in this case it holds that $\frac{\partial \tilde{\lambda}_A}{\partial \tilde{\lambda}_B} < 0$, while for low expected cost from liquidation and thus high probability of rescue we get $\frac{\partial \tilde{\lambda}_A}{\partial \tilde{\lambda}_B} > 0$.

Taking into account the effect of k_A, Equation (2.10) shows that a marginal increase in k_A decreases the optimal intervention threshold for three reasons. First, marginally increasing k_A reduces the expected cost from liquidation due to the lower probability of contagion [see eqs. (2.5) and (2.7)]. This in turn increases the expected return from successful investment and thus decreases the optimal intervention threshold. Second, an increase in k_A reduces the expected cost from default by limiting the amount of public funds [see eq. (2.3)], while third it increases the probability of rescue [see eqs. (2.5) and (2.6)]. Both effects decrease the expected cost of continuation and thus also lead to a decrease in the optimal intervention threshold.

We now turn to the intervention threshold that is chosen by a global supervisory regime:

$$\frac{\partial WF}{\partial \tilde{\lambda}_A} = \frac{\partial WF_A}{\partial \tilde{\lambda}_A} + (1-\tilde{\lambda}_A)\frac{1-\tilde{\lambda}_B^2}{2}c_B^l - \tilde{\lambda}_A\frac{(1-\tilde{\lambda}_B)^2}{2}p_B^r c_B^d = 0\,. \tag{2.11}$$

Equation (2.11) shows two externalities that are taken into account by the global supervisory regime. The first externality, which is captured in the second term of (2.11) is positive. The marginal increase in the intervention threshold for the subsidiary located in country A benefits country B due to the fact that it reduces the probability of failure for the subsidiary in country A and thus decreases the expected cost from liquidation for the subsidiary in country B. In contrast, the second externality that is equal to the third term of (2.11) is negative. This is caused by the negative effect of a marginal increase in $\tilde{\lambda}_A$ on the ex-ante success probability of the investment by the subsidiary in country A. In turn, this reduces the probability that the subsidiary in country B will be rescued through the internal capital market of the multinational bank.

We can now use (2.11) to compare the intervention threshold of the national and the global supervisory regime. As $\frac{\partial^2 WF_A}{\partial \tilde{\lambda}_A^2} < 0$ follows directly from (2.10), it is clear that the intervention threshold chosen by the global supervisory regime can be either more strict or more lenient than the intervention threshold by the national supervisory regime. It will be more strict whenever the positive welfare effect of an increase in $\tilde{\lambda}_i$ on the expected cost from liquidation in country j outweighs the negative welfare effect that is due to the decrease in the rescue probability. However, and clearly, if we stopped at this stage, the global supervisory regime would be welfare superior to the national regime independent of the direction of the deviation between both regimes.

2.3.3 t=2: Investment decision by the multinational bank

We now want to analyse the allocation of equity between the subsidiaries in country A and country B. The expected profit of the multinational bank is equal to

$$\begin{aligned} E[\pi] = &\left\{\frac{1-\tilde{\lambda}_A^2}{2}\left[R_A - 1 - \frac{(1-\tilde{\lambda}_B)^2}{2}c_A^p\right] - \frac{(1-\tilde{\lambda}_A)^2}{2}k_A\right\}\frac{\alpha}{k_A} \\ &+ \left\{\frac{1-\tilde{\lambda}_B^2}{2}\left[R_B - 1 - \frac{(1-\tilde{\lambda}_A)^2}{2}c_B^p\right] - \frac{(1-\tilde{\lambda}_B)^2}{2}k_B\right\}\frac{1-\alpha}{k_B}\,, \end{aligned} \tag{2.12}$$

where

$$c_A^p = p^r[\mu^r(l) + (1 - k_B)] + p^m\mu^m(l) + p^c(R_A - 1 + k_A) \tag{2.13}$$

$$c_B^p = p^r[\mu^r(l) + (1 - k_A)] + p^m\mu^m(l) + p^c(R_B - 1 + k_B)\ . \tag{2.14}$$

The first row in (2.12) captures the expected profit of the subsidiary located in country A, while the expected profit of the subsidiary located in country B is displayed in the second row. Abstracting from the success of the subsidiary in the other country, in case of no supervisory intervention and no shock, the net return of the subsidiary's investment in each country will be equal to $R_i - 1$. However, in case that the subsidiary in the other country is hit by a shock additional liquidation costs occur. Equations (2.13) and (2.14) show that these costs depend on the severity of the liquidation shock. In case that the liquidation shock is sufficiently weak, the subsidiary will not only incur these losses ($\mu^r(l)$) but also repay the depositors in the other country. For medium liquidation shocks, the subsidiary will still be able to repay its own depositors but lose $\mu^m(l)$ in expectation. However for severe liquidation shocks, the subsidiary will lose the entire return of the project but will benefit from limited liability as the depositors $(1-k_i)$ are reimbursed through the deposit insurance system. Finally, if the subsidiary is allowed to continue but hit by a shock, the bank owner will lose the amount of equity that is invested in the project. In this case, the depositors will either be repayed by the subsidiary in the other country (with probability p_r) or by the deposit insurance.[12]

We now want to analyse the allocation of equity at the level of the multinational bank that can choose between the subsidiaries in country A and country B. In Appendix B.1 we show that the amount of equity that the multinational bank allocates to the subsidiary that is located in country A is given by

$$\alpha = \frac{1}{2} + \frac{(1 - \tilde{\lambda}_A^2)k_A k_B^2\phi_A - (1 - \tilde{\lambda}_B^2)k_A^2 k_B\phi_B + k_A^2 k_B^2[(1 - \tilde{\lambda}_B)^2 - (1 - \tilde{\lambda}_A)^2]}{2a[(1 - \tilde{\lambda}_A)^2 k_B^2 + (1 - \tilde{\lambda}_B)^2 k_A^2]}\ , \tag{2.15}$$

[12]Due to our assumption of the supervisory regime liquidating with zero costs, the profit of the bank remains unaffected with probability $\tilde{\lambda}$.

where

$$\phi_A = A - \frac{a}{k_A} - 1 - \frac{(1-\tilde{\lambda}_B)^2}{2} c_A^p \tag{2.16}$$

$$\phi_B = A - \frac{a}{k_B} - 1 - \frac{(1-\tilde{\lambda}_A)^2}{2} c_B^p \, . \tag{2.17}$$

Equation (2.15) shows that the multinational bank will equally allocate its equity between its subsidiaries whenever both countries are symmetric. In this case, the second term of (2.15) becomes zero. Further, deriving the partial derivatives of α with respect to the regulatory instruments k_i and $\tilde{\lambda}_i$ yields the expected result that[13]

$$\frac{\partial \alpha}{\partial k_A} = -\frac{\partial \alpha}{\partial k_B} = -\frac{A - \frac{2a}{k} - 1 - \frac{(1-\tilde{\lambda})^2}{2} c^p}{4a} < 0 \, , \tag{2.18}$$

$$\frac{\partial \alpha}{\partial \tilde{\lambda}_A} = -\frac{\partial \alpha}{\partial \tilde{\lambda}_B} = \frac{-2\tilde{\lambda}k \left[A - \frac{a}{k} - 1 - \frac{(1-\tilde{\lambda})^2}{2} c^p\right] - (1-\tilde{\lambda})k \left[c^p(1-\tilde{\lambda}^2) - 2k\right]}{4a(1-\tilde{\lambda}^2)} < 0 \, . \tag{2.19}$$

Equations (2.18) and (2.19) make clear that a unilateral increase in one of the regulatory instruments will lead to an outflow of bank capital from this country. Intuitively, when k_i is increased, the subsidiary that is located in country i can use a lower amount of subsidized deposits for each unit of investment. This in turn decreases the attractiveness for the multinational bank to allocate (scarce) equity to the subsidiary that is located in country i. Similarly, an increase in the expected threshold of intervention $\tilde{\lambda}_i$ decreases the expected value of the investment in this country from the perspective of the multinational bank. Obviously, the results hinge on the (realistic) assumption that both regulatory instruments are binding. This will be the case whenever the cost from failure and liquidation that are not internalized by the bank are sufficiently high relative to the benefit of continuation from the perspective of the consumer.[14]

2.3.4 t=1: Capital standards

We can now turn to the analysis of the capital standards that are set non-cooperatively in the first stage of our model. Given the symmetric setup, maximizing (2.9) with

[13] This is shown in Appendix B.2.

[14] See Appendix B.2 for the precise condition.

respect to k_A gives us the following first-order condition:

$$\frac{\partial E[WF_A]}{\partial k_A} = \left(-\frac{\alpha}{k^2} + \frac{\partial \alpha}{\partial k_A}\frac{1}{k}\right)\psi + \frac{\alpha}{k}\sigma + \eta = 0 \tag{2.20}$$

where

$$\psi = \tilde{\lambda} + \frac{1-\tilde{\lambda}^2}{2}\left[A - a\frac{\alpha}{k} - \frac{(1-\tilde{\lambda})^2}{2}c^l\right] - \frac{(1-\tilde{\lambda})^2}{2}c^d\left[1 - \frac{1-\tilde{\lambda}^2}{2}p^r\right] - 1 \tag{2.21}$$

$$\begin{aligned}\sigma =& c\left[\frac{(1-\tilde{\lambda})^2}{2}\left(1 - \frac{1-\tilde{\lambda}^2}{2}p^r\right) + \frac{1-\tilde{\lambda}^2}{2}\frac{(1-\tilde{\lambda})^2}{2}p^c\right] \\ &+ h(l^c)\frac{1-\tilde{\lambda}^2}{2}\frac{(1-\tilde{\lambda})^2}{2}c^d + h(l^r)\frac{(1-\tilde{\lambda})^2}{2}\frac{1-\tilde{\lambda}^2}{2}c^d\end{aligned} \tag{2.22}$$

$$\begin{aligned}\eta =& \left[(1-\tilde{\lambda})\frac{1-\tilde{\lambda}^2}{2}c^l - \tilde{\lambda}\frac{(1-\tilde{\lambda})^2}{2}p^r c^d\right] \\ &\left\{D\left[\frac{-(1-\tilde{\lambda})c^d\frac{1-\tilde{\lambda}^2}{2}h(l^r)}{v - (1-\tilde{\lambda})^2c^l + c^d\left(1 - p^r\frac{1-\tilde{\lambda}^2}{2}\right)}\right]\right. \\ &\left.+ (1-D)\left[\frac{h(l^c)c^d\frac{1-\tilde{\lambda}^2}{2}(-1+2\tilde{\lambda}) - c\left[\frac{(1-\tilde{\lambda})^2}{2}(1-2\tilde{\lambda})(p^c - p^r) - (1-\tilde{\lambda})\right]}{v - (1-\tilde{\lambda})^2c^l + c^d\left(1 - p^r\frac{1-\tilde{\lambda}^2}{2}\right) + \frac{1-\tilde{\lambda}^2}{2}c^l + \frac{(1-\tilde{\lambda})^2}{2}p^r c^d}\right]\right\},\end{aligned} \tag{2.23}$$

and

$$D = \begin{cases} 0 & \text{if} \quad \text{global supervisory regime} \\ 1 & \text{if} \quad \text{national supervisory regime} \end{cases} \tag{2.24}$$

Looking at (2.20), we can decompose the welfare effect of a marginal increase in k_A into three parts. The first term in (2.20) measures the welfare effect that is due to the change in the subsidiary's investment in country A, while the second term in (2.20) includes the welfare effect of k_A on the expected cost of liquidation and failure. Finally, the third term in (2.20) captures the indirect effect of k_A on the intervention threshold in both countries. We will now analyze each effect in turn to emphasize the effect of different supervisory regimes on the level of capital standards at this stage.

According to the first term in (2.20), bank investment in country A decreases for two reasons when capital standards in country A are unilaterally increased. First, obviously, as the capital standard is binding and the amount of equity is fixed, higher

equity requirements mechanically translate into a reduction of total investment. Second, however, due to the mobility of bank investment [see eq. (2.18)] the multinational bank will allocate more equity to the subsidiary in country B whenever country A unilaterally increases its capital standard. The welfare loss that follows from this reduction in bank investment is shown in (2.21). Now, critically, due to the different intervention thresholds that are set by the national and the global supervisory regime [see eqs. (2.10) and (2.11)], the marginal social return to bank investment in country A will be higher under the global supervisory regime. Therefore, the negative welfare effect of a marginal increase in k_A that follows from the reduction in bank investment will be larger under the global supervisory regime.

The positive welfare effect of a marginal increase in k_A on the expected cost from bank investment is captured in (2.22). The first term in (2.22) measures the decrease in the social cost from bank failure. This will be relevant either when country A is hit by a shock [first term in square bracket of (2.22)] or when the liquidation loss of the subsidiary located in country A is sufficiently high [second term in square bracket of (2.22)]. As the probability of bank failure is decreasing in $\tilde{\lambda}$, it is clear that the positive welfare effect of k_A on the social cost of bank failure is reduced when the intervention threshold is higher. Further, as shown in the second line of (2.22), the marginal increase of k_A changes the probability of the different outcomes that can arise from the reallocation of capital. Both terms are positive as one can directly see from (2.5)-(2.7). Intuitively, by increasing the buffer that can take losses without causing insolvency, higher capital standards in country A increase the range of liquidation losses for the subsidiary in country B where it can still rescue the subsidiary in country A. Likewise the range of liquidation losses for which the subsidiary in country A can default is reduced. Again, these positive effects are decreasing in the intervention threshold. Consequently, (2.22) will be larger under the national supervisory regime whenever the global supervisory regime is more strict ($\tilde{\lambda}^g > \tilde{\lambda}^n$).

The third term in (2.20) captures the indirect welfare effects that are due to the change in the intervention threshold in both countries when k_A is increased. Under the national supervisory regime, we can ignore $\frac{\partial WF_A}{\partial \tilde{\lambda}_A}$ as one can directly see from the optimization problem in (2.10). Thus (2.23) measures $\frac{\partial WF_A}{\partial \tilde{\lambda}_B}\frac{\partial \tilde{\lambda}_B}{\partial k_A}$. Here, k_A only affects the intervention decision by the national supervisory regime in B to the degree that it changes the probability of rescue for the subsidiary in B. As an increase in k_A enhances the probability of rescue for the subsidiary in B [see eqs. (2.5) and (2.6)], this will decrease the intervention threshold in B. The induced welfare effect for A de-

pends on the relative importance of the rescue to the contagion effect [see eq. (2.23)]. Consequently, whenever the indirect welfare effect of k_A through λ is relatively strong, then this effect will be positive as A will be positively affected by the decrease in the intervention threshold in B due to the higher probability of rescue. This in turn reinforces the effects in (2.22) under the national supervisory regime. Turning to the global supervisory regime, we can use the maximization problem in (2.11) to rewrite $\frac{\partial E[WF_A]}{\partial \tilde{\lambda}_A} = -\frac{\partial E[WF_A]}{\partial \tilde{\lambda}_B}$ so that (2.23) captures $\frac{\partial E[WF_A]}{\partial \tilde{\lambda}_B}\left(\frac{\partial \tilde{\lambda}_B}{\partial k_A} - \frac{\partial \tilde{\lambda}_A}{\partial k_A}\right)$. Under the global supervisory regime there exist two indirect effects of k_A through $\tilde{\lambda}$. First, the decrease in the contagion risk in A leads to a decrease of the intervention threshold in both countries. Here, given that the lower intervention threshold partially reverses the decrease in the contagion risk, this indirect effect has negative welfare implications for country A whenever this effect is relatively strong.[15] Compared to the national supervisory regime, this again reduces the positive welfare effects of a marginal increase in k_A under the global supervisory regime. Second, the increase in k_A reduces the cost of default, which in turn reduces the intervention threshold in country A and country B under the global supervisory regime. While the effects of lower intervention thresholds in A and B partly balance each other, the overall welfare effect again depends on the relative importance of the rescue and contagion externality. We can now summarize our findings at this stage in:

Proposition 2.1 *When the intervention of national supervisory authorities into the local operation of multinational bank subsidiaries is less strict than globally optimal, then changing to a regime of global supervision will reduce the capital standards that are set non-cooperatively. The reduction in capital standards is less pronounced and can even be reversed when the intervention threshold of the national supervisory authorities is inefficiently high.*

Proposition 2.1 tells us that the incentives of national regulation authorities to impose capital standards on the resident subsidiaries of multinational banks are affected by the expectation about the procedure and the externalities that arise from the intervention regime. As the analysis of (2.20) has shown, this is mainly for two reasons. First, increasing the efficiency of intervention by changing to a global supervisory regime raises the value of one unit of bank investment from the perspective of the national regulator. This in turn increases the competition between the regulation authorities

[15] This effect is not present in the case of a national supervisory regime as the contagion risk of the other country is then not included in the maximization problem.

in both countries to attract mobile bank investment and thus decreases the amount of capital standards that are set non-cooperatively. Second, each regulator imposes capital standards to increase the safety of its banking system. Obviously, the incentive to impose strict capital standards depends on the probability of bank failure, which in our model is a negative function of the intervention threshold $\tilde{\lambda}$. Therefore, when national intervention regimes are too lax from a global welfare perspective, moving to a global supervisory will result in higher $\tilde{\lambda}$. This reinforces the incentive for national regulation authorities to decrease its capital standards. In contrast, whenever the positive externalities of bank continuation dominate, introducing a global supervisory regime will lower $\tilde{\lambda}$ and therefore, ceteris paribus, increase k. Thus, in this case we can not unambiguously sign the effect of a more centralized intervention regime on the level of capital standards that are set non-cooperatively.

2.4 The welfare effect of moving towards a global supervisory regime

We now want to use the results from the analysis in section 2.3 to discuss the welfare implications of a more centralized supervisory regime. Therefore, we assume that the supervisory regime takes account of the net externality that arises at the stage of intervention [see eq. (2.11)] with a factor $0 \leq \gamma \leq 1$. We start at $\gamma = 0$ and analyse the welfare effect of a marginal increase in γ. In Appendix B.3 we show that, given the symmetry of countries and thus $\delta\tilde{\lambda}_A/\delta\gamma = \delta\tilde{\lambda}_B/\delta\gamma = \delta\tilde{\lambda}/\delta\gamma$, the welfare effect of a marginal increase in the centralization of the supervisory regimes is given by

$$\frac{\partial E[WF_A]}{\partial \gamma} = \frac{\partial \tilde{\lambda}}{\partial \gamma}\left[\frac{\partial E[WF_A]}{\partial \tilde{\lambda}_B}\left(1 + \frac{\partial \tilde{\lambda}_B}{\partial \tilde{\lambda}_A}\right) + \frac{\partial E[WF_A]}{\partial k_B}\left(\frac{\partial k_B}{\partial \tilde{\lambda}_B} + \frac{\partial k_B}{\partial \tilde{\lambda}_A}\right)\right] , \quad (2.25)$$

where

$$\frac{\partial \tilde{\lambda}}{\partial \gamma} = \frac{(1-\tilde{\lambda})\frac{1-\tilde{\lambda}^2}{2}c^l - \tilde{\lambda}\frac{(1-\tilde{\lambda})^2}{2}p^r c^d}{v - \frac{(1-\tilde{\lambda})^2}{2}(c^l + p^c c^d) + c^d\left(1 - \frac{1-\tilde{\lambda}^2}{2}p^r\right) + \gamma\left[\frac{1-\tilde{\lambda}^2}{2}(c^l + p^c c^d) + \frac{(1-\tilde{\lambda})^2}{2}(p^r c^d)\right]}\ , \tag{2.26}$$

$$\frac{\partial E[WF_A]}{\partial \tilde{\lambda}_B} = (1-\tilde{\lambda})\frac{1-\tilde{\lambda}^2}{2}(c^l + p^c c^d) - \tilde{\lambda}\frac{(1-\tilde{\lambda})^2}{2}p^r c^d\ , \tag{2.27}$$

$$\frac{\partial E[WF_A]}{\partial k_B} = \frac{\partial \alpha}{\partial k_B}\frac{1}{k}\psi + h(l^r)\frac{1}{2k}\frac{(1-\tilde{\lambda})^2}{2}\frac{1-\tilde{\lambda}^2}{2}c^d > 0\ , \tag{2.28}$$

$$\frac{\partial k_B}{\partial \tilde{\lambda}_B} + \frac{\partial k_B}{\partial \tilde{\lambda}_A} = \frac{\frac{1}{2}\left(\frac{\partial \sigma_B}{\partial \tilde{\lambda}_A} + \frac{\partial \sigma_B}{\partial \tilde{\lambda}_B}\right) - \frac{\partial \psi_B}{\partial \tilde{\lambda}_A}\left(\frac{\partial \alpha}{\partial k_B} + \frac{1}{2k}\right)}{\frac{\partial \psi_B}{\partial k_B}\left(\frac{\partial \alpha}{\partial k_B} + \frac{1}{2k}\right) - \frac{1}{2k}\frac{\partial \sigma_B}{\partial k_B}}\ . \tag{2.29}$$

Equation (2.25) shows that moving towards a global supervisory regime affects the welfare of each country through two channels. The first effect, which is always positive, is due to the fact that the externality at the intervention stage is taken into account. This is the effect on which the theoretical literature(see Beck and Wagner 2013) as well as policy reports (see Claessens et al. 2010) have focused. The second effect is due to the interaction of the regulatory instruments. As we have already analyzed in the previous section, this relation critically depends on the sign of the externality. Therefore, we discuss both scenarios one after the other.

2.4.1 Case 1: national supervision that is too lax

We start with the scenario that $\tilde{\lambda}^g > \tilde{\lambda}^n$. Obviously, in this case a marginal increase in the centralization of the supervisory regime increases the intervention threshold in both countries [see eq. (2.26)] and thus increases the welfare in each country [eq. (2.27)]. This effect is mitigated by the interaction between the intervention threshold in both countries ($\delta\tilde{\lambda}_B/\delta\tilde{\lambda}_A < 0$). The increase of the intervention threshold in country A lowers the probability of contagion in country B and thus leads to a decrease in the intervention threshold of country B as the expected return of continuation is increased.[16]

Now interestingly, the indirect welfare effect of a more centralized supervisory regime that is due to the interaction of $\tilde{\lambda}$ and k is negative. This follows from the unambiguously negative effect of $\tilde{\lambda}$ on the capital standard that is set non-cooperatively [see

[16]Formally, this can be seen by using the implicit function theorem on (2.10).

eq. (2.29)], which in turn decreases the welfare in country A [see eq. (2.28)]. The negative sign in (2.29) is due to two effects. On the one hand, the marginal increase of $\tilde{\lambda}$ decreases the positive effect of capital standards on the expected cost of bank failure [first term in the numerator of (2.29)], while at the same time it increases the marginal social return of bank investment in country A [second term in the numerator of (2.29)]. Both effects lead to a decrease in the capital standards that are set non-cooperatively as summarized in Proposition 2.1. This in turn reduces the welfare in country A for two reasons. First, it reinforces the externality in the first stage of the model that is due to the competition for mobile bank investment [first term in (2.28)]. Second, the probability that the bank subsidiary in country A can draw on liquidation funds of the bank subsidiary that is located in country B is reduced [second term in (2.28)].

In Appendix B.4 we derive the overall welfare effect. This shows that a sufficient condition for the overall welfare effect of a marginal increase in the centralization of the supervisory regime to be negative is given by:

$$\left(A - \frac{2a}{k} - 1 - c^l\right)\left[\frac{\psi}{k}\left(A - \frac{2a}{k} - 1 - c^l\right) - 2 + 4k^2c\right] > 16k^4c\left[h(l^r) + h(l^c)\right] \ . \tag{2.30}$$

We can analyse condition (2.30) in the following way. If the externalities that are caused by the capital reallocation of the multinational bank react very sensitive to a marginal increase of capital standards, the right hand side of (2.30) will be very high. Thus, in this case the overall welfare effect of an increase in the centralization of supervision will very likely be positive. Intuitively, this is due to the fact that each national regulation authority will then only slightly decrease its capital standard when a more centralized intervention regime is introduced. Thus, the negative welfare effect that is illustrated in (2.28) is limited. In contrast, the left hand side is a positive function of the profitability of bank investment. Intuitively, with bank investment generating a large surplus, the positive externality of k is very high [see eq. (2.18)]. Therefore, the decrease in the non-cooperative equilibrium of capital standards that follows from a more centralized resolution regime imposes higher welfare losses. While k enters both sides of (2.30), we can directly see that it is weighted by different parameters. Whenever a is relatively low and thus bank investment is relatively mobile, the left hand side of (2.30) will be reduced to a lower degree. Similarly, whenever c is relatively low, the (positive) effect of k on the right hand side of (2.30) will be small. Therefore, we can summarize our findings at this stage in:

Proposition 2.2 *Whenever the capital standard is set non-cooperatively and the*

resulting externality due to the mobility of bank investment is sufficiently severe [(2.30) *holds], moving from a national intervention regime with too little intervention to a more globally oriented resolution regime will be welfare decreasing.*

Our model thus shows that in the presence of further regulatory instruments, the desirability of a more centralized intervention regime that was brought forward in the recent literature is no longer unambiguous. The reasoning follows the theory of the second best.[17] This is due to the fact that in our model, there exist externalities at multiple stages. First, when national regulation authorities choose the optimal amount of capital standards they only consider the negative effect of an increase in k_i on mobile bank investment ($\delta\alpha/k_i < 0$) in their country. From a global perspective this is a zero-sum game [see eq. (2.18)]. Second, when national supervision authorities choose the level of intervention they fail to account for the international spillovers that are caused by the reallocation of capital within the multinational bank network in case of unilateral shocks. Now, importantly, when both regulatory instruments are determined non-cooperatively, they partly balance each other. National authorities will impose stricter capital standards when they expect higher costs from the subsidiary that is resident in its country, which in turn partly compensates for the externality at the first stage. Therefore, once full cooperation is not achieved in both regulatory tools, the gains from a more centralized intervention regime might disappear in the presence of lower capital standards that arise due to less protection and more intense competition at the level of national regulation authorities.

2.4.2 Case 2: national supervision that is too strict

We now move to the case where the intervention threshold that is set by a national supervisory regime is too high from a global welfare perspective. While in this case a marginal increase in γ leads to a decrease in $\tilde{\lambda}$ [see eq. (2.26)] it obviously also increases the welfare in both countries [see eq. (2.27)]. Different to case 1, this positive welfare effect is reinforced through the interaction of the intervention thresholds in both countries. This is due to the fact that the decrease in the intervention threshold in country A increases the probability of rescue for the subsidiary that is located in country B. For country B, this in turn increases the expected social return from continuation of its locally resident subsidiary and thus equally decreases the intervention threshold in country B.

[17] See Lipsey and Lancaster (1956) for the seminal paper in this literature.

The indirect welfare effect of an increase in δ that is due to the interaction of $\tilde{\lambda}$ and k has two parts. First, as in case 1, moving to a more globally oriented intervention regime increases the value of each unit of bank investment. Ceteris paribus, this leads to a decrease in the capital standard that is set non-cooperatively [see eq. (2.20)]. Second, however, the decrease in $\tilde{\lambda}$ also leads to an increase in the expected probability of bank default. Taking the derivative of the failure probability $p_f = \frac{(1-\tilde{\lambda})^2}{2}\left(1 - \frac{1-\tilde{\lambda}^2}{2}p_r\right)$ with respect to the intervention threshold we get that $\frac{\partial p_f}{\partial \tilde{\lambda}} = -(1-\tilde{\lambda})\left(1 - p_r\frac{1+\tilde{\lambda}-\tilde{\lambda}^2}{2}\right) < 0$. Intuitively, the increase in the probability of rescue does not compensate the increase in the probability of bank failure. This in turn, ceteris paribus, increases the capital standard of each country [see eq. (2.20)]. We can summarize this result in:

Proposition 2.3 *Moving towards a more globally oriented intervention regime is more likely to be welfare increasing when the externality at this stage is negative, e.g. national supervisory regimes would intervene too often.*

Therefore, comparing case 1 and 2, we can conclude that the conventional result of a more centralized intervention regime being associated with positive welfare effects is more likely to hold when national supervisory authorities would intervene too often from a global welfare perspective. However, this is in contrast to the experience from the recent crisis, where national regulation authorities were accused of intervening only at the last stages (Claessens et al., 2010; Beck and Wagner, 2013). Intuitively, decreasing the intervention threshold (as in case 2) ceteris paribus increases the capital standards and thus reduces the positive externality at the first stage. In contrast, increasing the intervention threshold (as in case 1) ceteris paribus decreases the capital standard and therefore reinforces the positive externality at the first stage.

2.5 Conclusion

In this model, we have analyzed the interaction between capital standards and resolution procedures when bank investment is mobile. In our setting, national regulation authorities non-cooperatively choose capital standards at the first stage. The multinational bank then allocates capital between its subsidiaries in the second stage. The outcome of both stages depends on the anticipation of the intervention regime at the third stage. Here we differentiate between a national and global intervention regime. The results of this chapter stress the importance of a coordinated approach towards

the determination of capital standards and the decision to intervene into the operation of multinational bank subsidiaries. Interestingly, in this regard, Europe and the United States seem to follow different directions.

So far, the United States have abstained from closer international integration in the supervision and intervention of multinational banks. At the same time, however, the leverage ratio for eight systemically important banks has been substantially raised above the level that is foreseen under the Basel 3 framework. This reaction is in line with the results of this chapter. As the regulatory authorities in the United States can expect the intervention into multinational banks to be potentially very difficult, they have a strong incentive to impose strict capital standards as the main instrument to limit the potential costs.

In contrast, the introduction of the (not yet fully completed) Single Resolution Mechanism shows the determination of many European countries to move towards a centralized intervention regime for multinational banks. Clearly, this would be welfare optimal if all countries within the eurozone would also fully coordinate with respect to the determination of capital standards. To this regard, all countries within the eurozone have adapted the Basel 3 regulatory framework and are supervised under the Single Supervisory Mechanism. But, due to the lack of common capital definitions and further scope for national authorities, Danièle Nouy, chair of the supervisory board of the ECB, recently pointed out that the process of harmonisation is still far from completed.[18] Applying the results of this chapter, we should expect all countries within the Euro Zone to insist on most favorable terms for all banks that are located within their jurisdiction. However, comparing the approaches of the US and the eurozone, this chapter suggests that the consistent enforcement of harmonized capital requirements, in all details, will be the critical determinant for the centralised intervention approach of the eurozone to be successful.

[18] See www.bankingsupervision.europa.eu/press/speeches/date/2015/html/se150331.en.html for introductory remarks at the presentation of the first ECB annual report on supervisory activities on 31 March 2015

Chapter 3

Inactivity by design

3.1 Introduction

Severe financial crises produce the demand for a reform. Today, there is broad consensus among economists that the financial system is characterized by a regulatory framework that subsidizes lending to the state and thus distorts the smooth allocation of scarce resources: the current regulation represses economic growth and can sow the seeds for a dangerous bank-sovereign nexus, a 'deadly embrace' or 'doom loop' through which both banks and their sovereign can end up in crisis simultaneously (see Acharya et al., 2014a; Farhi and Tirole, 2014 for recent contributions). However, six years after the outbreak of the crisis, none of the remedies that economists advocate could pass the test of political viability. With zero capital requirements and unlimited exposures, post-crisis regulation still systematically privileges the bank's investment in sovereign bonds.

The consequences are far-reaching. Starting in 2008, domestic banks in the 'periphery countries' of the eurozone (Greece, Ireland, Portugal, Spain and Italy) sharply increased their holding of sovereign debt (see figure 3.1). Acharya and Steffen (2015) analyze how regulatory arbitrage to extract regulatory rents turned out to be an important motive in the portfolio decision of bank owners. However, the effects were not limited to the sovereign bond market. Using European stress test data, Crosignani (2015) shows that profit-maximizing banks in the periphery of the eurozone tilted their portfolio towards domestic sovereign securities and crowded-out private lending as the home sovereign became riskier. Further, Acharya et al. (2014b) extensively

This chapter is based on joint work with Florian Buck.

document that in the cases of Ireland, Spain, and Portugal the overall lending volume of newly issued loans fell by 82 percent, 66 percent, and 45 percent over the period 2008-2013, respectively. This contraction in the lending volume had real effects for the borrowing firms, e.g. in the form of lower levels of investment, lower sales growth and lower employment growth. Popov and Van Horen (2013) and De Marco (2014), also using syndicated loan market data, empirically support the significant transmission of the banking crisis to the private sector originating from the sovereign via the bank lending channel.

The contraction of credit has generated different effects among producers. The fundamental importance of bank lending for small and medium enterprises is well documented in the theoretical (Holmström and Tirole, 1997; Lloyd-Ellis and Bernhardt, 2000) and empirical literature (Gertler and Gilchrist, 1994; Aghion et al., 2007; Beck et al., 2008). In the aftermath of the financial crisis, frictions in the bank lending channel contributed to a contraction of output and employment of small and medium firms (Ivashina and Scharfstein 2010; Chodorow-Reich 2014). In contrast, large, established firms with access to capital markets have been relatively unaffected by the changes in bank-funding conditions (Ferrando and Mulier, 2013; Beck et al. 2014). As a consequence, lending rate spreads between loans for small and large firms have significantly increased in the crisis (OECD 2014; Kaya 2014) such that large firms were able to exploit a dominant position in the respective market.

This chapter identifies these stylized facts as a driving force for the status quo bias in sovereign bond regulation. We develop a simple model that reveals the channel through which the investment of banks in risky sovereign bonds can translate into less lending to the private sector. The erection of financing entry barriers to entrepreneurship, in turn, generates rents for the industrial incumbents since its undermines newcomers and preserves the social status quo of incumbent firms. Thus, lax regulation in sovereign bonds creates its own political support by maintaining rents for a fraction of the population.

The starting point for our analysis is the linkage between capital standards for sovereign bonds and expected bank payoffs in the case of sovereign default. Given the existence of a deposit insurance system, zero capital requirements incentivize banks to invest in risky sovereign bonds (figure 3.1) without creating a buffer to cover losses from sovereign default. Then, however, bank owners realize that in case of sovereign bond default, the expected return from loans will not accrue to them but only reduce the cost of the deposit insurance system. This causes banks to readjust their portfolio and

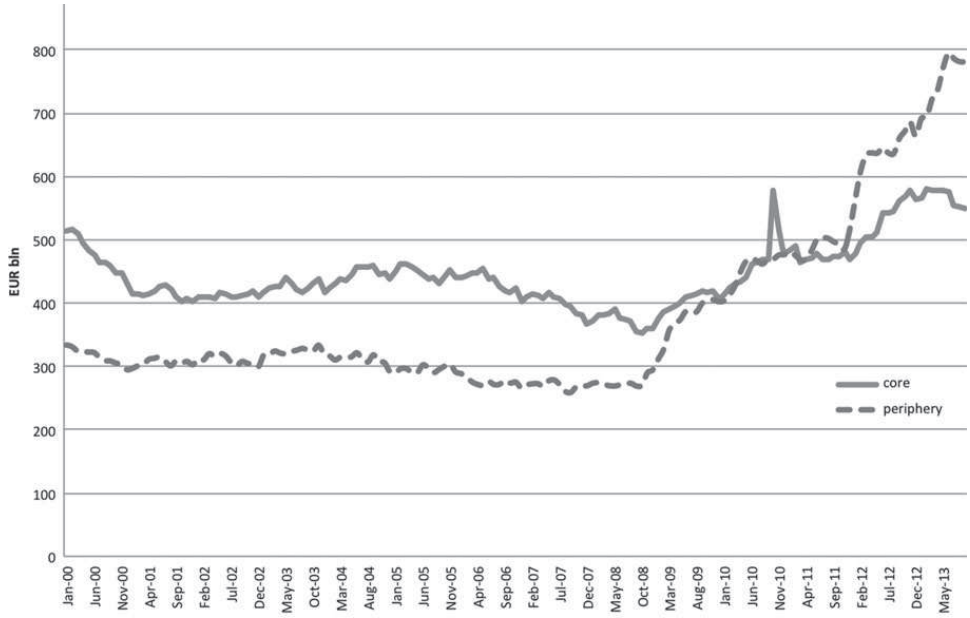


Figure 3.1: Domestic sovereign debt holdings
Graph taken from Battistini et al. 2014

gives birth to redistributional effects within the private sector.

The basic political conflict is simply described. Regulation significantly determines the allocation of credit between the private sector and the state. Established interests are willing to support a policy that subsidizes investments in sovereign bonds. Intuitively, incumbent producers benefit from less lending to entrepreneurs since this is a way to insure them from competition and to create scarcity rents. Provided that the median incumbent firm is a net beneficiary of the current regulatory framework, they will build a coalition with bank owners to block any reform of the status quo. In contrast, less wealthy entrepreneurs and consumers tend to fight for a reform. Fiscal illusion of consumers and a self-interested government that has the motive to hold down the cost of financing public debt through the clever design of banking rules are additional factors that strengthen the identified status quo bias in sovereign bond regulation. Our key point is that the regulatory induced allocation of credit has redistributive implications in the status quo and creates its own constituency such that the economy may be locked into an undesirable situation.

This chapter is related to two strands of the literature. According to the public interest theory the regulator should improve welfare and ameliorate failures in financial markets through the clever design of a regulatory framework. With imperfect information in

finance, capital requirements are necessary since they limit the risk-shifting behavior by banks (Dewatripont and Tirole 1994). The reasoning is that if bank owners have more capital at risk, the upside gains that they would enjoy from risk-taking would be counterbalanced by the potential loss of their equity if their bank suffers major losses (Jensen and Meckling 1976; Sinn 1980; Stiglitz and Weiss 1981). Accordingly, undercapitalized banks can trigger a financial crisis by inducing moral-hazard behavior when banks enjoy the privilege of limited liability. Minimum capital requirements should vary depending on the risks of the underlying bank investments. Furthermore, higher capital requirements increase the risk buffer of banks and therefore decrease both fiscal cost of a crisis to taxpayers as well as the risk of contagion among banks (Allen and Carletti 2013; Admati and Hellwig 2013).

The private interest theory, however, views regulation as a product and therefore analyzes supply and demand forces (Stigler 1971). Banking policies are primarily shaped by the private interests of the regulator ("grabbing hand" approach by Shleifer and Vishny 1998) or regulatees ("political support" approach by Becker 1983 and Hillman 1989).[1] Thereby the objective function of the regulator includes preferential treatment of an organized interest group as well as the cost of subsidies given by the welfare costs to society. Policy-makers then balance the private benefits with the social costs of distorted interventions. Turning to the arena of banking regulation, most proponents of the private interest theory argue that on the supply side, especially in crisis times, the politician has a self-interest to reduce his debt service and to use sovereign bond regulation as an instrument to adjust public finances. Given the economic, political and constitutional limits of an austerity policy of increasing taxation or spending cuts, a regulatory framework for banks that privileges access to finance to the state, so-called 'repressed financial systems', appears politically attractive (Reinhart and Sbrancia 2015). Concerning demand forces, the cross-country dataset on bank regulation and supervision in over 150 countries by Barth et al. (2006) strongly supports the view that bank regulators often end up serving the banking industry and private interests. Interestingly, throughout the history controlling finance proved out to be a powerful barrier to competition in the private sector and thus a channel for rent-creation (Calomiris and Haber 2014). The reason is that politically connected lending and access to finance could pose a threat to established industrial firms, since profits

[1]Policy for sale models introduced by Grossman and Helpman (1994) provide a microfoundated mutisectoral model of organized lobbies that make contributions to get polices in their favour against the unorganized population.

for incumbent firms will be impaired by broadening the access for potential entrants.[2] Competitive effects make the control of capital flows an important tool in the struggle for real market shares and thus shapes the demand for lax sovereign bond regulation relative to credits for firms.

This chapter follows the private interest theory of banking regulation and focuses on the demand forces for regulation by analyzing when regulation is supported by a majority of the electorate. We provide a microeconomic model that links the banking sector and its regulation to the market entry of firms, thus allowing us to specify the rents that are created for banks and agents in the private sector. This is new in the literature since most studies in this field either focus on the self-interest of politicians or on conflicts within the financial sector between small and large banks.[3]

The structure of this chapter is as follows: In section 3.2 we set up and solve the basic model where a change in portfolio policy affects the rents of private agents. Section 3.3 solves the political question when a welfare-improving reform is feasible. Section 3.4 extends the basic model to account for the case of 'financial repression' and presents empirical evidence. Section 3.5 discusses policy lessons and concludes.

3.2 The model

3.2.1 Setup

We study a closed economy with a continuum of risk-neutral citizens. Each citizen is born with some initial wealth w_i, which is uniformly distributed in the interval $[0, 1]$. Within the population, the share m of all citizens owns a monopolistic bank, while the share e of all citizens has the human capital to become an entrepreneur and open a firm. The remaining share of citizens $1 - m - e$ can only use its initial wealth for consumption and savings. Further, we include a government that can issue sovereign bonds to provide a public good.

[2]The idea that financial barriers deny fungible resources and hinder entrepreneurs to overcome obstacles to entry is based on the pioneering work of Rajan and Zingales (1998; 2003). Lloyd-Ellis and Bernhardt (2000) and Evans and Jovanovic (1989) show in a general equilibrium model that credit constraints induce lower entry of potentially good entrepreneurs. Moreover, Clementi and Hopenhayn (2006) and Cabral and Mata (2003) demonstrate that credit constraints arise from asymmetric information between firms and banks or limited enforcement and have strong impact on entry.

[3]See Haber and Perotti (2008) and Buck (2015) for surveys on the political economy perspective on banking regulation.

The entrepreneurial sector is composed of a market for one homogenous good X. The demand of each citizen is characterized by the following function:[4]

$$p = A - X \ , \tag{3.1}$$

where p equals the equilibrium output price, while A captures the (exogenous) size of the market. Further, to simplify, we assume that each entrepreneur is only able to produce one unit.

Each potential entrepreneur has to invest the fixed amount of $I = 1$ to start production. She thus needs external finance of $1 - w_i$ to open a firm. Critically, the lending relationship is characterized by asymmetric information problems. Instead of producing, the entrepreneur can also use the borrowed funds to enjoy private benefits. However, following Diamond (1984), the bank as the delegated monitor is characterized by its ability to reduce the asymmetric information problem between the borrower and the entrepreneur.

Besides loans, the bank can also invest in sovereign bonds G. In our basic model, we abstract from the politician's choice regarding the share of public expenditure that is financed with the issuance of sovereign bonds.[5] Rather, suppose that the government issues the fixed amount of sovereign bonds G to provide the amount of the public good that fulfills the Samuelson condition (Samuelson 1954).

Critically, we assume that the sovereign bond does not represent a safe asset. We think that this adequately describes the present situation in many countries. While before the financial crisis sovereign bonds were perceived to be a virtually safe asset class, this assessment changed. Figure 3.2 illustrates the sharp increase in the interest rate on sovereign bonds in several countries. Obviously, this reflected the sentiment of many market participants that countries could default on the repayment of their sovereign bonds. In contrast to the investment in loans, we make the (realistic) assumption that the bank has no specific technology of monitoring or enforcement with respect to sovereign bonds that would result in a higher probability of repayment. Therefore, in

[4]For simplicity, we assume that even citizens endowed with $w_i < p$ are able to consume the homogenous good, e.g. due to welfare benefits that are funded through lump-sum taxation.

[5]Starting with Barro's (1979) tax-smoothing model of deficits, many papers have come up with explanations why governments accumulate debt. Focusing on the political economy literature, Aghion and Bolton (1990) show that governments can use the issuance of sovereign bonds strategically to increase their probability of reelection. Alesina and Tabellini (1990) emphasize the fact that accumulated debt can bind the hands of future governments with different political preferences.

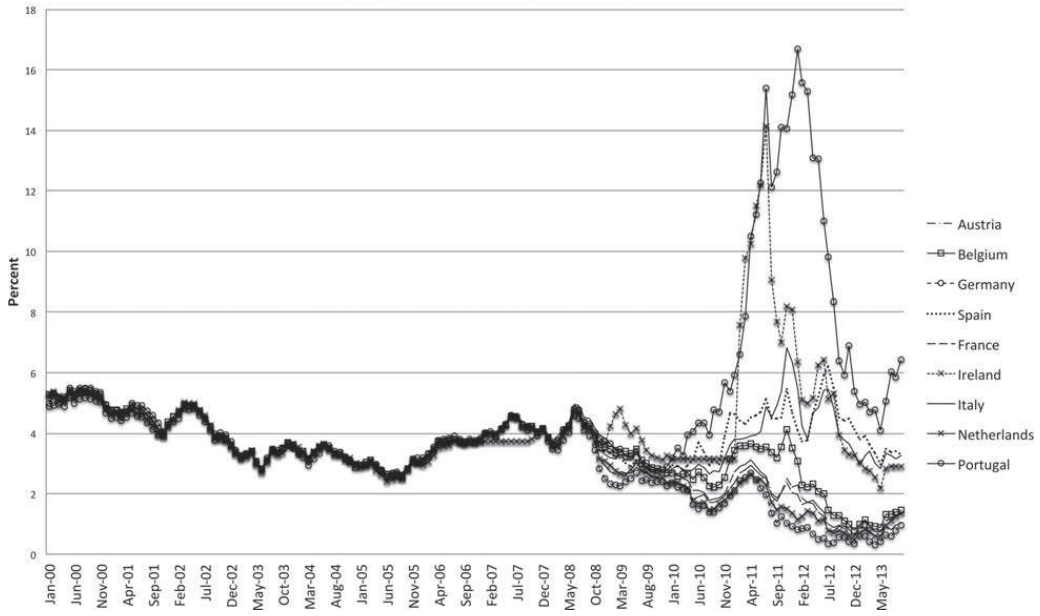


Figure 3.2: 5-year sovereign bond yields
Graph taken from Battistini et al. 2014

our model, the probability of repayment $0 < \theta_G \leq 1$ is exogenous and there exist no ex-ante reason why the bank should play a disciplining role as a holder of sovereign bonds.[6]

The monopolistic bank is financed through savings by citizens that can take the form of deposits or equity. To keep the basic model as simple as possible, we abstract from any additional cost for the bank of raising external equity and assume that each citizen is indifferent between the provision of deposits and equity as long as the expected return equals the (exogenous) interest rate r. The banking sector is characterized by a deposit insurance system. This resembles common practice in virtually all financially developed countries.[7] However, due to the possibility for the bank to externalize costs in case of its default, it becomes more attractive for bank owners to fund themselves with deposits. Critically, as we will analyze below, this can affect the bank's investment decision. To prevent this, the regulatory agency can stipulate capital standards that determine the amount of equity that the bank has to use for each unit of investment.

[6]We thus abstract from arguments provided in the literature, suggesting that during normal times banks hold sovereign bonds to store liquidity (Holmström and Tirole 1993).

[7]Its desirability has been shown in the seminal paper by Diamond and Dybvig (1983). Further paper in this literature have stressed the difficulties of charging banks with an adequate insurance premium (see e.g. Acharya and Dreyfuss, 1988). Therefore in our paper we abstract from any insurance premium for the bank.

Here, the regulatory agency can discriminate between the capital standards for loans (k_L) and sovereign bonds (k_G).

3.2.2 Bank investment

We start by analyzing the portfolio allocation of the monopolistic bank that can choose between the provision of loans to entrepreneurs and the purchase of sovereign bonds. Clearly, this decision depends on the risk of both asset classes as well as the implied correlation between the repayment of loans and sovereign bonds. Critically, the bank differs in its ability to monitor both asset classes. It can control the default risk of each loan through monitoring and the demand for collateral. In contrast, it has to take the default risk of the sovereign bond $1-\theta_G$ as given. We thus assume that in a given state of the world, the bank would be in default only due to the losses of its sovereign bond investment. This feature is critical for our model. On the other hand, we could also allow for bank insolvency to be caused by failed loans to entrepreneurs. However, this would not alter our main results as long as in some scenario bank default would only be caused by sovereign default. Therefore, to simplify, we consider the following objective function of the bank:

$$\begin{aligned} E[\pi] =& \theta_G \left\{ r_G G + r_L L - r \left[(1-k_G) G - (1-k_L) L \right] \right\} \\ &+ (1-\theta_G) \max \left\{ r_L L - r \left[(1-k_G) G - (1-k_L) L \right] ; 0 \right\} - r \left(k_G G + k_L L \right) \ , \end{aligned} \tag{3.2}$$

Whenever the sovereign bond does not default, the bank owners can use the (endogenous) return from loans ($r_L L$) and sovereign bonds ($r_G G$) to repay their depositors. Due to the existence of the deposit insurance system, the bank will choose to fund each unit of investment with the maximum amount of deposits that is allowed by the regulation authority ($1-k_i$). In contrast, whenever the sovereign bond defaults, the bank can only repay its depositors when the net return from the distribution of loans is sufficiently large relative to the amount of outstanding deposits. Reduced by the opportunity cost of investment $[r \left(k_G G + k_L L \right)]$, all excess profits accrue equally to the share m within the population that own the monopolistic bank.

3.2.2.1 Lending to the sovereign

We first consider the amount of sovereign bonds that the bank is willing to hold. Given the risk-adequate interest rate of $r_G = r/\theta_G$, which would be claimed by citizens, maximizing (3.2) with respect to G yields

$$\frac{\partial E[\pi]}{\partial G} = \theta_G \left[r_G - r\left(1 - k_G\right)\right] - rk_G - D(1-\theta_G)r(1-k_G) \geq 0 \ , \tag{3.3}$$

where

$$D = \begin{cases} 0 & \text{if} \quad r_L L - r\left[\left(1-k_G\right)G - \left(1-k_L\right)L\right] < 0 \\ 1 & \text{if} \quad r_L L - r\left[\left(1-k_G\right)G - \left(1-k_L\right)L\right] \geq 0. \end{cases} \tag{3.4}$$

Equations (3.3) and (3.4) show that the bank's portfolio investment decision into sovereign bonds is affected by the expectation about the repayment obligation in case of the default of the sovereign bond. Here we have to differentiate between two scenarios. In the first scenario, $D = 1$, the bank owners expect that they will always be able to repay the depositors. In this case, the expected profit of holding sovereign bonds is equal to

$$E[\pi_G]^{D=1} = 0 \ . \tag{3.5}$$

Obviously, as the bank does not own a specific monitoring technology for sovereign bonds, the bank cannot earn an additional rent by just forwarding funds to sovereign bonds. Citizens could equally invest in sovereign bonds and earn the same expected return. Thus, here the bank would be indifferent about holding sovereign bonds or not.

We now turn to the second scenario, where $D = 0$. We call this scenario 'doom loop' scenario, a term introduced by Tirole and Farhi (2014) to describe the feedback effect of sovereign fragility on bank balance sheets. In this scenario, the bank can only repay its depositors in cases where the sovereign bond does not default ($D = 0$) so that the expected profit of holding sovereign bonds is equal to

$$E[\pi_G]^{D=0} = G\left\{\theta_G r_G - r\left[k_G + \theta_G\left(1-k_G\right)\right]\right\} \ . \tag{3.6}$$

In the basic model we abstract from strategic behavior of the sovereign so that the bank receives the interest rate $r_G = r/\theta_G$. In section 3.4 we discuss the implication of lower sovereign bond interest rates as the result of a oligopolistic banking sector or strategic sovereign behaviour. We can then see from (3.6) that, due to the externalization of

repayment costs in case of sovereign bond default, the bank will make positive expected profit whenever sovereign bonds are risky ($\theta_G < 1$) and the bank is (partly) funded by insured deposits ($k_G < 1$). Intuitively, an increase in k_G raises the liability at the level of the bank, while high values of θ_G decrease the risk premium and thus the return that the bank owners can earn in the case that the sovereign bond repays. In the scenario of $D = 0$, the bank would thus purchase all sovereign bonds.

3.2.2.2 Lending to the entrepreneur

We now turn to the analysis of the loan market equilibrium. Each entrepreneur will be willing to borrow from the bank as long as

$$p - (1 - w_i)r_L - rw_i \geq 0 \ . \tag{3.7}$$

The net profit of producing is measured by the first two terms, whereas the third term captures the opportunity cost. Rearranging terms, one can see directly that the loan rate at which the entrepreneur will be just indifferent about producing is a positive function of its initial wealth as this reduces the necessary amount of external funding. Using (3.7), the demand for loans is given by

$$L^D = \int_{w_L(r_L)}^{w_M} (1 - w_i)dw_i \ , \tag{3.8}$$

where

$$w_L = 1 - \frac{A - r}{e + r_L - r} \ . \tag{3.9}$$

We will derive the upper limit of wealth w_M at which entrepreneurs are dependent on bank funding in the next section. This threshold is independent of the loan interest rate. In contrast, the critical level of wealth w_L at which the entrepreneur will still demand bank funding is defined through condition (3.7). For the entrepreneur that is identified with w_L this condition will be binding. Then, substituting (3.1) and rearranging terms, we arrive at (3.9).

We now turn to the monopolistic bank. Here we assume that the bank cannot discriminate between different entrepreneurs and thus strategically selects the combination

of r_L and L that maximizes its profit. Then, maximizing (3.2) with respect to L yields

$$\frac{\partial E[\pi]}{\partial L} = [\theta_G + D(1-\theta_G)] \left[r_L + \frac{\partial r_L}{\partial L} L - r\left(1-k_L\right) \right] - rk_L = 0 \; . \tag{3.10}$$

The marginal loan return net of deposit costs is measured in the second squared bracket. Taking into account (3.8) and (3.9), the bank owners choose the optimal combination of r_L and L. Crucially, thereby, they account for the effect of the sovereign default on the bank solvency [first squared bracket in (3.10)]. Thus, in equilibrium, the bank will choose the supply of loans such that the expected return net of deposit costs equals the opportunity cost of each unit of loan (rk_L).

We can now compare the different loan market equilibriums. Critically, in the case of $D = 0$, bank owners anticipate that the loan return net of deposit costs will only accrue to them whenever the sovereign bond will not default. Given the fixed opportunity cost of each unit of loan (rk_L), the bank owners will therefore also adjust their loan portfolio compared to the scenario of $D = 1$. More precisely, as shown in Appendix C.1 whenever $k_L > 0$ and thus the opportunity cost of bank investment into loans is positive, the bank owners will charge higher loan interest rates when they expect to become insolvent in the case of sovereign default ($D = 0$). Thus, in this scenario, the bank owners (partly) compensate for the higher portfolio risk by distributing less, but more profitable loans.

3.2.2.3 Sovereign bond regulation and portfolio choice

We are now left to analyze the circumstances under which we will end up in the doom loop scenario of $D = 0$. Looking at (3.2) and rearranging terms, we can see that this will be the case whenever it holds that

$$k_G \leq \hat{k}_G = 1 - \frac{L}{G}\left[\frac{r_L}{r} - \left(1-k_L\right)\right] \; . \tag{3.11}$$

The 'doom loop' scenario in our model arises whenever bank owners anticipate that the bank solvency is directly linked to the repayment of the sovereign bond. In this context, the level of k_G determines the buffer of the bank that can absorb losses once the sovereign would default. Therefore, whenever condition (3.11) holds, bank owners anticipate that the amount of deposits that they are allowed to use for the purchase of risky sovereign bonds exceeds the level that they will be able to repay in case of a sovereign default. Further, losses from sovereign bond holdings could also be absorbed

by the revenue generated through loans. Therefore, as shown in condition (3.11), the critical threshold below which banks enter the doom loop scenario is also critically affected by the portfolio allocation between sovereign bonds and loans as well as the profitability of loans.

We can now summarize our findings at this stage in

Proposition 3.1 ***(Refinancing spillover):*** *Whenever capital standards for sovereign bonds are inadequate [* (3.11) *holds], then loan supply for entrepreneurs decreases, and total output is reduced.*

Our analysis rationalizes how the absence of capital standards for risky sovereign bonds contributed to the observed decline in bank lending to the entrepreneurial sector. Further, it can explain that this effect was particularly pronounced in countries where sovereign bonds were perceived to be most risky. The spillover effect in our model is driven by the expectation of bank owners regarding the payoffs that accrue to them in the different states of the world. More precisely, given the fixed opportunity costs of lending towards the entrepreneurial sector (rk_L), bank owners should adjust the loan interest rate depending on the probability of accruing these returns. Capital standards for sovereign bonds affect this optimization. Given the existence of the deposit insurance system, the regulatory framework of zero capital requirements does not incentivize banks to create a buffer that can take losses caused by sovereign default. Then, however, bank owners know that the expected return from loans will not accrue to them but only reduce the cost of the deposit insurance system in case of sovereign bond default. Banks thus increase the marginal return of each loan, thereby reducing the total supply of loans. Obviously, this effect is more pronounced if the sovereign bond is perceived to be more risky. The effect of capital standards for loans is ambiguous. On the one hand, relatively high capital standards for loans increase the buffer that can take losses. However, once condition (3.11) holds and thus the 'doom loop' scenario is present, high capital standards for loans will reinforce the spillover effect as they constitute higher opportunity costs for bank owners [eq. (3.10)].

3.2.3 Rent creation in the private sector

We now turn to the distributional effects within the private sector that follow from the distortion in the bank's investment policy as described in the previous section. Critically, so far we referred to the bank as the only source of entrepreneurial funding.

This was due to the ability of the bank to monitor its borrowers and thus to overcome the asymmetric information problem. However, as we show in the following section, a subgroup of wealthy producers will be able to receive funding without having to rely on bank loans. We will refer to these producers as market-funded. To illustrate the mechanism, we use the setup of Holmström and Tirole (1997).

In this setup, investment generates a verifiable return only with a specific success probability that depends on an unobservable action taken by the entrepreneur. The action represents the entrepreneur's choice of technology usage. The intended purpose is to produce with an efficient technology, which gives a success probability of one. However, the entrepreneur also has the option to produce with a gambling technology, which gives a lower probability of success $\theta_L < 1$, but provides the entrepreneur with a private benefit B. We assume that only production with the efficient technology is economically viable so that $A - e - r > 0 > \theta_L (A - e - r) + B$.

Critically, now, to receive external funding without having to rely on bank loans, the entrepreneur will need to credibly assure the lender to use the efficient technology. The investor, in turn, will only expect the entrepreneur to repay the loan $1 - w_i$ when this is incentive compatible so that [8]

$$\underbrace{p - r_M \cdot (1 - w_i)}_{\text{prudent}} \geq \underbrace{B + \theta_L[p - r_M(1 - w_i)]}_{\text{moral hazard}} \quad \textit{(IC)} \quad , \tag{3.12}$$

where r_M denotes the interest rate of market funded entrepreneurs. The left-hand side (LHS) captures the entrepreneurial rent Π^E in case of prudent entrepreneurial behaviour. The right-hand side (RHS) measures the return from taking external funds to receive private benefits B by selecting the gambling technology with the low probability of success $\theta_L < 1$ (moral hazard).

Importantly now, we can rearrange terms in condition (3.12) and solve for the minimum endowment of wealth w_M that is still incentive compatible to chose the efficient technology:

$$w_M = 1 - \frac{p - \frac{B}{1-\theta}}{r_M} \quad . \tag{3.13}$$

This threshold arises due to the fact that only personal financial contributions of

[8] Due to the condition of economic viability, entrepreneurs will not borrow if they are expected to use the inefficient technology and would have to pay an risk adequate interest rate of r/θ_L.

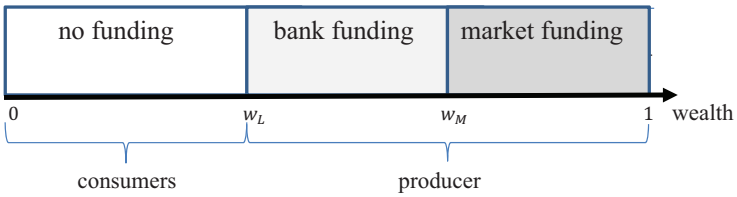


Figure 3.3: The funding structure for entrepreneurs with wealth w_i

$w_i \geq w_M$ limit the expected revenue from the exploitation of limited liability and prevent moral hazard behavior of the entrepreneur. Therefore, the threshold decreases in the profitability of producing the entrepreneurial good and increases in the private benefit B.

All entrepreneurs that are endowed with $w_i \geq w_M$ will be incentivized to choose the efficient technology without further external control. Thus, all citizens will be equally willing to invest. Consequently, the interest rate for these entrepreneurs will be equal to $r_M = r$.

Therefore, in our model, citizens that are endowed with the human capital to become an entrepreneur can be classified into three distinct groups. We illustrate this in figure 3.3. All citizens with $w_i > w_M$ can receive funding for the interest rate of r. Citizens with $w_L < w_i < w_M$ will be able to receive bank funding but will be charged an interest rate $r_L > r$. Potential entrepreneurs that are endowed with $w_i < w_L$ will not be able to produce.

We can now analyze the degree to which these groups are affected by the refinancing spillover identified in Proposition 3.1. First, and obviously, it leaves all entrepreneurs with $w_i \geq w_M$ better of, as these entrepreneurs benefit from the reduction in total output. Second, for all entrepreneurs with $w_L^0 \leq w_i < w_M$ this effect counteracts the increase in the loan interest rate. However, as the negative effect is decreasing in the entrepreneurial wealth, we can identify the critical level of wealth (see Appendix C.2)

$$\hat{w} = 1 - \frac{e(A-r)}{(e+r_L^0-r)(e+r_L^1-r)}\,, \tag{3.14}$$

where both effects exactly balance each other out. Consequently, all entrepreneurs with $w_L^0 < \hat{w}$ are worse off as they need external funding to a larger extent. All entrepreneurs with $w_L^1 \leq w_i < w_L^0$ lose access to credit funding and can thus no longer produce. Finally, entrepreneurs with $w_i < w_L^1$ and consumers are worse off due to the higher prices resulting from lower supply. We summarize these findings in

Proposition 3.2 ***(Rent Creation):*** *The refinancing spillover introduces redistributive effects within the private sector. Rents emerge for all entrepreneurs that are endowed with $w_i \geq \hat{w}$ at the cost of consumers and entrepreneurs with $w_i < \hat{w}$.*

Proposition 3.2 emphasizes that the deterioration in the provision of loans does not evenly burden all entrepreneurs within the private sector. Even reverse, it creates rents for a subgroup of producers that can fund themselves independent of banks and thus exclusively benefit from the decrease in competition.

3.2.4 Welfare

Now we combine the previous findings to analyze the welfare effects of inadequate capital standards for sovereign bonds ($k_G < \hat{k}_G$). Due to our simplified structure, there only exist two levels of credit provision [see (3.10)] that, in turn, determine the size of the production sector. Depending on the scenario $D = 0, 1$, the equilibrium number of producers is thus equal to

$$n^D = e(1 - w_L^D) = \frac{e(A - r)}{e + r_L^D - r} \,, \tag{3.15}$$

whereby the second step in (3.15) follows directly from substituting (3.9) and rearranging terms. As analyzed in Proposition 3.1, there are less producers in the 'doom-loop' scenario ($n^0 < n^1$). We can now study the welfare effect of capital standards for sovereign bonds below $\hat{k}_G$ compared to the scenario of $k_G > \hat{k}_G$:

$$\begin{aligned} \Omega &= \left(n^1 - n^0\right) \left[n^0 - \left(A - n^1 - r\right) - \frac{n^0 + n^1}{2}\right] + (1 - \theta_G)\, rG \left(m\frac{1}{m} - 1\right) \\ &= -\left(n^1 - n^0\right) \left(A - \frac{n^0 + n^1}{2} - r\right) < 0 \,. \end{aligned} \tag{3.16}$$

Non surprisingly, equation (3.16) tells us that the overall welfare effect of inadequate capital standards for sovereign bonds is negative. Further, as we abstract from any additional bank default cost, the reimbursement of depositors due to inadequate capital standards for sovereign bonds in itself only constitutes a non-distorting subsidy to the bank owners. The first term in the first row of (3.16) measures the decrease in

production, which follows from the reduction of loans. While all entrepreneurs that are endowed with sufficient funds will benefit from the increase in prices (first term in squared bracket), entrepreneurs without access to funds will lose the net return of producing the entrepreneurial good (second term in squared bracket). Further, consumer surplus will be reduced due to the lower total production (third term in squared bracket). Clearly, as shown in the second row of (3.16), the net effect is negative. Finally, while the direct net effect of the deposit insurance system is zero, it has redistributional effects. The benefit, which arises due to lower funding cost for the bank, is concentrated on the group of bank owners of size m. In contrast, the expected reimbursement costs of depositors in case of bank default is evenly distributed over all citizens.

As we have shown in this section, inadequate sovereign bond regulation not only induces a portfolio shift from the private sector to the state, but also creates rent-shifting among entrepreneurs.

3.3 Political feasibility of reforms

This section focuses on the analysis of the reform of sovereign bonds regulation. By reform we mean capital regulation of a bank's investment in sovereign bonds beyond the non-regulated scenario that is present today. Our model has shown that there is no economic reason for a preferential regulatory treatment of sovereign exposures if we introduce positive sovereign risk. Such a kind of intervention distorts the smooth allocation of scarce credit and is responsible for less lending to other asset classes, most notable the private sector. Consequently, there is consensus among economists to recommend a positive risk weight for bank lending to the state (e.g. Tirole, 2012; Gros, 2013; Weidmann, 2014). But, in practice, few of the remedies that economists advocate pass the test of political viability. In fact, we observe a zero risk weight for sovereign lending in most industrial countries despite the fact that the Basel Accords do not demand such a regulatory privilege.

The central question this section addresses is, what is the economic environment most favorable to reform and when there is a strong political support for the status quo? Thereby the key message is that repressing private credits is a powerful source for a status quo bias against policy changes in general. By status quo bias we refer to the fact described in Proposition 3.2 that lax regulation of investments in sovereign bonds creates its own political support, by maintaining rents for a fraction of the population.

This is a mass of people who are likely to oppose reforms because of two factors. First, those entrepreneurs who succeeded to open up a firm due to sufficient wealth benefit from the artificial scarcity of the entrepreneurial good (price-effect). Second, bank owners gain from artificial high net returns on investments in sovereign bonds due to low deposit interest rates. Consequently, a more rigid regulatory treatment of sovereign bonds has reallocative effects and implies losing that rent such that this mass of citizens forms a coalition in favour of the status quo. They are likely to be more opposed to the reform, the greater their joint rent.

Indeed, many policy interventions create rents directly to some groups of the society; for example, tariffs or subsidies for special industries. Here it is obvious that the profiteers will support such a regulation. In the context of banking regulation we have a more subtle mechanism. Minimum capital requirements for sovereign bonds do not in itself create rents in favour of some groups; it does so indirectly because it changes the portfolio composition and output level of the economy and, thus, redistributes wealth.

In what follows we consider an economy that does not regulate sovereign bonds in the status quo, $k_G^0 = 0$, but votes over becoming more strict concerning regulation of a bank's investment in sovereign bonds with $k_G^1 \geq \hat{k_G}$.

3.3.1 The case of a perfect political environment

The feasibility of reform depends on the political power of its supporters and the available information. In order to make clear that the rents identified in the last section do not necessarily generate a status quo bias, we first assume that all citizens are perfectly informed about the consequences of a reform, i.e. $k_G^1 \geq \hat{k}_G$. Moreover, the political power of the reformers and supporters of the regulatory status quo is simply proportional to their number. This is not a very realistic description of the political arena, but it is helpful to illustrate under what conditions a status quo bias arises.

In the above framework, we can split the society into three groups. The first group represents the consumers of the economy who are positively affected by an increase in sovereign bond regulation. Formally, the net gain from a reform for a consumer is strictly positive and equal to

$$R^C = (n^1 - n^0)\left(A - \frac{n^0 + n^1}{2}\right) + rG(1 - \theta_G) > 0. \tag{3.17}$$

The first term measures the increase in consumer surplus due to more production when $n^1 - n^0$ new entrepreneurs successfully enter the market for the entrepreneurial good. The second term measures the avoided costs for the deposit insurance system since the bank will always be able to pay out depositors and stays solvent. It is straight forward that this group will always support a reform.

Moreover, a subgroup of entrepreneurs will also benefit from a reform. To see this, remember that entrepreneurs with sufficient low wealth ($w_i < w_L^0$) have no access to external funding in the status quo and cannot produce. Either they keep the same consumer status when the economy moves from the status quo to stricter sovereign regulation, or they find funding after the reform and thus earn the producer surplus of $p - r_L(1 - w_i) \geq 0$ if their wealth exceeds the new critical entry barrier w_L^1. In both cases they are positively affected by the reform and will join the group of "reformers".

The second group in the society represents the producers of the entrepreneurial good in the status quo. Since entrepreneurs are heterogenous with respect to their initial wealth, the net effect of the reform on the individual rent depends on the individual funding structure of the entrepreneur i. Intuitively, stricter regulation of sovereign bonds enhances competition and reduces the price, $p^1 < p^0$, however, for a fraction of sufficient less wealthy entrepreneurs there is also an opposing effect on the refinancing situation because their interest rate decreases, $r_L^1 < r_L^0$. The net gain of a reform for a producer with wealth w_i thus reads

$$R^E(w^i) = \begin{cases} (p^1 - p^0) - (r_L^1 - r_L^0)(1 - w_i) + rG(1 - \theta_G) & \text{if} \quad w_L^0 < w_i < w_M \\ (p^1 - p^0) + rG(1 - \theta_G) & \text{if} \quad w_i \geq w_M. \end{cases} . \tag{3.18}$$

The first row indicates the net gain for a bank-funded entrepreneur, the second row for an entrepreneur who has access to market finance because of $w_i > w_M$. The reform affects bank-funded entrepreneurs in three ways. First, there is the negative price-effect (first term); second, entrepreneurs benefit from a positive refinancing-effect (second term); and third, there are avoided cost for the deposit insurance provision (third term). We hence can compute a threshold wealth level, $\tilde{w} = \hat{w} + \frac{rG(1-\theta_G)}{r_L^0 - r_L^1}$, from where the positive refinancing-effect and deposit insurance-effect of the reform will be dominated by the negative price-effect. Hence, we can say that all entrepreneurs with $w_i < \tilde{w}$ strictly benefit from a reform and also join the consumers to the group of reformers. The other entrepreneurs oppose the reform since they lose from such a

policy. Thus, among e entrepreneurs, we have $(1 - \tilde{w})$ who defend the status quo.

To complete the political environment, remember that the net gain from a reform for bank owner is always negative because of the loss of the deposit insurance subsidy:

$$R^B = \frac{1}{m}\left[r_L^1(L^1 - L^0) - (r_L^0 - r_L^1)L^0 - (1-m)rG(1-\theta_G)\right] < 0. \tag{3.19}$$

Consequently, the mass of bank owners will block any reform and prefer the status quo.

To determine the political equilibrium we have to add votes. Summing up all "reformers", we see that reform will pass majority voting if and only if

$$1 - e(1 - \tilde{w}) - m > \frac{1}{2}. \tag{3.20}$$

The left-hand side of (3.20) lists the total number of agents who benefit from the reform. Except for wealthy entrepreneurs (second term) and bank owners (third term), all citizens fall into this group. Thus, the political viability condition from (3.20) should be satisfied in most societies. In this case, we would end up in the optimal regulatory framework in the sense that the welfare loss identified in (3.16) is averted. In reality, however, there might be distortions in the political process that will change the political outcome as we will show in the next section.

3.3.2 The case of a manipulable political environment

Organized interest groups may modify the policy-making process and manipulate the political support for a reform. It is plausible to assume that campaign contributions by a lobby can increase the average popularity of the status quo relative to a reform.

Specifically, in the following we assume that producers and bank owners have a larger political clout than consumers. They earn profits in the status quo and have a strong incentive to get organized in order to protect their rents. In fact, founded in 1983, the largest and most influential global association of financial institutions (IIF) also includes multinational firms.[9] On the other side, it is much harder to form and to finance interest groups among less wealthy agents, especially for entrepreneurs who are excluded from external finance and cannot produce in the status quo. Hence,

[9]In this context, Lall (2012) shows that the implementation of the model-based approach in the Basel capital requirement framework, itself a lifting of equity constraints on large banks, was the regulatory outcome of lobbying the the IIF.

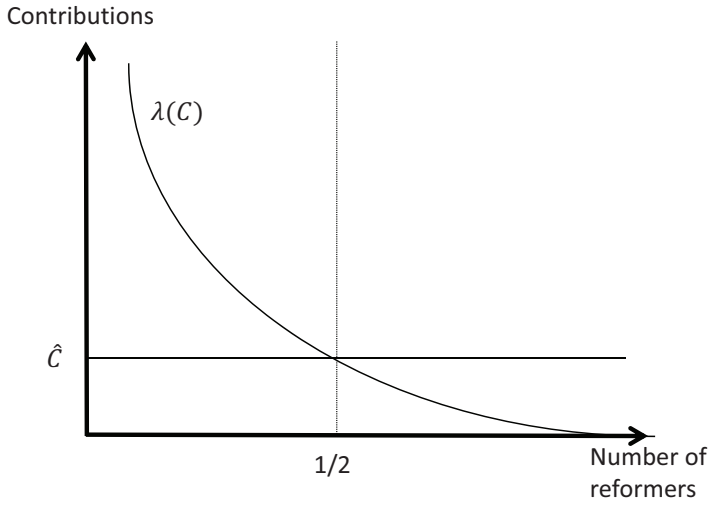


Figure 3.4: The critical threshold of lobby contributions

we assume that only the rent-making group of "supporters" of the status quo are organized politically and their encompassing lobby is the only one to collect campaign contributions.

Suppose that a fraction $\lambda < 1$ of 'reformers' can be manipulated through campaign contributions C financed by the lobby group, where C measures the total advertising expenditures or media exposure by the opponents. These contributions increase the overall popularity of the status quo by convincing part of the 'reformers' to block any regulatory change. The fraction of manipulable or bribable 'reformers' is endogenous and strictly increases with the sum of contributions; i.e. the lobby group uses a technology $\lambda(C), \lambda_C > 0, \lambda_{CC} < 0$, that converts the contributed money into votes against the reform. Then the condition for a majority of voters to support the reform becomes

$$(1 - \lambda(C)) \cdot (1 - e(1 - \tilde{w}) - m) > \frac{1}{2} \,. \tag{3.21}$$

Figure 3.4 illustrates this condition. For the inadequate status quo sovereign bond regulation to persist, the total contributions that are expended by the banking and entrepreneurial sector must be sufficiently large to attract the critical amount of $\hat{C}$ so that condition (3.21) is no longer satisfied.

Using the results from the previous section, we can now analyze the maximum level of contributions that will be provided by the supporter of the status quo. While the lobby group will never provide an amount larger than $\hat{C}$, the supporters will be willing

to contribute as long as they would still be net beneficiaries of the status quo. Thus, the lobby group will contribute $\hat{C}$ whenever $\hat{C} \leq C = C^B + C^E$, where

$$C^E = \begin{cases} \int_{w_L^0}^1 |R^E(w_i)| dw_i & \text{if} \quad \frac{1+w_L^0}{2} \geq \tilde{w} \\ 0 & \text{if} \quad \frac{1+w_L^0}{2} < \tilde{w} \end{cases} \tag{3.22}$$

$$C^B = m \cdot R^B \,, \tag{3.23}$$

In contrast, the lobby group will not provide any contributions when $\hat{C} > C = C^B + C^E$. Obviously, the maximum contributions of bank owners that are captured in (3.23) will always equal the additional rent that is generated by the inadequate capital regulation of sovereign bonds in the status quo. These contributions are decreasing in the share of bank owners m as this limits the expected cost from deposit insurance that is externalized to other citizens.

Producers, however, will only get organized and protect the status quo sovereign bond regulation when this is supported by the median within the group of entrepreneurs $\frac{1+w_L^0}{2} \geq \tilde{w}$. The formation of the lobby therefore critically depends on the composition of the entrepreneurial sector. More precisely, the larger the share of entrepreneurs μ^0 that are not dependent on bank funding in the status quo ($\mu^0 = \frac{1-w_M}{1-w_L^0}$), the higher is the probability that the entrepreneurs will lobby in favor of the status quo sovereign bond regulation as these entrepreneurs are only exposed to the positive price effect. Further, as can be directly seen from (3.22), a larger share μ^0 also increases total lobby contributions. This is due to the fact that it limits the positive refinancing effect that would follow from the reform in the capital standards of sovereign bonds. We can now summarize our finding at this stage in

Proposition 3.3 ***(Feasibility of reforms):*** *The higher the share of market funded producers μ^0 and the smaller the share of bank owners within the population m, the more likely it is that a lobby group of bank owners and producers will block welfare-improving reforms in sovereign bond regulation.*

Regulatory standstill arises, because a subgroup of beneficiaries of the status quo forms a coalition to oppose a reform. The clout of the interest group of bank owners and producers is strongly affected by the funding structure of active entrepreneurs in the status quo. Market-funded entrepreneurs are insulated from bank funding effects that result from distortive bank regulation. They always promote the status quo. The stronger their share in the group of active entrepreneurs, the less important are

banking conditions for the interest group of incumbent producers. This link between the funding structure of producers, banking regulation and interest group formation that stabilizes the status quo is the first important result in the analysis of political reforms.

3.3.3 The status quo bias

One important aspect of the above model is its potential to generate persistence in banking regulation. The regulation creates its own political support for the status quo by providing rents for a fraction of the population. Critically, in the above analysis the welfare-improving reform will be blocked if the lobby-power of bank owners and producers is sufficiently large to manipulate a critical fraction of the electorate. To show that the status quo crucially matters for the policy outcome and that a status quo-rent in itself is a source of persistence in sovereign regulation, this section now discusses the alternative option of a reform: a shift from prudent capital requirements to lax sovereign regulation. We will show that such a shift is not the reverse experiment of a shift to prudent regulation when the society is in the lax status quo. Due to an asymmetry of regulatory rents in the status quo, rent preservation might ensure that no reform occurs. The argument is as follows.

Consider the same economy like in the previous section, but a different status quo. Suppose now that the bank is initially constrained by prudent sovereign regulation $k_G^1 > \hat{k}_G$ and the society decides whether to go to (imprudent) zero sovereign regulation k_G^0 or not. In our baseline model, this implies that the entry barrier for entrepreneurship w_L^1 in the status quo is relatively low and the number of active firms jumps compared to the previous case. A change in regulation (the imprudent version of a 'reform') would drop some of them out of the market and makes bank-funding expensive. At the same time, this increases the scarcity rent for the remaining firms. The conflict of interest is thus as straight forward. Non-manipulated consumers would block any welfare-decreasing reform. In contrast, the lobby group of bank owners and producers may demand a regulatory change. Again, the support for a reform depends on the likelihood of coalition building and on the sum of contributions to 'persuade' consumers.

However, and critically, while bank owners will always support the reform for lax regulation, the condition for the group of producers to participate in the lobby-game and to form a coalition becomes more stringent. In fact, there are more entrepreneurs that become part of the group of producers and influence the internal decision-making

process ($\mu^1 < \mu^0$). As the median entrepreneur in the group of producers is less wealthy, she cares more about the negative refinancing-cost of the reform. As a result, it is less likely that $\frac{1+w_L^1}{2} > \tilde{w}$, holds. In other words, because of the internalization of a subset of entrepreneurs, i.e. less-wealthy ones, the barrier for producers to form a lobby group to promote a welfare-declining reform is higher when there is prudent regulation in the status quo.

Second, provided that there is a lobby group of producers, the joint contributions will shrink. The reason is that a fraction of producers, $w_i < w_L^0$ will get no funding after the reform and have to leave the market: they lose the complete entrepreneurial rent and hence reduce the aggregate contributions of the group of producers in the status quo. Formally, the resulting lobby contributions of 'reformers' is equal to

$$C^E = \begin{cases} \int_{w_L^0}^{1} |R^E(w_i)| dw_i - \left[(n^1 - n^0)p^1 - \int_{w_L^1}^{w_L^0} (1 - w^i) dw^i \right] & \text{if} \quad \frac{1+w_L^1}{2} \geq \tilde{w} \\ 0 & \text{if} \quad \frac{1+w_L^1}{2} < \tilde{w} \end{cases} \tag{3.24}$$

$$C^B = m \cdot R^B \ . \tag{3.25}$$

Thus, the sum of producers in the status quo gains less from lax regulation than in the previous case. The group of 'insiders' is larger and extended by a number of bank-funded entrepreneurs which constitutes an asymmetry compared to the previous section where there have been less (bank-dependent) entrepreneurs in the status quo. Again lobby contributions are affected by the price-, the refinancing- and the deposit insurance-effect [first term of (3.24) and (3.25)]. But in addition the reform punishes the less wealthy entrepreneurs by excluding them from the market [second term of (3.24)]. This reduces the ability to lobby and is bad news for a reform. Both the probability of lobby creation and the aggregate contributions decrease compared to the benchmark case in the reverse scenario. Since contributions enter the political viability condition (which now has to be interpreted as a condition for a reform), it is clear that the status quo bias is stronger the lower the contributions.

Proposition 3.4 ***(Relevance of the Status Quo):*** *The distribution of rents in the status quo affects the composition and the power of the lobby group. Hence, it creates its own source of persistence.*

Proposition 3.4 argues that the initial conditions in the economy, i.e. the allocation of producers between bank-funded and market-funded entrepreneurs, have a huge impact

on the policy outcome. If the initial conditions ensure the existence of a large fraction of bank-funded entrepreneurs in the status quo, the interest group of producers values the availability of cheap credits more. Thus, it has a stronger preference for the status quo compared to the reverse experiment where there is lax regulation and low output. Due to this asymmetry of 'insiders' in the lobby group, rent preservation ensures no reform may command broad support. The key mechanism is that the regulation creates its own constituency such that the economy may be locked into a desirable (or in the case of section 3.3.2: undesirable) situation.

This result is interesting since most of the theoretical literature ignores the existence of persisting differences in banking regulation. According to the regulatory competition view (Sinn, 1997; Dell'Arricia and Marquez, 2006) there is a competition of laxity among national regulators with respect to the provision of minimum capital requirements for banks. The underlying argument is that banks will move to jurisdictions that offer less onerous regulations (Dell'Ariccia and Marquez, 2006; Weinberg, 2002), or that national regulators will fail to take fully into account international spillovers (Sinn 1997, 2003). Therefore, the equilibrium outcome is a 'race to the bottom'.

In contrast, our model rationalizes why we observe heterogeneity in the design of sovereign regulation. The status quo matters. The model presented thus suggests that a society may not always seek ever-weaker sovereign regulation, even if a reform acts in the interests of the resident bank owners. Since access to finance is an important source for rent-creation for the private sector, the viability of a reform strongly depends on the market outcome of a reform compared to the status quo and hence the political support of the private sector. If the status quo had created its own constituency and sufficient entrepreneurs are dependent on bank-finance, they are ready to oppose a 'race to the bottom'. A policy-maker thus needs to weigh the indirect costs of soft sovereign regulation in the form of repressing private credits and losing the support of producers.

3.4 Extensions and discussion

Although the model economy analyzed is highly abstract, it can shed some light on further interesting questions.

3.4.1 What is the impact of sovereign risk?

First, one can analyze the influence of sovereign risk for the support of a welfare-improving reform. To see the impact of sovereign risk, consider the first derivative of the total rent of producers [eq. (3.18)] and bank owners [eq. (3.19)] with respect to θ_G that is equal to

$$\frac{\partial C}{\partial \theta_G} = \underbrace{-rG\left[1-m-e\left(1-w_L^0\right)+\frac{\partial n^0}{\partial \theta_G}\left(1-\theta_G\right)\right]}_{(-)} + \underbrace{\frac{\partial r_L^0}{\partial \theta_G} e\left(w_M-w_L^0\right)\left(1-\frac{w_M+w_L^0}{2}\right)}_{(+)} + \underbrace{\frac{\partial n^0}{\partial \theta_G}\left(p^0-p^1-n^0\right)}_{(-)} + \underbrace{\left(r_L^0-r_L^1\right)\left[\left(1-w_L^0\right)\frac{\partial w^0}{\partial \theta_G}-\left(1-w_M\right)\frac{\partial w^M}{\partial \theta_G}\right]}_{(-)} . \tag{3.26}$$

Equation (3.26) shows that a change in the default risk of the sovereign bond changes the willingness to lobby through four different channels. First, an increase in the default risk directly increases bank profits and thus lobby contributions for the status quo [first term of (3.26)]. The smaller the lobby group of entrepreneurs, the smaller the offsetting effect through the reduction in the rent of entrepreneurs. Second, an increase in in the sovereign bond default risk increases the loan interest rate.[10] This reduces the profits of all entrepreneurs that depend on bank funding and thus reduces the overall lobby contributions for the status quo [second term of (3.26)]. Third, the number of entrepreneurs that receive funding is reduced when the sovereign bond default risk increases. While this lowers the number of citizens that receive an entrepreneurial rent, it increases the rent for all remaining entrepreneurs. For all relevant levels of productions, the total gross return for entrepreneurs is thus increasing in the default risk of the sovereign bond [third term of (3.26)]. Finally, as shown in the fourth term of (3.26), an increase in the default risk of sovereign bonds changes the share of entrepreneurs that are not dependent on bank funding. Due to the negative effect of θ_G on w_L^0 and the positive effect on w_M, the fraction of market-funded entrepreneurs $\mu^0 = \frac{1-w_M}{1-w_L^0}$ increases when sovereign bonds become more risky. and thus the willingness to lobby for the status quo.

Summing up over all effects, it is clear that for all bank owners lobby contributions to

[10] This follows directly from using the implicit function theorem in (3.10) to derive $\frac{\partial r_L}{\partial \theta_G}$.

preserve the status quo of capital standards will be a positive function of the sovereign risk. For all entrepreneurs that are endowed with $w_i > w_M$, contributions will increase with sovereign risk up to the point where the positive price effect is no longer sufficient to compensate for the increase in the expected cost of deposit insurance. Finally, for all entrepreneurs that depend on bank funding the increase in the sovereign bond default risk causes an additional negative effect due to the increase in the loan interest rate. While the effect of θ_G on the total rent of entrepreneurs and bank owners is thus ambiguous, we can be more specific about the effect of θ_G on the formation of the lobby within the group of producers. On the one hand, the increase in the sovereign bond risk increases the critical threshold of wealth to receive funding w_L^0. At the same time it decreases the threshold w_M due to lower competition within the private sector [see eq. (3.13)]. Thus, an increase in the sovereign risk causes a shift within the production sector towards a higher share of market-funded entrepreneurs μ, which, in turn, can increase the support for distortive sovereign bond regulation.

3.4.2 What is the role of the visability of the spillover?

Throughout the above analysis we have considered a politically transparent process. All consumers anticipate the welfare loss that is caused by the status quo of inefficient sovereign bond regulation due to the spillover that arises from bank regulation on the private sector. However, recent seminal publications cast serious doubt on this assumption. Empirical studies on tax salience indicate that agents ignore utility losses from taxes, even though these taxes have first order effects on social welfare (Finkelstein 2009; Chetty et al. 2009). As the expected cost of status quo sovereign bond regulation for consumers seems to be rather more subtle, these perceptional limitations should be of particular importance for the political game. Citizens have to be convinced that strict regulation of sovereign bonds benefit them.

Critically, the welfare loss for consumers results from two channels [see eq. (3.16)] and both can be subject to fiscal illusion. First, consumers may not realize the price channel. The entry barrier to production is not created by direct taxation, subsidies or licensing. Rather, the entry barrier is caused by a shift in the bank‘s loan investment policy. Thus, it is not obvious that the consumers will link the status quo in sovereign bond regulation to the inefficient low level of production. Second, the increase in bank profits through lax sovereign bond capital regulation is realized instantaneously. In contrast, the associated increase in the contingent liability for the deposit insurance system is less visible for consumers both regarding the probability and the amount of

future payment obligations. In our model, both effects would induce an inward shift of the $\lambda(C)$ curve in figure 3.4. Consequently, the critical amount of contributions to preserve the status quo ($\hat{C}$) shrinks. This increases the probability for persistent zero capital standards of sovereign bonds.

To sum up, if consumers do not fully understand the spillover effect of sovereign bond regulation on production and on the deposit insurance system, less lobby contributions are necessary to block a welfare-improving reform.

3.4.3 Openness of the private sector

So far we have modeled a closed economy where incumbent producers are hostile to a reform. Specifically, there is (1) no competition for incumbent producers from abroad and (2) no possibility to get funding abroad. What will happen in our model if we relax both assumptions?

If we allow for foreign competition in the private sector, our model would predict that incumbents' opposition against reforms of the status quo will be weaker. The reason is that the price of the entrepreneurial good becomes more and more unaffected by domestic regulation since the home market has a relatively low impact on total output. Intuitively, the price effect as the regulatory rent for producers in the status quo will shrink and thus the willingness to lobby for its maintenance. In the extreme case of perfect competition in the market for the entrepreneurial good, the market price is exogenous and hence there is no reason for producers to protect the status quo anymore. In reality, there is a continuum of industries with varying degree of competition in international markets so that the identified spillover shapes the market outcome of the respective industries differently.

If, on the other hand, we allow cross-border capital flows and entrepreneurial funding from foreign banks (that are unaffected by domestic regulation), the results are less obvious. According to the literature (Beck et al. 2014), the supply of external credit critically depends on the opaqueness of domestic borrowers, or in terms of our model the technology of the foreign bank to reduce the problem of entrepreneurial moral hazard captured by the private benefit B. Small and young firms are mostly not publicly listed and hard information about their financial situation and business strategy is not easily available to foreign lenders. Accordingly, the fraction of foreign funded entrepreneurs crucially depends on the screening and monitoring technique of foreign banks. The less costly this technology, the more informed foreign lenders and the less

collateral, i.e. wealth, domestic borrowers have to pledge to compensate risk. Thereby, evidence suggests that foreign banks tend to lend more to large firms, neglecting small and medium ones (Berger et al., 2001; Berger et al., 2005; see Sengupta 2007 for the theoretical underpinning). Consequently, empirical findings point to the direction that the impact of cross-border capital flows on the identified channel for rent creation in the private sector is determined by the problem of asymmetric information for foreign banks. They can give birth to more competition in the private sector through credit substitution, thereby reducing the price effect, the more informed they are.

3.4.4 Market structure of the banking sector

Until now, we have considered a monopolist bank that can buy sovereign bonds for the risk adequate rate of $\frac{r}{\theta_G}$. Consequently, the rent of inadequate sovereign bond regulation accrued entirely to the owners of this bank. We now want to depart from this assumption and allow for an oligopolistic banking sector.

Obviously, in this case competition for sovereign bonds drives down the sovereign interest rates. It is straight forward that the anticipation to derive positive expected profits from sovereign bond holding will reduce the rent that can be extracted by the banking sector. Hence, this allows the government to issue sovereign debt at an artificially low interest rate that no longer reflects risk-adequacy ($r_G < \frac{r}{\theta_G}$).[11]

However, due to the installment of the deposit insurance scheme, bank still have a comparative advantage vis-a-vis citizens in the holding of sovereign bonds. Thus, sovereign bonds will remain on the banks' balance sheet. As a consequence, our qualitative results in section 3.2 are unaffected by the market structure of the banking sector. As long as bank owners anticipate that they will lose any loan return in case of sovereign-induced insolvency, the spillover effect of inadequate sovereign bond regulation on private lending remains. Total output in the economy declines and again rents are generated for a subgroup of privileged producers and bank owners. The political viability condition of welfare improving reforms does not change qualitatively.

To describe the favorable lending conditions for the government that arise in this

[11] An oligopolistic setting may introduce additional factors for banks to invest in sovereign bonds. As shown by Acharya and Yorulmazer (2007), Farhi and Tirole (2012) and Gennaioli et al. (2014) herding behaviour with respect to sovereign bonds can occur. These authors argue that the government's inability to commit not to bailout banks during a systemic crisis generates an incentive for banks to excessively and collectively invest in assets that decline during systemic crises such as sovereign bonds.

scenario, the term 'financial repression' has evolved in the finance literature and brings us to the next interesting implication of our model.[12]

3.4.5 Financial repression

In our model, the scenario of 'financial repression' can be the outcome of the political process even without the explicit intention of the politician to alter the conditions of public debt management. It is not motivated by the self-interest of politicians, but by the lobby power of a coalition of beneficiaries of the regulatory status quo. The persistence of inefficient sovereign bond regulation is caused by its rent creating effect within the private sector and the willingness of the privileged group of producers and bank owners to protect their rents. This argument is new in the literature.

Note in this context that the favorable conditions for the government to issue sovereign debt can only exist on a superficial basis in our setting. Obviously, it is irrelevant whether the expected cost of public debt will be reflected explicitly in the sovereign bond interest rate or, more subtle, in an increase of contingent liabilities within the deposit insurance system. Therefore, given a setup of full information of all agents, the politician will not benefit from artificially low sovereign bond interest rates as long as the electorate anticipates that repayment obligations are only reallocated.

However, incentives will change if we observe perceptional limitations regarding the liabilities within the deposit insurance system (fiscal illusion) in the electorate. This can be a source for opportunistic behavior by politicians to exploit these perceptional limitations in order to get reelected which can exacerbate the inefficiencies deriving from inadequate sovereign bond regulation. In the presence of large amounts of public debt, traditional fiscal policy instruments such as increased taxation and spending cuts seem to encounter their inherent economic, political and constitutional limit. Consequently, policy-makers can be enticed to use sovereign regulation as a politically preferred alternative to induce banks to lend to the state and crowd out private lending as a side-effect. Perceptional limitations by the electorate allows a 'grabbing hand'

[12]The term goes back to Shaw (1973) and McKinnon (1973) who argue that governments in emerging markets employ measures to channel funds to themselves. While in the last centuries financial repression was achieved with direct restrictions on the transfer of assets abroad through the imposition of capital controls, one can nowadays observe more sophisticated techniques of financial repression like the creation of a captive domestic market for government debt with reserve requirements or with direct or indirect controls over interest rates (*e.g.* Regulation Q). In the light of the ongoing financial crisis, most recently Reinhart and Sbrancia (2015) provide evidence how governments use regulatory tools to issue debt at lower interest rates.

behavior of the state (Shleifer and Vishny 1998) via lax sovereign bond regulation. This incentive is reinforced if the politician has a self-interest in the spirit of Niskanen's theory of bureaucracy (Niskanen 1971). He might derive utility from the pure size of the public budget and thus benefit from artificially low sovereign bond interest rates through less public resistance. Accordingly, our model can be easily extended by some supply forces for the lax regulation of sovereign bonds due to financial repression.

3.4.6 Empirical discussion

Our model establishes a negative relationship between distortive lax sovereign bond regulation and the sectoral output in the economy (Proposition 3.1). The central argument of inefficient allocation of scarce credits is in line with empirical findings in the periphery countries that are evidently affected by financial frictions during the crisis. For example, Brutti and Saure (2013) document that post-crisis balance sheets of banks in periphery countries of the eurozone consist of oversized amounts of government debt. It turns out that banks that were more affected by the crisis have changed their portfolio structure and reduced their supply of credit for entrepreneurs (Popov and Van Horen 2013; De Marco 2014). The bank lending channel, i.e. the spillover effect identified in Proposition 3.1, originates from subsidized sovereign bond regulation (Acharya and Steffen 2015) and constitutes financial frictions for the real economy.

This credit crunch has generated huge differences in the rents across producers. New credit to small and medium-sized enterprises (SMEs) in the eurozone declined by 35 percent between 2008 and 2013, but lending rate spreads between loans for small and large firms have significantly increased (OECD 2014; Kaya 2014).[13] Recent studies demonstrate that this contraction in the lending volume that occurred during the sovereign debt crisis, has real effects for the borrowing firms, e.g. in the form of lower levels of investment, lower sales growth and lower employment growth (Acharya et al. 2014). Ferrando and Mulier (2015), using SAFE-data, provide complementary evidence that less productive, more leveraged and younger SMEs in the eurozone have been more likey to experience financing obstacles. There is a consensus that less wealthy entrepreneurs were the hardest hit by the adverse bank credit conditions. This finding is consistent with our mechanism of rent creation elaborated in Proposition 3.2

[13]Kaya (2014) furthermore argues that liquidity measures to support the liability side of bank's balance sheets only had limited impact on SMEs borrowing costs.

which sets the ground for the political support motive of incumbent wealthy producers. This can also explain why several European industry organizations, such as the BDI, have waged a campaign during the consultation process on the European Commission's proposal for a regulation on banks, arguing that lower risk weightings for government bonds leads to a competitive disadvantage for firms with the consequence that corporate finance becomes more expensive.

The model implies that there is a hysteresis in sovereign regulation in the sense that, in order to get political support those countries that already privilege a bank's investment in sovereign bonds tend to continue such a policy. The European Union (EU) proves to be an illustrative example. Despite the Basel Accords force towards banks to assign positive risk weights for sovereign bonds, which depend on the formal rating or the classification of a rating agency, the EU stretched the Basel rules substantially in 2006, allowing banks to use their own risk models with a zero weight for sovereign bonds.[14] In the course of the crisis the European countries have adopted many more techniques to direct lenders toward their government securities (see Reinhart and Sbrancia 2015; van Riet 2013). For example, besides the discussed unlimited exposure for sovereign bonds, several euro area countries plan to introduce a common financial transaction tax under the so-called "enhanced cooperation procedure" following a proposal by the European Commission. However, transactions of government securities are excluded from the scope of the tax which creates a cost advantage for secondary market purchases of sovereign debt compared with alternative financial instruments. Moreover, credit rating agencies have been criticized for downgrading governments. Further legislation will make credit rating agencies subject to civil liability for damages caused intentionally or due to gross negligence set a fixed calendar for issuing sovereign ratings and rating outlook.

The basic model is static. However, empirical evidence suggests that the intersectorial misallocation of funds created by banking regulation has long-run effects for an economy. Given the key role of finance for growth, the regulatory privilege for state financing then may create underdevelopment traps (King and Levine 1993; Roubini and Sala-i Martin 1992). The main channels of the negative influence on economic growth are a fall in capital productivity, the decrease in the investment level and lower entry rates in the private sector. Consistent with our basic framework, most recently,

[14] In fact, the Capital Requirement Directive of the European Union softened this rule by saying "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 zero" (Directive 2006/48/EC), Annex VI, Part 1(4)).

Midrigan and Xu (2014) show in a macro framework the substantial drop in the level of TFP, output and consumption resulting from financial frictions. They point out that the most sizeable productivity losses arise from inefficient low levels of entry and technology adoption decisions.

Economic history suggests that this phenomenon is not limited to developing countries. The constrained banking era in the 1960's and 1970's of the UK shows that there is a negative effect on the economic development and the growth opportunities of a country. Because of the tightly regulated clearing banks, the average ratio of private credits by depositing banks during the decade 1960-69 was only 19 percent of GDP (Calomiris and Haber 2014). This was one third of the level of countries like the US, Germany or Italy. The result was the emergence of shadow banks since savers spurned the regulated clearing banks and created a parallel financial system that was outside the regulatory structure of the government (see Calomiris and Haber 2014 and Collins 2012).

3.5 Conclusion

This chapter has highlighted the role private interests play when a politician creates rules governing the banking sector. We set up a simple model to rationalize the fact why a society might be locked in regulatory frameworks that subsidizes a bank's investment in sovereign debt. Due to portfolio adjustments, spillover effects arise that create obstacles to entry in the product market constituting a regulatory rent that can be extracted to influence the policy outcome. Thereby we model how the political choice emerges as a trade-off between the rents from distorting financial investments and the associated welfare loss from suppressed production. Making private credits dearer is an effective way to change the distribution of income through the back door and create electoral support for the status quo in sovereign bond regulation.

Our results indicate that the support for the persistence of inadequate sovereign bond capital standards is likely to be strongest in those countries that have been most affected by the financial crisis. First, as shown by Acharya and Steffen (2015), bank owners have benefited from the increase in the risk premium of sovereign bonds. This is due to the fact that the increase in the risk premium fully accrues to the bank owners while the downside risk is limited through the deposit insurance scheme and shifted to the (international) taxpayers. Second, additional negative effects might result from the sharp contraction in bank lending that are documented in Becker and Ivashina

(2014) and Popov and van Horen (2014). By reducing the number of bank funded entrepreneurs, the fraction of active producers that would benefit from improved loan conditions in these countries has been shrinking. Those who 'survived' this episode of the crisis are likely to defend the regulatory status quo in the political process. They promote inactivity by design.

In the light of the ongoing debate about changing the regulatory environment for banks, we argue that an efficient policy of portfolio regulation may benefit from an insulation of political rent-seeking and from clear rules of accountability for the responsible regulator. To address the problems of redistributional conflicts, the regulation of a bank's investment policy should be delegated to a transparent independent authority or constrained by supranational law. If there is a limit on the bank's concentration of sovereign debt (like it is the case for any other asset in a bank's balance sheet), the spillover effect that constitutes rent-creation and the electoral support of agents for the status quo is alleviated. Thus, with respect to the international harmonization of banking regulation, we strongly recommend a harmonization of maximum government debt holdings by banks.

Second, a capital market union in the eurozone might offer credit substitution for bank-dependent small and medium sized enterprises (SMEs). This can improve credit availability of entrepreneurs such that the identified bank-lending channel of imprudent bank regulation is weakened. As a consequence, the impact of politics on the (mis)allocation of credits is likely to be constrained.

Conclusion

This thesis has considered regulatory interventions into the banking sector. In the first two chapters, a particular focus has been put on international aspects of banking regulation. Thereby, I have studied the outcome of non-cooperative national regulation policies when national banks compete on international markets to serve national consumers (first chapter) and when national entrepreneurs depend on mobile bank capital (second chapter). In the third chapter I have analyzed the regulation of sovereign bonds in a political economy framework. In all chapters, I have derived results that are somewhat unexpected at first glance.

The first chapter showed that regulation authorities have an incentive to impose capital standards on their national banking sector that are above the global cooperative level. Initially, one might be surprised why national regulation authorities would want to impose additional costs on their national banking system and why this would be opposed by other jurisdictions. However, once one takes into account that capital standards can alter the structure of a heterogeneous national banking sector, an important point is added. Then, driving out the worst banks through higher capital standards can become an attractive policy, while at the same time taxpayers and consumers abroad might suffer from the repercussions of this policy on the quality of the foreign banking sector.

Likewise, centralized resolution regimes might sound like a promising idea when this can limit externalities that are imposed by unilateral national activities. However, in a strict sense, this can only be unanimously approved when remaining instruments within the regulatory framework are already globally fixed. Otherwise, as shown in the second chapter, different regulatory measures might interact in a way that each externality mutually mitigates each other as long as all instruments remain nationally fixed.

Finally, this thesis questioned the common narrative that the present zero capital

requirement for sovereign bonds only serve self interested politicians. Rather, as analyzed in the third chapter, the distortive effects on the portfolio choice of banks can lead to redistributive effects within the private sector. Thus, inadequate regulatory standards can create beneficiaries that might help to stabilize an inefficient status quo.

All chapters thus show that taking a theoretical microeconomic perspective on topics within the range of banking regulation can add to both, the economic literature and the discussion in policy debates. Using this framework, one can identify new effects and channels that, based on the assumptions, can be vividly discussed and, based on the results, can be rigorously checked. Given the state of the finance literature previous to the financial crisis, more might be needed.

Appendices

A Appendix to Chapter 1

A.1 Equations 1.17 – 1.20

To analyze the effects of an increase in k_i on aggregate output and the cutoff qualities $\hat{q}_i$ in the two countries, we totally differentiate the equation system (1.10)-(1.12) to get

$$[A - y - 1 + k_i - 2\tilde{c}]\, d\hat{q}_i = \hat{q}_i dy + (\rho - \hat{q}_i) dk_i, \tag{A.1}$$

$$[A - y - 1 + k_j - 2\tilde{c}]\, d\hat{q}_j = \hat{q}_j dy, \tag{A.2}$$

$$dy = \frac{3(1-\hat{q}^3)c}{[3b + 2(1-\hat{q}^3)](2+\hat{q})^2}\,(d\hat{q}_i + d\hat{q}_j) - \frac{[3\rho(1-\hat{q}^2) - 2(1-\hat{q}^3)]}{6b + 4(1-\hat{q}^3)}\,(dk_i + dk_j), \tag{A.3}$$

where we have used the short-hand notation (1.3) and (1.23) from the main text, eq. (1.5) has been used to simplify terms, and (A.3) has used symmetry after the differentiation. This equation system can be simplified by substituting (A.3) into each of (A.1) and (A.2). This yields the two-equation system

$$\begin{aligned}\left\{(\hat{q}\tilde{c} + \phi)[6b + 4(1-\hat{q}^3)] - 2\hat{q}(1-\hat{q}^3)\tilde{c}\right\} dq_i &= 2\hat{q}\tilde{c}(1-\hat{q}^3) dq_j \\ + \left\{(\rho - \hat{q})[6b + 4(1-\hat{q}^3)] - [3\rho\hat{q}(1-\hat{q}^2) - 2\hat{q}(1-\hat{q}^3)]\right\} dk_i&\end{aligned} \tag{A.4}$$

$$\begin{aligned}&\left\{(\hat{q}\tilde{c} + \phi)[6b + 4(1-\hat{q}^3)] - 2\hat{q}(1-\hat{q}^3)\tilde{c}\right\} dq_j \\ &= 2\hat{q}\tilde{c}(1-\hat{q}^3) dq_i - \hat{q}[3\rho\hat{q}(1-\hat{q}^2) - 2\hat{q}(1-\hat{q}^3)] dk_i\end{aligned} \tag{A.5}$$

Solving the system (A.4) and (A.5) gives equations (1.17) and (1.18) in the main text. Substituting these results back into (A.3) yields

$$\frac{\partial y}{\partial k_i} = \frac{(1-\hat{q})\kappa}{2\phi\Omega}, \tag{A.6}$$

where κ and Ω are given in (1.22) and (1.21). Finally, differentiating (1.7) gives

$$dy_i = \frac{1}{6b}\left\{-2(1-\hat{q}_i^3) dy + 2(1-\hat{q}_i^3)\tilde{c} d\hat{q}_i - [3\rho(1-\hat{q}_i^2) - 2(1-\hat{q}_i^3)] dk_i\right\} \tag{A.7}$$

Substituting (1.17) and (1.18) along with (A.6) into (A.7) gives (1.19) and (1.20) in the main text.

A.2 Conditions 1.27 – 1.28

From (1.24) and (1.26) and using (1.19), a positive effect of capital standards on bank profits and consumer surplus, evaluated at $k = 0$ initially, requires that $\kappa > 0$ in (1.22). Evaluating κ at $k = 0$ and noting that $\hat{q} = 0$ for $k = 0$ from (1.5), this condition is

$$\kappa|_{k=0} = \frac{3\rho c}{2} - (R_i - 1)(3\rho - 2) > 0 \tag{A.8}$$

The endogenous variable $(R - 1)$ can be substituted using (1.9) together with (1.6) and (1.7). This yields

$$R_i - 1|_{k=0} = \frac{3b}{2(3b + 2)} \ (2A - 3c - 2)\,. \tag{A.9}$$

Substituting (A.9) in (A.8), a sufficient condition for $\kappa|_{k=0} > 0$ is

$$\frac{3}{2}\rho c - (3\rho - 2)\left[A - \frac{3c}{2} - 1\right] > 0.$$

Collecting the terms for c gives condition (1.27) in the main text.

A positive effect on taxpayers will result when the positive first two effects in (1.25) dominate the third effect, which is negative for $\kappa > 0$. Substituting in from (1.17) and (1.19), evaluating at $k = \hat{q} = 0$ and using $y|_{k=0} = (R-1)/3b$ from (1.6) and (1.7) gives, as a sufficient condition

$$\left.\frac{\partial T_i}{\partial k_i}\right|_{k=0} > 0 \quad \Leftrightarrow \quad 3\rho(R - 1) - \kappa > 0. \tag{A.10}$$

Using (A.8) and (A.9) yields

$$\left.\frac{\partial T_i}{\partial k_i}\right|_{k=0} > 0 \quad \Leftrightarrow \quad \frac{12b(2A - 3c - 2)(3\rho - 1)}{(3b + 2)} > \frac{3\rho c}{2}\,. \tag{A.11}$$

Collecting the terms involving c and noting that $(3\rho-1) \geq 2\rho$ gives (1.28) as a sufficient condition.

A.3 Equations 1.30 – 1.33

To derive (1.30), we first use (1.6) and (1.7) to rewrite:

$$\frac{dy_i}{dk_i} = \frac{1}{6b}\left[-3(1+\hat{q})\phi\frac{d\hat{q}_i}{dk_i} + (1-\hat{q})^2(2+\hat{q})\frac{d\phi_i}{dk_i}\right] . \tag{A.12}$$

In a second step, we totally differentiate (1.5) to get:

$$\frac{d\hat{q}_i}{dk_i} = \frac{1}{\phi}\left(\rho - \hat{q}\frac{d\phi_i}{dk_i}\right) , \tag{A.13}$$

Then, we substitute (A.13) in (A.12) to get:

$$\frac{dy_i}{dk_i} = \frac{1}{6b}\left[-3(1+\hat{q})\rho + 2(1+\hat{q}+\hat{q}^2)\frac{d\phi_i}{dk_i}\right] . \tag{A.14}$$

Similarly, we arrive at $\frac{dy_j}{dk_i}$, whereby the only difference is that $\frac{d\hat{q}_j}{dk_i} = -\frac{\hat{q}}{\rho}\frac{d\phi_j}{dk_i}$ so that:

$$\frac{dy_j}{dk_i} = \frac{2(1+\hat{q}+\hat{q}^2)}{6b}\frac{d\phi_j}{dk_i} . \tag{A.15}$$

Finally, we substitute (A.14) and (A.15) in (1.24)–(1.26), rearrange terms using (1.6) and (1.7) and sum over all terms in (1.24)–(1.26) to arrive at (1.30).

Equation (1.31) follows directly from substituting (1.19) in (A.14) and rearranging terms.

Equation (1.32) follows directly from substituting (1.20) in (A.15) and rearranging terms.

To arrive at (1.33) we first derive the condition for $d\pi_i/dk_i = 0$ which is equal to:

$$\frac{d\phi_i}{dk_i} = \frac{3\rho}{2+\hat{q}} \tag{A.16}$$

Substituting (A.16) in $dT_i/dk_i + dS_i/dk_i$ then yields:

$$\begin{aligned}\left.\frac{dT_i}{dk_i}\right|_{\frac{d\pi_i}{dk_i}=0} + \left.\frac{dS_i}{dk_i}\right|_{\frac{d\pi_i}{dk_i}=0} &= \beta\frac{(1-\hat{q})^3\phi}{6b} + \gamma\frac{(1-\hat{q})^3(2+\hat{q})\phi}{2(6b)^2}\frac{d\phi_j}{dk_i} \\ &+ \frac{(1-\hat{q})^3 3\rho}{6b(2+\hat{q})}\left[\beta(1-k) - \gamma\frac{(1-\hat{q})(2+\hat{q})\phi\hat{q}}{12b}\right] \end{aligned} \tag{A.17}$$

where the first and third term are always positive and the second term is positive for $\kappa < 0$. Therefore, for the overall term to be positive it is sufficient that the negative

last term is overcompensated by the positive first term, which is the case whenever condition (1.33) holds.

A.4 Equation 1.35

Using (1.14)–(1.16) we can write welfare in country j as

$$W_j = \frac{6\alpha b y_j^2}{(1-\hat{q}_j)(2+\hat{q}_j)^2} - \frac{\beta(1-k_j)(1-\hat{q}_j)y_j}{(2+\hat{q}_j)} + \frac{\gamma(y_i+y_j)^2}{4} \quad i \neq j.$$

Differentiating with respect to k_i gives in a first step

$$\begin{aligned}\frac{\partial W_j}{\partial k_i} &= \frac{12\alpha b y_j}{(1-\hat{q})(2+\hat{q})^2}\frac{\partial y_i}{\partial k_i} + \frac{18\alpha b y_j^2 \hat{q}}{(1-\hat{q})^2(2+\hat{q})^3}\frac{\partial \hat{q}_j}{\partial k_i} \\ &- \frac{\beta(1-k_j)(1-\hat{q})}{(2+\hat{q})}\frac{\partial y_j}{\partial k_i} + \frac{3\beta(1-k_j)y_j}{(2+\hat{q})^2}\frac{\partial \hat{q}_j}{\partial k_i} + \frac{\gamma(y_i+y_j)}{2}\frac{\partial y}{\partial k_i}\,. \quad \text{(A.18)}\end{aligned}$$

Substituting in from (1.18)–(1.20) and collecting terms gives eq. (1.35) in the main text.

A.5 Equations 1.41 – 1.43

To start, first note that the total output is now equal to the following expression

$$\begin{aligned}y = \frac{1}{b}\Bigg(&\frac{1-\tilde{q}_i^3}{3}\phi_i^h - \frac{1-\tilde{q}_i^2}{2}k_i^h\rho + \frac{1-\tilde{q}_j^3}{3}\phi_j^h - \frac{1-\tilde{q}_i^2}{2}k_j^h\rho \\ &+\frac{\tilde{q}_i^3-\hat{q}_i^3}{3}\phi_i^h - \frac{\tilde{q}_i^2-\hat{q}_i^2}{2}k_i^h\rho + \frac{\tilde{q}_j^3-\hat{q}_j^3}{3}\phi_j^h - \frac{\tilde{q}_j^2-\hat{q}_j^2}{2}k_j^h\rho\Bigg)\,, \quad \text{(A.19)}\end{aligned}$$

where the first row in eq. (A.19) measures the output of banks in the high quality pool of both countries, whereas the second row in (A.19) captures the output of banks in the low quality pool.

We start by totally differentiating eq. (1.39) for each quality pool in both countries,

which yields

$$d\phi_i^l = \frac{c}{(q^{e_l})^2} dq_i^{e_l} - dy + dk_i \tag{A.20}$$

$$d\phi_i^h = \frac{c}{(q^{e_h})^2} dq_i^{e_h} - dy \tag{A.21}$$

$$d\phi_j^l = \frac{c}{(q^{e_l})^2} dq_j^{e_l} - dy \tag{A.22}$$

$$d\phi_j^h = \frac{c}{(q^{e_h})^2} dq_j^{e_h} - dy \; . \tag{A.23}$$

We then substitute (A.20) - (A.23) into the total differential of eq. (A.19). Rearranging terms and using the symmetry between both countries gives us

$$\begin{aligned} dy = &\frac{\tilde{q}^3 - \hat{q}^3}{3b} \left[\frac{c}{(q^{e_l})^2} \left(dq_i^{e_l} + dq_j^{e_l} \right) - 2dy + dk_i \right] - \frac{\tilde{q}^2 - \hat{q}^2}{2b} dk_i \\ &+ \frac{1 - \tilde{q}^3}{3b} \left[\frac{c}{(q^{e_h})^2} \left(dq_i^{e_h} + dq_j^{e_h} \right) - 2dy \right] \; . \end{aligned} \tag{A.24}$$

We now want to substitute dq^{e_l} and dq^{e_h} in eq. (A.24). As $l_{\hat{q}} = 0$, it follows directly from (1.40) that $q^{e_l} = \frac{2\tilde{q}+\hat{q}}{3}$ and thus

$$dq_i^{e_l} = \frac{2}{3} d\tilde{q}_i + \frac{1}{3} d\hat{q}_i \tag{A.25}$$

$$dq_j^{e_l} = \frac{2}{3} d\tilde{q}_j + \frac{1}{3} d\hat{q}_j \; . \tag{A.26}$$

To get dq^{e_h}, we take the total derivative of (1.40) and substitute $dl_{\tilde{q}} = \frac{1}{b}(\tilde{q} d\phi^h + \phi^h d\tilde{q})$ and $dl_1 = \frac{1}{b} d\phi^h$ to get

$$dq_i^{e_h} = \left[\frac{2l_{\tilde{q}}(2l_1 + l_{\tilde{q}})}{3(l_1 + l_{\tilde{q}})^2} \right] d\tilde{q}_i - \left[\frac{(1-\tilde{q})^2 k^h \rho}{3(l_1 + l_{\tilde{q}})^2 b} \right] d\phi_i^h \tag{A.27}$$

$$dq_j^{e_h} = \left[\frac{2l_{\tilde{q}}(2l_1 + l_{\tilde{q}})}{3(l_1 + l_{\tilde{q}})^2} \right] d\tilde{q}_j - \left[\frac{(1-\tilde{q})^2 k^h \rho}{3(l_1 + l_{\tilde{q}})^2 b} \right] d\phi_j^h \; . \tag{A.28}$$

We then substitute (A.21) in (A.27) and (A.23) in (A.28) and rearrange terms to get

$$dq_i^{e_h} = \underbrace{\left[\frac{2l_{\tilde{q}}(2l_1+l_{\tilde{q}})b}{3(l_1+l_{\tilde{q}})^2b+\frac{c}{(q^{e_h})^2}(1-\tilde{q})^2k^h\rho}\right]}_{\equiv\Gamma} d\tilde{q}_i + \underbrace{\left[\frac{(1-\tilde{q})^2k^h\rho}{3(l_1+l_{\tilde{q}})^2b+\frac{c}{(q^{e_h})^2}(1-\tilde{q})^2k^h\rho}\right]}_{\equiv\chi_1} dy \tag{A.29}$$

$$dq_j^{e_h} = \underbrace{\left[\frac{2l_{\tilde{q}}(2l_1+l_{\tilde{q}})b}{3(l_1+l_{\tilde{q}})^2b+\frac{c}{(q^{e_h})^2}(1-\tilde{q})^2k^h\rho}\right]}_{\equiv\Gamma} d\tilde{q}_j + \underbrace{\left[\frac{(1-\tilde{q})^2k^h\rho}{3(l_1+l_{\tilde{q}})^2b+\frac{c}{(q^{e_h})^2}(1-\tilde{q})^2k^h\rho}\right]}_{\equiv\chi_1} dy\ . \tag{A.30}$$

Now, substituting (A.25), (A.26), (A.29) and (A.30) into (A.24) and rearranging terms gives us

$$\begin{aligned} dy\left\{1+2\left(\frac{\tilde{q}^3-\hat{q}^3}{3b}\right)+2\left(\frac{1-\tilde{q}^3}{3b}\right)\underbrace{\left[\frac{3(l_1+l_{\tilde{q}})^2b}{3(l_1+l_{\tilde{q}})^2b+\frac{c}{(q^{e_h})^2}(1-\tilde{q})^2k^h\rho}\right]}_{\equiv\chi_2}\right\} = \\ -\left(\frac{\tilde{q}^2-\hat{q}^2}{2b}-\frac{\tilde{q}^3-\hat{q}^3}{3b}\right)dk_i + \underbrace{\left[\frac{\tilde{q}^3-\hat{q}^3}{3b}\frac{2}{3}\frac{c}{(q^{e_l})^2}+\frac{1-\tilde{q}^3}{3b}\Gamma\frac{c}{(q^{e_h})^2}\right]}_{\equiv\chi_3}(d\tilde{q}_i+d\tilde{q}_j) \\ +\left[\frac{\tilde{q}^3-\hat{q}^3}{3b}\frac{1}{3}\frac{c}{(q^{e_l})^2}\right](d\hat{q}_i+d\hat{q}_j) \end{aligned} \tag{A.31}$$

Now, to get $d\tilde{q}_i$, we first substitute (A.25) in (A.20) and (A.29) in (A.21). We then substitute these terms in the total derivative of (1.38) and slightly rearrange terms. To arrive at $d\tilde{q}_j$ we follow the same steps. We then have

$$d\tilde{q}_i\left\{\underbrace{(\phi^h-\phi^l)-\tilde{q}\left[\frac{2}{3}\frac{c}{(q^{e_l})^2}-\Gamma\frac{c}{(q^{e_h})^2}\right]}_{\equiv\Lambda}\right\} = \tilde{q}\left[\frac{1}{3}\frac{c}{(q^{e_l})^2}d\hat{q}_i-\chi_1\frac{c}{(q^{e_h})^2}dy\right]-(\rho-\tilde{q})\,dk_i \tag{A.32}$$

$$d\tilde{q}_j\left\{\underbrace{(\phi^h-\phi^l)-\tilde{q}\left[\frac{2}{3}\frac{c}{(q^{e_l})^2}-\Gamma\frac{c}{(q^{e_h})^2}\right]}_{\equiv\Lambda}\right\} = \tilde{q}\left[\frac{1}{3}\frac{c}{(q^{e_l})^2}d\hat{q}_j-\chi_1\frac{c}{(q^{e_h})^2}dy\right]\ , \tag{A.33}$$

where $\Lambda > 0$ has to hold, as otherwise we would arrive at $\tilde{q} = 1$. Then, substituting eqs. (A.32) and (A.33) in (A.31) and rearranging terms gives us

$$dy\left[1+2\left(\frac{\tilde{q}^3-\hat{q}^3}{3b}\right)+2\left(\frac{1-\tilde{q}^3}{3b}\right)\chi_2+2\chi_3\frac{\tilde{q}\chi_1\frac{c}{(q^{e_h})^2}}{\Lambda}\right]=$$
$$\left[\frac{\tilde{q}^3-\hat{q}^3}{3b}\frac{1}{3}\frac{c}{(q^{e_l})^2}+\chi_3\frac{\tilde{q}\frac{1}{3}\frac{c}{(q^{e_l})^2}}{\Lambda}\right](d\hat{q}_i+d\hat{q}_j)-\left[\frac{\tilde{q}^2-\hat{q}^2}{2b}-\frac{\tilde{q}^3-\hat{q}^3}{3b}+\chi_3\frac{\rho-\tilde{q}}{\Lambda}\right]dk_i \tag{A.34}$$

Now, to get $d\hat{q}_i$, we first substitute (A.25) in (A.20) and then substitute this term in the total derivative of (1.5). Slightly rearranging terms and following the same steps for $d\hat{q}_j$, we get

$$d\hat{q}_i\left[\phi^l+\hat{q}\frac{1}{3}\frac{c}{(q^{e_l})^2}\right]=(\rho-\hat{q})\,dk_i-\left[\hat{q}\frac{2}{3}\frac{c}{(q^{e_l})^2}\right]d\tilde{q}_i+\hat{q}dy \tag{A.35}$$

$$d\hat{q}_j\left[\phi^l+\hat{q}\frac{1}{3}\frac{c}{(q^{e_l})^2}\right]=-\left[\hat{q}\frac{2}{3}\frac{c}{(q^{e_l})^2}\right]d\tilde{q}_j+\hat{q}dy \tag{A.36}$$

We can now substitute (A.32) in (A.35) and rearrange terms. Analogously, for $d\hat{q}_j$, we substitute (A.33) in (A.36) and rearrange terms. This yields

$$d\hat{q}_i\left[\phi^l+\hat{q}\frac{1}{3}\frac{c}{(q^{e_l})^2}+\hat{q}\frac{2}{3}\frac{c}{(q^{e_l})^2}\frac{\tilde{q}\frac{1}{3}\frac{c}{(q^{e_l})^2}}{\Lambda}\right]=\left[(\rho-\hat{q})+\hat{q}\frac{2}{3}\frac{c}{(q^{e_l})^2}\frac{\rho-\tilde{q}}{\Lambda}\right]dk_i$$
$$+\left[\hat{q}+\hat{q}\frac{2}{3}\frac{c}{(q^{e_l})^2}\frac{\tilde{q}\chi_1\frac{c}{(q^{e_h})^2}}{\Lambda}\right]dy \tag{A.37}$$

$$d\hat{q}_j\left[\phi^l+\hat{q}\frac{1}{3}\frac{c}{(q^{e_l})^2}+\hat{q}\frac{2}{3}\frac{c}{(q^{e_l})^2}\frac{\tilde{q}\frac{1}{3}\frac{c}{(q^{e_l})^2}}{\Lambda}\right]=\left[\hat{q}+\hat{q}\frac{2}{3}\frac{c}{(q^{e_l})^2}\frac{\tilde{q}\chi_1\frac{c}{(q^{e_h})^2}}{\Lambda}\right]dy\,. \tag{A.38}$$

Next, we substitute (A.37) and (A.38) in (A.34) and rearrange terms to get

$$\begin{aligned}
&\frac{dy}{dk_i}\Bigg\{1+2\left(\frac{\tilde{q}^3-\hat{q}^3}{3b}\right)+2\left(\frac{1-\tilde{q}^3}{3b}\right)\chi_2+2\chi_3\frac{\tilde{q}\chi_1\frac{c}{(q^{e_h})^2}}{\Lambda}\\
&\quad-\left[\frac{\tilde{q}^3-\hat{q}^3}{3b}\frac{1}{3}\frac{c}{(q^{e_l})^2}+\tilde{q}\frac{1}{3}\frac{c}{(q^{e_l})^2}\frac{\chi_3}{\Lambda}\right]\left[\frac{\hat{q}+\hat{q}\frac{2}{3}\frac{c}{(q^{e_l})^2}\frac{\tilde{q}\chi_1\frac{c}{(q^{e_h})^2}}{\Lambda}}{\phi^l+\hat{q}\frac{1}{3}\frac{c}{(q^{e_l})^2}+\hat{q}\frac{2}{3}\frac{c}{(q^{e_l})^2}\frac{\tilde{q}\frac{1}{3}\frac{c}{(q^{e_l})^2}}{\Lambda}}\right]\Bigg\}=\\
&\quad-\left[\frac{\tilde{q}^3-\hat{q}^3}{3b}-\frac{\tilde{q}^2-\hat{q}^2}{2b}+(\rho-\tilde{q})\frac{\chi_3}{\Lambda}\right]\\
&\quad+\left[\frac{\tilde{q}^3-\hat{q}^3}{3b}\frac{1}{3}\frac{c}{(q^{e_l})^2}+\tilde{q}\frac{1}{3}\frac{c}{(q^{e_l})^2}\frac{\chi_3}{\Lambda}\right]\left[\frac{(\rho-\hat{q})+\hat{q}\frac{2}{3}\frac{c}{(q^{e_l})^2}\frac{\rho-\tilde{q}}{\Lambda}}{\phi^l+\hat{q}\frac{1}{3}\frac{c}{(q^{e_l})^2}+\hat{q}\frac{2}{3}\frac{c}{(q^{e_l})^2}\frac{\tilde{q}\frac{1}{3}\frac{c}{(q^{e_l})^2}}{\Lambda}}\right]. \quad \text{(A.39)}
\end{aligned}$$

Then, multiplying all terms in (A.39) with $6b\left[1+\hat{q}\frac{1}{3\phi^l}\frac{c}{(q^{e_l})^2}+\hat{q}\frac{2}{3\phi^l}\frac{c}{(q^{e_l})^2}\frac{\tilde{q}\frac{1}{3}\frac{c}{(q^{e_l})^2}}{\Lambda}\right]$ and rearranging the third and fourth row of (A.39), we arrive at (1.44). Rearranging the first and second row of (A.39) gives us

$$\begin{aligned}
\Omega^s =&6b+\frac{\hat{q}}{\phi^l}\frac{1}{3}\frac{c}{(q^{e_l})^2}\left[6b+\frac{4b\tilde{q}\frac{c}{(q^{e_l})^2}+2(1-\tilde{q}^3)(\phi^h-\phi^l)\chi_2}{\Lambda}\right]\\
&+\left\{2+\frac{\hat{q}}{\phi^l}\frac{1}{3}\frac{c}{(q^{e_l})^2}\left[1+\frac{\tilde{q}\frac{2}{3}\frac{c}{(q^{e_l})^2}}{\Lambda}\right]\right\}\left[2(\tilde{q}^3-\hat{q}^3)+2(1-\tilde{q}^3)\chi_2+\frac{6b\tilde{q}\frac{c}{(q^{e_h})^2}\chi_1\chi_3}{\Lambda}\right]>0 \quad \text{(A.40)}
\end{aligned}$$

Finally, substituting (A.39) in (A.37) and (A.38) gives us (1.41) and (1.42), where we

have introduced the short-hand notations

$$\begin{aligned}\Upsilon_i =& \frac{\tilde{q}-\hat{q}}{\phi^l}\left[2\tilde{q}(\tilde{q}+\hat{q})(\rho-1)+2\rho\tilde{q}^2-\tilde{q}\hat{q}-\hat{q}^2\right]\left[1+\frac{\frac{c}{(q^{e_l})^2}\frac{2}{3}\frac{c}{(q^{e_h})^2}\chi_1(\rho-\tilde{q})}{\Lambda}\right]\\ &+\frac{2(1-\tilde{q}^3)\frac{c}{(q^{e_h})^2}\Gamma\rho(\tilde{q}-\hat{q})}{\Lambda}+\frac{\rho-\hat{q}}{\phi^l}\left[6b+2\left(\tilde{q}^3-\hat{q}^3\right)+2\left(1-\tilde{q}^3\right)\chi_2\right]\\ &+\frac{\rho-\hat{q}}{\phi^l}\left[6b\frac{\tilde{q}}{\phi^h-\phi^l}\frac{c}{(q^{e_h})^2}\chi_1+\frac{\tilde{q}2\left[\frac{c}{(q^{e_h})^2}\right]^2\chi_1(\tilde{q}^2-\hat{q}^2)}{\Lambda}\right]\\ &+\frac{(\rho-\tilde{q})\frac{\hat{q}}{\rho}\frac{c}{(q^{e_l})^2}\frac{2}{3}}{\Lambda}\left[4(\tilde{q}^3-\hat{q}^3)+4\left(1-\tilde{q}^3\right)\chi_2+\frac{6b\tilde{q}\frac{c}{(q^{e_h})^2}\chi_1\chi_3}{\Lambda}\right]>0 \qquad \text{(A.41)}\\ \Upsilon_2 =& 6b\hat{q}\left[1+\frac{2}{3}\frac{c}{(q^{e_l})^2}\frac{\tilde{q}\chi_1\frac{c}{(q^{e_h})^2}}{\Lambda}\right]>0 \qquad \text{(A.42)}\end{aligned}$$

B Appendix to Chapter 2

B.1 Equation 2.15

Maximizing Eq. (2.12) with respect to α yields

$$\begin{aligned}\frac{\partial \pi}{\partial \alpha} =& \left\{ \frac{1-\tilde{\lambda}_A^2}{2} \left[A - a\frac{2\alpha}{k_A} - 1 - \frac{(1-\tilde{\lambda}_B)^2}{2} c_A^p \right] - \frac{(1-\tilde{\lambda}_A)^2}{2} k_A \right\} \frac{1}{k_A} \\ & - \left\{ \frac{1-\tilde{\lambda}_B^2}{2} \left[A - a\frac{2(1-\alpha)}{k_A} - 1 - \frac{(1-\tilde{\lambda}_A)^2}{2} c_B^p \right] - \frac{(1-\tilde{\lambda}_B)^2}{2} k_B \right\} \frac{1}{k_B} = 0 \,,\end{aligned} \tag{B.1}$$

We can then factor out α and get

$$\begin{aligned}\alpha a \left(\frac{1-\tilde{\lambda}_A^2}{k_A^2} + \frac{1-\tilde{\lambda}_B^2}{k_B^2} \right) =& \frac{1-\tilde{\lambda}_A^2}{2k_A} \left[A - 1 - \frac{(1-\tilde{\lambda}_B)^2}{2} c_A^p \right] - \frac{(1-\tilde{\lambda}_A)^2}{2} \\ & - \frac{1-\tilde{\lambda}_B^2}{2k_B} \left[A - \frac{2a}{k_B} - 1 - \frac{(1-\tilde{\lambda}_A)^2}{2} c_B^p \right] - \frac{(1-\tilde{\lambda}_B)^2}{2} \,.\end{aligned} \tag{B.2}$$

Then, multiplying all terms with $k_A^2 k_B^2$ and solving for α gives us

$$\begin{aligned}\alpha =& \frac{(1-\tilde{\lambda}_A^2) k_A k_B^2 \left[A - 1 - \frac{(1-\tilde{\lambda}_B)^2}{2} c_A^p \right] - (1-\tilde{\lambda}_A)^2 k_A^2 k_B^2}{2a[(1-\tilde{\lambda}_A)^2 k_B^2 + (1-\tilde{\lambda}_B)^2 k_A^2]} \\ & - \frac{(1-\tilde{\lambda}_B^2) k_B k_A^2 \left[A - \frac{2a}{k_B} - 1 - \frac{(1-\tilde{\lambda}_A)^2}{2} c_B^p \right] - (1-\tilde{\lambda}_B)^2 k_A^2 k_B^2}{2a[(1-\tilde{\lambda}_A)^2 k_B^2 + (1-\tilde{\lambda}_B)^2 k_A^2]} \,.\end{aligned} \tag{B.3}$$

Finally, slightly rearranging terms we arrive at Eq. (2.15).

B.2 Equations 2.18 – 2.19

Substituting Eqs. (2.1) and (2.4) into (2.12), we can derive the marginal return of investment for the subsidiary in country A:

$$MR_A = A - a\frac{2\alpha}{k_A} - 1 - \frac{(1-\tilde{\lambda})^2}{2} c_A^l \,. \tag{B.4}$$

Now, for k_A to be binding independent of the allocation of equity by the multinational bank it must be true that $MR_A > 0$ even for $\alpha = 1$. Then, looking at Eq. (2.18), it becomes clear that in this case the numerator of (2.18) will be negative and thus $\frac{\partial \alpha}{\partial k_A} < 0$. Looking at Eq. (2.19), we can see that a sufficient condition for $\frac{\partial \alpha}{\partial \tilde{\lambda}_A} < 0$ is that

$$\gamma_1 \equiv -\tilde{\lambda}\left[A - \frac{a}{k} - 1 - \frac{(1-\tilde{\lambda})^2}{2}c_L^p\right] + (1-\tilde{\lambda})k < 0\ . \tag{B.5}$$

Now, substituting γ_1 into the intervention threshold that is chosen by the supervisory regime in Eq. (2.10) and rearranging terms we get that

$$\gamma_1 = -\tilde{\lambda}\left[\frac{(1-\tilde{\lambda})^2}{2}(c^l - c^p) - a\frac{\alpha}{2k}\right] - (1-\tilde{\lambda})\left[1 - k + c^d\left(1 - \frac{1-\tilde{\lambda}^2}{2}p^r\right)\right]\ . \tag{B.6}$$

This shows that $\gamma_1 < 0$ and thus $\frac{\partial \alpha}{\partial k_A} < 0$ whenever it holds that

$$(1-\tilde{\lambda})\left[1 - k + c^d\left(1 - \frac{1-\tilde{\lambda}^2}{2}p^r + \frac{\tilde{\lambda}(1-\tilde{\lambda})}{2}p^c\right)\right] + \tilde{\lambda}\frac{(1-\tilde{\lambda})^2}{2}(c^l - c^p) > \tilde{\lambda}a\frac{\alpha}{2k}\ , \tag{B.7}$$

where the left hand side of (B.7) is the sum of the failure cost (first term) and the liquidation cost (second term) that is not internalized by the bank. The right hand side measures the consumer surplus that is due to the investment of the subsidiary.

B.3 Equations 2.25 – 2.29

The welfare effect for country A of a marginal increase in γ is given by:

$$\frac{\partial WF_A}{\partial \gamma} = \left(\frac{\partial WF_A}{\partial \tilde{\lambda}_A} + \frac{\partial WF_A}{\partial \tilde{\lambda}_B}\frac{\partial \tilde{\lambda}_B}{\partial \tilde{\lambda}_A} + \frac{\partial WF_A}{\partial k_A}\frac{\partial k_A}{\partial \tilde{\lambda}_A} + \frac{\partial WF_A}{\partial k_B}\frac{\partial k_B}{\partial \tilde{\lambda}_A}\right)\frac{\partial \tilde{\lambda}_A}{\partial \gamma} \tag{B.8}$$

$$+ \left(\frac{\partial WF_A}{\partial \tilde{\lambda}_B} + \frac{\partial WF_A}{\partial \tilde{\lambda}_A}\frac{\partial \tilde{\lambda}_A}{\partial \tilde{\lambda}_B} + \frac{\partial WF_A}{\partial k_A}\frac{\partial k_A}{\partial \tilde{\lambda}_A} + \frac{\partial WF_A}{\partial k_B}\frac{\partial k_B}{\partial \tilde{\lambda}_B}\right)\frac{\partial \tilde{\lambda}_B}{\partial \gamma}\ , \tag{B.9}$$

which simplifies to Eq. (2.25) when we use that $\frac{\partial WF_A}{\partial \tilde{\lambda}_A} = \frac{\partial WF_A}{\partial k_A} = 0$ for $\gamma = 0$ and that, due to the symmetry between both countries, it holds that $\delta\tilde{\lambda}_A/\delta\gamma = \delta\tilde{\lambda}_B/\delta\gamma = \delta\tilde{\lambda}/\delta\gamma$. To arrive at Eq. (2.26), we first substitute Eq. (2.10) in Eq. (2.11) to derive the condition

for $\tilde{\lambda}$ as a function of γ. This gives us

$$\begin{aligned}\frac{\partial WF_\gamma}{\partial \tilde{\lambda}_A} =& 1-\tilde{\lambda}_A\left[v_A-\frac{(1-\tilde{\lambda}_B)^2}{2}c_A^l\right]+(1-\tilde{\lambda}_A)c_A^d\left[1-\frac{1-\tilde{\lambda}_B^2}{2}p_A^r\right]\\ &+\gamma\left[(1-\tilde{\lambda}_A)\frac{1-\tilde{\lambda}_B^2}{2}c_B^l-\tilde{\lambda}_A\frac{(1-\tilde{\lambda}_B)^2}{2}p_B^r c_B^d\right]=0\,. \end{aligned} \tag{B.10}$$

Then, using the implicit function theorem on (B.10) we arrive at Eq. (2.26). Eqs. (2.27) and (2.28) follow directly from taking the first derivative of the expected welfare function in Eq. (2.9) with respect to $\tilde{\lambda}_B$ and k_B, respectively. To arrive at Eq. (2.29), we take Eq. (2.20) and use the implicit function theorem.

B.4 Condition 2.30

As we are only interested in a sufficient condition for $\frac{\partial WF_A}{\partial \gamma}<0$, we can use that

$$\underbrace{\frac{\partial\tilde{\lambda}}{\partial\gamma}}_{(+)}\underbrace{h(l^r)c^d\frac{1}{2k}\frac{(1-\tilde{\lambda})^2}{2}\frac{1-\tilde{\lambda}^2}{2}}_{(+)}\underbrace{\left(\frac{\partial k_B}{\partial\tilde{\lambda}_B}+\frac{\partial k_B}{\partial\tilde{\lambda}_A}\right)}_{(-)}<0\,, \tag{B.11}$$

$$\underbrace{\frac{\partial\tilde{\lambda}}{\partial\gamma}}_{(+)}\underbrace{\frac{\partial\alpha}{\partial k_B}\frac{1}{k}\psi}_{(+)}\underbrace{\frac{1}{2}\left(\frac{\partial\sigma_B}{\partial\tilde{\lambda}_A}+\frac{\partial\sigma_B}{\partial\tilde{\lambda}_B}\right)}_{(-)}<0\,, \tag{B.12}$$

$$\underbrace{\frac{\partial\tilde{\lambda}}{\partial\gamma}}_{(+)}\underbrace{\frac{\partial WF_A}{\partial\tilde{\lambda}_B}}_{(+)}\underbrace{\frac{\partial\tilde{\lambda}_B}{\partial\tilde{\lambda}_A}}_{(-)}<0\,, \tag{B.13}$$

and therefore leave these terms out of Eq. (2.25). Further, we can use the fact that $\frac{\partial WF_A}{\partial\tilde{\lambda}_B}=\frac{\partial\phi_B}{\partial\tilde{\lambda}_A}$ in a symmetric setting. Then, as $\frac{\partial\tilde{\lambda}}{\partial\gamma}\frac{\partial WF_A}{\partial\tilde{\lambda}_B}>0$ we can exclude this term from Eq. (2.25) and state the following condition:

$$\frac{\partial WF_A}{\partial\gamma}<0 \qquad\Leftrightarrow\qquad 1-\frac{\frac{1}{k}\frac{\partial\alpha}{\partial k_B}\psi\left(\frac{\partial\alpha}{\partial k_B}+\frac{1}{2k}\right)}{\frac{\partial\psi_B}{\partial k_B}\left(\frac{\partial\alpha}{\partial k_B}+\frac{1}{2k}\right)-\frac{1}{2}\frac{\partial\sigma_B}{\partial k_B}}<0\,, \tag{B.14}$$

where the second term in Eq. (B.14) measures the indirect welfare effect that is due to the decrease in capital standards. Rearranging Eq. (B.14) then yields the following

condition for $\frac{\partial WF_A}{\partial \gamma} < 0$:

$$\left(\frac{\partial \alpha}{\partial k_B} + \frac{1}{2k}\right)\left(\frac{\psi}{k}\frac{\partial \alpha}{\partial k_B} - \frac{\partial \psi_B}{\partial k_B}\right) + \frac{\partial \sigma_B}{\partial k_B}\frac{1}{2} > 0 \,, \tag{B.15}$$

where

$$\frac{\partial \psi_B}{\partial k_B} = \frac{1}{2k^2} - c\left[\underbrace{\frac{1-\tilde{\lambda}^2}{2}\frac{(1-\tilde{\lambda})^2}{2}p^c + \frac{(1-\tilde{\lambda})^2}{2}\left(1 - \frac{1-\tilde{\lambda}^2}{2}p^r\right)}_{\leq 2}\right] > 0 \,, \tag{B.16}$$

$$\frac{\partial \sigma_B}{\partial k_B} = c\underbrace{\frac{(1-\tilde{\lambda})^2}{2}\left(1-\tilde{\lambda}^2\right)}_{\leq 1}[h(l^r) + h(l^c)] < 0 \,, \tag{B.17}$$

$$\frac{\partial \alpha}{\partial k_B} = \frac{A - a_{\frac{2}{k}} - 1 - \overbrace{\frac{(1-\tilde{\lambda})^2}{2}}^{\leq 1} c^p}{4a} \,. \tag{B.18}$$

Then, we apply the maximum values that are shown in Eqs. (B.16)-(B.18) for all terms that enter negatively in condition (B.15) . Finally, multiplying all terms in (B.15) with $16k^4(1-\tilde{\lambda}^2)^2$, taking the maximum value of $(1-\tilde{\lambda}^2)^2 \leq 1$ for all terms that enter negatively in (B.15) and slightly rearranging terms, we arrive at condition (2.30).

C Appendix to Chapter 3

C.1 Proposition 1

Taking the implicit function theorem on eq. (3.10) we get

$$\frac{\partial L}{\partial D} = \frac{-(1-\theta_G)\left[r_L + \frac{\partial r_L}{\partial L}L - r\left(1-k_L\right)\right]}{2\frac{\partial r_L}{\partial L} + \frac{\partial^2 r_L}{\partial L^2}L}\,, \tag{C.1}$$

where

$$\frac{\partial r_L}{\partial L} = \frac{(e+r_L-r)\frac{\partial w_L}{\partial L}}{1-w_L} = \frac{-(e+r_L-r)}{(1-w_L)^2} \tag{C.2}$$

$$\frac{\partial^2 r_L}{\partial L^2} = \frac{-\frac{\partial r_L}{\partial L}}{(1-w_L)^2} - \frac{e+r_L-r}{(1-w_L)^3}\frac{\partial w_L}{\partial L} = \frac{2(e+r_L-r)}{(1-w_L)^4}\,. \tag{C.3}$$

To arrive at eq. (C.2) we first use the implicit function theorem on (3.9). In the second step of (C.2), we derive $\frac{\partial w_L}{\partial L}$ using the the implicit function theorem on (3.8) and substitute this into eq. (C.2).

To get eq. (C.3), we start from (C.2) and then, again, derive $\frac{\partial w_L}{\partial L}$ using the the implicit function theorem on (3.8) and substitute this into eq. (C.3).

Finally, substituting eqs. (C.2) and (C.3) in eq. (C.1) and rearranging terms, we get

$$\frac{\partial L}{\partial D} = \frac{(1-\theta_G)(1-w_L)^4\left[r_L + \frac{\partial r_L}{\partial L}L - r\left(1-k_L\right)\right]}{2(e+r_L-r)\left[(1-w_L)^2 - L\right]}\,, \tag{C.4}$$

The numerator in eq. (C.4) will be positive whenever $k_L > 0$ [see eq. (3.10)]. The denominator is always positive, as L can take the maximum value of $\frac{(1-w_L)^2}{2}$ [see eq. (3.8)].

C.2 Proposition 2

The entrepreneur that is endowed with $\hat{w}$ is characterized by the following condition

$$p^0 - p^1 - (r_L^0 - r_L^1)(1-\hat{w}) \tag{C.5}$$

Now, substituting (3.1) in (C.5) and using $n = e(1 - w_L)$ we get

$$e(w_L^0 - w_L^1) - (r_L^0 - r_L^1)(1 - \hat{w}) = 0 \tag{C.6}$$

Finally, substituting (3.9) in (C.6) and rearranging terms, we arrive at (3.14).

Acharya, S., Dreyfus, J.F. (1988). Optimal bank reorganization policies and the pricing of federal deposit insurance. *Journal of Finance 44*, 1313-1334.

Acharya, V. (2003). Is the international convergence of capital adequacy regulation desirable? *Journal of Finance 58*, 2745-2781.

Acharya, V., Yorulmazer, T. (2007). Too many to fail - An analysis of time-inconsistency in bank closure policies. *Journal of Financial Intermediation 16*, 1-31.

Acharya, V., Drechsler, I., Schnabl, P. (2014a). A pyrrhic victory? Bank bailouts and sovereign credit risk. *Journal of Finance 69*, 2689-2739.

Acharya, V., Eisert, T., Eufinger, C., Hirsch, C. (2014b). Real effects of the sovereign debt crisis in Europe: Evidence from syndicated loans. CEPR Discussion Paper No. 10108.

Acharya, V., Steffen, S. (2015). The greatest carry trade ever? Understanding eurozone bank risks. *Journal of Financial Economics 115*, 215-236.

Admati, A., DeMarzo, P., Hellwig, M., Pfleiderer, P. (2010). Fallacies, irrelevant facts, and myths in the discussion of capital regulation: Why bank equity is *not* expensive. Stanford GSB Research Paper No. 2063 and Preprint of the Max Planck Institute for Research on Collective Goods, Bonn 2010/42.

Admati, A., Hellwig, M. (2013). The bankers' new clothes: What's wrong with banking and what to do about it. Princeton University Press.

Aghion, P, Bolton, P. (1990). Government domestic debt and the risk of default: A political-economic model of the strategic role of debt. MIT Press, Cambridge MA.

Aghion, P., Bolton, P., Fries, S. (1999). Optimal design of bank bailouts: The case of transition economies. *Journal of Institutional and Theoretical Economics 155*, 51-70.

Aghion, P., Fally, T., Scarpetta, S. (2007). Credit constraints as a barrier to the entry and post-entry growth of firms. *Economic Policy 22*, 731-779.

Aghion, P., Hemous, D., Kharroubi, E. (2014). Cyclical fiscal policy, credit constraints, and industry growth. *Journal of Monetary Economics 62*, 41-58.

Akerlof, G.A. (1970). The market for lemons: quality, uncertainty, and the market mechanism. *Quarterly Journal of Economics 84*, 488-500.

Alesina, A., Tabellini, G. (1990). A positive theory of fiscal deficits and government debt. *Review of Economic Studies 57*, 401-414.

Allen, F., Gale, D. (2000). Financial contagion. *Journal of Political Economy 108*, 1-33.

Allen, F., Beck, T., Carletti, E., Lane, P., Schoenmaker, D., Wagner, W. (2011). Cross-Border Banking in Europe: Implications for Financial Stability and Macroeconomic Policies. CEPR Report. Center for Economic Policy Research.

Allen, F., Carletti, E. (2013). What is systemic risk? *Journal of Financial Stability 9*, 242-249.

Anginer, D., Cerutti, E. and Martï¿½nez Perï¿½a, M.S. (2014). Foreign bank subsidiaries' default risk during the global crisis. What factors help insulate affiliates from their parents? World Bank Policy Research Working Paper, 7053.

Auerbach, A.J., Devereux, M.P., Simpson, H. (2010). Taxing corporate income. In: J. Mirrlees, S. Adam, T. Besley, R. Blundell, S. Bond, R. Chote, M. Gammie, P. Johnson, G. Myles and J. Poterba (eds), Dimensions of Tax Design: the Mirrlees Review, Oxford University Press, 837-893.

Barro, R. (1979). On the determination of public debt. *Journal of Political Economy 87*, 940-971.

Barth, J., Caprio Jr., G., Levine, R. (2006). Rethinking bank reguation: till angels govern. Cambridge: Cambridge University Press.

Basel Committee on Banking Supervision, (2014). Regulatory Consistency Assessment Programme (RCAP)- Assessment of Basel III regulations - European Union. Bank for International Settlements.

Battistini, N., Pagano, M., Simonelli, S. (2013). Systemic risk, sovereign yields and bank exposures in the euro crisis. *Economic Policy 78*, 203-251.

Beck, T., Demirgüc-Kunt, A., Levine, R. (2007). Finance, inequality and the poor. *Journal of Economic Growth 12*, 27-49.

Beck, T., Demirgüc-Kunt, A., Laeven, L., Levine, R. (2008). Finance, firm size, and growth. *Journal of Money, Credit and Banking 40*, 1379-1405.

Beck, T., Wagner, W. (2013). Supranational supervision - How much and for whom. CEPR Discussion Paper No. 9546.

Beck, T., Radomir, T., Wagner, W. (2013). Supervising cross-border banks: theory, evidence and policy. *Economic Policy 73*, 5-44.

Beck, T., Degryse, H., De Haas, R., van Horen, N. (2014). When arm's length is too far. Relationship banking over the business cycle. CESifo Working Paper No. 4877.

Becker, G. (1983). A theory of competition among pressure groups for political influence. *Quarterly Journal of Economics 98*, 371-400.

Becker, B., Ivashina, V. (2014). Cyclicality of credit supply: Firm level evidence. *Journal of Monetary Economics 62*, 76-93.

Benediktsdottir, S., Danielsson, J., Zoega, G. (2011). Lessons from a collapse of a financial system. *Economic Policy 66*, 183-235.

Berger, A., Klapper, L., Udell, G. (2001). The ability of banks to lend to informationally opaque small business. *Journal of Banking and Finance 25*, 2127-2167.

Berger, A., Miller, N. H., Petersen, M., Rajan, R., Stein, J. (2005). Does function follow organizational form? Evidence from the lending practices of large and small banks. *Journal of Financial Economics 76*, 237-269.

Bolton, P., Freixas, X., Gambacorta, L., Mistrulli, P.E. (2013). Relationship and transaction lending in a crisis. NBER Working Paper No. 19467.

Boot, A., Greenbaum, S., Thakor, A. (1993). Reputation and discretion in financial contracting. *American Economic Review 83*, 1165-1183.

Boot, A., Thakor, A. (2000). Can relationship banking survive competition? *Journal of Finance 55*, 679-713.

Brutti, F. and P. Saure (2013). Repatriation of Debt in the Euro Crisis. Evidence for the Secondary Market Theory. Center for Institutions, Policy and Culture in the Development Process Working Paper 109.

Bryant, J. (1980). A model of reserves, bank runs, and deposit insurance. *Journal of Banking and Finance 4*, 335-344.

Buch, C., Koch, C.T., Koetter, M. (2011). Size, productivity, and international banking. *Journal of International Economics 85*, 329-334.

Buck, F. (2015). The rents of banking - A public choice approach to bank regulation. ifo Beiträge zur Wirtschaftsforschung 59, ifo Institut.

Cabral, L. M. B., Mata, J. (2003). On the evolution of the firm size distribution: Facts and theory. *American Economic Review 93*, 1075-90.

Calomiris, C., Haber, S. (2014). Fragile by design: banking crises, scarce credit, and political bargains. Princeton University Press.

Calzolari, G., Loranth, G. (2011). Regulation of multinational banks: A theoretical inquiry. *Journal of Financial Intermediation 20*, 178-198.

Carbo-Valverde, S., Kane, E.J., Rodriguez-Fernandez, F. (2012). Regulatory arbitrage in cross-border banking mergers within the EU. *Journal of Money, Credit and Banking 44*, 1609-1629.

Cetorelli, N., Goldberg, L.S. (2012). Banking globalization and monetary transmission. *Journal of Finance 67*, 1811-1843.

Chan, Y.S., Greenbaum, S.I., Thakor, A.V. (1992). Is fairly priced deposit insurance possible? *Journal of Finance 47*, 227-245.

Chetty, R., Looney, A., Kroft, K. (2009). Salience and Taxation: Theory and Evidence. *American Economic Review 99*, 1145-77.

Chodorow-Reich, G. (2014). The employment effects of credit market disruptions: Firm level evidence from the 2008-09 financial crisis. *Quarterly Journal of Economics 129*, 1-59.

Chor, D. (2009). Subsidies for FDI. Implications from a model with heterogeneous firms. *Journal of International Economics 78*, 113-125.

Chor, D., Manova, K. (2012). Off the cliff and back? Credit conditions and international trade during the global financial crisis. *Journal of International Economics 87*, 117-133.

Claessens, S. (2010). The financial crisis and financial nationalism, in S.Evenett, B.M. Hoekman, Cattaneo (eds.), Effective crisis response and openess: Implications for the trading system. Joint Wold Bank-CEPR Publication, London.

Claessens, S., Herring, D., Schoenmaker, D. (2010). A safer world financial system: Improving the resolution of systemic institutions. 12th Geneva Report on the World Economy. International Center for Monetary and Banking Studies, London.

Clementi, G. L., Hopenhayn, H. A. (2006). A theory of financing constraints and firm dynamics. *Quarterly Journal of Economics 121*, 229-265.

Collins, M. (2012). Money and banking in the UK: A history. Croom Helm, Routledge.

Cordella, T., Yeyati, E. (2002). Financial opening, deposit insurance, and risk in a model of banking competition. *European Economic Review 46*, 471-485.

Crosignani, M. (2015). Why are banks not recapitalized during crises? A political economy explanation. Working paper, NYU Stern School of Business.

De Haas, R., Van Horen, N. (2012). International shock transmission after the Lehman Brothers collapse: Evidence from syndicated lending. *American Economic Review: Papers & Proceedings 112*, 231-237.

De Marco, F. (2015). Bank lending and the sovereign debt crisis. Working Paper, Boston College.

Dell'Ariccia, G., Marquez, R. (2006). Competition among regulators and credit market integration. *Journal of Financial Economics 79*, 401-430.

Dell'Ariccia, G., Detragiache, E., Rajan, R. (2008). The real effect of banking crises. *Journal of Financial Intermediation 17*, 89-112.

Dell'Ariccia, G., Marquez, R. (2010). Risk and the corporate structure of banks. *Journal of Finance 65*, 1075-1096.

Demirgüc-Kunt, A., Kane, E., Laeven, L. (2014). Deposit insurance database. NBER Working Paper No. 20278.

Devereux, M., Johannesen, N., Vella, J. (2013). Can taxes tame the banks? Capital structure responses to the post-crisis bank levies. Paper presented at the CESifo Area Conference on Public Sector Economics, April 2013.

Dewatripont, M., Tirole, J. (1993). The prudential regulation of banks. MIT Press, MIT.

Dewatripont, M., Freixas, X. (2011). Bank resolution: a framework for the assessment of regulatory intervention. *Oxford Review of Economic Policy 27*, 411-436.

Diamond, D.W., Dybvig, P. (1983). Banks runs, deposit insurance, and liquidity. *Journal of Political Economy 91*, 401-419.

Diamond, D. W. (1984). Financial intermediation and delegated monitoring. *Review of Economic Studies 51*, 393-414.

Diamond, D.W., Rajan, R. (2005). Liquidity shortages and banking crises. *Journal of Finance 60*, 615-647.

European Systemic Risk Board (2014). Is Europe overbanked? Reports of the Advisory Scientific Committee No.4.

Evans, D. S., Jovanovic, B. (1989). An estimated model of entrepreneurial choice under liquidity constraints. *Journal of Political Economy 97*, 808-27.

Farhi, E., Tirole, J. (2012). Collective moral hazard, maturity mismatch, and systemic bailouts. *American Economic Review 102*, 60-93.

Farhi, E., Tirole, J. (2014). Deadly embrace: Sovereign and financial balance sheets doom loops. Harvard University Working Paper, Nr.164191.

Finkelstein, A. (2009). E-ztax: Tax salience and tax rates. *Quarterly Journal of Economics 124*, 969-1010.

Ferrando, A., Mulier, K. (2013). Firms financing constraints: Do perceptions match the actual situation. European Central Bank, Working Paper No. 1577.

Freixas, X. (2010). Post-crisis challenges to bank regulation. *Economic Policy 25*, 375-399.

Fuest, C., Huber, B., Mintz, J. (2005). Capital mobility and tax competition. *Foundations and Trends in Microeconomics 1:1* (Now Publishers, Boston and Delft), 1-62.

Gennaioli, N., Martin, A., Rossi, S. (2014). Sovereign default, domestic banks, and financial institutions. *Journal of Finance 69*, 819-866.

Gertler, G., Gilchrist, M. (1994). Monetary policy, business cycles, and the behavior of small manufacturing firms. *Quarterly Journal of Economics 109*, 309-340.

Gianetti, M., Laeven, L. (2012). The flight home effect: Evidence from the syndicated loan market during financial crises. *Journal of Financial Economics 104*, 23-43.

Goodhart, C., Schoenmaker, D. (1995). Should the functions of monetary policy and banking supervision be separated? *Oxford Economic Papers 47*, 539-560.

Goodhart, C., Schoenmaker, D. (2009). Fiscal burden sharing in cross-border banking crises. *International Journal of Central Banking 5*, 141-165.

Gros, D. (2013). Banking union with a sovereign virus. *Intereconomics 48*, 93-97.

Grossman, G., Helpman, E. (1994). Protection for sale. *American Economic Review 84*, 833-50.

Guiso, L., Sapienza, P., Zingales, L. (2004). Does local financial development matter? *Quarterly Journal of Economics 119*, 929-969.

Haber, S., Perotti, E. (2008). The political economy of financial systems. Tinbergen Institute Discussion Papers Nr. 10-022/2.

Hagan, S., Vinals, J. (2010). Resolution of cross-border banks - A proposed framework for enhanced coordination. IMF Legal and Monetary and Capital Markets Departments.

Hillman, A. (1989). Political economy of protection. Harwood Academic Publishers, Chur.

Hellman, T., Murdock, K., Stiglitz, J. (2000). Liberalization, moral hazard in banking, and prudential regulation: Are capital requirements enough? *American Economic Review 90*, 147-165.

Holmström, B., Tirole, J. (1993). Market liquidity and performance monitoring. *Journal of Political Economy 101*, 678-709.

Holmström, B., Tirole, J. (1997). Financial intermediation, loanable funds, and the real sector. *Quarterly Journal of Economics 112*, 663-691.

Holmström, B., Tirole, J. (1998). Private and public supply of liquidity. *Journal of Political Economy 106*, 1-40.

Houston, J.F., Lin, C., Ma, Y. (2012). Regulatory arbitrage and international bank flows. *Journal of Finance 67*, 1845-1895.

Inderst, R. (2013). Prudence as a competitive advantage: On the effects of competition on banks' risk-taking incentives. *European Economic Review 60*, 127-143.

Ivashina, V., Scharfstein, D. (2010). Bank lending during the financial crisis of 2008. *Journal of Financial Economics 97*, 319-338.

Jensen, M., Meckling W. (1976). Theory of the firm: managerial behavior, agency costs and ownership structure. *Journal of Financial Economics 3*, 305-60.

Kahn, C., Santos, J. (2005). Allocating bank regulatory powers: lender of last resort, deposit insurance and supervision. *European Economic Review 49*, 2107-2136.

Kaya, O. (2014). SME financing in the euro area. New solutions to and old problem. EU Monitor, Global finance markets, Deutsche Bank Research, Oktober 14.

Keen. M. (2011). Rethinking the taxation of the financial sector. *CESifo Economic Studies 57*, 1-24.

King, R., Levine, R. (1993). Finance and growth: Schumpeter might be right. *Quarterly Journal of Economics 108*, 717-737.

Kopecky, K., VanHoose, D. (2006). Capital regulation, heterogeneous monitoring costs, and aggregate loan quality. *Journal of Banking and Finance 30*, 2235-2255.

Laeven, L., Valencia, F. (2012). Systemic banking crises database: An update. IMF Working Paper 12163.

Lall, R. (2012). From failure to failure: The politics of international banking regulation. *Review of International Political Economy 19*, 609-638.

Levine, R. (2005). Finance and growth: Theory and evidence. in: Philippe Aghion and Steven Durlauf (ed.), Handbook of Economic Growth, 865-934.

Lipsey, R.G., Lancaster, K. (1956). The general theory of second best. *Review of Economic Studies 24*, 11-32.

Lloyd-Ellis, H., Bernhardt, D. (2000). Enterprise, inequality, and economic development. *Review of Economic Studies 67*, 147-68.

McKinnon, R. (1973). Money and capital in economic development. Brookings Institution Press, Washington D.C.

Midrigan, V., Xu, D.Y. (2014). Finance and misallocation: Evidence form plant-level data. *American Economic Review 104*, 422-458.

Mitchell, J. (2000). Bad debts and the cleaning, transferring of banks' balance sheets: An application to transition economies. *Journal of Financial Intermediation 10*, 1-27.

Morrison, A., White, L. (2005). Crises and capital requirements in banking. *American Economic Review 95*, 1548-1572.

Morrison, A., White, L. (2009). Level playing fields in international financial regulation. *Journal of Finance 64*, 1099-1142.

Navaretti, G. B., Calzolari, G., Pozzolo, A.F., Levi, M. (2010). Multinational banking in Europe - financial stability and regulatory implications: lessons from the financial crisis. *Economic Policy 64*, 703-753.

Niepmann, F. (2013). Banking across borders. CESifo Working Paper No. 4120. Munich.

Niepmann, F., Schmidt-Eisenlohr, T. (2013). Bank bailouts, international linkages, and cooperation. *American Economic Journal: Economic Policy 5*, 270-305.

Niskanen, W. (1971). Bureaucracy and representative government. Aldine-Atherton, Chicago.

OECD (2014). Financing SMEs and entrepreneurs 2014: An OECD scoreboard. OECD Publishing, Paris.

Ongena, S., Popov, A., Udell, G. (2013). "When the cat's away the mice will play": Does regulation at home affect bank risk-taking abroad?. *Journal of Financial Economics 108*, 727-750.

Peek, J., Rosengren, E.S. (1997). The international transmission of financial shocks: The case of Japan. *American Economic Review 87*, 495-505.

Philippon, T. (2015). Has the US finance industry become less efficient? On the theory and measurement of financial intermediation. *American Economic Review 105*, 1408-1438.

Popov, A., Udell, G.F. (2012). Cross-border banking, credit access, and the financial crisis. *Journal of International Economics 87*, 147-161.

Popov, A., van Horen, N. (2014). Exporting sovereign stress: Evidence from syndicated bank lending during the euro area sovereign debt crisis. *Review of Finance 19*, 1-42.

Rajan, R., Zingales, L. (1998). Financial dependence and growth. *American Economic Review 88*, 559-86.

Rajan, R., Zingales, L. (2003). The great reversals: The politics of financial development in the 20th century. *Journal of Financial Economics 69*, 5-50.

Reinhart, C., Sbrancia, B. (2015). The liquidation of government debt. *Economic Policy 82*, 291-333.

Repullo, R. (2000). Who should act as a lender of last resort? An incomplete contracts model. *Journal of Money, Credit and Banking 32*, 580-605.

Repullo, R. (2004). Capital requirements, market power, and risk taking in banking. *Journal of Financial Intermediation 13*, 156-182.

Rochet, J.-Ch. (1992). Capital requirements and the behaviour of commercial banks. *European Economic Review 36*, 1137-1178.

Roubini, N., Sala-i Martin, X. (1992). Financial repression and economic growth. *Journal of Development Economics 39*, 5-30.

Samuelson, P. (1954). The theory of public expenditure. *Review of Economics and Statistics 37*, 350-356.

Sengupta, R. (2007). Foreign entry and bank competition. *Journal of Financial Economics 84*, 502-528.

Shaw, E. (1973). Financial deepening in economic development. Oxford University Press, New York.

Shleifer, A., Vishny, R. (1998). The grabbing hand. Harvard University Press.

Sinn, H.W. (1980). Ökonomische Entscheidungen bei Ungewissheit. Mohr Siebeck, Ti¿½bingen.

Sinn, H.W. (1997). The selection principle and market failure in systems competition. *Journal of Public Economics 66*, 247-274.

Sinn, H.W. (2003). Risktaking, limited liability, and the competition of bank regulators. *Finanzarchiv 59*, 305-329.

Stigler, J (1971). The theory of economic regulation. *The Bell Journal of Economics and Management Science 2*, 3-21.

Stiglitz, J., Weiss A. (1981). Credit rationing in markets with imperfect information. *American Economic Review 71*, 393-410.

Tirole, J. (2012). The euro crisis: some reflections on institutional reform. Banque de France, Financial Stability Review, 225-42.

van Riet, A. (2013). Financial repression to ease fiscal stress: turning back the clock in the eurozone? in Banco Central do Brasil, Financial Stability and Banking, Sao Paolo.

Weidmann, J. (2013). Stop encouraging banks to buy government bonds. in The Financial Times, September 30, 2013.

Weinberg, J. (2002). Competition among bank regulators. *Economic Quartlerly*, 19-36.

Eidesstattliche Versicherung

Ich versichere hiermit eidesstattlich, dass ich die vorliegende Arbeit selbständig und ohne fremde Hilfe verfasst habe. Die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sowie mir gegebenen Anregungen sind als solche kenntlich gemacht. Die Arbeit wurde bisher keiner anderen Prüfungsbehörde vorgelegt und auch noch nicht veröffentlicht. Sofern ein Teil der Arbeit aus bereits veröffentlichten Papers besteht, habe ich dies ausdrücklich angegeben.

München, 25. Juni 2015

Ulf Maier