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## Blanket guarantee and restructuring decisions for multinational banks in a bargaining model

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Juha-Pekka Niinimäki – Ville Mälkönen



# **Blanket guarantee and restructuring decisions for multinational banks in a bargaining model**




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## **Blanket guarantee and restructuring decisions for multinational banks in a bargaining model**

The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Bank of Finland.

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# Blanket guarantee and restructuring decisions for multinational banks in a bargaining model

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## Abstract

This paper examines blanket guarantee and restructuring decisions in respect of a multinational bank (MNB) using Nash bargaining, when the threat of a panic motivates countries to take decisions quickly. The failure of the bank would cause unevenly distributed externalities between the countries concerned, which influences restructuring incentives. In equilibrium, the bank is either liquidated or one – or both of the countries – recapitalizes it. The partition of the recapitalisation costs is sensitive to the country-specific benefits and costs from recapitalisation, panics and liquidation. The home regulator benefits from the privilege of being the only entity that can legally liquidate the MNB. Rational expectations regarding the bargaining result affect the incentives to declare a blanket guarantee.

Keywords: banking crises, bank restructuring, blanket guarantee, bargaining, deposit insurance

JEL classification numbers: G21, G22, G28

# Monikansallisuuden ongelma pankin talletussuojan laajennuksessa ja pankin uudelleenjärjestelyssä

Suomen Pankin keskustelualoitteita 16/2009

Juha-Pekka Niinimäki – Ville Mälkönen  
Rahapolitiikka- ja tutkimusosasto

## Tiivistelmä

Keskustelualoitteessa tutkitaan talletussuojan laajennus-päätöstä ja uudelleenjärjestely-ratkaisuja taloudellisiin vaikeuksiin joutuneen monikansallisen pankin tapauksessa. Tutkimuskehikkona on Nashin luoma neuvottelumalli sovellettuna niin, että talletuspaon uhka pakottaa pankin toiminta-alueen valtiot nopeisiin päätöksiin. Pankin uudelleenjärjestely voidaan suorittaa kahdella tavalla: joko pankki suljetaan (konkurssi) tai se pääomitetaan vakavaraiseksi. Koska konkurssin vaikutukset jakautuisivat epätasaisesti pankin toiminta-alueella, halu estää konkurssi vaihtelee valtioittain. Tutkimus osoittaa, että pääomituksen kustannusten jako valtioiden kesken riippuu valtioiden neuvotteluvoimasta, joka puolestaan perustuu valtioiden hyötyihin ja haittoihin eri vaihtoehtoissa (pääomitus, konkurssi, talletuspako). Pankin virallisen kotimaan neuvotteluvoimaa lisää vain sillä oleva oikeus sulkea pankki. Tietoisuus siitä, suljetaanko konkurssitilaan ajautunut monikansallinen pankki vai ei, vaikuttaa edeltävään päätökseen talletussuojan kattavuuden laajentamisesta.

Avainsanat: pankkikriisit, talletusvakuutus, neuvottelumallit

JEL-luokittelu: G21, G22, G28

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# 1 Introduction

The emergence of large and complex multinational banks (MNBs) has raised concerns that national supervision and crisis management practices – such as national deposit insurance schemes – should be redesigned to meet the requirements of the contemporary international financial markets. The concerns follow directly from the observation that managing for financial stability is no longer a national issue, as most policies targeted to restructure a distressed MNB involve cross-border externalities. Cross-border issues are especially important in the unified European financial system, where the number of pan-European banks is increasing and the largest institutions have systemic importance for the financial markets in multiple countries.<sup>1</sup>

The effects of an MNB failure vary among the countries concerned, which complicates cooperation, as national authorities pursue the policies they consider most beneficial for their country and domestic financial system. The restructuring negotiations concerning Fortis in 2008 between the Belgian, Dutch and Luxembourg governments and central bankers offer a topical example. The unilateral closure of Lehman Brothers in the same year by the US authorities illustrates how the closure of a large and complex financial institution generates severe cross-border externalities. The restructuring decision might well have been different had there been cooperation between, for instance, European and US authorities.

History has demonstrated that regulators are unable to establish a credible pre-commitment to a given policy scheme in banking crises. A similar commitment problem applies to any international ex-ante agreement on crisis management of an MNB, as the regulators cannot feasibly control for all states of the world in the contract. The most plausible prediction is that a crisis in an MNB will lead to ex-post negotiations between the affected countries on appropriate restructuring policy and burden sharing.

Most banking crises have demonstrated that once the first signs of distress in a bank emerge the regulators have limited time to reach an agreement, because while the regulators are negotiating on appropriate intervention, uninsured depositors are likely to panic. The threat of panic motivates regulators to restructure problem banks quickly. Again, the negotiations over Fortis provide a convincing example:

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<sup>1</sup> Schoenmaker (2009, p. 2) documents: ‘Average cross-border penetration in the EU has gradually increased from 11% in 1995 to 21% in 2007. Turning to individual banks, the European Central Bank has conducted a mapping exercise of EU banking groups with significant cross-border activity. While the number of banks included in the analysis increased only slightly – from 41 to 46 between years 2001 and 2005 – the consolidated assets of the sample as a whole increased from around 54% to 68% of overall consolidated EU banking assets.’

‘Belgium was desperate to prevent panic, because Fortis is the country’s biggest private sector employer and handles the bank accounts and insurance policies of 1.5 million Belgian households, or almost half the population.’ Financial Times 29 October 2008.

In this paper we explore the equilibriums of the bargaining game that is likely to emerge between the home and host countries of an insolvent MNB. The headquarters of the bank are in the home country in which it has received its operating licence. The home country regulators supervise the MNB and organize the deposit insurance scheme for its deposits in the host country as well as in the home country.<sup>2</sup> The regulators have two policy options available: liquidate the MNB or recapitalize it. While any country can recapitalize the bank, the option to liquidate it is obviously available only to the home country regulators who granted its operating licence.

The information and cost structure of our bargaining model captures the issues likely to emerge in the policy negotiations. As for the cross-border externalities, we assume that all costs related to the restructuring policies and bank panics are common knowledge, but their magnitude differs between the countries. The bargaining power of the regulators thus depends on the magnitude externalities associated with the policy options and on the expected costs of a bank panic.

The main contributions of the paper are as follows. Firstly, we show that when a unilaterally optimal policy for the home country calls for liquidation, the bargaining equilibrium exhibits recapitalization, which is socially optimal. This result supports the argument that MNBs are more likely to become subjects of bail-out policies when the regulators have the option to split the fiscal burden of costly recapitalization. Secondly, the equilibrium of the bargaining game entails a joint welfare-maximizing restructuring policy, but the costs for the tax-payers are unevenly allocated between the countries. The cost allocation is sensitive to country-specific bargaining power based on the expected costs and benefits from recapitalization as well as the costs from bank liquidation and bank panics. The home regulator benefits from the privilege that it is the only entity that can legally liquidate the MNB. In equilibrium, one of the countries may recapitalize the MNB alone, or the countries may recapitalize it together. Sometimes the socially optimal solution is achieved when the countries decide to liquidate the MNB.

In many financial crises, regulators attempt to mitigate panic by extending deposit insurance coverage and declaring a blanket guarantee on the deposits of an MNB in difficulties. Usually, a blanket guarantee is put in place when the first signs of distress emerge, but before the bank becomes legally insolvent.

We analyse how a blanket guarantee affects bargaining outcomes and the welfare implications of blanket guarantee policies. Firstly, we show that if the

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<sup>2</sup> This is in line with current legislation in the EU.

home country takes the decision on the blanket guarantee alone, it will be too reluctant to declare a blanket guarantee, due to the cross-border externalities. Thus, the blanket guarantee decision should be negotiated between the countries. Secondly, when a blanket guarantee is declared, the countries will always recapitalize the MNB, if it turns out to be insolvent, because recapitalization is less expensive than liquidation of a bank with fully insured deposits. This indicates that the countries should bargain over partition of the recapitalization costs simultaneously with the declaration of the blanket guarantee, even though the MNB is still solvent and may yet avoid failure. Thirdly, when it is socially optimal to recapitalize an MNB should it become insolvent, for example owing to the too-big-to-fail problem, it is always socially optimal to declare a blanket guarantee. Fourthly, it is socially optimal to reject a blanket guarantee only if a bank is such that the regulators are going to close down it later if it becomes insolvent.

The paper is related to two strands in the literature. One strand is Nash's (1950) classic bargaining theory. In this context, we utilize Muthoo's (2002) extensive survey. The second strand of the literature consists of analysis on bank regulation and bank restructuring: eg Merton (1977), Mailath and Mester (1994), Repullo (2001, 2004, 2005), Holthausen and Ronde (2002, 2005), Calzolari and Loranth (2005) and Niinimäki (2009). With the exception of Repullo (2001), Calzolari and Loranth (2005) and Holthausen and Ronde (2005), the papers do not explore multinational banks.<sup>3</sup>

The paper extends the existing literature on the regulation of multinational banks in the following directions. Holthausen and Ronde (2005) examine closure regulation, when it is possible to close a bank or leave it open. Regulators in both countries have access to private information that is relevant to the closure decision. Our approach differs from that in Holthausen and Ronde (2005) in several aspects. In their analysis, regulators are asymmetrically informed and exchange information, whereas in our model regulators have perfect information about the financial status of the MNB, which is in line with the consolidated supervision principle within the EU. Asymmetric information in our model is between the regulators and the market and revealed to the market through exogenous technology. This emphasizes the feature that a rapid decision is required when solving banking crises, because market reactions exacerbate the problem.

Holthausen and Ronde find that the equilibrium closure policies of a cheap-talk game between the regulators are less efficient the less aligned the regulators' incentives are. The bargaining results of this paper contradict this finding. We

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<sup>3</sup> Although theoretical and empirical research is scarce, the regulation of multinational banks has generated active debate: eg Mayes and Vesala (1998), Calzolari and Loranth (2001), Eisenbeis and Kaufman (2008), and Schoenmaker (2008). As far as we know, this paper is the first study on blanket guarantee.

show that the outcome is a joint maximizing policy, regardless of the distribution of the externalities. Finally, Holthausen and Ronde focus on the problem of asymmetric information between the regulators. We believe that, in the case of multinational banking crises, where the regulators must reach agreement rapidly, the results of the negotiations will be mainly driven by risk of bank panics, deposit insurance and blanket guarantees.

Repullo (2001) investigates the determinants of the takeover of a foreign bank by a domestic bank. The takeover is more likely to be realised if the foreign bank is relatively small, if it is relatively risky and if the deposit insurance premium is lower in the domestic bank's home country. Since Repullo concentrates on the determinants of international takeovers based on the risk diversification motive, his study differs from our paper. Calzolari and Loranth (2005) compare regulators' incentives to take disciplining regulatory actions in respect of two types of multinational bank: branches and subsidiaries. We explore only branch structure in a very different model setting.

The present paper is organized as follows. Section 2 describes the economy and the policies of bank restructuring. Section 3 examines the Nash bargaining process in period 1. Section 4 gives a numeric example on the effect of deposit insurance coverage. Blanket guarantee is analysed in Section 5, while Section 6 concludes.

## 2 Restructuring policies in period 1

We consider two countries, country A and country B. The banking sectors of the countries involve national banks and a multinational bank (MNB). The operations of the national banks are limited to the country in question. The MNB is organized under a branch structure so that it has headquarters in country A and a branch in country B. The branch structure means that the MNB is treated as a single legal entity that has received its operating licence from the regulators of country A. In line with current EU legislation, we assume that the regulator of country A supervises the MNB and insures its deposits.<sup>4</sup> It can also declare a blanket guarantee on deposits. The regulators share information regarding the MNB, but the regulator of country B cannot liquidate it. Liquidation is possible only by the regulator of country A (regulator A). Both regulators can, however, inject more equity capital into the MNB and in this way recapitalize it.

We explore a multinational bank in a financial downturn, which is assumed to extend over countries A and B. Negative news generates concerns about the financial condition of the MNB, which has a risk of becoming insolvent.

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<sup>4</sup> For current EU legislation, see Eisenbeis and Kaufman (2008).

Furthermore, anxious depositors may panic and rush to the MNB to withdraw their uninsured deposits. Given the illiquidity of bank assets, a panic can drive even a solvent bank to failure. We investigate the optimal policies of bank regulators in this environment. Will the regulators extend deposit insurance coverage by declaring a blanket guarantee for the MNB so that its deposits become completely secure? If the MNB later becomes insolvent, is it liquidated or recapitalized? If it is recapitalized, how are the costs of recapitalization split between the countries? To keep the analysis simple, we investigate a representative MNB in a model of two periods. In period 0, the MNB is assumed to be solvent but a financial downturn may trigger a panic that drives it to bankruptcy. To eliminate panics, the regulators may decide to declare a blanket guarantee. In period 1, if the MNB becomes insolvent, the regulators negotiate on the optimal rescheduling policy and the partition of the recapitalization costs employing Nash bargaining. Since the optimal rescheduling policy affects the declaration of a blanket guarantee, the analysis is dynamic. Firstly, we focus on period 1 and find the optimal rescheduling policy for the insolvent MNB (Sections 2–4). Thereafter, we turn to period 0 and investigate negotiations on the blanket guarantee (Section 5).

The MNB has no equity capital and uses deposits to fund its operations. The deposit insurance scheme covers a share  $\alpha$  of deposits. The bank must therefore pay positive interest  $r_{ud}$  only on uninsured deposits.<sup>5</sup> The initial bank size is  $D_{ini} = D(\alpha + (1 - \alpha)/(1 + r_{ud}))$  at the start of each period as long as the bank is successful. At the end of a period, the volume of deposits, principal and interest, amounts to  $D = D_A + D_B$  where subscript A (B) is used to denote deposits collected from country A (B). If bank lending is successful, the value of bank assets is  $D_{ini} + R_{suc}$  at the end of a period, where  $R_{suc}$  denotes liquid loan income that is spent to pay interest on uninsured deposits and dividends. In the case of bank failure, the value of bank assets is  $R < D$ .

Liquidation of bank assets entails costs and the liquidation value of the assets satisfies  $L < R$ . To simplify analysis, we assume the ratios of uninsured deposits and bank assets in countries A and B are equal to the ratio of bank deposits,  $D_A/D_B$ .

A net value of an insolvent MNB at the start of period 1 is  $V = R - D < 0$ . The regulators choose a costs-minimizing restructuring policy,  $\sigma_p$ . Subscript p denotes the restructuring policies available to regulators: recapitalization ( $\sigma_r$ ) and liquidation ( $\sigma_l$ ). The regulators may also be unable to reach agreement ( $\sigma_0$ ).

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<sup>5</sup> We do not model how the deposit interest rate of uninsured deposits is calculated, because the exact level of the interest rate is irrelevant for our analysis. We simply assume that uninsured deposits are priced correctly. If the MNB is too big to fail, the deposit interest rate of uninsured deposits is zero.

## 2.1 Liquidation

If regulator A chooses liquidation,  $\sigma_i$ , it closes the MNB. The combined costs the countries incur for the liquidation policy are given by

$$\Pi(\sigma_i) = \pi_A(\sigma_i) + \pi_B(\sigma_i) \quad (2.1)$$

where  $\pi_i(\alpha_i) < 0$  is the cost of liquidation for country  $i$ . The cost is composed of the following factors

$$\pi_i(\sigma_i) = \begin{cases} \alpha(L - D) - C_A^n(\bar{\beta}_A) - C_A^e(D_A) & \text{for } i = A \\ -C_B^n(\bar{\beta}_B) - C_B^e(D_B) & \text{for } i = B \end{cases} \quad (2.2)$$

The functions  $C_i^n(\bar{\beta}_i)$  and  $C_i^e(D_i)$  denote the costs the countries bear for restructuring the national banks in country  $i$  due to the liquidation of the MNB and the externality costs to the other sectors of the economy, respectively. Since the deposits of the MNB are insured by the home country, regulator A pays the difference,  $\alpha(D - L) < 0$ . The rest of the liquidation proceeds,  $(1 - \alpha)L$ , are channelled to uninsured depositors. The parameter  $\bar{\beta}_i = (D - L)(1 - \alpha)D_i / D$  denotes country  $i$ 's uninsured depositors' losses due to liquidation of the MNB. Here,  $D - L$  is the volume of the lost deposits resulting from liquidation of the MNB and  $(1 - \alpha)D_i / D$  is country  $i$ 's share of the uninsured deposits.

The restructuring costs of the national banks,  $C_i^n(\bar{\beta}_i)$ , can be interpreted in the following manner. Since the proceeds from the MNB liquidation do not cover the total uninsured deposits of the MNB, these depositors bear losses.<sup>6</sup> In practice, interbank loans constitute a substantial share of the uninsured deposits. The MNB's failure to repay domestic banks may have a contagious effect on other domestic banks, which may fail due to the lost interbank deposits. In this case, regulators must extend the restructuring policies to national banks.<sup>7</sup> The magnitude of the losses thus depends on the MNB's position in the interbank

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<sup>6</sup> In the European Union, the Deposit Guarantee Schemes Directive specifies the features that an acceptable deposit insurance scheme must have. 'Most specifically, the system must provide deposit insurance coverage of 20 thousand euros, must exclude coverage of interbank deposits, ...,' Eisenbeis and Kaufman (2008, p. 177).

<sup>7</sup> The insolvency of Continental Illinois in 1984 provides an interesting example. Davison (1998, p. 250) reports: 'With regard to the Continental Illinois, the regulator's greatest concern was systemic risk, and therefore handing Continental through a payoff and liquidation was simply not considered a viable option. Continental had an extensive network of correspondent banks, almost 2,300 of which had funds invested in Continental; more than 42 per cent of those had invested funds in excess of \$100,000, with a total investment of almost \$6 billion. The FDIC determined that 66 of these banks, with total assets of almost \$5 billion, had more than 100 per cent of their equity capital invested in Continental and that an additional 113 banks with total assets of more than \$12 billion had between 50 and 100 per cent of their equity capital invested.' Therefore, the liquidation of Continental Illinois would have triggered a surge of bank failures.

market. To illustrate this effect we assume that an increase in uninsured deposits with the MNB increases the cost country  $i$  incurs for the MNB's inability to meet its obligations

$$0 \leq \partial C_i^n(\bar{\beta}_i) / \partial \bar{\beta}_i < 1 \quad (2.3)$$

This expression implies that the total restructuring costs of national banks in country  $i$  due to the failure of the MNB are less than the amount of country  $i$ 's depositors' uninsured deposits with the MNB,  $C_i^n(\bar{\beta}_i) < (1 - \alpha)D_i$  for all  $\bar{\beta}_i$ .<sup>8</sup> Intuitively, the losses of the national bank consist entirely of their uninsured deposits with the MNB. The MNB obviously has uninsured deposits from multiple investors. Therefore, the deposits of national banks are only a fraction of the total uninsured deposits on the books of the MNB. In addition, the initial wealth of the national banking sector is positive. Thus, the restructuring costs of the national banks are lower than the volume of the uninsured deposits with the MNB.

The negative externalities to the other sectors of the economy resulting from the closure of the MNB,  $C_i^e(D_i)$ , involve, for example, the costs related to disturbances to the payment system and lending relationships in country  $i$ . We assume the function satisfies

$$\partial C_i^e(D_i) / \partial D_i > 0 \quad (2.4)$$

as it is plausible to think that this effect is increasing in the volume of the MNB's operations in country  $i$ .

## 2.2 Recapitalization

The second policy option for the regulator is recapitalization of the insolvent multinational bank, where regulators inject fresh equity capital into the MNB so as to boost its value from negative to zero. The MNB can then be resold to private investors. Essentially, recapitalization is a bail-out policy that insulates all depositors – whether or not their deposits are insured – from losses they would incur if the regulators closed the bank. The policy therefore eliminates the damage to other banks,  $C_i^n(\beta_i)$ . The negative externalities to the payment system and long-term lending relationships,  $C_i^e(D_i)$ , are also avoided, because no banks are

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<sup>8</sup> We do not study how the national banks are restructured. We simply assume that the restructuring process is optimal.



closed down. The financial costs of the recapitalization may, however, turn out to be high relative to liquidation. Formally, the costs of recapitalization are<sup>9</sup>

$$\Pi(\sigma_r) = R - D \quad (2.5)$$

## 2.3 Disagreement

If the countries fail to reach agreement, this is termed the disagreement point and leads to two types of costs arising in the bargaining model, and in practice: the risk of a panic and the costs of maintaining the operations of the insolvent MNB.

Let us first consider a panic during period 1 when the MNB is insolvent. The risk of the panic is defined in a standard way. Let  $\gamma_1 \Delta$  denote the risk of a panic during an extremely short time period, that is,  $\Delta$  approaches zero. Since the bank is now insolvent it can be hit both by information-based panics and by pure panics.<sup>10</sup> Even if a negotiated solution is achieved in the Nash bargaining process at the start of period 0, the risk of a panic influences the bargaining equilibrium via the disagreement point (see Muthoo, 2002).

When a panic occurs, the MNB must liquidate its illiquid assets to meet the demands of depositors. As a result, the losses of uninsured deposits amount to

$$\underline{\beta}_i = (1 - \alpha)D_i - \frac{D_i}{D} L \quad (2.6)$$

The constraint (2.3) is also satisfied for  $\underline{\beta}_i$ . The losses of uninsured depositors are smaller under a panic than under liquidation:  $\underline{\beta}_i < \bar{\beta}_i$ . This follows from the fact that under liquidation uninsured depositors' share of the bank's liquidation proceeds is  $1 - \alpha$ , whereas under a panic they have access to the full amount of the liquidation proceeds. Inequality  $\underline{\beta}_i < \bar{\beta}_i$  implies  $C_i^n(\underline{\beta}_i) \leq C_i^n(\bar{\beta}_i)$ .

The restructuring costs of national banks due to the failure of the MNB are likely to be lower under a panic than under liquidation, because panic implies a smaller volume of lost interbank deposits. The total costs of a panic add up to

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<sup>9</sup> We explore only two alternatives, liquidation and recapitalization, because the costs from recapitalization are almost the same as the costs from several other methods: nationalization, the purchase and assumption method and a merger with a large solvent bank. In each alternative, uninsured depositors do not (usually) lose their deposits and the regulators need to use sufficient fresh funds that the value of the insolvent bank's assets equals the value of its deposits.

<sup>10</sup> Two main views on bank panics exist. According to the first view, panics are pure panics but the second view rests on the idea of information based bank runs. In his extensive empirical analysis on the Great Depression, Wicker (2000) finds supporting evidence for both views. For theoretical analysis on pure panics see Diamond and Dybvig (1983) and Niinimäki (2003) whereas Jacklin and Bhattacharya (1988) model information based runs. Chen and Hasan (2008) construct a model which clarifies connections between pure panics with information based runs.

$$C_i(\sigma_0) = \begin{cases} -\alpha D - C_A^n(\beta_A) - C_A^e(D_A) & \text{for } i = A \\ -C_B^n(\beta_B) - C_B^e(D_B) & \text{for } i = B \end{cases} \quad (2.7)$$

Lemma 1 compares the costs of panic to those the regulators incur for liquidation. The proof is in Appendix A.<sup>11</sup>

**Lemma 1.** The cost of a bank panic is globally (and for country A) higher than the cost of liquidation. The cost of a panic is, however, lower than the cost of liquidation for country B.<sup>12</sup>

In addition to the risk of a panic, the disagreement point includes the costs from maintaining the operations of the insolvent MNB. Recall that the MNB must pay positive interest  $r_{ud}$  on risky uninsured deposits in each period. If no agreement is reached, regulator A needs to inject fresh funds into the MNB so that it can pay interest on uninsured deposits. Compounding the interest continuously gives  $r = \ln(1 + r_{ud})$ . The contribution of higher interest payments to the cost of delaying the decision for regulator A is therefore given by

$$\rho(\Delta) = [(1 + r_{ud})^\Delta - 1](1 - \alpha)D \quad (2.8)$$

We have now found out two costs from disagreement and next we will unify the costs. We use the following notation to denote the total expected costs of country  $i$  from disagreement

$$\Delta\gamma_i\pi_i(\sigma_0) = \begin{cases} \Delta\gamma_i C_i(\sigma_0) - (1 - \Delta\gamma_i)\rho(\Delta) & \text{for } i = A \\ \Delta\gamma_i C_i(\sigma_0) & \text{for } i = B \end{cases} \quad (2.9)$$

We have now detailed the costs and benefits from three policies of bank restructuring: liquidation, recapitalization and disagreement. We are thus in a

<sup>11</sup> Continental Illinois gives a good example regarding the speed and scale of a panic. Billions of dollars were withdrawn from the bank very quickly. The panic started on May 9 1984, and by May 11 Continental had to borrow \$3.6 billion at the Federal Reserve's discount window to make up for its lost deposits. During the following weekend, Continental aimed to solve its problems by creating a \$4.5 billion loan package provided by 16 banks, but this was insufficient to stop the panic. The volume of withdrawn deposits during the panic exceeded \$10 billion (Davison, 1998).

<sup>12</sup> The result: 'The cost of a panic is ... lower than the cost of liquidation for country B' may be surprising. It is based on the uninsured depositors' ability to withdraw a lot of funds from the MNB during a panic. Thus, regulator B favours a panic to liquidation. This type of effect could be avoided if the liquidation value of assets was sufficiently lower under a panic than under standard liquidation. For simplification, we have not made this kind of assumption. We also simplify the study by assuming that the MNB's assets are exhausted in a panic. In reality, regulator A might close the doors of the bank when the panic has continued for a while. The simplification does not affect the key ideas of this paper.

position to examine which policies will be chosen in the bargaining process and determine how the countries share the fiscal burden of restructuring an MNB.

### 3 Nash bargaining in period 1

#### 3.1 Equilibrium

At the start of period 1, the MNB is insolvent and the regulators begin negotiations on a restructuring policy. Since the regulators' incentives are not perfectly aligned, both countries have an incentive to negotiate. We begin with the following observation.

**Lemma 2.** Recapitalization is a joint welfare-maximizing policy,  $\Pi(\sigma_r) > \pi_A(\sigma_l) + \pi_B(\sigma_l)$ , when the value of bank assets is high, the liquidation value of the assets is low and the share of insured deposits is high. When the size of the MNB ( $D_A$  or  $D_B$ ) increases under the fixed value of bank assets, the cost of liquidation drops relative to the costs from recapitalization, if the negative externalities to the payment system and lending relationships,  $C_i^e(D_i)$  are small.

*Proof:* This is easy to see from  $\Pi(\sigma_r) - \pi_A(\sigma_l) - \pi_B(\sigma_l)$ . QED

The results just derived indicate that a bargaining situation emerges only when recapitalization is a joint welfare-dominating policy. We model the policy negotiations as Nash bargaining. The assumption is plausible, because the bargaining outcome is identical to that of Rubinstein's (1982) model, when the time period between the bargaining rounds,  $\Delta$ , approaches zero. This feature is quite realistic in the restructuring negotiations where the time the regulators use to decide on policies regarding restructuring a large bank is counted in hours rather than in days. Furthermore, the timing of negotiations is usually allocated to weekends and holidays, when the financial markets and banks are closed.

The solution of the bargaining game is driven by *outside options*. Since country A is the regulator of the MNB, it has more outside options than country B. Country A can liquidate the bank without the permission of country B or recapitalize it, whereas Country B can only decide to unilaterally recapitalize it. The bargaining equilibrium,  $\bar{x}_A, \bar{x}_B = \Pi(\sigma_r) - \bar{x}_A$ , is a solution to the problem

$$\max_{x_A, x_B} (x_A - d_A)(x_B - d_B) \quad (3.1)$$

where  $d_A = C_A(\sigma_0) - \ln(1 + r_{ud})(1 - \alpha)D / \gamma_1$ ,  $d_B = C_B(\sigma_0)$ .

Here  $d_A$  and  $d_B$  denote the utilities from the disagreement point to country A and country B. The equilibrium satisfies  $\Pi(\sigma_r) = x_A + x_B$ , because the recapitalization payments of the countries must add up to the costs of recapitalization.

Proposition 1, below, illustrates the equilibrium of the bargaining process. The first part illustrates the outcome under the assumption that the regulators do not have outside options to unilaterally restructure the MNB. The second part derives an equilibrium when the option to recapitalize the MNB alone (weakly) welfare-dominates the equilibrium without outside options. This occurs when  $\bar{x}_A, \bar{x}_B \notin [\Pi(\sigma_r), 0]$ . The last part of the result illustrates the outcome when country A's outside option to liquidate the MNB is binding. This means that the option to liquidate is a welfare-dominating option for regulator A compared with the outcome of a bargaining process with recapitalization as the only outside option.

**Proposition 1.**

i) The equilibrium of the Nash bargaining process without outside options is

$$\bar{x}_A = \frac{\Pi(\sigma_r) + C_A(\sigma_0) - C_B(\sigma_0) - \ln(1 + r_{ud})(1 - \alpha)D / \gamma_l}{2}$$

$$\bar{x}_B = \frac{\Pi(\sigma_r) + C_B(\sigma_0) - C_A(\sigma_0) + \ln(1 + r_{ud})(1 - \alpha)D / \gamma_l}{2}$$

ii) When the options to recapitalize the MNB alone are recognized, we have

$$\bar{x}_i^* = \begin{cases} 0 & \text{if } \bar{x}_i > 0 \\ \Pi(\sigma_r) & \text{if } \bar{x}_i < \Pi(\sigma_r) \\ \bar{x}_i & \text{if } 0 \leq \bar{x}_i \leq \Pi(\sigma_r) \end{cases}$$

iii) Two cases appear, depending on whether regulator A's option to liquidate the MNB is binding

- iii.i) When  $\bar{x}_A^* \geq \pi_A(\sigma_1)$ , then  $x_A^* = \bar{x}_A^*$ ,  $x_B^* = \bar{x}_B^*$
- iii.ii) When  $\bar{x}_A^* < \pi_A(\sigma_1)$ , then  $x_A^* = \pi_A(\sigma_1)$  and  $x_B^* = \Pi(\sigma_r) - \pi_A(\sigma_1)$

Here  $x_A^*, x_B^*$  denote the true partition of the recapitalization costs.

In an equilibrium where the regulators cannot unilaterally recapitalize or liquidate the MNB, a regulator may end up with a payment that is positive in equilibrium. That is, he earns profits from bank recapitalization. This result is implausible in theory and in practice, because the regulator would have an incentive to maximize the number of insolvent banks to collect payments from the foreign regulators.

The payment of the foreign regulators would exceed the true costs of bank recapitalization. Therefore, the foreign regulators would rather recapitalize the MNB alone than accept the payment.

So far we have investigated a case in which recapitalization represents the socially optimal solution. Suppose now that liquidation is the optimal policy. This produces the following result.

**Lemma 3.** If liquidation of the MNB is a joint welfare-maximizing policy, the MNB is liquidated at once.

*Proof:* The outside option point (liquidation) affects the set of possible utility pairs on which the Nash solution can be defined by requiring that each partition of recapitalization costs be such that the payment of a country is at most as severe as the cost the country would bear from its outside option. Liquidation is a joint welfare-maximizing policy when  $\Pi(\sigma_r) < \pi_A(\sigma_1) + \pi_B(\sigma_1)$ . Then, it is easy to observe that any partition of the recapitalization costs such that  $x_A + x_B = \Pi(\sigma_r)$ , when  $x_A \geq \pi_A(\sigma_1)$ ,  $x_B \geq \pi_B(\sigma_1)$ , is impossible (since  $\pi_B(\sigma_0) > \pi_B(\sigma_1)$ , country B never pays more than  $\pi_B(\sigma_1)$ ). The Nash bargaining solution cannot be achieved. Country A opts out and liquidates the MNB (recall  $\pi_A(\sigma_0) < \pi_A(\sigma_1)$ ). For more details on Nash bargaining and outside options see Muthoo (2002, p. 113–114). QED

## 3.2 Comparative statics

In this subsection we explore how sensitive the results are to assumptions regarding the restructuring costs, the relative size of the MNB and the deposit insurance policy applied by the home country. We focus on an equilibrium that involves burden sharing. Using the notation in Proposition 1, this means that  $0 \geq \bar{x}_i \geq \Pi(\sigma_r)$ . Focusing on interior solutions narrows the analysis to outcomes where changes in the parameters have an effect.

In a burden-sharing equilibrium the countries recapitalize the MNB. When regulator A's option to liquidate the MNB is not binding, the cost allocation is driven by the cost of a panic and the interest payments country A bears for each time period the MNB is at the state of insolvency. These determinants, in turn, depend on the deposit insurance policy and the relative size of the MNB.

An increase in the size of the MNB in one of the countries affects the burden-sharing outcome through the costs the country bears in the event of a panic or liquidation of the MNB. More specifically, if the relative share of the MNB's deposits in country  $i = A, B$  increases, but the overall quantity of deposits with the MNB remains unchanged, this will obviously increase the cost of a panic, and

therefore weaken regulator i's position in the negotiations. The following corollaries are proved in Appendix B.

**Corollary 1.** When the size of the multinational bank remains unchanged, but a relatively larger share of its operations take place in Country A (Country B), its share of the recapitalization payment rises whether or not the liquidation option of Country A is binding.

This result is intuitively straightforward. The outcomes of burden-sharing negotiations depend on the relative size of the MNB, which is a determinant of its importance in the financial system of the country and the economic externalities of a bank failure. These effects make the countries weaker in the negotiations, and therefore increase their share of the overall costs of recapitalization.

The fresh capital the regulator of country A must inject into the insolvent MNB so as to cover the interest the MNB must pay to uninsured depositors during policy negotiations affects the bargaining power of the countries differently. The rise in these interest payments weakens the position of country A in the negotiations and increases its share of the recapitalization payment in the equilibrium where the liquidation option is not binding.<sup>13</sup> If the liquidation option is binding, interest rates have no effect, because country A always pays just the amount equal to the cost of liquidation, which is independent of the interest rate.

The implications of the deposit insurance scheme on the bargaining equilibrium are as follows.

**Corollary 2.** Suppose that the deposit insurance coverage is extended. When the liquidation option is binding, country A's share of the recapitalization payments increases. The effect on the bargaining equilibrium is uncertain when the liquidation option is not binding. However, if the MNB is too big to fail and always recapitalized, the risk premium on uninsured deposits is zero,  $r_{ud} = 0$ . In this case, the payment of country A increases.

Corollary 2 shows that when deposit insurance has a higher coverage, the reimbursements country A must pay when it liquidates the MNB increase. Higher coverage obviously alleviates the losses for uninsured depositors (national banks), thereby contributing to lower liquidation costs. Comparison of these effects shows that the first effect dominates. An extension of the coverage therefore increases the share of Country A when the liquidation constraint is binding.

When the option to liquidate is not binding, the outcomes are also affected by the implications of changes in the deposit insurance on the economy of country B and the interest rate payments country A must pay to the uninsured depositors.

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<sup>13</sup> This follows immediately from the expression  $\bar{x}_A$

More specifically, higher coverage mitigates the losses of uninsured depositors in Country B, which weakens country A's position in the negotiations. On the other hand, higher coverage decreases the amount of capital regulator A must inject into an insolvent MNB during the bargaining process, which reduces country A's share of the total burden. The overall effect is uncertain, unless we take into account the property that burden sharing implies recapitalization, which essentially makes the uninsured deposits risk free. Under rational expectations and perfect markets, this means that the interest rate on the uninsured deposits is zero, and, therefore, the impact of higher deposit insurance on the burden-sharing negotiations is negative from the viewpoint of country A.

### 3.3 Policy negotiations under blanket guarantee or subordinated deposits

The previous subsection illustrated that the deposit insurance scheme run by the home country determines – at least to some extent – how the countries share the fiscal burden when a systemically important MNB requires restructuring. There is plenty of anecdotal evidence on banking crises suggesting that equally important are the adjustments policy-makers make when they observe the potential for a crisis to emerge. In practice, ex-ante agreements on deposit insurance coverage are usually revised ex-post to mitigate panic and sustain confidence. These adjustments usually involve a blanket guarantee that raises deposit insurance to 100%, thereby insulating the bank against runs.

In the present model we allow the regulators to declare a blanket guarantee at the start of period 0. Alternatively, panics can be eliminated by injecting sufficient subordinated deposits (capital) into the MNB. For simplification we assume that, if the regulators declare a blanket guarantee or inject subordinated debt into the MNB, the decision is definitive. A blanket guarantee or subordinated deposits cannot be removed at the start of period 1.<sup>14</sup> The effect of a blanket guarantee on the outcomes in the ex-post negotiations are as follows.

**Proposition 2.** If a blanket guarantee is declared at the start of period 0 and the bank later becomes insolvent, it will be recapitalized with certainty. If country A declares a blanket guarantee alone, it must always pay the whole recapitalization bill alone.

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<sup>14</sup> A solution in which the regulators remove the blanket guarantee at the start of period 1 is a bit eccentric. The regulators learn at the start of period 1 if the MNB is insolvent. They could immediately first remove the blanket guarantee and then liquidate the bank. This type of solution might be illegal, as it would cause severe losses for uninsured depositors. Alternatively, uninsured depositors might panic at the end of period 0 just before the maturity of blanket guarantee.

*Proof:* Suppose a blanket guarantee is declared for the deposits of the MNB at the start of period 0 and the MNB later becomes insolvent. If the MNB is recapitalized at the start of period 1, it can keep on operating. The losses of interbank deposits in the national banking sector are avoided as well as negative externalities to the payment system and lending relationships. The costs of recapitalization amount to  $D - R$ .

Suppose now that the MNB is liquidated. Thanks to the blanket guarantee, the liquidation entails no losses to other banks,  $C_A^n(.) = 0$ . Yet, since the MNB has been closed, the liquidation causes negative externalities in the payment system and lending relationships,  $C_A^e(.) > 0$ . The payments to depositors entail costs  $D - L$ . Since  $D - L > D - R > 0$ , the costs are higher than under recapitalization. Thus, it is optimal to recapitalize the MNB if a blanket guarantee has been declared.

Suppose that country A declares a blanket guarantee alone. When regulator A suggests in period 1 negotiations regarding recapitalization, regulator B declines in the knowledge that regulator A will capitalize the MNB with certainty even without the participation of regulator B. QED

Alternatively, the countries can inject subordinated deposits (capital) into the MNB at the beginning of period 0. When the amount of subordinated deposits is  $D - L$ , standard depositors cannot lose anything in a panic, because the liquidation value of bank assets,  $L$ , is equal to the value of their deposits. Consequently, the depositors know that their deposits are perfectly safe and thus have no reason to panic. Panic is therefore avoided. The result is as follows.

**Proposition 3.** If regulators inject subordinated deposits into the MNB at the start of period 0 and the bank later becomes insolvent, it will be recapitalized with certainty.

*Proof:* Suppose that the regulators (or one of them) inject subordinated deposits into the MNB at the start of period 0. The panic is avoided. If the MNB proves to be solvent, the regulators bear no losses, because the risk-free interest rate is zero.

Suppose now that the bank proves to be insolvent. The regulators have two options. They can either liquidate the MNB or recapitalize it. If they liquidate it, they lose the subordinated deposits and liquidation causes negative externalities for the payment system and lending relationships,  $C_A^e(.) > 0$ . If they recapitalize it, this entails costs  $D - R$ , which is less than the amount of subordinated deposits. There are no negative externalities. Hence, the regulators optimally recapitalize the MNB. QED



## 4 Effect of deposit insurance coverage: a numeric example

This section gives a numeric example which indicates that the deposit insurance coverage is likely to have a strong impact on the partition of the recapitalization costs. In the example, we consider an economy with the following parameters. Firstly, the parameter values are such that:  $D_A = 10$ ,  $D_B = 200$ ,  $L = 160$ ,  $r_{ud} = 0.05$ ,  $\gamma_1 = 0.9$ . Secondly, we assume the costs of restructuring national banking equals 20% of the lost uninsured deposits in the MNB failure. Finally, the value of negative externalities on the payment system and the long-term lending relationships equals 10% of the bank size (the amount of deposits). Table 4.1 illustrates four examples with the given parameter values and different levels of deposit insurance coverage.

Table 4.1 **The effect of insurance**

The column on the left shows the deposit insurance coverage. The next columns indicate externalities on other banks and the economy in both countries, the value of the liquidation option, costs to countries A and B from a panic, and the need to inject fresh funds into the MNB in each bargaining round,  $F = \ln 1.05(1 - \alpha)D/\gamma_1$ . The final two columns show the result from Nash bargaining without outside options.

Insured deposits	$C_B^n$	$C_A^e$	$C_B^n$	$C_B^e$	$\pi_A(\sigma_1)$	$C_A(\sigma_0)$	$C_B(\sigma_0)$	F	$\bar{x}_A$	$\bar{x}_B$
2%	0.47	1	9.33	20	-2.47	-5.6	-28.7	11.16	0.92	-10.92
5%	0.45	1	9.05	20	-3.95	-11.9	-27.5	10.82	-2.6	-7.4
10%	0.43	1	8.57	20	-6.43	-22.3	-25.5	10.25	-8.5	-1.5
23%	0.37	1	7.33	20	-12.87	-49.3	-20.3	8.77	-23.9	13.9

When the share of insured deposits is 2%, the liquidation option is not binding ( $-2.47 < 0.92$ ), but the recapitalization option of Country B is binding, because  $-10 > -10.92$ . Thus, country B recapitalizes the MNB alone and pays  $-10$ . When the share of insured deposits is 5%, the liquidation option is not binding, because  $-2.6 > -3.95$ . The recapitalization options are also not binding, because  $-2.6$ ,  $-7.4 > -10$ . The MNB is thus recapitalized according to the standard bargaining equilibrium without outside options. In this case, the share of country A is  $-2.6$  and that of country B is  $-7.4$ .

When the share of insured deposits is 10%, the liquidation option of country A is binding:  $-6.43 > -8.5$ . Here, the share of country A is  $-6.43$  and Country B pays the rest:  $-3.57$ . When the share of insured deposits is 23%, country A chooses the outside option to recapitalize the MNB alone.

This example shows that each of the four cases derived in section 3 is possible, depending on the deposit insurance scheme. This emphasizes the feature that the regulatory framework designed before a crisis will be a factor in determining the negotiations when an intervention is required to solve financial problems during a crisis in an MNB.

## 5 Blanket guarantee or subordinated deposits in period 0

### 5.1 Background

Recall that at the start of period 0 financial distress extends over countries A and B but the MNB is solvent. The financial distress together with mounting news on financial difficulties and bankruptcies in the economy may make uninsured depositors nervous so that they panic and aim to withdraw their deposits from the MNB. Since the MNB is solvent, a panic represents a pure panic. Given the illiquidity of bank assets, the panic drives even the solvent MNB to bankruptcy by exhausting its assets to zero. The probability of panics is  $\gamma_0\Delta$ , where  $\Delta$  approaches zero. Here we have  $\gamma_0 \leq \gamma_1$ : the probability of a panic is at least as high during period 1 as during period 0, because the bank is already insolvent in period 1. The probability that a panic occurs during period 0 is

$$t = 1 - e^{-\gamma_0} \quad (5.1)$$

When the regulators at the start of period 0 observe the financial distress, they become aware of the threat of insolvency and panics. Since the bank is still solvent, the regulators have two options.<sup>15</sup> They can extend the deposit insurance coverage by declaring a blanket guarantee so that the deposits of the MNB are protected, which prevents panics. Alternatively, one of the countries (or both) can inject sufficient subordinated deposits into the MNB so that panics are avoided.

We have noticed above that blanket guarantee an injection of subordinated deposits generate the very same costs and benefits. Firstly, panics are avoided. Secondly, if the MNB proves to be insolvent it is optimally recapitalized. Thirdly,

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<sup>15</sup> Regulators must have précis hard evidence on insolvency before than they can begin the liquidation process. Closing a solvent bank destroys the value of bank assets due to the costs of liquidation. Additionally, and more importantly, regulators cannot use illegal methods. The following example is from Argentina (BIS, 1999, p. 62): ‘In Argentina, judges forced the central bank to compensate the shareholders on the grounds that a bank was solvent at the time of intervention, and that the insolvency actually resulted from mismanagement during the intervention.’

if the MNB proves to be solvent, neither the blanket guarantee nor subordinated debt entails costs. Therefore, the regulators are indifferent between these two methods. Since the implementation of blanket guarantee is simple (no debt investment into the MNB is needed), we assume the regulators will prefer this alternative. Consequently, in the following, only a blanket guarantee is explored. Although only country A can declare a blanket guarantee, the countries optimally negotiate the solution together (this is shown below) and decide jointly on the partition of costs, and country A finally declares the blanket guarantee.

The probability that the MNB turns out to be solvent at the end of period 0 is  $s$ . It is insolvent with probability  $1 - s$ . Recall from above that without a blanket guarantee or subordinated debt a panic occurs with probability  $t$  during period 1.<sup>16</sup>

## 5.2 When does a blanket guarantee represent the socially optimal policy?

It is socially optimal to declare a blanket guarantee if

$$t(\pi_A(\sigma_{0S}) + \pi_B(\sigma_{0S})) + (1-t)(1-s)(\pi_A(\sigma^*) + \pi_B(\sigma^*)) \leq (1-s)\Pi(\sigma_r) + (1-s)(1-\alpha)Dr_{ud} \quad (5.2)$$

The right-hand side (RHS) expresses the expected costs from a blanket guarantee. With probability  $1 - s$  the MNB turns out to be insolvent and is recapitalized (Propositions 2 and 3). The second term on the RHS is positive, because a blanket guarantee allows the MNB can attract uninsured deposits without a risk premium. This cuts the interest payments of the MNB by  $(1 - \alpha)Dr_{ud}$  and thus reduces the expected costs of recapitalization.

The left-hand side (LHS) reveals the expected costs without a blanket guarantee. The second term represents a case in which the MNB avoids a panic during period 0 but becomes insolvent in period 1. Negotiations regarding the optimal restructuring policy then begin. The negotiations are illustrated in Sections 2–4. The results from the negotiations (the expected costs to country A from the optimal restructuring policy) are denoted by  $\pi_A(\sigma^*)$ . If country A, for example, recapitalizes the MNB alone, then  $\pi_A(\sigma^*) = \Pi(\sigma_r)$ , but if country B pays the recapitalization bill alone, then  $\pi_A(\sigma^*) = 0$ . The first term on the LHS shows a

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<sup>16</sup> Alternatively, it is possible to drop the assumption on financial distress and assume that the regulators receive at the start of period 0 a signal that MNB is insolvent. The signal is true with probability  $s$ . The depositors learn the signal with probability  $t$  and panic. The regulators cannot close the bank, because the bank is not insolvent with certainty. The closure decision needs to be based on hard, verifiable information.

new term,  $\pi_i(\sigma_{0S})$ ,  $i \in \{A, B\}$ , which denotes the costs when a solvent MNB fails due to a panic. It is equal to the costs when an insolvent bank fails due to a panic,  $\pi_i(\sigma_0)$ ,  $i \in \{A, B\}$ . Thus, we use symbol  $\pi_i(\sigma_0)$ .

It is easy to see from the LHS that the solution in which only one country takes the decision on a blanket guarantee (or subordinated debt) alone cannot be optimal because said country pays attention only to its own costs and benefits. Thus, the countries need to take the decision together.

If the optimal restructuring policy in (5.2) is recapitalization, we have  $\pi_A(\sigma^*) + \pi_B(\sigma^*) = \Pi(\sigma_r)$ , but if it is liquidation, the costs are  $\pi_A(\sigma^*) = \pi_A(\sigma_l)$  and  $\pi_B(\sigma^*) = \pi_B(\sigma_l)$ . When the socially optimal restructuring policy is recapitalization, the result is as follows.

**Proposition 4.** When the MNB is such that the socially optimal restructuring policy is to recapitalize it, it is socially optimal to declare a blanket guarantee when financial distress is observed.

*Proof:* Inserting  $\pi_A(\sigma^*) + \pi_B(\sigma^*) = \Pi(\sigma_r)$  into (5.2) provides

$$t(\pi_A(\sigma_0) + \pi_B(\sigma_0) - (1-s)\Pi(\sigma_r)) \leq (1-s)(1-\alpha)Dr_{ud} \quad (5.3)$$

The RHS is positive, but the LHS is negative because  $\pi_A(\sigma_0) + \pi_B(\sigma_0) < \pi_A(\sigma_l) + \pi_B(\sigma_l) < \Pi(\sigma_r)$ . QED

Intuitively, if the MNB later proves to be insolvent, a blanket guarantee entails no extra costs, because the MNB will be recapitalized even without it. If the MNB proves to be solvent, the guarantee also entails no cost, because no recapitalization is needed. Yet, since it can eliminate the threat of a panic, it is optimal to declare a blanket guarantee.

Suppose now that the socially optimal restructuring policy is liquidation. Restating (5.2), we observe that blanket guarantee is socially optimal if

$$\begin{aligned} & t(\pi_A(\sigma_0) + \pi_B(\sigma_0) - (1-s)\pi_A(\sigma_l) - (1-s)\pi_B(\sigma_l)) \\ & \leq (1-s)(\Pi(\sigma_r) - \pi_A(\sigma_l) - \pi_B(\sigma_l)) + (1-s)(1-\alpha)Dr_{ud} \end{aligned} \quad (5.4)$$

The term on the LHS is negative. On the RHS the first term is negative, because liquidation is now preferred to recapitalization, and the second term is positive. If the RHS is positive (this is possible only if  $r_{ud}$  is high), the inequality is always true and a blanket guarantee is optimal. If the RHS is negative, the inequality is satisfied if the probability of a panic is sufficiently high and the probability of bank insolvency,  $1-s$ , is sufficiently low. On the contrary, if  $1-s$  is large in

comparison with  $t$ , the inequality is not satisfied and no blanket guarantee is declared. A conclusion follows.

**Proposition 5.** Suppose that the socially optimal restructuring policy is liquidation. The parameter values will then determine whether it is optimal to declare a blanket guarantee. The probability that a blanket guarantee is declared increases with the probability of a panic, but decreases with the probability of bank insolvency.

We analyse in more detail a case in which the RHS of (5.4) is negative and the parameter values influence the optimal decision.

If the probability of a panic is high and the probability of insolvency is sufficiently low, it is optimal to declare a blanket guarantee. Now the risk that a panic will destroy a solvent MNB is severe. To prevent this, a blanket guarantee is needed. In addition, since the probability of bank insolvency is low, the probability that the regulators will need to recapitalize an insolvent bank is also low. Hence, the expected recapitalization costs owing to a blanket guarantee are small. Suppose that a blanket guarantee is declared. If the MNB proves to be solvent at the start of period 1, it can keep on operating. If insolvent, it is recapitalized, because it is always optimal to recapitalize the MNB under a blanket guarantee (Proposition 2). Note that the blanket guarantee changes the restructuring policy. If the restructuring process began at the start of period 1, it would be optimal to liquidate the MNB. Yet, when the threat of a panic during period 0 is recognized, it is optimal to declare a blanket guarantee at the start of period 0 and in this way make recapitalization the optimal restructuring policy.

When the risk of a panic is small and the probability of insolvency is high, it is not optimal to declare a blanket guarantee, as this would raise the costs of bank restructuring, because the insolvent MNB would then be recapitalized instead of the socially optimal liquidation. This ‘mistake’ is likely, because  $1 - s$  is high. On the other hand, the risk that a panic will destroy a solvent MNB is small. Under the policy choice of no blanket guarantee, a panic may drive the MNB to failure. If a panic is avoided, the financial condition of the MNB becomes apparent at the start of period 1. If the MNB is solvent, it can keep on operating. If it proves to be insolvent, it is liquidated.

Given propositions 4 and 5, if the regulators do not declare a blanket guarantee, this indicates that they will later liquidate the MNB if it proves to be insolvent.

### 5.3 Nash bargaining in period 0

When the regulators at the start of period 0 observe financial distress they analyse whether it is optimal to declare a blanket guarantee.<sup>17</sup> Since declaration of a blanket guarantee will make recapitalization the optimal policy at a later stage, the countries need to bargain over the costs of recapitalization at the same time.

Consider the disagreement point of country A in Nash bargaining. If the countries are unable to reach agreement, the bargaining process stops at the start of period 0. If the MNB later proves to be insolvent, a new bargaining process begins in period 1 (sections 2–4). The disagreement point of country A is

$$\hat{d}_A = tC_A(\sigma_0) + (1-t)(1-s)\pi_A(\sigma^*) \quad (5.5)$$

The first term on the RHS expresses the expected costs from a panic during period 0. The risk of a panic is present because no blanket guarantee is declared. The second term reveals the expected costs to country A from the optimal restructuring policy in period 1. These costs are realized only if the bank does not fail in a panic and if it proves to be insolvent. Note that (5.5) also represents the outside option of country A. It can opt out from the negotiations in period 0, wait for a period and then restart the negotiations in period 1 if the MNB then proves to be insolvent.

In the same way, the disagreement point and outside option of country B is

$$\hat{d}_B = tC_B(\sigma_0) + (1-t)(1-s)\pi_B(\sigma^*) \quad (5.6)$$

The outside options to opt out from the negotiations and to enter them in period 1 are not binding because these effects are already taken into account in the disagreement points. On the contrary, the outside options to recapitalize the MNB alone may be binding. In addition, the recapitalization payments of countries A and B,  $X_A$ ,  $X_B$ , must cover the recapitalization costs

$$X_A + X_B = \Pi(\sigma_r) + (1-\alpha)Dr_{ud} \quad (5.7)$$

The equilibrium partition of the recapitalization costs is found using two steps. First, we calculate the Nash bargaining solution without outside options. Then, we add the outside options to recapitalize the MNB alone (see Muthoo, p. 149–152). The solution to the bargaining problem maximizes

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<sup>17</sup> The fact that only country A can declare a blanket guarantee has no effect on the bargaining process, because the very same allocation can be achieved by employing subordinated debt and both regulators have the same opportunities to invest subordinated debt in the MNB.

$$\max_{x_a, x_b} (X_A - \hat{d}_A)(X_B - \hat{d}_B) \quad (5.8)$$

subject to constraints (5.5)–(5.7). The Nash bargaining process provides

**Proposition 6.** In period 0 the Nash bargaining process gives partition

$$\begin{aligned} \bar{X}_A &= \frac{\Pi(\sigma_r) + (1 - \alpha)Dr_{ud} - \hat{d}_B(\sigma_0) + \hat{d}_A(\sigma_0)}{2}, \\ \bar{X}_B &= \frac{\Pi(\sigma_r) + (1 - \alpha)Dr_{ud} + \hat{d}_B(\sigma_0) - \hat{d}_A(\sigma_0)}{2} \end{aligned}$$

When the outside options to recapitalize the MNB alone are recognized, we obtain,  $i = A, B$

$$\bar{X}_i^* = \begin{cases} 0 & \text{if } \bar{X}_i > 0 \\ \Pi(\sigma_r) + (1 - \alpha)Dr_{ud} & \text{if } \bar{X}_i < \Pi(\sigma_r) + (1 - \alpha)Dr_{ud} \\ \bar{X}_i & \text{if } 0 \geq \bar{X}_i \geq \Pi(\sigma_r) + (1 - \alpha)Dr_{ud} \end{cases}$$

Obviously, the Nash bargaining solution is not feasible if the utility in the breakdown point exceeds the bargaining payoff. Hence, the bargaining solution is obtained only if

$$\hat{d}_A + \hat{d}_B \leq (1 - s)\Pi(\sigma_r) + (1 - s)(1 - \alpha)Dr_{ud} \quad (5.9)$$

This is the same constraint as in (5.2). Hence, the Nash bargaining solution is an equilibrium when it is socially optimal to recapitalize the MNB. If (5.9) is not satisfied, the breakdown point comes true. No blanket guarantee is declared and the restructuring decision is postponed to period 1. The MNB is liquidated in period 1 if it then proves to be insolvent. However, this is again the socially optimal solution because (5.2) is not satisfied. Consequently, the Nash bargaining process provides the socially optimal decision.

**Proposition 7.** Suppose that uninsured depositors panic with certainty under the financial distress. If the amount of uninsured deposits does not exceed the value of the insolvent bank's assets,  $(1 - \alpha)D \leq R$ , the regulators declare a blanket guarantee.

*Proof:* Now (5.2) simplifies to

$$\pi_A(\sigma_0) + \pi_B(\sigma_0) \leq (1 - s)\Pi(\sigma_r) + (1 - s)(1 - \alpha)Dr_{ud} \quad (5.10)$$

The LHS is at most  $-\alpha D$  (the payments on insured deposits) and the RHS is larger than  $R - D$ . Hence, (5.10) is satisfied at least when  $-\alpha D \leq R - D$ . This implies that if  $(1 - \alpha)D \leq R$ , it is always optimal to declare a blanket guarantee. QED

Recall that it is implicitly assumed  $L < (1 - \alpha)D$ ; uninsured depositors bear losses in a panic. Therefore, we have  $L < (1 - \alpha)D < R$ . Since  $(1 - \alpha)D < R$ , the volume of uninsured deposits is sufficiently low in comparison with the value of the insolvent bank's assets,  $R$ , and the regulators optimally declare blanket guarantee. This is anticipated correctly by rational depositors. They know that even if their deposits are officially uninsured, the regulators will declare blanket guarantee when the financial crisis appears. Consequently, the uninsured deposits will also be secured and rational depositors are ready to save in them without a risk premium.

When  $(1 - \alpha)D < L$ , the volume of uninsured deposits is so small that they can be withdrawn from the bank as a whole in a panic of period 0. This makes uninsured depositors de facto risk free. Yet, since the flight of uninsured deposits would cause liquidation costs and thereby erode the value of the MNB's assets, the regulators optimally declare blanket guarantee. Consequently, when the MNB attracts uninsured deposits it optimally attracts short-term deposits. The liquidity of uninsured deposits makes them de facto risk free, because depositors can withdraw them immediately when the financial distress appears. The bank regulators, who must base bank closure decisions on hard verifiable information, cannot close down the MNB in period 0 even if they observe the flight of uninsured deposits and the erosion in the value of bank assets. To avoid the flight and the erosion, they declare blanket guarantee.

## 6 Conclusions

This paper studies equilibrium restructuring policies when regulators observe that a multinational bank (MNB) is in financial distress and how countries affected by the crisis share the financial burden. To this end, we develop a bargaining model that describes the key elements of policy negotiations likely to emerge and cross-border externalities that shape the regulators' decision whether to liquidate or recapitalize the MNB. The model illustrates that ex-post burden-sharing, which is an outcome of a policy bargaining after the MNB is found to be insolvent, (weakly) welfare-dominates unilaterally designed restructuring policies.

The equilibria of the model exhibit the usual properties in bargaining models, because the outside options available for the regulators determine the burden-sharing outcomes. Since the home country regulator has the legal right to liquidate



and close the MNB, it has stronger bargaining power when the cost of the option to liquidate is low relative to the cost the country incurs when it recapitalizes the MNB jointly with the foreign regulator. However, the feature, which is line with the current European legislation, that the home country is running the deposit insurance scheme of the MNB increases its share of the costs when the share of insured deposits in the MNB is larger. The home country also has the responsibility to maintain the operations of an insolvent MNB during the bargaining process, and therefore, it has an incentive accept less generous burden sharing offers to prevent delays in policy implementation.

Financial distress in the MNB may trigger a panic among depositors. The risk of a panic and the resulting breakdown of negotiations affect both countries, and therefore, the country with a high expected cost of a panic is more likely to end up with a higher share of the total costs. In the model a panic induces negative externalities for the payment systems in the countries, lending relationships and uninsured depositors. Thus, the expected costs from a breakdown point are high in a country where a relatively large proportion of the MNB's operations take place. The costs resulting from a panic are, however, relatively higher for the home country, because a panic among uninsured depositors destroys the value of the MNB the regulator can channel for insured depositors.

To prevent panics, regulators often declare a blanket guarantee on the deposits of the MNB or inject subordinated deposits into it. We illustrate that a blanket guarantee, which is declared before the regulators learn the financial status of the MNB, always induces recapitalization should the MNB become insolvent. The decision of a blanket guarantee can be made by the home country and the decision affects the ex-post policy bargaining. The countries may therefore have an incentive to cooperate on the decision regarding the blanket guarantee and the partition of the expected recapitalization costs ex-ante. In equilibrium, the regulators always declare a blanket guarantee when they anticipate that the ex-post bargaining decision entails full recapitalization, because a blanket guarantee insulates the MNB against panics. The MNB fails to receive protection from a blanket guarantee when the optimal ex-post policy equilibrium involves liquidation, the risk of a panic is sufficiently low and the risk of insolvency is sufficiently high.

The results of the paper help understand how cross-border externalities and the risk of panic may affect the policies aimed to solve financial problems of large, complex and international financial institutes. The model is obviously a simplification of a complex system of country and business level relationships. For instance, we do not consider financial contagion of panics or the moral hazard effects related to blanket guarantee. Moreover, we exclude political factors from the analysis. In practice, it might be optimistic to presume that in the event of collapse of a large MNB, the home country spends domestic taxpayers' money to

repay to the foreign depositors. In addition, the relative size (political power) of the countries may influence their bargaining power.

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## Appendix A

### The proof of Lemma 1

The total costs of liquidation in both countries is lower than the cost of a panic if

$$\Pi(\sigma_1) - C_A(\sigma_0) - C_B(\sigma_0) = \alpha L - C_A^n(\bar{\beta}_A) - C_B^n(\bar{\beta}_B) + C_A^n(\underline{\beta}_A) + C_B^n(\underline{\beta}_B) > 0 \quad (A.1)$$

In  $\underline{\beta}_A + \underline{\beta}_B = \bar{\beta}_A + \bar{\beta}_B - \alpha L$  the LHS denotes the losses of uninsured depositors under a panic, whereas the RHS indicates their losses under liquidation. Given this and (2.3), (A.1) is positive. In country B the cost of a liquidation is larger than the cost of a panic because  $C_B(\sigma_1) - C_B(\sigma_0) = -C_B^n(\bar{\beta}_B) - C_B^n(\underline{\beta}_B) < 0$ . Since the total cost of a panic is larger than the cost of liquidation, but the opposite is the case in country B, in country A the cost of a panic must exceed the cost of liquidation. QED

## Appendix B

### The proofs of corollaries 1 and 2

*The proof of corollary 1:* Since the size of the MNB does not change, we have  $dD_A = -dD_B$ ; if the size of the MNB grows in country A, the size must fall in country B and vice versa. This implies  $\partial D / \partial D_A = \partial D / \partial D_B = 0$ . From the liquidation constraint of country A we obtain

$$\frac{\partial \pi_A(\sigma_1)}{\partial D_A} = -\frac{\partial C_A^n(\bar{\beta}_A)}{\partial \bar{\beta}_A} \cdot \frac{\partial \bar{\beta}_A}{\partial D_A} - \frac{\partial C_A^e(D_A)}{\partial D_A} < 0 \quad (B.1)$$

because from  $\bar{\beta}_i = (D - LR)(1 - \alpha)D_i / D$  follows  $d\bar{\beta}_A / dD_A > 0$ . When the liquidation constraint is not binding, we obtain

$$\begin{aligned} \frac{\partial \bar{X}_A}{\partial D_A} &= \frac{1}{2} \frac{\partial C_A(\sigma_0)}{\partial D_A} - \frac{1}{2} \frac{\partial C_B(\sigma_0)}{\partial D_B} \cdot \frac{\partial D_B}{\partial D_A} \\ &= -\frac{1}{2} \frac{\partial C_A^n(\bar{\beta}_A)}{\partial \bar{\beta}_A} \frac{\partial \bar{\beta}_A}{\partial D_A} - \frac{1}{2} \frac{\partial C_A^e(D_A)}{\partial D_A} - \frac{1}{2} \frac{\partial C_B^n(\bar{\beta}_B)}{\partial \bar{\beta}_B} \frac{\partial \bar{\beta}_B}{\partial D_B} - \frac{1}{2} \frac{\partial C_B^e(D_B)}{\partial D_B} < 0 \end{aligned} \quad (B.2)$$

because  $d\bar{\beta}_A / dD_A > 0$ ,  $d\bar{\beta}_B / dD_B > 0$ . QED

*The proof of corollary 2:* The liquidation constraint gives

$$\frac{\partial \pi_A(\sigma_1)}{\partial \alpha} = (L - D) - \frac{\partial C_A^n(\bar{\beta}_A)}{\partial \bar{\beta}_A} \frac{\partial \bar{\beta}_A}{\partial \alpha} = -(D - R) \left( 1 - \frac{D_i}{D} \frac{\partial C_A^n(\bar{\beta}_A)}{\partial \bar{\beta}_A} \right) < 0 \quad (B.3)$$

If the liquidation constraint is not binding, we have

$$\begin{aligned} \frac{\partial \bar{X}_A}{\partial \alpha} &= \frac{\frac{\partial C_A(\sigma_0)}{\partial \alpha} - \frac{\partial C_B(\sigma_0)}{\partial \alpha} + \ln(1 + r_{ud})D / \gamma}{2} \\ &= \frac{-D + \frac{\partial C_A^n(\bar{\beta}_A)}{\partial \bar{\beta}_A} D_A - \frac{\partial C_B^n(\bar{\beta}_B)}{\partial \bar{\beta}_B} D_B + \ln(1 + r_{ud})D / \gamma}{2} \end{aligned} \quad (B.4)$$

In the dominator the sum of the first two terms is negative, the third term is negative and the fourth term is positive. As the result, the whole effect is uncertain. QED

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