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Cooperation in International Banking Supervision*

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Abstract

This paper analyzes cooperation between sovereign national authorities in the supervision and regulation of a multinational bank. We take a political economy approach to regulation and assume that supervisors maximize the welfare of their own country. The communication between the supervisors is modeled as a 'cheap talk' game. We show that: (1) unless the interests of the countries are perfectly aligned, first best closure regulation cannot be implemented; (2) the more aligned the interests are, the higher is welfare; (3) the bank can allocate its investments strategically across countries to escape closure.

Keywords: multinational banks, supervision, closure, cheap talk.

JEL codes: F36, G21, G28, L51.

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1 Introduction

The troubles surrounding the supervision, and later closure, of the multinational bank 'Bank of Credit and Commerce International' (BCCI) was a wake-up call for banking supervisors worldwide. It demonstrated how opportunistic behavior by national banking supervisors can create loopholes in the supervision that allow a multinational bank to hide from close supervisory scrutiny.[1] At the same time, prudent supervision of multinational banks is increasingly important as banking becomes more and more international. Amihud et al. (2002), for example, find that the number of cross-border bank mergers has increased steadily, and more than quintupled from 1985 until 1998. Similarly, in the euro area one can observe a significant increase in international merger activity involving credit institutions: between 1996 and 2001, the number of M&As between domestic and foreign banks increased by 77% to 55 per year.[2] This trend towards more multinational banks is expected to continue as new technologies, such as Internet banking, and deregulation lower the barriers to entry into the previously protected national markets.

Financial regulators have long been aware of the problems surrounding the supervision of multinational banks, and considerable efforts have been invested in developing a sound regulatory framework. Most of this work has taken place under the aegis of the Bank of International Settlements (BIS). The key document is the so-called 'Basel Concordat' (BIS, 1983) that consists of recommended guidelines of best practices. Together with the 'Core Principles for Effective Banking Supervision' (BIS, 1997) that were established following the BCCI crisis, they are now followed by many countries.

With the implementation of the Basel guidelines, responsibilities between different national authorities in banking supervision are now clearly divided. Moreover, many countries have established bilateral agreements (Memoranda of Understanding) that specify how information exchange should be organized. Still, in this paper we argue that these types of agreements are not sufficient to guarantee a complete flow of information between banking supervisors. While 'hard' information such as information contained in balance sheets is easily transmitted, supervisors also have access to 'softer' information that may not be easily quantified. This could, for instance, be informal information about borrowers, or market rumors about possible difficulties of a financial institution. Such information can be important in assessing the financial health of a bank. However, because of its nature, it may not automatically be reported to the foreign authorities engaged in the supervision of the institution.

In this paper, we analyze voluntary exchange of soft information between national authorities in the supervision of a multinational bank. The setup of the model is as follows: A bank is operating in two countries. The bank is legally incorporated in the 'home country', and conducts all business in the 'host country' through a branch. In line with the Basel rules, its consolidated

[1] The liquidation of Bank of Credit and Commerce International has been running for more than 11 years and the cost has passed \$1.2bn (*The Guardian*, May 15, 2003).

[2] Source: SDC Thompson Financial

activities are supervised by the home country supervisor. We consider closure regulation, and the home country supervisor has the choice of closing the bank or leaving it open. Both supervisors have access to private information that is relevant for the closure decision. The home country supervisor will thus base its decision on its own information and on information transmitted by the host country supervisor. It should be noted that we restrict our analysis to banks that operate through branches, but not to subsidiaries. International bank subsidiaries can be closed down independently by host country authorities, so the analysis would be a different one.

We take a political economy approach to supervision and assume that supervisors seek to maximize the welfare of their own country, disregarding the welfare of the other country. It is shown that the supervisors do not always agree whether to close the bank, because generally the two countries will be affected differently by the closure decision. The costs and benefits of closing the bank may differ across countries for a number of reasons. First, the bank may conduct different activities in the two countries, therefore the exposure of stakeholders that the supervisors care about could differ. Furthermore, the bank might not be of equal systemic importance in the two countries. Finally, the institutional environment plays a role. In Europe, for example, depositors in host countries are typically insured by the home country deposit insurance (exceptions arise when the coverage differs in home and host country), which could create a further asymmetry in interests.

The supervisors are both sovereign and have to cooperate as equals. To capture this idea, the communication is modelled as a 'cheap talk' game in the spirit of Crawford and Sobel (1982). The host country supervisor reports, orally or written, to the home country supervisor about the state of the branch located in its jurisdiction. However, as talk is cheap, the host country supervisor reveals only as much information as serves its own interests.

In the first part of the paper, we show that as long as the interests of the supervisors do not perfectly coincide, the host country supervisor does not reveal all the information that it possesses. More accurately, it does not reveal as detailed information as it could. Because of this, it is not possible to implement the first best closure regulation. The closure regulation is not unambiguously too soft or too hard. Rather, it is an inherent feature of the equilibrium that there will be mistakes both of 'type I' (the bank is left open where it should be closed) and 'type II' (the bank is closed where it should be left open). Finally, it is shown that the better aligned the interests of the supervisors are, the more detailed information can be exchanged, and the higher is the welfare resulting from the closure decision.

In the second part, we analyze how the equilibrium closure regulation influences the behavior of the bank. We first show that the bank has an incentive to select the country that is least inclined to close it as its home country. Afterwards, we study the bank's investment decision. It is found that the bank can strategically allocate its investments across the two countries in order to escape closure. When the interests of the two countries are relatively closely aligned, the bank concentrates its investments in the country that is least inclined to close it. More surprisingly, we show that the bank invests in both countries when the interests are sufficiently disaligned. This forces the home country supervisor to base its closure decision partly on information received from the host country. As this information is imprecise due to the conflict of interests, it results in a lower probability of closure for the bank.

A surge of interest has evolved around cross-border consolidation in the financial industry as well as contagion in international financial markets (Berger et al., 2000; Claessens and Forbes, 2001). Greater attention has also been given to the supervision and regulation of multinational financial institutions, a topic left virtually unexplored in the academic literature until a few years ago.

A number of recent papers study the effects of international regulatory competition. Acharya (2003), for example, shows that competition in capital standards may result in a race-to-bottom as regulators attempt to further the competitive position of their domestic banks. Dalen and Olsen (2003) illustrate how regulators may try to counter this effect by inducing banks to choose assets of higher quality. In a similar vein, Dell'Ariccia and Marquez (2003) study the conditions under which national regulators are willing to let a supranational authority set capital standards. The desirability of centralization versus decentralization of banking regulation is also analyzed by Calzolari and Loranth (2001).

A key assumption in our analysis is that national supervisors have access to some local information. This is also the point of departure in recent work by Holthausen and Rønde (2002) and Repullo (2001). Holthausen and Rønde show that public involvement in the regulation of large-value payment systems is desirable in spite of opportunistic behavior by the national regulators. Repullo demonstrates how lack of cooperation among national supervisors can lead to softer closure regulation for internationally active banks. This creates, in turn, an incentive for banks to become international through mergers or takeovers. We also look at closure of international banks here, but our focus is quite different. In particular, Repullo assumes away information exchange among the supervisors whereas it is the endogenous communication that is at the heart of this paper.

Related to our study is also the literature on closure regulation of banks: Acharya and Dreyfus (1989) derive the optimal closure rule in the presence of deposit insurance; Maliath and Mester (1994) look at subgame perfect closure rules; Fries et al. (1997) analyze different ways of resolving financial distress. These papers generally consider a richer environment than we do but look at domestic banks only.

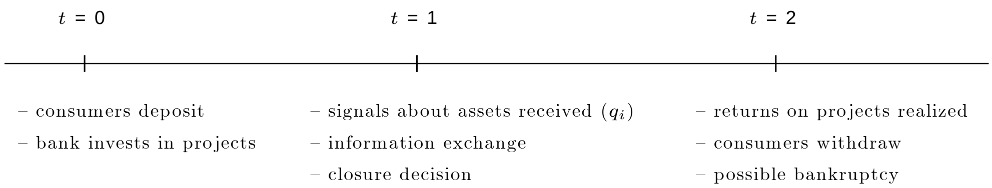
The theoretical setup of our paper is related to several recent papers that build upon Crawford and Sobel (1982). Both Glazer and Rubinstein (2003) as well as Levy and Razin (2003) analyze games with multidimensional cheap talk. However, in their settings, information on all dimensions is held by the sender, while the receiver does not have any private information. Contrarily, in our paper, both the sender and the receiver have some information that is not known to the other party.

The outline of the paper is as follows: In section 2 of the paper, we describe the model setup and find the supervisors' preferences for closure. In section 3, we start by deriving the first and second best closure rules. Afterwards, the information exchange between the supervisors is analyzed. We determine the equilibria of the game and discuss the welfare implications. Section 4 looks at the bank's choice of home country and its ex-ante investment decision. In section 5, some robustness checks are performed, and section 6 concludes.

2 The Model

We consider an international bank operating in two countries, A and B. The bank is incorporated in country A; i.e., country A is the 'home country' whereas country B is the 'host country'. The activities in country B are operated through a branch, so the offices in the two countries are jointly liable.

Before explaining the details of the model, it useful to sketch the timing. At time 0, the bank collects deposits of 1 in each of the two countries. The deposits are invested in risky and illiquid assets. At time 1, the supervisors observe a signal about the quality of the assets located in their jurisdiction. The home country supervisor consults the host country supervisor about the financial health of the branch in country B. That is, there is an information exchange between the supervisors. Afterwards, the home country supervisor decides whether to close the bank or to let it continue. If the bank is closed, all assets are liquidated. If the bank is allowed to continue, the assets pay out at time 2. At this point in time, the depositors wish to withdraw their funds. Therefore, the bank goes bankrupt if the return on the assets is not enough to cover the withdrawals. The timing is illustrated below:



We start by analyzing to what extent voluntary cooperation between national supervisors can achieve efficient closure regulation. To focus on this aspect, in the next section we look at the game starting from $t = 1$ where the bank's portfolio is given. In section 4, we discuss how the equilibrium closure regulation affects the bank's portfolio choice. In the following, we explain the details of the model.

2.1 The bank

The ownership of the bank is divided among shareholders in country A and B. Shareholders in country A own a fraction s_A of the bank, and profits are split accordingly. It is for now assumed that the bank collects deposits of size 1 in each country and invests them into a local project (this assumption will be relaxed in section 4). The bank has no other assets. The depositors are covered by a deposit insurance and receive no interests. Thus, they withdraw a total amount of 2 at time 2.

If the bank is closed at time 1, the assets are liquidated prematurely. A project pays then L, $L \leq 1$. If the bank is allowed to continue, the return depends both on the quality of the portfolio and the macroeconomic conditions. In country j, there are 'good times' with probability p_j and 'bad times' with probability $1 - p_j$. Each project consists of a 'good' and a 'bad' fraction. The good fraction pays 2 in good times and 1 in bad times per unit invested. The bad fraction pays 1 in good times and 0 in bad times.

The fraction of good assets in country j, denoted $\widetilde{q}_j$, is uncertain. $\widetilde{q}_j$ is uniformly distributed on $[0, 1]$, $j = A, B$. We assume that $\widetilde{q}_A$ and $\widetilde{q}_B$ are independently distributed. The realization of $\widetilde{q}_j$ is denoted q_j, which we sometimes will refer to as the 'type'. q_j is thus a measure of the quality of the assets in country j.

We assume that the macro shocks are perfectly correlated across the two countries. With probability p, the bank experiences good times in both countries and with probability $1 - p$ bad times.[3] This assumption is adopted for simplicity, but is not crucial for the results.[4] The realization of the macro shock is not known until time 2 where the projects pay out. The pay-off structure implies that the return is $2 + \widetilde{q}_A + \widetilde{q}_B$ with probability p and $\widetilde{q}_A + \widetilde{q}_B$ with probability $1 - p$, i.e. the bank is solvent in good times but not in bad times. It is assumed that $p \geq 1/2$ so that the risky assets have a positive expected return.

2.2 The Supervisors

We take a political economy approach to closure regulation and assume that the supervisor in country j maximizes the aggregate welfare of all parties located in country j and disregards the welfare of agents in the foreign country. The depositors are not affected by the success or failure of the bank, because they are covered by a deposit insurance. The other parties affected by the performance of the bank are risk-neutral. Therefore, we assume that aggregate welfare can be measured as the expected monetary pay-off to all agents in the country other than the depositors.

A major assumption of the model is that the supervisors collect different and complementary information. Hence, there is a need for an information exchange between the home and the host country supervisor, a point that has been stressed in the various BIS documents. We model this by assuming that the supervisor in country A observes q_A but not q_B and vice versa. We prefer to think of q_j as 'soft' information that only the local supervisor has access to. This could, for example, be information about local borrowers or market conditions. However, if there are

[3] This can, for example, be thought of as a situation where the bank has specialized in an industry that is strongly affected by input or output prices on the world market.

[4] Were shocks only imperfectly correlated, it would depend on the realizations of q_A and q_B whether the bank would fail if only one of the branches faced bad times. The analysis would not change qualitatively, but it would not always be possible to solve the model in closed form.

strong secrecy laws in place that deny foreign authorities access to detailed information about the bank's operations, q_j could contain both hard and soft information. Except from q_A and q_B, all other aspects of the game are common knowledge.[5]

In accordance with the principle of home country supervision, it is assumed that the home country supervisor takes the closure decision. Before taking this decision, the home country supervisor consults the supervisor in the host country. The timing is the following: First, the supervisors in country A and B observe q_A and q_B, respectively. Then, the host country supervisor sends a signal about q_B to the home country supervisor. We have in mind a situation where the home and the host country supervisor are sovereign and are not directly subject to any international authority. Therefore, it is assumed that the signal sent by the host country supervisor is costless, e.g., a written or an oral report, and it is not possible to use transfers to elicit the supervisors' private information. As a benchmark for a welfare assessment, we use the outcome when it is possible to set up a mechanism and use transfers to regulate closure. We discuss the signalling game in more detail later. Finally, based on the available information about q_A and q_B, the home country supervisor decides whether to close the bank or to let it continue.

2.3 Further assumptions

Deposit Insurance We assume that the deposit insurance company in the home country covers a fraction d_A of the losses incurred by the depositors in country B, $d_A \in [0, 1]$. This allows us to encompass both a situation with and without home country deposit insurance.

The Bankruptcy Rule If the bank is closed or fails, the remaining assets are allocated according to *the single entity* doctrine. This implies that depositors in country A and B are treated in the same way. As a bankruptcy rule, we assume that all depositors have the same seniority and split the proceeds according to the deposited amount.

Systemic Effect of Failure It makes a difference whether the bank is closed by the supervisors or fails. If the bank fails unexpectedly, this may have serious systemic effects. It could, for example, lead to interruptions in the payment system, trigger a bank panic, or induce liquidity shortages in other areas of the financial system. If, on the other hand, the bank is closed by the supervisors, we assume that it is possible to liquidate the bank orderly and in such a way that the systemic impact is minimized. As a normalization, we assume that a failure has a systemic cost of G_j in country j whereas a closure has no systemic cost.

2.4 Derivation of the Supervisors' Preferences

In this section, we determine the (q_A, q_B) for which the supervisor in the home and in the host country prefer the bank to be closed or to stay open. To this purpose, we determine a

[5] This implies, in particular, that both supervisors have access to aggregate information about the bank's operations and know that one unit of deposits is collected and invested in each country.

function $f_B^j(q_A)$ that determines for each q_A the minimum value of q_B for which the supervisor in country j prefers the bank to stay open. We will also sometimes use $f_A^j(q_B)$, which is defined as $f_A^j(\cdot) \equiv (f_B^j)^{-1}(\cdot)$.

Consider the home country supervisor first. The payoffs to local stakeholders are summarized in Table 1 (depositors always obtain 1):

Table 1. *The payoffs to home country stakeholders.*

Home Country	Deposit Insurance Company	Shareholders	Systemic Cost
Open			
- Success (prob. p)	0	$s_A(q_A + q_B)$	0
- Failure (prob. $(1-p)$)	$-(1+d_A)(1-\frac{q_A+q_B}{2})$	0	$-\ G_A$
Close	$-(1+d_A)(1-L)$	0	0

If the bank is left open and times are good, the profits after having paid depositors, $q_A + q_B$, are distributed to shareholders. If times are bad, the return $q_A + q_B$ is absorbed by the deposit insurance company, who covers the remainder in order to pay back depositors. Additionally, there is a systemic cost that arises from the unorderly closure of the bank. If, on the other hand, the bank is closed beforehand, the project is liquidated yielding L, which again goes to the deposit insurance company.

A regulator thus faces the following trade-off: Bank closure implies foregoing the (possibly high) returns from the projects if times are good. However, if the bank is left open and fails, the home country has to incur the systemic cost of failure and might have to pay more to the depositors in the host country.

A country's welfare is calculated as the expected sum of all local agents' pay-off. Denote by ΔW_A the gain of country A from leaving the bank open instead of closing it. From Table 1, it is given by

$$\begin{aligned}
\Delta W_A(q_A, q_B) &\equiv W_A^{open}(q_A, q_B) - W_A^{close} \\
&= ps_A(q_A + q_B) - (1-p)\left((1+d_A)\left(1 - \frac{q_A + q_B}{2}\right) + G_A\right) \\
&\quad -(1+d_A)(1-L).
\end{aligned}$$

The home country supervisor prefers to leave the bank in operation if and only if $\Delta W_A(q_A, q_B) \geq 0$, that is, if

$$q_B \geq f_B^A(q_A) \equiv Max\{0, a - q_A\}. \tag{1}$$

where $a \equiv 2(G_A + (1+d_A)L - p(G_A + 1 + d_A))/((1+d_A)(1-p) + 2ps_A)$.

We now turn to the pay-off to the stakeholders in the host country:

Table 2. *The payoffs to host country stakeholders.*

Host Country	Deposit Insurance Company	Shareholders	Systemic Cost
Open			
- Success (prob. p)	0	$(1-s_A)(q_A+q_B)$	0
- Failure (prob. $(1-p)$)	$-(1-d_A)(1-\frac{q_A+q_B}{2})$	0	$-\ G_B$
Close	$-(1-d_A)(1-L)$	0	0

The gain from leaving the bank open is

$$\Delta W_B(q_A, q_B) \equiv W_B^{open}(q_A, q_B) - W_B^{close}.$$

The host country supervisor prefers to leave the bank in operation if and only if

$$q_B \geq f_B^B(q_A) \equiv Max\{0, b - q_A\}, \tag{2}$$

where $b \equiv 2((1-p)G_B + (1-d_A)(L-p))/(1+p-(1-p)d_A - 2ps_A)$.

There is in general no reason to expect that $a = b$ such that the preferences of the home and host country coincide perfectly. We will thus analyze the game and derive the equilibrium for any combination of a and b. For specific values of $(d_A, G_A, G_B, L, p, s_A)$ it is then possible to calculate a and b and find the equilibrium outcome. We will impose the following restriction on a and b:

Assumption 1 $a, b \leq 1$.

This assumption serves primarily an expositional purpose, as it reduces the number of different cases that we need to consider in the text.[6]

Figure 1 displays an example of the supervisors' preferences for $a < b$. The solid lines indicate the supervisors' indifference curves. That is, combinations of (q_A, q_B) such that the supervisor is indifferent between leaving the bank open or closing it, i.e. $\Delta W_j(q_A, q_B) = 0$. For high expected returns, $q_A + q_B > b$, the supervisors prefer to leave the bank open. Similarly, for low returns, $q_A + q_B < a$, they prefer to close it. In the region $a < q_A + q_B < b$, the supervisors do not agree which action to take. The host country supervisor prefers to close the bank whereas the home country supervisor prefers to keep it open. This region of disagreement plays a crucial role in the later analysis as it impedes the flow of information between the supervisors.

We would like to add one remark on the supervisors' objective functions: In this analysis, we assume that supervisors care about the well-being of all stakeholders of the bank that are

[6] Since q_A and q_B are independently and uniformly distributed on $[0, 1]$, $E(q_A + q_B) = 1$. Hence, as $a, b \leq 1$, the supervisors would prefer to leave the bank open if no additional information about q_A and q_B became available. The parameter restriction $a, b \leq 1$ can thus be interpreted as the supervisors having a 'positive prior' about the state of the bank.

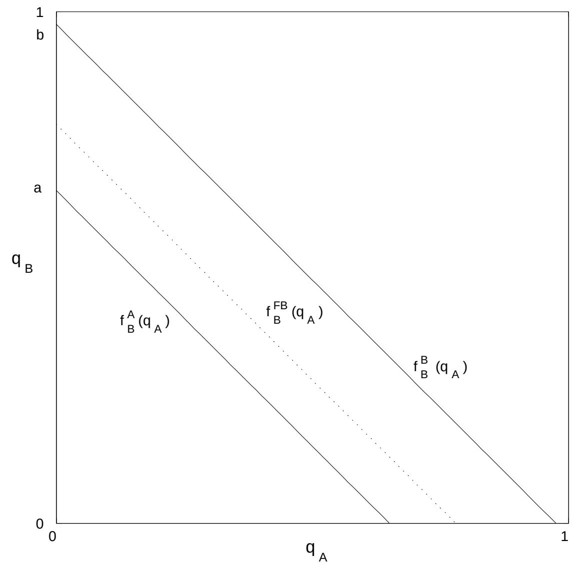


Figure 1: *The preferences of the supervisors in country A and in country B. Closure is preferred by country A (resp. B) to the left and below the line $f_B^A(\cdot)$ (resp. $f_B^B(\cdot)$). The dotted line $f_B^{FB}(\cdot)$ represents the first best closure rule.*

located in their own country. However, the statutes of different supervisory agencies quite differ in their objective functions: Some supervisors care primarily about depositor protection, while others have the mandate to protect a larger group of affected parties.[7] It is easy to see, however, that changing the supervisors' objective functions would have no qualitative consequences for our analysis, as long as the realized returns q_A and q_B matter for at least one of the stakeholders. The supervisors' preferences would have a similar shape as in our analysis, $\widetilde{f}_B^A(q_A) = \widetilde{a} - q_A$ and $\widetilde{f}_B^B(q_A) = \widetilde{b} - q_B$, but with $\widetilde{a}$ and $\widetilde{b}$ possibly different from a and b. This would not change the derivation of the equilibrium but would of course impact on the welfare analysis.

3 Solving the Game

In this section we analyze the equilibrium of the game set out above. As a benchmark we start by determining the optimal closure rule when the supervisors can use a mechanism with sidepayments to regulate closure. We then continue with the full model where no mechanism can be used and derive the endogenous communication between the supervisors and the resulting closure regulation.

[7] For example, one aim of the Financial Services Authority (FSA) of the UK is the protection of depositors. Contrarily, the German supervisory authority is obliged to care about risk that may affect the return to any investment made in the bank, hence it encompasses both deposits and shareholdings. Also, while some institutions care only about direct stakeholders of the banks being supervised, others such as the Office of the Comptroller of the Currency (OCC) in the US explicitly mention the safety of the banking system as a whole as an objective, so clearly care about systemic consequences.

3.1 First and Second Best Closure

The first best closure rule is defined as the one that maximizes the joint welfare of the two countries. Abusing notation slightly, we denote it $f_B^{FB}(\cdot)$, and it indicates the minimal value of q_B for which the bank should stay open as a function of q_A. $f_B^{FB}(\cdot)$ solves $\Delta W_A(q_A, f_B^{FB}) + \Delta W_B(q_A, f_B^{FB}) = 0$. We have that

$$f_B^{FB}(q_A) \equiv Max\{0, (G_A + G_B)(1-p) + 2(L-p) - q_A\}. \tag{3}$$

The dotted line in figure 1 represents $f_B^{FB}(\cdot)$. Since $f_B^{FB}(\cdot)$ takes into account the welfare of both countries, it lies between $f_B^A(\cdot)$ and $f_B^B(\cdot)$.

The following remark will be useful in the later analysis:

Remark 1 *If $G_A = G_B = G$, $s_A = 1/2$, and $d_A = 0$, the preferences of the supervisors coincide ($a = b$) and are identical to the first best closure rule. The degree of disalignment of interests as measured by $Max\{b, a\}/Min\{b, a\}$ is increasing in d_A whereas the first best closure rule is unaffected.*

Proof. In appendix. ¥

We define second best closure as a situation where the supervisors have private information about the activities of the bank in their country, but they can agree ex-ante on implementing a mechanism with sidepayments to regulate closure. The next proposition shows that $f_B^{FB}(\cdot)$ is also the second best closure rule, because it maximizes total surplus and is implementable if sidepayments can be used.

Proposition 1 *Suppose that the supervisors have private information about the activities of the bank in their country. If the supervisors can regulate closure using a mechanism with sidepayments, they implement $f_B^{FB}(\cdot)$.*

Proof. In appendix. ¥

In the proof it is shown that the preferences of the supervisors satisfy the single crossing condition (-) with respect to the closure rule. It follows then from a standard result in the mechanism design literature that $f_B^{FB}(\cdot)$ is implementable under asymmetric information as it is decreasing.

3.2 Equilibrium Closure Regulation

We now turn to the analysis of the full model where there is no possibility to set up a mechanism to regulate closure. The signal that the host country supervisor sends is costless ('cheap talk') and has real effects only to the extent that it is believed by the home country supervisor and changes the closure decision. Solving the game, we draw on the pioneering work by Crawford and Sobel (1982). Crawford and Sobel consider a game where a sender with private information signals to an uninformed receiver. Here, the game is different, as both the sender (the host country supervisor) and the receiver (the home country supervisor) have private information. It might therefore seem restrictive that we only allow the host country supervisor to signal the type. We show in section 5.2 that this is not necessarily the case: Any equilibrium closure regulation that can be sustained when both parties send signals and that depends only on the realized types can also be sustained if only the host country supervisor signals the type. To keep the presentation as simple as possible, we have chosen to let only the host country supervisor signal the type.

In the sequel, we solve the game backwards. First, we derive the closure rule of the home country supervisor. This rule indicates, as a function of the signal sent by the host country supervisor and q_A, whether the bank is closed or allowed to continue. After that we derive the signalling rule of the supervisor. This rule determines the signal send as a function of q_B. In equilibrium, the signalling and the closure rule are optimal taking the other rule as given.

The closure rule follows immediately from the analysis in the previous section. Suppose that the host country supervisor sends the signal z. Denote by $E(q_B \mid z)$ the expected type given the signal z. The closure decision of the home country supervisor is then given as:

$$C(q_A, z) = \begin{cases} \textit{Leave the bank open} & \text{if } q_A \geq f_A^A(z) \equiv f_A^A(E(q_B \mid z)), \\ \textit{Close the bank} & \text{if } q_A < f_A^A(z). \end{cases} \quad (4)$$

We now derive the signalling rule of the host country supervisor. Invoking the revelation principle, we focus on incentive compatible signalling rules. Without loss of insight, we make the following assumption:

Assumption 2 *There do not exist two signals, z' and z'' that are both played in equilibrium with positive probability such that either $E(q_B \mid z') = E(q_B \mid z'')$ or $E(q_B \mid z'), E(q_B \mid z'') \geq a$.*

Assumption 2 implies that in equilibrium there will not be used two signals that lead to the same closure decision for all q_A. The host country supervisor thus uses the minimal number of different signals necessary to sustain a given equilibrium.[8]

As mentioned above, the model satisfies the *single crossing condition (-)*, which allows for an equilibrium with (imperfectly) informative signalling. We are ready to derive the signalling rule. As a first step, we show that the host country supervisor only uses a finite number of signals in equilibrium. The proof of this lemma follows Crawford and Sobel quite closely and has been left out. Details are available upon request.

Lemma 1 *If $a \neq b$, the host country supervisor uses a finite number of signals in equilibrium.*

Proof. See Crawford and Sobel (1982), Lemma 1. ¥

[8] Consider an equilibrium where $E(q_B \mid z') = E(q_B \mid z'')$ or $E(q_B \mid z')$, $E(q_B \mid z'') \geq a$. This equilibrium outcome could clearly be sustained without the signal z' (or z''). All types sending the signal z' would then simply send the signal z'' instead. Assumption A.2. eliminates signals, which are superfluous in this way.

The next lemma shows that in equilibrium the host country supervisor 'scrambles' the information that it sends to the home country supervisor by dividing the unit interval into n sub-intervals, $\{I_B^1, I_B^2, .., I_B^n\}$. Instead of revealing the type, the host country supervisor only reveals the interval to which q_B belongs. Thus, the information that it transmits is less detailed than possible. Since the interests of the two countries do not perfectly coincide, this is the only way in which the host country supervisor can (credibly) transmit information to the home country supervisor. In equilibrium, the same signal is sent for all types belonging to a given interval.

Lemma 2 *The signalling rule used by the host country supervisor has the following form:*
i) The unit interval is partitioned into n intervals, $n \geq 1$, where interval i is defined as $I_B^i \equiv (q_B^{i-1}(n), q_B^i(n)]$ with $q_B^0(n) = 0$, $q_B^n(n) = 1$, and $q_B^{i-1}(n) < q_B^i(n)$.
ii) The host country supervisor signals the interval to which q_B belongs.
iii) For $i \in \{1, .., n-1\}$, $q_B^i(n)$ satisfies:

$$\Delta W_B \left(\frac{1}{2}(f_A^A(I_i) + f_A^A(I_{i+1})), q_B^i(n) \right) = 0. \tag{5}$$

Proof. Consider part i). Suppose that there exist two signals, z' and z'', such that $E(q_B \mid z') < E(q_B \mid z'')$. From Lemma 1 and Assumption 2 follows $f_A^A(z'') < f_A^A(z')$. Suppose that in equilibrium there exist two types, $q_B^{'}$ and $q_B^{''}$, such that $q_B^{'}$ sends the signal z' and $q_B^{''}$ sends the signal z''. Incentive compatibility requires that the type q_B' prefers signalling z' to z'':

$$\begin{aligned}
&\int_0^{f_A^A(z')} W_B^{close} dq_A + \int_{f_A^A(z')}^1 W_B^{open}(q_A, q_B') dq_A \\
&\geq \\
&\int_0^{f_A^A(z'')} W_B^{close} dq_A + \int_{f_A^A(z'')}^1 W_B^{open}(q_A, q_B') dq_A,
\end{aligned}$$

which reduces to:

$$\Delta W_B \left(\frac{1}{2} \left(f_A^A(z') + f_A^A(z'') \right), q_B' \right) \leq 0. \tag{ICC q_B'}$$

Similarly, the incentive constraint of a q_B'' type can be written as:

$$\Delta W_B \left(\frac{1}{2} \left(f_A^A(z') + f_A^A(z'') \right), q_B'' \right) \geq 0. \tag{ICC q_B''}$$

A necessary condition for the two incentive compatibility constraints to be satisfied simultaneously is $q_B' < q_B''$. This implies together with Lemma 1 part i) and ii) of the lemma. Since $\Delta W_B(q_A, q_B)$ is continuous, incentive compatibility requires that the host country supervisor is indifferent between signalling I_B^i and I_B^{i+1} if $q_B = q_B^i(n)$. This implies that (5) holds. Furthermore, as the single crossing condition holds and $f_A^A(I_B^i) > f_A^A(I_B^{i+1})$, (5) is enough to ensure that no types in I_B^i will deviate and signal I_B^{i+1} (and vice versa). An analogous argument establishes that no type has an incentive to deviate and signal another interval than the true one. ¥

We are now ready to characterize the set of possible equilibria. As in all games with costless signals, there is a 'babbling equilibrium' where the signal that the host country supervisor sends contains no information on the type and is ignored by the home country supervisor. The next proposition characterizes the equilibria where the host country supervisor reveals some information about the activities of the branch in country B.

Proposition 2 Characterization of the equilibria with information exchange.
Equilibrium of type 1 with n intervals:
i) The host country supervisor follows the signalling rule described in Lemma 2 with

$$q_B^i(n) = \frac{2i}{2n-1}\left[a + (b-a)(2n^2 - (i+1)(2n-1))\right].$$

ii) After receiving the signal I_B^i, the home country supervisor lets the bank continue if and only if:

$$q_A \geq q_A^{n-i}(n) = \frac{2(n-i)}{2n-1}\left[b - (b-a)(2n^2 - (n-i+1)(2n-1))\right].$$

Equilibrium of type 2 with n intervals:
i) The host country supervisor follows the signalling rule described in Lemma 2 with

$$\widehat{q}_B^i(n) = 2i(n-i)(b-a) + \frac{i}{n}.$$

ii) After receiving the signal I_B^i, the home country supervisor lets the bank continue if and only if:

$$q_A \geq \widehat{q}_A^{n-i+1}(n) = (b-a)(n - 2(n-i+1)i) + b - \frac{2i-1}{2n}.$$

Proof. Consider an equilibrium where the host country supervisor uses n intervals to signal the type. Using Lemma 2, $q_B^0(n) = 0$, and $q_B^n(n) = 1$, we obtain a linear system of $n-1$ equations with $n-1$ unknowns:

$$\Delta W_B\left(\frac{1}{2}(f_A^A(I_i) + f_A^A(I_{i+1})), q_B^i(n)\right) = 0 \text{ for } i = 1, .., n-1,$$

where $f_A^A(I_i)$ is given by (4) as $f_A^A(I_i) = Max\{0, a - (q_B^{i-1}(n) + q_B^i(n))/2\}$. This system of equations determines $\{q_B^1(n), ..., q_B^{n-1}(n)\}$. The equilibria of type 1 are characterized by $f_A^A(I_B^n) = 0$ and the ones of type 2 by $f_A^A(I_B^n) > 0$. The closure decision is as described in the proposition with $q_A^i(n) = f_A^A(I_B^{n-i})$ and $\widehat{q}_A^i(n) = f_A^A(I_B^{n+1-i})$. It can be verified that the $q_A^i(n)$ and $q_B^i(n)$ defined in the proposition satisfy all the above conditions. Finally, since the signalling rule satisfies the conditions in Lemma 2 and the closure decision follows (4), it is a Nash equilibrium. ¥

Figure 2 illustrates equilibria of type 1 and 2 with 2 intervals. The difference between the two types of equilibria is that the bank is always closed for low values of q_A in the equilibrium of type 2 but not in the equilibrium of type 1. Here, the bank is allowed to continue if the host country supervisor signals that the expected return on the assets in country B is high.

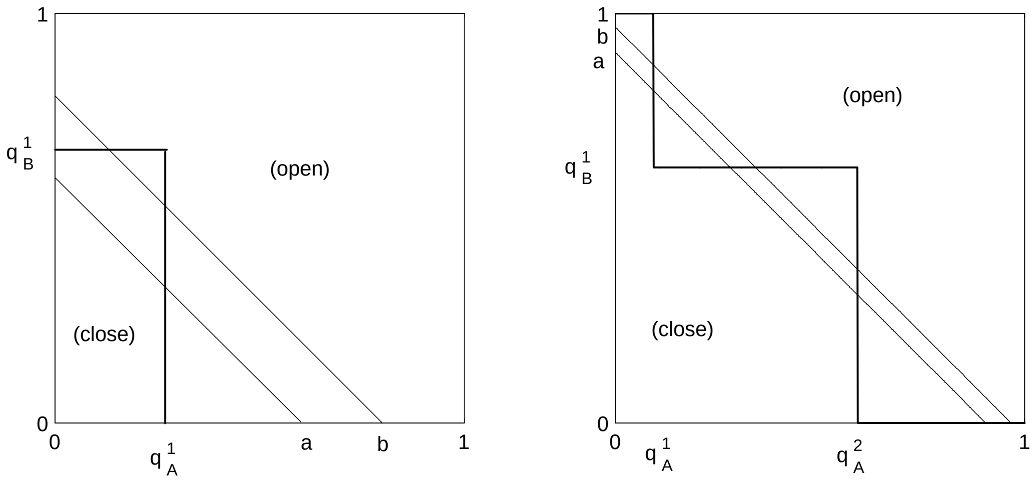


Figure 2: *An equilibrium of type 1 (left) and type 2 (right) where the host country supervisor uses two intervals to signal the type of the host country branch.*

To understand how an equilibrium works, consider the equilibrium of type 1 illustrated in figure 3. The host country supervisor partitions here the types into two intervals, I_B^1 and I_B^2. The bank is closed if the host country supervisor signals I_B^1 and $q_A \leq q_A^1(2)$. We solve the game backwards, and look first at the closure rule of the home country supervisor. Suppose that the home country supervisor has received the signal I_B^2. Since $E(q_B \mid I_B^2) > a$, it is optimal to leave the bank open for all q_A. Suppose instead that the signal was I_B^1. Notice that in equilibrium $q_A^1(2)+E(q_B \mid I_B^1) = a$. Hence, after receiving the signal I_B^1, the home country supervisor closes the bank if and only if $q_A \leq q_A^1(2)$. The closure rule is therefore optimal given the signalling rule used by the host country supervisor.

Let's now turn to the signalling rule. If $q_A > q_A^1(2)$, the bank stays open both when the signal is I_B^1 and I_B^2, so the signal does not matter. However, if $q_A \leq q_A^1(2)$, it makes a difference. The bank is then allowed to continue if and only if the host country supervisor signals that q_B belongs to the interval with the high types, I_B^2. The host country supervisor thus decides which signal to send conditional on $q_A \leq q_A^1(2)$. The equilibrium is constructed such that if $q_B \in I_B^1$ ($q_B \in I_2^B$) the host country supervisor prefers the bank to be closed (to stay open) conditional on $q_A \leq q_A^1(2)$. This can be seen from the figure where $q_B^1(2) + E(q_A \mid q_A \leq q_A^1(2)) = b$. Therefore, the host country supervisor truthfully signals the interval. The closure and the signalling rule constitute an equilibrium, because they are optimal taking the other rule as given. All other equilibria are constructed in a similar manner.

The next proposition gives the conditions under which the candidate equilibria exist.

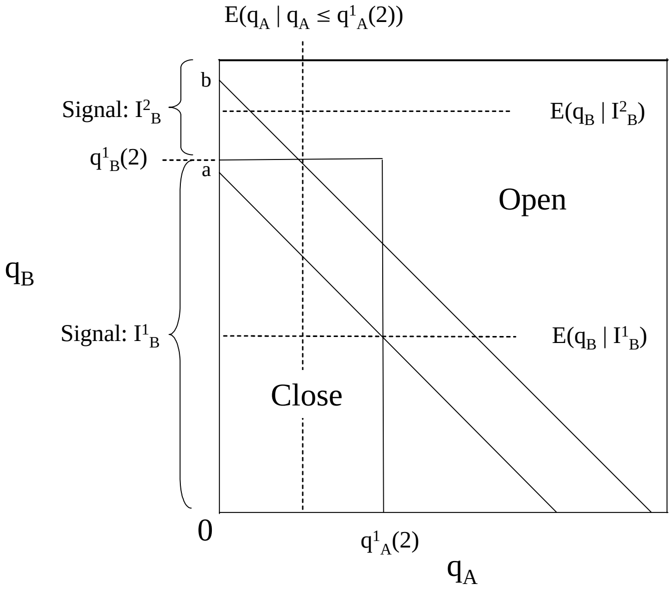


Figure 3: An equilibrium of type 1 with two intervals.

Proposition 3 Existence of equilibria with information exchange.
There exists an equilibrium of type 1 with n intervals if and only if

$$b < \frac{2(n-1)^2}{2(n-1)^2-1}a, \tag{6}$$

$$b > \frac{2(n-1)^2-1}{2(n-1)^2}a, \text{ and} \tag{7}$$

$$b \geq \frac{n}{n-1}a - \frac{2n-1}{2n(n-1)}. \tag{8}$$

There exists an equilibrium of type 2 with n intervals if and only if

$$b < \frac{n}{n-1}a - \frac{2n-1}{2n(n-1)}, \text{ and} \tag{9}$$

$$b > a - \frac{1}{2n(n-1)}. \tag{10}$$

Proof. See appendix. ¥

A number of results follow immediately from the conditions in Proposition 3. Conditions (8) and (9) imply that an equilibrium of type 1 and 2 with n intervals do not coexist. We will thus simply refer to a n interval equilibrium when it does not matter whether it is of type 1 or 2.

Corollary 1 *If there exists an equilibrium where the host country supervisor uses n intervals to signal the type, then there also exists an equilibrium where it uses l intervals, $l < n$.*

Proof. See appendix. ¥

We know from Corollary 1 that if there does not exist an equilibrium with two intervals, neither does an equilibrium with more than two intervals exist. This gives an upper bound on how disaligned the interests of the supervisors can be and still allow for the information exchange to impact on the closure decision.

Corollary 2 *The closure decision is not influenced by the information send by the host country supervisor if* $b > 2a$ *or* $Max\{a - \frac{1}{4}, \frac{a}{2}\} > b$.

Proof. Follows directly from Proposition 3 with $n = 2$. ¥

Finally, we derive two additional results that are useful in the later analysis.

Corollary 3 *i) An equilibrium of type 1 with* n *intervals and an equilibrium of type 2 with* $n+1$ *intervals,* $n \geq 2$*, cannot coexist.*
ii) If $b \geq a$*, the equilibrium with the highest number of intervals is of type 1.*

Proof. In appendix. ¥

3.3 Welfare Analysis

The first thing to notice is that if the supervisors have somewhat conflicting interests ($a \neq b$), it is not possible to implement the first best closure regulation. Compared to the first best closure rule, the bank risks being closed when it shouldn't be and may stay open when closing it would be better. To put it differently, the home country supervisor will commit both errors of 'type I' and 'type II'. Figure 4 illustrates this point. Indeed, the equilibrium is constructed such a way that the bank is closed for some (q_A, q_B) for which $q_B + q_A > Max\{a, b\}$, and left open for some (q_A, q_B) for which $q_A + q_B < Min\{a, b\}$. The bank is thus closed in situations where both supervisors would prefer it to stay open and vice versa.

The next proposition shows that the home and the host country supervisor have an interest in coordinating on the equilibrium with the highest possible number of intervals. The intuition for this result is that in an equilibrium where the host country supervisor partitions the information finer, it is possible to approximate the preferences of the supervisors better.

Proposition 4 *The expected welfare of the home and the host country are for given* a *and* b *increasing in the number of intervals used in equilibrium.*

Proof. In appendix. ¥

Another factor that is crucial for the quality of the information exchange is the degree of disalignment of the supervisors' preferences. To isolate the effect due to alignment, we do the following exercise: We start from the benchmark case of Remark 1 where $G_A = G_B = G$, $s_A = 1/2$, and $d_A = 0$ so that preferences of the supervisors coincide ($a = b$). We then consider the effect of increasing d_A. The interests get more disaligned as d_A increases, whereas our benchmark, the first best closure rule, is unaffected. This exercise allows us to determine

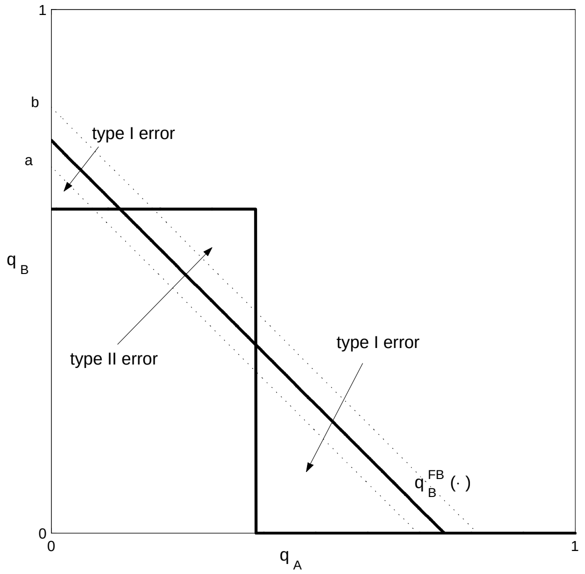


Figure 4: *Compared to the first best outcome, any equilibrium with information exchange can lead to too little closure (type I error) or too much closure (type II error).*

how the degree of alignment affects the efficiency of closure regulation relative to a constant benchmark.

We first show that for a given equilibrium, more disaligned interests lead to a lower joint welfare of the two countries.

Lemma 3 *For any given equilibrium either of type 1 or 2 with* n *intervals, the total expected welfare is decreasing in the degree of disalignment of interests.*

Proof. In appendix. ¥

Using Lemma 3 and Proposition 4, we show that total expected welfare decreases as the interests of the supervisors get more disaligned, i.e. as d_A increases.[9]

Proposition 5 *Assuming that the supervisors coordinate on the equilibrium with highest possible number of intervals, total expected welfare is decreasing in the disalignment of interests.*

Proof. In appendix ¥

It is important to notice that it is total welfare of the two countries that decreases. It is possible that the welfare of the host country increases as the deposit insurance company of the home country covers a larger share of the losses in the host country. This increase, however, is more than offset by a decrease in the home country's welfare.

[9] We could instead have chosen to do the comparative statics on s_A starting from $s_A = 1/2$ and $G_A = G_B = G$ and $d_A = 0$.

4 Regulatory Arbitrage

Up to now, the bank has played a rather passive role in the analysis. It has collected deposits and invested them, but it has not taken any strategic decisions. In this section, we analyze different ways that the bank can exploit the conflict of interests among the supervisors to reduce the probability of closure and increase profits.

4.1 Endogenous Choice of Investment Location

We show first how the bank has an incentive to allocate its investments strategically across the two countries in order to exploit the disagreement among the supervisors. There are, of course, many factors that affect the decision of a multinational bank where to invest. The investment climate may, for example, be better in one country than in another.[10] The bank may also spread investments across countries to diversify its portfolio or even concentrate investments in certain countries or regions to increase risk-taking.[11] Here, we want to abstract from these issues and isolate the effect due to the disagreement among supervisors when to close the bank.

We will consider the following variation of the base line model. Investment projects come in the size of 1 and have the pay-off described above. However, the bank can now choose either to invest one unit in each of the countries or two units in only one country. If the bank invests everything in country A or B, the local supervisor has an informational monopoly concerning the quality of the bank's assets. The superior information will be used to further the interests of the supervisor's own country. If the bank instead invests in both countries, everything is as in the base model and the previous analysis applies. To save on notation, the good fraction of the two projects are again denoted q_A and q_B no matter where the projects are invested. That is, even when both projects are invested in, say, country A so that the home country supervisor obtains signals about both projects, the good fractions are denoted q_A and q_B.

We consider the bank's profit maximizing investment as a function of the degree of disalignment of interests, $Max\{a,b\}/Min\{a,b\}$. In the analysis, we focus on the case $b > a$ so that country A is more lenient. We will use the following notation: $E\Pi^{20}(a,b)$ and $E\Pi^{02}(a,b)$ are the profit of the bank, as a function of a and b, if everything is invested in country A and in country B, respectively. If the bank invests one unit in each country, profit is denoted $E\Pi^{11}(a,b,n)$ and is a function of a, b, and the number of intervals used in equilibrium, n. We assume that the supervisors are able to maximize welfare by coordinating on the equilibrium with the highest number of intervals.

Suppose first that the bank invests everything in the home country. The home country supervisor does not need to consult the host country supervisor, as it has all the available information about the solvency of the bank. The home country supervisor closes the bank if

[10] Indeed, one of the intrinsic advantages of multinational banks is the possibility of funneling funds to regions where the expected return is highest.

[11] It is well-known that banks may have an incentive to choose too risky a portfolio due to limited liability. This problem, however, may be alleviated by, e.g., a positive franchise value and capital requirements, see Hellmann et al. (2000).

and only if $q_A + q_B \leq a$. If the bank is allowed to continue, it will earn positive profits if times are good. The bank's expected profits are:

$$\begin{aligned} E\Pi^{20}(a,b) &= p\left(\int_0^a \int_{a-q_A}^1 (q_A+q_B)dq_A dq_B + \int_a^1 \int_0^1 (q_A+q_B)dq_A dq_B\right) \\ &= p\left(1-\frac{a^3}{3}\right). \end{aligned} \tag{11}$$

Suppose now instead that the bank invests everything in the host country. The host country supervisor observes (q_A, q_B) and can decide how much information to reveal to the home country supervisor. Information exchange is relevant if there exists an equilibrium such that (at least) two of the signals used in equilibrium lead to a different closure decision. In such an equilibrium it has to hold that the bank is closed in equilibrium if and only if $q_A + q_B \leq b$. Otherwise, the host country would for some (q_A, q_B) have an incentive to deviate and send the signal that implements its preferred closure decision. The candidate equilibrium is thus one where the host country supervisor sends the signal I_B^1 if $q_A + q_B \leq b$ and the signal I_B^2 if $q_A + q_B > b$. The closure rule is such that the bank is closed if the signal is I_B^1 and left open otherwise.

To check whether this is indeed an equilibrium, we need to consider the home country supervisor's optimal closure decision. Whenever the signal is I_B^2, the home country supervisor leaves the bank open as $b > a$. However, if the signal is I_B^1, it only closes the bank if $E(q_A+q_B \mid I_1^B) = b/2 \leq a$. Therefore, the candidate equilibrium is sustainable if and only if $b \leq 2a$. For $b > 2a$ the interests are so disaligned that communication between the supervisors breaks down. Since $E(q_A + q_B) = 1 > a$, the bank is never closed, which, of course, makes investing in the host country a very attractive option. The expected profit of the bank is:

$$E\Pi^{02}(a,b) = \begin{cases} p\left(1-\frac{b^3}{3}\right) & \text{if } b/a < 2, \\ p & \text{otherwise.} \end{cases} \tag{12}$$

The host country supervisor is able to achieve its preferred closure decision for $b < 2a$, as it has private information about q_A and q_B. Using the terminology of Aghion and Tirole (1997), the host country supervisor has 'real authority' over the closure decision even if it is the home country supervisor that has the 'formal authority'.

Finally, if the bank decides to invest in both countries, the analysis of the base line model applies. We assume that the supervisors coordinate on the equilibrium with the highest possible number of intervals. Since $b \geq a$, this is an equilibrium of type 1, see Corollary (3). Using Proposition 2, we have that the expected profit of the bank is:

$$E\Pi^{11}(a,b,n) = \begin{cases} p\left(\begin{array}{c} \sum_{i=1}^{n-1} \int_{q_A^{i-1}(n)}^{q_A^i(n)} \int_{q_B^{n-i}(n)}^1 (q_A+q_B)dq_B dq_A \\ + \int_{q_A^{n-1}(n)}^1 \int_0^1 (q_A+q_B)dq_B dq_A \end{array}\right) & b/a \leq 2, \\ p & \text{for } b/a > 2. \end{cases} \tag{13}$$

The next proposition derives the optimal investment of the bank taking the equilibrium closure regulation as given.

Proposition 6 *Suppose that $b \geq a$ and that the supervisors coordinate on the welfare maximizing equilibrium. There exists a $\overline{b/a} \in ((1+\sqrt{3})/2, 2)$ such that the bank's profit as a function of b/a satisfies the following conditions:*

$$\begin{array}{rr} \Pi^{20}(a,b) > Max\{\Pi^{11}(a,b,n), \Pi^{02}(a,b)\} & \text{for } b/a \leq \overline{b/a}, \\ \Pi^{11}(a,b,n) > \Pi^{20}(a,b) > \Pi^{02}(a,b) & \text{for } \overline{b/a} < b/a < 2, \\ \Pi^{02}(a,b) = \Pi^{11}(a,b,n) > \Pi^{20}(a,b) & \text{for } b/a \geq 2. \end{array}$$

Proof. In appendix. ¥

The bank's profit-maximizing investment strategy shows an interesting pattern. For a and b relatively close ($1 \leq b/a < \overline{b/a}$), the bank chooses to invest everything in the home country. The bank does here regulatory arbitrage by investing in the country where the supervisor is less inclined to close the bank. As the distance between a and b gets larger ($\overline{b/a} \leq b/a < 2$)), the bank exploits the fact that the communication between the supervisors works poorly due to their disaligned interests. Therefore, it invests in both countries to reduce the probability of being closed. Finally, for $b/a > 2$, the host country supervisor cannot transmit any information to the home country supervisor. The bank invests in the host country and avoids closure altogether.

A few simple calculations can illustrate how the probability of closure indeed changes with the investment decision and b/a. Denote the probability that the banks is closed by $v^z(\cdot)$ where z is the allocation of investments. We have:

$$v^{20}(a) = a^3/3 \text{ and } v^{02}(b) = \begin{cases} b^3/3 \text{ for } b \leq 2a, \\ 0 \text{ otherwise.} \end{cases}$$

Using Proposition 3 and disregarding integer constraints, the maximal number of intervals can be written as:

$$n^{\max}(a,b) = \sqrt{(1 + a/(b-a))/2}. \tag{14}$$

For $b/a < 2$ we can then approximate $v^{11}(a,b)$ by

$$v^{11}(a,b) \approx \sum_{i=1}^{n^{\max}(a,b)-1} \int_{q_A^{i-1}(n^{\max}(a,b))}^{q_A^i(n^{\max}(a,b))} \int_0^{q_B^{n-i}(n^{\max}(a,b))} (q_A + q_B) dq_B dq_A,$$

which reduces to:

$$v^{11}(a,b) \approx \begin{cases} (2a-b)b(b+a)/6 \text{ for } b \leq 2a, \\ 0 \text{ otherwise.} \end{cases}$$

Comparing the probabilities of closure shows that i) $v^{11}(a,b) < (=) v^{02}(b)$ for all $b/a < (\geq)2$ and ii) $v^{11}(a,b) \geq v^{20}(a) \iff b/a \leq (1+\sqrt{7})/3$. The investment decision described in Proposition 6 is thus roughly the one that minimizes the probability that the bank is closed. However, the probability of closure does not alone determine the investment choice. For a given probability of closure, the profit is lower when the bank invests in both countries, because the supervisors will commit type I and type II errors when deciding on closure. This explains why the bank invests two units in the home country for $b/a \in ((1+\sqrt{7})/3, \overline{b/a})$ even if $v^{11}(a,b) < v^{20}(a)$.

The next proposition determines the welfare maximizing investment of the bank. Denote EW_j^z the expected welfare in country j for the bank's investment allocation z.

Proposition 7 *Suppose that $b \geq a$ and that the supervisors coordinate on the welfare maximizing equilibrium. The preferences of the supervisors are given by the following equations:*
i) $b/a < 2$:

$$\begin{array}{rcl} \textit{home country} & : & \left\{ \begin{array}{ll} EW_A^{20} > EW_A^{02} > EW_A^{11} & \textit{for } b \leq \widetilde{b/a}, \\ EW_A^{20} > EW_A^{11} > EW_A^{02} & \textit{for } b > \widetilde{b/a}, \end{array} \right. \\ \textit{host country} & : & EW_B^{02} > EW_B^{20} > EW_B^{11}, \end{array}$$

where $\widetilde{b/a} \in (8/7, \overline{b/a})$ and $\overline{b/a}$ is defined as in Proposition 6.
ii) $b/a \geq 2$: $EW_j^{20} > Max\{EW_j^{02}, EW_j^{11}\}$ for $j = \{A, B\}$.

Proof. In appendix. ¥

Proposition 7 states that when the supervisor's interests are rather close ($b/a < 2$), each supervisor would prefer the bank to invest both projects in its own country, because it then can implement its most preferred closure decision. Moreover, the host country supervisor prefers investment in the home country only to investment in both countries. On the other hand, if the divergence of interests is large ($b/a \geq 2$) both supervisors prefer the bank to invest everything in country A to ensure closure when the quality of the assets is low (recall that in this case, no information exchange is possible).

Comparing the investment decision of the bank with the supervisors' preferences, we find the following: for $b/a \leq \overline{b/a}$ the bank invests everything in the home country, which does not run counter to interests of the supervisors. The host country supervisor would have preferred that the bank had invested two units in the host country, but two units in the home country is preferred to one unit in each country. For $\overline{b/a} < b/a$, it is optimal for the bank to invest one unit in each country. This decision is suboptimal from point of view of welfare. Indeed, the welfare of both countries would have been higher had the bank invested two units in the home country. Our analysis suggests therefore that strategic investment by the bank is more likely have adverse welfare effects when there is a serious conflict of interests between the home and the host country.

The results in Proposition 7 provide a nice link to recent work by Dessein (2002) that extends on Crawford and Sobel (1982). In the model by Crawford and Sobel there is a principal that takes a decision based on the signal that an agent sends. Dessein shows that it may be optimal for the principal simply to delegate the decision right to the agent. The agent, of course, takes the decision that serves her interests best. Still, this might be better for the principal than taking his first best decision based on an imprecise signal. It is shown that the more aligned the interests of the principal and the agent are, the more attractive is delegation. The intuition is that if the interests of the parties are close, more information is revealed in absolute terms (i.e. more intervals can used be in equilibrium), but less information is revealed relative to the degree of conflict of interests. Therefore, the decision that the principal takes based on the agent's signal becomes worse relative to the decision that the agent would take herself.

Let us reconsider our model in the light of the analysis by Dessein. Suppose that $b/a \leq 2$. If the bank invests in both countries, the home country supervisor has to take the closure decision based on an imprecise signal from the host country supervisor. On the other hand, if the bank invests two units in one country, the closure decision is essentially delegated to the supervisor in the country that receives the investment. The decision based on communication becomes worse relative to delegation as b and a come closer. This can be seen in the following way: Define the degree of conflict of interests as $b - a$.[12] Then, disregarding integer constraints and using (14), the average size of an interval is $1/n^{\max}(a, b)$. We can now define the average size of an interval relative to the degree of conflict as a measure of how well the communication works relative to delegation. It is easy to show that $\frac{1}{n^{\max}(a,b)(b-a)}$ is strictly decreasing in $(b - a)$: Less information gets revealed relative to the conflict of interests as interests get more aligned. Delegating the closure decision to the foreign country is more attractive for the host than for the home country, because it is the home country that has to give up authority. Therefore, the host country supervisor prefers that the bank invests everything in the foreign country rather than spreading investments for all $b/a \leq 2$ whereas the home country supervisor only prefers this if b and a are sufficiently close.

4.2 Endogenous Choice of Home Country

In our base line model country A was the home and country B the host country. The historical origins of the bank often determines, which country is assigned the role as home country. However, the bank can often decide where to register its headquarters, so the home country should be seen as a strategic choice. Luxembourg, for example, was the home country of BCCI despite that most of BCCI's business was operated out of London.

In the following we extend the previous analysis by allowing the bank to choose the home country. We consider a US type of system without home country deposit insurance. This keeps the analysis tractable, because the preferences of the two countries do not change with the role as home or host country. We will assume that $a < b \leq 2a$. This implies that country B is more inclined to close the bank than country A and that an equilibrium with at least two intervals exists when country A is home country, see Proposition 3. It will be assumed that the supervisors coordinate on the welfare maximizing equilibrium.

Figure 5 illustrates how the equilibrium changes depending on whether country A or B is home country. Suppose first that country A is the home country. This is the graph to the right in figure 5. Since $a < b \leq 2a$, we have:

$$\frac{2n^2 a}{2n^2 - 1} \leq b \leq \frac{2(n-1)^2}{2(n-1)^2 - 1} a \text{ for some } n \geq 2. \tag{15}$$

[12] We could instead have defined it as $b/a - 1$, which would not have changed the results.

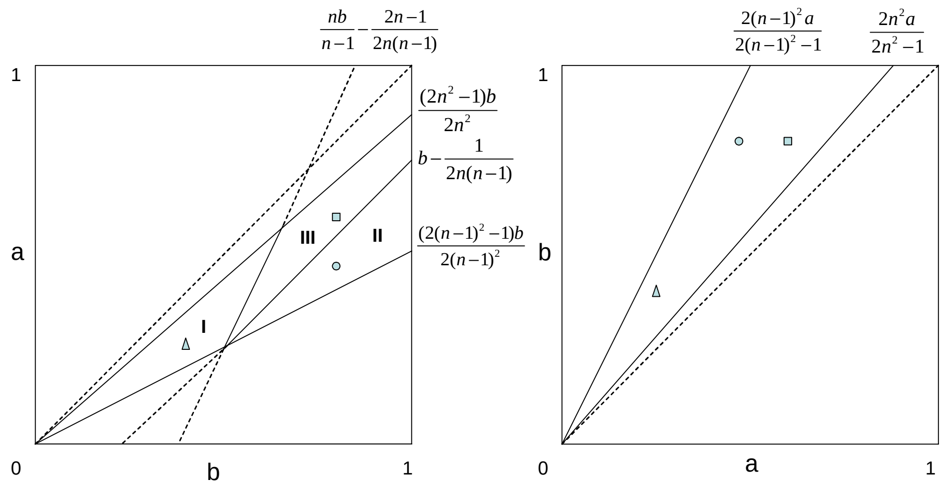


Figure 5: *The graph to the left illustrates a situation where country B is home country. There are here three regions where different kinds of equilibria can be sustained, see text. The graph to the right illustrates a situation where country A is home country. The supervisors will here coordinate on an equilibrium of type 1 with n intervals. The lines in both graphs are drawn for $n = 2$.*

It follows then from Corollary 3 and Proposition 4 that the supervisors will coordinate on an equilibrium of type 1 with n intervals.

Suppose instead that country B is home country. This is illustrated in the graph to the left in figure 5. Switching the role of a and b in Proposition 3,[13] we find that there exist three regions with different kinds of equilibria:

Region I: For $a \geq \frac{n}{n-1}b - \frac{2n-1}{2n(n-1)}$, the supervisors coordinate on an equilibrium of type 1 with n intervals.

Region II: For $a \leq b - \frac{1}{2n(n-1)}$, the supervisors coordinate on an equilibrium of type 2 with $n-1$ intervals.

Region III: For $a < \frac{n}{n-1}b - \frac{2n-1}{2n(n-1)}$ and $a > b - \frac{1}{2n(n-1)}$, the supervisors coordinate on an equilibrium of type 2 with n intervals.

The three regions are shown in figure 5. This completes the description of the equilibrium closure regulation conditional on the choice of home country.

We turn now to the bank's choice of home country. Consider first a combination of a and b such that (b, a) belongs to region I. The triangle in figure 5 illustrates one such (b, a). Here, there will be an equilibrium of type 1 with n intervals both when country A and B is the home country, and it is shown below that the bank is indifferent with respect to the home country.

[13] For example, with country A as host and country B as home country, equation (6) in Proposition 3 becomes: $a < \frac{2(n-1)^2}{2(n-1)^2-1}b$.

The choice of home country does matter for the bank if (b, a) belongs either to region II or region III, because the kind of equilibrium that can be sustained changes. The equilibrium is of type 1 (with n intervals) if country A is home country and of type 2 (with $n-1$ intervals in region II and n intervals in region III) if country B is home country. The circle and the square in figure 5 illustrate a (b, a) that belongs to region II and III, respectively. The next proposition derives the bank's optimal choice of home country:

Proposition 8 *Consider the three regions illustrated in figure 5. For (b,a) belonging to region I, the bank is indifferent between having country A or B as home country. For (b,a) belonging to region II or III, the bank prefers country A, the more lenient country, as the home country.*

Proof. See appendix. ¥

Proposition 8 shows that the bank has an interest in choosing the country that is least inclined to close it as home country. The result is intuitive, but the underlying argument is subtle as it relies on the type of equilibrium that can be sustained in the information exchange. The next proposition looks at the welfare consequences of the bank's choice.

Proposition 9 *Consider the three regions illustrated in figure 5. For (b,a) belonging to region I, the joint welfare of the two countries is independent of whether country A or B is the home country. For (b,a) belonging to region II or III, a sufficient condition for the joint welfare to be maximized when country A is home country is:*

$$f_B^{FB}(0) \leq (a+b)/2. \tag{16}$$

Proof. See appendix. ¥

If condition (16) is satisfied, the bank's choice of home country maximizes the joint welfare of the two countries. This condition has the interpretation that country A's preferences are closer to the first best preferences than country B's. If condition (16) does not hold, there will be combinations of a and b where the bank's choice is welfare maximizing and others where it is not. Notice also that condition (16) is satisfied in the numerical example considered in figure 1. The choice of home country may thus be in conflict with overall welfare but it needs not be.

5 Robustness

5.1 Reputation and Cooperation

The supervisors in our model interact only once. This keeps the analysis tractable, but excludes reputation concerns as a mechanism to increase cooperation. A complete analysis of reputation and cooperation in our cheap talk environment is outside the scope of this paper, but we will develop an example that illustrates some of the additional issues that arise in a dynamic context. Derivations have been left out but are available upon request.

Suppose that the game considered in section 3 is repeated every period for an infinite number of periods. The types are independently distributed across periods. The discount factor between periods is δ. To keep things simple, it is assumed that if the bank is closed, an identical (but different) bank starts the following period. Therefore, the supervisors do not destroy future investment opportunities by closing the bank.

We will consider an example where the host country supervisor signals the true type, q_B. The home country supervisor decides to close the bank iff. $q_A + q_B < a$. After the closure decision has been made, but before the next period, the home country supervisor performs an audit that reveals whether the host country supervisor signalled the true type. If yes, the supervisors continue to play this equilibrium in the next period. However, if the host country supervisor lied, they revert to a static Nash equilibrium forever. We assume that $2a > b > 8a/7$ and that the supervisors play the two interval equilibrium following a deviation.

The first thing to notice is that only the host country supervisor can have an incentive to deviate. Indeed, assuming that the home country supervisor believes that the true type has been revealed, the signal that maximizes the host country's expected welfare in the current period is $\widehat{q}_B = Max\{0, q_B - (b-a)\}$. The host country supervisor adjusts thus the signal for the difference in preferences. Compared to signalling the true type, the welfare of the host country is increased by:

$$\Delta W_B^{Deviate}(q_B) = \begin{cases} -q_B \Delta W_B(a - q_B/2, q_B) \geq 0 & \text{for} \quad q_B \leq b - a \\ -(b-a)\Delta W_B((a+b)/2 - q_B, q_B) > 0 & \text{for} \quad b - a < q_B \leq a \\ -(b - q_B)\Delta W_B((b-q_B)/2, q_B) \geq 0 & \text{for} \quad a < q_B \leq b \\ 0 & \text{otherwise,} \end{cases}$$

which is maximized for $b - a < q_B \leq a$.

However, lying is costly. We show in the proof of Proposition 8 that the two interval equilibrium gives a lower expected welfare for the host country than closing the bank for all $q_A + q_B < a$. Denote by $\Delta W_B^{Cooperate}$ the expected welfare gain (i.e. before q_B is known) from having the bank closed for $q_A + q_B < a$ instead of playing the two interval equilibrium. We have that

$$\Delta W_B^{Cooperate} = \frac{\Psi}{108}\left(99a^2b - 96b^2a + 32b^3 - 34a^3\right) > 0,$$

where Ψ is a positive constant. A lie destroys the host country supervisor's reputation for telling the truth. As a result, the supervisors revert to the two interval equilibrium where the host supervisor reveals less information. This reduces welfare in the host country by $\Delta W_B^{Cooperate}$ in all future periods.

The host country supervisor compares current benefit and future costs of lying when signalling the type. The candidate equilibrium is sustainable if and only if:

$$\begin{aligned}\delta \Delta W_B^{Cooperate} + \delta^2 \Delta W_B^{Cooperate} + ... &= \frac{\delta \Delta W_B^{Cooperate}}{1-\delta} \geq \Delta W_B^{Deviate}(q_B = a) \Leftrightarrow \\ \delta &\geq \frac{\Delta W_B^{Deviate}(q_B = a)}{\Delta W_B^{Deviate}(q_B = a) + \Delta W_B^{Cooperate}}.\end{aligned}$$

The equilibrium is sustainable if the discount rate is sufficiently close to 1. The relevant discount rate will depend on a number of factors including how frequently the supervisors interact (see, e.g. Cabral, 2000). It is easier to sustain cooperation among supervisors that work together regularly, because a deviation will be punished sooner. Similarly, it has been shown that collaboration on several issues (say, in the supervision of more than one multinational bank) facilitates cooperation, see Bernheim and Whinston (1986).

The equilibrium described above is not the only one possible. Another possibility would be that the host country supervisor reveals the true type, but the home country supervisor closes the bank iff. $q_A + q_B < z$ for some $z \in (a, b]$. This would make cooperation by the host country supervisor easier to sustain, because $\Delta W_B^{Cooperate}$ would increase and $\Delta W_B^{Deviate}$ decrease. On the other hand, the home country supervisor would sometimes need to close the bank for $q_A + q_B > a$, which would introduce an additional incentive constraint. One problem of sustaining such an equilibrium is that the host country supervisor usually does not have access to the books of the mother bank in the home country. The host country supervisor may therefore have a hard time observing q_A and knowing whether the home country supervisor has cheated the agreement.[14]

5.2 More General Cheap Talk Games

The difference between a mechanism and a cheap talk game is that signals are binding in a mechanism but not in a cheap talk game. In particular, after the supervisors have sent their signals, the mechanism decides whether the bank is closed or not. However, in a cheap talk game, the home country supervisor decides whether to close the bank after having received the signal(s) send by the host country supervisor.

Clearly, any equilibrium in a cheap talk game can be implemented using a direct mechanism with no sidepayments.[15] However, the opposite is not true. In the main text, only the host

[14] If monitoring the agreement is difficult, cooperation becomes harder to sustain. Still, cooperation is in some circumstances possible even with imperfect monitoring; see, e.g., Green and Porter (1984).

[15] Consider an equilibrium in the cheap talk game. Suppose that the supervisors in country A and B play the strategies $s_A^*(q_A)$ and $s_B^*(q_B)$, respectively. The mechanism designer essentially promises to play these strategies for the supervisors. Formally: Denote by $W_j((q_A, s_A), (q_B, s_B))$ the expected welfare of country j as a function of the strategies played and the types. The direct mechanism has the payoff $W_j((q_A, s_A^*(\widehat{q}_A)), (q_B, s_B^*(\widehat{q}_B)))$ for country j as a function of the signals send, $\widehat{q}_A$ and $\widehat{q}_B$, and the true types q_A and q_B. Take, for example, the home country supervisor. Since $(s_A^*(q_A), s_B^*(q_B))$ constitute a Nash equilibrium in the cheap talk game, we have that $W_A((q_A, s_A^*(q_A)), (q_B, s_B^*(q_B))) \geq W_A((q_A, s_A), (q_B, s_B^*(q_B)))$ for any possible strategy s_A. This implies

country supervisor signals the type. We want to show that it is not possible to sustain different equilibrium outcomes by considering more general cheap talk games where, for example, both supervisors signal the type. We show this result for all equilibria such that the equilibrium outcome is deterministic once the types are realized. We will refer to this class of equilibria as 'deterministic equilibria'.

The method of proof is the following: First, we derive the set of incentive compatible mechanisms without sidepayments. Afterwards, we find necessary conditions for an outcome induced by such a mechanism to be sustainable as an equilibrium of a cheap talk game. Finally, we show that if the necessary conditions are satisfied, the outcome of the mechanism can be sustained as an equilibrium of the simple cheap talk game considered in the text. The necessary conditions are thus also sufficient. Furthermore, as long as we restrict attention to deterministic equilibria, it would not expand the set of equilibrium outcomes to consider more general cheap talk games.

Proposition 10 *Consider the class of deterministic equilibria. Then, the equilibrium outcome of any cheap talk game can also be sustained as an equilibrium outcome of the simple cheap talk game analyzed in section 3.*

Proof. See appendix. ¥

We would like to point out that the restriction to deterministic equilibria is not necessarily innocuous. In recent work on cheap talk games where only the sender has private information, Aumann and Hart (2003) and Krishna and Morgan (2003) have shown that it can lead to a Pareto improvement to break the deterministic link between types and equilibrium outcomes.[16] Whether and when this is also the case in games like ours where both the sender and the receiver have private information is an interesting topic for future research.

in particular that $W_A((q_A, s_A^*(q_A)), (q_B, s_B^*(q_B))) \geq W_A((q_A, s_A^*(q_A')), (q_B, s_B^*(q_B)))$ for $q_A' \neq q_A$. Therefore, it is a Nash equilibrium for both supervisors to reveal their types truthfully.

[16] Krishna and Morgan, for example, introduces a stage with face-to-face communication in the model by Crawford and Sobel. This stage works like a lottery that determines how much information is revealed by the sender.

6 Conclusion

This paper studies conflicts of interests in the supervision of multinational banks. We analyze a situation in which national supervisors have complementary information about the assets of a multinational bank. Taking a political economy approach, it is assumed that the supervisors act in the interest of their respective local economies, but do not care about welfare in other countries. Under this assumption, we study their incentives to exchange information before deciding upon the possible closure of the bank.

The information exchange is modelled as a cheap talk game. Since the supervisors do not always agree on the closure decision, they do not reveal as detailed information as they could. This has several implications. First, the first best closure regulation can never be reached. Second, the better aligned the interests of the countries are, the more detailed information can be exchanged in equilibrium. The joint welfare of the two countries depends thus negatively on the divergence of interests. We also analyze how the bank's investment decision is influenced by the equilibrium closure regulation. It is found that the bank can allocate its assets strategically across countries to reduce the probability of closure. That is, the supervisors' inability to exchange detailed information creates regulatory slack that the bank can exploit.

Several documents by the Bank for International Settlements emphasize that prudent supervision of multinational banks requires close cooperation and information exchange among national supervisors. However, this paper suggests that even if the appropriate (formal) channels for the exchange of information are in place, the current regulatory framework might not work well if the interests of the supervisors are very different. Although the analysis focuses on multinational banks, similar problems arise in other areas. An obvious example are financial conglomerates. In many countries, the different sections of a conglomerate (i.e. banks, insurance companies, etc.) are supervised by separate agencies with different objectives. For example, systemic risks have typically not been considered as important in insurance as they are in banking or even securities (Skipper, 1996). Consolidated supervision requires these agencies to cooperate and exchange information.[17] Here, similar conflicts of interests arise that could be studied using the methodology developed in this paper.

[17] BIS have issued guidelines of how this cooperation should work (BIS, 1999). The general principles are essentially the same as for the supervision of multinational banks.

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A Proofs of Lemmata, Propositions, and Remarks

A.1 Proof of Remark 1

The proof of the first part follows directly from the expressions for a and b. We have that $\partial a/\partial d_A \leq 0$ and $\partial b/\partial d_A \geq 0$ ($\partial a/\partial d_A > 0$ and $\partial b/\partial d_A < 0$) iff $L \leq (>)\ G(1-p)^2/p + p$, which is equivalent to $b \geq (<)a$. Therefore, $Max\{b,a\}/Min\{b,a\}$ is increasing in d_A. Finally, it follows from (3) that the first best closure rule is unaffected by d_A

A.2 Proof of Proposition 1

The proof consists in showing that $f_B^{FB}(q_A)$ is implementable. If there exist transfers such that $f_B^{FB}(q_A)$ is implementable, it is the second best mechanism as it replicates the first best solution and participation in the mechanism can be ensured through a lump-sum payment ex-ante. We write $\Delta W_j(q_A, q_B) = (q_A + q_B)x_j - y_j$, $j = A, B$, where $x_j, y_j > 0$. Denote the signal that the supervisors in country A and B send about their type by s_A and s_B, respectively, and write the direct mechanism chosen by the supervisors as

$$\{f_A(s_B), f_B(s_A), t_A(s_A), t_B(s_B)\}_{(s_A,s_B)\in[0,1]\times[0,1]},$$

where $t_j(s_j)$ is the transfer from country k to country j and $f_j(s_k)$ indicates the minimum value of q_j for which the bank is allowed to stay open as a function of s_k, $j,k \in \{A,B\}$ and $j \neq k$. Consistency of the mechanism requires that $f_A(\cdot) = f_B^{-1}(\cdot)$. Consider the situation at time $T = 1$ after the types have been realized. Assuming truthtelling by the foreign supervisor, the expected welfare of country j is a function of q_j and s_j:

$$EW_j(q_j, s_j) = \int_0^{f_j(s_j)} W_j^{close} dq_k + \int_{f_j(s_j)}^1 W_j^{open}(q_j, q_k)dq_k + t_j(s_j) - \int_0^1 t_k(q_k)f(q_k)dq_k.$$

The model satisfies the single crossing (-) condition as $\partial^2 E(W_j(q_j, s_j))/\partial f_j \partial q_j = -x_j < 0$. It follows from a standard result in the mechanism design literature that $f_B^{FB}(\cdot)$ is implementable, because it is decreasing (Fudenberg and Tirole, 1991).

A.3 Proof of Proposition 3

The following conditions need to be satisfied for an equilibrium of type 1 with n intervals to exist: *(i)* $q_B^i(n) > q_B^{i-1}(n)$, $i = \{2, .., n-1\}$; *(ii)* $q_B^1(n) > 0$; *(iii)* $1 > q_B^{n-1}(n)$; *(iv)* $q_A^1(n) > 0$; and *(v)* $a \leq \frac{1+q_B^{n-1}(n)}{2}$. Conditions *(i)* - *(iii)* are necessary to ensure that the signalling rule in Proposition 2 is well-defined. Condition *(iv)* follows from $q_A^1(n) = f_A^A(I_B^{n-1}) > 0$ and from

Assumption 2 that the signals I_B^n and I_B^{n-1} should lead to a different closure decision for some q_A. Condition *(v)* ensures that $q_A^0(n) = f_A^A(I_B^n) = 0$.

The sequence $\{q_B^1(n), .., q_B^{n-1}(n)\}$ defined in Proposition 2 satisfy always condition *(i)*. It is furthermore easy to show that condition *(ii)* holds iff. (7) holds, while condition *(iv)* is equivalent to (6). Condition *(v)* is satisfied iff. (8) holds. Finally, condition *(iii)* is implied by $q_A^1(n) > 0$, $b < 1$, and $\Delta W_B(q_A^1(n)/2, q_B^{n-1}(n)) = 0$.

For an equilibrium of type 2 with n intervals to exist, the relevant conditions are: *(i)* $\widehat{q}_B^1(n) > 0$; *(ii)* $\widehat{q}_A^1(n) > 0$; and *(iii)* $a > \frac{1+\widehat{q}_B^{n-1}(n)}{2}$. We find that *(i)* is equivalent to condition (10), and *(ii)* and *(iii)* hold iff. (9) is satisfied.

A.4 Proof of Corollary 1

From Proposition 3 we have that there exists an equilibrium with n intervals if $b \in [Max\{a - \frac{1}{2n(n-1)}, \frac{2(n-1)^2-1}{2(n-1)^2}a\}, \frac{2(n-1)^2}{2(n-1)^2-1}a]$. The proof follows then from

$$\begin{aligned} & [Max\{a - \frac{1}{2n(n-1)}, \frac{2(n-1)^2-1}{2(n-1)^2}a\}, \frac{2(n-1)^2}{2(n-1)^2-1}a] \\ \subset \quad & [Max\{a - \frac{1}{2l(l-1)}, \frac{2(l-1)^2-1}{2(l-1)^2}a\}, \frac{2(l-1)^2}{2(l-1)^2-1}a] \end{aligned}$$

for $2 \leq l < n$.

A.5 Proof of Corollary 3

Consider the first part of the corollary. From (8) and (9) follows that an equilibrium of type 1 with n intervals exists only if $b \geq na/(n-1) - (2n-1)/(2n(n-1))$ and an equilibrium of type 2 with $n+1$ intervals exists only if $b < (n+1)a/n - (2n+1)/(2n(n+1))$. The two equilibria can therefore coexist only if $a > n/(n+1)$. It follows from (9) and (10) that this condition is never satisfied when the equilibrium of type 2 with $n+1$ intervals exists.

Consider now the second part. Suppose that $b \geq a$ and that the maximal number of intervals that can be used in an equilibrium of type 2 is n. This implies that

$$(n+1)a/n - (2n+1)/2n(n+1) < b \leq n/(n-1)a - (2n-1)/2n(n-1). \qquad (1.a)$$

As method of proof, we want to show that whenever the equilibrium of type 2 with n intervals exists, the equilibrium of type 1 with $n+1$ intervals also exists. Equations (1.a) and (6) imply that the equilibrium of type 1 with $n+1$ intervals exists iff. $b \leq 2n^2a/(2n^2-1)$.

From $1 \geq b \geq a$ and (1.a) follows that $1 - 1/2n \leq a \leq 1 - 1/2(n+1)^2$. First consider the region $1 - 1/2n \leq a \leq 1 - 1/2n^2$. From equation (9) follows that a necessary condition for the equilibrium of type 2 with n intervals to exist is $b \leq na/(n-1) - (2n-1)/2n(n-1)$. Since $na/(n-1) - (2n-1)/2n(n-1) \leq 2n^2a/(2n^2-1)$ for $a \leq 1 - 1/2n^2$, the equilibrium of type 1 exists whenever the one of type 2 does. Finally, consider the region $1 - 1/2n^2 \leq a \leq 1 - 1/2(n+1)^2$. Here, it follows from $b \leq 1 \leq 2n^2a/(2n^2-1)$ that there always exists an equilibrium of type 1 with $n+1$ intervals and proof follows.

A.6 Proof of Proposition 4

We will show below that whenever the equilibria of type 1 with n and with $n+1$ intervals coexist, the equilibrium with $n+1$ intervals gives the highest welfare in both countries. It follows from Corollary 3 that there are two additional cases to consider: 1) equilibria of type 2 with n and with $n+1$ intervals coexist, and 2) an equilibrium of type 1 with $n+1$ and an equilibrium of type 2 with n intervals coexist. The method of proof follows here closely the one used for equilibria of type 1, so the proofs have been left out. Details are available upon request.

From Proposition 2, we have that $q_j^{i+1}(n+1) > q_j^i(n) > q_j^i(n+1)$, $j = A, B$ and $i = 1, ..., n$. This implies that there are $2n-1$ areas where the closure decision is different in the two equilibria. In n of these areas, the bank would remain open in the n interval but close in the $n+1$ interval equilibrium. Denote these areas by α_l, $l = 1, .., n$. In the other $n-1$ areas, the bank would be closed in the n interval but remain open in the $n+1$ interval equilibrium. Denote these areas β_l, $l = 1, .., n-1$. α_l and β_l are defined as follows:

$$\begin{aligned}
\alpha_l &\equiv \{(q_A, q_B) \mid q_A \in (q_A^{l-1}(n), q_A^l(n+1)) \text{ and } q_B \in (q_B^{n-l}(n), q_B^{n+1-l}(n+1))\}, \\
\beta_l &\equiv \{(q_A, q_B) \mid q_A \in (q_A^l(n+1), q_A^l(n)) \text{ and } q_B \in (q_B^{n-l}(n+1), q_B^{n-l}(n))\}.
\end{aligned}$$

We denote the probability that the bank belongs to area α_l and β_l by

$$\begin{aligned}
\theta(\alpha_l) &= \left(q_A^l(n+1) - q_A^{l-1}(n)\right)\left(q_B^{n+1-l}(n+1) - q_B^{n-l}(n)\right), \\
\theta(\beta_l) &= \left(q_A^l(n) - q_A^l(n+1)\right)\left(q_B^{n-l}(n) - q_B^{n-l}(n+1)\right).
\end{aligned}$$

Furthermore, denote $E(q_A + q_B \mid (q_A, q_B) \in \alpha_l)$ (resp. $E(q_A + q_B \mid (q_A, q_B) \in \beta_l)$) by $q(\alpha_l)$ (resp. $q(\beta_l)$).

$EW_j(n)$ is the expected welfare of country j in an equilibrium with n intervals. The expected welfare gain for country j when switching from a n to a $n+1$ interval equilibrium is then given by

$$EW_j(n+1) - EW_j(n) = \sum_{l=1}^{n-1} \theta(\beta_l)\Delta W_j(q(\beta_l)) - \sum_{l=1}^{n} \theta(\alpha_l)\Delta W_j(q(\alpha_l)),$$

where ΔW_j has been written as a function of $q(\beta_l)$, because the expected welfare depends only on the sum of q_A and q_B. Undertaking some tedious calculations, it can be shown that

$$\begin{aligned}
q(\alpha_l) &\equiv q(\alpha) = \frac{(2n^2-1)(a+b)}{2(2n-1)(2n+1)} \text{ for } l = 1, .., n, \\
q(\beta_l) &\equiv q(\beta) = \frac{2n^2(a+b)}{2(2n-1)(2n+1)} \text{ for } l = 1, .., n-1.
\end{aligned}$$

Hence,

$$EW_j(n+1) - EW_j(n) = \Delta W_j(q(\beta)) \sum_{l=1}^{n-1} \theta(\beta_l) - \Delta W_j(q(\alpha)) \sum_{l=1}^{n} \theta(\alpha_l)$$

Defining $\psi \equiv \frac{4\left[2n^2a-(2n^2-1)b\right]\left[2n^2b-(2n^2-1)a\right]}{(4n^2-1)^2}$, we have that

$$\theta_\alpha = \sum_{l=1}^{n} \theta(\alpha_l) = \frac{\psi n}{3}(2n^2+1) \text{ and } \theta_\beta = \sum_{l=1}^{n-1} \theta(\beta_l) = \frac{\psi n}{3}(2n^2-2).$$

ΔW_j can be rewritten as $\Delta W_j(q_A, q_B) = x_j(q_A+q_B) - y_j$ where $a = x_A/y_A$ and $b = x_B/y_B$. It follows that

$$\begin{aligned} EW_j(n+1) &\geq EW_j(n) \Leftrightarrow \theta_\beta \Delta W_j(q(\beta)) \geq \theta_\alpha \Delta W_j(q(\alpha)) \Leftrightarrow \\ \frac{y_k}{x_k} &\geq \frac{\theta_\alpha q(\alpha) - \theta_\beta q(\beta)}{\theta_\alpha - \theta_\beta} = (a+b)/3. \end{aligned}$$

Thus,

$$EW_A(n+1) \geq EW_A(n) \Leftrightarrow a \geq \frac{a+b}{3} \text{ and } EW_B(n+1) > EW_B(n) \Leftrightarrow b \geq \frac{a+b}{3}.$$

From Corollary 2 follows that these two conditions are satisfied when the n interval equilibrium exists.

A.7 Proof of Lemma 3

We prove the proposition for $b \geq a$, i.e. for $L \leq G(1-p)^2/p + p$, where the equilibrium with the highest number of intervals is of type 1 (Corollary 3). The proof for $b \leq a$ is analogous. Consider an equilibrium of type 1 with n intervals. The expected joint welfare of country A and B is

$$\begin{aligned} EW(n) &= \sum_{i=1}^{n-1} \int_{q_A^{i-1}(n)}^{q_A^i(n)} \int_0^{q_B^{n-i}(n)} (W_A^{close} + W_B^{close}) dq_B dq_A + \\ &\quad \sum_{i=1}^{n} \int_{q_A^{i-1}(n)}^{q_A^i(n)} \int_{q_B^{n-i}(n)}^{1} (W_A^{open}(q_A, q_B) + W_B^{open}(q_A, q_B)) dq_B dq_A \\ &= W^{open} - \sum_{i=1}^{n-1} \int_{q_A^{i-1}(n)}^{q_A^i(n)} \int_0^{q_B^{n-i}(n)} \Delta W(q_A, q_B) dq_B dq_A \\ &= W^{open} - \sum_{i=1}^{n-1} \int_{q_A^{i-1}(n)}^{q_A^i(n)} \int_0^{q_B^{n-i}(n)} ((x_A + x_B)(q_A + q_B) - (y_A + y_B)) dq_B dq_A \end{aligned}$$

where $W^{open} = \int_0^1 \int_0^1 (W_A^{open}(q_A, q_B) + W_B^{open}(q_A, q_B)) dq_B dq_A$ is a constant that is independent of d_A. x_j and y_j, $j = A, B$, are positive constants where $a = y_A/x_A$ and $b = y_B/x_B$. We have that $x_A + x_B = 1$. Integration yields then

$$EW(n) = W^{open} - \sum_{l=1}^{n-1} \theta_l \left(\alpha(q_l) - \frac{m}{2}\right),$$

where $m/2 = (y_A + y_B)/2 = G(1-p) + L - p$, $\theta_l = (q_A^l(n) - q_A^{l-1}(n)) q_B^{n-l}(n)$, and $\alpha(q_l) = (q_A^{l-1}(n) + q_A^l(n) + q_B^{n-l}(n))/4$. Calculations show that for the set of parameters considered, it holds that $0 \leq m - a \leq m - b$, which implies $m \in [a, (a+b)/2]$. We will use this result in the following.

When a change in d_A occurs, notice that $m/2$ is not affected. All changes in expected welfare occur through a and b, which affect θ_l and $\alpha(q_l)$. From the definitions of a and b, we find:

$$\begin{aligned} \frac{\partial a}{\partial d_A} &= -2\frac{((1-p)(1+G)-1-L)(1-p)-(L-p)}{(1+d_A(1-p))^2} \\ \frac{\partial b}{\partial d_A} &= 2\frac{((1-p)(1+G)-1-L)(1-p)-(L-p)}{(1-d_A(1-p))^2}. \end{aligned}$$

Since the only difference being the denominator, it is easy to see that $\left|\frac{\partial b}{\partial d_A}\right| \geq \left|\frac{\partial a}{\partial d_A}\right|$. Thus, we can define a constant $\gamma = \frac{(1-\delta(1-p))^2}{(1+\delta(1-p))^2} \in [0,1]$ so that $\frac{\partial a}{\partial d_A} = -\gamma \frac{\partial b}{\partial d_A}$. We obtain:

$$\frac{\partial EW(n)}{\partial d_A} = \frac{\partial EW(n)}{\partial a}\frac{\partial a}{\partial d_A} + \frac{\partial EW(n)}{\partial b}\frac{\partial b}{\partial d_A} = \frac{\partial b}{\partial d_A}\left(\frac{\partial EW(n)}{\partial b} - \gamma\frac{\partial EW(n)}{\partial a}\right).$$

To show that $\frac{\partial EW(n)}{\partial d_A} < 0$, we separately show that $\frac{\partial EW(n)}{\partial a} \geq 0$ and $\frac{\partial EW(n)}{\partial b} \leq 0$. Calculations show that

$$\frac{\partial EW(n)}{\partial a} = \frac{-n(n-1)\left(n(n-1)(b-a)(3a+b-6m) - b(2a+b-3m)\right)}{3(2n-1)^2}.$$

Hence, $\frac{\partial EW(n)}{\partial d_A} \geq 0$ iff.

$$n(n-1)(b-a)(3a+b-6m) - b(2a+b-3m) \leq 0. \tag{2a}$$

The left hand side (LHS) of (2a) is decreasing in n, because $m > a$ and $a \leq b < 2a$. It is thus enough to show that $\frac{\partial EW(n)}{\partial a} \geq 0$ for $n = 2$. Here, (2a) reduces to $2(b-a)(3a+b-6m) - b(2a+b-3m) < 0$. Using $b < 2a$, we find that $2(b-a)(3a+b-6m) - b(2a+b-3m) < 0$ for $m = a$ and for $m = (a+b)/2$. Since the derivative of the LHS of (2a) wrt. m takes on a constant sign, this implies that $\frac{\partial EW(n)}{\partial a} \geq 0$ for all $m \in [a, (a+b)/2]$.

We consider now $\frac{\partial EW(n)}{\partial b} \leq 0$. Calculations show that

$$\frac{\partial EW(n)}{\partial b} = \frac{n(n-1)\left(n(n-1)(b-a)(a+3b-6m) - a(a+2b-3m)\right)}{3(2n-1)^2}.$$

Hence, sign$(\frac{\partial EW(n)}{\partial b})$=sign$(n(n-1)(b-a)(a+3b-6m) - a(a+2b-3m))$. Since $(a+b)/2 \geq m$, $a + 2b - 3m \geq 0$. It is thus sufficient to show that $a + 3b - 6m \leq 0$. Since $m = y_A + y_B$, we have:

$$\begin{aligned} a + 3b - 6m &= a + 3b - 6y_A - 6y_B = a(1-3x_A) + 3b(1-x_B) \leq 0 \Leftrightarrow \\ \frac{b}{a} &\leq \frac{3x_A - 1}{3(1-x_B)} = 1 + \frac{2}{3(1-p)d_A}. \end{aligned}$$

Finally, the assumption $p \geq \frac{1}{2}$ implies that $1 + \frac{2}{3(1-p)} > 2$. It follows then from Corollary 2 that $\frac{\partial EW(n)}{\partial b} \geq 0$, which concludes the proof.

A.8 Proof of Proposition 5

We consider the maximal number of intervals that can be sustained in equilibrium before and after an increase in d_A. Suppose that there exists an equilibrium with n intervals before and after the increase. It is possible that the type of equilibrium changes after the increase in d_A, for example, from type 1 to type 2. If so, notice that the welfare function is continuous at the point where the type of equilibrium changes, because $q_A^i(n) = \widehat{q}_A^{i+1}(n)$ and $q_B^i(n) = \widehat{q}_B^i(n)$ when equation (8) holds with equality. From continuity of the welfare function and Lemma 3 follows then that the welfare is decreasing in d_A. Suppose now that there exists an equilibrium with n intervals before the change but only $n - i$ intervals after the change, $i > 0$. It follows from Corollary 1 that there also exists an equilibrium with $n - i$ intervals before the change in d_A. Arguing as above, we have that the welfare of the $n - i$ interval equilibrium is decreasing in d_A. Using Proposition 4, it follows that the welfare of the n interval equilibrium before the increase in d_A is higher than the welfare of the $n - i$ interval after the increase.

A.9 Proof of Proposition 6

We derive the optimal investment decision of the bank. To do so, it is necessary to consider different regions. The calculations of some of the expressions are quite long and tedious and have been left out. They are available upon request.

Region I: $b/a > 2$. Comparing equations (11), (12), and (13), we see that investing one or two units in the host country is the profit maximizing strategy.

Region II: $2 \geq b/a > 8/7$. Equations (11) and (12) show that $E\Pi^{20}(a,b) > E\Pi^{02}(a,b)$, because $b > a$. Therefore, we compare now and in the following two regions $E\Pi^{11}(a,b,n)$ and $E\Pi^{20}(a,b)$. In region II only the two interval equilibrium exists when the bank invests in both countries. Calculations show that $E\Pi^{11}(a,b,2)$ is convex in b. Furthermore, $E\Pi^{11}(a,b,2)$ has a minimum at $b/a = (1+\sqrt{3})/2$ and this is the only extremum in the interval considered. Hence, $E\Pi^{11}(a,b,2)$ takes on the maximal value at the border of the interval. $E\Pi^{11}(a,b,2) = 1 - 120a^3/343 < E\Pi^{20}(a,b) = 1 - a^3/3$ for $b/a = 8/7$ and $E\Pi^{11}(a,b,2) = 1 > E\Pi^{20}(a,b)$ for $b/a = 2$. This implies that there exist a $\overline{b/a} \in ((1+\sqrt{3})/2, 2)$ such it is optimal to invest two units in the home country for $b/a \leq \overline{b/a}$ and one unit in each country for $b/a > \overline{b/a}$.

Region III: $8/7 \geq b/a > 18/17$. In this region, the supervisors coordinate on the three interval equilibrium. Analyzing $E\Pi^{11}(a,b,3)$ as above, it is easy to see that it is optimal for the bank to invest two units in the home country in the whole interval.

Region IV: $18a/17 > b/a \geq 1$. In this region, there exists a n interval equilibrium, $n \geq 4$. From Proposition 3 it follows that the supervisors coordinate on a n interval equilibrium iff. $n^2/(n^2-1) < b/a \leq (n-1)^2/((n-1)^2-1)$. Solving $\partial E\Pi^{11}(a,b,n)/\partial b = 0$, we obtain two solutions: $b/a = (n^2+1-n \pm (2n-1)\sqrt{n(n-1)+1})/3(n-1)n$. It can be shown that these solutions lie outside the interval considered and that $\partial E\Pi^{11}(a,b,n)/\partial b$ has constant, negative sign for $18/17 > b/a \geq 1$. Finally, since $(1-a^3/3) - E\Pi^{11}(a,b,n) = a^3(2n^4-4n^2+1)/3(2n^2 -$

$1)^3 > 0$ for $b/a = n^2/(n^2-1)$, it follows that bank maximizes its profit by investing two units in the home country.

A.10 Proof of Proposition 7

We derive the welfare maximizing investment decision of the bank. To do so, it is necessary to consider different regions. The calculations of some of the expressions are quite long and tedious and have been left out. They are available upon request. We will use the following notation: $EW_j^{20}(a,b)$ and $EW_j^{02}(a,b)$ is the expected welfare of country j, $j = A, B$, as a function of a and b when everything is invested in country A and in country B, respectively. If the bank invests one unit in each country, the expected welfare is denoted $EW_j^{11}(a,b,n)$ and is a function of a, b, and the number of intervals used in equilibrium, n. We have:

$$EW_j^{20}(a,b) = \int_0^a \int_0^{a-q_A} W_j^{close} dq_B dq_A + \int_a^1 \int_0^1 W_j^{open}(q_A, q_B) dq_B dq_A.$$

For $2 \geq b/a \geq 1$,

$$\begin{aligned} EW_j^{02}(a,b) &= \int_0^b \int_0^{b-q_A} W_j^{close} dq_B dq_A + \int_b^1 \int_0^1 W_j^{open}(q_A, q_B) dq_B dq_A, \\ EW_j^{11}(a,b) &= \int_0^1 \int_0^1 W_j^{open}(q_A, q_B) dq_B dq_A - \sum_{i=1}^{n-1} \int_{q_A^{i-1}(n)}^{q_A^i(n)} \int_0^{q_B^{n-i}(n)} \Delta W_j(q_A, q_B) dq_B dq_A, \end{aligned}$$

while for $b/a > 2$,

$$EW_j^{02}(a,b) = EW_j^{11}(a,b) = \int_0^1 \int_0^1 W_j^{open}(q_A, q_B) dq_B dq_A.$$

Region I: $b/a > 2$. The welfare of both the home and the host country is the same whether the bank invests one or two units in the host country. Obviously, the welfare of the home country is maximized when the bank invests two units in the home country. For the host country, we have that $Sign\left[EW_j^{20}(a,b) - EW_j^{02}(a,b)\right] = Sign\left[a^2(3b-2a)\right]$. Since $a^2(3b-2a) > 0$, the first part of the proposition follows.

In the next regions that we will consider, the welfare of a country is maximized when the bank invests everything in its own country. We will therefore only compare the welfare when the bank invests one unit in each country and when it invests two units in the foreign country.

Region II: $2 \geq b/a \geq 8/7$. Suppose that the bank invests one unit in each country. There can then be used two intervals in equilibrium. Let us first consider the host country. We have that

$$sign\left[EW_B^{20}(a,b) - EW_B^{11}(a,b,2)\right] = sign\left[99a^2b - 96b^2a + 32b^3 - 34a^3\right].$$

Analysis shows that $99a^2b - 96b^2a + 32b^3 - 34a^3 > 0$ for all $b \geq a$. We now turn to the home country:

$$sign\left[EW_A^{02}(a,b) - EW_A^{11}(a,b,2)\right] = sign\left[32a^3 - 96a^2b + 99ab^2 - 34b^3\right].$$

It can be shown that $32a^3 - 96a^2b + 99ab^2 - 34b^3$ is positive for all $b \leq \widetilde{b/a}$ and negative for $b > \widetilde{b/a}$ where $\widetilde{b/a} \in (8/7, \overline{b/a})$.

Region III: $8/7 > b/a \geq 1$. Define the maximal number of intervals that can be used in equilibrium as $N(a,b)$. Since $b/a < 8/7$, $N(a,b) \geq 3$. Let us consider the host country. We want to show that $\omega(a,b) \equiv EW_B^{20}(a,b) - EW_B^{11}(a,b,N(a,b))$ is increasing in b. Suppose that we are in the region where $N(a,b) = n$ and consider an increase in b. We have that $Sign\left[\partial^2\omega(a,b)/\partial b^2\right] = Sign\left[40(b-a)(n-1)^2n^2 + 8(bn(n-1) - 2a)n(n-1)\right]$. From $n \geq 3$ and $b > a$ follows that $\partial^2\omega(a,b)/\partial b^2 > 0$. Furthermore, since $Sign\left[\partial\omega(a,b)/\partial b\right] = Sign\left[a^2/2(2n-1)^2\right]$ for $b = a$, $\omega(a,b)$ is increasing in b. Consider now an increase in b so large that $N(a,b) = n-1$. $\omega(a,b)$ is continuous in b, because $EW_B^{11}(a,b,n) = EW_B^{11}(a,b,n-1)$ when equation (6) holds with equality. We conclude that $\omega(a,b)$ is increasing in b in all of region III. As $\omega(a,b) \to 0$ for $b \to a$, we have shown that $EW_B^{20}(a,b) > EW_B^{11}(a,b,N(a,b))$ in region III. A similar argument establishes that $EW_A^{02}(a,b) > EW_A^{11}(a,b,N(a,b))$.

A.11 Proof of Proposition 8

If country A is the home country, the profit of the bank in an equilibrium of type 1 and 2, respectively, with n intervals is:

$$E\Pi_A(a,b,n) \equiv p\begin{pmatrix} \sum_{i=1}^{n-1}\int_{q_A^{i-1}(n)}^{q_A^i(n)}\int_{q_B^{n-i}(n)}^{1}(q_A+q_B)dq_Bdq_A \\ +\int_{q_A^{n-1}(n)}^{1}\int_0^1(q_A+q_B)dq_Bdq_A \end{pmatrix},$$

$$E\widehat{\Pi}_A(a,b,n-1) \equiv p\begin{pmatrix} \sum_{i=1}^{n-2}\int_{\widehat{q}_A^{i}(n)}^{\widehat{q}_A^{i+1}(n)}\int_{\widehat{q}_B^{n-i}(n)}^{1}(q_A+q_B)dq_Bdq_A \\ +\int_{\widehat{q}_A^{n}(n)}^{1}\int_0^1(q_A+q_B)dq_Bdq_A \end{pmatrix}.$$

We derive the bank's profit maximizing choice of home country, and consider region I-III separately. The calculations of some of the expressions are quite long and tedious and have been left out. They are available upon request.

Region I: The supervisors coordinate on an equilibrium of type 1 with n intervals independently of the home country. Abusing notation slightly, we can write expected profit when country B is home country as $E\Pi_A(b,a,n)$. It can be verified that $E\Pi_A(a,b,n) = E\Pi_A(b,a,n)$. Therefore, the bank is indifferent with respect to the choice of home country.

Region II and III: We consider first region II. Suppose that (15) is satisfied for $n = 2$. Then, there is an equilibrium of type 1 with 2 intervals if country A is home country, but no information exchange if country B is home country. Consider the profit if country B is the home country. Since there will be no information exchange, the supervisor closes the bank if $q_B < Max\{0, b - E(q_A)\}$. The conditions $a < b \leq 2a$ and $a \leq b - 1/4$ imply that $b \geq 1/2$. Using $E(q_A) = 1/2$, the expected profit can be written as:

$$p\left(\int_{b-1/2}^{1}\int_0^1(q_A+q_B)dq_Adq_B\right) = p(9/8 - b^2/2),$$

which is less than $E\Pi_A(a,b,2)$. Hence, the bank prefers country A as the home country. Suppose now that (15) is satisfied for some $n > 2$. There is then an equilibrium of type 1 with n intervals if country A is the home country and an equilibrium of type 2 with $n-1$ intervals if country B is the home country. Solving the equation $E\widehat{\Pi}_A(b,a,n-1) = E\Pi_A(a,b,n)$ in a, we find three roots that all do not belong to region II. Therefore, $E\Pi_A(a,b,n) - E\widehat{\Pi}_A(b,a,n-1)$ takes on a constant sign in region II. Finally, by considering the profit for $(b,a) = (1,(2(n-1)^2-1)/2(n-1)^2)$ belonging to region II, we find that the bank prefers country A as home country. A similar argument establishes the claim for region III.

A.12 Proof of Proposition 9

Suppose that country A is the home country. The expected joint welfare when the supervisors coordinate on an equilibrium of type 1 and type 2, respectively, with n intervals is:

$$EW(a,b,n) \equiv \sum_{j=A,B}\left(\int_0^1\int_0^1 W_j^{close}dq_Bdq_A + \sum_{i=1}^{n-1}\left(\begin{array}{c}\int_{q_A^{i-1}(n)}^{q_A^i(n)}\int_{q_B^{n-i}(n)}^1 \Delta W_j(q_A,q_B)dq_Bdq_A \\ +\int_{q_A^{n-1}(n)}^1\int_0^1 \Delta W_j(q_A,q_B)dq_Bdq_A\end{array}\right)\right),$$

$$\widehat{EW}(a,b,n) \equiv \sum_{j=A,B}\left(\int_0^1\int_0^1 W_j^{close}dq_Bdq_A + \sum_{i=1}^{n-2}\left(\begin{array}{c}\int_{\widehat{q}_A^{i}(n)}^{\widehat{q}_A^{i+1}(n)}\int_{\widehat{q}_B^{n-i}(n)}^1 \Delta W_j(q_A,q_B)dq_Bdq_A \\ +\int_{\widehat{q}_A^{n}(n)}^1\int_0^1 \Delta W_j(q_A,q_B)dq_Bdq_A\end{array}\right)\right).$$

We now derive the welfare maximizing choice of home country, and consider region I-III separately. The calculations of some of the expressions are quite long and tedious and have been left out. They are available upon request.

Region I: The supervisors coordinate on an equilibrium of type 1 with n intervals independently of the home country. The expected welfare when country B is elected home country can be written as $EW(b,a,n)$. Since $EW(b,a,n) = EW(a,b,n)$, the joint welfare does not depend on the home country.

Region II and III: We consider first region II. Suppose that (15) is satisfied for $n = 2$. There is an equilibrium of type 1 with 2 intervals if country A is home country, but no information exchange otherwise. Consider the welfare if country B is the home country. Arguing as in the proof of Proposition 8, we have that the expected welfare can be written as:

$$\sum_{j=A,B}\left(\int_0^1\int_0^1 W_j^{close}dq_Bdq_A + \int_{b-1/2}^1\int_0^1 \Delta W_j(q_A,q_B)dq_Bdq_A\right).$$

Comparing this expression to $EW(a,b,2)$, we find that the expected welfare is highest when country A is the home country if and only if

$$-(9+4a(3+4a)-6b-16ab-32b^2-12(3+4a-8b)f_B^{FB}(0)) \geq 0. \tag{17}$$

The left hand side of equation (17) is decreasing in $f_B^{FB}(0)$ since $a \leq 2b-3/4$ in region II. For $f_B^{FB}(0) = (a+b)/2$, equation (17) reduces to $(3+2a-4b)(-3+4a+4b) \geq 0$, because $1 \geq b \geq 1/2$ and $a \geq b/2$. Therefore, the joint welfare is maximized when country A is home country for all $f_B^{FB}(0) \leq (a+b)/2$. Suppose now that (15) is satisfied for some $n > 2$. The welfare is $EW(a,b,n)$ if country A is home country and $\widehat{EW}(b,a,n-1)$ if country B is home country. It is possible to show that $\partial(EW(a,b,n) - \widehat{EW}(b,a,n-1))/\partial f_B^{FB}(0) < 0$ in region

II. Furthermore, $EW(a,b,n) > \widehat{EW}(b,a,n-1)$ for $f_B^{FB}(0) = (a+b)/2$. We conclude that $EW(a,b,n) > \widehat{EW}(b,a,n-1)$ in region II for $f_B^{FB}(0) \leq (a+b)/2$. An analogous argument establishes the claim for region III.

A.13 Proof of Proposition 10

First, we derive the set of incentive compatible mechanisms without sidepayments. Afterwards, we find necessary conditions for an outcome induced by such a mechanism to be sustainable as an equilibrium of a cheap talk game. Finally, we show that if the necessary conditions are satisfied, the outcome of the mechanism can be sustained as an equilibrium of the cheap talk game considered in the text.

A.13.1 Mechanisms without sidepayments

Denote by $\Phi(\cdot)$ a mechanism. It indicates for a given value of q_j the minimal value of q_k for which the bank is allowed to stay open, $j,k = A,B$ and $j \neq k$. The timing is the following: The supervisors signal their type. Afterwards, the mechanism decides on closure. If $q_B \leq \Phi(q_A)$, the bank is closed. Otherwise, it continues. Invoking the revelation principle, we restrict attention to incentive compatible mechanisms.

Lemma 4 $\Phi(\cdot)$ *cannot be continuously increasing or decreasing on an open set.*

Proof. Denote country j's most preferred mechanism $\Phi_j^*(q_j)$. In particular, $\Phi_A^*(q_A) \equiv a - q_A$ and $\Phi_B^*(q_B) \equiv b - q_B$. Suppose that there exists some $\widehat{q}_j$ belonging to the open set $(\underline{q}, \overline{q})$ st. $\Phi(\widehat{q}_j) < \Phi_j^*(\widehat{q}_j)$. If $\Phi(\cdot)$ were strictly decreasing on $(\underline{q}, \overline{q})$, there would exist some ε st. $\Phi(\widehat{q}_j) < \Phi(\widehat{q}_j - \varepsilon) \leq \Phi_j^*(\widehat{q}_j)$. Therefore, if the true type was $\widehat{q}_j$, the supervisor in country j would have an incentive to deviate and signal the type $\widehat{q}_j - \varepsilon$. Similarly, the supervisor would deviate to $\widehat{q}_j + \varepsilon$ if $\Phi(\cdot)$ was strictly increasing on $(\underline{q}, \overline{q})$. A similar argument applies to the case of $\Phi(\widehat{q}_j) > \Phi_j^*(\widehat{q}_j)$. Hence, if $\Phi(\cdot)$ were strictly increasing or decreasing on $(\underline{q}, \overline{q})$, the only mechanism that could induce truthtelling by country j's supervisor would be $\Phi(q_j) = \Phi_j^*(q_j)$ for all $q_j \in (\underline{q}, \overline{q})$. However, as $a \neq b$, $\Phi(q_j) = \Phi_j^*(q_j)$ would not induce truthtelling by the supervisor in country k, $j,k \in \{A,B\}$ and $j \neq k$. ¥

We know from Lemma 1 that the mechanism has to consist of constant segments plus 'jumps.' Consider a mechanism where the possible types of country j, $j \in \{A,B\}$, are divided into n_j intervals. Interval i is defined $I_j^i \equiv (q_j^{i-1}(n_j), q_j^i(n_j)]$. We have $q_j^0(n_j) = 0$ and $q_j^{n_j}(n_j) = 1$.

Lemma 5 *Consider two neighboring intervals* $I_j^i = (q_j^{i-1}(n_j), q_j^i(n_j)]$ *and* $I_j^{i+1} = (q_j^i(n_j), q_j^{i+1}(n_j)]$, $q_j^{i-1}(n_j) < q_j^i(n_j) < q_j^{i+1}(n_j)$, *where* $\Phi(q_j) = q_h$ *for* $q_j \in I_l^i$ *and* $\Phi(q_j) = q_h'$ *for* $q_j \in I_j^{i+1}$, $q_h \neq q_h'$. *Necessary conditions for the scheme to be incentive compatible are:*
i) $\Delta W_j \left(q_j^i(n_j), (q_h + q_h')/2\right) = 0$
ii) $q_h > q_h'$.

Proof. Incentive compatibility requires that

$$\int_0^{q_h} W_j^{close} dq_k + \int_{q_k}^1 W_j^{open}(q_j,q_k)dq_k \underset{(\leq)}{\geq} \int_0^{q'_h} W_j^{close} dq_k + \int_{q'_h}^1 W_j^{open}(q_j,q_k)dq_k$$

$\forall\ q_j \in I_j^i$ ($\forall\ q_j \in I_j^{i+1}$). These constraints reduce to:

$$(q_h - q'_h)\,\Delta W_j\left(q_j, (q_h+q'_h)/2\right) \begin{cases} \leq 0 & \forall q_j \in I_i^i \\ \geq 0 & \forall\ q_j \in I_i^{i+1} \end{cases} \tag{18}$$

Part *i)* of the lemma then follows from $q_h \neq q'_h$ and continuity of ΔW_j. Since $\partial\Delta W_j/\partial q_j > 0$, it has to hold that $q_h > q'_h$ for (18) to be satisfied for all types in I_j^i and I_j^{i+1}. ¥

There are four different types of mechanisms possible depending on the initial and the terminal value of $\Phi(\cdot)$. We denote these mechanisms $\Phi_x(\cdot)$ where $x \in \{1,2,3,4\}$ indicates the type.

Type 1 mechanisms are characterized by $\Phi_1(0) = q_B^{n-1}(n) < 1$, $\Phi_1(1) = 0$, and $n_A = n_B = n$. Using Lemma 5, we obtain a system of $2(n-1)$ equations and unknowns, which determines the endpoint of the first $n-1$ intervals of the two countries:

$$\begin{aligned} \Delta W_A\left(q_A^i(n), (q_B^{n-i-1}(n) + q_B^{n-i}(n))/2\right) &= 0 \text{ for } i = 1,..,n-1, \\ \Delta W_B\left((q_A^{n-i-1}(n) + q_A^{n-i}(n))/2, q_B^i(n)\right) &= 0 \text{ for } i = 1,..,n-1. \end{aligned} \tag{19}$$

If country j signals a q_j that belongs to interval I_A^i, the bank closed if country k signals that $q_k \leq q_k^{n-i}(n)$.

Type 2 mechanisms are characterized by $\Phi_2(0) = 1$, $\Phi_2(1) = 0$, $n_A = n+1$, and $n_B = n$. Using Lemma 5, we obtain a system of $2n-1$ equations and unknowns:

$$\begin{aligned} \Delta W_A\left(q_A^i(n+1), (q_B^{n-i-1}(n) + q_B^{n-i}(n))/2\right) &= 0 \text{ for } i = 1,..,n, \\ \Delta W_B\left((q_A^{n+1-i}(n+1) + q_A^{n-i}(n+1))/2, q_B^i(n)\right) &= 0 \text{ for } i = 1,..,n-1. \end{aligned} \tag{20}$$

If the home country signals a q_A that belongs to interval I_A^i, the bank is closed if the host country signals that $q_B \leq q_B^{n+1-i}(n)$. If the host country signals a q_B that belongs to interval I_B^i, the bank is closed if the home country signals that $q_A \leq q_A^{n+1-i}(n+1)$.

Type 3 mechanisms are characterized by $\Phi_3(0) = q_B^{n-1}(n) < 1$, $\Phi_3(1) = q_B^1(n) > 0$, $n_A = n-1$, and $n_B = n$. Similarly, type 4 mechanisms are characterized by $\Phi_4(0) = 1$, $\Phi_4(1) = q_B^1(n) > 0$, and $n_A = n_B = n$. We show below that an outcome induced by a mechanism of type 3 or 4 never can be sustained as the equilibrium outcome of a cheap talk game, so there is no need to characterize these mechanisms further.

Furthermore, the following conditions have to be satisfied for all four types of mechanisms:

$$\begin{aligned} q_A^i(n_A) &> q_A^{i-1}(n_A) \text{ for } i = 1,...,n_A, \\ q_B^i(n_B) &> q_B^{i-1}(n_B) \text{ for } i = 1,...,n_B. \end{aligned} \tag{21}$$

Finally, since the mechanisms satisfy the conditions in Lemma 5, no type will deviate to a neighboring interval. As the single crossing condition is satisfied, there is no incentive to deviate to any other interval as well.

A.13.2 Necessary conditions for a cheap talk equilibrium

We now turn to the question of whether the closure regulation induced by the above mechanisms can be sustained as the equilibrium outcome of a cheap talk game. First, as $a \leq 1$, the home country supervisor never closes the bank if $q_A = 1$. Therefore, outcomes induced by mechanisms of type 3 and 4 can never be sustained as outcomes of cheap talk games, because $\Phi_3(1), \Phi_4(1) > 1$. Consider now mechanisms of type 1. Suppose that there exists an equilibrium of a cheap talk game that leads to the same closure regulation as the mechanism. It has then to hold that there are no types belonging to different intervals that send the same signal(s), as this would lead to the same closure decision. It is possible, however, that types belonging to the same interval send different signals. Consider types in $I_B^n(n)$. Denote by $\{z_1, .., z_m\}$ the set of signals used by types in this interval. Since the cheap talk game leads to the same closure regulation as the mechanism, it must hold that the home country supervisor wishes to leave the bank open for all q_A after observing a signal in $\{z_1, .., z_m\}$. This implies, in particular, that

$$\Delta W_A(0, E(q_B \mid z_l)) \geq 0 \text{ for all } l = 1, ..., m.$$

This is feasible only if

$$\Delta W_A(0, (q_B^{n-1}(n) + 1)/2) \geq 0. \qquad (22)$$

Suppose that we want to sustain an outcome induced by a mechanism of type 1 as the equilibrium outcome of a cheap talk game. A necessary condition for this to be possible is that there exist $\{q_A^1(n), .., q_A^{n-1}(n)\}$ and $\{q_B^1(n), .., q_B^{n-1}(n)\}$ such that (19), (21), and (22) are satisfied. However, if such $\{q_A^1(n), .., q_A^{n-1}(n)\}$ and $\{q_B^1(n), .., q_B^{n-1}(n)\}$ exist, we know from the proof of Proposition 2 and 3 that the outcome can be sustained as an equilibrium of type 1 with n intervals of the cheap talk game considered in the text.

A necessary condition for the regulation induced by a mechanism of type 2 to be sustainable as the equilibrium outcome of a cheap talk game is that there exist $\{q_A^1(n), .., q_A^n(n+1)\}$ and $\{q_B^1(n), .., q_B^{n-1}(n)\}$ such that (20) and (21) are satisfied. If this condition is satisfied, we know from the proof of Proposition 2 and 3 that the outcome can be sustained as an equilibrium of type 2 with n intervals of the cheap talk game considered in the text.

The necessary conditions are thus also sufficient. Furthermore, as long as we restrict attention to deterministic equilibria, considering more general cheap talk games does not expand the set of possible equilibrium outcomes.