Fiscal Burden Sharing in Cross-Border Banking Crises*

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This paper focuses on the recapitalization of failing banks. A recapitalization is efficient if the social benefits (preserving systemic stability) exceed the cost of recapitalization. In a national setting, the implementation of an optimal policy is relatively straightforward. But in a cross-border setting, one is confronted with possible coordination failure. Using a multi-country model, it is shown that ex post negotiations on burden sharing lead to an underprovision of recapitalizations. Next, we explore different ex ante burden-sharing mechanisms to overcome the coordination failure. The first is a general scheme financed collectively by the participating countries (generic burden sharing). The second relates the burden to the location of the assets of the bank to be recapitalized (specific burden sharing). The working of the two mechanisms is calibrated with data on large cross-border banks in Europe. Because the costs and benefits are better aligned in the specific scheme, it is better able to overcome the coordination failure.

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1. Introduction

An integrated European banking system is emerging with a small group of large pan-European banks spanning national banking markets. This raises the issue of the appropriate level (federal or national) for managing financial stability (Vives 2001). Financial stability is currently managed at the national level. In particular, the fiscal competence to deal with banking crises is a responsibility of national governments.

The fiscal costs of resolving a banking crisis can be large. In a worldwide sample of forty banking crisis episodes, Honohan and Klingebiel (2003) find that governments spent on average 13 percent of national GDP to clean up the financial system. To clarify our position, the preferred route to solving a banking failure is a private-sector solution. The use of public money should only be considered when the social benefits (in the form of preventing a wider banking crisis) exceed the costs of recapitalization via taxpayers' money. The issue at stake in the European context is that not only national, but also cross-border, externalities should be taken into account in the process of decision making (Schoenmaker and Oosterloo 2005).

In a multicountry setting, the costs of such recapitalization can be shared between countries. Freixas (2003) shows in a model that ex post negotiations on burden sharing lead to an underprovision of recapitalizations. Countries have an incentive to understate their share of the problem in order to have a smaller share in the costs. This leaves the largest country, almost always the home country, with the decision whether to shoulder the costs on its own or to let the bank close and possibly be liquidated. Freixas (2003) labels this mechanism, which reflects the current arrangements in Europe, as improvised cooperation.

The aim of the paper is to explore possible ex ante mechanisms for fiscal burden sharing in a banking crisis in Europe. We will expand the Freixas model. The first mechanism could be a general fund to shoulder the burden of recapitalization. This general fund could be financed directly by the participating countries, which would pay their relative share (e.g., based on GDP) in the fund. The main advantage of this system is that the cost of recapitalization is smoothed over countries. There are, however, serious problems with this approach, not least that there is little (political) enthusiasm for

cross-border fiscal transfers. The second mechanism involves specific burden sharing. In this scheme, only countries in which the problem bank is conducting business contribute to the burden sharing. A country's contribution can be related to the share of the problem bank's business in that country. In this way, cross-border transfers are largely avoided. Both schemes are subject to the free-rider problem. Countries that do not sign up for burden sharing nevertheless profit from burden sharing, as the stability of the European financial system is a public good.

The paper is organized as follows. In section 2, we model the possibility of coordination failure in crisis management in a multi-country setting. Next, in section 3, we explore different mechanisms for ex ante burden sharing to overcome the coordination failure. The mechanisms are illustrated with numerical examples. In section 4, we discuss the policy implications of the different burden-sharing mechanisms. The final section concludes.

2. A Model of Cross-Border Recapitalizations

The fiscal costs of resolving a banking crisis can be large. Scandinavia and Japan, for example, experienced a severe banking crisis in the 1990s. While the Scandinavian crisis amounted to a fiscal cost of 8 percent of GDP, the long, drawn-out Japanese crisis added up to a total fiscal cost of 20 percent of GDP. There are also broader, real, costs to the welfare of the economy. Hoggarth, Reis, and Saporta (2002) find that the cumulative output losses incurred during crisis periods are roughly 15–20 percent of GDP.

National authorities (central banks and finance ministries) have a mandate for financial stability in their national financial system. They may be reluctant to provide liquidity or solvency support for solving problems in other European Union (EU) countries, and thus not take into account cross-border externalities caused by financial institutions under their jurisdiction (Schoenmaker and Oosterloo 2005). Financial problems occurring in one country can affect the health of the financial system in other countries through different channels. The first type of contagion risk occurs when the financial shock causes the institution itself to fail. We refer to this state of affairs as the first-round effect of financial contagion. In this round,

financial problems spread throughout the institution and across borders to its foreign branches and subsidiaries. In particular, in countries where the financial system is dominated by foreign banking groups, the consequences of these first-round effects can be significant. The second type of contagion risk is the risk that the failure of an institution will be transmitted to other institutions because of explicit financial linkages between these institutions. This is referred to as the second-round effect of financial contagion; see also De Bandt and Hartmann (2002). What is the impact of these cross-border externalities on the economy? When parts of the financial system break down, the credit capacity may be constrained. In this paper, we are interested in the economic effects of credit contraction in a country as a result of financial contagion.[1]

Current nationally based arrangements do not incorporate these cross-border externalities and may therefore lead to a coordination failure in crisis management. To formalize this issue, we look at two different models of recapitalization developed by Freixas (2003): a single-country model and a multicountry model. The models only deal with the funding of a recapitalization. In an earlier paper (Goodhart and Schoenmaker 2006), we also deal with some practical aspects of a recapitalization. For example, before public money is considered, private-sector solutions should be explored and the shareholders and managers of an ailing bank should be removed to preserve incentives to prevent problems developing.

2.1 Single-Country Model of Recapitalization

Freixas (2003) presents a model of the cost and benefits of recapitalization.[2] The model considers the ex post decision whether to recapitalize or to liquidate a bank in financial distress. The choice to continue or to close the bank is a variable x with values in the space $\{0, 1\}$. Moreover, θ denotes the social benefits of a recapitalization and C its costs. Among other things, the benefits of a recapitalization may include those derived from avoiding contagion

[1]See Allen and Gale (2000) and De Bandt and Hartmann (2002) for a full discussion of contagion risk.

[2]The recapitalization would involve firing the pre-existing management and writing down shareholder value to zero.

and maintaining financial stability. If the direct cost of continuing the bank activity is denoted by C_c and the cost of stopping its activities by C_s, we only deal with the difference, $C = C_c - C_s$. The case $C < 0$ is obviously possible, but is a case where continuing the bank's operations is cheaper than closing it down, so that continuation is preferred and the recapitalization decision is simplified. In this situation private-sector solutions are possible and the central bank can play the role of "honest broker."

The optimal decision for the authorities will be to maximize

$$x^*(\theta - C)$$

so that

$$\begin{cases} x^* = 1 & \text{if } \theta - C > 0 \\ x^* = 0 & \text{if } \theta - C < 0. \end{cases} \tag{1}$$

This simple model shows that a bank will be recapitalized whenever the total benefits of an intervention are larger than the net costs. In the case of recapitalization, the authorities will contribute C.

2.2 Multicountry Model of Recapitalization

In the multicountry model, Freixas (2003) considers the case where the mechanism is set in such a way that the bank is recapitalized only if a sufficient contribution from the different countries can be collected. This is an interpretation of improvised cooperation:[3] the different countries meet to find out how much they are ready to contribute to the recapitalization, denoted by t. If the total amount they are willing to contribute is larger than the cost, the bank is recapitalized. The decision is

$$\begin{cases} x^* = 1 & \text{if } \sum_j (t_j - C_j) > 0 \\ x^* = 0 & \text{if } \sum_j (t_j - C_j) < 0 \end{cases} \tag{2}$$

[3]The term "improvised cooperation" has been coined to convey the view of an efficient, although adaptive, exchange of information and decision making. It relies on the idea that financial stability is a goal that every individual country is interested in achieving, so there are good grounds for cooperation (Freixas 2003). In our opinion, improvised cooperation corresponds to the current situation in the EU.

and the j-country objective will be to maximize

$$x^*(\theta_j - t_j).$$

This game may have a multiplicity of equilibria, and, in particular, the closure equilibrium $t_j = 0$, $x^* = 0$ will occur, provided that for no j we have

$$\theta_j - \sum_j C_j > 0.$$

That is, no individual country is ready to finance the recapitalization by itself. Obviously, if this equilibrium is selected, the recapitalization policy is inefficient, as banks will almost never be recapitalized.

The fact that in most cases the closure equilibrium will occur can be explained by the fact that part of the externalities fall outside the home country, although we assume that the country with the highest social benefits of a recapitalization is the home country. The home country may not be prepared to meet the costs of recapitalizing a failing bank in its entirety. The problem becomes more acute for large banks in small countries. The cost relative to the fiscal budget may be large in small countries, so the home country simply cannot bear the full burden alone (Dermine 2000). We group the countries as follows: the home country, denoted by H; all European countries, denoted by E; and all countries in the world, denoted by W. The social benefits can then be decomposed into the social benefits in the home country ($h \cdot \theta = \theta_h$), the rest of Europe ($e \cdot \theta = \theta_e$), and the rest of the world ($w \cdot \theta = \theta_w$):

$$\sum_{j=1}^{W} \theta_j = \theta_h + \sum_{j \notin H}^{E} \theta_{e,j} + \sum_{j \notin E}^{W} \theta_{w,j}.$$

In this equation h, e, and w are indexes for the social benefits (i.e., externalities caused by the possible failure of a financial institution) in the home country, the rest of Europe, and the rest of the world. The sum of h, e, and w is 1.

Proposition 1. *In a setting of improvised cooperation, the efficiency of the recapitalization scheme depends on the size of h. When the total social benefits are close (or equal) to the social benefits*

of the home country ($h \to 1$)*, the home country recapitalizes the entire financial institution, provided that recapitalization is the optimal strategy. This is situation (1). Otherwise* ($h \prec 1$)*, the home country only deals with the social benefits within its territory and the closure equilibrium occurs for sufficiently low levels of h, even when recapitalization is the optimal strategy.*

Current nationally based arrangements undervalue externalities related to the cross-border business of financial institutions. As a result, insufficient capital will be contributed and the financial institution will not be recapitalized. The model pinpoints the public-good dimension of collective recapitalization and shows why improvised cooperation (ex post negotiations) will lead to underprovision of public goods—that is, to an insufficient level of recapitalizations. The outcome of our model is consistent with Schinasi (2007). Applying the theory on "economics of alliances," he examines decision making in a group of countries. Schinasi (2007) also concludes that the provision of shared financial stability public goods results in an equilibrium that is suboptimal from a European perspective, even though each country views its own decision as optimal and has no incentive to change its resource allocation decision if other countries maintain theirs. More specifically, countries choose a level of the public good that is inferior relative to the socially optimal level for European financial stability.

To avoid an insufficient level of recapitalizations, other—more centralized—coordination mechanisms may be explored. While a global jurisdiction does not exist, the member states of the European Union have a possibility of extending the jurisdiction to the European level in order to incorporate the social benefits in other European countries in the decision making. Schoenmaker and van Laecke (2007) document a statistically significant upward trend of emerging European banking groups. This trend illustrates that the need for coordination mechanisms at the European level is becoming more acute.

3. Mechanisms for Fiscal Burden Sharing

We extend the model of Freixas (2003) to explore ex ante mechanisms for burden sharing to overcome the coordination failure in

ex post negotiations. At the outset, we note that burden sharing in the case of an international banking crisis is a general problem. The Freixas model applies to any multicountry setting. We confine our search for solutions to the European setting, as a jurisdiction is available in the EU to implement binding agreements amongst national states. Treaties with a wider coverage of states can, of course, be signed, but there is no international enforcement mechanism.

3.1 Modeling Burden Sharing

In our model of burden sharing, the European countries (E) share the burden according to a prespecified key denoted by k with $\sum_{j=1}^{E} k_j = 1$, while countries outside Europe ($W - E$) do not participate in the scheme. The contribution will become for the European countries and non-European countries, respectively,

$$\begin{cases} t_j = k_j \cdot C & \forall j \in E \\ t_j = 0 & \forall j \notin E. \end{cases}$$

The European countries will maximize

$$x^*(\theta_j - (k_j \cdot C)) \quad \forall j \in E.$$

We assume that there is a collective vote of all involved countries: they jointly decide to rescue or to close the bank. In the particular case that the share of a country's contribution to the costs is fully aligned with that country's benefits ($k_j/\theta_j \ \forall j \in E$ is a constant), every country will vote in the same way. The decision in (2) will become

$$\begin{cases} x^* = 1 & \text{if } \sum_{j=1}^{E} \theta_j - C > 0 \\ x^* = 0 & \text{if } \sum_{j=1}^{E} \theta_j - C < 0. \end{cases} \tag{3}$$

If the social benefits in the home country and other European countries are larger than the total costs, the involved countries vote in favor of recapitalization. So the underprovision of recapitalizations would be reduced and come closer to the optimal solution of (1).

Proposition 2. *European coordination improves the efficiency of the recapitalization policy for positive values of e. If a bank's activities outside Europe are negligible* ($(h + e) \to 1$)*, we get an optimal*

decision for recapitalization (situation (1)), even for low values of h. Only when a bank's activities outside Europe are large $((h+e) \prec 1)$ *does the closure equilibrium occur, even when recapitalization is the optimal strategy.*

Proposition 2 demonstrates that European coordination is useful when cross-border business of banks (e) is non-negligible. In that case, coordination will improve the efficiency of the recapitalization policy, as both the externalities in the home country (h) and other European countries (e) are incorporated in the decision making. Only truly international banks with sizable business outside Europe (w) will pose a problem leading to socially insufficient recapitalizations.

Earlier we assumed that the share of a country's contribution to the costs is aligned with that country's benefits. However, the social benefits (financial stability) and the contributions to the costs may not be evenly spread over the different European countries. The design of the key for sharing the burden, k, is crucial for solving the model. The key needs to reflect the financial stability benefits. In a first general mechanism, we assume that financial stability is a truly public good which affects all participating countries. All countries then contribute according to their relative share. In a second specific mechanism, we assume that financial stability is only affected in those countries where a failing bank is doing business. The burden is financed directly by the involved countries according to some key reflecting the geographic spread of the business of the failing bank.

The working of the mechanisms will be illustrated with examples of sharing the burden for the recapitalization of some European banks. As small and medium-sized banks tend to be predominantly domestically oriented, we focus on the cross-border activities of large banking groups. To calibrate the numerical examples, table 1 provides some details on the twenty-five largest banks in Europe. The assets of this top twenty-five range from €300 to €1,500 bn. The average minimum capital requirement (calculated as the regulatory minimum of 4 percent of risk-weighted assets) of this group of large banks is €12.6 bn. These banks conduct on average 55 percent of their business at home ($h = 0.55$) and 26 percent in the rest of Europe ($e = 0.26$).

Table 1. Top 25 European Banks (2006 Figures)

Bank (Country)	Minimum Capital in €bn	Assets in €bn	h (%)	e (%)
1. HSBC (UK)	28.5	1,412.9	30	14
2. Royal Bank of Scotland (UK)	23.8	1,298.9	68	7
3. Crédit Agricole (France)	20.9	1,380.6	77	13
4. Santander Central Hispano (Spain)	19.1	833.9	36	47
5. BNP Paribas (France)	18.5	1,440.3	66	23
6. Barclays Bank (UK)	17.7	1,485.8	41	20
7. UniCredit (Italy)	16.9	823.3	26	70
8. HBOS (UK)	16.4	880.9	85	8
9. ING Bank (Netherlands)	13.5	895.0	38	32
10. Sociéte Générale (France)	11.4	956.9	63	18
11. ABN AMRO Bank (Netherlands)	11.2	987.1	29	43
12. Deutsche Bank (Germany)	11.0	1,126.2	18	47
13. Banco Bilbao Vizcaya Argentaria (Spain)	10.1	411.9	80	2
14. Rabobank Group (Netherlands)	9.9	556.3	61	19
15. Fortis Group (Belgium)	9.6	674.7	55	37
16. Lloyds TSB Group (UK)	9.3	512.1	97	2
17. Commerzbank (Germany)	9.1	608.4	73	21
18. Crédit Mutuel (France)	8.9	482.7	93	5
19. UBS (Switzerland)	8.5	1,491.2	9	31
20. Groupe Caisse d'Epargne (France)	8.4	539.7	94	1
21. Nordea Group (Sweden)	7.4	346.9	30	70
22. Groupe Banques Populaires (France)	6.5	305.3	75	10
23. Credit Suisse Group (Switzerland)	6.3	781.5	13	32
24. Danske Bank (Denmark)	6.0	367.4	67	33
25. Dexia (Belgium)	5.3	566.7	56	35
Average Top 25 Banks	12.6	846.7	55	26

Notes: Banks are ranked according to minimum capital, which is calculated as the regulatory minimum of 4 percent of risk-weighted assets (as of year-end 2006). Home is defined as a bank's assets in its home country (denoted by h); rest of Europe is defined as a bank's assets in other European countries (denoted by e); rest of world is defined as a bank's assets outside Europe (figures not shown). The three categories add up to 100 percent.
Source: "Top 1000 World Banks," *The Banker*, July 2007 for minimum capital and assets; Schoenmaker and Van Laecke (2007) for division of assets over home country and rest of Europe.

3.2 General Fund

In the first general mechanism, a European fund could be set up to shoulder the burden of a recapitalization. In an earlier paper (Goodhart and Schoenmaker 2006), we proposed to let the European Central Bank (ECB) issue bonds to set up a general fund and to use the seigniorage of the ECB to finance the annual costs (interest payment and write-down) of the fund. This solution has two drawbacks. First, it may violate the prohibition on monetary financing enshrined in the Maastricht Treaty. Second, it only provides an intermediary solution. While a central bank can create unlimited amounts of liquidity, its capacity to absorb losses is limited to its capital. To give the ECB a credible role in rescues (lender of last resort or recapitalization), its capital needs to be explicitly underwritten by national governments.[4]

Rather than using the ECB, the EU countries could use their own bank, the European Investment Bank (EIB),[5] to set up a general fund. There is no need to have a pre-funded (ex ante) fund, if receipts are nationally invested (Ricardian equivalence), since this would just raise the measured fiscal deficit while changing nothing real. During a crisis, bonds are issued by the EIB to finance the recapitalization. These borrowed moneys are used to recapitalize the failing bank. This would cover the full nominal value needed for the rescue. The annual servicing costs of the bonds would be paid by the governments. First, interest on the outstanding bonds (flow) is paid out of the fund. Second, any loss on the bonds (stock) is also paid out of the fund. This is a sinking fund for the amortization of losses. Each participating country would pay into the fund, as and when needed, according to a relative key: $k_j = g_j$. We propose to apply a GDP-based key, which measures a country's relative share

[4] A possible European Deposit Insurance Fund (EDIF), funded by premia levied on the large cross-border European banks, would run into the same problem. Deposit insurance schemes have at times run out of funds (as did the FSLIC in the United States) and, more generally, lack credibility without the ultimate backup of pledged government support. It only takes the issue of burden sharing back one step. In order to establish a credible EDIF, it would be necessary to decide how the burden of meeting shortfalls from the calls upon its funds could be met.

[5] The EU member states are the shareholders, and thus the owners, of the European Investment Bank.

in total GDP. GDP reflects the size of a country's economy and is an indirect indicator of a country's financial system (see the appendix).

3.2.1 Numerical Example

The working of a general fund for burden sharing can be illustrated with a numerical example for a possible recapitalization of a representative European bank i. We make the following assumptions:

(i) $L_i = 1.5 \cdot E_i$. There is a large loss (L_i). Equity is wiped out and there is negative equity of half of the regulatory minimum capital (E_i). Adequate recapitalization requires the restoration of the minimum capital requirement.
(ii) $W_i = 0.75 \cdot E_i$. In a worst-case scenario, the write-down (W_i) is the full negative equity with a margin of one-fourth of minimum capital. The write-down is over a period of four years (given a loss of this extent, it will take at least three to four years to restore the bank to health and to sell it back to the private sector).
(iii) $i = 5$ percent. Annual interest is 5 percent.
(iv) $E_i = 12.6$ bn. The regulatory minimum capital requirement of a "representative" European bank is €12.6 bn (average of the top twenty-five banks in table 1).
(v) All EU countries join the general fund.

The EIB needs to issue €18.9 bn of bonds to recover the negative equity of €6.3 bn and to restore minimum capital of €12.6 bn. The annual interest payment on the bonds is €0.9 bn. The sinking fund for write-down is €9.5 bn. The annual write-down is €2.4 bn. These amounts add to a total annual cost for countries of €3.3 bn. Countries that join the burden-sharing scheme pay this amount according to the GDP key (g_j) as specified in table 2 (see the appendix). The annual contribution is, for example, €0.7 bn ($k_j = 20.2$ percent) for Germany and €0.3 bn ($k_j = 8.6$ percent) for Spain.

This numerical example illustrates that the recapitalization of a "typical" large European bank appears to need a general fund of €18.9 bn. The servicing of this general fund results in an annual cost of €3.3 bn. The contribution of individual countries to the annual

cost ranges from €0.7 bn for Germany to €0.003 bn for countries such as Cyprus and Malta.

3.3 Specific Sharing

In the second mechanism, only countries in which the failing bank is present share in the burden. Each involved country pays its "relevant" part of the burden. A key can be designed to reflect the relative presence of the problem bank in the different countries. Sullivan (1994) has examined different indicators to measure the geographic segmentation of international firms. These indicators are assets, income, and employees. Using just a single indicator increases the margin for error, as the indicator could, for example, be more susceptible to external shocks. Sullivan (1994) has developed the Transnationality Index, which is calculated as an unweighted average of (i) foreign assets to total assets, (ii) foreign income to total income, and (iii) foreign employment to total employment.

The selection of an adequate key should be related to the aim of a possible rescue (i.e., the social benefits). We see two main aims. The first aim is mitigating the effects on the real economy. The second is mitigating the impact on the wider financial system (contagion). We do not include a third objective of helping depositors. There is already mandatory deposit insurance in the EU (with a minimum coverage of €20,000 per depositor) to take care of depositors. A good proxy for the real and contagious effects of the failure of bank i is assets: $k_{ij} = a_{ij}/(h_i + e_i)$. Note that since only European countries join the burden sharing, the key needs to be rebased to the European part $(h_i + e_i)$ of the assets of bank i (a_{ij}). On the real side, assets (including loans) reflect the credit capacity of a bank. The availability of credit will be disrupted in case of a failure (Gale 1993). The contraction of credit in the various countries further depends on the leverage of the respective entities in these countries. The higher the leverage, the larger the contraction would be. The asset key could be adjusted for that. However, banks are increasingly run on a consolidated basis.[6] On the contagion side,

[6]While subsidiaries have their own capital structure and thus their own leverage, branches are part of the overall group and do not have their own balance sheet. Deutsche Bank has organized its large cross-border operation in London

assets reflect the size of a bank. The contagious impact is (partly) related to the size of a failing bank. We have calculated how the assets of the top twenty-five European banks are allocated between the home market (h_i), the rest of Europe (e_i), and the rest of the world (w_i) for each bank i. While these three categories add up to 100 percent, we only show the home market and the rest of Europe shares in table 1.

3.3.1 Numerical Example

The working of a specific burden-sharing program can be illustrated with a numerical example for the possible recapitalization of a few large European banks. Three different banks i are taken to demonstrate the specifics of each case: a pan-European bank (Deutsche Bank), a regional bank (Nordea), and a global bank (HSBC). Again, we make the following assumptions:

(i) $L_i = 1.5 \cdot E_i$. There is a large loss (L_i). Equity is wiped out and there is negative equity of half of the regulatory minimum capital (E_i). Adequate recapitalization requires the restoration of the minimum capital requirement.
(ii) $W_i = 0.75 \cdot E_i$. In a worst-case scenario, the write-down (W_i) is the full negative equity with a margin of one-fourth of minimum capital. The write-down is over a period of four years (given a loss of this extent, it will take at least three to four years to restore the bank to health and to sell it back to the private sector).
(iii) $i = 5$ percent. Annual interest is 5 percent.
(iv) All EU countries join the specific burden-sharing program.

The involved countries need to issue €16.5 bn of bonds to rescue Deutsche Bank ($E_i = 11.0$ bn). The burden is shared according to the asset key: $a_{ij}/(h_i + e_i)$. The specific geographic distribution of Deutsche Bank's assets (in table 1) is used to calculate the respective shares of the countries. Deutsche Bank has 18 percent of its assets in Germany and 47 percent of its assets in the rest of Europe.

in a branch. Nordea is currently considering restructuring its organization from a subsidiary structure to a branch structure. In these cases, the parent bank and the foreign branches have a common leverage ratio.

The United Kingdom accounts for over half of assets in the rest of Europe; let's say 25 percent. So Germany needs to issue €4.6 bn of bonds ($k_{ij} = 0.28$), the United Kingdom €6.4 bn ($k_{ij} = 0.38$), and certain other EU countries €5.6 bn ($k_{ij} = 0.34$). The respective annual costs to service (interest and write-down) their bond issue are €0.8 bn for Germany, €1.1 bn for the United Kingdom, and €1.0 bn for the other EU countries.

The involved countries need to issue €11.1 bn of bonds to rescue Nordea ($E_i = 7.4$ bn). Nordea has 30 percent of its assets in Sweden and 70 percent of its assets in the rest of Europe. The rest of Europe is divided into 31 percent in Finland, 28 percent in Denmark, 11 percent in Norway,[7] and less than 1 percent in Poland and the Baltic States. So Sweden needs to issue €3.3 bn of bonds ($k_{ij} = 0.30$), Finland €3.4 bn ($k_{ij} = 0.31$), Denmark €3.1 bn ($k_{ij} = 0.28$), and Norway €1.2 bn ($k_{ij} = 0.11$). The respective annual costs to service its bond issue are €0.6 bn for Sweden, €0.6 bn for Finland, €0.5 bn for Denmark, and €0.2 bn for Norway.

The involved countries need to issue €42.8 bn of bonds to rescue HSBC ($E_i = 28.5$ bn). HSBC has 30 percent of its assets in the United Kingdom and only 14 percent of its assets in the rest of Europe. France accounts for 6 percent of assets in the rest of Europe. So the United Kingdom needs to issue €29.2 bn of bonds ($k_{ij} = 0.68$), France €5.8 bn ($k_{ij} = 0.14$), and certain other EU countries €7.8 bn ($k_{ij} = 0.18$). The respective annual costs to service its bond issue are €5.1 bn for the United Kingdom, €1.0 bn for France, and €1.4 bn for the other EU countries.

Summing up, it appears that in the case of the Scandinavian bank, Nordea, the costs are shared almost equally by the four Scandinavian countries—Denmark, Finland, Norway, and Sweden. This is a clear example of a regional distribution of the burden. The costs of rescuing a pan-European bank, such as Deutsche Bank, are spread over Europe, with large contributions by the home country, Germany (28 percent), and Europe's financial center, London, in the United Kingdom (38 percent). Finally, the burden sharing for the international bank HSBC, headquartered in London, would be difficult.

[7]Norway is not a member state of the European Union. For this example, we assume that Norway, as a member of the European Economic Area, joins the specific burden-sharing scheme.

Less than half of HSBC's business is in Europe (44 percent, of which 30 percent is in the United Kingdom, 6 percent is in France, and 8 percent is in other European countries), while these European countries have to shoulder the full burden in a European-based specific burden-sharing program.

4. Policy Implications

Which mechanism is better? We will assess both mechanisms in detail below. The main issue is the specification of the key for burden sharing. The goal of selecting an appropriate key is to align the benefits and the contribution to the costs as much as possible. If the alignment is perfect, we get into the situation of equation (3): a bank will be recapitalized if the social benefits in Europe exceed the total costs of recapitalization.

4.1 General Fund

The general fund mechanism is an example of generic burden sharing by countries (proportionate to the size of the participating countries). The costs of recapitalization are smoothed over the participating countries, irrespective of the location of the failing bank. In addition, the costs are smoothed over time. From a macroeconomic perspective, these smoothing mechanisms are positive.

However, we see three major problems with such a general fund mechanism. First, this construction will lead to international transfers between countries (a country may have to contribute its share to a recapitalization while the problem bank is not operating in its jurisdiction). Countries are not keen to sign up for schemes with built-in transfers, unless there is strong political commitment for solidarity (e.g., development aid and, less so, European regional funds). This is a reflection of the earlier-mentioned problem that benefits and costs are not aligned. Second, general burden sharing generates adverse selection and moral hazard problems. Countries with weak banking systems profit over countries with strong banking systems. Therefore, countries with strong banks are less inclined to sign up (adverse selection). As the link between payment for a recapitalization and responsibility for ex ante supervision is lessened, supervisory authorities may feel less of an incentive to provide an

adequate level of supervisory effort (moral hazard). Third, burden-sharing arrangements are subject to the free-rider problem. Countries that do not sign up for burden sharing profit from burden sharing, as the stability of the European financial system is a public good.

There are also some technical issues. What happens if the fund is exhausted? The numerical example in section 3.2.1 illustrates that a large bank can be saved at a moderate annual cost for countries. The general fund can thus shoulder the recapitalization of a few large banks. In the case of multiple, contagious bank failures, we are in a different setting, as explained above. The authorities will then need to take more drastic action to restore confidence in the financial system. Moreover, the authorities may also need to take measures, such as reductions in interest rates, to counter the macroeconomic causes of the banking crisis.

4.2 Specific Sharing

An important advantage of specific sharing arrangements is that there are almost no international transfers. Countries that experience the benefits of the recapitalization also pay for the recapitalization. Provided that assets are a good proxy for measuring the benefits (i.e., averting the real and contagious effects of a bank failure), the costs and the benefits are fully aligned. The specific sharing scheme is also incentive compatible: the fiscal authorities as principal will require from the supervisor as agent an optimal level of supervisory effort.

As in the general fund scheme, however, the specific sharing arrangement is subject to a free-rider problem. This would be, in particular, a problem for the United Kingdom. All major banks have a large presence in London. Twenty-six percent of banking assets in the EU are located in the United Kingdom, while the United Kingdom's share in the EU economy is far lower, at 17 percent of GDP (see the appendix). So it might be more difficult for the United Kingdom to join such a specific sharing arrangement. The United Kingdom would have to pay a sizable proportion of such burden sharing, as can be seen in the numerical example of Deutsche Bank in section 3.3.1 But, at the same time, the United Kingdom

might also experience sizable stability benefits from pre-arranged recapitalizations.[8]

An important technical issue is gaming on the key. A country may have an incentive to put pressure on a faltering bank to move assets cross-border or off-balance (securitization) to reduce its share in any such burden sharing. To prevent last-minute asset movements at the onset of banking problems, we would propose to use the last audited (and published) figures on assets. Moreover, securitization does not pose a problem if it is properly done (i.e., the risk has really gone from the balance sheet in line with the Basel II rules on securitization). Finally, there are various ways of measuring assets—for example, measuring whether they are risk-weighted assets or not, and measuring their historic cost or market value. At this early stage in the discussion we would not want to try to be too specific, except to note that, in order to deter gaming, the key should relate to the last pre-crisis set of audited figures, not to post-crisis estimates.

4.3 Overall Assessment

Insofar as assets are a good proxy for the real and contagious effects of a bank failure, the specific sharing mechanism will come close to an efficient solution of the coordination problem. Countries facing systemic disruption are asked to contribute. They will do so if the stability effects in their country exceed their contribution. The general mechanism will work differently: there need to be a majority of countries that have sufficient benefits. For example, regional banks (Scandinavia, Benelux) will never be rescued, because the share of their countries in the vote is too small. Remember that we assume that there is a collective vote of all involved countries: they jointly decide to rescue or to close the bank. Given that most European banks do not have a relatively equal spread over all European countries, the voting in the general scheme will be suboptimal to the voting in the specific scheme.

[8]An issue for discussion is whether assets are a good proxy for the presence of banks in the United Kingdom. The London operations of the major banks are primarily wholesale. This should make no difference for measuring the contagious effects. But the real effects can be overstated, as these effects are more related to retail than to wholesale operations of banks.

It is possible to implement a mix of general and specific sharing. To the extent that EU-wide financial stability is affected, general sharing will be preferable. When only stability in the countries where the bank is located is affected, specific sharing will be the preferred solution. While each banking crisis is different, we detect an overall pattern. It appears that most bank failures affect the countries concerned in particular (e.g., the Scandinavian and Japanese banking crises in the 1990s). In addition, there is often a (minor) impact on worldwide interbank markets affecting worldwide/EU-wide financial stability. We could imagine a division, though admittedly arbitrary, of 10 percent general sharing and 90 percent specific sharing.[9]

Our results with one bank can be easily generalized to multiple banks. However, when one moves to the mode of a full-blown banking crisis, the differences between the mechanisms become less relevant, and macroeconomic factors, such as a deep recession or large terms of trade decline, come into play (see, e.g., Caprio and Klingebiel 1997; Kaminsky and Reinhart 1999; Honohan and Klingebiel 2003). During such crisis periods, the authorities (government and central bank) will need to stand behind the banks and implicitly or explicitly guarantee their deposits to restore confidence in the financial system. This was the experience of the Scandinavian authorities during the 1990s.

There are some concerns surrounding both mechanisms. First, there is a concern with foreign banks in small countries. What if the bank is systemic in the host country, but not in the home country? The bank might then not be rescued. This could be a problem for the new member states in particular. To alleviate this problem, the key could be made a function of the assets of the problem bank in a country and the assets of the problem bank in that country divided by the total assets of that country's banking system. The small countries would then shoulder a larger share of the burden and have, accordingly, a larger share in the vote. However, the mostly West European parent banks of the subsidiary banks in Eastern Europe are often large retail banks that are also systemic in the home country.

[9]We would like to thank Xavier Freixas for suggesting this mix of 10–90 percent.

Second, some would argue that crisis-management arrangements for lender-of-last-resort and solvency support should not be specified in advance to counter moral hazard. We agree that constructive ambiguity regarding the decision to recapitalize or not can be useful to contain moral hazard (Freixas 1999). But the model of Freixas (2003), replicated in this paper, demonstrates that additional ambiguity over burden sharing would lead to fewer recapitalizations than socially optimal. Our goal is to attain the same clarity at the European level that we currently have at the national level. At the national level, the ministry of finance bears the financial risk of support operations, if any, and therefore decides on these operations. Clarity at the European level on how to share the costs among treasuries in the case of the failure of a European bank does not increase moral hazard compared with the national level in the case of the failure of a domestic bank. So we propose full transparency on crisis-management arrangements (the "how" question) but constructive ambiguity on the application of these arrangements (the "whether" question).

Third, it could be difficult to organize burden sharing for truly international banks that have a large part of their business outside Europe (see also proposition 2). While only a part of the benefit will fall within Europe, the European countries have to pay the full cost. Examples are the Swiss banks (UBS and SBC) and HSBC (see the numerical example in section 3.3.1). Moreover, such mechanisms fail to address crisis problems caused by the failures of banks headquartered outside Europe—e.g., in the Americas, Asia, or Australia. That said, the specific approach to burden sharing could be undertaken for any international group, not just within the EU. Indeed, the wider the set of countries involved, the better. There would be nothing, in principle, to stop such cross-border burden-sharing arrangements from being extended beyond the EU to encompass the United States, Australia, Japan, and other willing countries.

Fourth, it should be recognized, however, that a legal basis is needed to create binding ex ante burden-sharing arrangements. We believe that memoranda of understanding (MoUs), which are often used between national supervisors (and central banks), will not be sufficient because MoUs (soft law) are not enforceable. A legal basis (hard law) can be readily provided within the EU. The legal instruments and the institutional framework to negotiate and enforce such

instruments are available. Legally binding arrangements beyond the EU (i.e., a full international treaty) may be much more difficult to get agreed upon, signed, and enforced. Clear and hard-edged ex ante rules are also helpful during a crisis, when speed of decision making is crucial. By contrast, ex post principles on burden sharing leave themselves open to interpretation, delaying the decision-making process.

Finally, the guiding principle for decision making on crisis management is "he who pays the piper calls the tune" (Goodhart and Schoenmaker 1995). So long as recapitalizations are organized on a national basis, the national governments will normally want to oversee and undertake the function of supervision. That is the current setup for financial supervision and crisis management, which are nationally organized. As there is no fiscal backup to the ECB, the ECB is happy to let the national central banks take the lead on lender-of-last-resort operations. The decision-making arrangements to support an ex ante burden-sharing scheme would be complex, but manageable, and modeled on the kind of tripartite (supervisor, central bank, finance minister) system already in place in the United Kingdom. The Committee of European Banking Supervisors (CEBS) would provide information on the scale of the problem. The General Council of the ECB (i.e., including the EU countries outside the euro zone) would decide whether the crisis was systemic. The Ministers of Finance in Ecofin would decide on the use of taxpayers' funds.[10] In the specific sharing mechanism, only the countries in which the failing cross-border bank had a significant presence would attend and vote.

5. Conclusions

The management of a banking crisis is always difficult. Decisions to close or to recapitalize an ailing bank have to be made under time pressure. Theory suggests that recapitalization of a failing bank is only efficient if the expected benefits (prevention of a systemic crisis) exceed the costs of a recapitalization. Crisis management is even more difficult in a cross-border setting, in which various countries have to coordinate. Applying the model of Freixas (2003), we show

[10]The European Commission needs to be consulted to ensure that the rules on state aid are not violated.

that ex post negotiations on burden sharing lead to an underprovision of recapitalizations. Countries have an incentive to understate their share of the problem in order to have a smaller share in the costs. The model suggests that the home country would be left with the decision, including the funding, on the recapitalization of a failing bank.

We doubt whether the home-country supervisors, politicians, and taxpayers would, in the event of a failure of a large cross-European bank, be prepared to meet the costs of recapitalizing such a bank in its entirety. While depositors would be partly protected by national deposit insurance, the bank itself, perhaps outside its own country, would then probably be forced to close. Such abrupt closure could cause widespread concern and systemic effects.

If pan-European burden sharing to allow for cross-border recapitalization is to be made possible, it would have to be on the basis of agreed ex ante rules. This paper explores two sets of ex ante burden-sharing mechanisms. The first is a general mechanism, based on full solidarity between EU member states. The underlying assumption is that financial stability is a truly public good. While general burden sharing has some attractive smoothing properties, it runs into problems of causing cross-border fiscal transfers and adverse selection (countries with weak banking systems are keen to join the burden-sharing scheme). The second is a specific burden-sharing mechanism. The assumption is that financial stability is only affected in the countries in which the bank is located. These countries contribute according to the geographical spread of that bank's business. Specific burden sharing has somewhat fewer problems. Because a country's benefits (in the form of preserving systemic stability) and that country's contribution to the costs are better aligned in the specific burden-sharing scheme, this scheme is better able to overcome the coordination failure in the Freixas model.

With the ongoing integration of European financial markets, symbolized by the emergence of pan-European banks, there may be a need for European arrangements for financial stability.

Appendix. Country Keys

Table 2 contains several keys that can be used to share the costs in case of a general burden-sharing mechanism for a banking crisis. The

GDP key is a country's share in total GDP. GDP reflects the wealth of a country and is an indirect indicator of the size of a country's financial system. The assets key is total assets of credit institutions (banks) in a country divided by total assets of EU-25 credit institutions. The banking assets key is a direct indicator of the size of a country's banking system.

Table 2. Country Keys (in %; 2006 Figures)

Country	GDP	Assets
Austria	2.3	2.1
Belgium	2.8	3.0
Cyprus	0.1	0.2
Czech Republic	1.0	0.3
Denmark	1.9	2.2
Estonia	0.1	0.0
Finland	1.5	0.7
France	15.7	15.6
Germany	20.2	19.3
Greece	1.7	0.9
Hungary	0.8	0.3
Ireland	1.5	3.2
Italy	12.9	7.6
Latvia	0.1	0.1
Lithuania	0.2	0.0
Luxembourg	0.3	2.3
Malta	0.0	0.1
Netherlands	4.6	5.1
Poland	2.4	0.5
Portugal	1.4	1.1
Slovakia	0.3	0.1
Slovenia	0.2	0.1
Spain	8.6	6.8
Sweden	2.7	2.1
United Kingdom	16.7	26.2
Total EU-25	100	100

Source: Authors' calculations based on "EU Banking Structures," ECB (2007).

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