

Does financial integration make banks more vulnerable? Regulation, foreign owned banks, and the lender-of-last resort

Helge Berger · Carsten Hefeker

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Abstract We describe a simple model in which banks' prudential efforts and public regulation can reduce the probability of bankruptcy. Focusing on the European example, we contrast the national case with an integrated banking market and find that banks will exert, and public regulators will demand, greater prudential effort to monitor their bank's activities. Thus, financial integration may increase voluntary prudential behavior by banks, avoid a regulatory "race to the bottom," and improve the soundness of the financial system. Along similar lines, we show that the absence of a dedicated lender of last resort within the euro area can reduce the probability of financial crisis. Despite these findings, the overall level of regulatory activity may remain suboptimal from a European perspective. We also discuss incentives for European banks to organize their foreign holdings in branches or subsidiaries.

Keywords Bank regulation · Lender of last resort · European financial markets

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H. Berger
Free University of Berlin, Berlin, Germany

H. Berger · C. Hefeker
CESifo, München, Germany

C. Hefeker (✉)
University of Siegen, Hoelderlinstrasse 3, 57068, Siegen, Germany
e-mail: carsten.hefeker@uni-siegen.de

C. Hefeker
HWWI, Hamburg, Germany

1 Introduction

The relation between financial integration and financial fragility is subject to two opposing forces. The ongoing process of consolidation in the European banking sector should make banks (or other financial institutions) more resilient to crises because only profitable banks will survive increased competition and concentration.¹ At the same time, banks will become more connected with each other and across borders and this could imply that financial crises will tend to extend beyond national banking systems, affecting other national banking sectors as well. As a result, increasing cross-border involvement could make the European banking system as a whole more vulnerable to crises. Therefore, it is argued, the process of integration will force European regulators and supervisors to increase cooperation and coordination concerning the level of regulation and the requirements they place on their national system (Padoa-Schioppa 2004). A more integrated banking system with uncoordinated multiple regulators, it is feared, could lead to a race to the bottom among national regulators (Sanio 2005).

This raises the question if a full centralization of regulation is necessary and who, in the event of a European financial crisis, should have the responsibility to act as a lender-of-last-resort (LOLR). Opinions vary widely from those who argue that there should be no lender of last resort (because it would create moral hazard problems), to those who argue that a national bailout might simply be insufficient in a European context.

In this paper we focus on one largely neglected aspect in the debate about the regulatory coordination and the importance of a LOLR in the European context. We argue that an increase in the degree of integration of European banking system might be helpful in the sense that it increases banks' awareness of the positive international externalities of their individual efforts in prudential banking and risk reduction. We show that under certain circumstances banks undertake more efforts to make themselves less vulnerable to crises in the presence of cross-border holdings. The reason is that cross-border holdings provide partial internalization of the positive repercussions of their own efforts on the systemic stability of the European banking system. Therefore, a more integrated banking system could see an increase in efforts undertaken by private banks and not, as some fear, lower efforts.

The same effect can also be at work with regard to national regulators, possibly preventing a "race to the bottom," in which national regulation is competitively reduced to support "domestic champions." If regulators start to worry about the health of their clientele's foreign holdings, they will partly internalize the positive spillovers of more prudential regulation at the national level for the international financial system. However, since national regulators do not fully take into account the international effects of their action, the level of regulation will not necessarily be adequate from a European perspective. Only full cooperation instead will allow to internalize all positive external effects of individual actions and to take into account the costs of regulation to other governments.

¹ We use the term banks in an encompassing sense, meaning any kind of financial institution subject to financial sector regulation and possibly eligible for lender-of-last-resort support. Similarly, we use the terms regulators and/or supervisors to describe government action with regard to banking regulation and oversight.

One consequence of the above is that, despite financial integration, the case for a European LOLR is less obvious than sometimes argued. Indeed, we show that the *absence* of a LOLR can induce regulators to demand and private banks to provide more efforts and regulation to avoid financial crises. Similarly, the creation of a common regulator might reduce prudential regulation because a common regulator would be less ambiguous about the actions of a common lender of last resort.

The paper is structured as follows. In the next section, we discuss some of the main arguments in the literature to put our paper into perspective. Given the great number of contributions, including several surveys, this section is selective rather than complete. In Section 3 we provide a brief discussion about the current status of regulation in Europe, while Section 4 presents our model. We begin with the national case and the interaction between national banking sectors and regulators in the presence of a national lender of last resort. The next section moves to the case of integrated national banking systems, the possibility of an EMU wide lender of last resort, and a common regulator. The last section presents conclusions.

2 The literature

With the increasing and ongoing integration of the European banking market, a lively discussion about the need of a European regulator has begun. Positions vary widely, and we will briefly present the main arguments pro and con before we look at the current state of cooperation in Europe.

The basis for regulation of the banking industry is the interest to protect consumers and the systemic risks in the banking market. Because of informational asymmetries, consumers are not able to assess the safety and soundness of financial institutions which therefore requires official intervention and regulation (Dewatripont and Tirole 1995). Moreover, banks are seen as being particularly prone to systemic risk and vulnerable to contagion, for instance, in the form of fast-spreading bank-runs leading to sector-wide illiquidity and (if unchecked) bankruptcy. Thus, individual crisis-prevention entails sizable positive externalities, while much of the associated effort takes the form of private costs. As a consequence, supervision and regulation is needed to ensure prudential banking and sufficient risk reduction efforts at the bank level (De Bandt and Hartmann 2000). Besides regulation and monitoring a safety net is provided by lender-of-last-resort, often assumed to be the central bank, which should intervene in case of a systemic crisis and lend to those banks which are temporarily illiquid (Goodhart and Huang 1999; Giannini 1999).

Arguments in favor of more cooperation between national regulators and supervisory authorities when banks are internationally connected builds on the notion that in its absence there will be too little regulation and that authorities invest too little in the prevention of crisis relative to the social optimum realized by a social planner with an European perspective (Holthausen and Ronde 2005; Makaja-Jartby and Olafsson 2005).² Because of ongoing integration of European financial markets,

² Eggert and Schindler (2004) argue that this need not lead to a suboptimal level of regulation. A globalized banking market leads to more competition and reduces excessive risk taking. Hence, the optimal amount of regulation falls.

interdependencies have increased and hence the potential for systemic risk affecting the European markets as a whole (Schoenmaker and Oosterloo 2005). The failure of a national bank might not only put other banks in the respective country at risk but banks in other countries as well (Allen and Gale 2000). The expected consequence is that the advent of EMU will eventually lead to pressures for some centralized supervisory authority, either within the ECB or independent of it (Eichengreen and Ghironi 2001).

Increased interdependencies between European banks over the last 15 years have indeed led to higher correlation between measures of bank performance during times of duress, such as the 1987 crash and the Nordic banking crises in the early 1990s.³ This has been supported by the completion of the internal banking market in the response to the second banking directive 1993, and it can therefore be expected that more mergers and acquisitions between European banks will further increase the correlation between banks' profits (Prati and Schinasi 1999). This naturally raises the question whether more centralized regulation and supervision should be part of the common central bank or remain independent of it (Kahn and Santos 2004).

Arguments for centralization are twofold. First, the information of the supervisory authority can be useful for the conduct of monetary policy. Second, the central bank must act as a LOLR in case of crisis and needs the information of the supervisory authority in this case (Eichengreen and Ghironi 2001). In order to fulfill its lender of last resort function, it needs timely and adequate information on the liquidity and solvency of private banks. Also, the fact that central banks are independent may enhance their abilities to enforce actions, more than a body under the direction of governments might be able to in certain cases. Padoa-Schioppa (2004, pp. 3–4), speaking for the European Central Bank (ECB) at the time, seems to lean toward this view when he suggests that the existing coordination framework for national regulators and supervisors under the so-called Lamfalussy process, while not without merits, would need to be “exploited to the maximum” to be able to face the challenges of financial market integration ahead—otherwise “more radical solutions” would need to be envisaged. And the ECB's president warned that the potential for accounting and regulatory arbitrage in the absence of watertight coordination could bear risks for financial stability.⁴

Arguments against centralization are also twofold. First, the responsibilities of the supervisory function, if linked to the ECB, could conflict with the conduct of monetary policy. The expectations about a possible intervention of the central bank might create inflationary expectations and thus make the conduct of monetary policy more difficult. Second, exchange of necessary information can, in principle, also be ensured without housing both responsibilities under one roof. For instance, Sanio (2005, 6–7) argues that regulators are “well prepared to handle crisis situations” and “calls for central European supervisory authority...[are] not worth debating at this

³ Evidence on increasing financial integration suggests that bond and equity markets may converge faster than loan credit markets (Schüler 2007; Barros et al. 2005; Baele et al. 2004; Adam et al. 2002; Schoenmaker and Oosterloo 2005). di Nicolò and Tiemann (2006) stress that economic integration need not imply a decrease in risk exposure as it limits benefits from diversification.

⁴ Trichet at a conference organized by the Committee of European Insurance and Occupational Pension Supervisors in November 2005 (<http://www.globalriskregulator.com/grnews5.htm>).

stage.” On the other hand, the LOLR action is usually required very fast and exchanging information between separate authorities might simply take too long (Eichengreen and Ghironi 2001).

3 The status quo in the European Union

Despite increasing cross-border activity, including mergers and retail banking,⁵ the EU has not made steps into the direction of a full centralization of regulation and supervision of national banking systems.⁶ The Economic and Financial Committee (EFC) of the EU merely proposed in a report, endorsed by Ecofin, that arrangements already in place for securities regulation (the Lamfalussy process) should be extended to other financial sectors as well, including the banking sector.⁷ Its main principles are the home rule and mutual recognition. Extending to the banking sector, each bank with a domestic license (a “single passport”) can do business in the whole EU under the supervision of the authority that issued the license provided that its foreign activity takes the form of branch-banking. Foreign subsidiaries are supervised and regulated by the foreign authorities.⁸ Member states recognize and accept national decisions. With the Lamfalussy principle EU member states seem to have accepted the continued coexistence of a multitude of different models of supervision in the union.

To foster cooperation, several Memoranda of Understanding (MoU) between European supervisors at the bilateral level have been signed. These agreements between national authorities provide a framework for regular exchange of information and define procedures and reciprocal commitments. Nearly all member states have signed such memoranda with each other. In addition, there are MoU between the ECB and national central banks and national banking supervisors on a multilateral basis, for instance among Nordic countries. The first MoU was adopted in 2003 between banking supervisors and central banks and should apply when bank problem with potential cross-border implications arise. The 2005 MoU should preserve stability of national banking systems and the EU system as a whole (Schinasi and Teixeira 2006).

The application of the Lamfalussy approach to banking is a fairly recent development (the final decision at the EU level dates May 2004), the outcome of the underlying political process being less than certain. A joint proposal by then finance ministers Brown and Eichel (of Great Britain and Germany), suggesting the creation

⁵ Cross-border activity may be growing from low levels, however. Many European banks are still focused on a national business model, with only 5% of retail activities falling into the cross-border category (Cihak and Decressin 2007).

⁶ The status quo is described, among others, in Schüler (2007); Gulde and Wolf (2005); Prati and Schinasi (1999); and Schinasi and Teixeira (2006). See also ECB (2006).

⁷ This might be due to the fact that harmonization and cooperation in supervision has evolved gradually. It is likely that a newly created system would look differently (Gulde and Wolf 2005).

⁸ See Padoa-Schioppa (2004) for a discussion. According to him, measured along total assets, branches and subsidiaries are about equally important for EU-wide banking activity. Schinasi and Teixeira (2006) and Cihak and Decressin (2007) argue that subsidiaries are more frequent than branches.

of a modern and effective supervisory body at the EU level but leaving financial responsibility with national governments, was opposed by national central banks and stalled. It led, however, to the proposal by the EFC, accepted by Ecofin, eventually approved (with amendments) by the European Parliament, whose main feature it is to extend the Lamfalussy model to other financial sectors and thus to preserve the existing inter-institutional arrangements. This proposal also maintains the role for national central banks and thus finds their support.⁹

Even within the new framework the ECB does not have an explicit mandate to act as a lender of last resort, nor is it explicitly involved in banking supervision. Art. 105 (5) of the treaty remains rather ambiguous in stating that “the ESCB shall contribute to the smooth conduct of policies pursued by the competent authorities relating to the prudential supervision of credit institutions and the stability of the financial system.” In particular, there is no explanation who the competent authorities might be. Moreover, according to Freixas et al. (2004), financial crises within EMU constrained to national boundaries—to the extent that they still exist—may be handled by national authorities, including through limited collateralized credit extended by the respective *national* central bank. On the other hand, there can be little doubt that the ECB will need to be involved in any major liquidity crises within the EMU area, in particular if it exceeds national boundaries and approaches systemic levels. This view, probably shared by most observers, seems also to underlie the July 2005 MoU which explicitly involves the ECB and its member banks in a process of crises-preventing information exchanges and advance planning (ECB 2005).

While the lack of an explicit function of the ECB as a lender of last resort has led to criticism (Prati and Schinasi 1999; Vives 2001), the ECB itself has stressed the positive role of “constructive ambiguity,” and that private alternatives (such as deposit insurances schemes) and the presence of fiscal authorities might assume the role of bailing out particular banks in case of crisis. It is doubtful, however, that these alternatives would be sufficient and fast enough (Vives 2001). The question, hence, is to what extent a common lender of last resort should be introduced, whether his existence should be made public or left partly in the dark to exploit constructive ambiguity. As our model will show, a case for the existence and strategic exploitation of such ambiguity can be made.

4 The model

In our theoretical analysis, we develop a simple model that focuses on the relation between three national players. There is a private banking sector in each country with n symmetric *private banks* that compete against each other. We do not assume that national banks cooperate. National mergers and acquisitions would lead to a fall in n and we would treat merged banks as single national banks; thus n is our measure

⁹ The two so called Brouwer reports, commissioned by EFC confirm that the current system based on national competencies is appropriate but that there is also a need for more cross-border and cross-sectoral cooperation between national authorities. Bini-Smaghi and Gros (2000) criticize that convergence of regulation does not automatically imply equal application of rules and thus common treatment of national banks.

of the degree of non-cooperation between national banks. Given the symmetry of national banks, we consider a representative national bank.

The second actor is the national *central bank* whose sole objective it is to avoid that private banks sector fail. In case of large negative shocks which could lead to the failure of the banking system the central bank will intervene and act as a lender-of-last resort to the banking system. This action is however accompanied by costs for the central bank because it may be forced to increase the monetary base which may then lead to inflation. We thus assume that the central bank's objective is to minimize the risk of having to bail out private banks.

The third player, the national *government* or *regulator*, reflects the interests of private banks and the central bank. It aims at keeping the private banking sector from failing and avoiding systemic crises. It also is affected if the central bank has to intervene. This might imply that the central bank's profits fall and the government obtains less revenue, or it might be that the government suffers from an increase in inflation in the wake of a bailout.

We assume that the central bank is responsible for bailing out private banks should systemic crises arise. The government is assumed to be responsible for the regulation of the banking sector and it can force private banks to undertake "efforts" to reduce the probability they end up in a situation in which the central bank will have to intervene. There is no direct relation between the central bank and the government because central banks in the EU are politically and legally independent.¹⁰

The government will create rules that, among other things, require private banks to invest in the build up of reserves, to lend prudently, to reduce their exposure to bad loans, and to ensure prudent loan risk assessment. These activities are costly for the private banks which, as a consequence, might be reluctant to undertake these measures—at least to the degree demanded by the regulator. The government is likely to consider at least some of these efforts when setting regulatory standards. This could be because the government takes into account potential short- and long-run consequence of reduced risk-taking in the real economy, in particular lower investment and potential growth, or because of successful private-sector lobbying.

However, the government is unlikely to put as much weight on the cost of prudential regulation as the private sector and will, as a rule, demand prudential effort in excess of private interest. One reason is that not all private costs may translate into social costs. Another is that the government takes into account the cost arising from regulatory shortfalls that require central bank bailout. As a consequence, regulatory demands may exceed unrestricted private efforts in this area.

The model makes a number of simplifying assumptions. First, we do not model implementation of regulation—all regulation is enforced ceaselessly. Second, there is no private or tax-payer supported insurance for banks. In our setup the only authority that can support banks is the central bank in its lender-of-last resort function. The assumption mirrors the facts that deposit insurance schemes are rarely intended to cover larger scale or systemic crisis repercussions, may be slow to take effect and are

¹⁰ In a broader sense, the model involves both the government and the central bank in the regulation of the banking sector. See Prati and Schinasi (1999); Gulde and Wolf (2005) or Schüler (2007) for a description of actual separation of powers between central banks and governments in Europe.

likely to involve lengthy discussions about who has to pay how much in an EU wide setting (Prati and Schinasi 1999). Third, we do not explicitly distinguish between the forms in which banks' cooperation (or merger and acquisitions) takes place. There is some literature explicitly distinguishing between branches and subsidiaries (Repullo 2001; Holthausen and Ronde 2005). We ask, however, under what circumstances banks prefer opening branches or subsidiaries if they are active in other countries. Finally, we do not look at "intermediate" forms of cooperation between governments and only compare the cases of non-cooperation and full cooperation in the level of regulation. Simple information sharing is not looked at (see Holthausen and Ronde 2005) as we assume that governments are perfectly informed about regulation in other countries.

4.1 The single economy

We proceed by first showing the case of the single economy and the equilibrium determined by the private banks' efforts undertaken to reduce vulnerability to shocks and the government's amount of regulation. In the next step, we will see how this equilibrium is changed through integration among private banks in a European setting. To simplify, we only consider two countries, indexed by $i=1,2$, representing, for instance, the process of financial market integration between two older member states or between the old member states and new member states.

4.1.1 Private banks

The utility function of a representative private bank is given as

$$EU_i^B = f(e_i)E\pi_i - v(e_i) \quad (1)$$

where E denotes the expectations operator, π are the bank's profits and e are the bank's efforts undertaken to make it less vulnerable and to increase profits. Efforts might include more careful lending policies, a better control of lenders' behavior, or better monitoring.

The bank's effort, e , has a twofold effect on expected profits.¹¹ The first effect is based on the assumption that the effort generates a positive *return* for the bank, perhaps because a more careful balancing of the loan portfolio or an improved risk matching of assets and liabilities. Formally, this can be captured by multiplying expected profits, $E\pi_i$, by a return factor increasing in e_i . We assume that $f(e_i)$ takes a simple linear form: $f(e_i) = 1 + e_i$. As to expected profits, we define $E\pi_i = [p_i\bar{\pi} + (1 - p_i)\underline{\pi}]$, where $\bar{\pi}$ are high profits realized in the "good" situation and $\underline{\pi}$ are negative profits realized under the "bad" outcome, such that $\underline{\pi} < 0 < \bar{\pi}$. We assume

¹¹ Cordella and Levy-Yeyati (2005) make similar assumptions with regard to government reform efforts in crisis prevention. Since we argue here that the bank's efforts are of the same nature as the efforts the government will demand from banks through regulators, there is a similarity in perspective. Freixas et al. (2004) make a related point when they distinguish between banks' efforts in screening credit projects in the selection phase (which might shape expected profits) and monitoring thereafter (which might influence the probability of default).

that the bank will have to close and go out of business if $\underline{\pi}$ is realized unless it is bailed out.¹²

The second influence of efforts works indirectly on the probability of a negative outcome, for instance, because of greater vigilance in monitoring risks. Thus, we assume a probability function $p_i = p_i(e_i, \theta_i)$; $p_{\theta_i}, p_{e_i} > 0$, where θ_i is the exogenously given chance of a “good” development in the economy (anchored, perhaps, in the national or international macroeconomic environment), which makes $1 - \theta_i$ an exogenous measure of the level of systemic risk. Even if θ_i is low, the bank can improve its individual chance through reinforced efforts. In what follows, we use the specification $p_i = \frac{1}{2}e_i + \theta_i$ with $0 \leq \frac{1}{2}e_i + \theta_i \leq 1$. Finally, the effort spend by the bank has increasing marginal costs $v(e_i) = \frac{\gamma}{2}e_i^2$, where $\gamma > 0$ measures the bank’s aversion to efforts. Thus, we can rewrite its expected utility (1) as $EU_i^B = [p_i\bar{\pi} + (1 - p_i)\underline{\pi}](1 + e_i) - \frac{\gamma}{2}e_i^2$.

There is the possibility that the bank is bailed out by the central bank in its capacity as the lender-of-last-resort (LoLR). The size of the bailout will be such that the bank does not go bankrupt, that is, we assume that the bailout B is sufficient to keep the bank in operation. However, the individual bank can not be sure that it will be bailed out by the central bank because a single bank’s potential failure may or may not put the whole banking system at risk, and the central bank will only spring into action to stop a systemic crisis. Thus, there is only a probability $0 \leq \tau^B \leq 1$ that the central bank will bail out an individual bank. The expected payout to the bank’s managers is $\underline{\pi} = \tau^B B - L$ where we have defined L as the expected loss to the bank and its manager under the bad outcome.

Finally, we assume that the bank’s probability of being bailed out, while exogenous to the individual private bank, is a negative function of the overall number of private banks operating in the economy. Under symmetry, if there are many banks in the economy, a single bank’s failure is less likely to cause a crisis of the entire banking system. If there are only few banks, however, a bank’s default is more likely to cause a run on the banking system, rendering it unstable along the logic of Diamond and Dybvig (1983). In this case, the central bank will have to intervene in order to save the system. Assuming that each bank is a Nash-player with respect to other banks and the regulating authority, a reasonable presumption is that for each single bank the probability of being bailed out is simply $\tau^B = 1/n$. The private bank’s expected payout in case of a negative shock is thus $\underline{\pi}^B = \frac{1}{n}B - L$ with $\bar{\pi} - \underline{\pi}^B = \Delta^B > 0$. Because $\underline{\pi}$ is a function of the subjective probability of being bailed out, we index it for the private bank.

Based on these definitions and assumptions we can calculate the representative private bank’s optimal prudential efforts by maximizing expected utility (1) as

$$e_1^B|_{NAT} = \frac{\theta_i\bar{\pi} + (1 - \theta_i)\underline{\pi}^B}{\gamma - \Delta^B}. \quad (2)$$

The efforts undertaken by the private bank are increasing in the probability that a systemic crisis can be avoided θ_i , and falling in the marginal cost of private effort γ . Effort increases in $\Delta^B = \bar{\pi} - \underline{\pi}^B$ which captures the marginal benefit (or “produc-

¹² Since this is a one period model we cannot distinguish between solvency and illiquidity of the bank and Bagehot’s rule cannot be applied.

tivity”) of prudential efforts. In particular, as $\Delta^B = \bar{\pi} + L - \tau^B B$, efforts increase in the bank’s cost of a bailout, L , and fall in the probability of being bailed out, τ^B . Since this probability is presumably a negative function of the number of banks, a larger number of banks enhances the efforts of the representative private bank and increases the stability of the banking system. Note that, because banks are symmetric, the level of efforts undertaken by the representative bank equals the average level of efforts undertaken by “the banking system.”

4.1.2 The central bank

We turn next to the objective function of the central bank. In this setup, the central bank focuses solely on avoiding a collapse of the banking system. This simplification can be justified, for instance, by pointing to the potentially dire consequence of a financial collapse for price stability and the stability of the real economy.

Assuming that the central bank has no further direct costs from bailing out the banking system, its expected utility is given as

$$EU_i^{CB} = -2(1 - p_i)B. \quad (3)$$

That is, the central bank benefits from higher prudential efforts by the private banking sector reducing the probability of a banking crisis.

4.1.3 The regulator

The government or regulator balances concerns for the stability and profitability of the national banking system, the cost of prudential regulation and is concerned with the implications of a bail out for the central bank. The government’s objective function is

$$EU_i^G = E\pi_i - \omega(e_i) + \delta EU_i^{CB}, \quad (4)$$

where δ denotes the relative influence of central bank losses and $\omega(e_i)$ is a positive function of the effort undertaken in the national banking sector. In what follows, we set $\omega(e_i) = \frac{\phi}{2} e_i^2$. The government’s utility function is thus akin to a weighted sum of individual welfare functions that also be interpreted as a political support function of a politically self-interested government (see Mueller 2003).

While (4) assumes that the government values a healthy national banking sector, the government’s perspective on the cost of prudential effort differs from private banks. First, we have that $\phi \neq \gamma$, with a natural assumption being that the government considers a smaller share of the private risk-reducing effort in its target function than the private sector itself $\phi < \gamma$. Second, the government will take into account the costs that occur if the central bank has to intervene to save the banking system. While each private bank considers only its own situation, the government considers the probability of any bank requiring bailout. Moreover, other than the individual private bank, the government is aware of the fact that if all banks are in trouble the central bank will have to bailout the system.¹³ As a consequence, from the

¹³ Hence, we have a typical difference between the perception of individual banks, employing the Nash-assumption, and the government that takes an encompassing view. Banks optimize without taking other banks into account but government takes a systemic view.

government's perspective, the probability of central bank intervention in case of an individual bank failure (which we defined τ^B for the individual bank) takes a value of one, $\tau^G=1$, so that $\underline{\pi}^G = B - L$.¹⁴

Taking into account the above and maximizing (4), we find the optimal level of effort from the point of view of the government is

$$e_i^G|_{Nat} = \frac{\theta_i \bar{\pi} + (1 - \theta_i) \underline{\pi}^G + \delta B}{\phi - \Delta^G}. \quad (5)$$

Since the government is the regulatory authority, we assume that it can impose its desired level of efforts on the private banks. Defining e_i^G as the measure of prudential effort or "regulation" demanded by the government, the level of effort provided in the banking system will be

$$e_i^*|_{Nat} = \max \left\{ e_i^G|_{Nat}, e_i^B|_{Nat} \right\}. \quad (6)$$

Under reasonable assumptions, the level of effort that the government will impose on the economy is larger than the level preferred by the private banking sector. In particular, we will always have $e_i^G > e_i^B \Rightarrow e_i^* = e_i^G$ if $\delta > 0$, $\phi < \gamma$, and n is not too large (see Appendix 1). This is because under these conditions the government has an interest to avoid bailouts, it is less averse against banks' efforts, and banks' incentives to provide efforts are not too strong (which are increasing in n because private banks then have higher incentives to provide effort).

4.2 An integrated banking system

With financial integration, the well-being of domestic banks will not only depend on their own profits but—through various channels—on the profits of banks abroad. We consider three different cases reflecting possible integration scenarios in the European banking industry.

A first scenario is that financial integration takes the form of domestic banks acquiring shares in a foreign bank, which implies that domestic banks will be sharing foreign profits. Under the so-called home rule, the domestic bank will continue to be regulated by the domestic regulator and the foreign bank will be regulated by the foreign regulator. To distinguish this case from the branch-scenario (see below), we shall assume that the foreign bank, even when becoming a full subsidiary of the domestic bank, is managed independently from the domestic bank. Secondly, we look at the case of cross-holdings where domestic banks hold shares abroad and foreign banks hold shares of domestic banks. In this case, too, domestic and foreign banks are supervised by their respective national regulators. Finally, we consider a scenario in a multinational bank holds a controlling stake in a foreign bank and contemplates running the foreign bank as a branch or subsidiary. In both cases the domestic bank will provide the prudential effort necessary to run the foreign bank. In all of these cases, regulation is carried out by national supervisors. The case of centralized regulation by an EU regulator is considered in Section 4.4.

¹⁴ This is for simplification only. Any $\tau^G > \tau^B$ will yield the same result.

4.2.1 Scenario 1: domestic bank with shares in foreign banks

For this case, we assume that a domestic bank acquires a share λ ($0 < \lambda < 1$) in a foreign bank. The domestic bank is labeled 1, the foreign bank is labeled 2. We consider only country 1. As already noted, we assume that the connection between banks remains loose and that both foreign and domestic banks continue to decide on their efforts individually.

The domestic bank's utility is

$$EU_1^B|_{Share} = [p_1\bar{\pi} + (1 - p_1)\underline{\pi} + \lambda E\pi_2](1 + e_1) - \frac{\gamma}{2}(1 + \lambda)e_1^2 \quad (7)$$

where $E\pi_2 = (p_2\bar{\pi} + (1 - p_2)\underline{\pi})(1 + e_2)$. In line with the previous section $p_2 = \theta_2 + \frac{1}{2}e_2$, but we allow for differing exogenous risk levels, that is $\theta_1 \geq \theta_2$. For simplicity, let $\theta_1 \neq \theta_2$ be the only difference between the two banks at home and abroad, so that the expected gain and losses (as well as the LoLR support) in both countries are equal. In other words, some countries are more likely to be hit by bad shocks than others but all else is symmetric.

Note that the bank's foreign holdings are treated similar to their domestic assets. Domestically banks can increase their profits by exerting costly efforts, for instance, through more closely monitoring their domestic credit projects. The basic idea here is that more of the same effort will also be helpful to increase revenue flows from abroad—for instance, by monitoring foreign bank managers and their credit projects or by ensuring that a larger part of foreign profits is distributed and not diverted to other uses, thereby increasing expected profits for a given level of foreign efforts.¹⁵

Another crucial feature of the expected utility function is that the domestic bank shares the foreign bank's profits but not its efforts. This reflects the assumed continued independence of the foreign banks—domestic managers do not take into account the efforts paid by foreign managers. They do, however, take into account the positive repercussions of the (given) level of expected foreign profits (linked to a given level of the foreign managers' efforts, $E\pi_2 > 0$, there is an additional benefit from a marginal increase in domestic effort.

Finally, we assume that the effort costs of the bank reflect both domestic and foreign activity. More specifically, Eq. (7) stipulates that a marginal increase in prudential effort e_1 will reduce marginal utility by $\gamma + \lambda\gamma$, with the first term reflecting domestic effort costs and the second term reflecting the costs of extra activities to monitor foreign holdings. Note that the assumption foreign prudential effort costs being proportional to λ is fairly conservative given the likely existence of increasing return to scale in monitoring domestic and foreign holdings in other banks.¹⁶

¹⁵ A key assumption is that efforts to e.g. monitor foreign activities are similar to monitoring domestic activity. While this will not apply for all types of foreign asset held by the bank, it seems a plausible assumption for an extension of the bank's core business activity to foreign markets.

¹⁶ Obviously, the bank will be more inclined to provide prudential effort in case of increasing returns to scale. Another extreme, albeit less plausible, scenario would be one in which the bank would have to prudentially monitor *all* activities of the foreign bank, even if it holds only a fraction of its assets. This would tend to discourage efforts and possibly cause the bank to abstain from making a foreign investment in the first place. Thus, our assumption that costs increase by a factor of $(1 + \lambda)$ seems fairly moderate in nature.

The bank's optimal efforts will thus be

$$e_1^B|_{Share} = \frac{\theta_1 \bar{\pi} + (1 - \theta_1) \underline{\pi}^B + \lambda (1 + e_2^*) \pi_2 (e_2^*)}{\gamma(1 + \lambda) - \Delta^B} \quad (8)$$

where e_2^* is the amount of effort provided by or imposed on the foreign bank (cf. (6)) and $\pi(e_2^*) = (\theta_2 + \frac{1}{2}e_2^*)\bar{\pi} + (1 - \theta_2 - \frac{1}{2}e_2^*)\underline{\pi}^B$.

The higher is the domestic bank's share in the foreign bank, the larger is the positive feedback effect it reigns from increasing its own efforts. Compared to the autarky case, discussed in the previous section, this leads to higher domestic efforts and higher expected domestic profits if the probability of a good state in country 2, θ_2 , is high enough and if the level of regulation demanded from the regulator in country 2, $e_2^*|_{NAT}$ (which increases in θ_2) is not much smaller than the level of regulation applied by the bank itself in autarky, $e_1^B|_{NAT}$ (see Appendix 2). The first two requirements ensure that the profitability of domestic efforts extended to the foreign investment are high enough, while the last condition ensures that efforts under autarky are not already too high (which would prevent them from being increased with holding foreign shares). If these conditions are fulfilled—a plausible assertion in a scenario in which foreign assets are acquired—overall efforts increase with financial integration. Thus, the higher is the effort level provided by the foreign bank, the higher is the incentive for the domestic bank to provide more efforts itself because it increases the payoff from more efforts.

For the government or regulator, we have the same effect. Optimal regulation from a national perspective requires an effort of

$$e_1^G|_{Share} = \frac{\theta_1 \bar{\pi} + (1 - \theta_1) \underline{\pi}^G + \lambda (1 + e_2^*) \pi_2 (e_2^*) + \delta B}{\phi(1 + \lambda) - \Delta^G}, \quad (9)$$

and, as before, regulation is binding in the sense that the effort demanded by the regulator exceeds the effort level that would be privately provided by banks. If the conditions shown in Appendix 1 are fulfilled, it also follows that $e_1^*|_{Nat} < e_1^*|_{Share}$.

Thus, the incentive for private banks to increase their efforts extends to regulators: financial integration need not result in a “race to the bottom.” Like the domestic bank, the government takes into account that the domestic banking system's profits are related to the profits of foreign banks. Because the government realizes that more foreign efforts make the provision of more efforts more worthwhile, it increases its regulation of the domestic banking system. Intuitively, this corresponds to a regulator who demands that banks that invest in foreign banks also invest in better surveillance of those banks and to monitor carefully their investments.

4.2.2 Scenario 2: cross holdings between banking systems

In the case of cross-holdings, bank 1 shares the profits of bank 2 and bank 2 shares the profits of bank 1. This probably best describes financial integration among equals—within the EU, say—where banks from already well developed banking systems acquire shares in each other. In contrast, the case of one-sided foreign holdings discussed above might characterize a form of involvement of old EU

member banks in the new EU member banking markets, with, for instance, a Finnish bank acquiring a share in a bank operating in the Baltics.

The objective function of bank i , ($i, j=1, 2, i \neq j$) is

$$EU_i^B|_{Cross} = [p_i\bar{\pi} + (1 - p_i)\underline{\pi} + \lambda E\pi_j](1 + e_i) - \gamma(1 + \lambda)e_i^2, \tag{10}$$

which implies that an additional channel exists through which banks’ prudential efforts influence benefits. Whereas in the case of one-sided asset holdings banks correctly assumed that their own efforts would not influence effort and profit levels abroad, two-sided asset holdings open the door for a “second round” effect. Banks in country 1 take into account that their own monitoring efforts also have a positive impact on the profits and effort level of the banks in country 2, which in turn feeds back into their own profits. The underlying mechanism is that, given λ , the marginal benefit for bank i from increasing e_i is increasing in the expected profit level of the bank j and vice versa.

Banks in country i provide efforts of

$$e_i^B|_{Cross} = \frac{(1 + \lambda^2(1 + e_j^*))[\theta_i\bar{\pi} + (1 - \theta_i)\underline{\pi}^B] + \lambda(1 + e_j^*)\pi_j(e_j^*)}{\gamma - \Delta^B(1 + \lambda^2(1 + e_j^*))}, \tag{11}$$

where $\pi(e_j^*) = (\theta_j + \frac{1}{2}e_j^*)\bar{\pi} + (1 - \theta_j - \frac{1}{2}e_j^*)\underline{\pi}^B$ and $i, j=1,2, i \neq j$. Because of the additional benefit channel, banks internalize some of the positive externalities of their own activities, which, in turn, will motivate foreign banks to increase their efforts as well. Whereas in the case of one-sided asset holdings, foreign banks had no incentive to increase their efforts due to financial integration, now both domestic and foreign banks will produce higher prudential efforts. The additional boost in the efforts of the representative bank in country 1 is visible in the factor $\lambda^2(1 + e_j^*)$.

Government regulation is

$$e_i^G|_{Cross} = \frac{(1 + \lambda^2(1 + e_j^*))[\theta_i\bar{\pi} + (1 - \theta_i)\underline{\pi}^G] + \lambda(1 + e_j^*)\pi_j(e_j^*) + \delta B}{\phi - \Delta^G(1 + \lambda^2(1 + e_j^*))}. \tag{12}$$

Following the logic developed earlier, the government will take into account the positive feedback from domestic regulation inducing higher prudential efforts at home in the case of cross-holdings. Accordingly, it will demand higher levels of effort from the domestic financial sector. As in scenario 1, financial integration need not lead to a “race to the bottom.”

4.2.3 Scenario 3: multinational banks with a controlling stake

Finally, we consider the case of a multinational bank. This could take two forms. First, the bank might acquire a foreign bank and take control of that bank. Examples would include a take-over of, say, a German by an Italian bank or banks from old EU member states taking over banks in the new member states as a subsidiary. The other case would be a domestic bank opening branches abroad. The two cases differ

under current EU law because subsidiaries are under the regulation of a foreign regulator, whereas branches are regulated by the domestic regulator. The organizational choice of the bank—or “supervisory arbitrage”, as it is sometimes called—is considered in the next subsection. The bank’s optimization with regard to prudential effort, however, is independent of the supervisory structure and will be discussed first.

4.2.4 Optimal effort

In the multinational bank scenario—be it in the form of branches or subsidiaries—the domestic bank now has a more profound interest in foreign banks. It shares not only the foreign profits but also the effort undertaken (and the implied cost) abroad. This reflects the fact that the domestic bank is now fully responsible for the behavior and stability of the foreign bank. Assuming that it can set domestic and foreign effort levels separately, its optimal choice will reflect national markets’ characteristics, that is, differences between θ_1 and θ_2 .

Expected utility in the multinational bank case is

$$EU_1^B|_{Multi} = [p_1\bar{\pi} + (1 - p_1)\underline{\pi}](1 + e_1) + \lambda[p_2\bar{\pi} + (1 - p_2)\underline{\pi}](1 + e_2) - \gamma(e_1^2 + \lambda e_2^2) \quad (13)$$

where e_1 and e_2 , mark the bank’s efforts in the two countries. The optimal levels are

$$e_i^B|_{Multi} = \frac{\theta_i\bar{\pi} + (1 - \theta_i)\underline{\pi}^B}{\gamma - \Delta^B} \quad i, j = 1, 2 \quad (14)$$

This shows that private efforts under multinational banking are similar to a situation where the two banks optimize independently. This is because we assume no cross-holdings here but that the two banks are run only with a perspective to their individual markets. Thus, in both cases the optimal levels correspond to (2). In other words, the optimal private effort levels do not depend on who owns the banks (given that preference parameters are assumed to be identical across countries).¹⁷ Likewise, regulators continue to determine regulation independently and the level of effort required by them is the same as in the national case (cf. (5)). This is because under the home rule principle governments set regulatory levels only with respect to national markets.

4.2.5 Branches or subsidiaries?

In the case of multinational banks that hold controlling interests in foreign banks, the question arises whether banks should open branches in foreign countries and compete with foreign banks or rather try to acquire them. In our simple model, the two strategies only differ in the regulatory authority to which the banks have to refer.

¹⁷ Efforts in the banking system in country 2 would be higher if controlled by the multinational bank than by an independent bank in country 1 if the multinational bank’s aversion to efforts are lower than the independent bank’s ($\gamma_1 < \gamma_2$) which we have excluded by assumption. In general, there can of course be a difference between effort levels provided by the domestic and the foreign banking system.

As already mentioned, branches are regulated by the home authority (by virtue of the “single banking pass”) while subsidiaries are subject to the host country’s regulation.

To understand better the bank’s organizational decision, consider a simple thought experiment where the effort levels demanded by governments or regulators in country 1, e_1^* , and country 2, e_2^* , differ, reflecting varying views of the national authorities regarding the optimal levels of regulation as given in (5).¹⁸ With a branch structure (indexed b), bank 1 has expected utility of $EU_1^B|_{Multi}^b = E[(1 + e_1^*)(\pi_1(e_1^*) + \lambda\pi_2(e_1^*))] - \gamma(1 + \lambda)(e_1^*)^2$ whereas with subsidiaries it is $EU_1^B|_{Multi}^s = E[(1 + e_1^*)\pi_1(e_1^*) + \lambda(1 + e_2^*)\pi_2(e_2^*)] - \gamma(e_1^*)^2 - \lambda\gamma(e_2^*)^2$ with $e_i^* = e_i^*|_{Nat}$.

Appendix 3 shows that the domestic banks will prefer the branch structure (where it is subject to domestic regulation) over the subsidiaries structure (even if the domestic regulatory burden is higher) if θ_2 is high, if Δ^B is large and if γ is not too large. Thus, if the profitability of higher efforts is larger than the increased costs with more efforts the bank is willing to accept higher regulation. If this is not the case, the bank will only choose branches if the regulatory burden imposed by the domestic regulator is lower. In this case, the bank will follow a strategy of regulatory arbitrage. That is, the bank will cast its foreign activity in the organizational form that minimizes the difference between the optimal efforts it would undertake from its own point of view and the (higher) levels of effort that are enforced by regulators at home or abroad.

4.2.6 Welfare

Two results are particularly relevant from a European perspective. First, even when unrestricted by regulators, prudential efforts undertaken by private domestic banks increase if banks share in the profits of foreign banks. Banks realize there is a feedback-effect from their own efforts: higher domestic efforts will increase the profits of foreign banks, which, in turn, will lead to higher domestic profits. As a consequence, internationally active banks will not necessarily reduce their prudential efforts. By the same logic national regulators will require domestic banks to provide more efforts.

However, nothing ensures that the amount of effort enforced by national regulators is optimal from a European (or international) planner’s perspective. In fact, as Appendix 4 shows, a social planner, maximizing $EU^{SP} = \frac{1}{2}EU_1^G + \frac{1}{2}EU_2^G$ would in general set levels of regulation that deviate from those that national regulators will set. The reason is that national regulators do not take into account how national efforts reduce crisis probabilities in other countries. Appendix 4 demonstrates that from a European point of view, national regulation will therefore be inadequately low because it does not take these spillovers into account. In the case of a national bank holding a share in the foreign bank, the regulator in country 2 is ignorant of the fact that more efforts in country 2 induce banks in country 1 to provide more efforts. Hence, regulation in country 2 is too low from a European perspective. Since regulation in country 1 is increasing in e_2^G , it is too low as well from a European perspective. The same logic applies to the case of cross-holdings.

¹⁸ In the model this could only be the case if $\theta_1 \neq \theta_2$. In reality, there can of course many additional reasons for differences in the level of regulation, not least preferences.

Here, too, national regulators react positively to effort levels provided by foreign banks but ignore that domestic regulatory levels influence foreign regulators.

What are the policy implications of inefficiently low levels of national regulation? One conclusion would be to demand a common regulation of banks at the European level. To address this question, we now consider the role of a common lender of last resort and the case of a European regulator of banking activities.

4.3 The lender-of-last-resort

Monetary integration in Europe changes the setup under which private banks and governments or regulators operate. A common central bank implies that national lenders-of-last resort disappears. National central banks can no longer independently bail out national banking systems in case of negative shocks because they are part of the Eurosystem.¹⁹ To the extent that EU members have already joined ERM2 and, thereby, restricted exchange rate movements to the euro, this constraint will be binding for them as well. In what follows, we will assume that both the domestic and the foreign country are part of the euro area in this wider sense.

Assume that the common central bank, the ECB, is concerned with the stability of the international banking system as a whole—for instance, because both country 1 and country 2 are euro area members or because country 1 represents the euro area and country 2 is an ERM2 member at the brink of joining the euro area. More specifically, we assume that it is concerned with a weighted average of national banking systems of member states. That is, the ECB's utility function is a weighted sum of the national banking systems, depending on the national probabilities to be hit by a negative shock (a function of national efforts) and the bailouts that would be necessary to save national banking systems in the EU

$$EU^{ECB} = \frac{1}{2}EU_1^{CB} + \frac{1}{2}EU_2^{CB}. \quad (15)$$

The ECB, like the national central banks before it, will aim to minimize the probability that the banking system is faced with collapse—only that it takes an area-wide perspective. It will intervene, however, only if the banking system is hit by a crisis large enough to make the *entire* system collapse. If only one national banking system is hit, the ECB might decide not to intervene in order to avoid that private banks and national regulators revise their subjective probability of private banks being bailed out and reduce their own prudential efforts or regulatory demands.

As a consequence, private prudential efforts will increase under a European bailout scheme. The argument is quite straightforward: in all domestic and financial integration scenarios discussed so far, private prudential effort, e_1^B , is increasing in $1/\tau^B$. At the same time, for any single national bank, the probability of being bailed out by the common central bank was $\tau^B = \frac{1}{n}$, with n representing the number of domestic banks. Under ECB-rule, however, the denominator will increase and τ^B will fall by a factor

¹⁹ This might not literally be the case, but European monetary integration has significantly reduced the powers of national central banks and national governments can no longer be sure of the intervention of the (or their national) central bank.

proportional to the number of countries that are members of the euro area (or the group of countries the ECB takes into consideration because of other reasons). In the symmetrical case, we have $\tau^B = \frac{1}{2n}$. Thus, prudential efforts of private banks across the area will be higher if bailouts are delegated to the area level than under a national bailout-regime. Financial integration without a single central bank does not have this effect because only a single central bank creates more ambiguity and hence induces more efforts from private banks.

A similar result holds for national regulators or governments. With a national LoLR, national authorities calculated the aggregate probability of a central bank bailout in case of systemic bank failure as unity. However, for national regulators, too, this probability is now a declining function of the size of the area subjected to the ECB regime. Accordingly, in the two-country case, the bailout probability falls to $\tau^G = 1/2$.²⁰ At the same time, national authorities take into account bailout costs occurring at the ECB level by a correspondingly smaller factor (i.e., costs are shared). On the one hand, a decrease in the probability of a bailout should increase national regulatory demand; on the other, a reduced government concern for bailout costs points in the other direction. Appendix 5 shows that regulatory demands are likely to be higher under the ECB regime compared to a national LoLR setup if national authorities pay little attention to regulation costs occurring at the private level (i.e., if ϕ is low).

This logic can directly be extended to the case of the absence of a LoLR at the area level—which is linked to the case for creative ambiguity.²¹ In this case, both governments or regulators and private banks will set the bailout probability to zero. Therefore the absence of a LoLR unambiguously increases prudential efforts undertaken by private banks and the demand for regulation by national authorities.

4.4 Coordination of regulators

So far, we have assumed that the regulators in the two regions set their regulations independently. But apart from creating (or not creating) a common LoLR, regulating authorities might go beyond the current degree of cooperation and information sharing following the Lamfalussy-model and opt for a more centralized solution. Arguably, if financial markets in the EU continue to integrate and if private sector interdependencies increase further, governments may decide that the time has come for a common regulator.

In this case it is reasonable to expect that the common regulator would apply the same level of regulation to all member countries and follow a “one size fits all” strategy.²² We assume that the common regulator is paired with one area-wide

²⁰ With m member countries the subjective probability of a national regulator would be $\tau^G = 1/m$. Thus, national regulators increase their regulatory demands from national banks with the number of member countries.

²¹ Arguably, such a scenario captures elements of the euro area status quo where a clear LoLR responsibility has not been assigned to the ECB. This ignores opinions that argue that the ECB de facto has this function nevertheless (see discussion above).

²² Here the common regulator deviates from what the social planner would do. The latter would allow for nationally differentiating levels of regulation which is unlikely to be possible in practice.

LoLR, and that the common regulator maximizes a target function that represents a weighted average of the objective functions of national regulators:

$$EU^{CR} = \frac{1}{2}EU_1^G + \frac{1}{2}EU_2^G. \quad (16)$$

Optimal regulated prudential effort in this case would be

$$e^{CR} = \frac{\frac{1}{2}[\theta_1\bar{\pi} + (1 - \theta_1)\underline{\pi}^{CR}] + \frac{1}{2}[\theta_2\bar{\pi} + (1 - \theta_2)\underline{\pi}^{CR}] + \delta B}{\phi - \Delta^{CR}}. \quad (17)$$

In contrast to national regulators, the common regulator will naturally adopt an EU-wide perspective. In particular, this implies the regulator takes into account that the ECB intervenes if national banking systems are in trouble. While every national government or regulator assigns a probability of $\tau^G = 1/2$ to the central bank's intervention, the common regulator assigns $\tau^{CR} = 1$ to this possibility.

There are two opposing forces determining the area-wide regulators demand for prudential effort. On the one hand, the common regulator is aware the lender of last resort will intervene if the European banking system is in danger of failure. Therefore, the creative ambiguity created by the common LoLR in case of national regulators is lost and regulatory demand for prudential effort falls. On the other, the common regulator will take full account of the bailout costs arising for the common central bank and LoLR, while national authorities ignored the share of cost paid for abroad. This will tend to increase demanded precautionary effort from private banks. Setting $\theta_1 = \theta_2$ to isolate the influence of the common LoLR, it becomes obvious, however, that a common regulator will be less demanding on banks than a national regulator in the presence of a common lender of last resort.

5 Conclusion

The paper develops a simple model of financial integration between national banking systems. The basic mechanism builds on the twofold impact of prudential effort by private banks: more prudential selection and monitoring of lending and other asset-related activities will both reduce the probability of financial crises and increase expected profits. If more of the same effort will also be helpful to increase revenue flows from foreign banking assets held by domestic banks (e.g., through better monitoring foreign bank managers or their credit projects), international financial integration can increase the national banking system's overall prudential efforts even if extending efforts increases costs. Thus, financial integration need not imply, as is often feared, more crisis prone banking systems. Along similar lines, if national regulators take into account at least some of these effects, it is less likely that financial integration will lead to "a race to the bottom" between regulators. That does not mean, however, that private efforts or uncoordinated national regulation reach efficient levels. As a rule, private efforts will fall short of the effort level demanded by regulators. And because regulators do not fully internalize the external

effects of their activities on other member states in an international (or European) context, the level of prudential effort demanded by national regulators tends to be too low from a social planner's point of view.

While this would justify a centralization of regulation at the European level, a European regulator may be problematic from another perspective. This is because the prudential efforts of private banks and the level of regulation set by national authorities are decreasing functions of the subjective probability that the central bank would intervene as a lender of last resort. European monetary integration and the creation of the ECB have lowered the probability that a central banks would intervene to save individual banks or single national banking systems in the euro area or ERM2 countries. The creation of a common regulator at the European level, however, could imply that the positive effect of this "creative ambiguity" that arises with national regulators is lost. A common regulator will be less uncertain about an eventual intervention of a common lender of last resort and regulatory requirements may therefore be lower with a common regulator. The implication of this result is that centralizing financial regulatory authority is not necessarily desirable in the presence of a centralized LoLR. In fact, there is a trade-off when centralizing LoLR and regulatory functions. By abolishing national central banks and not explicitly creating a European lender of last resort, individual national regulatory and private efforts to avoid financial crises are reinforced, and centralizing national regulators in the absence of a common (or national) LoLR will lead to more prudential regulation because externalities that national authorities ignore are internalized. However, centralizing *both* the LoLR and the regulatory function may reduce the level of prudential efforts.

The theoretical framework described here is a simple one that usefully could be extended in a number of directions. For instance, we only look at the extreme cases of full or no cooperation among national regulators, ignoring the many shades in between that might strike a balance between the trade-off derived here. Likewise, the assumption that domestic and foreign prudential efforts by banks are complements rather than substitutes, while reasonable in general, may not hold for all types of financial institutions. Allowing for different types of "efforts" with different consequences is an interesting field for further research. Finally, we have only looked at a one-shot game between regulator and bank, leaving room for future research based on a more explicit dynamic time-structure.

Appendix 1: The condition for $e_i^G > e_i^B$

The condition for $e_i^G > e_i^B$ is $(1 - \theta)(\phi \underline{\pi}^B - \gamma \underline{\pi}^G) + \theta \bar{\pi}(\phi - \gamma) + \bar{\pi}(\underline{\pi}^G - \underline{\pi}^B) < \delta B(\gamma - \Delta^B)$. It is clear that $\underline{\pi}^G > \underline{\pi}^B$ because the probability of a bailout is larger from the point of view of the government; moreover, $\gamma > \phi$ by assumption. Thus, the first two terms on the LHS are negative and thus the RHS of the inequality is larger if δB is sufficiently large and if n is not too large (in which case $\underline{\pi}^G > \underline{\pi}^B$ becomes too large).

Appendix 2: Comparing bank efforts when banks holds shares in foreign banks

Comparing (5) and (8) it follows that $e_1^B|_{\text{NAT}} < e_1^B|_{\text{Share}}$ if $\gamma\lambda \frac{[\theta_1\bar{\pi}+(1-\theta_1)\underline{\pi}^B]}{\gamma-\Delta^B} < \lambda\pi_2 (e_2^*|_{\text{Nat}}) (1 + e_2^*|_{\text{Nat}})$ which collapses to $(e_1^B|_{\text{Nat}}) < \frac{1}{\gamma}\pi_2 (e_2^*|_{\text{Nat}}) (1 + e_2^*|_{\text{Nat}})$. The first expression shows that this condition is always fulfilled if costs from monitoring foreign shares are not increasing (the term on the left would become zero). Moreover, the condition is fulfilled if expected gains from the investment and foreign efforts $\pi_2 (e_2^*|_{\text{Nat}})$ are high enough. A simple thought experiment shows this clearly: Setting $\theta_1 = \theta_2 = \theta$ and using $\pi_2 (e_2^*|_{\text{Nat}})$ as defined above and substituting e_2^B for e_2^* yields that it is always fulfilled. Because e_2^B is the minimum value for e_2^* , the condition is fulfilled for $e_2^* > e_2^B$ and $\theta_1 = \theta_2 = \theta$. Only if θ_2 is much smaller than θ_1 , the condition could be violated.

Appendix 3: Branches vs. Subsidiaries

$EU_1^B|_{\text{Multi}}^B > EU_1^B|_{\text{Multi}}^S$ requires $(\theta_2\pi + (1-\theta)\underline{\pi}^B)(e_1^* - e_2^*) + \Delta^B \left[(1 + e_1^*) \frac{e_1^*}{2} - (1 + e_2^*) \frac{e_2^*}{2} \right] > \frac{\gamma}{2} (e_1^{*2} - e_2^{*2})$, which compares the profitability of higher efforts in increasing the profits from activities abroad (collected on the LHS) with the higher costs of efforts if $e_1^* > e_2^*$. This is the case if θ_2 is high, if Δ^B is large and if γ is not too large. The optimal level of efforts from the point of view of the bank is given by (14). Using this in the above condition, it can be rewritten more compactly as $2e_2^B + \frac{\Delta^B}{\gamma-\Delta^B} > e_1^* + e_2^*$.

Appendix 4: Comparison of efforts under national regulation and optimal efforts

Bank 1 holding a share of bank 2 The optimal level of effort for bank 1 from the government's point of view is given as $e_1^G|_{\text{Share}} = \frac{[\theta_1\bar{\pi}+(1-\theta_1)\underline{\pi}^G]+\lambda\pi_2(e_2^*)(1+e_2^*)+\delta B}{\phi(1+\lambda)-\Delta^G}$ which is also what the social planner would set. The government in country 2, however, will set a level of effort corresponding to (5), while the social planner sets $e_2^{SP}|_{\text{Share}} = \frac{[\theta_2\bar{\pi}+(1-\theta_2)\underline{\pi}^G](1+\lambda(1+e_1^*))+\delta B}{\phi-\Delta^G(1+\lambda(1+e_1^*))}$ which is higher than in (5).

Cross holdings With cross holdings, the government would demand a level of efforts of $e_i^G|_{\text{Cross}} = \frac{[\theta_i\bar{\pi}+(1-\theta_i)\underline{\pi}^G](1+\lambda^2(1+e_j^*))+\lambda\pi_j(e_j^*)(1+e_j^*)+\delta B}{\phi-\Delta^G(1+\lambda^2(1+e_j^*))}$. The optimal efforts from the social planner's point of in the two countries are however $e_i^{SP}|_{\text{Cross}} = \frac{[\theta_i\bar{\pi}+(1-\theta_i)\underline{\pi}^G](1+\lambda(1+\lambda)(1+e_j^*))+\lambda(1+\lambda)\pi_j(e_j^*)(1+e_j^*)+\delta B}{\phi-\Delta^G(1+\lambda(1+\lambda)(1+e_j^*))}$ which is higher.

Appendix 5: Comparison of regulation with a national and a common central bank

The condition for $e_i^G|_{CB} > e_i^G|_{ECB}$, where CB refers to the national central bank and ECB to the common central bank by using (5) and the respective values for τ is $(1 - \theta_i + \delta)\phi > (1 + \delta)\bar{\pi} + \delta L$. Thus, if the potential bank losses under a default are high and if the aversion to regulation ϕ is low, the government will increase regulation with a single central bank.

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