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Can European Bank Bailouts work?

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Can European Bank Bailouts Work?

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Abstract

Cross-border banking needs cross-border recapitalisation mechanisms. Each mechanism, however, suffers from the financial trilemma, which is that cross-border banking, national financial autonomy and financial stability are incompatible. In this paper, we study the efficiency of different burden-sharing agreements for the recapitalisation of the 30 largest banks in Europe. We consider bank bailouts for these banks in a simulation framework with stochastic country-specific bailout benefits. Among the burden sharing rules, we find that the majority and qualified-majority voting rules come close to the efficiency of a bailout mechanism with a supranational authority. Even a unanimous voting rule works better than home-country bailouts, which are very inefficient.

JEL codes: F33, G28, H41.

Keywords: Financial Stability, Public Good, International Monetary Arrangements, International Banking

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1. Introduction

Financial stability is a public good, as the producer cannot exclude anybody from consuming the good (non-excludable) and consumption by one does not affect consumption by others (non-rivalness). A key issue is whether governments can still produce this public good at the national level with today's globally operating banks. The Financial Trilemma states that (1) financial stability, (2) international banks and (3) national financial policies are incompatible, see Schoenmaker (2011). Any two of the three objectives can be combined but not all three; one has to give. Figure 1 illustrates the financial trilemma. The financial stability implications of cross-border banking are that international cooperation in banking bailouts is needed.

Financial stability is closely related to systemic risk, which is the risk that an event will trigger a loss of economic value or confidence in a substantial portion of the financial system that is serious enough to have significant adverse effects on the real economy. De Bandt and Hartmann (2002) provide an extensive discussion of the concept of systemic risk. A key element is that a considerable number of financial institutions or markets are affected by a systematic event. In a similar vein, Acharya (2009) defines a financial crisis as systemic if many banks fail together, or if one bank's failure propagates as a contagion causing the failure of many banks (see also Allen and Gale (2000) on contagion). In Acharya (2009), the joint failure of banks arises from correlation of asset returns and the externality is a reduction in aggregate investment.

The 2007-2009 financial crisis illustrates the financial trilemma, with the handling of Lehman Brothers and Fortis as examples of coordination failures (Claessens, Herring and Schoenmaker, 2010). The US acted unilaterally, providing an orderly resolution for the US broker/dealer arm of Lehman, but there was no cooperation offered in the resolution of the foreign Lehman subsidiaries, including the major operations in the UK. The Lehman collapse triggered the global financial crisis. During the rescue-efforts of Fortis, cooperation between the Belgian and Dutch authorities broke down despite a long-standing relationship in ongoing supervision. Fortis was split along national lines and subsequently resolved by the respective national authorities at a higher overall cost.

Rodrik (2000) provides a lucid overview of the general working of the trilemma in an international environment. As international economic integration progresses, the policy domain of nation states has to be exercised over a much narrower domain and global federalism will increase (e.g. in the area of trade policy). The alternative is to keep the nation state fully alive at the expense of further integration.

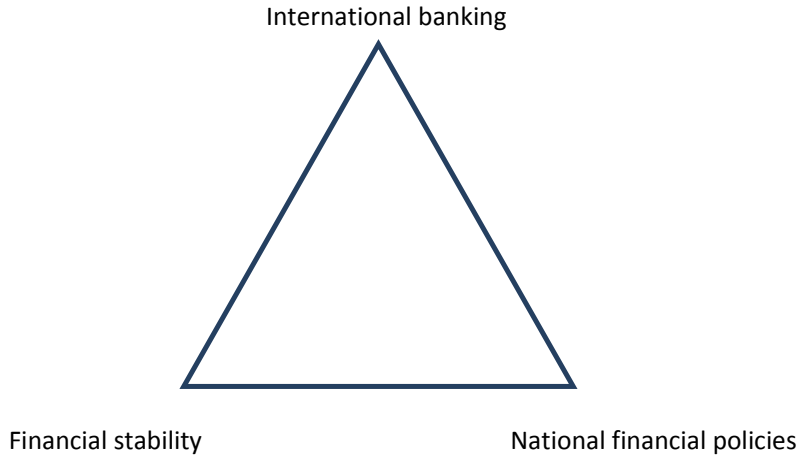

Figure 1: The Financial Trilemma

The financial trilemma from Schoenmaker (2011). It states that national financial policies, having international banks and financial stability are incompatible. I.e., these three objectives cannot be met at the same time.

The domestic orientation of the financial safety net is a barrier to cross-border banking, as national authorities have limited incentives to bail out an international bank. This is visible in the results of Bertay, Dermirguc-Kunt and Huizinga (2011), who find that an international bank's cost of funds raised through a foreign subsidiary is higher than the cost of funds for a purely domestic bank.

How to solve the financial trilemma? There is a large body of literature on international policy coordination (e.g. Obstfeld, 2009; Fischer, 1999; Moshirian, 2008; Rogoff, 1999; and Summers, 2000). Broadly speaking, three main strands can be distinguished. The first is to develop supranational solutions, such as an international lender of last resort (Obstfeld, 2009; and Fischer, 1999) or a world financial regulator (Eatwell and Taylor, 2000). In this case, national financial policies will be replaced by an international approach. The second is to segment national markets through restrictions on cross-border flows (Eichengreen, 1999). In the case of international banks, the segmentation can be done through a network of fully self-sufficient subsidiaries (Cerutti *et al.*, 2010). The objective of financial integration is given up. This approach is not without cost: the separately capitalised subsidiaries have to operate with higher levels of liquidity and capital in the absence of cross-border transfers. The third is to restrict public intervention to attain financial stability and to strengthen national policies enforcing market discipline (Rogoff, 1999). The argument is that public intervention unduly increases moral hazard. While containing moral hazard is important, the history

of financial crises has shown that public intervention can be effective to resolve swiftly a financial crisis in order to resume economic growth (e.g. Claessens, Herring and Schoenmaker, 2010; and Laeven and Valencia, 2012).

This paper fits in the first strand of developing supranational solutions. Our contribution is that we provide a model to analyse the efficiency of several solutions to the financial trilemma. A first best solution is a supranational approach to financial stability. This approach would be similar to the supranational approach to monetary stability with the establishment of the ECB.[1] Alesina (2003) explains the trade-off between the benefits of economies of scale and internalisation of externalities versus the costs of heterogeneity of preferences of the population. Supranational institutions can perform tasks for which externalities are large, and heterogeneity of preferences low. Applying this criterion to international banks, the externalities are large. Moreover, the preferences for financial stability are homogeneous. But financial stability needs a fiscal backstop, which is politically controversial (Pauly, 2009; and Obstfeld, 2011). Fiscal redistribution within a country with relatively closely-knit, cohesive groups is far easier than between groups of different countries. A second best solution is a binding rule among national governments to share the burden of failing banks in order to maintain financial stability. Following Goodhart and Schoenmaker (2009), we model *ex ante* mechanisms for burden sharing, which are legally binding. The 2007-2009 financial crisis has shown that soft law arrangements, such as Memoranda of Understanding, do not work during a crisis (Claessens, Herring and Schoenmaker, 2010).

In this paper we compare the efficiency of the various mechanisms in the European context, as the internationalisation of banking is most advanced in Europe. For the 30 largest European banks, we simulate the bailout probability under these mechanisms. We find that national financial policies cannot produce financial stability for cross-border banks in Europe. The supranational and burden sharing approaches can help achieving financial stability by improving the efficiency of the bailout policy. We are able to derive the efficiency gains for three categories of banks: domestic banks, European banks (operating across Europe) and global banks.

The investigated solutions to the financial trilemma assume international coordination. What if there is no political support for coordination at the European level (Pauly, 2009)? An alternative approach to the financial trilemma is to reverse cross-border banking. But a segmented banking system with

[1] The supranational approach of the ECB is a solution to the monetary trilemma, developed by Fleming (1962) and Mundell (1963). See Obstfeld *et al.* (2005) for an overview of the trade-offs between fixed exchange rates, capital mobility and national monetary policy.

self-sufficient subsidiaries is costly, as argued above. It may also reduce financial stability at the country level (Slijkerman, 2007; Allen *et al.*, 2011).

The remainder of this paper is organised as follows. Section 2 presents the coordination mechanisms in the context of bank recapitalisation with multiple countries. Section 3 introduces a simulation setup to compare the efficiency of the different schemes. Section 4 presents the results. Section 5 concludes.

2 Coordination Mechanisms in Bank Bailouts

We build on the model of Freixas (2003) and Schoenmaker (2011) to formalise the systemic effects of bank failure. The policy instrument in this model is a contribution of funds t by the authorities to recapitalise a failing bank. Our model considers the ex post decision whether to recapitalise or to liquidate a bank in financial distress. The choice to close or to continue the bank is a variable x with values in the space {0, 1}. Moreover, B denotes the social benefits of a recapitalisation and C its costs. Among other things, the benefits of a recapitalisation may include those derived from maintaining financial stability and avoiding contagion (Allen and Gale, 2000; Acharya, 2009). A minor, idiosyncratic, bank failure (e.g. Barings) would pose no systemic problem. 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, $C = C_c - C_s$. These costs can also include the monitoring costs that are necessary for the recapitalised bank to stay solvent and keep an acceptable risk level. For each country, α_i denotes the fraction of benefits that accrue to country i.

We assume that recapitalisation can take place without legal limits to shareholder dilution, which has sometimes been the case in bank recapitalisation schemes. In the recapitalisation, existing shareholders are completely wiped out. Also, we abstract from any incentive effects that might arise from the existence of a resolution mechanism that might have an impact on the costs and benefits of recapitalising banks. For example, moral hazard might be increased through mechanisms as too-big-to-fail or too-complex-to-fail. We assume that the welfare-enhancing effect of an ex ante resolution mechanism outweighs the possible increase in moral hazard, see Cordella and Yeyati (2003).

Our modelling of the benefits and costs of a bailout includes the systemic aspects of individual bank failures, but not a failure of the banking system. So, our analysis is, for example, relevant for the case of bank failures during the 2007-2009 financial crisis, with the failures like those of Lehman Brothers,

Fortis, Dexia Bank, Commerzbank, Hypo Real Estate, RBS and Lloyds Bank. Systemic banking crises due to a common factor (like a housing bubble), such as the collapse of the Irish and Spanish banking systems, are outside the scope of our analysis. Such crises require a system-wide approach instead of our bank-by-bank resolution approach.

The way we model bailout benefits assumes that the financial stability benefits of recapitalisation are linear in the size of the benefits. This implies that bailout benefits are additive, e.g., the bailout benefits of a cross-border bank with benefits of € 4 billion, distributed over two countries, is equal to the bailout benefits of a domestic bank with € 4 billion benefits. A potential lower (or higher) impact of a cross-border banking failure relative to domestic banking failures are not taken into account. A lower impact could come from geographical diversification of banking activities. A higher impact could result from the international transmission of shocks.

In analysing resolution of a failing bank, which is either a bailout or a liquidation, we take the existing configuration of banks as given. We are not modelling the dynamic effects of resolution schemes on banks' cross-border activities. This also underlies our analysis in Sections 3 and 4, where we measure the efficiency of different resolution mechanisms for European banks.

Finally, we distinguish between four distinct institutional setups for resolution: (i) home country resolution, (ii) a supranational resolution authority, (iii) improvised coordination, and (iv) burden sharing. In our setup, we assume that the home country has the highest single share of benefits of a bank.

2.1 Home country resolution

The current situation of the resolution of internationally active banks can be best described as a 'home country' solution. Under this mechanism, the home country solely decides whether or not a bank should be recapitalised, taking into account only domestic benefits with the prospect of paying all bailout costs. With α_h the fraction of benefits in the home country, the condition for a bailout boils down to

$$\alpha_h \cdot B > C, \tag{1}$$

i.e., the share of benefits that accrue to the home country should exceed the total costs. In the context of internationally active banks, this approach seems highly inefficient. However, it is representative of the current situation in most countries, whereby bank resolution is confined to the

national level. Examples are the bailout of RBS by the UK government, or the bailout of AIG by the US government in 2008. In these cases, the financial institutions that were bailed out did have cross-border activities, but the social benefits of these activities were not taken into account, nor were foreign governments involved in sharing the costs of the bailout.

2.2 A supranational resolution authority

A first best solution to internalise the externalities of a cross-border banking failure is to move from a national to a supranational approach for financial stability policies. Such a supranational approach requires fiscal powers at the supranational level to fund a possible bank rescue, but leads to economically efficient outcomes, see Eatwell and Taylor (2000).

The supranational body is responsible for bank resolution in all countries of its jurisdiction (for example, the European Union) and takes a decision at the aggregate level with no regard for national interests. This approach is akin to the functioning of the European System of Central Banks (ESCB), where the voting members are required to base their vote on the inflation outlook of the euro area and not that of their own country, see Cristadoro *et al.* (2005).

Under a supranational authority, a bailout takes place whenever benefits B exceed the costs C of rescue, where benefits are measured as the summed benefits over all countries for the supranational body has authority. With α_i the fraction of benefits to country i, we have that a bank is recapitalised if and only if

$$\sum_{i \in A} \alpha_i \cdot B > C, \tag{2}$$

where A is the set of countries over which the supranational authority has jurisdiction. So, under a "world authority", Equation (2) boils down to the condition that B exceeds C, as the α_i sum to 1.

To analyse our solutions in the European setting, we denote the home country by h, all European countries by the set EU, and all countries outside the EU (the rest of the world) as the set ROW. The benefits in the home country, the rest of Europe and the rest of the world sum up to 1, i.e., we have that $\alpha_h + \alpha_{EU\setminus\{h\}} + \alpha_{ROW} = 1$.

The supranational body in the EU maximises the net benefits within the EU, so that a bank rescue is only done when $\alpha_{EU} \cdot B > C$, i.e., the EU-specific benefits exceed the costs. The decision x^* to rescue a bank is given by

$$x^* = \begin{cases} 1 & if\ \alpha_{EU} \cdot B - C \geq 0 \\ 0 & if\ \alpha_{EU} \cdot B - C < 0. \end{cases} \tag{3}$$

Proposition 1. *(i) A supranational approach in Europe improves the efficiency of a national based recapitalisation policy for positive values of $\alpha_{EU\setminus\{h\}}$, (ii) To produce an efficient outcome, the social benefits within the European countries need to be sufficiently large, i.e., $\alpha_{EU} > C/B$.*

Proof: The efficient solution is $x^* = 1\ \ if\ B \geq C$ and $x^* = 0\ \ if\ B < C$. A recapitalisation under the supranational approach $x^*_{SN} = 1$ will only happen if the social benefits in Europe as a whole are larger than the total costs: $\alpha_{EU} \cdot B - C > 0$. So if $\alpha_{EU} > C/B$, the supranational body recapitalises the entire financial institution. Otherwise, the closure equilibrium occurs $x^*_{SN} = 0$, even in the case of $B \geq C$ and recapitalisation is the optimal strategy. The supranational policy is more efficient than the national policy when $x^*_N \leq x^*_{SN}$ with strict inequality for at least one pair (B, C): $B > C$. It is clear that $x^*_N = x^*_{SN}$ when $\alpha_h > C/B$ and $x^*_N < x^*_{SN}$ when $\alpha_h < C/B < \alpha_{EU}$. ■

Proposition 1 demonstrates that a supranational approach is useful when banks' cross-border business within Europe, $\alpha_{EU\setminus\{h\}}$, is non-negligible. In that case, the supranational approach will improve the efficiency of the recapitalisation policy as both the externalities in the home country α_h and other European countries, $\alpha_{EU\setminus\{h\}}$, are incorporated in the decision-making: $\alpha_{EU} > C/B$. Only truly international banks with sizeable business outside Europe ($\alpha_{EU} \ll 1$) will pose a problem leading to socially insufficient recapitalisations.

Bailout decisions by a supranational authority are the most efficient that can be achieved for a given set of countries and banks. Decisions are taken without regard to the financing, or the division of costs over countries, and only with respect to the aggregate benefits and costs within the set of countries. Coordination between countries is not necessary, since the distribution of benefits over countries is not taken into account, by institutional design. An example of such a resolution authority is the Federal Deposit Insurance Corporation (FDIC) in the US, which winds down or recapitalises failed banks, regardless of the States in which the bank is active.

Having a supranational (or supra-State) authority does not overcome the problem of uncertainty: any bailout decision involves an estimate of the costs and benefits of the options for resolution. For example, some FDIC resolutions of banks can be considered as inducing a failure of an otherwise healthy bank, see Ashcraft (2005). Also, it remains a challenge for any resolution authority to strike a healthy balance between the minimisation of externalities and enforcing discipline, see Beck (2011). In the following, we assume for the supranational mechanism that the level of benefits is correctly assessed.

2.3 Improvised cooperation

Under improved cooperation, the different countries meet to find out how much they are ready to contribute to the recapitalisation. Each country i proposes a contribution t_i and if the sum of all contributions exceeds the cost, the bank is recapitalised. This is an interpretation of improvised cooperation, as in Freixas (2003). As bank failures are neither frequent nor predictable, we model improvised cooperation as a non-repeated game.

To analyse the equilibrium outcome, take x as the decision to a bailout, where x takes on the value 1 if there is a bailout, and zero otherwise. Each country i chooses its contribution t_i by optimising

$$\max_{t_i} \; x^* \cdot (\alpha_i \cdot B - t_i), \tag{4}$$

where x^* is the bailout decision that follows from

$$x^* = \begin{cases} 1 & if \; \sum_i t_i - C \geq 0 \\ 0 & if \; \sum_i t_i - C < 0 \, . \end{cases} \tag{5}$$

Equation (5) simply states that a bailout takes place whenever the sum of contributions exceeds the costs, while each country maximises its net benefits of a bailout (if it occurs) through Equation (4). In a non-cooperative setup, the game in (4) and (5) leads to a free-rider problem, where each country minimises its own contribution, conditional on the contributions of others. Formally speaking, the game may have a multiplicity of equilibria, and, in particular, the closure $t_i = 0$, $x^* = 0$ is an equilibrium provided that for no country i we have:

$$\alpha_i \cdot B - C > 0, \tag{6}$$

that is, no individual country is ready to finance the recapitalisation by itself. If this non-cooperative equilibrium is selected, the policy is inefficient, as banks will only be recapitalised for extremely high levels of benefits, B. As crisis management is a rare event (non-repeated game) with high financial stakes, the repeated game solution to the non-cooperative equilibrium is not applicable. 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. In the spirit of Acharya (2009), these externalities result from forced asset sales impacting negatively on aggregate investment in a country. With the home country having the highest share of benefits (by definition), improvised coordination boils down to the home country solution of Subsection 2.1: a bank is rescued only if the benefits in the home country exceed the aggregate costs of a bailout.

The home country may not be prepared to meet the costs of recapitalisation a failing bank in its entirety. This leads to the following proposition.

Proposition 2. *In a setting of improvised cooperation, the efficiency of the recapitalisation scheme depends on the size of α_h. Only when the social benefits of the home country are sufficiently large, i.e., $\alpha_h > C/B$, national financial policies will produce an efficient outcome.*

Proof: The efficient solution is $x^* = 1 \;\; if \; B \geq C$ and $x^* = 0 \;\; if \; B < C$. Using (4) and (5), the first best decision will be implemented in case $\alpha_h = 1$. Given that $\alpha_h > \alpha_i \;\; \forall \, i \neq h$, a recapitalisation under improvised coordination $x_{IC}^* = 1$ will only happen if the social benefits in the home country are larger than the total costs: $\alpha_h \cdot B - C > 0$. The home country recapitalises the entire financial institution if $\alpha_h > C/B$. Otherwise, the closure equilibrium occurs, $x_{IC}^* = 0$, even when $B \geq C$ and recapitalisation is the optimal strategy. ■

Proposition 2 is a reflection of the idea that increasing internationalisation of the banking system (with $\alpha_h \downarrow$), national financial policies cannot ensure a stable financial system. Cross-border banks in difficulties will be closed, even when it is optimal to recapitalise to maintain financial stability. The improvised coordination that takes place at a critical moment, under high pressure and with no ex ante commitment of other countries, boils down to a home-country solution, where the home country bears all the costs of a bailout.

The impossibility of meaningful coordination after the fact is the public good dimension of collective recapitalisation and implies an underprovision of recapitalisations under such a regime. In terms of the financial trilemma, we see that financial stability and national financial policies are compatible in

the case of no, or only limited, internationalisation, $\alpha_h > C/B$. With more internationalisation, the domestic benefits of a resolution are smaller than the total costs, $\alpha_h < C/B$, and financial stability suffers.

The degree of internationalisation of banks determines the likelihood of coordination failure among national governments to obtain financial stability. That raises the question how to measure banking internationalisation. Schoenmaker and Oosterloo (2005) use cross-border business of banks as a proxy for financial integration of international banks. Schoenmaker (2011) reports the cross-border business of the global top 60 banks. It is found that American and Asian-Pacific banks are primarily domestically oriented ($\alpha_h \approx 0.8$). The degree of internationalisation is limited ($\alpha_f \approx 0.2$). So, financial autonomy is still a viable strategy for American and Asian-Pacific countries. By contrast, the cross-border penetration of the European banks is close to 50% ($\alpha_f \approx 0.5$). This advanced level of internationalisation may lead to coordination failure in a setting with national financial autonomy.

Improvised coordination is the least efficient and thus unfit for the requirements of financial stability under the existence of cross-border banking. But there is no loss of sovereignty. A supranational agreement is the most efficient, but it is the most demanding in terms of national sovereignty. The two extremes are visualised in Figure 2. In terms of costs (x-axis) and benefits (y-axis), the supranational decision to a bailout is taken whenever total benefits exceed costs. Thus, in costs-benefits space, the line that separates bailout from no-bailouts has a slope of one. The solution under improvised coordination is to have a bailout only when the home country benefits exceed the total costs, i.e., $\alpha_h \cdot B > C$, which leads to the line $B = C/\alpha_h$ above which a bailout takes place.

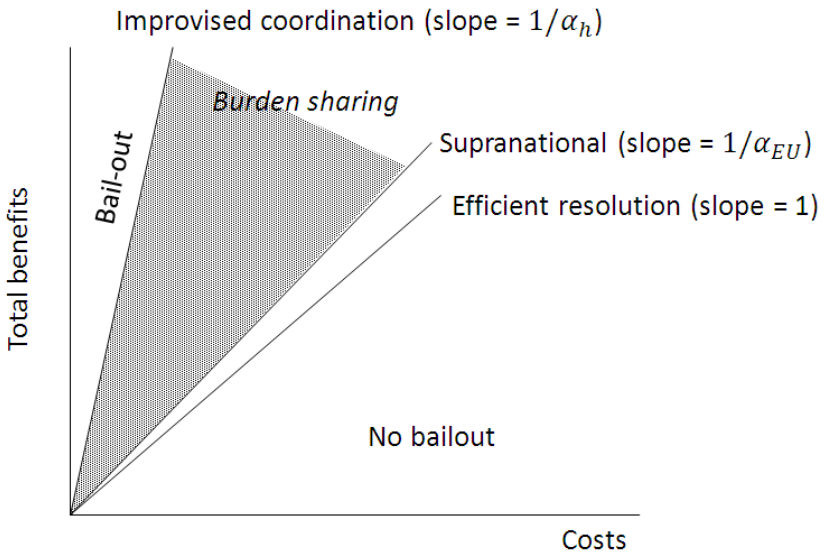

Figure 2: Equilibrium outcomes for the different resolution mechanisms

This figure gives the threshold level for benefits over costs above which a recapitalization takes place. Under efficient resolution, a bailout takes place when the aggregate (world-wide) benefits exceed the total costs, so that the line is characterized by $B = C$, i.e., a slope of 1. Under a EU-supranational authority, bailouts take place when EU-specific benefits exceed total costs, i.e., $\alpha_{EU} \cdot B > C$, so that the slope is $1/\alpha_{EU}$. Under improvised coordination, the equilibrium outcome is that the burden falls completely on the home country, which only takes the home share α_h into account. The grey area identifies an area of potential improvement, where ex ante burden sharing or voting agreements can improve on the outcome under improvised coordination.

2.4 Burden sharing agreements

The essence of burden sharing is that governments commit *ex ante* on a voting scheme that determines the bailout decision and cost-sharing. The voting schemes assigns a voting share to each country in which an ailing bank is active, which becomes a legally binding cost share in case of a bailout decision, see Goodhart and Schoenmaker (2009). If a banking crisis happens, the sum of the voting shares determines whether ailing banks are liquidated or recapitalised. Strategic behaviour with respect to the size of their contribution is ruled out, as there is no negotiation about the cost share. Binding burden sharing rules can thus improve on improvised cooperation, while limiting the degree of loss of national sovereignty.[2]

The burden sharing key is the same for costs as for benefits, so that the incentives of national governments are aligned. Also, we abstain from the possibility of different regulatory standards or

[2] Under burden sharing there is still a need for supranational institution to apply the burden sharing agreement in the case of a failing bank. As funds are needed fast in such a situation, the supranational institution would typically have pre-committed funds, or the ability to borrow. See, for example, the European Stability Mechanism (ESM) and the IMF.

competition among regulators, which could give rise to different per-country costs and benefits in case of recapitalisation, see Dell'Ariccia and Marquez (2006).

We model burden sharing in the European countries (EU) by a burden sharing key k_i with $\sum_{i \in EU} k_i = 1$. The key determines the voting outcome as well as the contributions by each country in Europe, and non-European countries are singled out. Each European country votes in favour of recapitalisation if and only if

$$\alpha_i \cdot B > k_i \cdot C, \tag{7}$$

with α_i the benefit share and k_i the burden share. As some of the benefits of recapitalisation fall outside Europe, it will usually hold that $\alpha_i < k_i$, so that, for any country to favour a recapitalisation, the benefits *B* need to be strictly larger than the costs *C*.

Under burden sharing, the outcome of the voting process is as follows. Define the set of countries that vote in favour by $I = \{i \in EU | \alpha_i \cdot B > k_i \cdot C\}$ and the sum of votes as $K_I = \sum_{i \in I} k_i$. Then, the voting decision is

$$x^* = \begin{cases} 1 & if \ K_I \geq \bar{v} \\ 0 & \text{otherwise,} \end{cases} \tag{8}$$

where $\bar{v}$ is the threshold fraction of votes that is required for a bailout to go through, see Barberà and Jackson (2006). In the case of majority voting, 50 per cent or more of the weighted votes has to be in favour, so that $\bar{v} = 0.5$. In the case of unanimity, all participating countries have to vote in favour, i.e., $\bar{v}$=1. We model qualified majority voting by having a threshold that is higher than 0.5, see Section 3.

Burden sharing improves on improvised coordination, which boils down to a home country solution in absence of *ex ante* binding rules. In all cases where $\alpha_h \cdot B < C$ and $K_I \geq \bar{v}$, burden sharing improves the efficiency of bank recapitalisation. The most likely cases of improvement are those where a bank has many cross-border activities, so that α_h is relatively small. Little or no improvement is expected for a domestic bank, where α_h is large, and specifically, larger than C/B.

Burden sharing is identical to the supranational approach when there is full alignment of costs and benefits, i.e., $k_i = \alpha_i / \alpha_{EU}$, for all countries in Europe. Note that asset share is divided by α_{EU} as only the European countries participate in the burden sharing. In the case of full alignment, each

country votes in favour when EU-benefits exceed total costs, and against otherwise. This holds regardless of the voting rule.

Burden sharing is not identical to the supranational approach when the burden shares, and likewise the voting shares, are not equal to the benefit shares. There are a number of reasons why this could be the case, mostly related to the short time span in which votes have to be cast. First, for each country the most likely benefits of a bailout have to be estimated, which might be difficult. Although a supranational bank supervisor is likely to be involved, its expertise might not always be sufficient enough to estimate burden shares. The estimate of the per-country benefits would likely involve the country-specific distribution of the loan portfolio, employees, assets, and impact on the economy in case of liquidation. The data might not be readily available, or involve some degree of subjectivity (in case of the liquidation costs and impact on the economy).

A second reason why voting sharing might deviate from benefit-shares is that countries might have different political preference regarding a bailout decision. And since burden sharing rules out negotiations over the cost distribution, some power play could be likely in the process of agreeing on the burden sharing keys. Countries that oppose a bailout might try to keep estimates of the impact of liquidation on the economy low. Countries that are in favour of a bailout have an incentive to overestimate the impact of a bank failure on the economy. With supranational decision-making, these effects should not be of first order, but they cannot be ruled out completely.

Uncertainty over the likely per-country benefits of a bailout is the reason behind the greying of the area between supranational and improvised coordination in Figure 2. A supranational solution is most efficient, being least likely to be influenced by political sentiments and subjectivity in estimating bailout benefits. The efficiency of burden sharing is lower because of the necessity of having to estimate country-specific costs and benefits, on which voting shares are based. The extent of inefficiency introduced by burden sharing is examined in the next section.

3. Simulation Setup

The country-specific uncertainty regarding bailout benefits has an impact on the relative efficiency of voting agreements. Therefore, we model bank failures of Europe's biggest banks and the efficiency of voting agreements under uncertainty over bailout benefits. We focus on the large banks, as small- and medium-sized banks are largely domestically oriented and do not suffer from the coordination problems in the event of a bailout.

In the simulation, we compute *bailout probabilities*. A bailout probability is the average occurrence of a bailout over all simulation scenarios. The optimal solution is to have a bailout probability of 1 when benefits exceed costs, and 0 otherwise. For the supranational approach, this will not be reached, as some benefits fall outside Europe. Under improvised coordination, bailout probabilities will be 0, even for high benefits, until α_h is larger than C/B, as described in Subsection 2.3 above.

To assess the efficiency of burden sharing, we will compare the bailout probabilities with the supranational outcome under no uncertainty for the aggregate benefits. The closer the probabilities are to those of the supranational solution, the more efficient.

3.1 Costs and benefits of bailout

For each bank j in the sample we consider a loss L_j of 2 times equity E_j: $L_j = 2 \cdot E_j$, which makes the bank insolvent. If the bank is recapitalised to its original equity, 100% of equity becomes the new value of the bank. Thus, the total net costs of the bailout are 100% of the initial (pre-shock) equity of the bank: $C_j = 1 \cdot E_j$, see Goodhart and Schoenmaker (2009).

Given a benefit parameter θ, the total, objective benefits B_j of keeping bank j open are θ times equity: $B_j = \theta \cdot E_j$, where we use the book value of equity of the bank. Having a benefit parameter θ enables us to analyse the efficiency of bailout over a range of benefits, as low benefits should lead to a low probability of bailout and a high benefit parameter should lead to a high probability of bailout.

Bailout benefits can be thought of as preventing a temporary reduction of credit availability (credit crunch) through shortening of balance sheets by a forced liquidation of the loan book in a particular country. Another source of benefits is the safeguarding of financial stability of the total banking system, which might be jeopardised by a fire sale of assets or other externalities. See Dell'Ariccia *et al*. (2008) for empirical evidence on the real effects of banking crises. Thus, we take size and distribution of bank assets to represent the bailout benefits. This is in accordance with the "credit view" on the impact of bank failures on the economy, see Bernanke (1983). An alternative proxy would be the distribution of liabilities, as the liability-holders bear the cost of a failure. But that does not take into account the loan channel as a source of macroeconomic risk. The relative share of the assets of bank j in country i is denoted as α_{ij}.

The per-country benefits are stochastic. For bank j in country i they are equal to

$$\hat{B}_{ij} = (1 + \varepsilon_i) \cdot \alpha_{ij} \cdot B_j, \quad (9)$$

where the ε_i are i.i.d. and normal-distributed with mean 0 and standard deviation σ. So, there is uncertainty around the actual benefits of a bank bailout, with mean level $\alpha_{ij} \cdot B_j$. The noise term represents the uncertainty around public support for bailout, which depends on the political climate of a country, the political situation or previous government actions related to the banking sector.

The noise in benefits is the only source of uncertainty in the model. The i.i.d.-assumption of country-specific shocks could be relaxed to allow for correlations between shocks, such as in the case of public anti-bailout sentiment being correlated across European countries. This has no significant impact on the outcomes, however.[3]

3.2 Decision rules for bailouts

We summarise the following rules for bank rescue, based on the various coordination agreements that we considered in Section 2.

Rule #1: Supranational (European) arrangement

Assuming that there is a supranational arrangement, this rule states that a bank i is rescued only if the sum of benefit-shares over the European countries exceeds the total bailout costs, i.e., if

$$\sum_{i \in EU} \alpha_{ij} \cdot B_j \geq C_j$$

This rule assumes that there is a supranational entity with decision-power over the bailing out of banks. Note that for the supranational body there is no uncertainty over the total bailout benefits B_j. There is only uncertainty about the per-country benefits. The benefits that lie outside the EU are not taken into account, but costs are.

Rule #2: Majority voting

Under majority voting a bank is rescued if the sum of burdens (=voting right) of net-benefiting countries exceeds the voting threshold 0.5. A country i is a net-benefiter, i.e., it votes in favour, if the country-specific benefits of rescuing bank j, exceed the burden-share of total costs:

$$\hat{B}_{ij} > \frac{\alpha_{ij}}{\alpha_{EU,j}} \cdot C_j$$

[3] Results are available upon request.

where $\frac{\alpha_{ij}}{\alpha_{EU,j}}$ is the European asset-share of bank j in country i, equal to its voting right for the bailout of bank j.

Rule #3: Qualified majority voting

This rule is identical to Rule #2, with the exception that the voting threshold is now at 0.74. That is, the asset-weighted votes need to comprise a 74 per cent majority over all countries that are involved in a bank. The level of 74 per cent is equal to the qualified majority under the current voting arrangements of the Lisbon Treaty, where a qualified majority is reached with 255 out of 345 votes (73.9%).

Rule #4: Unanimity

Under veto, a bank j is only rescued if the net benefits are non-negative for all countries involved. This means that if for one country the net benefits are negative, that country vetos and effectively blocks the bailout.

Rule #5: Home country only

Under the home country rule a bank j in home country h is saved if and only if

$$\hat{B}_{hj} \geq C_j$$

This reflects the arrangement without a supranational approach or burden sharing between countries. It is up to the home country to assume all the costs, while incurring only the home country-specific benefits of rescuing the bank.

3.3 Simulation Setup

For each bank j and a given value of the benefit parameter θ, we generate 500 realisations for the country-specific benefits $\hat{B}_{ij}$ for country i of saving bank j. Each element in the vector represents a separate draw for each country i. Each simulation run represents a different "state of the world" where one specific state is represented by the country-specific benefits of rescuing bank j for each country i. For each realisation of benefits the voting rule determines whether bank j is rescued and the average over the 500 simulations gives us the bailout probability for bank j and benefit-parameter θ.

In the simulation setup, the most efficient outcome under objective measurement of benefits is that a bank is only rescued if the parameter θ is 1 or higher: $\frac{B_j}{C_j} = \frac{\theta \cdot E_j}{E_j} = \theta \geq 1$. In that case, the net benefits are non-negative $B \geq C$ and a supranational agreement would lead to a bailout. The

remaining inefficiency is for banks that have activities outside Europe, so that the value of θ for which a bailout is efficient will be higher than 1.

3.4 Data

We select the top 30 European banks in 2010 by capital strength, as published by The Banker (2011) and report the values for capital and total assets. Table 1 provides the details. The top 30 banks have average assets of € 898 billion and capital of € 36 billion.

*** INSERT TABLE 1 HERE ***

The geographic segmentation of assets is taken as a proxy for the geographic spread of the benefits, and is shown in Table 2.

*** INSERT TABLE 2 HERE ***

Table 2 clusters the banks in three groups. The first group is composed of global banks with less than 50 per cent of assets in the home country and the majority of international assets in the rest of the world. The second group are European banks with less than 50 per cent of assets in the home country and the majority of international assets in the rest of Europe. The third group are domestic banks with more than 50 per cent of assets in the home country. The numbers for the assets are obtained from the annual reports of the banks and represent the geographical breakdown of assets, loans or credit risk as given in the annual report. Usually, banks report the breakdown for only one category of assets, loans, or credit risk, so we take the one that is given. In all, this gives a representation of where country-specific bailout costs and benefits might be reasonably expected to materialise and for short hand we refer to the distribution as "asset shares". Table 3 reports the country specific asset shares. Sometimes only the major asset shares in countries are specified in a bank's annual report. The remaining, minor asset shares in Europe (beyond the specified countries) are reported under other EU.

*** INSERT TABLE 3 HERE ***

4 Results

4.1 Bailout Probabilities as a Function of Benefits

To facilitate interpretation, we start with the outcomes for four selected banks. Figure 3 gives the bailout probabilities as a function of the relative benefits θ (i.e. the benefits relative to the costs) for Nordea, ING, Deutsche Bank and Intesa SanPaolo. Each banks has a distinct geographic distribution of assets. Nordea is a bank with activities in a few distinct countries (Sweden 23%, Denmark 38%, Finland 16%, Norway 12%), ING and Deutsche bank are banks with a quite dispersed distribution of assets, albeit with 36% in the home country (Netherlands) respectively 38% in the home country (Germany), and Intesa SanPaolo is a bank with 81% of assets in the home country (Italy).

*** INSERT FIGURE 3 HERE ***

The three internationally active banks in Figure 3 (panel A, B and C, which are Nordea, ING and Deutsche Bank) show roughly the same pattern of bailout probabilities. The supranational approach is the theoretical optimum from the European-perspective: the bailout probability jumps from zero to one at the point where EU-benefits exceed costs. With a bank having activities outside Europe, this point is always above one. The voting rules are less efficient, in that they lead to bailouts where it is not beneficial (to the left of the supra-line) and to no bailout (to the right of the supra-line). Bailout probabilities are the highest for the majority voting rule (MV), followed by QMV, unanimity and the home country rule. The home country rule leads to almost no bailouts for the shown range of benefits, which is obvious for large international banks.

Panel D in Figure 3 has the outcome for Intesa SanPaolo, a bank that has very few activities outside its home country, Italy. The outcomes are therefore predictable. The supranational bailout probability is one for θ greater or equal than 1.05. The threshold is not exactly at 1 since this bank has 4% of assets outside the EU. The burden sharing rules (MV, QMV and unanimity) and the home country rule all lie on the same line, because the home country is the only party involved in a bailout. Given the country-specificity in valuing bailout benefits, the bailout probability is non-zero for a range of values for θ below 1.05. When θ rises, the bailout probability moves up to one, which is reached at $\theta = 1.65$.

Bailout probabilities in the aggregate

We now turn to average bailout probabilities for the full sample of 30 European banks, which are in Figure 4. First of all, we see that the supranational solution is not a vertical line. This comes from the

fact that the threshold for bailout from a EU-perspective is bank-specific, depending on the fraction of assets outside the EU. Second, we find that the MV and QMV lines are very close together. The explanation is that, for bailing out a bank, usually only 2 or 3 countries are involved. So whether the voting threshold is 50% or 74% is not of great importance. Third, we find that unanimity voting performs worse than MV and QMV, but not by much. The reason is that, although unanimity is a strong condition, it does involve only the European countries in which a bank has assets and both assets and costs are shared. Which is not the case for home country bailout, where the home country assumes all the costs but not all the benefits.

*** INSERT FIGURE 4 HERE ***

Banks grouped by degree of internationalisation

Figure 5 shows the average bailout probabilities for three groups of banks. The grouping is defined on the geographic dispersion of the banks, as shown in Table 2. Global banks have less than 50 percent of business in the home country and the majority of international business in the rest of the world. Pan-European banks have less than 50 percent of business in the home country and the majority of international business in the rest of Europe. Domestic banks have more than 50 percent of business in the home country.

*** INSERT FIGURE 5 HERE ***

Panel A of Figure 5 shows the bailout probabilities for Global banks as a function of relative benefits. Because of their geographical dispersion, the bailout probabilities increase only slowly with benefits: many of the bailout benefits are obtained by the rest of the world, which is not involved in the bailout. Thus, from a EU-perspective, bailout is inefficient up to high levels of benefits. Nevertheless, the supranational approach and (Q)MV burden sharing improve on the home country rule. Panel B and C of Figure 5 have the bailout probabilities for Pan-European and Domestic banks. The lines are quite similar to the aggregate patterns of Figure 4. A notable exception is the performance of the Home country rule for Pan-European banks, which is much lower. The intuition is that European coordination has the greatest impact compared to the Home country rule, when banks have activities outside the home country, but inside Europe. If banks have most of their activities in the home country and outside Europe, a European approach (Supra, MV, QMV, Unanimity) can be helpful, but not that much. Moreover, within the concept of European coordination, Figure 5 shows that the type of coordination mechanism selected is not the most important consideration, as the bailout probabilities are quite close for Supra, MV and QMV, with Unanimity being a bit further

away. This suggests that for the efficiency of cross-border recapitalisation, the question of whether to coordinate is more important than the exact choice of mechanism.

4.2 Threshold Levels of Relative Benefits

Table 4 provides a comparison of the average levels of benefits needed for a bailout under the different resolution mechanisms. For the Global banks, the levels are obviously quite large at almost all resolution mechanisms. Even for the supranational solution, where benefits outside Europe are not taken into account. For pan-European and Domestic banks the required benefits are close to one for the supranational solution, as this is the socially optimal method of recapitalisation in our setup. The degree to which required benefits are larger than one is determined by the share of banking assets outside the EU.

*** INSERT TABLE 4 HERE ***

For all banks except two (La Caixa and UniCredit), the required benefits under simple majority voting (MV) are significantly larger than in the Supranational approach. QMV has larger required benefits on the whole, but only significantly so for all pan-European banks, two Global and two Domestic banks. Unanimity leads to an increase in required benefits for a bailout for almost all banks, compared to QMV. The same banks have significantly higher required benefits under the Home country rule compared to Unanimity, with the exception of Deutsche Bank, Crédit Mutuel and ABN Amro. ABN Amro is special, in that the required benefits under Home country rule are significantly lower than under Unanimity. (1.18 versus 1.24). This might be due to the split-up of ABN Amro in 2007/2008, which has left it with many very small pockets of activities in European countries. These small asset shares can block recapitalisation under Unanimity, but have no material impact under Home country rule; hence the higher required benefits under Unanimity.

Table 5 shows an aggregation of the results in Table 4, resulting from taking the average per group of banks. For every group of banks, the increase in average required benefits is clearly visible in going from Supra to MV, QMV, Unanimity and Home country rule. Majority and Qualified majority voting lead to similar outcomes, and unanimity is less efficient but still far better than a home country solution. In efficiency terms, the Supranational mechanism leads to an efficiency improvement of 65% compared to the home rule, as the Home rule is at a distance of 1.33 from the efficient benchmark of 1 and the supranational setting is at 0.47 from 1. Similarly, the MV rule leads to an improvement of about 50% on the home country approach (0.67 compared to 1.33), almost at par with the QMV rule. A unanimous voting rule still gives an improvement of 40% (0.80 compared

to 1.33). Stated in terms of the Financial Trilemma, we have found that efficiency gains of cooperation between EU-countries are large, at the cost of giving up domestic, home country-only rules of dealing with the recapitalisation of banks.

*** INSERT TABLE 5 HERE ***

5. Conclusion

We analyse the efficiency of various bank-bailout coordination mechanisms in Europe, based on per-country assets shares of the 30 largest European banks. The supranational approach improves the range of efficient outcomes with 65% compared to the benchmark of improvised coordination, which is the current policy. Burden sharing with (qualified) majority voting achieves an improvement of 50% in comparison with improvised coordination. Unanimity has less potential to improve efficiency, but is still at a 40% efficiency increase. We conclude that cross-border coordination mechanisms as explored in this paper (supranational approach and burden sharing with MV or QMV) can make a substantial improvement on the current home country rule.

The results can be interpreted in the context of the financial trilemma, which highlights the challenge of providing the public good of financial stability in an international environment. It states that (1) financial stability; (2) international banks; and (3) national financial policies are incompatible, so that governments have to choose any two of these three objectives. Our findings suggest that implementing burden sharing agreements, which limit national financial policies, can facilitate the efficient resolution of international banks and thus increase financial stability.

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Appendix A: Tables and Figures

Table 1: The top 30 European banks

This table shows the top 30 European banks selected on the basis of capital strength ultimo 2010 (Tier 1 capital as published in The Banker). The figures for capital and total assets are from The Banker (July 2011).

Bank no.	Bank name	Capital strength (in EUR billion)	Total assets (in EUR billion)
1	HSBC (UK)	100	1837
2	RBS (UK)	70	1703
3	BNP Paribas (France)	69	1999
4	Barclays (UK)	63	1744
5	Banco Santander (Spain)	61	1218
6	Crédit Agricole (France)	58	1732
7	Lloyds Banking Group (UK)	55	1162
8	UniCredit (Italy)	43	930
9	Deutsche Bank (Germany)	43	1907
10	Groupe BPCE (France)	41	1049
11	ING Bank (Netherlands)	40	1248
12	Société Générale (France)	35	1132
13	Rabobank Group (Netherlands)	34	653
14	BBVA (Spain)	33	553
15	Commerzbank (Germany)	31	754
16	Intesa Sanpaolo (Italy)	31	659
17	Credit Suisse Group (Switzerland)	30	822
18	UBS (Switzerland)	28	1048
19	Crédit Mutuel (France)	28	592
20	Standard Chartered (UK)	25	387
21	Nordea Group (Sweden)	21	581
22	Dexia (Belgium)	19	567
23	Banco Financiero y de Ahorros Group (Spain)	18	329
24	KBC Group (Belgium)	16	321
25	Danske Bank (Denmark)	16	429
26	La Caixa (Spain)	16	286
27	ABN Amro Group (Netherlands)	15	379
28	Bayerische Landesbank (Germany)	14	317
29	Landesbank Baden-Württemberg (Germany)	13	375
30	DnB NOR (Norway)	13	238
	Average	**36**	**898**

Table 2: Segmentation of assets of top 30 European banks

This table shows the geographic segmentation of the top 30 European banks as ranked and published in The Banker (July 2011). Data on the segmentation of assets for 2010 are taken from the annual reports. Global banks: less than 50 per cent of business in the home country and the majority of international business in the rest of the world. Pan-European banks: less than 50 per cent of business in the home country and the majority of international business in the rest of Europe. Domestic banks: more than 50 per cent of business in the home country.

Banking groups (2010 figures)	1 Total assets (in EUR billion)	2 Assets in home country (as % of 1)	3 Assets in rest of EU (as % of 1)	4 Assets in rest of world (as % of 1)
Global banks				
1. HSBC	1,837	36	11	53
2. Barclays	1,744	33	25	42
3. Deutsche Bank	1,907	38	29	33
4. Credit Suisse	822	18	26	56
5. UBS	1,048	31	10	59
6. Standard Chartered	387	13	4	83
Pan-European banks				
1. BNP Paribas	1,999	48	34	18
2. Santander	1,218	27	43	30
3. UniCredit	930	45	49	6
4. ING	1,248	36	44	19
5. Société Générale	1,132	41	34	25
6. Nordea	581	23	69	8
7. Dexia	567	48	42	10
Domestic banks				
1. Royal Bank of Scotland	1,703	65	16	19
2. Crédit Agricole	1,732	66	19	15
3. Lloyds Group	1,162	88	7	5
4. Groupe BPCE	1,049	68	15	17
5. Rabobank	653	73	9	18
6. BBVA	553	53	13	34
7. Commerzbank	754	50	32	18
8. Banca Intesa	659	81	15	4
9. Crédit Mutuel	592	85	11	4
10. Banco Financiero y de Ahorros	329	95	3	2
11. KBC	321	64	18	18
12. Danske Bank	429	56	43	1
13. La Caixa	286	100	0	0
14. ABN Amro	379	86	10	3
15. Bayerische Landesbank	317	70	15	15
16. Landesbank Baden-Württemberg	375	90	3	7
17. DnB Nor Group	238	73	17	9

Table 3: Country-specific distribution of bank assets

Bank	HSBC	RBS	BNP Paribas	Barclays	Banco Santander	Crédit Agricole	Lloyds Banking Group	UniCredit	Deutsche Bank	Groupe BPCE	ING Bank	Société Générale	Rabobank	BBVA	Commerzbank	Intesa Sanpaolo	Credit Suisse Group	UBS	Credit Mutuel	Standard Chartered	Nordea Group	Dexia	Banco Financiero y de Ahorros Group	KBC Group	Danske Bank	La Caixa	ABN Amro Group	Bayerische Landesbank	Landesbank Baden-Württemberg	DnB NOR
Home country	UK	UK	FR	UK	SP	FR	UK	IT	DE	FR	NE	FR	NE	ES	DE	IT	CH	CH	FR	UK	SE	BE	ES	BE	DK	ES	NL	DE	DE	NO
Austria								0.15																						
Belgium		0.01	0.07	0.00							0.11											0.48		0.65			0.01			
Bulgaria																								0.00						
Cyprus																														
Czech Republic												0.04												0.04						
Denmark																					0.38				0.56					
Estonia																														0.00
Finland																					0.16				0.10					
France	0.07	0.05	0.48	0.03		0.66				0.68	0.04	0.41					0.04		0.85			0.17					0.03			
Germany	0.00	0.05	0.02		0.03			0.28	0.38		0.11	0.05			0.50		0.04		0.04			0.04			0.01		0.01	0.70	0.90	
Greece																						0.01								
Hungary																								0.02						
Ireland		0.01		0.00			0.06															0.01		0.05	0.03					
Italy		0.01	0.08	0.02		0.07		0.45			0.04	0.04		0.02		0.81	0.01					0.04								
Latvia																														0.01
Lithuania																														0.02
Luxembourg			0.02												0.04		0.01					0.03					0.01			
Malta	0.00																													
Netherlands		0.02	0.02								0.36		0.73				0.03										0.86			
Poland								0.06			0.02				0.06						0.01			0.03						0.01
Portugal				0.01	0.04									0.08								0.00								
Romania												0.02																		
Slovakia																								0.01						
Slovenia																														
Spain		0.02		0.02	0.27						0.07	0.06		0.53								0.05	0.95			1.00				
Sweden																					0.23				0.13					0.06
Switzerland	0.01													0.01			0.18	0.31									0.01			
UK	0.36	0.65	0.03	0.33	0.29		0.88		0.17		0.04	0.09			0.18		0.14	0.04		0.13					0.03		0.01			0.02
Norway																					0.12				0.10					0.73
Other EU	0.02	0.00	0.09	0.16	0.07	0.12	0.02		0.12	0.15	0.01	0.05	0.09	0.02	0.05	0.15		0.07	0.07	0.04	0.01	0.07	0.03	0.03	0.02	0.00	0.03	0.15	0.03	0.05
Rest of the world	0.53	0.19	0.18	0.42	0.30	0.15	0.05	0.06	0.33	0.17	0.19	0.25	0.18	0.34	0.18	0.04	0.56	0.59	0.04	0.83	0.08	0.10	0.02	0.16	0.01	0.00	0.03	0.15	0.07	0.09
Total	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 4: Average Benefits Needed for Recapitalisation

This table gives the average benefits needed for recapitalisation per bank and resolution mechanism. The threshold level of benefits for which recapitalisation is efficient is 1. Global banks have less than 50 per cent of business in the home country and the majority of international business in the rest of the world. Pan-European banks have less than 50 per cent of business in the home country and the majority of international business in the rest of Europe. Domestic banks have more than 50 per cent of business in the home country. Supra is the supranational approach, MV is majority voting, QMV is qualified majority voting, Unanimity is unanimity voting and Home is the home country solution. The values for the t-test are the test result for comparing the average value with the average in the model to the left of the column. *, **, *** denote significance at the 10%, 5% and 1% level. The table is continued on the next page.

	Supra	MV			QMV			Unanimity (U)			Home country		
Global banks	mean	mean	stdev	t-test v. Supra	mean	stdev	t-test v. MV	mean	stdev	t-test v. QMV	mean	stdev	t-test v. U.
HSBC	2.12	2.30	0.01	16.72***	2.30	0.01	0.00	2.58	0.01	19.43***	2.88	0.01	18.11***
Barclays	1.73	2.50	0.01	64.86***	2.50	0.01	0.00	2.86	0.01	23.41***	3.11	0.01	14.05***
Deutsche Bank	1.49	1.83	0.01	40.74***	1.95	0.01	10.40***	1.95	0.01	0.00	2.69	0.01	51.19***
Credit Suisse Group	2.27	2.32	0.01	6.79***	2.49	0.01	13.83***	2.70	0.01	14.94***	5.67	0.03	103.17***
UBS	2.50	2.99	0.01	34.00***	2.99	0.01	0.00	3.18	0.01	9.70***	3.34	0.02	7.62***
Standard Chartered	6.00	7.77	0.04	48.02***	7.77	0.04	0.00	7.77	0.04	0.00	7.77	0.04	0.00
average	2.69	3.28	0.01		3.33	0.02		3.51	0.01		4.25	0.02	
Pan-European banks													
BNP Paribas	1.23	1.41	0.01	27.26***	1.43	0.01	2.92***	1.61	0.01	22.65***	2.14	0.01	46.70***
Banco Santander	1.43	1.61	0.00	36.10***	1.72	0.01	13.66***	1.81	0.01	8.61***	3.77	0.02	104.32***
UniCredit	1.06	1.07	0.00	1.87*	1.14	0.00	12.15***	1.19	0.00	8.84***	2.25	0.01	90.35***
ING Bank	1.25	1.28	0.00	5.47***	1.34	0.00	9.66***	1.49	0.00	22.13***	2.85	0.01	97.24***
Société Générale	1.34	1.46	0.01	18.08***	1.51	0.01	4.87***	1.67	0.01	20.35***	2.56	0.01	67.76***
Nordea Group	1.10	1.12	0.00	5.40***	1.18	0.00	11.58***	1.27	0.00	15.30***	4.49	0.02	154.10***
Dexia	1.11	1.22	0.01	19.46***	1.27	0.00	7.35***	1.42	0.00	23.02***	2.12	0.01	63.97***
average	1.22	1.31	0.01		1.37	0.01		1.50	0.01		2.88	0.01	

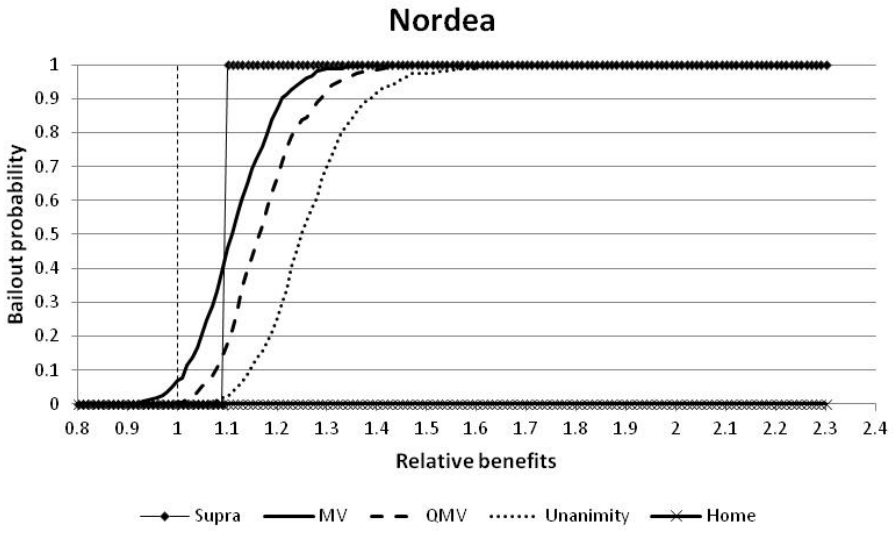
Table 4 (continued)

	Supra	MV			QMV			Unanimity (U)			Home country		
Domestic	mean	mean	stdev	t-test v. Supra	mean	stdev	t-test v. MV	mean	stdev	t-test v. QMV	mean	stdev	t-test v. U.
Domestic banks													
RBS	1.24	1.26	0.01	3.17***	1.26	0.01	0.00	1.45	0.00	25.32***	1.58	0.01	14.33***
Crédit Agricole	1.18	1.40	0.01	33.73***	1.40	0.01	0.00	1.48	0.01	8.46***	1.55	0.01	7.37***
Lloyds Banking Group	1.05	1.09	0.01	7.76***	1.09	0.01	0.00	1.15	0.00	8.33***	1.16	0.01	1.62
Groupe BPCE	1.21	1.51	0.01	42.83***	1.51	0.01	0.00	1.51	0.01	0.00	1.51	0.01	0.00
Rabobank Group	1.22	1.39	0.01	25.73***	1.39	0.01	0.00	1.39	0.01	0.00	1.39	0.01	0.00
BBVA	1.51	1.57	0.01	8.60***	1.57	0.01	0.00	1.76	0.01	18.77***	1.91	0.01	13.64***
Commerzbank	1.22	1.30	0.01	13.58***	1.35	0.00	6.55***	1.45	0.01	14.04***	2.03	0.01	53.97***
Intesa Sanpaolo	1.05	1.25	0.01	33.00***	1.25	0.01	0.00	1.25	0.01	0.00	1.25	0.01	0.00
Credit Mutuel	1.05	1.15	0.01	19.00***	1.15	0.01	0.00	1.21	0.00	7.67***	1.21	0.01	0.40
Banco Financiero y de Ahorros	1.02	1.06	0.00	7.89***	1.06	0.00	0.00	1.06	0.00	0.00	1.06	0.00	0.00
KBC Group	1.19	1.25	0.01	10.82***	1.25	0.01	0.00	1.44	0.00	25.61***	1.55	0.01	12.46***
Danske Bank	1.02	1.06	0.00	7.54***	1.09	0.00	5.43***	1.22	0.00	23.57***	1.83	0.01	66.76***
La Caixa	1.01	1.01	0.00	0.16	1.01	0.00	0.00	1.01	0.00	0.00	1.01	0.00	0.00
ABN Amro Group	1.04	1.08	0.01	8.28***	1.08	0.01	0.00	1.24	0.00	24.98***	1.18	0.01	-9.86***
Bayerische Landesbank	1.18	1.45	0.01	40.93***	1.45	0.01	0.00	1.45	0.01	0.00	1.45	0.01	0.00
Landesbank Baden-Württemberg	1.08	1.12	0.01	7.43***	1.12	0.01	0.00	1.12	0.01	0.00	1.12	0.01	0.00
DnB NOR	1.11	1.19	0.01	15.02***	1.19	0.01	0.00	1.37	0.00	24.85***	1.39	0.01	3.00***
average	1.14	1.24	0.01		1.25	0.01		1.33	0.01		1.42	0.01	
Overall average	1.47	1.67			1.69			1.80			2.33		

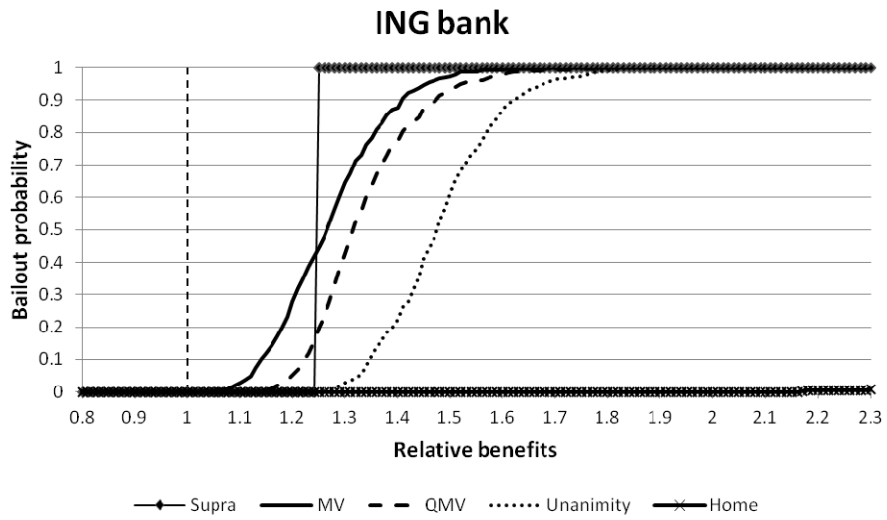
Table 5: Threshold Benefits by Degree of Internationalisation

This table shows the average benefit at which banks are bailed out, for three groups of banks and the five resolution mechanisms. The threshold level of benefits for which recapitalisation is efficient, is 1. Global banks have less than 50 per cent of business in the home country and the majority of international business in the rest of the world. Pan-European banks have less than 50 per cent of business in the home country and the majority of international business in the rest of Europe. Domestic banks have more than 50 per cent of business in the home country. Supra is the supranational approach, MV is majority voting, QMV is qualified majority voting, Unanimity is unanimity voting and Home is the home country solution. Standard deviations between parentheses.

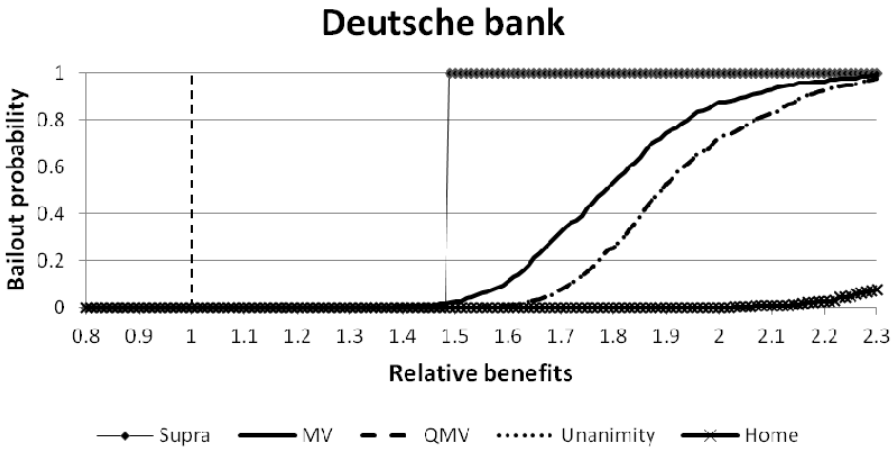
	Supra	MV	QMV	Unanimity	Home
Global banks	2.69	3.28	3.33	3.51	4.25
	(0.00)	(0.01)	(0.02)	(0.01)	(0.02)
Pan-European banks	1.22	1.31	1.37	1.50	2.88
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Domestic banks	1.14	1.24	1.25	1.33	1.42
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Total group of banks	1.47	1.67	1.69	1.80	2.33



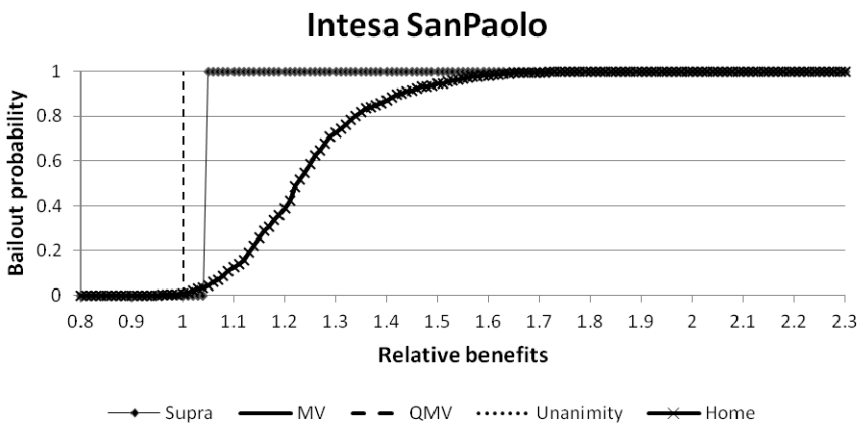
Panel A: Nordea



Panel B: ING Bank



Panel C: Deutsche Bank



Panel D: Banco Intesa SanPaolo

Figure 3: Bailout probabilities for selected banks

This Figure shows the bailout probabilities for four banks as a function of the relative benefits θ, based on 500 simulations for the stochastic benefits per country. The dashed vertical line is at $\theta = 1$, the value of θ for which bailout of the bank is economically efficient from a global perspective. The line with diamonds represents the supranational solution, where all EU-benefits are taken into account. The solid line is the majority voting rule, whereby the weighted average of the votes of participating countries is 0.5 or higher. The dashed line is qualified majority voting, which is majority voting with a threshold of 0.74. The dotted line is unanimity, whereby all countries with bank assets need to agree to the bailout. The line with crosses is the probability of a home-country bailout whereby the home country assumes all costs of the bailout.

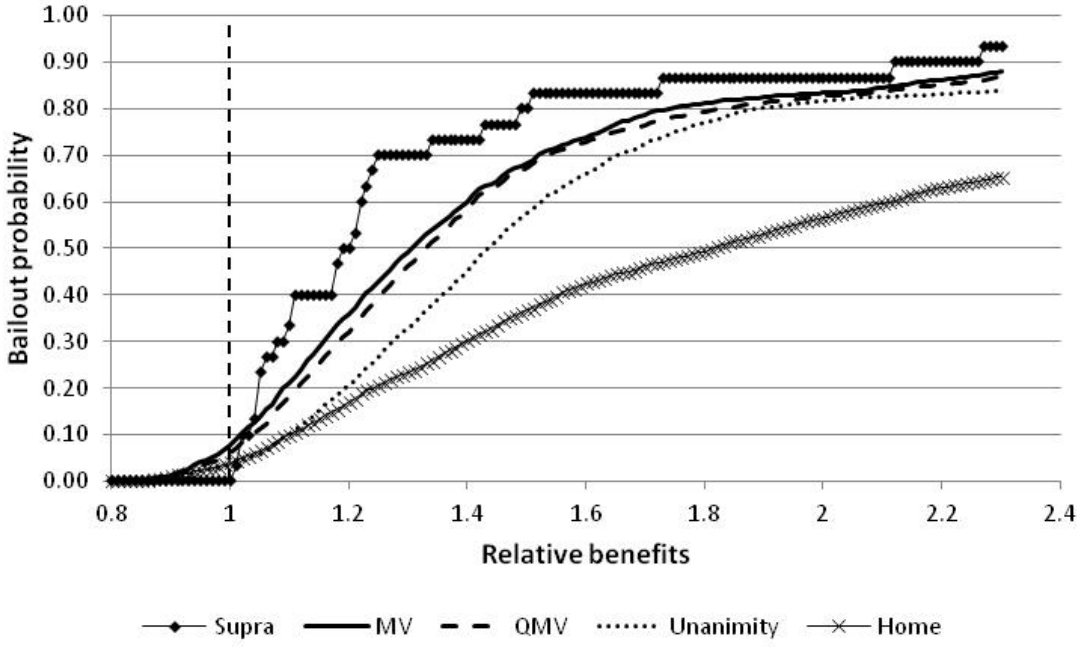
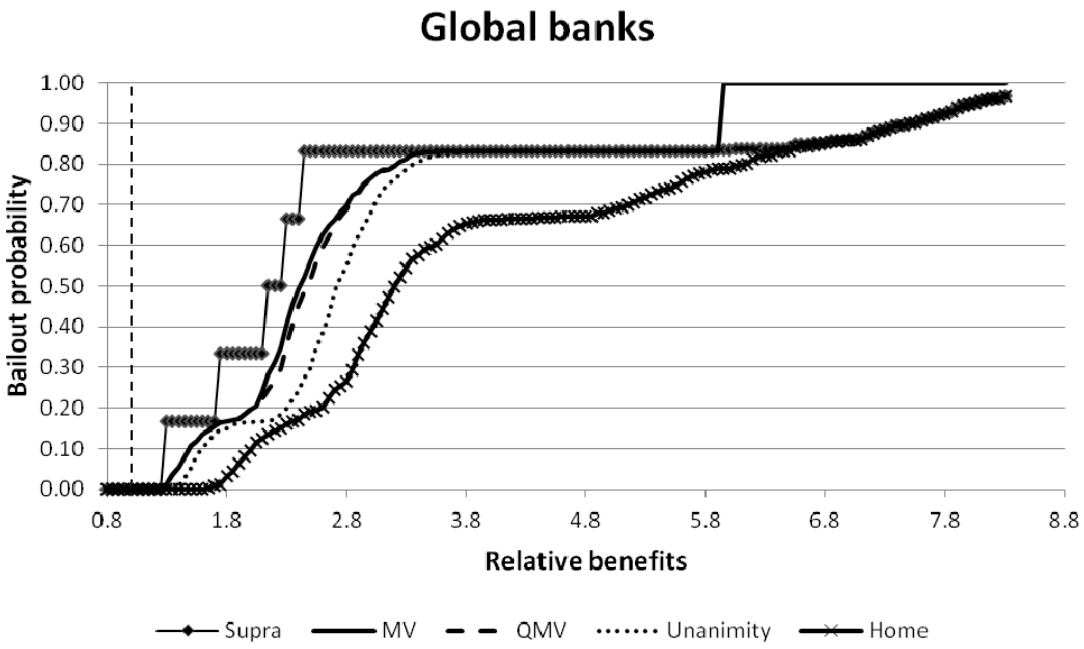
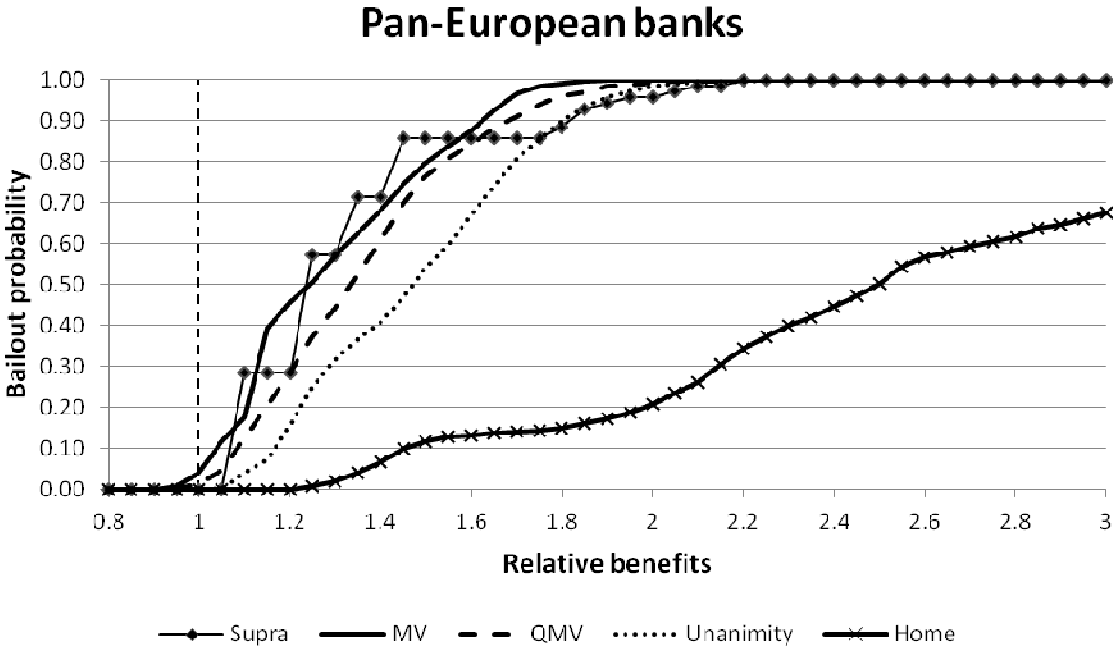


Figure 4: Average bailout probabilities

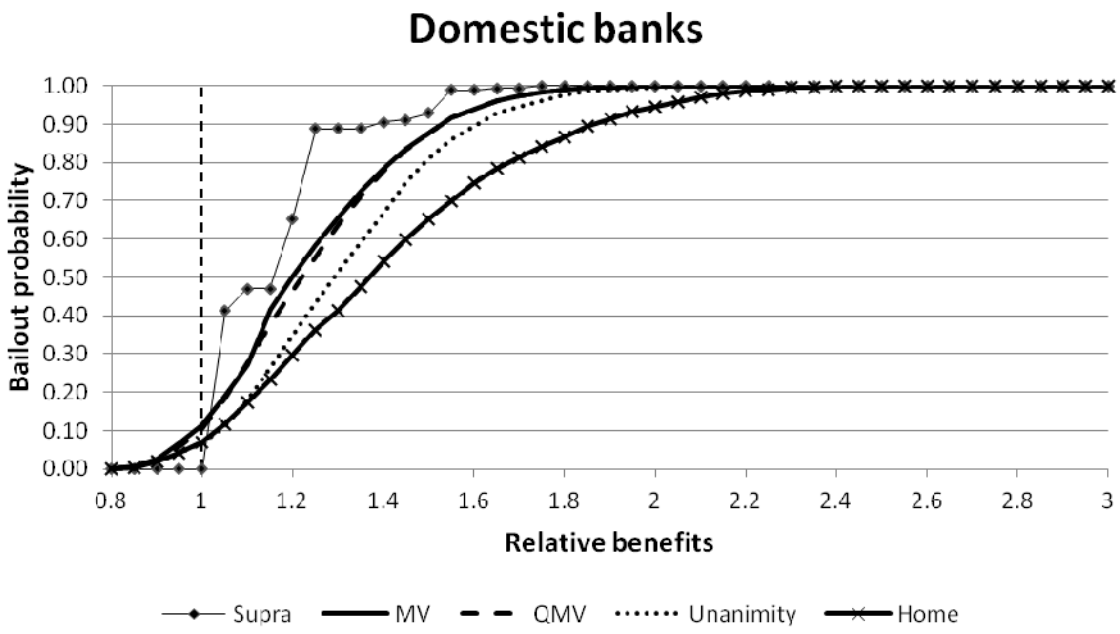
This Figure shows the average bailout probabilities taken over all banks, i.e., the top 30 EU-banks. The benefit-parameter θ measures the size of the benefits. The results are based on 500 simulations for the country-specific assessment of the bailout benefits. The dashed vertical line is at $\theta = 1$, the value of θ for which bailout of the bank is economically efficient from a global perspective. The line with diamonds represents the supranational solution, where all EU-benefits are taken into account. The solid line is the majority voting rule, whereby the weighted average of the votes of participating countries is 0.5 or higher. The dashed line is qualified majority voting, which is majority voting with a threshold of 0.74. The dotted line is unanimity, whereby all countries with bank assets need to agree to the bailout. The line with crosses is the probability of a home-country bailout whereby the home country assumes all costs of the bailout..



Panel A: Global banks



Panel B: Pan-European banks



Panel C: Domestic banks

Figure 5: Aggregate bailout probabilities for selected groups of banks

This Figure shows the bailout probabilities for three groups of banks as a function of the relative benefits θ, based on 500 simulations for the stochastic benefits per country. The dashed vertical line is at $\theta = 1$, the value of θ for which bailout of the bank is economically efficient from a global perspective. The line with diamonds represents the supranational solution, where all EU-benefits are taken into account. The solid line is the majority voting rule, whereby the weighted average of the votes of participating countries is 0.5 or higher. The dashed line is qualified majority voting, which is majority voting with a threshold of 0.74. The dotted line is unanimity, whereby all countries with bank assets need to agree to the bailout. The line with crosses is the probability of a home-country bailout whereby the home country assumes all costs of the bailout. Note that the scale for the x-axis in Panel A differs from the scale for Panels B and C.