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## Banking Unions: Distorted Incentives and Efficient Bank Resolution

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Tinbergen Institute Discussion Paper



# Banking Unions: Distorted Incentives and Efficient Bank Resolution

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# Banking Unions: Distorted Incentives and Efficient Bank Resolution\*

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*- preliminary and incomplete. comments and suggestions are welcome -*

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# Banking Unions: Distorted Incentives and Efficient Bank Resolution

## Abstract

This paper studies the optimality of a banking union in a setting with cross-country liquidity spillovers and moral hazard. Generally, the banking union improves welfare by efficiently providing liquidity to banks, thus limiting spillovers from bank defaults across the member countries. At the same time, however, the banking union will resort to bank bailouts more often, distorting risk incentives of banks. For low bank liquidation costs, the net welfare effect of a banking union can be thus negative. For welfare enhancing banking unions, countries with net creditor banking systems always pay most of the joint bailout costs. In equilibrium, all countries are less willing to join a banking union which induces moral hazard.

**Keywords:** banking, financial intermediation, risk shifting, banking union

**JEL Codes:** G15, G18, G21, G33

# 1 Introduction

IN LIGHT OF THE RECENT FINANCIAL AND DEBT CRISES, the design of a banking union has become one of the focal points in the Eurozone policy debate. On July 10, 2013, the European Commission proposed a Single Resolution Mechanism (to be enforced from 2015) which has as main purpose to:

“centralise key competences and resources for managing the failure of any bank in the Euro area” (European Commission Press Release, July 10, 2013) <sup>1</sup>.

One of the main benefits of such an institution is that it might create a mechanism to avoid interbank liquidity and insolvency spillovers across countries. Thus, it would provide a more efficient resolution mechanism, reducing the cost taxpayers would have to pay for bailouts. [Carletti and Allen \(2012\)](#) argue that a regulatory union will allow breaking the vicious circle between banking and sovereign risk, as currently credit institutions hold significant amounts of national government debt. Sovereigns’ failure can also impact credit institutions abroad: the French and Belgian bank Dexia has been bailed out three times since 2008, mainly due to large exposures to Greek sovereign debt instruments.

The Dexia bailout<sup>2</sup> also unveiled a different problem, intimately related to the concept of a banking union: how would multi-national banks optimally be bailed out when the cost has to be shared by multiple regulators? It is now a widely accepted view that the financial crisis has been exacerbated by a lack of co-ordinated regulatory response in Europe. [Allen, Beck, Carletti, Lane, Schoenmaker, and Wagner \(2011\)](#) state that “*national regulators care first and foremost about domestic depositors, domestic borrowers, domestic owners and, ultimately, domestic taxpayers*”, which created severe conflicts of interest between national regulators when confronted with cross-border bailouts. This points out a crucial difference ([Coeure \(2013\)](#)) between the European the U.S. financial environments: in the United States, the introduction of the FDIC (a common resolution fund) followed the fiscal union. In Europe, the cost-sharing rules between member countries of any bank bailout are not fully established, as there is no European fiscal union.

A single regulatory institution is also more natural in an integrated banking environment. As banks become increasingly interconnected, shocks to the banking sector in one country can easily transmit across borders. Cross-border banking flows in Europe have increased steadily since as early as 1989, when new legislation has been passed in the form of two regulatory acts: the Single Banking Licence and the Second Banking Directive. Contagion, either through direct interbank exposure, systemic risk holdings or panic runs, has created externalities at European rather than national level: [Claessens, Herring, and Schoenmaker \(2010\)](#) report that for 20 systemic European

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<sup>1</sup>The full document is available [here](#)

<sup>2</sup>as well as the bailout/take-over of Fortis, a Dutch-Belgian bank

credit institutions, the average foreign asset holding, as well as the average foreign share of income, was around 65%. We compile evidence on European banks in 11 Eurozone countries and we find that more than 60% of the international exposures are with European counterparties (Figure 1), amounting between 3 and 7 trillion dollars.

Figure 1 here

A closer look to individual positions shows the cross-border capital flows within Europe have a certain directional pattern. The largest Eurozone economies (Germany, France, Netherlands) are large net creditors to banking sectors from the highly-indebted GIIPS countries (Greece, Spain, Portugal, Italy, Ireland)<sup>3</sup>. The significant cross-border imbalances makes the European financial system vulnerable to spillovers of negative shocks between debtor and creditor countries, as shown by the recent financial crisis. We report the net and total international balances of banks from selected countries against the two groups of European states in Figure 2.

Figure 2 here

Figure 2 shows the *total* net exposure of the banking sectors against other countries<sup>4</sup>. Developed countries such as Germany, France and the Netherlands had the largest gross position with the GIIPS countries. Their position is remarkably one-sided: about 80% is represented by claims on the GIIPS. By contrast, the positions taken by German, French and Dutch banks among themselves are much more balanced.

A supranational regulator is expected to limit the cross-border spillovers from bank defaults, conduct ex-post interventions more efficiently and at lower cost. However though, there is some indication that the supranational regulator would be more lenient ex-post, exactly to avoid contagion to other member banks. [Allen, Beck, Carletti, Lane, Schoenmaker, and Wagner \(2011\)](#), [Gimber \(2012\)](#) and [Allen, Carletti, Goldstein, and Leonello \(2013\)](#) argue that regulators with a large pool of resources might face a relatively worse commitment issue and higher moral hazard. [Beck, Todorov, and Wagner \(2011\)](#) also find that a supranational regulator will be more lenient to avoid contagion, but they abstract from including any endogenous risk taking decisions of the banks. The recent development of the crisis seems to confirm the academic theories. In January 2012 the ECB insisted

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<sup>3</sup>[Avdjiev, Upper, and Kleist \(2010\)](#) presents additional evidence on the significant net exposure of the largest Eurozone countries to the banking sectors in the GIIPS (see Graph 3 ).

<sup>4</sup>Due to data limitations, we cannot further disaggregate the positions into exposures to the public sector, to the non-bank private sector and to the financial sector

that Irish government repay senior debt in the Anglo Irish Bank at face value, whereas the Irish national bank was ready to impose haircuts<sup>5</sup>.

The main contribution of our paper is to study the interaction between the efficiency gains and the potential incentive problems implied by a joint resolution mechanism. We allow for cross-border spillover effects in a setting with endogenous moral hazard at the bank level. The contagion effects are modelled through direct interbank exposures, as in [Freixas, Parigi, and Rochet \(2000\)](#) or [Allen and Gale \(2000\)](#). Our focus is on ex-post policies (resolution mechanisms) rather than ex-ante supervision (through capital requirements for instance). We take this perspective following the argument of [Acharya \(2003\)](#), who states that the ex-ante regulatory framework is fairly common across countries, partly due to common agreements such as Basel III.

Our findings indicate that indeed, a banking union can provide liquidity more efficiently in case of a bank failure by eliminating cross-border spillover effects. Thus, the fiscal burden taxpayers have to support is reduced. On the other hand, systemically important banks will be bailed out more often, which reduces their incentive to monitor risks. Internalizing the effect of spillovers makes liquidation or bail-in threats less credible, worsening risk-taking incentives under a banking union. The net impact on welfare depends on the cost of liquidation relative to the the fiscal cost of a bailout. For low enough bank liquidation losses the reduction in market discipline outweighs the benefits from eliminating spillovers and the net effect of introducing banking union is a drop in welfare.

The key to understand the mechanism is acknowledging that the cross-border interbank market acts as a double disciplining force under national resolution policies. Firstly, banks earn profits by leveraging in the international market. The potentially higher profit offers better incentives for a bank to monitor its loans. Secondly, it allows national regulators to make a credible liquidation threat, as they do not internalize the cross-border spillover losses (a similar point is made by [Beck, Todorov, and Wagner \(2011\)](#)). A banking union, on the other hand, will internalize the international effect and liquidation threats lose their credibility.

We endogenize the decision of a national regulator to join a banking union. Net creditor countries contribute more than proportionally to the union bailout costs, as they benefit most from a banking union eliminating exposure spillovers. However, when a banking union worsens market discipline, their share of the costs drops significantly. Moreover, in the presence of additional risk taking incentives, there is less room for negotiating a feasible banking union. This set of findings could have important policy implications in designing the country specific shares in the European banking union by taking into account the total effect of a single resolution authority.

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<sup>5</sup>See [here](#)



The remainder of the paper is structured as follows. Section 2 discusses the relevant literature on banking unions, bailouts and moral hazard in financial intermediation. We present the model in Section 3. In Section 4 we look at the influence of credible ex-post bailout strategies on the moral hazard problem of banks, in a very simple setting. We extend our analysis to a multi-country setting with national resolution mechanism in Section 5. Section 6 studies the equilibrium under a joint resolution mechanism and comparative welfare analysis. Endogenous banking unions and cost sharing rules are considered in Section 7. Section 8 concludes.

## 2 Related Literature

Our paper adds to the European public and academic debate on banking unions. [Schoenmaker \(2011\)](#) points out there is a "financial trilemma" in banking regulation: the impossibility of having financial integration, national policies and financial stability at once. [Carmassi, Di Noia, and Micossi \(2012\)](#) argue for a supervisory institution with full crisis management powers in Europe, similar to the FDIC in the United States. In a similar fashion, [Schoenmaker and Gros \(2012\)](#) argue for a European Deposit Insurance and Resolution Authority (EDIRA), and prove that local resolution and central supervision are not incentive compatible. [Ferry and Wolff \(2012\)](#) discuss the fiscal implications of a banking union, or how the cost could be shared between different countries: either by an European Resolution Fund, ex-ante burden sharing agreement, or contingent European taxation). [Schoenmaker and Siegmann \(2013\)](#) find that a common regulatory institution can better deal with cross-border externalities. On the other hand, [Allen, Beck, Carletti, Lane, Schoenmaker, and Wagner \(2011\)](#) notice that the future common regulator can be more lenient towards failing institutions than national regulators and thus distort ex-ante risk taking incentives of banks. They also discuss the feasibility of creating a well-functioning banking union in Europe. On the empirical side, [Schoenmaker and Wagner \(2013\)](#) look at cross-border banking and propose a methodology to compare benefits and cost of financial integration.

The largest part of the banking literature focuses on the ex-ante regulation of banks. Close to our paper, [Dell’Ariccia and Marquez \(2006\)](#) find that, when the degree of regulatory control is heterogeneous, centralised regulation is preferred by individual countries only if it entails higher regulatory standards for all participating countries. However, they mainly focus on capital requirements. [Bengui \(2011\)](#) looks at international coordination in financial regulation and considers ex-ante policies in a two-country model with liquidity shocks. He finds that prudential regulatory policies are strategic substitutes across countries and thus international coordination is necessary to prevent national regulators from free-riding on foreign liquidity provision when a crisis materialises.

The importance of ex-post policies is recognised in a number of studies: [Acharya \(2003\)](#) makes

the point that since the ex-ante banking regulations are converging to international standards, the interaction between ex-ante and ex-post incentives becomes crucial to understanding banking systems. In his model, national regulators conduct too lenient bailout policies in order to give domestic banks a comparative advantage over foreign competitors. [Allen, Carletti, Goldstein, and Leonello \(2013\)](#) discuss a moral hazard model where government guarantees induce risk taking by banks and less incentive to run by depositors. Blanket guarantees are not desirable, as authorities with deeper pockets face a more severe commitment problem.

The ex-post regulator commitment not to bail out is a theoretical challenge in the literature. [Gimber \(2012\)](#) considers endogenous bailouts, where the government commits ex-ante by investing in a bank resolution regime. Closest to our paper, [Acharya and Yorulmazer \(2008\)](#) consider fiscal costs above the face value of the bailout as a commitment device for the regulators. [Chari and Kehoe \(2013\)](#) find that limits to debt-to-value ratio can be used to mitigate the incentives of governments to take bailouts.

Our paper is closest in spirit to [Beck, Todorov, and Wagner \(2011\)](#), who develop a model featuring ex-post regulatory intervention and cross-border banking. They also find that a larger share of cross-border liabilities can incentivise the regulator to liquidate the domestic bank. However, their model abstracts from any moral hazard issues arising with a common regulator, as well as endogenous formation of a banking union. To our knowledge, this paper is the first to integrate these features into a cross-border banking model.

Our analysis also relates to the literature of bank failure spillovers and moral hazard. [Freixas, Parigi, and Rochet \(2000\)](#) model interbank lines in a systemic setting and point out the role of central bank in preventing liquidity shocks spillovers. [Farhi and Tirole \(2012\)](#) find an equilibrium where banks coordinate on large maturity mismatch and take too much risk, in a setting where the government only intervenes in the financial sector for high enough social costs. In modelling the scope of the interbank market, we come close to [Allen, Carletti, and Gale \(2009\)](#), where the interbank market is mainly used to hedge liquidity shocks. Finally, [Kara \(2012\)](#) finds that national regulators have incentives to cooperate when there is systemic risk: a central regulator can achieve a Pareto improvement by internalising the systemic component.

In a different setting, studying the debt overhang problem, [Philippon \(2010\)](#) discusses a similar mechanism: coordinated bank bailouts can improve overall system efficiency, whereas individual countries might not have the incentives to bail out their own financial system - as some gains are transferred abroad. We extend this framework by adding ex-ante incentives (moral hazard) for the banks, as well as endogenizing the participation to a coordinated resolution mechanism (banking union).

## 3 Model

### 3.1 Primitives

This section presents the model's primitives. Extensive motivation for these primitives is left to subsection 3.2. The model is largely based on Acharya and Yorulmazer (2008) and Holmstrom and Tirole (1997). We consider an economy with four dates,  $t \in \{-1, 0, 1, 2\}$  and 2 countries labeled  $A$  and  $B$ , each with its own banking sector, regulator, depositors and outside investors. In each country there are three types of agents: a bank ( $BK_A$  and  $BK_B$ ), a local regulator ( $RG_A$  and  $RG_B$ ), depositors and "deep pockets" outside investors. At date  $t = -1$ , local regulators can agree to merge in a supra-national banking union:  $RG_{BU}$ .

**Depositors** Depositors receive heterogenous endowments at dates 0 and 1: depositors in country  $A$  receive  $1 + \gamma$  units and depositors in country  $B$  receive  $1 - \gamma$  units. We let  $\gamma$  take values in the interval  $[\underline{\gamma}, 1]$ , where  $\underline{\gamma}$  is positive and can be arbitrarily close to 0. Every period, they have the choice to invest their money in the bank (earning the deposit rate  $r > 1$ ) or in a cash storage technology that yields zero interest rate. At date  $t = 1$ , a fraction  $\phi$  of depositors receive a liquidity shock and withdraw their deposits without earning interest (as in Diamond and Dybvig (1983), for example); conditional on  $\phi$ , all depositors have an equal chance of being hit by the liquidity shock. Depositors are fully insured by the regulator - we do not consider any bank run equilibrium.

**Long-term asset** Both banks have access to a constant returns to scale productive technology that requires an investment,  $X \in [0, 1]$ , at date  $t = 0$  and produces returns at both  $t = 1$  and  $t = 2$ . The investment has a country specific stochastic return at  $t = 1$  of  $\tilde{R}_1 = \{0, R_1^A\}$  per unit for bank A and  $\tilde{R}_1 = \{0, R_1^B\}$  for bank B, whereas the second period return per unit of investment is deterministic and equal to  $R_2 > 1$  for both countries. In addition to loans, banks also have access to a cash storage technology that yields zero return.

**Assumption 1:** *We impose the following (technical) conditions on  $R_1^A$  and  $R_1^B$ :*

1. *The maximum project proceeds at  $t = 1$  cover all liquidity shocks. There is no default in the best case scenario.*

$$R_1^A + R_1^B \geq 2\phi \tag{1}$$

2. *The maximum project proceeds at  $t = 1$  for Bank A are insufficient to cover the liquidity shock if the deposits exceeding the productive capacities are kept as a zero-yield buffer.*

$$R_1^A \leq \phi + \underline{\gamma}(\phi - 1) < \phi \tag{2}$$

**Monitoring** We allow for potential moral hazard at each bank: banks can choose to monitor or not their loans. The probability of a strictly positive cashflow at  $t = 1$ ,  $\mathbb{P}(\tilde{R}_1 = R_1)$  is dependent on the banks monitoring decisions. If a bank monitors the loans, we have that  $\mathbb{P}(\tilde{R}_1 = R_1) = \alpha$ . If it chooses not to monitor, then the probability of a positive return in period  $t = 1$  is reduced to  $\alpha - \delta$ , while the bank owners enjoy a private benefit  $B$  (non-monetary, of fixed size) regardless of the state. Bank effort is unobservable and/or unverifiable by the regulator or the banking union.

**Interbank market** At  $t = 0$ , bank A can lend excess funds (not invested in the long term asset) on the interbank market to bank B. The interbank loans are short-term and yield a per-unit-loan return of  $r_I$  at  $t = 1$ , which is endogenously determined. For tractability, we assume bank B has full bargaining power.

**Regulators** Regulators can either bail out banks at  $t = 1$  by providing them with a liquidity grant or sell their assets to outside investors. In the case of a bailout, the bank owners continue to operate the loan portfolio also at  $t = 2$ . In the case of a fire sale to outside investors, the latter can only obtain  $(1 - L)R_2$  at  $t = 2$  per unit of investment, where  $L \in (0, 1)$ . The regulator incurs a linear fiscal cost  $f(c) = Fc$  for the cash it injects in the banking sector, where  $F \in \left(1, \frac{1}{1-L}\right)$ . The regulator's objective function is to maximise the assets under management in its own country at  $t = 2$ .

**Assumption 2:** *In both countries the proceeds from bank liquidation are not sufficient to pay domestic depositors in full. In this case foreign creditors lose their whole investment:*

$$(1 - L)R_2 \leq \phi(1 - \gamma) + (1 - \phi)(1 - \gamma)r \quad (3)$$

**Banking Union** The banking union can choose whether and which bank to bail out. Fiscal costs of a banking union are spread across the two countries according to an endogenously set sharing rule. The banking union's objective function is to maximise the assets under management in both countries.

**Timeline** The timeline is described in Figure 3.

Figure 3 here

### 3.2 Discussion of the primitives

Below we present the motivation and further discussion of the key features of the model. We closely follow [Acharya and Yorulmazer \(2008\)](#) and [Beck, Todorov, and Wagner \(2011\)](#) in describing the moral hazard problem and government intervention instruments. We are considering a multiple regulator framework with endogenous cross-bank exposures to analyse the spillovers a banking union can potentially solve.

**Heterogeneity** The two countries are endowed with unequal deposit bases  $(1 + \gamma, 1 - \gamma)$  and differ in the cash-flow at  $t = 1$ :  $R_1^A < R_1^B$ . The heterogeneity in deposits ensures that identical banks do not net cash-flows in equilibrium, and thus there is always a net lender ( $BK_A$ ) and a net borrower ( $BK_B$ ). Hence, we can analyse exposure spillovers from debtors to creditors without creating a very complex network structure. Such an assumption is not unrealistic: banks in emerging countries usually have investments opportunities that exceed their deposit base and draw funds from banks in developed countries. This is also in line with our empirical findings in [Figure 2](#).

The difference in the  $t = 1$  cashflow in the two countries is a technical condition which guarantees existence of a positive net interest rate that clears the interbank market.

**Investment opportunity set** Both banks face a maximum investment opportunity of 1, which can be scaled down. As the bank's problem is linear and the loan has positive NPV, it will always choose to invest all the domestic deposits in loans. In [Section 5.2](#), we solve for the interbank short-term interest rate and prove that banks have an incentive to exchange funds, and  $BK_B$  will extend its loan investment to the maximum of 1.

Only domestic banks can directly invest in their country specific opportunities, whereas foreign banks have to use them as an intermediary. One can think of this assumption as a form of local expertise.

**Depositors** Depositors are fully insured by the regulator, hence there is no bank run equilibrium. Additionally, they have very large transportation costs to the other country (as in [Hotelling \(1929\)](#), for instance): this gives them a strict preference for depositing funds with domestic banks.

**Monitoring** We closely follow [Holmstrom and Tirole \(1997\)](#), where the bank's decision to monitor increases the likelihood of a high payoff, but comes at a price of a private benefit loss to the bank manager. In this setting, the bank will monitor only if the change in the expected profit induced by monitoring exceeds the private benefit loss.

**Bargaining power and the interbank interest rate** Under Assumption (2), the investment of  $\gamma$  in the interbank market is necessary for Bank A to satisfy the  $t = 1$  liquidity demand. This constitutes a rationale for giving the full bargaining power to the interbank borrower ( $BK_B$ ), who is then able to extract all profits from the interbank transaction from Bank A. The resulting interbank interest, denote it  $r_1$ , is set so that bank A earns zero profit at  $t = 1$ . This assumption is made for tractability purposes, as it allows a closed form solution. A lower interest rate maximises the incentives of the borrower to monitor and makes a bailout more likely. For more generality, the model can be extended with the interbank interest rate defined as  $r_I = r_1 + \eta(\bar{r}_I - r_1)$ , where  $\eta$  is the Bank A’s bargaining power. We discuss the implications of varying  $\eta$  in Section 5.2.

**Government intervention** We follow Acharya and Yorulmazer (2008) in assuming that the bank liquidation results in an efficiency loss  $(1 - L)$  and in assuming a linear fiscal cost function. The condition  $F < \frac{1}{1-L}$  is imposed to ensure that there are no profitable liquidations: the fiscal proceeds from liquidated assets are always lower than the actual face value of the debt.

## 4 The single country problem

In this section we provide a simplified analysis of the disciplining role of efficient bailouts, focusing on the single country case: one bank with exactly 1 unit of deposits and one regulator deciding on bank resolution at  $t = 1$ . In this autarchic case there is no international interbank market. Ex-post, the regulator decides to bailout a failing bank if and only if the fiscal cost of providing liquidity is lower than the efficiency loss from transferring the bank assets to outside investors. Hence, the “no bailout” threat can be made credible by the fact bailouts are fiscally (and politically costly), an argument also put forward by Acharya and Yorulmazer (2008).

**The bank’s monitoring IC** For a bank to choose monitoring, we need to have that the two-period profit from monitoring is larger than when not monitoring. If the bank monitors, with probability  $\alpha$  it is successful in the first period, earns  $R_1 - \phi$  and can continue to the second period without the need for government intervention. With probability  $(1 - \alpha)$  it fails to produce a positive return in the first period. Then it earns the  $t = 2$  profit if and only if the regulator decides to bail it out. The expected payoff of the bank as a function of the monitoring/not monitoring decision is given by:

$$\Pi_{BK}(\alpha, b) = \alpha(R_1 + R_2 - (\phi + (1 - \phi)r)) + (1 - \alpha)(R_2 - (1 - \phi)r)\mathbb{I}_{Bailout} + b \quad (4)$$

where the indicator variable  $\mathbb{I}_{Bailout} = 1$  if the regulator decides to bail out the bank (and zero

otherwise). As the variable  $b$  can take only two values: 0 in case of monitoring and  $B$  in absence of monitoring, the incentive compatibility constraint can be written as:

$$\Pi_{BK}(\alpha, 0) \geq \Pi_{BK}(\alpha - \delta, B)$$

Simplifying, this leads to:

$$\frac{B}{\delta} \leq R_1 - \phi + (R_2 - (1 - \phi)r)(1 - \mathbb{I}_{Bailout}) \quad (5)$$

We notice that the incentive compatibility constraint is tightened when  $\mathbb{I}_{Bailout} = 0$ : when the regulator decides not to bail out the bank, the bank will choose to monitor even if the benefit  $B$  is larger or the probability difference  $\delta$  is smaller, since otherwise it forgoes the second period profits.

**The bailout decision** The regulator decides to bail out the bank if the fiscal cost incurred at time  $t = 1$  to provide  $\phi$  (such that the bank pays all the interest and is solvable again) is lower than the efficiency loss from selling the loans to the outside investors.

The welfare includes the final wealth of the banker and depositors, minus the costs of fiscal intervention. The cost of fiscal intervention is equal to the regulator payment to claimants (depositors and/or foreign entities) minus any bank liquidation proceeds, times the fiscal cost  $F$ . By assumption, the cost of fiscal intervention is always positive (liquidation proceeds are never sufficient to pay depositors). The policy-dependent expressions for welfare are:

$$\begin{aligned} \text{Welfare}_{Bailout} &= R_2 - F\phi + \phi \\ \text{Welfare}_{Liquidation} &= (\phi + (1 - \phi)r)(1 - F) + F(1 - L)R_2 \end{aligned} \quad (6)$$

The bailout condition is thus given by:

$$R_2(1 - F(1 - L)) \geq (1 - F)(1 - \phi)r \quad (7)$$

Note that for  $F \in \left(1, \frac{1}{1-L}\right)$  we have the left hand side of the previous equation larger than zero, and the right hand side smaller than zero. Hence, the bank is always bailed out and the regulator cannot commit to a liquidation resolution policy that will lead to better incentives for the bank.

## 5 International banking with national resolution policies

In this section, we solve the model assuming all bank resolution policies are in hands of national regulators, who ignore cross-country externalities. Thus, we consider the case when two banks can operate internationally, but are regulated by their domestic authorities. This is the *status quo* in current European banking markets. We focus on one externality that arises in the presence of cross-border banking: the spillover of insolvency through an interbank exposure channel. Cash-rich banks invest deposits that exceed the local investment opportunities in cash-poor banks with positive NPV investments available. If the latter enter default and it is suboptimal for the local regulator to bail them out, the creditor banks face a liquidity shortage themselves that may require costly state intervention.

### 5.1 Bank profits and default resolution policies

**Resolution policy space** If bank B defaults, the domestic regulator in country B has to decide how to treat foreign funds  $\gamma$  on bank B's balance sheet. If the regulator opts for a bailout, it has to provide funds sufficient to satisfy liquidity demands of both domestic as well as foreign creditors of the defaulting bank. If the regulator opts for liquidation of bank B, bank A does not receive any cashflow, as the liquidation proceeds are not enough by themselves to pay depositors in full (see Assumption 2).

Depending on the realisation of payoffs and liquidity shocks to the two banks at  $t = 1$  several cases can be considered. Table 1 summarises all the cases.

Table 1 here

#### 5.1.1 Scenario 1: both banks earn maximum payoffs

The problem of bailouts is irrelevant here, as both banks are able to pay demand deposits in their own country ( see Panel (A) in Table 1 ).

First, at  $t = 1$ :  $BK_A$  receives  $R_1^A$  from the project,  $r_I\gamma$  from the interbank loan and pays  $\phi(1 + \gamma)$  as domestic demand deposits.  $BK_B$  receives  $R_1^B$  from the project, pays  $r_I\gamma$  to bank A in the interbank market and  $\phi(1 - \gamma)$  as domestic demand deposits. In the second period, at  $t = 2$ ,  $BK_A$  receives  $R_2$  from the project, while it pays back  $r(1 - \phi)(1 + \gamma)$  to its own depositors. Bank B receives  $R_2$  from the project and pays  $(1 - \gamma)(1 - \phi)r$  to domestic depositors. The final bank profits are:



$$\begin{aligned}
\Pi_{BK_A} &= \underbrace{R_1^A + R_2 - \phi(1 + \gamma) - (1 - \phi)(1 + \gamma)r}_{\text{Loan Profits}} + \underbrace{r_I \gamma}_{\text{Interbank Market}} \quad (8) \\
\Pi_{BK_B} &= \underbrace{R_1^B + R_2 - (\phi + (1 - \phi)r)(1 - \gamma)}_{\text{Loan Profits}} - \underbrace{r_I \gamma}_{\text{Interbank Market}}
\end{aligned}$$

There is no regulatory intervention in the banking sectors, the ex-post welfares in the two countries are equal to:

$$\begin{aligned}
\text{Welfare}^A &= R_1^A + R_2 + \gamma r_I \quad (9) \\
\text{Welfare}^B &= R_1^B + R_2 - \gamma r_I
\end{aligned}$$

### 5.1.2 Scenario 2: $BK_A$ earns 0 and $BK_B$ earns $R_1^B$

As  $BK_B$  is successful at  $t = 1$ , there is no need for government intervention in country B. The final payoff to  $BK_B$  and country B's welfare are again as in (8) and (9). Meanwhile, at  $t = 1$ ,  $BK_A$  earns 0 from the productive investment,  $r_I \gamma$  from the interbank loan and has to pay  $\phi(1 + \gamma)$  as demand deposits. Given any interbank interest rate  $r_I$  that is incentive compatible for both banks, the proceeds  $r_I \gamma$  are not sufficient to keep bank A from defaulting, as  $r_I \gamma - \phi(1 + \gamma) < 0$ .

The regulator  $RG_A$  bails bank A out if the domestic welfare after a bailout is higher or equal to the welfare in case of liquidation, where:

$$\begin{aligned}
\text{Welfare}_{Bailout}^A &= R_2 - F[\phi(1 + \gamma) - r_I \gamma] + \phi(1 + \gamma) \quad (10) \\
\text{Welfare}_{Liquidation}^A &= (1 + \gamma)(\phi + (1 - \phi)r)(1 - F) + F(1 - L)R_2 + F \times r_I \gamma
\end{aligned}$$

The welfare conditional on liquidation is given by the cash receipts of insured depositors, subtracting the net costs of the regulator: the liquidity provision needs net of the liquidation proceeds. The bailout condition is thus given by:

$$R_2(1 - F(1 - L)) \geq (1 - F)(1 - \phi)(1 + \gamma)r \quad (11)$$

The payoffs to both banks can be summarised as follows:

$$\begin{aligned}
\Pi_{BK_A} &= \mathbb{I}_{Bailout_A} [R_2 - (1 - \phi)(1 + \gamma)r] \quad (12) \\
\Pi_{BK_B} &= R_1^B + R_2 - (\phi + (1 - \phi)r)(1 - \gamma) - r_I \gamma
\end{aligned}$$

### 5.1.3 Scenario 3: $BK_A$ earns $R_1^A$ and $BK_B$ earns 0

Bank B defaults and the regulator  $RG_B$  has to decide on the bailout. There is a potential spillover of the bank B's default to the bank in country A. We therefore analyse the optimal resolution policies in both country B and country A below.

In case of a bailout, regulator B has to finance all demands of bank creditors, including those on the international banking market, thus providing a liquidity injection of  $\phi(1 - \gamma) + r_I\gamma$ . The ex-post welfare in case of a bailout and in case of a liquidation is:

$$\begin{aligned} \text{Welfare}_{Bailout}^B &= R_2 + \phi(1 - \gamma) - F[\phi(1 - \gamma) + r_I\gamma] \\ \text{Welfare}_{Liquidation}^B &= [(\phi + (1 - \phi)r)(1 - \gamma)](1 - F) + F(1 - L)R_2 \end{aligned} \quad (13)$$

Again, welfare conditional on liquidation is computed as the cash receipts of insured depositors, minus the regulator's net costs. Hence, bank B is bailed out by regulator  $RG_B$  if the welfare after a bailout exceeds the welfare after liquidation, equivalent to:

$$R_2(1 - F(1 - L)) \geq (1 - F)(1 - \phi)(1 - \gamma)r + Fr_I\gamma \quad (14)$$

Bank A's profits are a function of the resolution policy in country B, as the proceeds from the interbank loan are wiped out in case of liquidation. First, if (14) holds and bank B is bailed out, bank A is able to pay all liquidity demands and continues operating into  $t = 2$  without any state intervention. Otherwise, if bank B is liquidated, then bank A defaults. The regulator  $BK_A$  steps in and bails out bank A if the domestic welfare after a bailout is at least equal to the welfare after a bank liquidation:

$$\begin{aligned} \text{Welfare}_{Bailout}^A &= R_2 - F[\phi(1 + \gamma)] + \phi(1 + \gamma) \\ \text{Welfare}_{Liquidation}^A &= (\phi + (1 - \phi)r)(1 + \gamma)(1 - F) + F(1 - L)R_2 \end{aligned} \quad (15)$$

We note that the the bailout condition is identical to (11).

The payoffs to the two banks summarising subsection 5.1.3 are following:

$$\begin{aligned} \Pi_{BK_A} &= \mathbb{I}_{Bailout_B} (R_1^A + r_I\gamma - \phi(1 + \gamma)) + [\mathbb{I}_{Bailout_B} + (1 - \mathbb{I}_{Bailout_B})\mathbb{I}_{Bailout_A}] [R_2 - (1 - \phi)(1 + \gamma)r] \\ \Pi_{BK_B} &= \mathbb{I}_{Bailout_B} [R_2 - (1 - \phi)(1 - \gamma)r] \end{aligned} \quad (16)$$

#### 5.1.4 Scenario 4: both $BK_A$ and $BK_B$ earn 0

In the final case,  $BK_B$  defaults and the bailout condition for the regulator  $RG_B$  is identical to (14). Bank A also defaults, because even in the case of a bailout of bank B, the proceeds  $r_I\gamma$  are not sufficient to satisfy depositors' demand. The bailout condition for the regulator  $RG_A$  is then given by (11). Payoffs to both banks are:

$$\begin{aligned}\Pi_{BK_A} &= \mathbb{I}_{Bailout_A} [R_2 - (1 - \phi)(1 + \gamma)r] \\ \Pi_{BK_B} &= \mathbb{I}_{Bailout_B} [R_2 - (1 - \phi)(1 - \gamma)r]\end{aligned}\tag{17}$$

We can now state the following lemma related to the optimal strategy of the regulator in country A.

**Lemma 1.**  *$BK_A$  resolution policy.* Under national bank regulators, Bank A is always bailed out when it defaults, either due to an own failure at  $t = 1$  or due to a failure of the interbank market.

*Proof.* The bailout condition for  $BK_A$  is given by (11) in every potential default scenario. The condition holds strictly for any set of parameters that satisfy the restriction  $1 - F(1 - L) > 0$ .  $\square$

## 5.2 Interbank market

In this subsection we determine the interbank interest rate  $r_I$ . We first need to explicitly state the incentive compatibility conditions for both banks to trade in the interbank market.

**Bank A** The result in Lemma 1 ensures that bank A always receives the non-stochastic profit at  $t = 2$ . Without investing in the interbank market however, it will never be able to fulfil the liquidity demand at  $t = 1$  and thus earn a positive payoff in the interim period. Hence, it would accept any interest rate  $r_I$  which ensures a positive profit at  $t = 1$ , conditional on its own success (with probability  $\alpha$ ):

$$\text{InterbankGains}_A = \alpha (R_1^A - \phi(1 + \gamma) + \gamma r_I) \geq 0 \implies r_I \geq \frac{\phi(1 + \gamma) - R_1^A}{\gamma}\tag{18}$$

Let  $\underline{r}_I = \frac{\phi(1 + \gamma) - R_1^A}{\gamma}$  the minimum interest rate required by bank A to trade in the interbank market.

**Bank B**  $BK_B$  gains from borrowing on the interbank market as it can leverage up its return. If successful (for expositional purposes, we will use probability  $\alpha$ ), it gains thus a maximum of:

$$\text{InterbankGains}_B = \alpha [(R_1^B + R_2) \gamma - r_I \gamma]$$

From Section 4, we know that without borrowing on the interbank market, bank B will always be bailed out given default. However, we note that the bailout condition for  $BK_B$  - equation (14) - is tightened as  $\gamma$  is larger. For some value of  $\gamma$ , bank B will no longer be bailed out after a failure (the fiscal costs for the government, including paying international creditors, become too large). Hence, the expected losses in this case are given by the expected foregone profit at  $t = 2$ :

$$\text{InterbankLosses}_B = (1 - \alpha) (1 - \gamma) (R_2 - (1 - \phi) r)$$

A sufficient condition for  $r_I$  to be incentive compatible for all possible  $\gamma$  values, regardless whether borrowing changes the regulator decision, is thus:

$$\text{InterbankGains}_B - \text{InterbankLosses}_B \geq 0 \implies r_I \leq (R_1^B + R_2) - \frac{(1 - \gamma)(1 - \alpha)}{\gamma \alpha} (R_2 - (1 - \phi) r)$$

Let  $\bar{r}_I = (R_1^B + R_2) - \frac{(1 - \gamma)(1 - \alpha)}{\gamma \alpha} (R_2 - (1 - \phi) r)$  be the maximum rate bank B is willing to pay on the interbank rate, in the situation where borrowing is least favourable for it.

A sufficient condition for the existence of an interest rate  $r_I$  for which the interbank market exists is given in Lemma 2. If the leverage opportunities and the probability of success are large enough, then bank B will borrow on interbank market even when borrowing means its balance sheet becomes too large to be bailed out given failure.

**Lemma 2.** *If  $\gamma + \alpha \geq 1$ , then  $\bar{r}_I > \underline{r}_I$ , and thus the interval  $[\underline{r}_I, \bar{r}_I]$  is non-empty.*

*Proof.* Immediate mathematic calculation. □

In what follows, we are going to assume  $BK_B$  has full bargaining power, and thus the interbank market clears at  $r_I^* = \underline{r}_I$ . This assumption is in line with the work of [Allen, Chapman, Echenique, and Shum \(2012\)](#), who empirically find the bargaining power on the interbank market to be sharply tilted towards the borrowers. Furthermore, focusing on a borrower's market makes the externality we are focusing on the weakest: a lower interest rate maximises the incentives of the borrower to monitor and makes a bailout more likely.

### 5.3 Equilibrium with national resolution policies

The equilibrium of the game when there is no banking union is characterised by the results in Propositions 1 and 2

**Proposition 1. (Optimal Strategies in Country B)** Under national bank regulation, we have that the following results hold:

(i) **Strategy Independence.** The monitoring strategy  $BK_B$  is independent of the strategy adopted by  $BK_A$ .

(ii) **Resolution Policy.** The regulator  $RG_B$  bails out the local bank  $BK_B$  iff the following condition holds:

$$\gamma \leq \frac{R_2(1 - F(1 - L)) + (F - 1)(1 - \phi)r}{Fr_I^* + (F - 1)(1 - \phi)r}$$

For  $r_I^* = \underline{r}_I$ , the condition above becomes  $\gamma \leq \gamma^*$ , where we define the threshold interbank market size as:

$$\gamma^* = \frac{R_2(1 - F(1 - L)) + (F - 1)(1 - \phi)r + F(R_1^A - \phi)}{F\phi + (F - 1)(1 - \phi)r} \quad (19)$$

(iii) **Monitoring Decisions.** For  $\gamma < \gamma^*$ , monitoring is optimal for  $BK_B$  if and only if the moral hazard problem is lower than a certain threshold:  $\frac{B}{\delta} \leq b_1^B$ . If  $\gamma \geq \gamma^*$ , monitoring is optimal if  $\frac{B}{\delta} \leq b_2^B$ , where it holds that  $b_2^B > b_1^B$ . The moral hazard thresholds are given by:

$$b_1^B = R_1^B - \underline{r}_I\gamma - \phi(1 - \gamma) \quad (20)$$

$$b_2^B = b_1^B + R_2 - (1 - \phi)(1 - \gamma)r \quad (21)$$

*Proof.* See Appendix A. □

The first part of the proposition is intuitive. Since bank B has no claim on the cash flows raised by bank A at any moment in time, the monitoring strategy of the (net) creditor bank is irrelevant.

The second part states that for low enough interbank market sizes, bank B will always be bailed out. The interbank market loans are used by  $BK_B$  for extra leverage. In case of success at  $t = 1$ ,  $BK_B$  uses its superior bargaining power to keep most gains from trade. In case of failure though, the government has to provide liquidity to pay for the surplus share of the creditor bank, although it does not internalise its profit as welfare. If the losses from bank liquidation  $L$  are large enough, the regulator in country B is willing to accept a welfare transfer to country A at  $t = 1$  (at a larger

fiscal cost) in exchange for the bank B operating at full productivity in the next period. As a larger  $\gamma$  implies a larger transfer of welfare outside the country, the gains from the bailout of  $BK_B$  are decreasing in  $\gamma$ . Over a certain threshold, the liquidation welfare loss becomes relatively smaller and  $BK_B$  is liquidated.

To analyse the monitoring decisions, we first state the following corollary to Proposition 1:

**Corollary 1.** *If bank B has full market power in determining the interbank interest rate and  $r_I^* = \underline{r}_I$ , we have that:*

$$b_1^B = 2(R_1^B - \phi)$$

$$b_2^B = 2(R_1^B - \phi) + R_2 - (1 - \phi)(1 - \gamma)r$$

*Proof.* Immediate mathematic calculation. □

The interbank market plays a two-fold discipling role for  $BK_B$  in its monitoring decision. First, when  $\gamma < \gamma^*$  and it is always bailed out in case of failure, the incentives of  $BK_B$  to monitor and forego the private benefits are defined by the profits at  $t = 1$ , increasing in the interbank market size  $\gamma$ . This is the leverage effect kicking in at  $t = 1$ , when the debtor keeps most of the gains from trade and enjoys the increased scale of profits. Secondly, and most important for our argument, is the market discipline stemming from liquidation threats becoming a credible instrument. For large enough levels of  $\gamma$ ,  $BK_B$  knows that the liquidation threat is credible, as bailouts become suboptimal. Hence, a failure would lead to losing not only the profit at  $t = 1$ , but also at  $t = 2$ . Bank B's incentives to monitor jump at  $\gamma = \gamma^*$ , and then increase linearly with  $\gamma$  due to the leverage effect on  $t = 2$  profits.

Figure 4 here

The next proposition describes the equilibrium strategies of players in country A.

**Proposition 2. (Optimal Strategies in Country A)** *Under national bank regulation, we have that the following results hold:*

- (i) **Partial Strategy Independence.** *If  $\gamma \leq \gamma^*$ , the monitoring strategy  $BK_A$  is independent of the strategy adopted by  $BK_B$ .*
- (ii) **Resolution Policy.** *The regulator  $RG_A$  always bails out the local bank  $BK_A$ .*

(iii) **Monitoring Decisions without Spillovers** For  $\gamma < \gamma^*$ , monitoring is optimal for  $BK_A$  if and only if the moral hazard problem is lower than a certain threshold:  $\frac{B}{\delta} \leq b^A$ , where we have:

$$b^A = R_1^A + r_I^* \gamma - \phi(1 + \gamma) \quad (22)$$

(iv) **Monitoring Decisions with Spillovers** If  $\gamma \geq \gamma^*$  and if  $BK_B$  monitors, monitoring is optimal for  $BK_A$  if  $\frac{B}{\delta} \leq \alpha b^A$ . If  $BK_B$  does not monitor, the condition for bank A is tightened to:  $\frac{B}{\delta} \leq (\alpha - \delta) b^A$ .

*Proof.* See Appendix A. □

The intuition behind  $BK_A$  always being bailed out relies on the fact that the regulator internalizes the welfare of depositors. Unlike the case of  $BK_B$ , no funds leave the country. Hence, paying a supra-unitary fiscal cost for each unit of liquidity enjoyed by the local depositors is suboptimal and the regulator has no ex-post mechanism to impose a higher level of discipline ex-ante by incentivising monitoring.

The second part of the proposition is trivial. For any  $\gamma \leq \gamma^*$ , bank B is bailed out, so the creditor  $BK_A$  receives the payments regardless of the state of nature in country B. Hence, the strategy of  $BK_B$  becomes irrelevant.

For  $\gamma > \gamma^*$ , without imposing full bargaining power to  $BK_B$  the monitoring incentives of  $BK_A$  are decreasing in the probability of  $BK_B$  not being in default at  $t = 1$ . The explanation for this effect is that all profits gained by Bank A at  $t = 1$  depend on the resolution and monitoring decisions in country B. If the likelihood of receiving the payments drops, the creditor has less to lose from riskier behaviour and will not monitor its loans ex-ante.

However, this effect is secondary for the spillover we are interested in. By assuming  $BK_B$  has full bargaining power, the profits of  $BK_A$  are reduced to 0 at  $t = 1$  so it will have no incentive to monitor. Formally, we state the following corollary.

**Corollary 2.** *If Bank B has full market power in determining the interbank interest rate and  $r_I^* = \underline{r}_I$ , we have that  $b^A = 0$  and thus Bank A never monitors its loans.*

*Proof.* Immediate mathematic calculation. □

## 6 Banking Unions

We now allow the two countries to form a banking union. There is now a single supranational regulator  $RG_{BU}$  and a common bank resolution mechanism. In particular, the union's regulator maximises the sum of welfares in the two member countries and follows the ex-post bailout condition:

$$[\text{Welfare}^A + \text{Welfare}^B]_{\text{Bailout}} \geq [\text{Welfare}^A + \text{Welfare}^B]_{\text{Liquidation}} \quad (23)$$

Given the new bailout rule (23), we first analyse bailout decisions of the new regulator. Next we consider bank monitoring decisions in the banking union. We finish this Section with a welfare comparison of the banking union with the national regulatory system from Section 5 and investigate the countries' incentives to form a banking union in Section 7.

### 6.1 A common resolution mechanism

In order to investigate the  $RG_{BU}$  bailout strategy we consider again the four different states of the world, depending on the bank payoffs at  $t = 1$ . The bank profits and joint welfare are described in Table 2.

Table 2 here

The new bailout policy is now extremely simple and given by Lemma 3.

**Lemma 3. (*Bailout strategy in a banking union*)** *The supranational regulator  $RG_{BU}$  always bails out a defaulting bank.*

*Proof.* See Appendix A. □

In particular, the common regulator always bails out bank B, independently of the size of the interbank lending  $\gamma$ . Intuitively, this happens as the supranational regulator internalizes the negative effect the liquidation of bank B, through the interbank exposure, will have on bank A. In order to avoid further welfare losses, regulator  $RG_{BU}$  always bails out bank B.

### 6.2 Equilibrium in a banking union

Proposition 3 summarises properties of the equilibrium under a common resolution mechanism.

**Proposition 3. (*Equilibrium in a banking union*)** *Under the supranational bank regulation, we have that the following results hold:*



- (i) **Strategy Independence.** *The monitoring strategies of  $BK_B$  and  $BK_A$  are mutually independent.*
- (ii) **Resolution Policy.** *The regulator  $RG_{BU}$  always bails out a defaulting bank.*
- (iii) **Monitoring Decisions.** *Monitoring is never optimal for  $BK_A$ .  $BK_B$  monitors if and only if the moral hazard problem is lower than the threshold:  $\frac{B}{\delta} \leq b_1^B$  with  $b_1^B$  defined in (20).*

*Proof.* See Appendix A. □

### 6.3 Welfare analysis

The evaluation of the banking union requires conducting a welfare comparison with the welfare under national regulatory systems. Ex-ante, we can distinguish two main effects of a banking union. Firstly, it can eliminate inefficient liquidation outcomes due to interbank market exposure spillovers, as it internalizes both countries' welfare. Secondly, for the same reason, the banking union will resort to bailouts more often, as it cannot credibly commit not to internalize liquidity spillovers. Banks can thus take additional risks while still being offered a bailout in case of a liquidity shortage. The first effect is clearly welfare improving, while the second is welfare reducing. We are interested thus in studying the net effect of a banking union on joint welfare in the two countries.

First, we are stating an indifference result:

**Lemma 4.** *The welfare under the banking union coincides with the welfare under the national regulators if there are no differences in the ex-post bailout strategies between the two systems ( $\gamma < \gamma^*$ ).*

*Proof.* Immediate mathematic calculation. □

Lemma 4 is intuitive. As the monitoring decisions of the banks depend on the regulators ex-post bailout decisions, the only cases when the ex-ante welfare values can differ, is when there are discrepancies between the bailout strategies of  $RG_{BU}$  and national regulators. This only happens when the interbank market is large enough:  $\gamma > \gamma^*$ , such that a bailout of  $BK_B$  under national supervision becomes suboptimal. In what follows we only focus on the case when having a banking union changes the bailout policy:  $\gamma > \gamma^*$ .

**Proposition 4. (Welfare Effects of a Banking Union)** *Under a banking union, we have that:*

- (i) **Externality effect with moral hazard** *If  $\delta \leq \frac{B}{b_2^B}$ , a banking union always improves welfare. The welfare surplus is increasing in  $\delta$  and given by:*

$$\mathbb{E}\Delta Welfare_{BU}^N = (1 - \alpha + \delta) [R_2 (1 - F (1 - L)) + (F - 1) (1 - \gamma) (1 - \phi) r] \geq 0 \quad (24)$$

(ii) **Externality effect without moral hazard** If  $\delta \geq \frac{B}{b_1^B}$ , a banking union also always improves welfare. The welfare surplus is constant in  $\delta$  and given by:

$$\mathbb{E}\Delta Welfare_{BU}^M = (1 - \alpha) [R_2 (1 - F (1 - L)) + (F - 1) (1 - \gamma) (1 - \phi) r] \geq 0 \quad (25)$$

(iii) **Market discipline effect** If  $\delta \in \left(\frac{B}{b_2^B}, \frac{B}{b_1^B}\right)$ , the banking union is only welfare improving if  $\delta \leq \delta^*$ , where  $\delta^*$  is given by:

$$\delta^* = \frac{(1 - \alpha) (R_2 (1 - F (1 - L)) + (1 - \gamma) (1 - \phi) (F - 1) r)}{F (2\phi - R_1^A) + (R_1^A + R_1^A - 2\phi)} \quad (26)$$

*Proof.* See Appendix A. □

If the drop in success probability at  $t = 1$  is small enough, bank  $BK_B$  will not monitor either under a banking union, nor under national regulator supervision. Hence, the introduction of a banking union does not worsen the incentives of  $BK_B$  to monitor. The only effect of a union is eliminating the exposure spillover: losses in creditor country  $A$  due to  $BK_B$  not being bailed out. Hence, the banking union is strictly welfare improving. Moreover, the surplus is increasing in  $\delta$ : the higher the probability of a loss - and hence of a spillover - the better off are the countries under a banking union.

The other extreme case is when  $\delta$  is so large that  $BK_B$  will actually monitor under a banking union as well as under national supervision. Again, the incentives of the bank are not affected by the introduction of the union and the only effect is the liquidity externality being solved: hence a banking union is also strictly welfare improving in this case.

The most interesting case is though for intermediate values of  $\delta$  ( $\delta \in \left(\frac{B}{b_2^B}, \frac{B}{b_1^B}\right)$ ). In this situation,  $BK_B$  has incentives to monitor its loans under national supervision since it will not be bailed out given a liquidity shock. However, when it is always bailed out under a banking union, it has an incentive never to monitor its loans.

We find that the welfare difference between a banking union and national supervision can be written out as a sum of two components: a positive one due to the banking union solving the international exposure externality and a negative one due to lower market discipline of  $BK_B$ .

$$\mathbb{E}\Delta\text{Welfare}_{BU}^D = \underbrace{(1 - \alpha) [R_2 (1 - F (1 - L)) + (F - 1) (1 - \gamma) (1 - \phi) r]}_{\text{Externality Effect}} - \underbrace{\delta (F (2\phi - R_1^A) + (R_1^A + R_1^A - 2\phi))}_{\text{Discipline Effect}} \quad (27)$$

For  $\delta$  high enough (or  $L$  low enough), the negative market discipline effect outweighs the benefits of eliminating international externalities and thus a banking union becomes suboptimal. In Figure 5 we plot the welfare surplus as a function of  $\delta$ .

Figure 5 here

## 7 Endogenous Banking Union and Cost Sharing

In this section we are focusing on the case when a banking union is welfare improving in order to determine the optimal participation decisions of the two countries at  $t = -1$ . It is trivial that there can be no equilibrium in which national regulators decide to enter a banking union which reduces total welfare, as they cannot be both weakly better off by joining forces. Even if the banking union is welfare improving, national regulators will join it only if it is *individually* optimal to move away from local resolution policies.

We are considering ex-ante linear contracts through which  $RG_A$  supports a share  $\beta \in (0, 1)$  of any banking union costs, whereas  $RG_B$  supports  $1 - \beta$ . Thus, if a bailout requires a liquidity injection of  $C$ , country  $A$  will pay  $\beta F \times C$  and country  $B$  will pay  $(1 - \beta) F \times C$ . Our goal is thus to determine the feasible (range of)  $\beta$  for which a banking union comes into existence at  $t = -1$ .

We are considering two cases: first when the banking union has no effect on bailout policies and thus on ex-post welfare and secondly when the banking union changes the bailout policy of regulator  $B$  and has a positive effect on welfare, as described in Section 6.3. Regulators decide to join a banking union if the following equations hold simultaneously:

$$\mathbb{E} [\text{Welfare}_{BU}^A - \text{Welfare}_{National}^A] \geq 0 \quad (28)$$

$$\mathbb{E} [\text{Welfare}_{BU}^B - \text{Welfare}_{National}^B] \geq 0 \quad (29)$$

## 7.1 Banking union has zero welfare effect

Consider first the case when the banking union has a zero net welfare effect. From Lemma 4, this is the case for  $\gamma < \gamma^*$ . With an arbitrary  $(\beta, 1 - \beta)$  cost sharing rule, the differences between welfare in a banking union and without for each individual country, scenario by scenario, are given in Table 3.

Table 3 here

Table 3 shows that with zero net welfare effect of the banking union, one country's surplus is another country's loss in each scenario. Hence, the only way for (28) to hold is if  $\mathbb{E} [\text{Welfare}_{BU}^A - \text{Welfare}_{National}^A] = 0$ . Lemma 5 uniquely identifies the linear contract between the two countries that satisfies this condition.

**Lemma 5. *Endogenous union with zero surplus*** *The fiscal cost share of country A that makes a banking union feasible is unique when  $\gamma < \gamma^*$  and given by:*

1. *If  $BK_B$  monitors its loans,  $\beta = \beta_{1,M}$ , where:*

$$\beta_{1,M} = \frac{(1 - \alpha + \delta) R_1^A}{2(1 - \alpha)\phi + \delta R_1^A} \in (0, 1) \quad (30)$$

2. *If  $BK_B$  does not monitor its loans,  $\beta = \beta_{1,N}$ , where:*

$$\beta_{1,N} = \frac{R_1^A}{2\phi} \in \left(0, \frac{1}{2}\right) \quad (31)$$

*Proof.* See Appendix A. □

Note that we have  $\beta_{1,M} > \beta_{1,N}$ : if the bank in country  $B$  takes less risk, more of the fiscal burden can be shifted towards country  $A$ . Secondly, if  $BK_B$  does not monitor, country  $A$  supports less than half of the fiscal costs. In absence of any externality benefits of the banking union, the debtor country is penalised for excessive risk taking by a larger share of the costs given a bailout. Thirdly, the shares are independent of the interbank market size  $\gamma$ , as there is no externality effect of the banking union in this case.

## 7.2 Banking union has positive welfare effect

The banking union improves the global welfare when  $\gamma > \gamma^*$ , and when the banking union helps resolve the liquidity spillover externality. With an arbitrary  $(\beta, 1 - \beta)$  cost sharing rule, the differences between welfare in a banking union and without it, for each individual country, scenario by scenario, are given in Table 4.

Table 4 here

For  $\gamma \geq \gamma^*$  we can distinguish between three cases, as in the previous section. First two are concerned with the situation when the introduction of the banking union does not change the incentives of  $BK_B$  to monitor and thus neither the probability distribution over the scenarios, while in the last case introduction of the banking union shifts the incentives of  $BK_B$  from monitoring to not monitoring (the disciplining effect), and the surplus for regulator A is reduced by the shift in the probabilities. The following Proposition 5 describes the feasible contract sets for each of the three cases.

**Proposition 5. *Endogenous union with positive welfare surplus.*** *When  $\gamma > \gamma^*$  and the banking union produces a total net welfare surplus (positive spillover externality is larger than loss of market discipline externality), we have that the cost sharing rule  $(\beta, 1 - \beta)$  feasible set is given by:*

1. (Monitoring case) When  $\delta \geq \frac{B}{b^B}$  and  $BK_B$  always monitors,  $\beta \in (\underline{\beta}_{2,M}, \bar{\beta}_{2,M})$ , where:

$$\bar{\beta}_{2,M} = \frac{(1 - \alpha)(1 - \delta + \alpha(1 - \gamma) + \gamma(1 + \delta))\phi + \delta R_1^A}{2(1 - \alpha)\phi + \delta R_1^A} \in (\beta_{1,M}, 1) \quad (32)$$

$$\underline{\beta}_{2,M} = \bar{\beta}_{2,M} - \frac{\mathbb{E}\Delta \text{Welfare}_{BU}^M}{2F(1 - \alpha)\phi + F\delta R_1^A} \in (\beta_{1,M}, 1) \quad (33)$$

2. (Not monitoring case) When  $\delta \leq \frac{B}{b^B}$  and  $BK_B$  never monitors,  $\beta \in (\underline{\beta}_{2,N}, \bar{\beta}_{2,N})$ , where:

$$\bar{\beta}_{2,N} = \frac{1 + \alpha(1 - \gamma) + \gamma(1 + \delta) - \delta}{2} \in \left(\frac{1}{2}, \bar{\beta}_{2,M}\right) \quad (34)$$

$$\underline{\beta}_{2,N} = \bar{\beta}_{2,N} - \frac{\mathbb{E}\Delta \text{Welfare}_{BU}^N}{2F\phi(1 - \alpha + \delta)} \quad (35)$$

3. (*Discipline effect*) When  $\delta \in \left(\frac{B}{b_2^B}, \frac{B}{b_1^B}\right)$  and  $BK_B$  chooses not to monitor only under a banking union, the welfare surplus is reduced and we have  $\beta \in \left(\underline{\beta}_{2,D}, \bar{\beta}_{2,D}\right)$ , where:

$$\bar{\beta}_{2,D} = \bar{\beta}_{2,N} - \frac{\delta(\phi(1+\gamma) - R_1^A)}{2\phi(1-\alpha+\delta)} \quad (36)$$

$$\underline{\beta}_{2,D} = \underline{\beta}_{2,N} + \frac{\delta(Welfare^B[R_A^1, R_B^1] - Welfare^B[R_A^1, 0])}{2F\phi(1-\alpha+\delta)} > \underline{\beta}_{2,N} \quad (37)$$

*Proof.* See Appendix A. □

It can be shown that if a banking union is jointly optimal under the discipline loss externality, then a contract can be written such that both countries benefit from the union.

**Corollary 3. *Banking Union Feasibility.*** *If the banking union has a positive expected welfare surplus,  $\mathbb{E}\Delta Welfare_{BU}^D > 0$  then we have that  $\bar{\beta}_{2,D} > \underline{\beta}_{2,D}$  and there exists a linear sharing rule  $(\beta, 1 - \beta)$  such that the banking union is optimal for both countries.*

*Proof.* See Appendix A. □

It is easy to see that as  $\bar{\beta}_{2,M} - \bar{\beta}_{2,N} = \frac{(1-\alpha+\delta)(1-\gamma)R_1^A}{2(1-\alpha)\phi+\delta R_1^A} \geq 0$  and from the definition of  $\bar{\beta}_{2,D}$ , it holds that:

$$\bar{\beta}_{2,M} \geq \bar{\beta}_{2,N} \geq \bar{\beta}_{2,D} \quad (38)$$

The dynamics of the fiscal cost sharing rule  $\beta$  as a function of the interbank market size are presented in Figure 6 below.

Figure 6 here

The interpretation of this result is that  $RG_A$  would ask for a lower share of the fiscal costs if the union worsens the moral hazard. The mechanism through which a banking union reduces market discipline shifts the fiscal burden away from the creditor country. Importantly, this effect is also present when we compare this case when moral hazard is present both with and without a banking union. The explanation is that the opportunity cost of renouncing national regulation is always higher for the creditor country.

Secondly, we have that the market disciplining externality reduces the space of potential contracts leading to a banking union. As  $\bar{\beta}_{2,D} - \underline{\beta}_{2,D} < \bar{\beta}_{2,N} - \underline{\beta}_{2,N}$ , the interval where  $\beta$  can be set to successfully incentivise a banking union is reduced. This happens since the market disciplining effect reduces the total welfare surplus from a union. At the same time, as previously discussed,  $RG_A$  will demand even more of a declining surplus.

Thirdly, it is easy to see that if  $\gamma > \gamma^*$ ,  $RG_A$  will always be willing to pay more to be part of a banking union relative to the case when  $\gamma < \gamma^*$ . Formally,  $\underline{\beta}_{2,M} > \beta_{1,M}$  and  $\underline{\beta}_{2,N} > \beta_{1,N}$ . The fact that a banking union solves a spillover externality that affects country  $A$  induces  $RG_A$  to pay relatively more as it gains most from the union. At the same time,  $RG_B$  also demands a lower share in the union costs as it is now forced to pay for bailouts of  $BK_B$  which are suboptimal under national regulation.

As we additionally have that  $\underline{\beta}_{2,D} > \underline{\beta}_{2,N} > \beta_{1,N}$ , the market discipline loss negative effect on  $\beta$  is not strong enough to compensate the positive effective of eliminating the externalities:  $RG_A$  will still pay more in a banking union that creates positive welfare surplus.

## 8 Concluding Remarks

We study the effects of a banking union in presence of cross-border interbank markets and endogenous risk-taking decisions by banks. We model the banking union as a joint resolution mechanism, by which we closely follow recent European debate, with the Single Resolution Mechanism for Eurozone announced by the European Commission in July 2013. There are two main results we want to highlight.

First, the banking union can eliminate cross-border liquidity spillovers from a bank default, that otherwise arise under national regulators who only value domestic welfare. Hence, by providing liquidity where it is needed, the banking union can reduce the fiscal costs of bank defaults. On the other hand, it suppresses the disciplining role of the interbank market and can incentivise risk taking for systemically important banks. In some cases (low bank liquidation costs), the net welfare effect of a banking union becomes negative. This result supports the concern expressed in [Allen, Carletti, and Gale \(2009\)](#) that the future Pan-European regulator will be too lenient for failing banks, inducing them to take more risks ex-ante.

We also discuss how the bailout costs should optimally be divided in a banking union. We find that countries with banking sectors that are net debtors in the interbank market benefit the most from the introduction of the banking union, as the creditor countries are always willing to take on most of the fiscal burden of the single resolution mechanism in order to eliminate systemic liquidity externalities. However, when a banking union worsens market discipline, creditors optimally pay

less, as higher moral hazard reduces the expected net welfare surplus for creditor countries.

Our results have important policy implications. In our model, we do not consider ex-ante mechanisms that allow a regulator to commit to ex post inefficient actions, such as bail-in regulations or reputation building. In light of the evidence from the recent financial crisis, this is not an unrealistic assumption. However, for a more normative approach, one can extend our framework to allow for optimal ex-ante commitment contracts for the regulators. An alternative ex-ante policy to alleviate the incentive distortion is for regulators to take into account the systemic importance of individual banks in their monitoring policies. Designing a banking union that takes into account not only the benefits, but also the incentive costs, is crucial for the well-functioning of the Single Resolution Mechanism to be introduced in the Eurozone.



## Tables and Figures

Table 1: **Welfare and bank profits with national resolution mechanisms.**

All possible scenarios at  $t = 1$ , when uncertainty is resolved and parameter values are considered. In most of the following analysis, the interbank interest rate is taken to correspond to  $BK_B$  having maximum bargaining power:  $r_I = \frac{(1+\phi)\gamma - R_1^A}{\gamma}$ . The threshold  $\gamma^*$  is the size of the interbank market above which a bailout is suboptimal for the regulator in country B and it is defined by

$$\gamma^* = \frac{R_2(1-F(1-L)) + (F-1)(1-\phi)r + F(R_1^A - \phi)}{F\phi + (F-1)(1-\phi)r}.$$

Parameter Range	Default $BK_A$	Default $BK_B$	Welfare / Profits
Panel A: $BK_A$ earns $R_1^A$ and $BK_B$ earns $R_1^B$ at $t = 1$			
all	No	No	$\text{Welfare}_A = R_1^A + R_2 + \gamma r_I$ $\text{Welfare}_B = R_1^B + R_2 - \gamma r_I$ $\Pi_{BK_A} = R_1^A + R_2 + \gamma r_I - (1 + \gamma)(\phi + (1 - \phi)r)$ $\Pi_{BK_B} = R_1^B + R_2 - \gamma r_I - (1 - \gamma)(\phi + (1 - \phi)r)$
Panel B: $BK_A$ earns 0 and $BK_B$ earns $R_1^B$ at $t = 1$			
all	Yes	No	$\text{Welfare}_A = R_2 + (1 + \gamma)\phi - F((1 + \gamma)\phi - r_I\gamma)$ $\text{Welfare}_B = R_1^B + R_2 - r_I\gamma$ $\Pi_{BK_A} = R_2 - (1 + \gamma)(1 - \phi)$ $\Pi_{BK_B} = R_1^B + R_2 - \gamma r_I - (1 - \gamma)(\phi + (1 - \phi)r)$
Panel C: $BK_A$ earns $R_1^A$ and $BK_B$ earns 0 at $t = 1$			
$\gamma \leq \gamma^*$	No	Yes	$\text{Welfare}_A = R_1^A + R_2 + r_I\gamma$ $\text{Welfare}_B = R_2 + (1 - \gamma)\phi - F((1 - \gamma)\phi + r_I\gamma)$ $\Pi_{BK_A} = R_1^A + R_2 + \gamma r_I - (1 + \gamma)(\phi + (1 - \phi)r)$ $\Pi_{BK_B} = R_2 - (1 - \gamma)(1 - \phi)r$
$\gamma > \gamma^*$	Yes	Yes	$\text{Welfare}_A: R_2 + (1 + \gamma)\phi - F((1 + \gamma)\phi - R_1^A)$ $\text{Welfare}_B: (1 - F)[(1 - \gamma)\phi + (1 - \gamma)(1 - \phi)r] + F((1 - L)R_2)$ $\Pi_{BK_A} = R_2 - (1 + \gamma)(1 - \phi)$ $\Pi_{BK_B} = 0$
Panel D: Both $BK_A$ and $BK_B$ earn 0 at $t = 1$			
$\gamma \leq \gamma^*$	Yes	Yes	$\text{Welfare}_A = R_2 + (1 + \gamma)\phi - F((1 + \gamma)\phi - r_I\gamma)$ $\text{Welfare}_B = R_2 + (1 - \gamma)\phi - F((1 - \gamma)\phi + r_I\gamma)$ $\Pi_{BK_A} = R_2 - (1 + \gamma)(1 - \phi)$ $\Pi_{BK_B} = R_2 - (1 - \gamma)(1 - \phi)r$
$\gamma > \gamma^*$	Yes	Yes	$\text{Welfare}_A = R_2 + (1 + \gamma)\phi - F((1 + \gamma)\phi)$ $\text{Welfare}_B: (1 - F)[(1 - \gamma)\phi + (1 - \gamma)(1 - \phi)r] + F((1 - L)R_2)$ $\Pi_{BK_A} = R_2 - (1 + \gamma)(1 - \phi)$ $\Pi_{BK_B} = 0$

Table 2: **Welfare and bank profits with a joint resolution mechanism (banking union).**

All possible scenarios at  $t = 1$ , when uncertainty is resolved and parameter values are considered. In most of the following analysis, the interbank interest rate is taken to correspond to  $BK_B$  having maximum bargaining power:  $r_I = \frac{(1+\phi)\gamma - R_1^A}{\gamma}$ . The threshold  $\gamma^*$  is the size of the interbank market above which a bailout is suboptimal for the regulator in country B and it is defined by  $\gamma^* = \frac{R_2(1-F(1-L)) + (F-1)(1-\phi)r + F(R_1^A - \phi)}{F\phi + (F-1)(1-\phi)r}$ .

Parameter Range	Default $BK_A$	Default $BK_B$	Welfare / Profits
Panel A: $BK_A$ earns $R_1^A$ and $BK_B$ earns $R_1^B$ at $t = 1$			
all	No	No	$\text{Welfare}_{BU} = R_1^A + R_1^B + 2R_2$ $\Pi_{BK_A} = R_1^A + R_2 + \gamma r_I - (1 + \gamma)(\phi + (1 - \phi)r)$ $\Pi_{BK_B} = R_1^B + R_2 - \gamma r_I - (1 - \gamma)(\phi + (1 - \phi)r)$
Panel B: $BK_A$ earns 0 and $BK_B$ earns $R_1^B$ at $t = 1$			
all	Yes	No	$\text{Welfare}_{BU} = 2R_2 + R_1^B + (1 - F)((1 + \gamma)\phi - r_I\gamma)$ $\Pi_{BK_A} = R_2 - (1 + \gamma)(1 - \phi)$ $\Pi_{BK_B} = R_1^B + R_2 - \gamma r_I - (1 - \gamma)(\phi + (1 - \phi)r)$
Panel C: $BK_A$ earns $R_1^A$ and $BK_B$ earns 0 at $t = 1$			
all	No	Yes	$\text{Welfare}_{BU} = 2R_2 + R_1^A + \gamma r_I + (1 - \gamma)\phi - F(r_I\gamma + (1 - \gamma)\phi)$ $\Pi_{BK_A} = R_1^A + R_2 + \gamma r_I - (1 + \gamma)(\phi + (1 - \phi)r)$ $\Pi_{BK_B} = R_2 - (1 - \gamma)(1 - \phi)r$
Panel D: Both $BK_A$ and $BK_B$ earn 0 at $t = 1$			
$\gamma \leq \gamma^*$	Yes	Yes	$\text{Welfare}_{BU} = 2R_2 + 2\phi - F(2\phi)$ $\Pi_{BK_A} = R_2 - (1 + \gamma)(1 - \phi)$ $\Pi_{BK_B} = R_2 - (1 - \gamma)(1 - \phi)r$

Table 3: **Banking union  $\Delta$ Welfare for individual countries for  $\gamma < \gamma^*$ .**

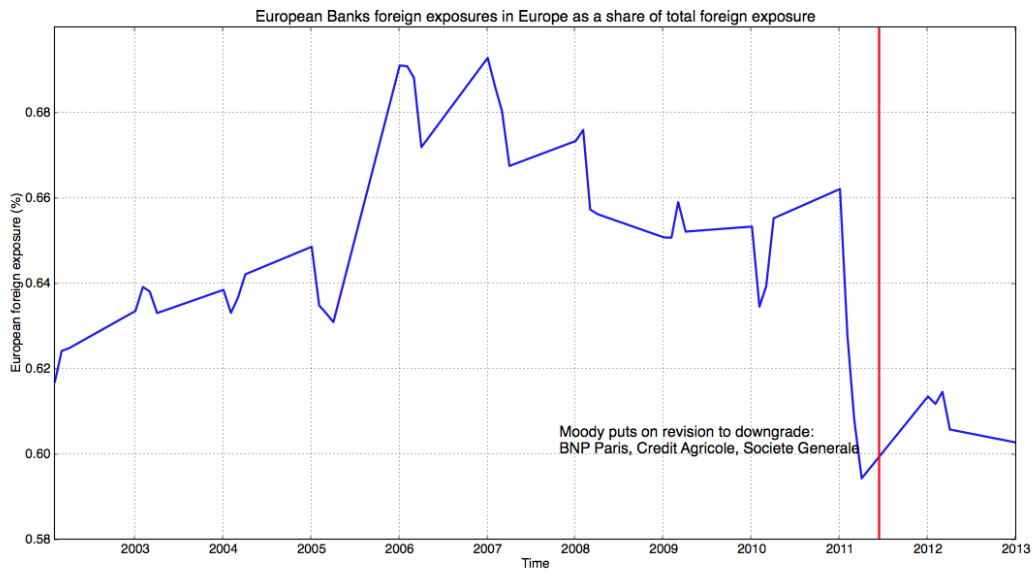
The table shows the welfare changes for each individual country in each state of the world when  $\gamma < \gamma^*$ . The net welfare effect in this case is zero.

Scenario	$\Delta$ Welfare: Country A	$\Delta$ Welfare: Country B
A: $R_1^A$ and B: $R_1^B$	0	0
A: 0 and B: $R_1^B$	$(1 - \beta) FR_1^A$	$-(1 - \beta) FR_1^A$
A: $R_1^A$ and B: 0	$-\beta F (2\phi - R_1^A)$	$\beta F (2\phi - R_1^A)$
A: 0 and B: 0	$FR_1^A - 2\beta F\phi$	$2\beta F\phi - FR_1^A$

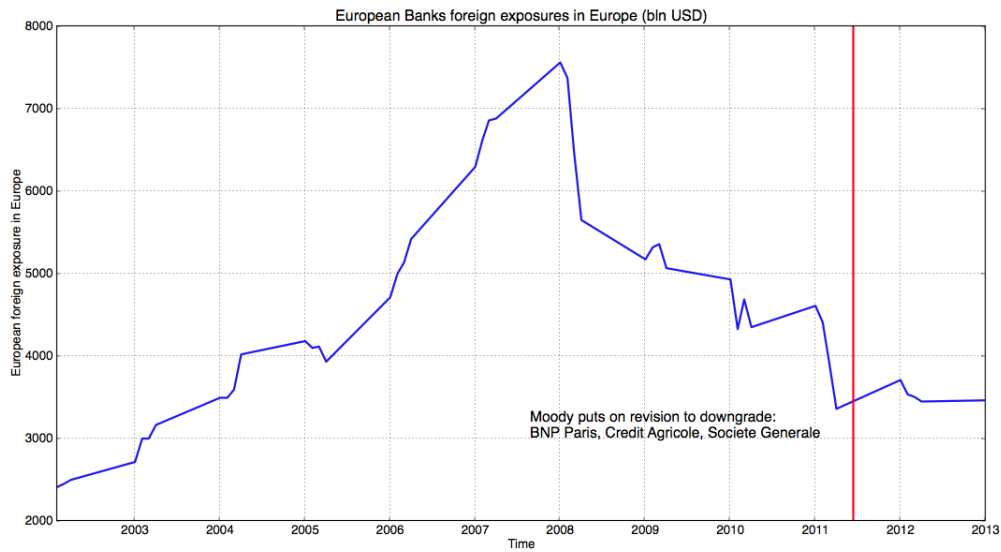
Table 4: **Banking union  $\Delta$ Welfare for individual countries for  $\gamma \geq \gamma^*$ .**

The table shows the welfare changes for each individual country in each state of the world when  $\gamma \geq \gamma^*$ . The net welfare effect is positive if  $\Delta$ Welfare<sub>BU</sub> > 0.

Scenario	$\Delta$ Welfare: Country A	$\Delta$ Welfare: Country B
A: $R_1^A$ and B: $R_1^B$	0	0
A: 0 and B: $R_1^B$	$(1 - \beta) FR_1^A$	$-(1 - \beta) FR_1^A$
A: $R_1^A$ and B: 0	$(1 - \beta) F (2\phi - R_1^A)$	$\Delta$ Welfare <sub>BU</sub> - $(1 - \beta) F (2\phi - R_1^A)$
A: 0 and B: 0	$F (1 + \gamma) \phi - 2\beta F\phi$	$\Delta$ Welfare <sub>BU</sub> - $F (1 + \gamma) \phi + 2\beta F\phi$



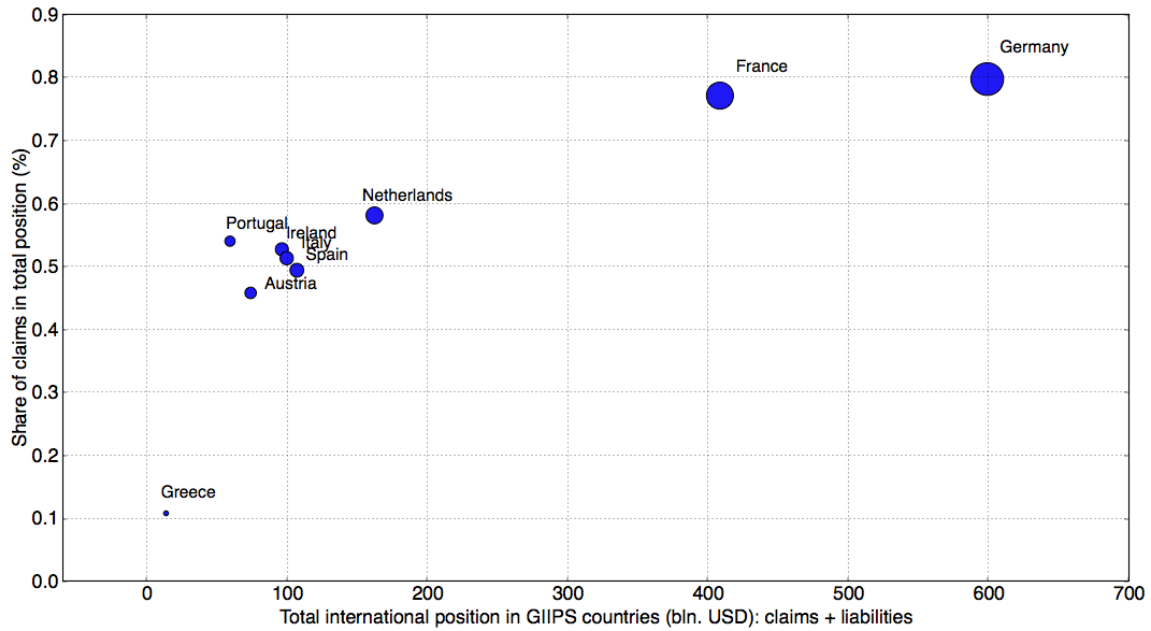
(a) Dynamics of Eurozone banks foreign exposure in Europe as a fraction of total foreign exposure



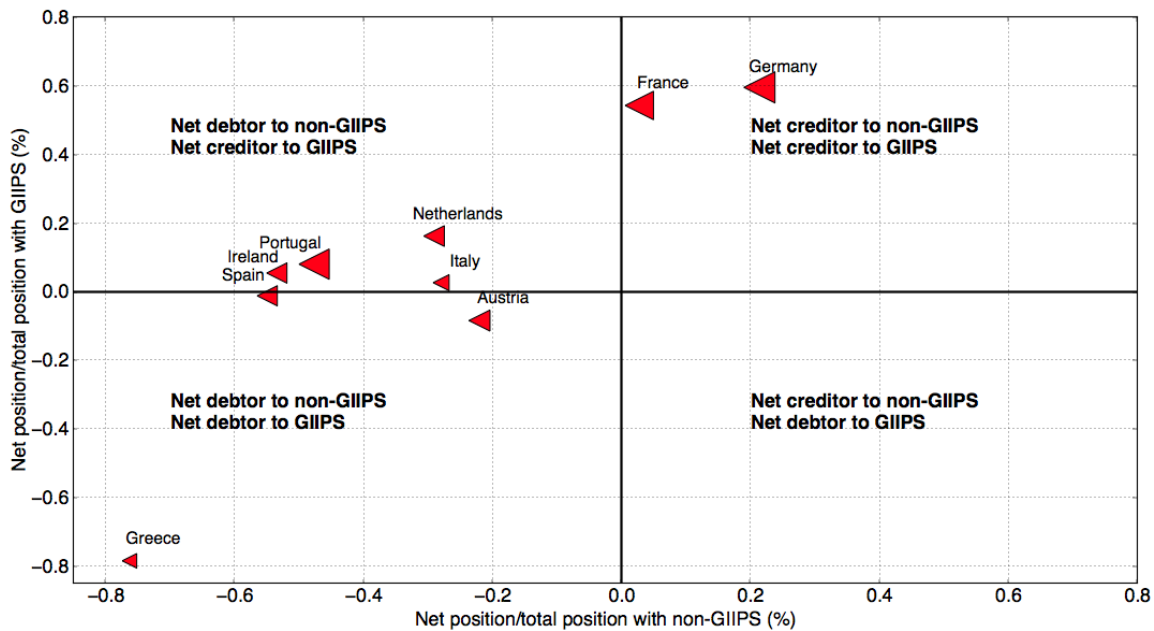
(b) Dynamics of Eurozone bank foreign exposure in Europe

**Figure 1: Eurozone Countries Exposure to Foreign European Assets**

The exposure of Eurozone banks in 11 countries (Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, the Netherlands and Portugal) in developed European countries banking sector. Panel (A) shows the exposure dynamics as a fraction of total foreign exposure, whereas Panel (B) shows the exposure in absolute terms. Note the sharp decline around the onset of the sovereign crisis. Source: Bank for International Settlements data and own calculations.



(a) Share of claims against GIIPS countries and total positions.



(b) Relative balances against GIIPS and non-GIIPS countries.

Figure 2: **Exposures of European banks to GIIPS and non-GIIPS international assets**  
The figure plots the net and total international balances of banks from selected countries against two groups of European states. The GIIPS include Greece, Italy, Ireland, Portugal and Spain. The non-GIIPS group includes Germany, France, the Netherlands and Austria. All measures are computed as quarterly averages from 2008:Q1 to 2013:Q1. Panel (A) plots the share of claims in the total position (claims + liabilities) of each country against all the GIIPS country. The size of the marker is proportional to the total position. Panel (B) plots the relative balance (assets-liabilities / assets+liabilities) against GIIPS and non-GIIPS countries. The size of the marker is proportional to the total position in the GIIPS countries.

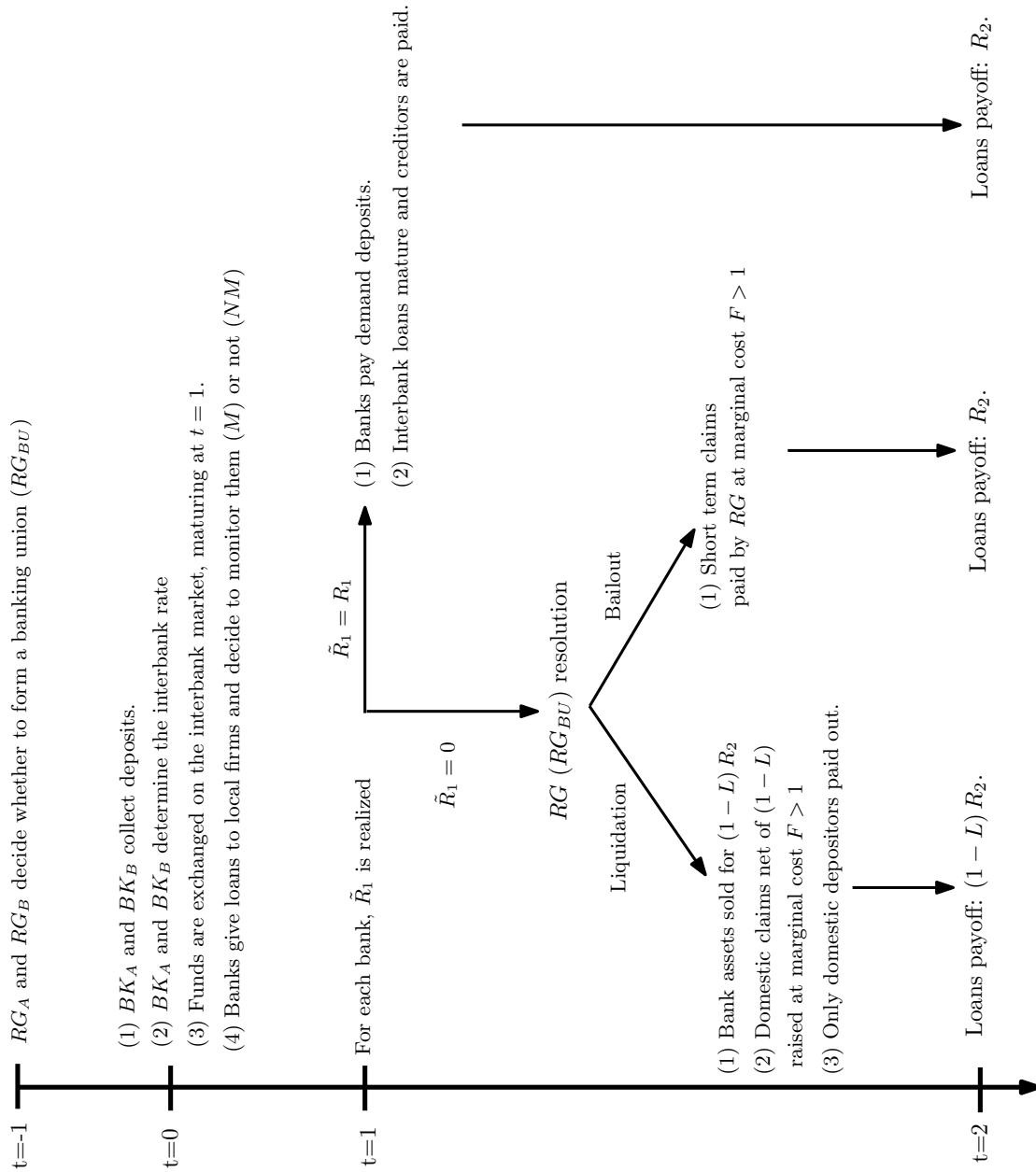


Figure 3: Model Timing

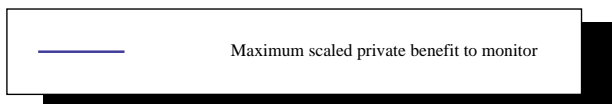
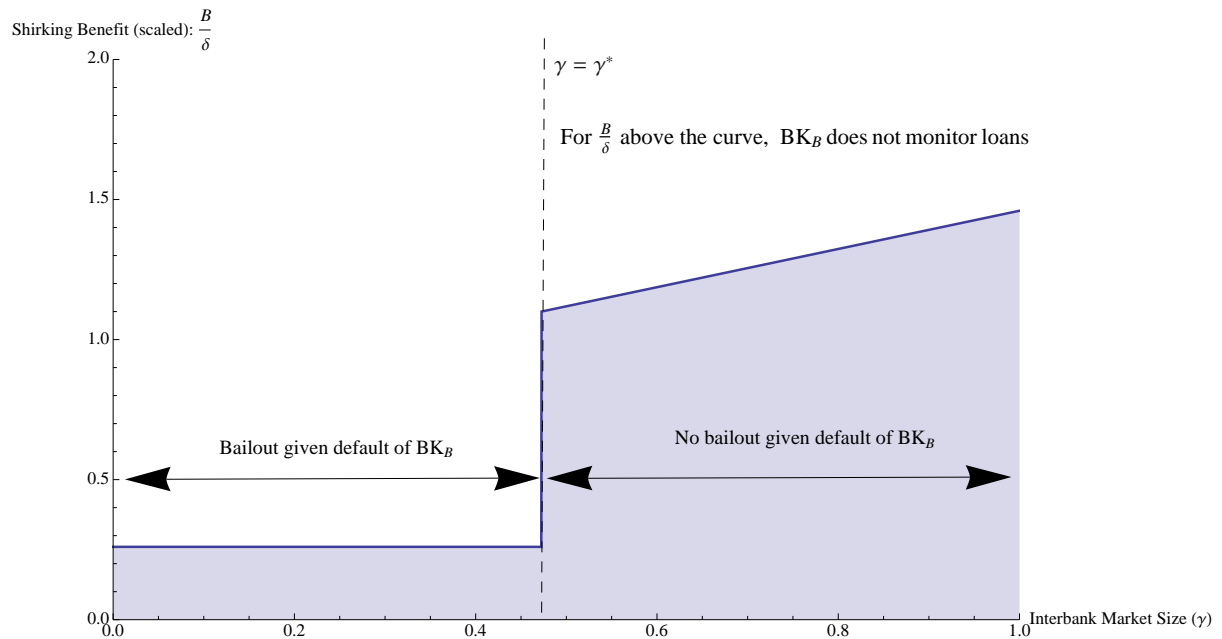


Figure 4: **Equilibrium Monitoring Decisions of  $BK_B$  under National Regulation**  
 The figure shows the indifference curve of  $BK_B$  with national resolution policy. For a given interbank market size and private benefit,  $BK_B$  monitors in the shaded region (below the indifference curve). Note that the liquidation threat becomes credible for  $\gamma \geq \gamma^*$  and the bank has better incentives to monitor its loans.

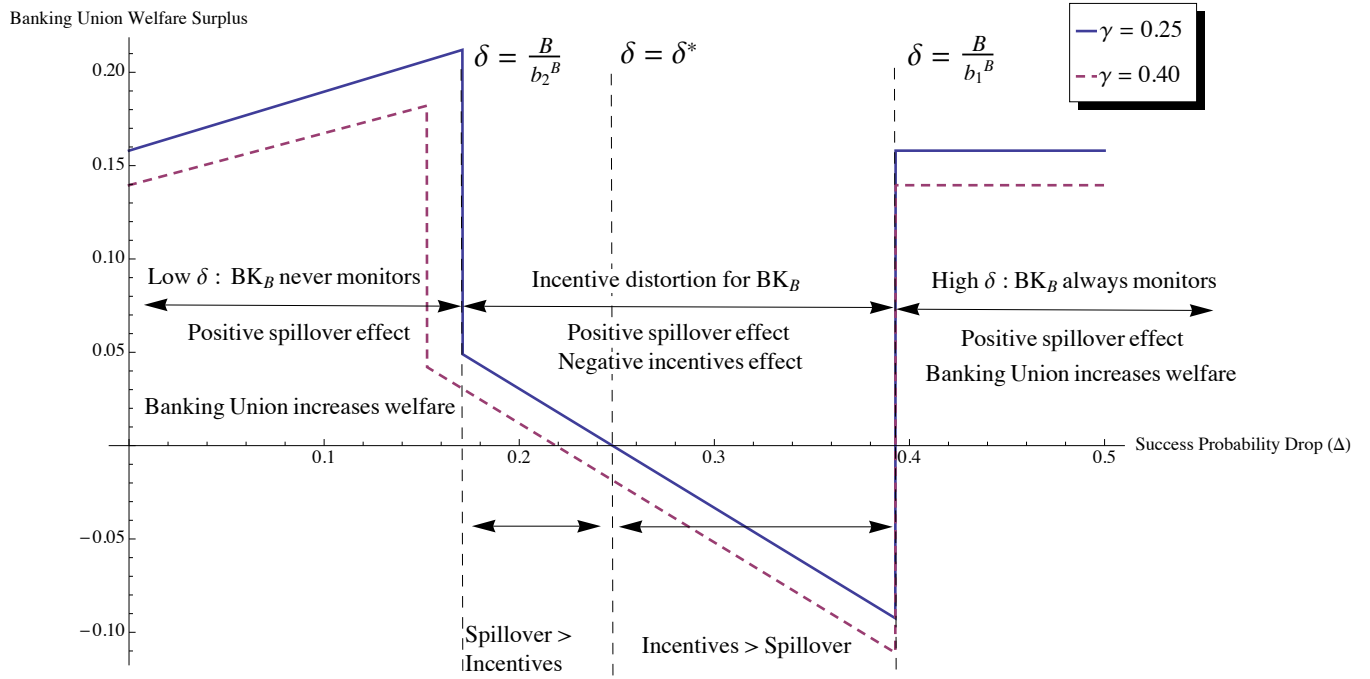


Figure 5: **Banking Union Welfare Surplus and Moral Hazard**

The figure shows the welfare surplus from a banking union relative to national regulation systems as a function of the moral hazard effects  $\delta$ . For low or high values of  $\delta$ , a banking union never distorts incentives and always improves welfare by eliminating spillovers. For intermediate values of  $\delta$ , it is possible that the loss of market discipline outweighs the benefits from lower spillovers and a banking union is suboptimal.



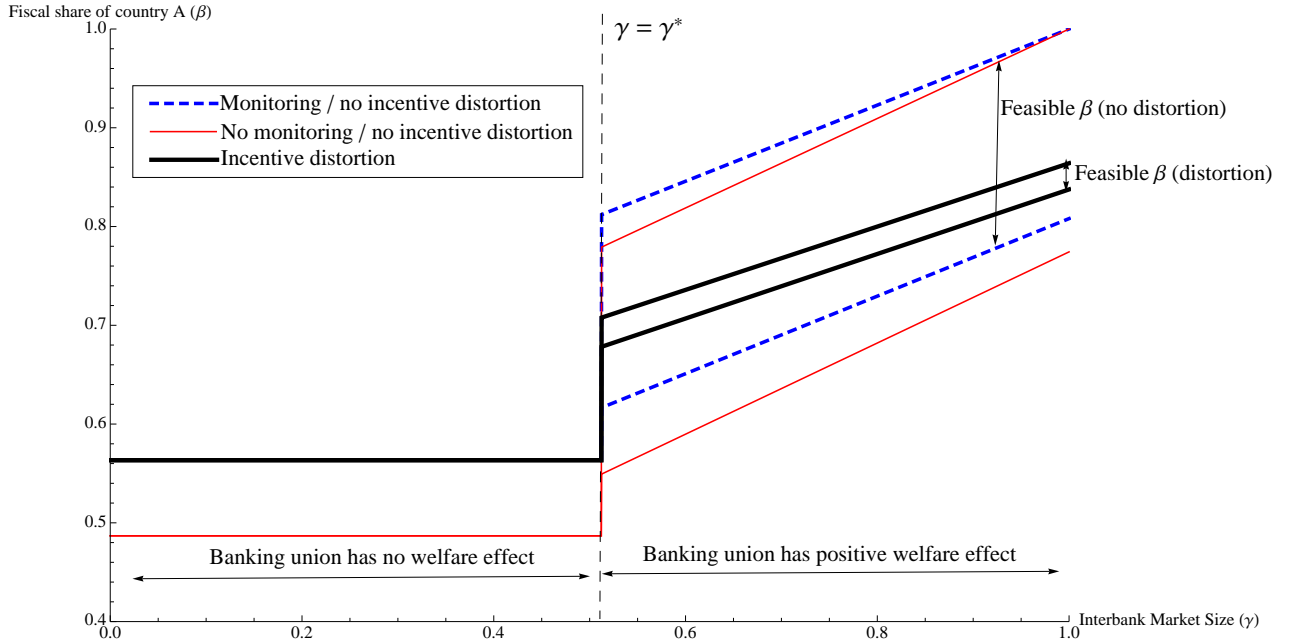


Figure 6: **Feasible Cost Sharing Rules for the Banking Union**

The figure shows the feasible linear sharing rules of the fiscal cost of the form  $\{\text{Country A:}\beta, \text{Country B:}1 - \beta\}$ . For small sizes of the interbank market, the banking union does not improve welfare and there is a unique way to split the costs between countries. For situations when there is a positive welfare surplus from a banking union (large  $\gamma$ ), the country which benefits from resolving the externality also internalizes the largest part of the fiscal cost.

## A Proofs for Theorems and Lemmas

### Proposition 1

*Proof. Resolution Policy.* We begin with the bailout strategies of the regulator in country B. In a default event,  $RG_B$  bails out the bank only if the after-bailout domestic welfare is higher or equal to the welfare resulting from the bank liquidation. Moreover, Bank B only defaults if its  $t = 1$  payoff is equal zero. Thus, the ex-post welfares (for the bailout and the liquidation decision) are given by (13) and the regulator opts for the bailout if:

$$\begin{aligned} R_2(1 - F(1 - L)) &\geq (1 - F)(1 - \gamma)(1 - \phi)r + Fr_I\gamma \\ &\Leftrightarrow \\ \gamma &\leq \frac{R_2(1 - F(1 - L)) + (F - 1)(1 - \phi)r}{Fr_I + (F - 1)(1 - \phi)r} \end{aligned} \quad (39)$$

Replacing  $r_I$  with  $\underline{r}_I = \frac{(1+\gamma)\phi - R_1^A}{\gamma}$  gives the bailout condition when Bank B has a full bargaining power in the interbank market:

$$\gamma \leq \frac{R_2(1 - F(1 - L)) + (F - 1)(1 - \phi)r + F(R_1^A - \phi)}{F\phi + (F - 1)(1 - \phi)r} = \gamma^* \quad (40)$$

**Monitoring and Strategy Independence.** Consider next Bank B's monitoring decision when  $\gamma \leq \gamma^*$ , i.e. when  $BK_B$  is always bailed out. The expected profit for Bank B if it monitors and if it does not monitor are equal respectively:

$$\begin{aligned} \Pi_B(\alpha, 0) &= \alpha(R_1^B + R_2 - (1 - \gamma)\phi - (1 - \gamma)(1 - \phi)r - r_I\gamma) + (1 - \alpha)(R_2 - (1 - \gamma)(1 - \phi)r) \\ \Pi_B(\alpha - \delta, B) &= (\alpha - \delta)(R_1^B + R_2 - (1 - \gamma)\phi - (1 - \gamma)(1 - \phi)r - r_I\gamma) + \\ &\quad (1 - \alpha + \delta)(R_2 - (1 - \gamma)(1 - \phi)r) + B \end{aligned}$$

The two expressions do not depend on the monitoring decision of Bank A, because payoffs to Bank B are independent of the payoffs to the foreign bank. A direct comparison of the two expressions yields the monitoring condition:

$$\frac{B}{\delta} \leq R_1^B - (1 - \gamma)\phi - r_I\gamma = b_1^B$$

When  $\gamma > \gamma^*$ , expected payoffs to Bank B are lower, because in case of a default regulator  $RG_B$

never bails out Bank B:

$$\begin{aligned}\Pi_B(\alpha, 0) &= \alpha (R_1^B + R_2 - (1 - \gamma) \phi - (1 - \gamma) (1 - \phi) r - r_I \gamma) + (1 - \alpha) \times 0 \\ \Pi_B(\alpha - \delta, B) &= (\alpha - \delta) (R_1^B + R_2 - (1 - \gamma) \phi - (1 - \gamma) (1 - \phi) r - r_I \gamma) + \\ &\quad (1 - \alpha + \delta) \times 0 + B\end{aligned}$$

Bank B monitors if:

$$\frac{B}{\delta} \leq R_1^B + R_2 - (1 - \gamma) \phi - (1 - \gamma) (1 - \phi) r - r_I \gamma = b_2^B$$

and the new threshold is always smaller than the threshold  $b_1^B$  for  $\gamma \leq \gamma^*$ . It is again independent of the monitoring decision of Bank A.  $\square$

### Proposition 2

*Proof. Resolution Policy.* Bank A defaults following one of two events: 1) the  $t = 1$  payoff is equal zero, or 2) the  $t = 1$  payoff is  $R_1^A$  but Bank B in country B defaults and is liquidated. In the latter case Bank A does not receive the amount  $r_I \gamma$  back and is not able to satisfy all domestic deposit demands at  $t = 1$ , by Assumption 1. In both situations the regulator in country A decides on bailout if the after-bailout welfare is higher or equal to the domestic welfare following the bank liquidation. Moreover, in both cases the after-bailout and after-liquidation welfares are given by (10). The bailout takes place if:

$$R_2 (1 - F (1 - L)) \geq (1 - F) (1 + \gamma) (1 - \phi) r \quad (41)$$

Under assumption  $1 < F < \frac{1}{1-L}$  (Section 3.1), the LHS of (41) is always positive, as  $F (1 - L) < 1$ , and the RHS is always negative because  $F > 1$ . Therefore, regulator  $RG_B$  always bails out Bank A.

**Monitoring and Partial Strategy Independence.** Now we consider the monitoring decision of Bank A. From (5.1.3) we see that Bank A's payoff depends on the bailout decision of the regulator in country B. In what follows we thus first analyse Bank A's monitoring decision when Bank B is always bailed out (i.e. when (39) holds) and then consider the case when Bank B is always liquidated (when (39) does not hold).

When regulator  $RG_B$  always opts for a bailout, Bank A always receives  $r_I \gamma$  back. Thus, the expected

payoffs for Bank A when monitoring and in absence of monitoring are given by:

$$\begin{aligned}\Pi_A(\alpha, 0) &= \alpha (R_1^A + R_2 + r_I \gamma - (1 + \gamma) \phi - (1 + \gamma) (1 - \phi) r) + (1 - \alpha) (R_2 - (1 + \gamma) (1 - \phi) r) \\ \Pi_A(\alpha + \delta, B) &= (\alpha - \delta) (R_1^A + R_2 + r_I \gamma - (1 + \gamma) \phi - (1 + \gamma) (1 - \phi) r) + \\ &\quad (1 - \alpha + \delta) (R_2 - (1 + \gamma) (1 - \phi) r) + B\end{aligned}$$

A comparison of the two values yields the monitoring condition:

$$\frac{B}{\delta} \leq R_1^A + r_I \gamma - (1 + \gamma) \phi = b^A \quad (42)$$

From (42) it immediately follows that for  $\gamma$  that satisfies (39), the monitoring decision of Bank A is independent of the monitoring decision of Bank B (no spillovers).

Turning to the case with no bailouts by the regulator in country B (the condition (39) is violated), we see that payoffs to Bank A now depend on the monitoring decision of Bank B, as the return payment of  $r_I \gamma$  is realised only if Bank B is successful at  $t = 1$ . If bank B monitors ( $\frac{B}{\delta} \leq b_2^B$ ), expected payoffs to Bank A are given by:

$$\begin{aligned}\Pi_A(\alpha, 0) &= \alpha^2 (R_1^A + R_2 + r_I \gamma - (1 + \gamma) \phi - (1 + \gamma) (1 - \phi) r) + \\ &\quad (1 + \alpha) (1 - \alpha) (R_2 - (1 + \gamma) (1 - \phi) r) \\ \Pi_A(\alpha + \delta, B) &= \alpha (\alpha - \delta) (R_1^A + R_2 + r_I \gamma - (1 + \gamma) \phi - (1 + \gamma) (1 - \phi) r) + \\ &\quad (1 - \alpha (\alpha - \delta)) (R_2 - (1 + \gamma) (1 - \phi) r) + B\end{aligned}$$

and the monitoring condition is equal to:

$$\frac{B}{\delta} \leq \alpha (R_1^A + r_I \gamma - (1 + \gamma) \phi) = \alpha b^A$$

The new monitoring threshold  $\alpha b^A$  is lower than the threshold  $b^A$  for the case with bailouts of Bank B. If, in turn, Bank B does not monitor ( $\frac{B}{\delta} \geq b_2^B$ ), expected payoffs to Bank A are:

$$\begin{aligned}\Pi_A(\alpha, 0) &= \alpha (\alpha - \delta) (R_1^A + R_2 + r_I \gamma - (1 + \gamma) \phi - (1 + \gamma) (1 - \phi) r) + \\ &\quad (1 - \alpha (\alpha - \delta)) (R_2 - (1 + \gamma) (1 - \phi) r) \\ \Pi_A(\alpha + \delta, B) &= (\alpha - \delta)^2 (R_1^A + R_2 + r_I \gamma - (1 + \gamma) \phi - (1 + \gamma) (1 - \phi) r) + \\ &\quad (1 + \alpha - \delta) (1 - \alpha + \delta) (R_2 - (1 + \gamma) (1 - \phi) r) + B\end{aligned}$$

and the new monitoring condition follows:

$$\frac{B}{\delta} \leq (\alpha - \delta) (R_1^A - r_I \gamma - (1 + \gamma) \phi) = (\alpha - \delta) b^A$$

□

with the monitoring threshold  $(\alpha - \delta) b^A$  lower than when Bank B monitors, which finishes the proof.

**Lemma 3.**

*Proof.* In what follows, we calculate the welfares for  $r_I = \underline{r}_I = \frac{(1+\gamma)\phi - R_1^A}{\gamma}$ . The supranational regulator,  $RG_{BU}$ , maximises the sum of domestic welfares in countries A and B (we assume that both countries receive the same weight in the objective function of the banking union's regulator). In order to determine the bailout strategy of the new regulator, four scenarios described in Section 5 have to be considered again: 1) Bank A receives  $R_1^A$  and Bank B receives  $R_1^B$  at  $t = 1$ . There are no defaults.

2) Bank A receives zero and Bank B's payoff is  $R_1^B$  at  $t = 1$ . Bank A defaults and the regulator  $RG_{BU}$  decides on the bailout, according to the rule (23). In particular, the banking union's welfare after the bailout of Bank A is:

$$[\text{Welfare}^A + \text{Welfare}^B]_{\text{Bailout}} = 2R_2 + R_1^B + (1 - F) R_1^A$$

and the welfare after liquidation of Bank A is:

$$[\text{Welfare}^A + \text{Welfare}^B]_{\text{Liquidation}} = R_2 + R_1^B + R_1^A + (1 + \gamma) (1 - \phi) r - F ((1 + \gamma) (1 - \phi) r + R_1^A - R_2 (1 - L))$$

The bailout takes place if:

$$R_2 (1 - F (1 - L)) \geq (1 - F) (1 + \gamma) (1 - \phi) r$$

which, under the assumption that  $1 < F < \frac{1}{1-L}$ , always holds. Therefore, the supranational regulator,  $RG_{BU}$ , always bails out defaulting Bank A.

3) Bank A receives  $R_1^A$  and Bank B's payoff is zero at  $t = 1$ . Within this case several scenarios can be considered. In particular, if the regulator does not decide to bail out Bank B, then Bank A will enter into a default, in which case the regulator can decide either to bail out or not to bail out Bank A. Consider first the welfare following the decision to bail out Bank B immediately:

$$[\text{Welfare}^A + \text{Welfare}^B]_{\text{BailoutB}} = 2R_2 + 2\phi - F (2\phi - R_1^A) \quad (43)$$

If, instead, the regulator  $RG_{BU}$  opts for liquidation, then it has to decide whether allow also Bank A to fall and be liquidated or to bail it out. The ex-post welfares for the two alternative cases are respectively:

$$[\text{Welfare}^A + \text{Welfare}^B]_{\text{Liquidation}} = 2\phi + 2(1 - \phi)r - F(2\phi + 2(1 - \phi)r - R_1^A - 2(1 - L)R_2) \quad (44)$$

$$[\text{Welfare}^A + \text{Welfare}^B]_{\text{BailoutA}} = 2\phi + R_2 + (1 - \gamma)(1 - \phi)r - F(2\phi + (1 - \gamma)(1 - \phi)r - (1 - L)R_2) \quad (45)$$

A direct comparison of (43) with (44) and (45) gives two conditions that need to be satisfied for the regulator  $RG_{BU}$  to prefer the immediate bailout of Bank B:

$$\begin{aligned} R_2(1 - F(1 - L)) &\geq (1 - F)(1 - \phi)r \\ R_2(1 - F(1 - L)) &\geq (1 - F)(1 - \phi)(1 - \gamma)r - FR_1^A \end{aligned}$$

Again, for  $1 < F < \frac{1}{1-L}$ , the two conditions always hold and the supranational regulator always bails out Bank B.

4) Both Bank A and Bank B receive zero at  $t = 1$ . The banking union's regulator needs to choose between four options: 1) bailing out Bank A only, 2) bailing out Bank B only, 3) bailing out both banks, and 4) liquidating both banks. The respective ex-post welfares corresponding to the four cases are:

$$\begin{aligned} [\text{Welfare}^A + \text{Welfare}^B]_{\text{BailoutA}} &= 2\phi + R_2 + (1 - \gamma)(1 - \phi)r - F(2\phi + (1 - \gamma)(1 - \phi)r - (1 - L)R_2) \\ [\text{Welfare}^A + \text{Welfare}^B]_{\text{BailoutB}} &= 2\phi + R_2 + (1 + \gamma)(1 - \phi)r - F(2\phi + (1 + \gamma)(1 - \phi)r + rI\gamma - (1 - L)R_2) \\ [\text{Welfare}^A + \text{Welfare}^B]_{\text{BailoutAB}} &= 2R_2 + 2\phi - F(2\phi) \\ [\text{Welfare}^A + \text{Welfare}^B]_{\text{Liquidation}} &= 2\phi + 2(1 - \phi)r - F(2\phi + 2(1 - \phi)r - 2(1 - L)R_2) \end{aligned}$$

Again, a direct comparison of the four expressions results in two conditions that need to be satisfied for the regulator  $RG_{BU}$  to always bail out both banks:

$$\begin{aligned} R_2(1 - F(1 - L)) &\geq (1 - F)(1 + \gamma)(1 - \phi)r - FrI\gamma \\ R_2(1 - F(1 - L)) &\geq (1 - F)(1 - \phi)r \end{aligned}$$

We conclude that the two conditions always hold and the supranational regulator always bails out

both banks. □

**Proposition 3**

*Proof.* In the previous proof we have already shown that the supranational regulator always bails out a defaulting bank. Thus, we only consider here bank monitoring decisions under a banking union. We again focus on the case when  $r_I = \underline{r}_I = \frac{(1+\gamma)\phi - R_1^A}{\gamma}$ . Consider Bank A first: in case of default it is always bailed out by the regulator  $RG_{BU}$ . Its interbank return  $r_I\gamma$  is also secured in case of Bank B's default, as the union's regulator never allows for liquidation of Bank B. The monitoring condition for Bank A is thus the same as under national regulatory system and under  $\gamma \leq \gamma^*$ : independent of the monitoring decision of Bank B and given by the threshold  $b^A = 0$  as in Corollary 2. It follows that Bank A never monitors in presence of the banking union. Bank B's payoffs are also the same as under  $\gamma < \gamma^*$  and under the national regulatory system (Bank B is always bailed out after a default). Thus, the monitoring decision can be summarised by the condition:

$$\frac{B}{\delta} \leq R_1^B - (1 - \gamma)\phi - r_I\gamma = b_1^B$$

We conclude that under a banking union there is now only one threshold value of  $\frac{B}{\delta}$  below which Bank B monitors. □

**Proposition 4**

*Proof.* We consider three parameter sets for which there is a difference in welfare under the banking union and under the national regulators:

1.  $\gamma > \gamma^*$  and  $\frac{B}{\delta} \leq b_1^B$

Bank B always monitors, is always bailed out by the supranational regulator  $RG_{BU}$ , but never by the domestic regulator  $RG_B$ . Global ex-ante welfare under domestic regulation is equal:

$$\begin{aligned} \text{Welfare}_{National}^{A+B} &= \alpha(\alpha - \delta) [R_1^A + R_1^B + 2R_2] \\ &\quad + \alpha(1 - \alpha + \delta) [R_1^B + 2R_2 + R_1^A - F(R_1^A)] \\ &+ (1 - \alpha)(\alpha - \delta) [R_2 + 2\phi + (1 - \gamma)(1 - \phi)r - F(2\phi + (1 - \gamma)(1 - \phi)r - R_1^A - (1 - L)R_2)] \\ &\quad + (1 - \alpha)(1 - \alpha + \delta) [R_2 + 2\phi + (1 - \gamma)(1 - \phi)r - F(2\phi + (1 - \gamma)(1 - \phi)r - (1 - L)R_2)] \end{aligned} \tag{46}$$

Under the banking union welfare is:

$$\begin{aligned}
\text{Welfare}_{BU}^{A+B} &= \alpha(\alpha - \delta) [R_1^A + R_1^B + 2R_2] \\
&+ \alpha(1 - \alpha + \delta) [R_1^B + 2R_2 + R_1^A - F(R_1^A)] \\
&+ (1 - \alpha)(\alpha - \delta) [2R_2 + 2\phi - F(2\phi - R_1^A)] \\
&+ (1 - \alpha)(1 - \alpha + \delta) [2R_2 + 2\phi - F(2\phi)]
\end{aligned} \tag{47}$$

Using that  $r_I = \underline{r}_1$  and thus  $r_I\gamma = (1 + \gamma)\phi - R_1^A$ , comparison of the two values yields:

$$\begin{aligned}
\text{Welfare}_{National}^{A+B} \geq W_{BU}^{A+B} &\Leftrightarrow \\
(1 - \alpha) [R_2(1 - F(1 - L)) + (F - 1)(1 - \gamma)(1 - \phi)r] &\geq 0
\end{aligned} \tag{48}$$

where equation (48) always holds. Thus, the introduction of the banking union is welfare-improving in this case.

**2.  $\gamma > \gamma^*$  and  $b_1^B < \frac{B}{\delta} \leq b_2^B$**

Bank B does not monitor in the banking union, but does so under the national resolution mechanism. In case of a default, it is bailed out by  $RG_{BU}$  but never by  $RG_B$ . Global welfare under national regulators is the same as in (46). Welfare in the banking union changes, as the probabilities of reaching high payoff states at  $t = 1$  are now different:

$$\begin{aligned}
\text{Welfare}_{BU}^{A+B} &= (\alpha - \delta)^2 [R_1^A + R_1^B + 2R_2] \\
&+ (\alpha - \delta)(1 - \alpha + \delta) [R_1^B + 2R_2 + R_1^A - F(R_1^A)] \\
&+ (1 - \alpha + \delta)(\alpha - \delta) [2R_2 + 2\phi - F(2\phi - R_1^A)] \\
&+ (1 - \alpha + \delta)^2 [2R_2 + 2\phi - F(2\phi)]
\end{aligned} \tag{49}$$

Again, a direct comparison of (49) with (46) yields:

$$\begin{aligned}
\text{Welfare}_{National}^{A+B} \geq W_{BU}^{A+B} &\Leftrightarrow \\
\delta \leq \frac{(1 - \alpha)(R_2(1 - F(1 - L)) + (1 - \gamma)(1 - \phi)(F - 1)r)}{F(2\phi - R_1^A) + (R_1^A + R_1^B - 2\phi)} &= \delta^*
\end{aligned}$$

The banking union is welfare improving only for the values of  $\delta$  small enough.

**3.  $\gamma > \gamma^*$  and  $\frac{B}{\delta} > b_2^B$**

Bank B never monitors. In case of a default, it is bailed out by  $RG_{BU}$  but never by  $RG_B$ . The global welfare under banking union is the same as in (49), while the welfare under domestic



regulations is now:

$$\begin{aligned}
\text{Welfare}_{National}^{A+B} &= (\alpha - \delta)^2 [R_1^A + R_1^B + 2R_2] \\
&+ (\alpha - \delta) (1 - \alpha + \delta) [R_1^B + 2R_2 + R_1^A - F(R_1^A)] \\
&+ (1 - \alpha + \delta)(\alpha - \delta) [R_2 + 2\phi + (1 - \gamma)(1 - \phi)r - F(2\phi + (1 - \gamma)(1 - \phi)r - R_1^A - (1 - L)R_2)] \\
&+ (1 - \alpha + \delta)^2 [R_2 + 2\phi + (1 - \gamma)(1 - \phi)r - F(2\phi + (1 - \gamma)(1 - \phi)r - (1 - L)R_2)]
\end{aligned} \tag{50}$$

Comparing (50) with (49) yields the condition:

$$\begin{aligned}
\text{Welfare}_{National}^{A+B} &\geq W_{BU}^{A+B} \Leftrightarrow \\
(1 - \alpha + \delta) [R_2 (1 - F(1 - L)) + (F - 1)(1 - \gamma)(1 - \phi)r] &\geq 0
\end{aligned} \tag{51}$$

which always holds. Thus, the banking union again improves the global welfare, by the amount in (51).

□

**Lemma 5.**

*Proof.* With zero net welfare effect of the banking union, one country's surplus is another country's loss, as for each scenario the total welfare difference is zero. Hence, the only way for (28) to hold is if  $\mathbb{E} [\text{Welfare}_{BU}^A - \text{Welfare}_{National}^A] = 0$ . The monitoring strategy of  $BK_B$  is unchanged by the introduction of a banking union - see Propositions 2 and 3. We also know  $BK_A$  never monitors its loans in equilibrium (Propositions 1 and 3)

If  $BK_B$  never monitors its loans we have the  $\mathbb{E} [\text{Welfare}_{BU}^A - \text{Welfare}_{National}^A] = 0$  is equivalent to:

$$(1 - \alpha + \delta)(\alpha - \delta)(1 - \beta)FR_1^A - (\alpha - \delta)(1 - \alpha + \delta)\beta F(2\phi - R_1^A) + (1 - \alpha + \delta)^2(FR_1^A - 2\beta F\phi) = 0$$

From this condition we can derive the equilibrium fiscal cost share of country A:

$$\beta_{1,N} = \frac{R_1^A}{2\phi}$$

which, by Assumption 1, is in the interval  $(0, \frac{1}{2})$ .

In the other case, if  $BK_B$  is monitoring, we have that the following condition should hold:

$$(1 - \alpha + \delta)\alpha(1 - \beta)FR_1^A - (\alpha - \delta)(1 - \alpha)\beta F(2\phi - R_1^A) + (1 - \alpha + \delta)(1 - \alpha)(FR_1^A - 2\beta F\phi) = 0$$

and the corresponding equilibrium fiscal cost share of country A is:

$$\beta_{1,M} = \frac{(1 - \alpha + \delta) R_1^A}{2(1 - \alpha) \phi + \delta R_1^A}$$

which is positive and, again by Assumption 1, is always smaller than 1.  $\square$

**Proposition 5**

*Proof.* **1.**  $\gamma > \gamma^*$  and  $\frac{B}{\delta} \leq b_1^B$  OR  $\gamma > \gamma^*$  and  $\frac{B}{\delta} > b_2^B$

The probabilities of reaching particular payoff states do not change when moving from national regulations to the banking union and thus we can write the participation constraints for both countries as conditions on their share of the expected welfare surplus. For country A we have:

$$\mathbb{P}(0, R_1^B) (1 - \beta) F R_1^A + \mathbb{P}(R_1^A, 0) (1 - \beta) F (2\phi - R_1^A) + \mathbb{P}(0, 0) (F\phi(1 + \gamma) - 2F\beta\phi) \geq 0$$

which is a linear decreasing function of  $\beta$  and can be rewritten as an upper bound for feasible  $\beta$ s:

$$\beta \leq \frac{\mathbb{P}(0, R_1^B) F R_1^A + \mathbb{P}(R_1^A, 0) F (2\phi - R_1^A) + \mathbb{P}(0, 0) (F\phi(1 + \gamma))}{\mathbb{P}(0, R_1^B) F R_1^A + \mathbb{P}(R_1^A, 0) F (2\phi - R_1^A) + 2\mathbb{P}(0, 0) F\phi} \in (0, 1) \quad (52)$$

The  $\beta$  upper bound establishes thus the minimum share of the welfare surplus (or the maximum share of the bailout costs)  $RG_A$  requires in order to participate in the banking union. The country B regulator,  $RG_B$  has a similar participation constraint:

$$\begin{aligned} &\mathbb{P}(0, R_1^B) (\beta - 1) F R_1^A + \mathbb{P}(R_1^A, 0) (\beta - 1) F (2\phi - R_1^A) + \\ &\mathbb{P}(0, 0) (2F\beta\phi) - F\phi(1 + \gamma) + \mathbb{E}\Delta W_{BU}^i \geq 0 \end{aligned}$$

with  $i = M, N, D$ , that yields a lower bound for  $\beta$ :

$$\beta \geq \frac{\mathbb{P}(0, R_1^B) F R_1^A + \mathbb{P}(R_1^A, 0) F (2\phi - R_1^A) + \mathbb{P}(0, 0) (F\phi(1 + \gamma)) - \mathbb{E}\Delta \text{Welfare}_{BU}^i}{\mathbb{P}(0, R_1^B) F R_1^A + \mathbb{P}(R_1^A, 0) F (2\phi - R_1^A) + 2\mathbb{P}(0, 0) F\phi}$$

The probabilities of reaching each of the four payoff states can be expressed in terms of monitoring effort of both banks:

**(1a)**  $\gamma > \gamma^*$  and  $\frac{B}{\delta} \leq b_1^B$

Bank B monitors both under the national regulation and under the banking union. The upper bound for the feasible  $\beta$ s is equal:

$$\beta \leq \frac{(1 - \alpha + \delta) \alpha F R_1^A + (\alpha - \delta) (1 - \alpha) F (2\phi - R_1^A) + (1 - \alpha + \delta) (1 - \alpha) (F\phi (1 + \gamma))}{(1 - \alpha + \delta) \alpha F R_1^A + (\alpha - \delta) (1 - \alpha) F (2\phi - R_1^A) + 2(1 - \alpha + \delta) (1 - \alpha) F\phi}$$

and a similar expression for the lower bound of  $\beta$ s, which together can be further simplified to:

$$\begin{aligned} \beta &\leq \frac{(1 - \alpha) (1 - \delta + \alpha (1 - \gamma) + \gamma (1 + \delta)) \phi + \delta R_1^A}{2(1 - \alpha) \phi + \delta R_1^A} = \bar{\beta}_{2,M} \\ \beta &\geq \bar{\beta}_{2,M} - \frac{\mathbb{E}\Delta W_{BU}^M}{2F(1 - \alpha) \phi + F\delta R_1^A} = \underline{\beta}_{2,M} \end{aligned}$$

It is straightforward to verify that  $\bar{\beta}_{2,M}$  is smaller than 1. We further notice that  $\bar{\beta}_{2,M} > \beta_{1,M}$  since:

$$\begin{aligned} \bar{\beta}_{2,M} &> \beta_{1,M} \Leftrightarrow \\ (1 - \delta + \alpha (1 - \gamma) + \gamma (1 - \delta)) \phi &\geq R_1^A \end{aligned}$$

which by Assumption 1 always holds if the LHS is larger than  $\phi$ . This allows us to further simplify the condition to:

$$\alpha (1 - \gamma) \phi - \delta \phi + (\gamma - \delta \gamma) \phi \geq 0$$

Because  $\alpha \geq \delta$ , the LHS is always positive and thus  $\bar{\beta}_{2,M} \in (\beta_{1,M}, 1)$ .

**(1b)**  $\gamma > \gamma^*$  and  $\frac{B}{\delta} > b_2^B$

Bank B never monitors under the national regulation and under the banking union. The upper bound for the feasible  $\beta$ s is given by:

$$\beta \leq \frac{(1 - \alpha + \delta) (\alpha - \delta) F R_1^A + (\alpha - \delta) (1 - \alpha + \delta) F (2\phi - R_1^A) + (1 - \alpha + \delta)^2 (F\phi (1 + \gamma))}{(1 - \alpha + \delta) (\alpha - \delta) F R_1^A + (\alpha - \delta) (1 - \alpha + \delta) F (2\phi - R_1^A) + 2(1 - \alpha + \delta)^2 F\phi}$$

with a similar expression for the lower bound of  $\beta$ s, which together leads to:

$$\begin{aligned} \beta &\leq \frac{1 + \alpha (1 - \gamma) + \gamma (1 + \delta) - \delta}{2} = \bar{\beta}_{2,N} \\ \beta &\geq \bar{\beta}_{2,N} - \frac{\mathbb{E}\Delta W_{BU}^N}{2F\phi (1 - \alpha + \delta)} = \underline{\beta}_{2,N} \end{aligned}$$

It is also straightforward to prove that  $\underline{\beta}_{2,M} > \beta_{1,M}$ . This is equivalent to showing that:

$$(1 - \alpha) F R_1^A \leq (1 - \alpha) F (1 - \delta + \alpha (1 - \gamma) + \gamma + \delta \gamma) \phi \\ - (1 - \alpha) [R_2 (1 - F (1 - L)) + (1 - \gamma) (1 - \phi) r (F - 1)]$$

Since  $R_1^A < \phi$  it is enough to prove:

$$(1 - \alpha) F \phi \leq (1 - \alpha) F (1 - \delta + \alpha (1 - \gamma) + \gamma + \delta \gamma) \phi \\ - (1 - \alpha) [R_2 (1 - F (1 - L)) + (1 - \gamma) (1 - \phi) r (F - 1)]$$

Some further algebraic manipulation yields the equivalent condition:

$$0 \leq (1 - \alpha) F \phi (\alpha (1 - \gamma) + \gamma + \delta (\gamma - 1)) \\ - (1 - \alpha) [R_2 (1 - F (1 - L)) + (1 - \gamma) (1 - \phi) r (F - 1)]$$

Since we have  $\gamma > \gamma^*$  it holds that:

$$R_2 (1 - F (1 - L)) + (F - 1) (1 - \phi) r (1 - \gamma) + F (R_1^A - \phi) \leq F \phi \gamma$$

The original condition becomes then the true inequality:

$$0 \leq F \phi [(\alpha - \delta) (1 - \gamma)] + F ((R_1^A - \phi))$$

**(2)**  $\gamma > \gamma^*$  and  $b_1^B < \frac{B}{\delta} \leq b_2^B$

Introduction of the banking union shifts the incentives of  $BK_B$  from monitoring to not monitoring (the disciplining effect), and the surplus for regulator A is reduced by the shift in the probabilities. Moreover, only if  $\delta \leq \delta^*$  the difference in welfares is actually positive. Assuming  $\delta \leq \delta^*$ , the upper bound for the feasible range for  $\beta$ s is derived from the two participation constraints for individual countries. The participation constraint for country A, that gives the upper bound for  $\beta$  is given by:

$$\mathbb{E} \text{Welfare}_{BU}^A \geq \mathbb{E} \text{Welfare}_{National}^A$$

Let  $W_1^i$ ,  $W_2^i$ ,  $W_3^i$  and  $W_4^i$  be short hand notations (for expositional purposes) for the country  $i$  welfare under national regulation in the four states of the world:  $(R_1^A, R_1^B)$ ,  $(0, R_1^B)$ ,  $(R_1^A, 0)$  and

$(0, 0)$ . Let also  $S_i$ ,  $i \in \{1, 2, 3, 4\}$  be the welfare surpluses for country A in all states of the world. Then, we have:

$$\begin{aligned} \mathbb{E}\text{Welfare}_{BU}^A &= (\alpha - \delta)^2 [W_1 + S_1] + (1 - \alpha + \delta)(\alpha - \delta) [W_2 + S_2] + \\ &\quad (1 - \alpha + \delta)(\alpha - \delta) [W_3 + S_3] + (1 - \alpha + \delta)^2 [W_4 + S_4] \end{aligned}$$

$$\begin{aligned} \mathbb{E}\text{Welfare}_{National}^A &= \alpha(\alpha - \delta) W_1 + (1 - \alpha + \delta)\alpha W_2 + \\ &\quad (1 - \alpha)(\alpha - \delta) W_3 + (1 - \alpha + \delta)(1 - \alpha) W_4 \end{aligned}$$

The banking union feasibility condition for country A reads then, after trivial simplification:

$$\begin{aligned} &(\alpha - \delta)^2 S_1 + (1 - \alpha + \delta)(\alpha - \delta) S_2 + (1 - \alpha + \delta)(\alpha - \delta) S_3 + \\ &(1 - \alpha + \delta)^2 S_4 + \delta(\alpha - \delta) [W_3 - W_1] + \delta(1 - \alpha + \delta) [W_4 - W_2] \geq 0 \end{aligned}$$

The first four terms of the above equation disregard the externality. Setting to zero the previous expression and disregarding the last 2 terms would thus yield  $\bar{\beta}_{2,N}$ . However, we have that:

$$\delta(\alpha - \delta) [W_3 - W_1] + \delta(1 - \alpha + \delta) [W_4 - W_2] = -\delta F ((1 + \gamma)\phi - R_1^A)$$

For simplicity, we denote:

$$\mathcal{C}_1 = (1 - \alpha + \delta)(\alpha - \delta) F R_1^A + (\alpha - \delta)(1 - \alpha + \delta) F (2\phi - R_1^A) + (1 - \alpha + \delta)^2 (F\phi(1 + \gamma))$$

$$\mathcal{C}_2 = (1 - \alpha + \delta)(\alpha - \delta) F R_1^A + (\alpha - \delta)(1 - \alpha + \delta) F (2\phi - R_1^A) + 2(1 - \alpha + \delta)^2 F\phi$$

Note that, as we proved above,  $\bar{\beta}_{2,N} = \frac{\mathcal{C}_1}{\mathcal{C}_2}$ . Then, the upper limit  $\bar{\beta}_{2,D}$  is given by:

$$\mathcal{C}_1 - \mathcal{C}_2 \bar{\beta}_{2,D} - \delta F ((1 + \gamma)\phi - R_1^A) = 0 \iff \bar{\beta}_{2,D} = \bar{\beta}_{2,N} - \frac{\delta F ((1 + \gamma)\phi - R_1^A)}{\mathcal{C}_2}$$

Or, after further simplification:

$$\bar{\beta}_{2,D} = \bar{\beta}_{2,N} - \frac{\delta((1+\gamma)\phi - R_1^A)}{2\phi(1-\alpha+\delta)} = \bar{\beta}_{2,N} - \frac{\delta[W_1^A - W_3^A]}{2\phi(1-\alpha+\delta)F}$$

We can provide a similar computation for country B and obtain the lower bound:

$$\underline{\beta}_{2,D} = \underline{\beta}_{2,N} + \frac{\delta[W_1^B - W_3^B]}{2\phi(1-\alpha+\delta)F} \quad (53)$$

Since  $W_1^B - W_3^B \geq 0$  under the model assumptions (the welfare is larger in country B when bank B succeeds at  $t=1$ ), we trivially have that:

$$\underline{\beta}_{2,D} > \underline{\beta}_{2,N}$$

□

### Corollary 3

*Proof.* To prove  $\bar{\beta}_{2,D} > \underline{\beta}_{2,D}$ , it is enough to show (using the definitions of the 2 measures) that:

$$\bar{\beta}_{2,N} - \underline{\beta}_{2,N} - \frac{\delta(W^A[R_1^A, R_1^B] - W^A[R_1^A, 0])}{2F\phi(1-\alpha+\delta)} - \frac{\delta(W^B[R_1^A, R_1^B] - W^B[R_1^A, 0])}{2F\phi(1-\alpha+\delta)} \geq 0$$

We know that  $\bar{\beta}_{2,N} - \underline{\beta}_{2,N} = \frac{\mathbb{E}\Delta W_{BU}^N}{2F\phi(1-\alpha+\delta)}$ . Replacing the expression for  $\mathbb{E}\Delta W_{BU}^N$ , the fact that  $\mathbb{E}\Delta W_{BU}^D > 0$  allows us to write:

$$(1-\alpha+\delta)[R_2(1-F(1-L)) + (F-1)(1-\gamma)(1-\phi)r] > \delta[F(2\phi - R_1^A) + (R_1^A + R_1^B - 2\phi)] + \delta[R_2(1-F(1-L)) + (F-1)(1-\gamma)(1-\phi)r]$$

Now, replacing in the expressions  $W^i[R_1^A, R_1^B]$  and  $W^i[R_1^A, 0]$ , the proof of the corollary is reduced to simply showing that:

$$\delta[F(2\phi - R_1^A) + (R_1^A + R_1^B - 2\phi)] + \delta[R_2(1-F(1-L)) + (F-1)(1-\gamma)(1-\phi)r] > \delta[R_1^A + R_1^B + R_2(1-F(1-L)) - (1+\phi)\gamma + F[(1+\gamma)\phi - R_1^A] + (F-1)((1-\gamma)\phi + (1-\gamma)(1-\phi)r)]$$

Some further simplification leads to the inequality:

$$2\phi F - 2\phi > F\phi + F\phi\gamma + (F - 1)\phi - (F - 1)\gamma\phi \iff -2\phi > -2\phi - 2\phi\gamma$$

which is true since  $\phi > 0$  and  $\gamma > 0$ .

□

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