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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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Coordinating Bank Failure Costs and Financial Stability

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Abstract

Banking groups have become increasingly multinational but the institutional infrastructure to deal with solvency or liquidity problems is still largely national. This might lead to financial instability if national authorities do not internalise externalities abroad. Recently ex-ante burden sharing agreements have been established (e.g. EFSF), but little empirical work has been done on potential costs and benefits of such agreements. We estimate the costs and benefits of financial stability support for large, internationally active banks under several proposed agreements. We show costs according to the ‘national solution’, where only home authorities inject capital, as our benchmark. ‘Specific’ sharing agreements would be redistributive at the expense of smaller and East European countries (not home to large cross-border banking groups). The ‘general fund’ mechanism will smooth costs across countries but may lead to unequal redistribution of costs. We also show that coordinating bank failure costs may bring about financial stability benefits.

Keywords: Burden sharing, crisis resolution, cross-border banks

JEL classification: F55; G18; G21

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1. Introduction

The recent financial crisis has shown that in a systemic banking crisis the injection of public capital or provision of liquidity may be needed, even though this source of funding should be considered as a last resort. And given the increased interconnectedness of global financial systems, the provision of capital or liquidity to financial institutions may have to be supplied by different national authorities. A sizeable proportion of for instance the US support packages benefited foreign owned institutions.²

Large cross-border financial institutions have increasingly significant operations in several countries but supervisory and fiscal authorities are still organized at a national level. The Fortis and Dexia rescues, which involved several different national authorities providing liquidity and capital support, have shown the need for a more structural solution to cope with cross-border financial crises. This friction, which is evident in the EU but also globally, may lead to an inefficient provision of liquidity or capital support and therefore increase financial instability. Authorities in the home country might - as they attach more weight to domestic (electoral) concerns - decide not to intervene to support a subsidiary abroad. In case the subsidiary is systemic in a small host country, its failure may affect group wide financial stability to some degree but cause a severe contraction of lending in the host country. Alternatively, small sovereigns home to large cross-border banking groups may not be able to avoid the failure of these institutions which may lead to the failure of the sovereign itself, initiating a financial instability spiral. One means of enhancing cooperation between national authorities in resolving cross-border banking groups is to agree ex-ante on a framework or formula for sharing the costs of intervention, as so called ex-ante burden sharing agreement.

The European Financial Stability Facility, established in 2010, is an important step in this direction and constitutes the first example of an ex-ante burden sharing agreement (see also Schoenmaker (2010)). The EFSF can issue bonds backed by the Euro-zone national authorities and use the proceeds to provide liquidity to a sovereign in trouble.³ And when the source of instability derives from banking

² See <http://www.federalreserve.gov/newsevents/press/monetary/20101201a.htm> for details.

³ The first bond issuance was completed on 25 January 2010 totalling EUR5bn.

failures, EFSF funds indirectly provide liquidity support to financial institutions in distress as the sovereign can use the borrowed funds to supplement its liquidity needs. The financial stability benefits of the EFSF are clear during the current Eurozone sovereign crisis.

In international policy circles ex-ante cooperation agreements have also been widely discussed in the context of reforming cross-border financial crisis management arrangements (Fonteyne et al. (2010), IMF (2010)). The De Larosière report highlighted the need to improve arrangements for cross-border financial crisis management, and suggested that the June 2008 EU Memorandum of Understanding on Financial Stability be amended to include more specific metrics for burden sharing agreements (De Larosière (2009)). Separately, the 2009 Nyberg report supports the creation of voluntary firm-specific ex-ante burden sharing agreements on an EU level,⁴ and the 2009 EU Council conclusions has invited the Commission to carry out further work to explore pros and cons of ex-ante and ex-post burden sharing mechanisms.⁵ Deutsche Bank's CEO Josef Ackermann proposed the creation of a pan-European fund, privately and publicly funded, to deal with distressed banks (Deutsche Bank (2010)). Notwithstanding the discussions, very little empirical research has been done on ex-ante burden sharing agreements.⁶ This paper aims to shed light on ex-ante burden sharing agreements, and in particular by quantifying potential costs and financial stability benefits for various agreements. We are unaware of any published work aiming to show the relative expected costs of the various sharing schemes. We do so by comparing the outcome of a 'national solution', where each home country recapitalizes their own groups, to the cooperative outcome where all stakeholder sovereigns support the financial institutions in distress. To properly assess potential exposure we incorporate default expectations as captured in the financial markets. To estimate the financial benefits of ex-ante burden sharing agreements we perform Monte Carlo simulations to determine the loss distribution for the national solution and the different burden sharing agreements.

Our analysis requires a geographical breakdown of bank activities and risks. We

⁴ Economic and Financial Committee, Ad Hoc Working Group report on a European Policy coordination framework for crisis prevention, management and resolution, including burden sharing arrangements, ECFIN/CEFCPE Ares (2010)190792.

⁵ http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ecofin/110617.pdf

⁶ An exception is Schoenmaker (2010) although the data set used only discerns domestic, European and Rest of the World exposures

therefore extend the data set used in De Haas and van Lelyveld (2010), resulting in a detailed breakdown of balance sheets of all major cross border banking groups. The data set covers the period 1992-2008 but is unbalanced due to mergers and acquisitions. We only present 2008 results and leave the time dimension for future work.

As we focus our analysis on quantifying potential costs it is limited in some important respects. First, we abstract from time-inconsistency, moral hazard and adverse selection. Given some (endogenous) key, national authorities might push for a reshuffle of the (organisation) of banking groups. Second, we do not consider whether burden sharing requires an ex-ante fund. We feel these, and other related issues, are important but want to focus on our main question: what is the – latent – exposure of different governments?

The set-up of the paper is as follows. In Section 2 we discuss the academic literature analyzing both the theoretical and practical aspects of burden sharing. In Section 3, we describe our data set followed by our results in Section 4. In the results section we show potential costs under specific burden sharing agreements, for the general fund mechanism and compare the cooperative solution with the national solution, i.e. when the home authority recapitalizes the whole group. In Section 5 we show how the distribution of costs varies with different CBC frameworks in place. Section 6 concludes.

2. The Coordination Problem

Many financial institutions operate across national borders. Although cross-border financial integration brings benefits, for instance in the form of more efficient production, it also increases the risk of financial contagion from one country to another. This contagion can be channeled through foreign direct investment or through local subsidiaries of foreign banks (Claessens and van Horen (2009), De Haas and van Lelyveld (2006), De Haas and van Lelyveld (2010)).

Integration also brings about the risk that, if a cross-border firm gets into difficulty, the authorities of the countries in which it operates may fail to achieve what Nguyen (2008) describes as the “Optimal Resolution Policy” (ORP): the policy that “minimizes any potential impact at the lowest cost”. This is because fiscal resources

and the tools for dealing with failing and failed banks remain in the hands of nation states, whose authorities are ultimately accountable to a national electorate. This is likely to remain the case for the foreseeable future, as resolving banks often requires fiscal resources only available to sovereign authorities with tax-raising power (cf. Krimminger (2008)).

The main reason why authorities might fail to cooperate is that negative externalities deriving from a banking failure across borders are usually not incorporated in the decision process of individual national authorities. Since financial stability is a public good, there will be the incentive to free-ride, resulting in a general under-provisioning of financial stability on a cross-border basis. This could mean that total welfare losses in case of a financial crisis may be larger than if negative externalities are internalized. When the level of recapitalization is lower than the optimal amount, subsidiaries' failures could generate further financial market instability, while undercapitalized banks may lend sub-optimal amounts depressing economic growth (Brinkmann and Horvitz (1995), Bernanke and Lown (1991), Peek and Rosengren (1995)).

In theory, coordination failures can be resolved by committing to the optimal decision rule *ex-ante*. This is especially the case if (future) reputation is at stake. Because the “financial crisis game” is played very rarely, and thus approximates a one shot game, credibly pre-committing is very difficult.⁷ Moreover, some countries may be unable to cooperate due to lack of fiscal resources (for example in the case of big banks domiciled in small countries), or due to time constraints in crisis. Finally, Goodhart and Schoenmaker (2009) point out that the current insolvency laws may not be flexible enough to cope with a global financial system (cf. IMF (2010)).

The coordination problem can be formally analyzed using an “economics of alliances” approach. Such a framework analyses the outcome of a game where members of a group of rational players share the benefits of a public good, deciding how to allocate their own resources to the production of the public good (Nieto and Schinasi (2008)), in our case cross-border financial stability. The model can be used to, first, study the outcome of a decentralized decision making process in providing a “pure” public good (e.g. only conveying benefits to the whole group of

⁷ In this sense it is different from the monetary policy setting where authorities and economic agents interact repeatedly.

countries). Secondly, to study the outcome of a decentralized decision-making process in providing both “exclusive” (e.g. only benefiting national financial stability) and “pure” public goods.

With “pure” public goods the game is a non cooperative, one-shot game, with a Nash equilibrium as the solution.⁸ Firstly, the outcome of this game is sub-optimal when compared to the Pareto efficient allocation, which would maximize a group of nations’ welfare. It results from each country not including the benefits for the group of countries as a whole in producing the public good in its own decision process. Secondly, smaller countries may find it optimal to free-ride, resulting in an over allocation of the burden to bigger countries. In practice, we would have a pure public good when the cross-border bank has many small subsidiaries in different countries and the capital injection yields benefits to the group only.

With a mix of pure and exclusive goods, the outcome of the game is still a Nash equilibrium and it is still sub-optimal when compared to the Pareto-efficient outcome. However, the coexistence of “pure” and “exclusive” public goods could provide greater incentives to cooperate than in the case of “pure” public goods (Sandler and Sargent (1995)). Firstly, there may be a Nash equilibrium in which every participant contributes to the production of the public good, even though the final outcome would not be Pareto optimal. Moreover, if the share of “exclusive” public good benefits out of total benefits is sufficient, contributing to the activity may even be a dominant strategy.⁹ Secondly, as “exclusive” benefits as a proportion of total benefits approach one, the formation of coalitions (e.g. the Nordic countries or the Benelux) could lead to more efficient outcomes closer to the Pareto optimal solution. Thirdly, the existence of a shared financial stability product results in an outcome where benefits received and costs incurred in the production of the public good are better matched.

In practice, the best description of a case of a joint exclusive-pure public good is when we have systemic entities in big countries and small entities in other countries.¹⁰ An injection of rescue capital would yield benefits both to individual coun-

⁸ This is for example the description of a standard prisoner’s dilemma game. A Nash Equilibrium is a set of strategies in which every player is maximising its pay-off, given that all the other players are playing their optimal strategy. No player has an incentive to change strategy and the outcome is not Pareto optimal.

⁹ The strategy yielding the highest possible payoff independently to what other players do.

¹⁰ Such entities can be either a branch or a subsidiary.

tries and to the group of counties as a whole. Lack of coordination may result in economic losses in terms of destruction of banking groups, excessive spending of tax payers' money and depressed market prices due to asset fire sales.

2.1. Solutions to the coordination problem

Nguyen (2008) analyses the necessary preconditions to implement agreements to share resolution costs. He distinguishes between a “burden-sharing principle” (commitment to share the burden, but no specific ex-ante rule), and a “burden-sharing rule” (ex-ante agreement based on pre-specified criteria). Nguyen concludes that when the Optimal Crisis Resolution¹¹ (OCR) policy cannot be enforced externally, then an agreement on burden sharing principle may be preferred (the rule to be decided ex-post). On the other hand, when we have a “disconnection” between the choice of the OCR policy and the burden sharing agreement (i.e. OCR policy can be enforced by an independent authority), then a burden sharing rule would be preferable. As such, there are two main alternatives within the EU framework: agree on a burden sharing principle or modify the institutional structure so that the final cost of the burden allocation will not influence the choice of the OCR policy.

The main theoretical model to study possible interactions and outcomes in a burden sharing agreement has been developed by Freixas (2003). The provision of rescue capital is considered a public good, and the resolution measure to solve the crisis is a bank recapitalization.¹² The rescue is the optimal solution when the total benefit of the operation (e.g. in terms of financial stability) outweighs the costs of the recapitalization procedure. Freixas analyses the outcomes in the case of “improvised cooperation” (authorities meet to find out how much they are willing to contribute ex-post), and in the case of an ex-ante agreement (the authorities committed on a rule based on pre-specified criteria). The main conclusion is that “improvised cooperation” is economically inefficient (i.e. Pareto inefficient), as it leads to a general under-provisioning of the public good.

¹¹ The crisis resolution is optimal when it “keeps global welfare losses to a minimum”, Nguyen (2008).

¹² In practice other measures which may involve public funds can be taken, eg liability guarantees or a good/bad bank split.

A more recent contribution is Niepmann and Schmidt-Eisenlohr (2010); the authors focus on contagion across borders and show that, in absence of cooperation, stronger interbank linkages make government interests diverge, whereas cross-border asset holdings tend to align them. Increased cross border integration thus has different effect depending on the type of integration.

On the other hand, Padoa Schioppa (1999) defines “self-contradictory” the use of rule-based policies in order to manage crises successfully because emergency situations always contain unpredictable elements. Indeed, they often require a departure from procedures formulated during normal times or - more likely - following previous episodes of financial turmoil. Secondly, “constructive ambiguity” may be useful to contain moral hazard, preventing banks from knowing ex-ante possible emergency actions. Padoa-Schioppa concludes that “full explanation of the actions taken and procedures followed may be appropriate ex-post, but unnecessary and undesirable ex-ante”.

Setting up ex-ante agreements should also include punishment mechanisms in order to discipline national authorities during a crisis. These should ensure that authorities stick to the first-best solution agreed upon ex-ante. As a (systemic) financial crisis is a “one-shot game”, since such events are relatively rare, a loss of reputation may not constitute a sufficient deterrent. Only in repeated games would it be possible to establish a punishment mechanism directing national authorities towards the Pareto optimal outcome using the threat of lost reputation. A complicating factor is the high level of uncertainty about the total burden at the onset of a crisis. If costs are unexpectedly high, some nations may even not be able to contribute as previously agreed because of insufficient fiscal resources (too-big-to-save).

An alternative solution is pre-funded capital insurance to cover losses in case of a bank failure, instead of using tax payers’ funds ex-post (Goodhart (2005), Deutsche Bank (2010)). In this case, authorities identify systemically important banks active across borders and may require them to pay a premium for a special deposit insurance fund.¹³ But in cases of systemic financial crises such funds may be too small and ultimately require national authorities’ backing.

¹³ See Kashyap et al. (2008) for a related proposal. They do not tackle the cross-border dimension, however.

Goodhart and Schoenmaker (2006) and, more recently, Goodhart and Schoenmaker (2009) provide an extensive overview of the possible ex-ante agreements including a discussion of their strengths and weaknesses. The first mechanism of burden sharing discussed is a “general fund” in which every country of a group contributes to the programme according to pre-determined variables or keys. If, for example, EU GDP share is the key, this would imply that (in 2008) the UK would have to contribute 14.6% of total costs. In the event of a cross-border financial crisis the fund could be used to recapitalize systemically important financial institutions, thus internalizing the negative externalities of a systemic banking failure.

The second mechanism is “specific sharing”, where each country affected by a crisis pays its relevant share of recapitalisation costs according to a pre-determined key. The difference with the General Fund is that the key is related to the individual institutions activities. Keys that have been suggested are for instance (risk weighted) total assets and deposits. Overall the specific sharing mechanism seems to be preferred, as it has fewer drawbacks than the general fund framework. In particular the specific sharing scheme is close to an efficient solution of the coordination problem (Goodhart and Schoenmaker (2009)).

Goodhart and Schoenmaker suggest that a mix of the two approaches (10% paid by the general fund and 90% for the specific sharing mechanism) could be considered. The weight given to the two mechanisms is discretionary and was suggested by Freixas (Goodhart and Schoenmaker (2009)). Indeed the general mechanism would be more effective in dealing with financial stability of a groups of countries, because the fund would be used only for crises affecting the financial stability of the whole group. On the other hand, the specific sharing mechanism is more efficient when only the stability of countries affected is concerned, as resources are more likely to be used in cases of regional crises or crises involving a small number of countries.

3. Description of Data and Assumptions

To analyse cross-border burden sharing issues we need a geographic breakdown of internationally active groups. We base our sample on the Top 1000 of the world’s largest banks (asset rank) as published by The Banker. From the 150 largest banks

on this list we identified banks with more than one significant foreign bank subsidiary. We then identified – on the basis of BankScope, banks’ websites, and correspondence with banks – all subsidiaries of which the assets account for 0.5 per cent or more of the parent bank’s assets and that are at least 50 per cent owned by the parent bank. We therefore limit ourselves to relatively large subsidiaries in which the parent has a controlling stake.¹⁴

For each significant subsidiary (level 1) we check whether it owns sub-subsidiaries (level 2) that are larger than 0.5 per cent of the ultimate bank holding (level 0). If this is not the case, we include consolidated data for the level 1 subsidiaries. If it is, we include unconsolidated data for the level 1 subsidiary and separately include consolidated data for the sub-subsidiary.

If parent banks are the result of a merger or acquisition in year t we only include them from year $t+1$ onwards. We disregard banks for which we have less than three consecutive years of data (all Chinese and most Japanese banks). For each subsidiary we trace back in which year it became part of the holding. For the greenfield subsidiaries we use data from year t onwards, whereas we include subsidiaries that result from a takeover from $t+1$.

We obtain financial data for all parent banks and subsidiaries from Bureau van Dijk’s BankScope database. Our sample period is 1992-2008, but the panel is unbalanced as we do not have data for all years for each bank.¹⁵ A drawback is that multinational banks not only operate foreign subsidiaries but foreign branches as well. For example, according to the 2008 EU Banking Structure Report, foreign branches assets constituted 14.2% of total banking assets in the EU, while subsidiaries constituted 14.5% of total banking assets in 2007. As these branches do not have to report separately, they are included in the accounts of the parent. But their activities do directly affect the host economy. Separating this effect using public data is unfortunately not possible. Another issue is that we cannot properly account for intra group transactions (e.g. guarantees) that would cancel out with

¹⁴ We include commercial banks, savings banks, cooperative banks, mortgage banks, and long-term credit banks, investment banks, securities houses, and non-bank credit institutions. A full list of sample banks in our sample is included in the Annex.

¹⁵ A strength of our data set is that we can track the development of international groups over time. For example, we can track ABN Amro’s acquisition of Italian Antonveneta in 2005 followed by its acquisition by a consortium of Fortis, RBS and Santander in October 2007. This dimension could be explored in future work

proper consolidation.¹⁶

Cross-border banking has become more and more important both in terms of assets and number of banks. Total assets of the banks in our sample increase from \$1.5tr in 1992 to \$60tr in 2008.¹⁷ The number of international groups in our sample increases from 15 to 45 in the same period. An international group typically has major subsidiaries in 7 jurisdictions and this number has been rising over time. Subsidiaries are generally very small compared to the parent: the average share of a subsidiary of total group assets is 3%.

To estimate the expected costs of default we extract a risk neutral probability of default from 5-year CDS spread on senior debt using an approximation formula for CDS implied average risk neutral default probabilities.¹⁸ This gives us the average annual probability of default over the entire life of the contract (5 years in our case). The spreads are available on a daily basis and we take the annual average to smooth seasonal effects. In 2008 the average implied probability of default was 1.9% (compared to 0.4% in 2007), ranging from 0.9% to 5.2%.

It is difficult to determine the likely costs of failures, especially because it is complex to predict the magnitude of the shock and the negative externalities that a cross-border crisis may entail. Instead of adding ad hoc speculation we simply take the average capital injections in the recent crisis as our estimate for future capital injections. We thus assume that authorities will have to recapitalize cross-border banks to an amount equivalent to 2% of the group's total assets.¹⁹ We call this Rescue Capital (RC) from now on. We also assume that negative externalities

¹⁶ For eight banks in our sample, unconsolidated balance sheet of the holding company was unavailable. For these banks we assumed that unconsolidated assets of the holding company (and of the other variables we have used in our research) are equal to the difference between total group's assets as in published accounts and the sum of all the other unconsolidated subsidiaries in the group.

¹⁷ Please note that part of this increase is due to the increasing number of banking groups in our sample.

¹⁸ The formula used is $d=s/(1-R+s/2)$, where s is the spread, R is the recovery rate, and d is the default probability. We assume a mean recovery rate $R=0.356$ for the financial industry from 1981 until 2005. See for instance Bruche and González-Aguado (2010) for a similar application.

¹⁹ The banks considered are Bank of America, Bank of New York Mellon, Citigroup, Commerzbank, Goldman Sachs, HBOS, ING, JP Morgan, Lloyds, Merrill Lynch, Morgan Stanley, Royal Bank of Scotland, UBS and Wells Fargo, BayernLB, WestLB, IKB, Dexia, Fortis and Northern Rock.

are non-existent. It is thus likely that the estimated cost is an underestimation of potential costs in a cross-border financial crisis.

4. Results

In this section we compare estimates of the cost of different ex-ante burden sharing agreements. As noted earlier, the status quo is a mixture of a ‘national solution’ strategy (NS), where the home authority recapitalises the whole group (e.g. RBS and AIB), and less coordinated actions (e.g. Fortis and Icelandic banks).

We first present the contingent liabilities of national fiscal authorities with the NS,²⁰ and then we show how the potential burden could be allocated differently according to a specific burden sharing agreement and a general fund mechanism (similar to the EFSF). Then we compute the expected recapitalisation costs using CDS implied probabilities of default and we compare the burden allocation of all the different frameworks. Finally we compare the distribution of outlays under different agreements and the NS. We included all major EU countries and all non-EU countries with significant economic and financial links with European countries. To simplify the presentation we created two additional groups for the smaller countries in the sample: Rest of Europe (RoE) and Rest of the World (RoW).²¹

4.1. *The national solution*

The ‘national solution’ (NS) applies to some recent cross-border recapitalisations, e.g. in the case of RBS where a capital injection by the UK Treasury was followed by capital downstreamed to its Irish subsidiary, Ulster Bank Ireland.²² Figure 1 shows the total contingent liabilities when home authorities have to recapitalise the whole cross-border group with rescue capital (RC) (i.e. 2% of total

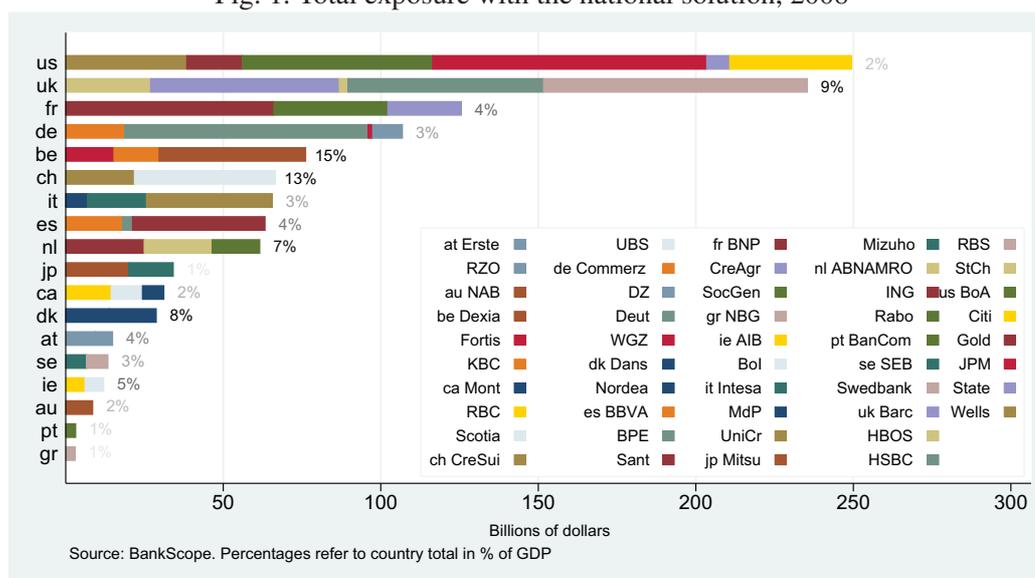
²⁰ We limit our counterfactual to this case as uncooperative outcomes are very difficult to quantify.

²¹ The RoE category consists of virtually all other European countries (23 in total) and the RoW covers 24 countries.

²² The total capital provided to Ulster Bank Ireland totalled EUR2.06bn as of 23 October 2009, see ‘RBS Pumps Additional EU480 Million Into Ulster Bank (Update1)’, www.bloomberg.com.

assets) for all groups. In this case the UK would have to disburse around \$235bn while the US would have to inject around \$250bn. France and Germany are potentially exposed to around \$125bn and \$110bn respectively. These figures relate to the exposures linked to cross-border institutions only, thus exposures related to purely domestic groups are not included. Under this framework, small, East European and Rest of the World countries would never have to inject any capital, since none of the cross-border banks included in our sample is domiciled in those areas.

Fig. 1. Total exposure with the national solution, 2008



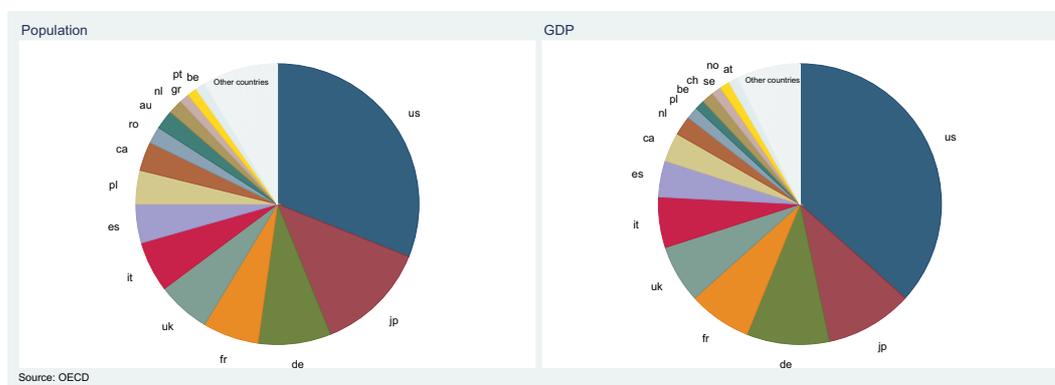
4.2. General fund mechanism

In a general fund mechanism a group of countries agrees to contribute to a fund according to keys related to the financial capacity of participant countries. Several keys have been proposed such as GDP and Population (Goodhart and Schoenmaker (2009)), but also the share of total financial assets or total deposits could be used. The EFSF is a practical example of a general fund mechanism, where the European Central Bank key (an average of GDP and population shares) is used to share the support (see also Schoenmaker (2010)).²³ When a public capital injection or liquidity provision is needed, every country will be called to contribute and not only the countries involved in the crisis (as in the case of specific burden sharing agreements). Thus, regardless of which banking group is involved, a country's share of

²³ See also Annex 2 of the EFSF Framework Agreement (2010) for the EFSF contribution keys by Eurozone member.

the total cost does not vary. Figure 2 shows the different shares according to population and GDP.

Fig. 2. General fund - Population key, 2008



A general mechanism would smooth costs across countries, because every authority is called to inject RC. But a country's costs are always positive, even if the failing group has no domestic activities. For example, Germany will have to contribute 8.1% of the total costs to recapitalize a bank like AIB with a general fund mechanism based on population (even though the Irish bank does not have significant activities in Germany), while it will not contribute in a specific burden sharing mechanism, where only UK, Poland and Ireland would contribute.

4.3. Specific burden sharing agreements

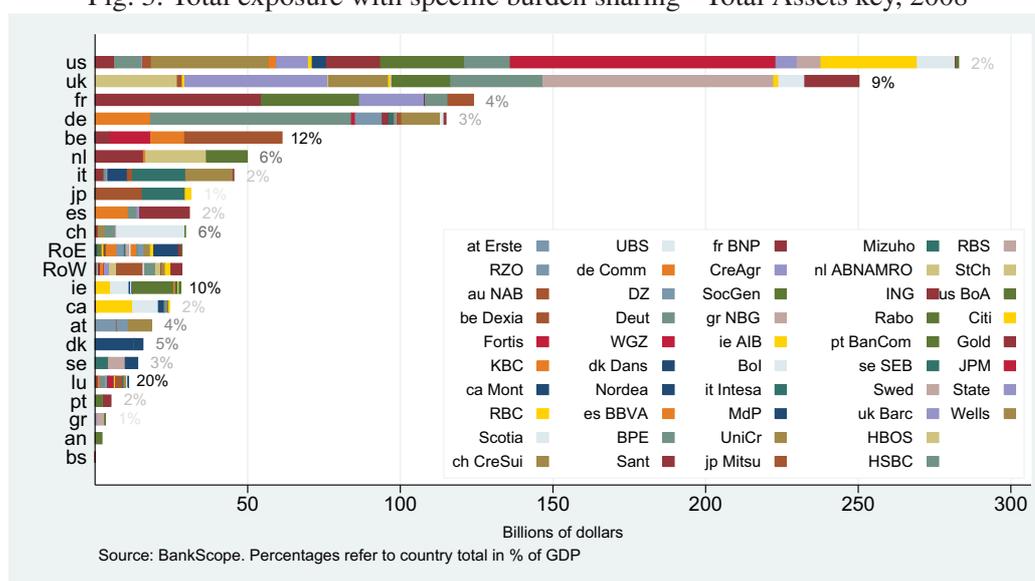
With a specific burden sharing agreement, the total needed to recapitalise banks is shared according to a key related to the activities of the individual bank in the different countries. Suggested keys have been (risk weighted) assets, deposits and problem loans.²⁴ Figure 3 shows how the potential burden varies across countries with specific burden sharing mechanism using assets as a key. The US has the highest total exposure, just above \$280bn, with the main exposure related to UK owned banks (HSBC, Barclays and RBS) totalling around \$30bn. The UK has the second highest exposure to our set of cross-border banks with around \$250bn to be injected if all home banks or foreign banks with operations in the UK needed RC. The foreign owned banks with the highest share of assets in the UK are respectively Bank

²⁴ Taking the a different key, such as the share of problem loans and deposits, changes the picture but given space constraints, we focus on total assets.

of America, Credit Suisse, Banco Santander; each is contributing approximately \$20bn exposure. It is important to note that this exposure is independent of where the losses are accrued. The UK would have to participate in the group's recapitalization even if Bank of America's losses materialized entirely in the US, and vice versa.

However, there are also smaller shares of French, German, Swiss and Japanese banking groups. France and Germany could also be largely exposed with ex-ante firm specific burden sharing agreements, with respectively \$120bn and \$110bn total exposure.

Fig. 3. Total exposure with specific burden sharing - Total Assets key, 2008



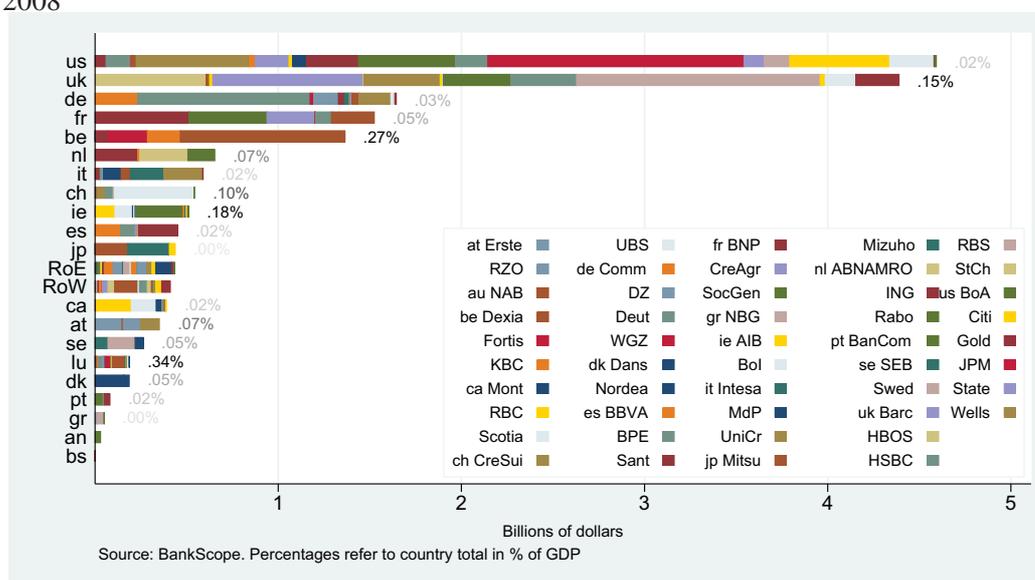
Small nominal exposures may translate into high relative burden on a country and vice versa as shown by the percentages adjacent to the bars in 3. In comparison to other countries, Luxembourg has a small total exposure, but it equals around 20% of GDP. The US exposure equals only around 2% of GDP even though it has the largest total exposure. Other countries where specific burden sharing agreements may create strain to fiscal capabilities (e.g. the burden is higher than 10% of GDP) are Belgium and Ireland.

4.3.1. Specific burden sharing agreements: risk weighted exposure

Figures 1 through 3 showed the total contingent liability for different burden sharing agreements. In other words, how much are the various countries supposed

to pay in the event of a cross-border failure relative to other countries? Figure 4 introduces actual probabilities of default derived from the 5 year CDS spread on banks' senior debt. The amounts shown can be interpreted as the actuarially fairly priced insurance a government would have to pay to receive 2% total assets in case of default. The figure thus shows how much a country can expect to pay for insurance in any given year (based on 2008 data) broken down by bank. When accounting for exposures' riskiness, the US has the largest outlay with around \$4.5bn, while the UK should expect to pay slightly less than that. Insurance would cost France and Germany around \$1.5bn.

Fig. 4. Risk weighted exposure with specific burden sharing agreements - Total Assets, 2008



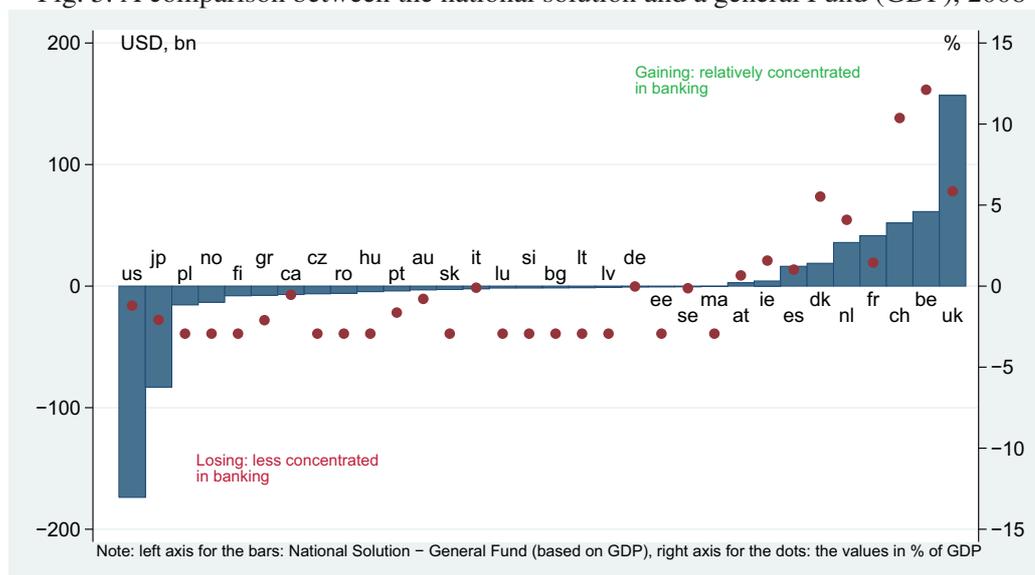
Note that these amounts are *annual* outlays. Again, the percentages next to the bars in 4 show the impact in terms of GDP. To put these in perspective: the 2008 OECD average total tax revenue is 34.8%.

5. Comparing burden sharing agreements with the national solution

The Netherlands, France, Switzerland, Belgium and the UK are likely to gain significantly from the establishment of burden sharing agreements, as they are net exporters of banking services (i.e. their groups are relatively international). This is clear from Figure 5 which shows the difference the cost of a National Solution, where each country pays for its own banks and a general fund (in this case with

GDP as a key, other comparisons available on request). On the other hand the US and Japan would be the biggest losers from the establishment of general fund based on the GDP key.

Fig. 5. A comparison between the national solution and a general Fund (GDP), 2008



In practice, burden sharing agreements would lead to a redistribution of potential recapitalisation costs. Comparing these differentials to GDP may give us an indication of authorities' potential willingness to sign the agreements ex-ante. Note that for countries without their own international banks, the cost is zero under NS. A general fund based on GDP will allocate a fixed percentage of GDP to such countries where the percentage is determined by the ratio of the burden to be shared and total GDP. In our case, the percentage turns out to be 2.9 %. This is the percentage of GDP needed to recapitalise all banks simultaneously. This is obviously unrealistic but the relative gains and losses would still hold if we would incorporate the actual default risks as shown in Figure 4.

It is interesting to note that the reallocation of contingent liabilities is more 'unfair' with general fund mechanisms. The standard deviation of the difference between the national solution and a burden sharing agreement across countries is much larger under general fund mechanisms, compared with specific agreements. Among all the different options analysed the specific burden sharing agreement based on assets would lead to the fairest redistribution of contingent liabilities.

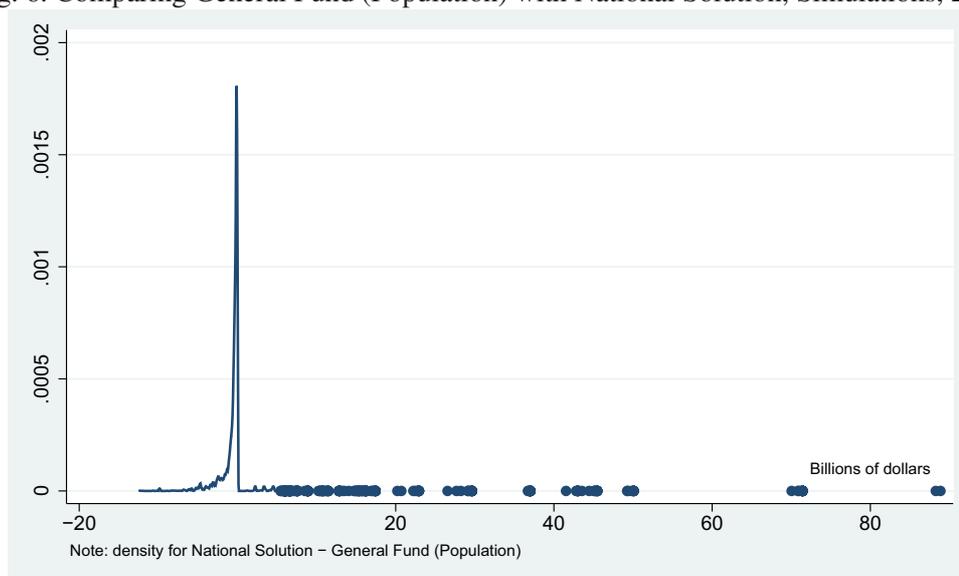
6. Comparing outlays distribution for different schemes

So far we have framed the question of costs in terms of allocation. Countries contribute depending on the location of the activities of the failing bank(s) and the cost sharing rule in operation. In both the national solution and under specific burden sharing rules, the costs for an individual country can be significant. As a general fund spreads the costs, these costs will not show as much variability. The drawback of a general fund however is that countries will also have to contribute to defaults of banks not active in their jurisdiction at all.

An alternative view of any scheme that shifts costs is that it can act as an insurance against bad states of the world. Defaults of large cross-border banks are very infrequent events with very large costs. A cost sharing scheme for such events can thus be seen as a mutual insurance scheme. Countries would pay a relatively small amount for all defaults (i.e. a pay-as-you-go premium) to cover defaults in their own jurisdiction. As systemic crises are few and far between, estimating premia from empirical data is challenging. But to illustrate the general funds's insurance properties we perform a Monte Carlo experiment with 2008 default expectations. We first draw (hypothetical) defaults using the default probability implied in the 2008 CDS spread. This provides us with a state of the world where generally none, sometimes some and occasionally many banks fail.²⁵ We then compute the costs for each country according to 1) the National Solution (NS) and 2) to the different cost sharing rules. We repeat these steps 1000 times. The difference between the NS costs and the sharing rule would show the value of insurance, as shown in Figure 6. In this figure we show the distribution of the 1000 draws for a sharing rule based on population. The results for other keys investigated (GDP, Financial Sector Size) show similar results. Three things stand out. First, the vast majority of states of world drawn show no default, as expected. Second, if default(s) occur most countries only have to pay a limited amount because of their fund obligations: most of the area under the curve (probability mass) is to the left but close to zero. Third, outlays under both schemes can be sizable but the right tail is much longer than the negative tail. This implies that under the national solution some countries might have to pay extremely large amounts.

²⁵ This assumes that the probabilities of default are independent. We feel that this is more appropriate as the firms in the sample are generally very large (i.e. systemic) and are thus likely to be rescued. Contagious defaults thus seems unlikely.

Fig. 6. Comparing General Fund (Population) with National Solution, Simulations, 2008



The simulations should be interpreted with some care. We assume that defaults are independent while it is clear that the default of one systemic bank will affect (the default of) the other banks. We also assume that the existence of a sharing rule does not affect the behaviour of stakeholders involved (moral hazard). We also abstract from the questions whether outlays should be pre-funded or not.

7. Conclusions

This paper aims to shed light on ex-ante burden sharing agreements, in particular showing how the establishment of such agreements would impact the distribution of resolution costs in crisis. These agreements are important to establish cross-border burden sharing principles which could be used in event of cross-border systemic crises. Our results show that the UK and the US would be the countries with the highest contingent liabilities with the establishment of specific burden sharing agreements. This is to be expected given the significance of New York and London as global financial centers. But it is interesting to note that for the UK the establishment of general fund burden sharing agreement would constitute a net gain compared to the status quo (i.e. a reduction of contingent liabilities), while the US would lose, even though the loss is small relative to GDP. Among others, the Netherlands, France, Switzerland and Belgium would gain from such a agreement.

More generally, specific agreements would redistribute costs of eventual interventions at the expense of smaller and East European countries which are not home to large cross-border banking groups. But, with the exception of Luxembourg, these amounts do not seem to constitute a large burden in terms of GDP.

In case a single cross-border firm fails, the general fund mechanism is likely to smooth costs across countries. This is because every country will contribute to the resolution independently from where the crisis happened (e.g. EFSF mechanism). But its establishment may generate an unfair redistribution of costs compared to the national solution, which broadly describes the status quo at the moment. A specific burden sharing mechanism based on assets would redistribute contingent liabilities more ‘fairly’ across countries. Burden sharing agreements can also be seen as an insurance scheme. Our simulations show that joining such schemes would reduce the outlays in the event of the failure of a large bank (especially for small countries given their smaller tax base). These simulations merit further work.

Appendix Multinational banks and their subsidiaries: 1992-2009

Bank name	Home country	Number of Subsidiaries	Subsidiary countries
ABN AMRO Holding NV	nl	6	gr, mz, pl, us, ky
Allied Irish Banks plc	ie	1	ie
Banca Monte dei Paschi di Siena SpA	it	3	au, ca, pl
Banco Bilbao Vizcaya Argentaria SA	es	2	gb, za
Banco do Brasil S.A.	br	7	hr, cz, ro, at, sk
Banco Popular Espanol SA	es	5	hk, kr, my, th, gb
Bank of America Corporation	us	12	br, ca, fr, de, hk, ind, my, mx, gb, us, ch
Bank of Ireland	ie	4	be, fr, it
Bank of Montreal	ca	7	be, cz, de, hu, pl
Bank of Nova Scotia	ca	5	gb, us
Barclays Bank Plc	gb	1	gb
Bayerische Hypo- und Vereinsbank AG	de	5	ie, gb, us, ch
Bayerische Landesbank	de	4	de, hu, lu
BNP Paribas	fr	7	fr, it, us, lu
Citi Group	us	2	ie, nl
Commerzbank AG	de	4	de, pl, lu
Crédit Agricole Group-Crédit Agricole	fr	5	fr, de, it
Credit Suisse Group AG	ch	2	gb, us
Danske Bank A/S	dk	2	dk, lu
Deutsche Bank AG	de	7	au, de, it, es, us, lu
Deutsche Zentral-Genossenschaftsbank-DZ Bank AG	de	3	bg, ro, mk
Dexia	be	12	bg, hr, cz, hu, ie, it, pl, ru, at
Dresdner Bank AG	de	2	de, lu
Erste Group Bank AG	at	2	gb, us
FIA Card Services NA	us	7	be, fr, de, es, lu
Foerne sparkassen	se	5	jm, mx, pe, gb
HBOS Plc	gb	4	jp, us
HSBC Holdings Plc	gb	7	hr, ie, it, lu
ING Bank NV	nl	10	ar, cl, co, mx, pe, pt, es, us, ve
Intesa Sanpaolo	it	3	be, nl, lu
Itau Unibanco Holdings	br	5	br, pt, ky, lu
KBC Bank NV	be	4	at
Millennium bcp-Banco Comercial Português, SA	pt	3	pt, es, us
Mitsubishi UJF	jp	7	de, ie, lu
National Australia Bank Limited	au	6	dk, ee, de, lv, lt, lu
National Bank of Greece SA	gr	2	pl, gb
Raiffeisen Zentralbank Oesterreich AG	at	3	ch
Royal Bank of Canada RBC	ca	3	nl, sg, us
Royal Bank of Scotland Plc	gb	6	dk, fi, no, ru, se
Skandinaviska Enskilda Banken AB	se	4	ee, lv, lt, se
Société Générale	fr	6	cz, fr, de, lu
Standard Chartered Plc	gb	14	bg, hr, cz, hu, pl, ru, si, ro, at, sk, al, ba, rs
Swedbank AB	se	3	ie, us
Toronto Dominion Bank	ca	1	at
UniCredit SpA	it	16	br, cl, de, mx, pt, es, gb, us, ve
WestLB AG	de	4	be, br, fr, lu
WGZ-Bank AG Westdeutsche Genossenschafts-Zentralbank	de	3	de, ie, lu

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