



Discussion paper

# Bank Supervision Going Global? A Cost-Benefit Analysis

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# Bank Supervision Going Global? A Cost-Benefit Analysis*

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**Abstract**

This paper analyzes the distortions that banks' cross-border activities, such as foreign assets, deposits and equity, can introduce in the regulatory process. We find that while each individual dimension of cross-border activities distorts the incentives of a domestic regulator, a balanced amount of cross-border activities does not necessarily cause inefficiencies, as the various distortions can offset each other. In the case of imbalanced cross-border activities, a supranational regulator can improve outcomes, if her realm matches the geographic activity of banks, her capacity of extracting information is not lower than that of national supervisors, and the available resolution techniques do not cause higher external costs than under national resolution. Results from a numerical simulation exercise and empirical analysis using bank-level data from the recent crisis provide support to our theoretical findings. Specifically, banks with a higher share of foreign deposits and assets and a lower foreign equity share were intervened at a more fragile state, reflecting the distorted incentives of national regulators.

Keywords: Bank regulation, bank resolution, cross-border banking
JEL classification: G21, G28

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# 1 Introduction

The problematic resolution of failing cross-border banks in Europe during the current crisis has focused academics' and policy makers' attention alike on the misalignment of geographic boundaries of banks and their supervision. The resolution of Fortis on the national level, undertaken separately by Dutch, Belgian and Luxembourg authorities has confirmed Charles Goodhart and Mervyn King's point that "banks are international in life and national in death." The failure of the Icelandic banks, with wide-ranging economic and political repercussions has shed doubts on the viability of large multinational banks in small countries. The recent reform debate has - among other items - focused on issues of national versus supra-national supervision, the responsibility, obligation and capacity of home country supervisor relative to host country supervisor to resolve large cross-border banks and, in general, the need to coordinate the resolution of large international banks across borders. On the political level, arguments over national sovereignty and the role of European institutions are being used to argue in favor or against the establishment of a European-level bank supervisory authority. Recent proposals by the European Commission and the IMF aim at establishing a Europe-wide supervision and resolution authority (Fonteyne et al, 2010; European Commission, 2010). But what are the distortions of national supervision of international banks? What are the rationales behind national and supra-national supervisors; what are the trade-offs of national versus supra-national resolution authority?

This paper first presents a simple model to show both benefits and costs of national versus supra-national supervisors. The model highlights the distorted incentives that purely national supervisors face when deciding to intervene in failing banks with activity outside their borders. However, it also highlights potential problems that might arise from having a supranational supervisor, in terms of higher intervention costs and limited information on banks' performance. The model allows us to disentangle various trade-offs between national and supranational supervision. A numerical exercise suggests that the arising distortions in regulatory intervention decisions are significant.

Second, we provide empirical evidence for our theoretical model using bank level data during the crisis of 2007-2009. Specifically, we study banks that have been intervened during the crisis. We take their CDS spread at the time of intervention as a measure of regulatory lenience (a higher spread suggests a more lenient regulator, as the regulator lets bank health deteriorate significantly before intervening). We then relate this measure of lenience to various proxies of a bank's cross-border activities. Consistent with the predictions of our model we find that higher foreign asset and deposit share and lower foreign equity share is associated with more lenient regulatory decisions. We also show that non-intervened banks had - on average - CDS spreads over the three years that were below the threshold predicted by our model.

Our paper is related to a small but growing theoretical literature on the regulation of cross-border banks.[1] Loranth and Morrison (2007) discuss the implications of capital requirements and deposit insurance for cross-border banks. Dell'Arricia and Marquez (2006) show that competition between national regulators can lead to lower capital adequacy standards, since national regulators do not take into account the external benefits of higher capital adequacy standards in terms of higher stability in other countries. Acharya (2003), however, shows that coordinating capital adequacy ratios across countries without coordinating on other dimensions of the regulatory framework, such as resolution policies, can have detrimental effects. Freixas (2003) and Goodhart and Schoenmaker (2009) show that ex-post negotiations on recapitalization of failing cross-border banks can lead to underprovision of the necessary resources and prove the advantage of ex-ante burden sharing agreements in helping overcome coordination problems between regulators. Our paper is most closely related to Calzolari and Loranth (2010) who show how the organization structure of multi-national banks can influence regulatory behavior. Specifically, organization of foreign presence through branches leads to higher incentives to intervene as the home country regulator can draw on all assets, while at the same time it reduces the incentives if the regulator is responsible for repaying all deposits, including in foreign branches. There is also a more institutionally oriented liter-

[1] For an early discussion, see White (1994).

ature on legal differences across countries in the treatment of domestic and foreign creditors (e.g. Krimminger, 2007). Osterloo and Schoenmaker (2007) and Schoenmaker (2010) show the empirical relevance of regulation of cross-border banks within Europe, with an increasing trend. Allen et al. (2011) discuss policy options for the regulation of cross-border banks in the European Union.

The resolution of cross-border banks during the recent crisis informs our theoretical model. Intervention into large cross-border banks came often at a late stage and often with conflicts between home and host country supervisors. While the lack of an effective bank resolution framework in most European countries was certainly an important factor in explaining the late and uncoordinated intervention into failing bank, incentives for domestic regulators facing weak international banks have certainly played a role (Claessens et al., 2010).

This paper contributes to the literature on regulation of cross-border banks by focusing on one specific aspect, the intervention decision of supervisors. While the previous literature has considered capital regulations and deposit insurance across borders, to our best knowledge, this paper is one of the first to analyze the implications of cross-border banking for the intervention into failing banks. In focusing on this specific aspect, we hold constant other elements, such as capital requirements and deposit insurance. We also abstract from endogenous risk decisions by banks and market discipline to thus focus exclusively on supervisory discipline. While the basic set-up of this model is similar to Calzolari and Loranth (2010), we differ along several dimensions, including the distinction between cross-border activities in terms of assets, deposits and equity and discussing the merits of a supra-national supervisor. In addition, we provide empirical evidence on regulatory bias in intervention decisions during the recent crisis.

The remainder of the paper is organized as follows. The next section presents the basic model. Section 3 analyzes the incentives of the national supervisor in the presence of foreign deposits, assets and equity, while Section 4 analyzes the incentives and constraints of a global supervisor. In each case do we derive the welfare implications. Section 5 contains the

empirical analysis. The final section concludes.

# 2 The model

We present a simple model of bank supervision, with three periods, $0$, $1$ and $2$. For ease of analysis, we assume that the discount factor and the deposit interest rate are zero. There is a single representative bank whose balance sheet is normalized to 1 and that issues debt $d$ and equity $k$, so that $d + k = 1$. In period 0, the bank invests its resources into an investment project whose success is random and outside the control of the bank. Specifically, with probability $\lambda$ ($\lambda \in (0, 1)$), the investment succeeds and yields a return $R > 1$ in period 2, and with probability $1 - \lambda$, the project fails and yields zero gross return in period 2.

While the supervisor has imperfect information about $\lambda$ at date 0, $\lambda$ becomes known at date 1. Based on this information, a supervisor can decide whether to intervene in the bank or to allow it to continue. If the supervisor decides to intervene in the bank, she can recover the initial investment of one. This intervention can take different forms, ranging from liquidation to a purchase and assumption operation involving another bank. The intervention is assumed to cause costs $c_1$ external to the bank, arising for example from the disruption that depositors and borrowers might experience during the intervention.[2] If the supervisor decides to not intervene and allows the bank to continue to period 2, with probability $\lambda$ , the bank will be successful and be able to repay its debt and equity holders. With probability $1 - \lambda$, the bank will fail and there are again external costs of $c_2$, which can be lower or higher than $c_1$.

We assume that the supervisor maximizes domestic welfare, thus maximizing returns to domestic debt and equity minus domestic external costs. In the case of a purely domestic bank, her intervention decision will hence coincide with the one that maximizes (world) welfare. The intervention threshold is given by the $\lambda$ which equates the expected returns

[2] For a discussion on the external costs that bank failure can impose on the remaining financial system and the real economy, see Beck (2011).

from continuation with the return from immediate liquidation. We have

$$\lambda R - (1 - \lambda)c_2 = 1 - c_1. \tag{1}$$

Solving for $\lambda$ gives

$$\lambda^* = \frac{1 + c_2 - c_1}{R + c_2}. \tag{2}$$

Quite intuitively, we can see that intervention becomes less likely when the date 1 bank failure costs, $c_1$, increase but becomes more likely when date 2 bank failure costs, $c_2$, increase (the latter follows from $\lambda^{*\prime}(c_2) > 0$ for $\lambda < 1$). A higher return $R$ reduces the intervention probability in period 1.

We can use this model and different interpretations for $c_1$ and $c_2$ to understand intervention decisions by bank regulators. Higher external costs of intervention in period 1 can stem from an inefficient failure resolution framework that, e.g., does not allow for a purchase and assumption transaction, and where depositors loose temporarily access to their savings and borrowers are cut off from external financing. Similarly, the size of these external costs increases in the size of the institutions, as more depositors and borrowers are affected and the likelihood of contagion to other financial institutions increases. At the same time, the resolution of such an institution is made more difficult.[3] An increase to the same extent in external costs of both $c_1$ and $c_2$ will make intervention in period 1 more likely, while a larger increase in $c_1$ than in $c_2$ makes intervention in period 1 less likely.

While we assume throughout the paper that $\lambda$ becomes perfectly known at date 1, we can easily introduce a noisy signal on $\lambda$. As long as the signal is symmetrically distributed around the true $\lambda$, the intervention threshold is the same. This can be seen by noting that the costs from intervening are linear in $\lambda$ (left hand side of equation 1). Welfare, however, will decrease when there is uncertainty about $\lambda$ at date 1, as the regulator will make more Type 1 and Type 2 mistakes, i.e. intervene when she should not, and not intervene when she should.

[3] See Beck (2011) and Wagner (2010) for discussions on the external costs of bank failures, including how these costs depend on the number and size of failing banks and the health of remaining surviving banks.

# 3 The incentives of a national supervisor with cross-border banking

We now introduce cross-border banking into our model. For this we allow the bank to be partially financed by foreign deposits and foreign equity, as well as having asset holdings abroad. More specifically we denote with $\gamma_D$ the domestic share of deposits, with $\gamma_E$ the domestic share of equity and with $\gamma_A$ the share of domestic firms (assets) financed by the bank.

The introduction of cross-border banking obviously does not modify the efficient intervention threshold as it does not affect total payoffs in the world economy (thus including foreigners). It only affects the share of the payoffs that accrue to domestic agents. As national supervisors only care about domestic payoffs, this can change the intervention incentives for the domestic supervisor and drive a wedge between the socially efficient and the domestic intervention point.

The domestic intervention point can be derived as follows. If the domestic regulator intervenes at the intermediate date, the bank will be liquidated. Total (world) proceeds from this are $1 - c_1$. Domestic depositors obtain $\gamma_D d$ and domestic equity obtains $\gamma_E(1 - d)$ of these proceeds. In addition, the domestic economy suffers its share of the external costs, which amount to $\gamma_A c_1$. Total payoff in the domestic economy is thus $\gamma_D d + \gamma_E(1-d) - \gamma_A c_1$. In case there is no intervention the bank succeeds with probability $\lambda$. In this case domestic depositors obtain $\gamma_D d$, while equity obtains $\gamma_E(R - d)$. With probability $1 - \lambda$ the bank fails. In this case both equity and debt holders do not obtain any return and the country in addition suffers $\gamma_A c_2$ due to bank failure costs. Total expected domestic payoff is hence $\lambda(\gamma_D d + \gamma_E(R - d)) - (1 - \lambda)\gamma_A c_2$. The domestic intervention threshold is defined by

$$\lambda(\gamma_D d + \gamma_E(R - d)) - (1 - \lambda)\gamma_A c_2 = \gamma_D d + \gamma_E(1 - d) - \gamma_A c_1. \tag{3}$$

Rearranging for $\lambda$ gives

$$\widehat{\lambda} = \frac{\gamma_D d + \gamma_E(1-d) + \gamma_A(c_2 - c_1)}{\gamma_D d + \gamma_E(R-d) + \gamma_A c_2}. \tag{4}$$

Note that for $\gamma_D = \gamma_E = \gamma_A = 1$ we obtain $\widehat{\lambda} = \lambda^*$.

## 3.1 The case of no external costs in period 1

We focus in the following on the case of $c_1 = 0$, i.e. the case of an efficient resolution scheme. We start with this somewhat simpler case, as for $c_1 > 0$ the comparative statics are more complex and generally depend on the entire set of parameters. At any rate, external costs from bank liquidations at date 1 are likely to be significantly smaller than in the case of project failure at date 2 ($c_1 < c_2$) because in the former case the supervisor can allow for an orderly intervention and resolution.

**Proposition 1** *The intervention threshold of the domestic supervisor, $\lambda^D$, is*

*i) increasing in the share of domestic deposits $\gamma_D$,*

*ii) decreasing in the share of domestic equity $\gamma_E$,*

*iii) increasing in the share of domestic assets $\gamma_A$.*

***Proof.*** *i) We have for the derivative of the intervention threshold with respect to $\gamma_D$:*

$$\widehat{\lambda}'(\gamma_D) = \frac{(R-1)d\gamma_E}{(\gamma_D d + \gamma_E(R-d) + \gamma_A c_2)^2} > 0 \tag{5}$$

*ii) We have for the derivative of the intervention threshold with respect to $\gamma_E$*

$$\widehat{\lambda}'(\gamma_E) = -\frac{(R-1)(\gamma_D d + \gamma_A c_2)}{(\gamma_D d + \gamma_E(R-d) + \gamma_A c_2)^2} < 0. \tag{6}$$

*iii) We have for the derivative of the intervention threshold with respect to $\gamma_A$*

$$\widehat{\lambda}'(\gamma_A) = \frac{(R-1)c_2\gamma_E}{(\gamma_D d + \gamma_E(R-d) + \gamma_A c_2)^2} > 0. \tag{7}$$

■

The intuition behind these results is as follows.

**Deposits**. Since the national regulator only cares about domestic depositors, a higher share of foreign deposits will effectively reduce the costs for her in period 2 and thus make intervention in period 1 less likely. A higher share of domestic deposits, in turn, makes the domestic regulator less inclined to gamble on bank success in the second period. Hence, with a higher share of domestic deposits, the domestic regulator becomes more likely to intervene, that is, the range of $\lambda's$ where intervention takes place increases.

**Equity**. Shareholders have a relatively higher interest in continuing the bank due to the standard risk-shifting problems (the costs of bank failure are partly borne by debt holders and firms). A higher share of domestic shareholders aligns the interests of the regulator more with the one of shareholders. This makes interventions less likely, that is, the threshold decreases. If, on the other hand, the share of foreign equity holders is higher, the regulator is more likely to intervene in period 1.

**Assets**. The external costs of bank failures incur for $c_1 = 0$ only in period 2. When a higher share of bank assets is domestically invested, this raises the domestic external costs of bank failure. This, in turn, makes the domestic regulator more averse to continuation. As a result, she becomes stricter at date 1 (the minimum required success probability increases). On the other hand, a higher share of foreign assets involves that a higher share of external costs in period 2 are being borne by agents outside the home economy, which makes the regulator more reluctant to intervene in period 1.

Proposition 1 has straightforward welfare implications. We know that for $\gamma_D = \gamma_E = \gamma_A = 1$, domestic and efficient liquidation thresholds coincide. Since we also know, for example, that the domestic liquidation threshold is increasing in the share of domestic deposits, it follows that whenever $\gamma_D < 1$ (and $\gamma_E = \gamma_A = 1$) we have $\widehat{\lambda} < \lambda^*$. This implies that there is a range of $\lambda$ ($\lambda \in [\widehat{\lambda}, \lambda^*]$) where it is efficient to liquidate but the domestic supervisor decides to let the bank continue to operate (the domestic regulator is then too lenient).

The following corollary summarizes this welfare result, alongside with the corresponding ones for foreign equity and assets.

**Corollary 2** *When there is cross-border banking, domestic and efficient interventions generally do not coincide. In particular we have:*

*i) If cross-border banking takes place only via deposits ($\gamma_D < 1$ and $\gamma_E = \gamma_A = 1$): there are ranges for $\lambda$ where the domestic regulator lets the bank continue even though this is inefficient (the domestic regulator is too lenient);*

*i) If cross-border banking takes place only via equity ($\gamma_E < 1$ and $\gamma_D = \gamma_A = 1$): there are ranges for $\lambda$ where the domestic regulator liquidates the bank even though this is inefficient (the domestic regulator is too strict)*

*iii) If cross-border banking takes place only via assets ($\gamma_A < 1$ and $\gamma_D = \gamma_E = 1$): there are ranges for $\lambda$ where the domestic regulator lets the bank continue even though this is inefficient (the domestic regulator is too lenient)*

***Proof.*** *Follows directly from Proposition 1 and $\widehat{\lambda} = \lambda^*$ for $\gamma_D = \gamma_E = \gamma_A = 1$.* ■

If cross-border banking takes place through more than one channel, the welfare results obviously depend on the strength of each channel. For example, if there are both cross-ownership of deposits and equity, the biases created by each channel go in opposite directions and hence tend to offset each other. If there is mainly foreign deposit-taking but little foreign ownership, we are then likely to end up with a too lenient domestic regulator, and vice versa. This implies that in order to evaluate the efficiency properties of cross-border banking, one has to look at all aspects of cross-border banking jointly, and not only at one channel in isolation.

The following corollary establishes the precise conditions under which regulators are too lenient or too strict in the presence of cross-border banking.

**Corollary 3** *Domestic interventions are*

*i) always efficient if $\gamma_E = \frac{d\gamma_D+\gamma_A c_2-Rd\gamma_D+R\gamma_A c_1-R\gamma_A c_2-d\gamma_D c_1}{d+c_2+Rc_1-Rc_2-dc_1-Rd}$,*

*ii) tend to be too lenient if $\gamma_E < \frac{d\gamma_D+\gamma_A c_2-Rd\gamma_D+R\gamma_A c_1-R\gamma_A c_2-d\gamma_D c_1}{d+c_2+Rc_1-Rc_2-dc_1-Rd}$,*

*iii) tend to be too strict if* $\gamma_E > \frac{d\gamma_D+\gamma_A c_2-Rd\gamma_D+R\gamma_A c_1-R\gamma_A c_2-d\gamma_D c_1}{d+c_2+Rc_1-Rc_2-dc_1-Rd}$.

***Proof.*** *Follows from setting* $\lambda^* = \widehat{\lambda}$ *in equations (2) and (4) and solving for* $\gamma_E$. ■

There is thus a threshold value for $\gamma_E$ below which there is excessive lenience but above which domestic regulation tends to be too tight. In the case when the cross-border shares of assets and deposits are identical ($\gamma_D = \gamma_A =: \gamma$), this threshold value can be easily determined: the efficiency condition in Corollary 3 then becomes $\gamma_E = \gamma$. Thus, if cross-border ownership equals the cross-border ownership of the other two dimensions, the domestic regulator always takes efficient decisions *regardless* the overall level of cross-border activities. The intuition for this is straightforward: if cross-border engagement is the same along all three dimensions, the domestic regulator will simply perceive a fraction of both benefits and costs of intervention. Since this fraction is the same for the costs and benefits, her decision will not be distorted.

Our analysis focuses exclusively on cross-border activities as the source of inefficient liquidation decisions. Consequently, we have assumed that intervention decisions maximize domestic welfare. However, this assumes that the domestic authority responsible for the intervention decision maximizes the returns to all domestic stakeholders. If this is not the case, other distortions can arise, which can either strengthen or weaken the initial bias. If, for example, the authority which decides about interventions is the (domestic) deposit insurance fund, intervention behavior will tend to be tougher as the deposit insurer will try to maximize returns to domestic depositors rather than domestic equity holders. If the central bank is in charge of intervention decisions, there may likewise be a tendency towards strict interventions, if the central bank primarily cares about financial stability, thus trying to minimize external costs. On the other hand, if intervention decisions are taken by an independent supervisor, interventions may be relatively lenient, in case of regulatory capture by domestic equity holders.

## 3.2 Numerical analysis

The analysis suggests that the intervention decision of a domestically-oriented supervisor depends in principle on the various dimensions of a bank's cross-border activities. An interesting question is whether the cross-border activities can also be quantitatively important for the intervention decision. Only if this is the case, can we expect significant welfare losses to result from cross-border activities.

This subsection contains a simple numerical exercise, with the aim of providing some sense of the potential quantitative implications of cross-border activities. For this we parameterize the model and analyze the intervention threshold for different assumption on cross-border activities. We assume a return on investment $R$ in period $2$ of $1.085$ (thus a net return of 8.5% conditional on success of the project) and a debt share $d$ of $0.9$. We take external failure costs in period $2$ as $c_2 = 0.5$. Box 1 summarizes the parameter choices. In Box 2 we report the resulting intervention thresholds $\widehat{\lambda}$ (calculated from equation (4)) for different foreign activity levels. We consider four cases: a purely domestic bank and banks that have respectively $50$ percent of either foreign assets, deposits or equity. Next to the intervention threshold we also calculate the implied CDS spread at the time of intervention.[4] We can see that under the chosen parameters the critical intervention threshold for a domestic bank is $0.946$. This translates into a CDS spread of 536bps (by means of comparison, the average spread of 54 intervened banks considered in the empirical analysis of Section 5 is 484bps). A bank with 50% foreign deposits sees a higher critical CDS spread of 749bps, consistent with Proposition 1 that the regulator is then more lenient. The magnitude of the increase in the critical spread is quite large, suggesting that the presence of foreign deposits can induce significant changes in regulatory behavior. Next, we see that a bank with 50% foreign assets has a critical spread of about 637bps. Even though the change is smaller than for foreign deposits, the implied impact on regulatory lenience remains large. Finally, we see that a bank that has 50% foreign equity has a critical CDS spread of only 284bps, suggesting a much

[4]Noting that the expected loss at the critical value is $(1-\widehat{\lambda})\cdot 1$ and assuming that the $CDS$ premium reflects the expected loss on the underlying asset, we obtain a corresponding CDS spread of $CDS = 1 - \widehat{\lambda}$.

stricter regulator. Again, the magnitude of the impact is large.

A key implication of our analysis is that a bank with substantial foreign activities still can be subject to efficient regulatory treatment – as long as its activities are balanced along the various dimensions. In order to better understand the trade-offs involved in achieving balance, Figure 1 shows the combinations of the cross-border shares for which the regulatory intervention is efficient (the x-axis is domestic deposits, the y-axis is domestic assets and the z-axis (vertical axis) is domestic equity). Above the surface the regulator is too lenient (domestic equity is too high given the banks cross-border mix of deposits and assets), while below the surface the regulator is too strict (domestic equity is too low for efficiency). We can see that the trade-offs between the various shares are fairly linear and reasonable. For example, for most combinations of domestic assets and deposits, there exists a domestic (equity) ownership share that avoids regulatory inefficiency. This implies that achieving balance is feasible for banks regardless of how international they are. We can also see that none of the three activity-shares is dominating, that is, each activity share can be offset by appropriate shares along the other two dimensions.

Taken together, the simple numerical analysis in this section suggests that even though each individual foreign activity severely distorts regulatory decisions, the distortions can effectively be avoided if the cross-border activities are balanced along their dimensions.

## 3.3 The case of external costs in period 1

We now discuss the case that also liquidation at date 1 results in externalities ($c_1 > 0$). In this case it is easy to show that the first part of Proposition 1 (domestic deposits increase the intervention threshold) still holds. However, the other parts of the proposition no longer hold generally. Take the case of cross-border banking through assets. Previously, higher foreign assets made the domestic supervisor too lenient as she does not internalize the externalities that arise abroad when the bank fails (due to $c_2 > 0$). When $c_1 > 0$, however, intervention at date 1 will also cause externalities, to be shared between the home and the host economy. As

the domestic supervisor ignores this, she will be too strict. The overall efficient implications in the presence of foreign assets then depend on the relative size of $c_1$ and $c_2$. If it is reasonable to presume the $c_2$ is much larger than $c_1$, the part of Proposition 1 applying to foreign assets will still hold.

The intuition in the case of foreign equity is more of technical nature. Taking derivative of (4) with respect to $\gamma_E$ and using (3) to substitute in $\widehat{\lambda}$ we obtain that

$$\widehat{\lambda}'(\gamma_E) = \frac{(1-d) - \widehat{\lambda}(R-d)}{\gamma_D d + \gamma_E(R-d) + \gamma_A c_2}. \tag{8}$$

The sign of the derivative thus depends on $(1-d) - \widehat{\lambda}(R-d)$. Only if $(1-d) < \widehat{\lambda}(R-d)$ does the third part of the Proposition ($\widehat{\lambda}'(\gamma_E) < 0$) still hold. The intuition for this is as follows: when the regulator intervenes at date 1, domestic equity holders obtain $1-d$ for sure, while if she does not, domestic equity obtains $\widehat{\lambda}(R-d)$ in expectation. Thus, if $\widehat{\lambda}(R-d) > 1-d$, gains from continuation are higher for equity. Hence, as the share of domestic equity increases, the regulator becomes more likely to not intervene and allow the bank to continue. Note now that the expected gains from continuation depend on the value of the critical threshold ($\widehat{\lambda}$) itself. And when $c_1$ becomes large, the threshold will be small (as can be verified from equation (4)), making it possible that the first effect outweighs the second one. Again, however, when $c_1$ is sufficiently small, this will not be the case and Proposition 1 will continue to hold. Considering our numerical simulation from above, however, we find that the original result for foreign equity is only overturned if $\lambda$ is below 0.55. This would imply a CDS of 4500bps, which is higher than the CDS spread of any of the intervened banks in the sample that we use below in empirical analysis.

## 3.4 Branches versus subsidiaries

We can use the model so far to discuss regulatory implication of organizational forms for international banks in establishing their presence in host markets. Banks have two main ways to undertake foreign operations: through branches or by having a foreign subsidiary.

The key difference between branches and subsidiaries is that in the case of a branch the supervisor in the country of the parent bank has responsibility (home supervisor), while in the case of a subsidiary it is the regulator in the country where the supervisor is located (host supervisor). Our model can be used to understand the relative regulatory attractiveness of either mode of foreign entry in terms of their welfare properties.

Consider first the case of a subsidiary. From the perspective of the host regulator, the subsidiary has a large share of foreign equity as the profits of the subsidiary will return to the parent company (low $\gamma_E$). Since the subsidiary will typically lend largely domestically in the host economy, the share of domestic assets is, however, large (high $\gamma_A$). In addition, the subsidiary might also source deposits largely locally (high $\gamma_D$). Thus, applying our model, from the perspective of the host supervisor, cross-border banking largely takes place through foreign equity ownership. Corollary 2 thus tells us that regulation and supervision will hence tend to be too strict. On the other hand, intervention costs $c_1$ might be higher in the case of a foreign subsidiary than a domestically-owned bank, as even in the case of a self-standing subsidiary, it might be hard to undertake a merger and acquisition or purchase and assumption operation in an efficient manner given the subsidiary's links with the parent bank (to some extent these additional cost can be avoided by ringfencing the subsidiary – which should serve to reduce the complexity of the intervention).

Consider next branching. Under branching, the home country supervisor has responsibility for supervision and the intervention decision. This supervisor can decide to intervene in the foreign branch but only jointly with intervention at the parent bank. We distinguish in the following between two cases: i) the size of the branch is small relative to the parent bank and, ii), the size of the branch is large relative to the parent bank. To focus ideas, we also assume that the health of the parent and the foreign branch are fully correlated (in terms of the model: both have the same realization of $\lambda$ at date 1), an assumption we relax below. In the case of the parent bank having more than one foreign operation (possibly in different countries), relative size is defined as the combined size of all foreign branches relative to the parent company.

Consider first the case where the foreign operations are small. From the perspective of the home regulator there is hence effectively no cross-border banking. Her liquidation decision is hence unbiased and efficient. In the case of large foreign operations, things play out as follows. Due to presence of foreign lending by the foreign branches, there is a substantial part of foreign assets ($\gamma_A$ low). In addition, there are also foreign deposits ($\gamma_D$ low), while there is no foreign equity ($\gamma_E$ high). Using corollary 2 we thus obtain that the domestic supervisor is too lenient. This lenience might be exacerbated if the share of investment that can be recovered in period 1 increases in $\gamma_A$, i.e. the recovery rate on foreign assets is less than one.

What does this imply for the regulatory desirability of branching versus representation through a subsidiary? In the case of a small foreign operation, branching is preferred as this leads to unbiased intervention decisions. When the foreign operation is large, there is a trade-off. In the case of a subsidiary, intervention in the foreign operation might be too strict, especially in countries with effective resolution frameworks, i.e. low $c_1$. In the case of a branch, intervention is too lenient. In either case, this leads to inefficient liquidation decisions both domestically and abroad.

**Conclusion 4** *When (total) foreign operations are small relative to the size of the parent bank, cross-border banking should take place through branching. When (total) foreign operations are large relative to the size of the parent bank, either branches or subsidiaries may be preferred.*

Relaxing the assumption of perfect correlation between $\lambda$ in the home and the host countries complicates things somewhat in the case of large cross-border activity. If $(1-\gamma_A)\lambda_F + \gamma_A\lambda_D < \widehat{\lambda}$, where $F$ denotes foreign and $D$ domestic, the home country supervisor will intervene. If the two $\lambda$s are sufficiently different, this might imply that external costs of failure resolution are imposed on a country where the banking operation is perfectly healthy (i.e. high $\lambda$). As the home country supervisor internalizes only $\gamma_A c_2$ , the supervisor is more lenient towards negative signals from the host countries. This can be further complicated if the

home country supervisor receives only a noisy signal about $\lambda$ in the host countries. While not affecting the intervention threshold, it will increase both type I and type II errors and thus reduce welfare.

Comparing the regulatory effects of branch versus subsidiary structure with the actual decision of international banks shows that banks with cross-border retail operations prefer indeed subsidiaries, while banks with small cross-border operations prefer branches (Cerutti et al., 2007). The recent expansion of some European banks (e.g. Icelandic banks and Nordea) in the form of branches, however, provides serious regulatory challenges, as we have shown in this sub-section.

# 4 Gains and losses from a supra-national supervisor

Until now, we have considered only a domestic supervisor and shown that the efficient and actual intervention threshold differ in the presence of foreign operations, be they in form of deposits, equity or assets. When domestic and efficient intervention thresholds differ, a supra-national supervisor could, in principle, always improve welfare because this supervisor would also take into account the effects that materialize outside the country. However, supra-national supervision might itself also be subject to imperfections.

First, the global supervisor may have imperfect knowledge about the success probability at date 1, receiving only a noisy signal.[5] Alternatively, we can assume that the domestic supervisor receives a less noisy signal about the success probability. This means that the supra-national supervisor, even though having the correct incentives, will make sometimes wrong decisions due to imperfect knowledge of the success probability. The benefits from delegation to a supra-national supervisor as it avoids the distorted incentives of domestic supervision have to be weighted against the costs arising because the global supervisor has an informational disadvantage. Without going into the formal argument, it is relatively easy to see that larger distortions due to higher shares of either foreign assets or deposits or due to

[5] See Holthausen and Ronde (2002) for a similar argumentation.

a higher share of foreign equity tip the welfare balance towards the supra-national supervisor, while larger information disadvantages for the supra-national supervisor tip the welfare balance towards the national supervisor.

Second, the global supervisor may be less efficient in intervening in either period 1 or in period 2 (in terms of the model: $c_1$ and $c_2$ are higher when the global supervisor is in charge), implying higher external costs for the affected economies. Such higher costs could arise from being farther away from the relevant market and thus being disadvantaged - relative to a national supervisor - in terms of arranging for a merger and acquisition or purchase and assumption operation. In addition, intervening and resolving a bank that is present in markets with different legal frameworks can result in extended and costly resolution, raising the external costs for the economies in question. However, there is one countervailing effect; a supra-national supervisor might be in a better position to resolve a financial institution that dominates its home country when operating in a supra-national banking market.[6]

The comparison between national and supra-national supervision has clear implications for the current debate on establishing a European-level failure resolution framework. First, such a regime can only improve the failure resolution for banks whose mix of foreign deposits, assets and equity puts them below or above the surface in Figure 1 and for which the intervention decision is thus distorted. However, such a supra-national framework also has to relate to the appropriate geographic area. As shown by Osterloo and Schoenmaker (2007) and Schoenmaker (2010), the largest 25 European have, on average, 25% of their assets outside their home country in other European countries. This share ranges, however, from two percent in the case of BBVA (which has 31% of assets outside Europe) to the Nordea Group, with 74% of assets outside its home countries in other European countries (and no assets outside Europe). A European-level supervisor would not help reduce distortions in the case of banks with significant share of assets outside Europe. Second, such a regime can only improve on a purely national resolution framework, if equipped with the necessary means and resources to resolve a bank efficiently. Third, such resolution powers have to come with the

[6]What is too big-to-resolve for one country might not be the too-big-to-resolve on the European level.

necessary supervision and monitoring tools; a close relationship with national supervisors is therefore critical.

# 5 Empirical analysis

The failure and intervention of Icelandic banks provide an illustrative example for our theoretical model. The late intervention by the Icelandic supervisors can be explained by the high shares of both foreign assets and deposits that Icelandic banks were holding, while equity was almost exclusively held by domestic agents. The fact that a large share of deposits were collected through branches rather than subsidiaries exacerbated the situation for host country supervisors as they had little information and even less power to intervene in time.

In the following, we subject our theoretical model to a formal empirical test by exploring a sample of 54 banks across 15 countries that failed and were intervened between 2007 and 2009. Specifically, we use the CDS spread at the time of intervention as indicator of regulatory lenience or strictness and relate it to the mix of foreign equity, assets and deposits of these banks, controlling for an array of other bank characteristics. We first explain the methodology, before presenting the data and discussing the results

## 5.1 Methodology

In our model, information about bank health ($\lambda$) is realized at a single point in time (date 1). This means that the regulator intervenes whenever the realization of $\lambda$ is anywhere below the critical $\lambda$. In reality, bank health will rather evolve in a more continuous fashion. This suggests that regulators will intervene precisely when the health has deteriorated to the degree that the critical $\lambda$ is reached – at least if the regulator does not perceive an option value of not closing down the bank. As a consequence, the CDS spread at the time of intervention would be an excellent indicator of regulatory lenience or strictness. An option effect may arise from the fact that a regulator may prefer not to close down a bank that has reached the critical threshold because there is the chance that the bank will recover in the future and

end up above the threshold. Such a consideration would simply serve to reduce the critical threshold at which the regulator intervenes – but the threshold would still depend on the various dimensions of "foreignness" as outlined in the analysis of the previous section. Hence, it remains appropriate to study how bank health at the time of intervention (as a measure of regulatory lenience) depends on foreignness.

Proposition 1 and the discussion above suggest the following testable hypotheses:

*1.The CDS-spread at the time of intervention i) decreases in the share of foreign equity, ii) increases in the share of foreign assets, and iii) increases in the share of foreign deposits.*

In the previous section we have argued that the liquidation decisions will be determined by the overall balance of all variables. We thus construct also a *net foreign balance* variable, defined as the difference between the share of foreign equity and the sum of the shares of foreign assets and deposits. The net foreign balance should be negatively associated with the lenience of the regulator. Consequently, our second empirical hypothesis is:

*2.The CDS-spread at the time of intervention decreases in a bank's net foreign balance.*

We test these two hypotheses with the following empirical specification:

$$y_i = \alpha + \beta \cdot \mathbf{F}_i + \theta \cdot \mathbf{Z}_i + \varepsilon_i. \tag{9}$$

where $\mathbf{F}_i$ is a vector of cross-border activities (share of foreign deposits (*FORD*), assets (*FORA*) and equity (*FORE*)) and $\mathbf{Z}_i$ is a vector of control variables. The dependent variable $y_i$ is the log of the CDS spread (*CDS*) or the log difference between CDS spread and the CDS index for the region where the bank is located (*CDS / Index*). The set of control variables includes different bank characteristics that can possibly explain the timing of regulatory intervention, but are outside our theoretical model. We include bank size, defined as the log of bank total assets, as there might be a regulatory bias towards intervening large banks too late, a phenomenon known as too-big- or too-complex-to-fail. We include the logs of the tier-1 capital ratio, as regulators face higher pressure to intervene undercapitalized banks, while lower liquidity, as measured by the ratio of liquid assets to total assets, might provide

an additional indication of fragility and thus trigger regulatory intervention. We include the ratio of non-performing loans relative to gross loans as indicator of loan portfolio quality and thus possible trigger for intervention.

In addition, we control for government ownership and timing of intervention. The considerations when intervening in banks with an equity stake owned by the government are presumably different ones and this is may be reflected in bank CDS spreads. For this reason, we use a dummy (*State*) in all specifications which indicates that the government has a stake of more than 5 percent in the bank. We also include a crisis dummy (*Sep08)* in our empirical model to isolate the effect of Lehman Brothers' collapse on CDS spreads – as this event has arguably increased pressure on regulators to intervene weak banks. The bailout dummy takes the value of 0 prior to September 2008 and 1 afterwards. We expect to find a negative association of *Sep08-Dummy* and the *State-Dummy* with the intervention threshold.

Moreover, we include two additional control variables in all specifications to control for other possible determinants of regulatory lenience. The dummy *CB* takes the value of 1 if the central bank is involved in the supervision of banks and the dummy variable *SPV* indicates whether more than one agency is involved in the supervision of banks. As discussed above, we expect central banks to be more stringent supervisors when being granted with such supervisory function. In addition, we expect that intervention decisions are more lenient in the case of multiple supervisors, as coordination problems may make it more difficult to agree on intervention. CDS spreads at intervention should hence be higher. Data on these variables come from the World Bank Survey on Banking Regulation (2008).

## 5.2 Data

Our analysis is based on a unique hand-collected bank-level dataset, which contains information on cross-border activities of European and U.S. banks that were intervened during the financial crisis in the period between 2007 and 2009. Our main sources of information on foreign equity, assets and deposits are annual reports and the accompanying notes to bank

financial statements from the fiscal year preceding bank intervention. The data on foreign assets and deposits are complemented by additional data sources provided by SNL Financial and Bloomberg. When data on foreign assets are missing, we use the share of foreign loans or deposits instead. In a similar way, we use the available data on foreign assets and loans as a complement for missing shares of foreign deposits.[7] In the case of foreign equity, we complement missing information in the annual reports with data from Bankscope on ownership by foreign shareholders. Since equity shares are likely to change quickly within a year, the share of foreign ownership is taken at the last available time period prior to the month of bank intervention.

We obtain the dates when banks were intervened from Laeven and Valencia (2010). We measure regulatory lenience or strictness by the CDS spread of the bank at the time of intervention. The idea is that a higher CDS spread at intervention reflects that the regulator has waited for bank health to deteriorate significantly before intervening, that is, her critical $\lambda$ is low.[8] Such a regulator is lenient in the language of our model. Conversely, a regulator who tends to intervene already at low CDS spreads is considered a strict regulator. We collect daily observations on five year senior debt CDS spreads from Datastream before bank intervention. Ideally we would like to use the values of the CDS spreads prior to the first release of a public announcement on bank intervention. However, the CDS spread at the day of intervention (or the previous day) may already reflect intervention expectations. In order to mitigate this problem, we use CDS spreads 3 days prior to intervention. As a bank's CDS spread might partly be driven by overall market movements, we use the difference (in logs) between a bank CDS spread and a CDS index as alternative indicator. A CDS index from Datastream about the European bank sector is used if the bank is located in Europe and the Datastream CDS index pertaining to the US banking sector - if the bank is located in the US. This captures the idea that regulators may base their intervention decision not on absolute

[7]The missing share of foreign assets is replaced with data on foreign loans or deposits in 5 cases. Replacement of missing data on foreign deposits with available data on foreign loans or assets occurs in 4 cases.

[8]Recalling that $\lambda$ is the likelihood of project success and that the LGD in our model is 100%, the relationship between CDS spread and threshold lambda is: $CDS = 1 - \lambda$.

bank health, but on how a bank fares relative to other banks. Looking at the difference to the CDS index will also help to control for non-credit risk factors in CDS spreads, such as economy-wide risk and liquidity premia. These premia have been shown to be an important part of CDS prices (see Amato (2005) and Bongaerts, de Jong and Driessen (2008)) but should in principle not affect regulatory intervention decisions. The CDS spreads in all regressions are winsorized at the 5 percent level and taken in logs.

Table 1 provides summary statistics. On average, the cross-border activities of banks in our sample seem balanced - the mean share of bank foreign equity is $35$ percent and the average share of foreign assets and deposits is $32$ percent. The mean of the net foreign balance, computed as foreign equity share minus foreign deposit share minus foreign asset share, is $-30$ percent.[9] There is a large variation in CDS spreads across banks. While the mean CDS spread is approximately $500$ around the time of intervention, it varies between $51$ and $3600$ basis points across banks. The U.S.-based bank Washington Mutual Inc. had the highest CDS spread at time of intervention in the dataset followed by the three Icelandic banks. On the other tail of the distribution, we have Commerzbank and BNP Paribas with the lowest CDS spreads at the time of intervention followed by two other French banks - Credit Agricole SA and Societe Generale SA.

Table 2 reports correlations. The pair-wise correlations between the CDS-based measures of lenience and the shares of foreign bank activities have the expected signs but are not significant at the 10 percent level. The CDS spread for example is decreasing in foreign equity and bank net foreign balance and increasing in the share of foreign assets and deposits (as well as in the average of their shares). The insignificance of the correlation estimates may reflect that we need to control for various other factors that influence the intervention decision. Next we look at the control variables and their correlation with our measures of lenience. Bank size, the ratio of non-performing loans to total loans and the liquid asset

[9]The intervention threshold for the bank with mean net foreign balance implied by the model of Section 3.2 is $515$ bps, which is close to the implied CDS for a purely domestic bank (CDS spread of $526$ bps). This suggests that even though each individual foreign activity share may distort the intervention decision, for the mean bank the various effects are approximately offsetting.

ratio have a statistically significant and negative correlation with the CDS spread relative to the CDS spread index and have the expected signs in the correlations with the CDS spread. There is a high correlation between foreign assets and deposits suggesting that their joint inclusion in regressions can lead to multicollinearity. Thus in regressions we either use their average *(FORAD)* or include them in separate specifications.

## 5.3 Results

The results in Table 3 provide evidence consistent with the hypotheses derived from our model. Here, we relate the CDS spreads at time of intervention with the various foreign activity shares. In column 1 of Table 3 we fit a model that includes foreign equity and foreign deposits while in column 2 the share of foreign deposits is replaced with the share of foreign assets. Due to high correlation between foreign assets and deposits, we include the average of both in column 3. In column 4, we fit the same model as in column 3 but also include our set of additional controls.[10] The coefficient estimates of the variables of interest have signs consistent with the theoretical model. Banks' foreign equity share is negatively associated with the CDS spread at time of intervention, with coefficient estimates that are statistically significant either at the one or the five percent level. An increase in the share of bank foreign equity by one percentage point is associated with an increase in CDS spreads around the period of intervention between 0.85 and 1.50 percent, ceteris paribus. Similarly, the coefficient estimates of foreign assets and deposits are significant and have the expected positive sign. An one percentage point increase in those shares is associated with a decrease in CDS spreads by about 0.90 and 1.25 percent.

In columns 5 to 8 of Table 3 we replace the log of bank CDS spread as the dependent variable with the log of the CDS spread relative to the log of the regional CDS index. We confirm our results. It is important to note that the impact of the different types of cross-border activities on CDS spreads is of a similar magnitude. For example, the column 4 estimates

[10]We include some of the variables only in column 4 as they are not available for all banks and thus reduce the sample size.

show that an increase in the average share of foreign assets and deposits by one percentage point is associated with an increase in CDS spreads by about 1.69 percent, suggesting higher regulatory lenience. The magnitude of the effect of share of foreign equity is of similar size, but of the opposite direction. An increase by one percentage point in foreign equity is associated with a decrease in CDS spreads by about 1.47 percent, ceteris paribus. The similarity of the coefficients suggests that for balanced banks the regulatory intervention may not need to be distorted as the effect of one foreign dimension can be easily offset by another one. Note that a better fit (as indicated by the R-squared) is obtained for the regressions with the relative CDS spreads.

Turning to the control variables, we find that bank size is negatively and significantly associated with the CDS spread at time of intervention, suggesting that regulators are actually stricter with larger banks, contrary to the too-big-to-fail hypothesis. Banks that were intervened after September 2008 were intervened at lower CDS spreads, suggesting a stricter regulatory approach after this event. The negative and significant sign on state ownership suggests a stricter approach of regulators towards these banks. In columns (4) and (8), we also find that a higher tier one capital ratio is associated with later intervention, while high liquidity is associated with earlier intervention. There is no evidence that the quality of the loan portfolio is associated with the timing of intervention. We also do not find evidence that the institutional structure of supervision matters for intervention thresholds. Neither the involvement of the central bank nor the existence of multiple supervisors is significantly associated with the CDS spread at time of intervention.

In addition, we also estimate our model using as dependent variable CDS spreads taken at different points in times (relative to the intervention date). Table 4 reports regression results with the average CDS spreads of banks two weeks before intervention as the dependent variable. The coefficient estimates of the variables of interest are significant except the share of foreign assets in column (2). Comparison of results with Table 3 shows, however, that the estimates on the foreign activity variables are less precise, with higher standard errors. This is to be expected since CDS spreads may then not fully reflect the deterioration in bank health

that is very likely to take place just prior to the intervention. We have also run regressions where we use the average CDS spreads either one week, three weeks or one month prior to intervention (available on request); as we move farther away from the intervention date, the coefficient estimates become less precise.

The Table 5 results confirm our previous findings using the mix of foreign activities as gauged by the net foreign balance as principal explanatory variable. Panel A presents results using a simple unweighted version of the net foreign balance defined as foreign equity share minus foreign asset share minus foreign deposit share. The net foreign balance enters negatively and significantly at the one percent level, suggesting that regulators are stricter the more biased the foreign activity balance is towards foreign payoffs. Across all specifications, an increase by one percentage point in the NFB leads to a decrease in CDS spreads by between 0.60 and 0.95 percent. The goodness of fit as indicated by the R-squared is again higher when the relative CDS spreads are used as dependent variables; suggesting that this may be the more appropriate specification.

The results in Table 5 Panel B confirm our findings with an alternative measure of the net foreign balance. So far, we have assumed that the influence of each foreign dimension on the regulatory intervention is the same (in absolute terms). The analysis in the theoretical model, however, suggests that these influences differ (even though they are of similar magnitude). We therefore construct an alternative net foreign balance measure that takes this into account. For this we take as the basis a bank that has foreign shares equal to the respective sample means. For this bank we compute, using the parameters of section 3.2, the derivative of the critical lambda with respect to a foreign activity. To obtain the "weights" we then normalize these derivatives such that their average takes one, that is, equal to the average value for the unweighted net foreign balance, thus making the coefficient sizes comparable. The results in Panel B of Table 5 use the weighted version of the net foreign balance. The coefficient estimates are of the same significance and similar size as the results in Panel A, thus showing little difference between weighted and unweighted versions of the net foreign balance variables.

In a final step, we test the validity of our intervention model for a sample of 24 banks that were not intervened during the financial crisis.[11] As in the case of our sample of intervened banks, the share of foreign activity ranges widely, from zero percent foreign ownership to over 80 percent of foreign ownership or foreign assets or deposits. If our model provides a reasonable description of intervention thresholds, the spreads of non-intervened banks should tend to be below their predicted intervention threshold. We test this by calculating the predicted intervention thresholds for non-intervened banks (using the estimated coefficients from regression 3 in Table 3). We then compare these predicted spreads to the actual spreads of these banks during the sample period. Table 6 contains the results, reporting the fraction of days for which the actual spreads of a bank are below its predicted intervention spread. For this, the table separates the sample in a pre- and a post-Lehman Brothers period, as the predicted intervention threshold is lower for all banks after the Lehman Brothers shock (see last two columns).

The Table 6 results provides additional support for our theoretical model, as most non-intervened banks had spreads below the intervention threshold as predicted by their foreign ownership and asset/deposit shares. On average, 99 percent of daily spreads are below predicted spreads before Lehman Brothers' collapse and about 83 percent afterwards. For many banks, 100 percent of CDS spreads are below the predicted intervention threshold, with a few outliers, such as the Spanish Banco Popular, the US investment bank Morgan Stanley, Barclays and the US financial conglomerate Metlife Inc. that have a substantial period with CDS spreads above the predicted threshold after Lehman Brothers' failure. Overall, this lends support to our empirical model of the intervention decision since the model (when estimated on intervened banks) tends to predict that non-intervened banks are below the intervention threshold.

[11] Bank size and location are used as main criteria for the inclusion of banks in the sample of non-intervened banks. The data on foreign asset and deposit shares is collected for the fiscal year of 2007. Data on foreign ownership comes from Bankscope.

# 6 Conclusions

This paper uses a very simple model to discuss the trade-offs in bank resolution frameworks when dealing with cross-border banks. We show that foreign assets and deposits, on the one hand, and foreign equity, on the other hand, have different implications for the intervention decisions of home country regulators. Critically, a mix of the three can lead to the same intervention threshold as a purely domestic bank. We also show that a supra-national supervisor can improve on the efficiency of the intervention decision, but only if equipped with the necessary mechanisms and information. Our model can inform both the discussion on national versus supra-national bank supervision and the discussion on the optimal organization of cross-border activity from the regulator's viewpoint.

Our empirical estimation using a sample of intervened banks during the recent crisis confirm the predictions of the model. Banks with a higher share of foreign equity were intervened relatively early as their financial health deteriorated, while banks with a high share of foreign deposits and assets were intervened relatively late. These findings clearly support the predictions of the theoretical model that national regulators have biased incentives when dealing with cross-border banks and have critical implications for the reform of resolution regimes around the world.

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| Box 1: Parameter Values used in the Numerical Analysis | |
|---|---|
| Parameters | |
| R | 1.085 |
| d | 0.9 |
| $c_2$ | 0.5 |

| Box 2: Estimated Intervention Thresholds | | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | DOMESTIC | 50% FORD | 50% FORA | 50% FORE |
| FORD | 1 | 0.5 | 1 | 1 |
| FORA | 1 | 1 | 0.5 | 1 |
| FORE | 1 | 1 | 1 | 0.5 |
| Lambda | 0.946 | 0.925 | 0.936 | 0.972 |
| CDS (in bps) | 536 | 749 | 637 | 285 |

Note: Box 1 and Box 2 summarize the set-up and results from our numerical analysis. Box 1 gives an overview of the parameter choices. Box 2 reports the resulting intervention thresholds for four cases: a purely domestic bank (Column 1), and banks that have respectively 50 percent of either foreign deposits (Column 2), assets (Column 3) or equity (Column 4). Next to the intervention threshold we also calculate the implied CDS spread at the time of intervention (in basis points).

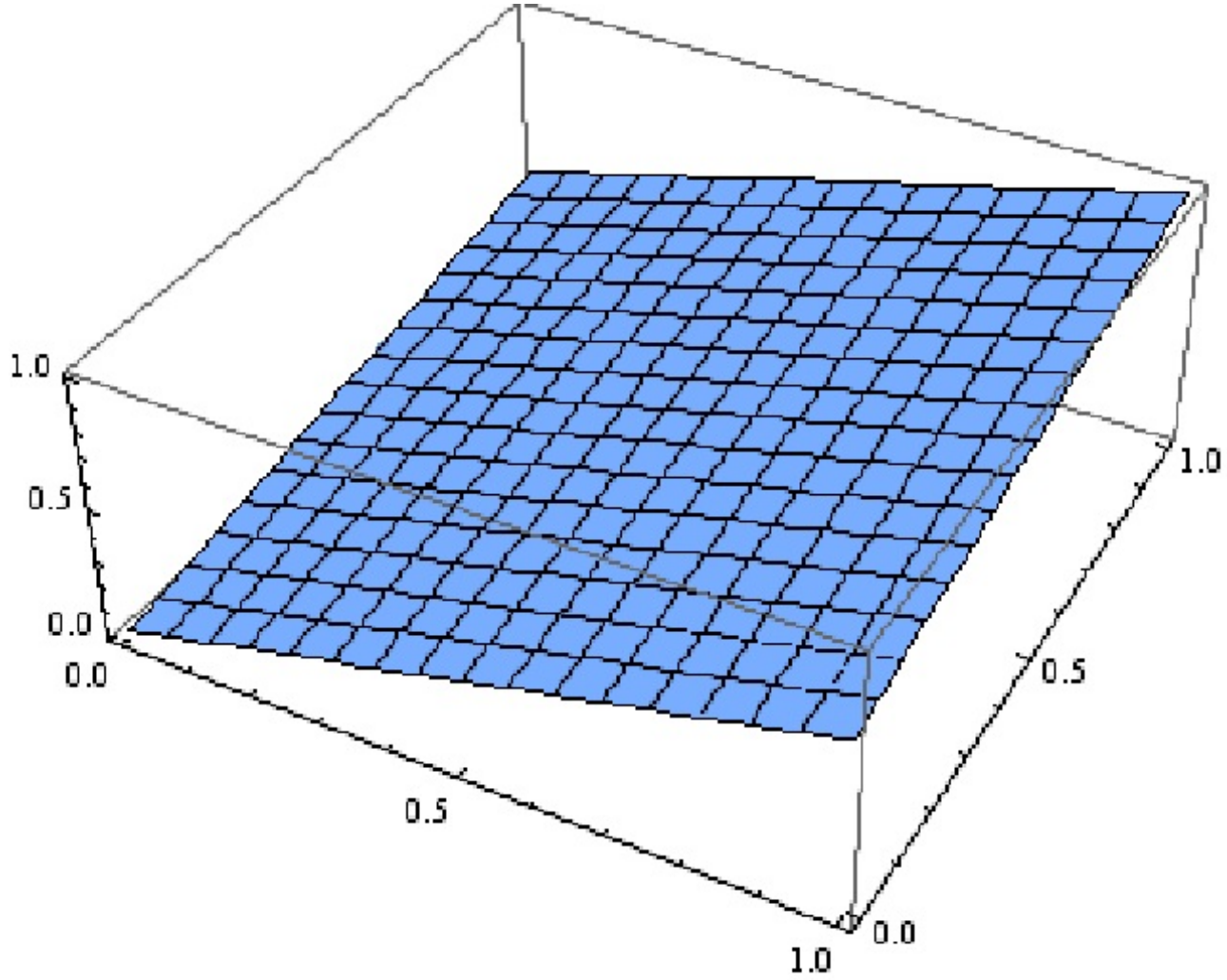


Figure 1: Efficient Regulatory Intervention

Note: This graph shows the combination of the three (domestic) shares for which regulatory intervention is efficient. X-axis is domestic deposits, y-axis is domestic assets, z-axis (horizontal axis) is domestic equity. Above the surface the regulator is too lenient (domestic equity is too high given the bank's cross-border mix of deposits and assets), while below the surface the regulator is too strict (domestic equity is too low for efficiency). We can see that the trade-offs between the various shares are fairly linear and reasonable. For example, for most combinations of domestic assets and deposits, there exists a domestic (equity) ownerhip share that avoids regulatory inefficiency. This implies that achieving balance is feasible for banks regardless of how international they are. We can also see that none of the three activity-shares is dominating, that is, each activitiy share can be offset by appropriate shares along the other two dimensions.

Table 1: Summary Statistics

| Variable | Observations | Mean | Median | St. Dev. | Min. | Max. |
|---|---|---|---|---|---|---|
| CDS (3 days b/e intervention) | 54 | 484.05 | 235.60 | 692.48 | 51.70 | 3626.20 |
| CDS (at day of intervention) | 54 | 486.30 | 205.17 | 938.55 | 56.50 | 6055.40 |
| CDS / INDEX (3 days b/e intervention) | 54 | 301.32 | 69.17 | 686.03 | -151.14 | 3452.72 |
| Foreign ownership share | 54 | 0.35 | 0.33 | 0.25 | 0 | 1 |
| Foreign asset share | 54 | 0.32 | 0.31 | 0.24 | 0 | 0.90 |
| Foreign deposit share | 54 | 0.32 | 0.27 | 0.25 | 0 | 1 |
| Net Foreign Balance | 54 | -0.29 | -0.28 | 0.47 | -1.20 | 0.64 |
| Average foreign asset and deposit share | 54 | 0.32 | 0.28 | 0.23 | 0 | 0.87 |
| SIZE (total assets in mil. EUR) | 54 | 464,850 | 279,465 | 488,836 | 5,528 | 2,586,701 |
| SPV - multiple supervisors | 54 | 0.48 | 0 | 0.50 | 0 | 1 |
| CB - central bank involved in supervision | 54 | 0.57 | 1 | 0.50 | 0 | 1 |
| TIER1 capital-asset ratio | 46 | 0.08 | 0.08 | 0.02 | 0.05 | 0.21 |
| Liquid asset share | 53 | 0.22 | 0.20 | 0.13 | 0.01 | 0.57 |
| NPLs, relative to total loans | 46 | 0.02 | 0.02 | 0.02 | 0.01 | 0.08 |
| SEPT08 | 54 | 0.67 | 1 | 0.48 | 0 | 1 |
| State ownership | 54 | 0.17 | 0 | 0.38 | 0 | 1 |

Sources: Bank annual reports and financial statemens; SNL Financial, DataStream, Bloomberg, BankScope, World Bank and authors' calculations. CDS spreads are reported before being winsorized.

Note: This table contains summary statistics on the variables used in the empirical analysis. The sample includes US and European banks that were intervened in the period between 2007 and 2009 (taken from Laeven and Valencia (2010).

Table 2: Correlation Table

| | CDS | CDS / INDEX | FORE | FORA | FORD | NFB | FORAD | SIZE | SPV | CB | TIER1 | LIQAS | NPLs/TLs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CDS | 1 | | | | | | | | | | | | |
| CDS / INDEX | 0.8776 | 1 | | | | | | | | | | | |
| | *0.0000* | | | | | | | | | | | | |
| FORE | -0.1179 | -0.1182 | 1 | | | | | | | | | | |
| | *0.3957* | *0.3945* | | | | | | | | | | | |
| FORA | 0.0628 | 0.0855 | 0.4428 | 1 | | | | | | | | | |
| | *0.6518* | *0.5389* | *0.0001* | | | | | | | | | | |
| FORD | 0.18 | 0.1773 | 0.3303 | 0.7951 | 1 | | | | | | | | |
| | *0.1929* | *0.1996* | *0.0043* | *0.0000* | | | | | | | | | |
| NFB | -0.1914 | -0.2016 | 0.16 | -0.7534 | -0.8304 | 1 | | | | | | | |
| | *0.1656* | *0.1437* | *0.1763* | *0.0000* | *0.0000* | | | | | | | | |
| FORAD | 0.1317 | 0.142 | 0.4055 | 0.9428 | 0.9518 | -0.8375 | 1 | | | | | | |
| | *0.3425* | *0.3057* | *0.0004* | *0.0000* | *0.0000* | *0.0000* | | | | | | | |
| SIZE | -0.3628 | -0.4903 | 0.1577 | 0.1595 | 0.1367 | -0.0664 | 0.1558 | 1 | | | | | |
| | *0.0070* | *0.0002* | *0.1795* | *0.1778* | *0.2490* | *0.5767* | *0.1882* | | | | | | |
| SPV | 0.0434 | 0.1913 | -0.1172 | 0.1106 | 0.1355 | -0.2025 | 0.1304 | -0.2726 | 1 | | | | |
| | *0.7555* | *0.1657* | *0.3199* | *0.3517* | *0.2530* | *0.0857* | *0.2715* | *0.0188* | | | | | |
| CB | -0.101 | -0.1986 | -0.0238 | -0.0585 | -0.1345 | 0.1061 | -0.1035 | 0.0569 | -0.3837 | 1 | | | |
| | *0.4673* | *0.1499* | *0.8404* | *0.6229* | *0.2566* | *0.3717* | *0.3834* | *0.6304* | *0.0007* | | | | |
| TIER1 | 0.374 | 0.4303 | 0.3814 | 0.257 | 0.1527 | -0.0342 | 0.2139 | 0.0978 | -0.2312 | -0.1347 | 1 | | |
| | *0.0105* | *0.0028* | *0.0029* | *0.0515* | *0.2524* | *0.7991* | *0.1069* | *0.4611* | *0.0780* | *0.3092* | | | |
| LIQAS | -0.2912 | -0.2957 | -0.0664 | 0.2579 | 0.188 | -0.3029 | 0.234 | 0.3108 | -0.0404 | -0.1693 | 0.0857 | 1 | |
| | *0.0344* | *0.0316* | *0.5821* | *0.0311* | *0.1192* | *0.0108* | *0.0512* | *0.0083* | *0.7378* | *0.1580* | *0.5188* | | |
| NPLs/TLs | -0.2025 | -0.3033 | -0.2331 | -0.2265 | -0.2468 | 0.1317 | -0.2503 | -0.0263 | -0.0769 | 0.3163 | -0.3576 | 0.1537 | 1 |
| | *0.1772* | *0.0404* | *0.0782* | *0.0902* | *0.0642* | *0.3287* | *0.0604* | *0.8444* | *0.5660* | *0.0156* | *0.0079* | *0.2494* | |

Note: p-values reported in italics. Significance levels notation:*** p<0.01, ** p<0.05, * p<0.1.

Table 3: Regulatory Lenience and Cross-Border Activities

| Dep. Variable | CDS | | | | CDS / Index | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Foreign ownership share | -0.865*** | -0.936** | -0.945*** | -1.477*** | -0.680** | -0.763** | -0.755** | -1.284*** |
| | *0.318* | *0.396* | *0.350* | *0.449* | *0.312* | *0.364* | *0.335* | *0.428* |
| Foreign deposit share | 1.253*** | | | | 1.021*** | | | |
| | *0.371* | | | | *0.366* | | | |
| Foreign asset share | | 0.905* | | | | 0.830** | | |
| | | *0.474* | | | | *0.381* | | |
| Average foreign asset and deposit share | | | 1.244*** | 1.687*** | | | 1.065** | 1.382*** |
| | | | *0.442* | *0.415* | | | *0.405* | *0.358* |
| SIZE | -0.300*** | -0.305*** | -0.304*** | -0.257*** | -0.357*** | -0.361*** | -0.360*** | -0.235*** |
| | *0.0894* | *0.0964* | *0.0949* | *0.0886* | *0.0722* | *0.0773* | *0.0753* | *0.0829* |
| SEPT08 | -1.074*** | -0.991*** | -1.043*** | -1.297*** | -1.075*** | -1.013*** | -1.054*** | -1.185*** |
| | *0.212* | *0.224* | *0.217* | *0.371* | *0.183* | *0.185* | *0.183* | *0.309* |
| State ownership | -0.660** | -0.752** | -0.737** | -0.308 | -0.595*** | -0.686*** | -0.663*** | -0.594** |
| | *0.310* | *0.314* | *0.306* | *0.312* | *0.209* | *0.212* | *0.207* | *0.245* |
| SPV - multiple supervisors | -0.185 | -0.169 | -0.169 | 0.0384 | 0.267 | 0.285 | 0.282 | 0.468** |
| | *0.243* | *0.251* | *0.244* | *0.193* | *0.225* | *0.229* | *0.225* | *0.186* |
| CB - central bank | -0.0546 | -0.186 | -0.0993 | -0.114 | -0.00240 | -0.0975 | -0.0305 | 0.108 |
| | *0.239* | *0.258* | *0.245* | *0.262* | *0.206* | *0.197* | *0.199* | *0.232* |
| NPLs, relative to total loans | | | | 0.203 | | | | 0.00420 |
| | | | | *0.128* | | | | *0.113* |
| TIER1 capital-asset ratio | | | | 1.208** | | | | 1.267*** |
| | | | | *0.536* | | | | *0.451* |
| Liquid asset share | | | | -2.992*** | | | | -2.083*** |
| | | | | *0.970* | | | | *0.739* |
| Constant | 10.19*** | 10.41*** | 10.28*** | 7.836*** | 5.473*** | 5.636*** | 5.529*** | 1.812 |
| | *1.173* | *1.249* | *1.224* | *1.820* | *0.979* | *1.024* | *1.004* | *1.507* |
| Observations | 54 | 54 | 54 | 45 | 54 | 54 | 54 | 45 |
| R-Squared | 0.541 | 0.494 | 0.525 | 0.678 | 0.639 | 0.612 | 0.633 | 0.731 |

Note: Robust standard errors in italics. Significance levels notation:*** p<0.01, ** p<0.05, * p<0.1.

Table 4: Regulatory Lenience and Cross-Border Activities (CDS spread two weeks prior to intervention)

| Dep. Variable | CDS | | | | CDS / Index | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Foreign ownership share | -0.811** | -0.896** | -0.895** | -1.307*** | -0.563* | -0.674* | -0.648* | -0.830** |
| | *0.319* | *0.401* | *0.353* | *0.464* | *0.308* | *0.363* | *0.331* | *0.338* |
| Foreign deposit share | 1.090*** | | | | 0.915*** | | | |
| | *0.367* | | | | *0.325* | | | |
| Foreign asset share | | 0.774 | | | | 0.787* | | |
| | | *0.499* | | | | *0.396* | | |
| Average foreign asset and deposit share | | | 1.071** | 1.656*** | | | 0.971** | 1.369*** |
| | | | *0.456* | *0.407* | | | *0.385* | *0.352* |
| SIZE | -0.305*** | -0.316*** | -0.313*** | -0.274*** | -0.358*** | -0.369*** | -0.365*** | -0.249*** |
| | *0.0863* | *0.0939* | *0.0915* | *0.0984* | *0.0721* | *0.0775* | *0.0754* | *0.0813* |
| SEPT08 | -0.757*** | -0.673*** | -0.726*** | -0.791* | -0.785*** | -0.727*** | -0.768*** | -0.605** |
| | *0.189* | *0.201* | *0.195* | *0.402* | *0.184* | *0.183* | *0.185* | *0.260* |
| State ownership | -0.829** | -0.874** | -0.884** | -0.489 | -0.328* | -0.396 | -0.386* | -0.354 |
| | *0.327* | *0.390* | *0.351* | *0.365* | *0.192* | *0.254* | *0.217* | *0.235* |
| SPV - multiple supervisors | -0.216 | -0.256 | -0.237 | -0.210 | 0.184 | 0.149 | 0.167 | 0.165 |
| | *0.197* | *0.212* | *0.200* | *0.200* | *0.163* | *0.169* | *0.163* | *0.155* |
| CB - central bank | -0.235 | -0.376* | -0.297 | -0.470** | -0.127 | -0.235 | -0.169 | -0.291* |
| | *0.197* | *0.219* | *0.201* | *0.201* | *0.144* | *0.143* | *0.136* | *0.151* |
| NPLs, relative to total loans | | | | 0.192 | | | | 0.0685 |
| | | | | *0.158* | | | | *0.133* |
| TIER1 capital-asset ratio | | | | 1.094** | | | | 1.385*** |
| | | | | *0.510* | | | | *0.403* |
| Liquid asset share | | | | -3.516*** | | | | -2.526*** |
| | | | | *1.025* | | | | *0.850* |
| Constant | 10.06*** | 10.39*** | 10.22*** | 8.225*** | 5.278*** | 5.551*** | 5.404*** | 1.471 |
| | *1.131* | *1.207* | *1.173* | *1.719* | *0.981* | *1.024* | *1.006* | *1.281* |
| Observations | 49 | 49 | 49 | 40 | 49 | 49 | 49 | 40 |
| R-Squared | 0.463 | 0.414 | 0.445 | 0.615 | 0.613 | 0.589 | 0.608 | 0.720 |

Note: Robust standard errors in italics. Significance levels notation:*** p<0.01, ** p<0.05, * p<0.1.

Table 5: Regulatory Lenience and Bank Net Foreign Balance

| | Panel A | | | | Panel B | | | |
|---|---|---|---|---|---|---|---|---|
| Dep. Variable | CDS | | CDS / Index | | CDS | | CDS / Index | |
| | (1) | (2) | (3) | (4) | (1) | (2) | (3) | (4) |
| Net Foreign Balance | -0.683*** | -0.941*** | -0.567*** | -0.774*** | -0.716*** | -1.053*** | -0.585*** | -0.889*** |
| | *0.207* | *0.216* | *0.193* | *0.190* | *0.194* | *0.242* | *0.192* | *0.212* |
| SIZE | -0.301*** | -0.254** | -0.370*** | -0.266** | -0.293*** | -0.256*** | -0.363*** | -0.268*** |
| | *0.097* | *0.098* | *0.083* | *0.098* | *0.081* | *0.085* | *0.0724* | *0.087* |
| SEPT08 | -1.069*** | -1.184*** | -1.000*** | -1.049*** | -1.074*** | -1.337*** | -1.003*** | -1.186*** |
| | *0.212* | *0.361* | *0.178* | *0.298* | *0.211* | *0.351* | *0.180* | *0.287* |
| State ownership | -0.831*** | -0.285 | -0.523*** | -0.362 | -0.798** | -0.284 | -0.494*** | -0.364 |
| | *0.272* | *0.298* | *0.155* | *0.215* | *0.305* | *0.310* | *0.179* | *0.223* |
| SPV - multiple supervisors | 0.008 | 0.092 | 0.103 | 0.153 | -0.060 | 0.038 | 0.048 | 0.105 |
| | *0.191* | *0.186* | *0.137* | *0.147* | *0.200* | *0.188* | *0.139* | *0.148* |
| CB - central bank | 0.049 | -0.104 | -0.145 | -0.153 | -0.045 | -0.107 | -0.225 | -0.153 |
| | *0.208* | *0.253* | *0.144* | *0.219* | *0.219* | *0.242* | *0.151* | *0.212* |
| NPLs, relative to total loans | | 0.235* | | 0.092 | | 0.191 | | 0.0578 |
| | | *0.120* | | *0.121* | | *0.124* | | *0.127* |
| TIER1 capital-asset ratio | | 1.098* | | 1.174** | | 1.321** | | 1.358*** |
| | | *0.604* | | *0.503* | | *0.555* | | *0.465* |
| Liquid asset share | | -3.272*** | | -2.114** | | -2.769*** | | -1.717* |
| | | *0.965* | | *0.932* | | *0.974* | | *0.882* |
| Constant | 9.953*** | 7.682*** | 5.699*** | 2.335 | 10.19*** | 7.699*** | 5.900*** | 2.365 |
| | *1.267* | *2.065* | *1.098* | *1.794* | *1.084* | *1.889* | *0.943* | *1.606* |
| Observations | 54 | 45 | 54 | 45 | 54 | 45 | 54 | 45 |
| R-squared | 0.517 | 0.660 | 0.620 | 0.687 | 0.522 | 0.685 | 0.622 | 0.714 |

Note: In Panel A the NFB variable is constructed as NFB=FORO-FORD-FORA. The defintion of the NFB variable in Panel B is NFB=1.54*FORO-0.93*FORD-0.51*FORA. In this second case the weights refer to the representative bank in our bank sample and the estimates are obtained by use of numerical analysis as described in Section 5.3. Robust standard errors in italics. Significance levels notation:*** p<0.01, ** p<0.05, * p<0.1.

Table 6: Predicted Intervention Thresholds for Non-Intervened Banks and Actual CDS Spreads

| Bank | CDS Nr.Observ. | Share foreign ownership | Average share for. assets and deposits | % share CDS below predicted values | |
|---|---|---|---|---|---|
| | | | | prior to Lehman failure | after Lehman failure |
| DEUTSCHE BANK AG | 262 | 55.00% | 30.00% | 100.00% | 97.71% |
| JPMORGAN CHASE & CO | 262 | 20.99% | 33.50% | 100.00% | 97.33% |
| BANCO SANTANDER SA | 262 | 47.52% | 60.78% | 100.00% | 100.00% |
| BARCLAYS PLC | 262 | 37.30% | 32.48% | 100.00% | 58.78% |
| BANK OF SCOTLAND PLC | 251 | 0.00% | 15.00% | 99.60% | 68.92% |
| CREDIT SUISSE GROUP AG | 262 | 43.99% | 74.00% | 100.00% | 100.00% |
| BANCO BILBAO VIZCAYA ARGENTA | 262 | 37.68% | 45.60% | 100.00% | 100.00% |
| DRESDNER BANK AG | 262 | 0.00% | 39.14% | 100.00% | 100.00% |
| NORDEA BANK AB | 169 | 33.00% | 71.26% | 100.00% | 100.00% |
| STANDARD CHARTERED PLC | 262 | 93.00% | 83.00% | 100.00% | 100.00% |
| DNB NOR ASA | 143 | 47.73% | 18.03% | 100.00% | 100.00% |
| SKANDINAVISKA ENSKILDA | 172 | 24.20% | 36.93% | 100.00% | 100.00% |
| UBI BANCA SCPA | 133 | 17.11% | 6.25% | 100.00% | 100.00% |
| BANCO POPULAR ESPANOL | 138 | 39.73% | 6.54% | 100.00% | 41.30% |
| MEDIOBANCA SPA | 262 | 60.68% | 42.51% | 100.00% | 100.00% |
| BANCO DE SABADELL SA | 242 | 21.04% | 5.95% | 100.00% | 78.47% |
| BANCO ESPIRITO SANTO | 209 | 72.67% | 27.29% | 100.00% | 100.00% |
| CAJA DE AHORROS DEL MEDITER. | 262 | 0.00% | 8.00% | 100.00% | 29.25% |
| BANCO COMERCIAL PORTUGUÊS. | 147 | 56.32% | 23.70% | 100.00% | 100.00% |
| IRISH LIFE & PERMANENT GROUP | 262 | 37.51% | 5.00% | 100.00% | 63.95% |
| MORGAN STANLEY | 258 | 23.79% | 34.00% | 93.13% | 35.88% |
| BANKINTER SA | 262 | 20.75% | 5.00% | 100.00% | 96.83% |
| METLIFE INC | 63 | 18.14% | 7.50% | 82.44% | 52.67% |
| RABOBANK | 262 | 0.01% | 34.33% | 100.00% | 84.73% |
| Mean | | | | 98.97% | 83.58% |
| Median | | | | 100.00% | 98.85% |

Sources: Bank annual reports and financial statemens; SNL Financial, DataStream, Bloomberg, BankScope, and authors' calculations.