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ABSTRACT

Regulation of Multinational banks: A Theoretical Inquiry*

This Paper studies prudential regulation of a multinational bank (MNB hereafter). We analyse how two frequently chosen representation forms for MNBs ? branch and subsidiary representation ? affect the behaviour of national regulators. We find that the different liability structure and insurance arrangements for non-local depositors under the two representations have a crucial impact on regulators' behaviour. We show that branch representation leads to a more lenient regulation for the home unit (the unit of incorporation) than subsidiary representation. Regulation of the foreign unit can be softer or tougher in branch MNBs depending on the prospect of the home unit. We examine how intervention of a regulator in charge of a given bank's unit changes with the information received about the foreign units. We discuss the effect of lobbying activity and international resources transfers on its regulation.

JEL Classification: F23, G21, G28 and L51
Keywords: branch, multinational banks, prudential regulation, representation form and subsidiary

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1 Introduction

The gradual elimination of barriers to international capital flows in most countries and the general relaxation of barriers to entry have led to a significant increase in multinational banking activities. At the end of 1996 the total assets of overseas branches and subsidiaries of US banks exceeded 1.1 trillion, more than twice the 1992 figure. In 2001 US located subsidiaries and branches of foreign banks accounted for 20 percent of total banks' assets in the US, 26 percent of total business loans in the US (Federal Reserve Board, 2002), and almost 10 percent of US deposits in 2000 (Buch and Golder 2001). In emerging markets the surge of multinational banks (MNBs) is even more spectacular. In Central Europe the proportion of total bank assets controlled by foreign-owned banks rose from 8 percent in 1994 to 59 percent in 1999 and in some major Latin American countries, almost 50 percent of total bank assets are controlled by foreign banks (IMF, 2000). As for Europe, in 1997 the total assets of branches and subsidiaries of domestic institutions in foreign countries accounted for 30, 34 and 27 percent of total domestic assets respectively in France, Ireland and Germany (ECB, 1999).

The rapid expansion of MNBs represents a source of new concerns for regulators. MNBs can easily take advantage of ill-harmonized national supervisions, increasing the complexity of supervisory tasks.

MNBs can operate under two main representation forms in foreign countries. They can operate either with *branches* or with *subsidiaries*.[1] A particular representation form has two major features: first, it defines a liability structure between units; second, it implies a different regulatory structure.

If a foreign unit is set up as a *branch* of the mother bank, each unit is fully liable for the losses of other units in the MNB. Thus, the foreign unit cannot fail without the mother bank failing too. Branch-represented MNBs are supervised by a single regulator, located in the mother bank's country (the *home regulator)*, i.e. in the country of original incorporation. All depositors of the MNB located in different countries are covered by

[1] Other representation forms such as correspondent banking, representative offices and agencies exist. However, MNB supervision becomes a relevant issue when banks are allowed to perform the full range of banking activities, including retail banking, accepting deposits and making loans. Hence, we will concentrate on the two representations, branches and subsidiaries, which generally allow a MNB to perform all activities. Recent figures show that the branch structure is more frequent than that through subsidiaries. A more detailed treatment on representation is in Bain et al. (1999), Houpt, (1999) and Calzolari and Loranth (2001).

the deposit insurance scheme of the home country, and in bankruptcy they are treated on an equal basis. Instead, foreign subsidiaries are incorporated and capitalized separately. Therefore they generally operate more like independent foreign banks.[2] These entities can fail separately from the parent bank, but the reverse is not true. Although the regulator of the mother bank' s country (i.e. the home regulator) oversees the activities of the MNB on a consolidated basis, the regulator of the foreign country (the *foreign regulator)* has independent regulatory power over the locally incorporated subsidiary. Depositors are normally insured by local deposit insurance schemes.[3]

This paper studies prudential regulation of a MNB and analyzes the implications of the representation form (branch or subsidiary) of a MNB for its regulation. It provides a simple framework to examine whether the two representation forms imply different incentives for regulators to intervene, and analyzes the responsiveness of these incentives to information received from units located in the other country.[4] We model a MNB operating at home and in a foreign country. Depositors are fully insured by a deposit insurance net, and banks are too slow to stop inefficient projects because they are protected by limited liability. This generates the need for regulation, so that the regulator in charge can intervene and shut down banks or part of their operations. However, intervention is an imperfect remedy, because regulators do not posses all relevant information. A regulator intervening in a bank might stop valuable investments. Or, on the contrary, by not intervening, she might allow continuation of bad investment activities.

We show that there is a material difference in the likelihood of intervention in branch and in subsidiary MNBs. The difference arises from (1) the difference in the amount of assets available to compensate depositors upon intervention; and (2) the differences in responsibilities towards depositors located in the other country. The first point is strictly related to the MNB's liability structure, i.e. to the extent to which units of the MNB are liable for losses made by other units, while the second follows from the different arrangements to insure non local depositors under the two representation forms.

[2]Even if subsidiaries are formally independent from the parent bank, all subsidiaries are controlled by the parent bank which is in the position of taking all the relevant decisions for any subsidiary.

[3]Generally, foreign regulators facing a troubled subsidiary of a MNB may not be able to attach assets located in the other countries even if owned by the very same MNB.

[4]Regarding co-operation between national supervisors, the main (multilateral) institutional channel is the Banking Supervision Committee of the European Central Bank (ECB), where national regulators of the EU countries are represented. This Committee meets four times a year. However, several bilateral agreements have been signed between member countries that lay down the framework for regular exchange of information between national supervisory institutions.

In our base model regulators only care about costs coming from their deposit insurer function. Thus, they compare the cost of current intervention with the expected cost of bank failure in a future period. As under both representation forms the foreign unit is liable for home losses, the home regulator can reduce her cost of intervention at home from the residual assets of the foreign unit, independently of the representation form. This implies that the home regulator tends to be more lenient when no intervention takes place in the foreign unit. Instead, as with subsidiary representation the home unit is shielded from foreign losses, the foreign regulator cannot reduce her cost of intervention. Thus, with subsidiary representation the home regulator is tougher than the foreign one. Further, we show that intervention in the home unit is less likely in branch than in subsidiary MNBs. This difference in regulation of the home unit is a consequence of the home regulator's responsibility towards foreign depositors in branch represented MNBs. In branch MNBs the home regulator pondering about intervention in the home unit takes into consideration that she may be able to reduce the cost incurred abroad if she lets the home unit continue and the investment of the home unit pays out. This effect is not relevant for the home regulator when the MNB is represented by a subsidiary abroad, as in this case she bears no responsibility towards foreign depositors.

As for intervention in the foreign unit, we find that intervention in the *foreign* unit in branch represented MNBs is less likely as long as prospects for the home unit are not very good, and more likely when prospects for the home unit are good. The intuition for this result is as follows. As the home unit enjoys limited liability towards the subsidiary, the foreign regulator cannot rely upon residual assets from the home unit. Thus her decision to intervene does not depend on what happens in the home unit. Instead, due to joint liability of units, in branch MNBs the home regulator's behavior towards the foreign unit is influenced by two forces: the possibility of reducing foreign losses by home assets, and the possibility of subsidizing home losses from foreign assets. The first effect pushes the regulator towards a tougher, while the second effect towards a softer behavior on the foreign unit. The balance of these two effects changes as prospects for the home unit changes. When prospects for the home unit are not very good, intervention is likely at home and the only relevant effect is the second one, making the home regulator softer on the foreign unit. As home prospects improve, the first effect becomes stronger, finally counteracting the second effect, and making the home regulator tougher on the foreign unit.

Further, we show that irrespective of the MNB's representation, good (bad) news about the foreign unit makes the home regulator more conservative (lenient) in regulating the home unit. Therefore good news from abroad triggers more (less) intervention at home. This is a consequence of joint liability among units that enables the regulator to grab all residual assets of the foreign unit. As in a branch represented MNB any unit is liable for the other unit, the previous effect also applies to the foreign unit. On the contrary, in a subsidiary represented MNB, the foreign subsidiary is liable to the losses incurred by the home unit, but the reverse is not true. As the home unit is shielded from foreign losses by limited liability, the foreign regulator cannot recover any assets from the home unit. Thus, the foreign regulator of the subsidiary is insensitive to any news received from the home country.

We extend the base model in two directions. First, we ask what happens to regulators' behavior if they do not only care about costs but also about the MNB's profits, e.g. as a consequence of lobbying by the MNB. Second, we introduce active bank managers who, in the absence of intervention, can gamble for resurrection. By inefficiently shifting resources between units, the MNB can expect some profits even from a bad unit. Extending the base model with active bank managers shows incentives to gamble can be more severe in branch- than in subsidiary-organized banks. Because of joint liability of units in branch MNBs, failure of a any unit will bring down the other unit. Thus, a good performing unit has incentives to inject funds to keep the bad performing unit alive. Instead, in subsidiary MNBs the home unit can let a foreign unit fail without failing itself. It will therefore have lower incentives to keep it unduly afloat.[5]

As for regulators' behavior, the two extensions share the feature that, contrary to the base model, the foreign regulator's decision is now affected by the home regulator's decision. Thus, the subsidiary representation shows an interesting set of results with respect to the base model. In both extensions the possibility to share some benefit produced by the home unit makes the foreign regulator softer when the home regulator opts for no intervention at home. Thus, softer (tougher) home regulation brings about softer (tougher) foreign regulation.

[5] This result is related to Kahn and Winton (2003) who examine the impact of organisational structure of banks on risk-taking incentives. They find that separating the high risk assets in a subsidiary reduces the bank's risk-taking incentives.

Including the MNB's profits in the regulators' objective function and gambling for resurrection have more involved effects on the behavior of the home regulator. The home regulator in the base model tends to be more lenient with the home unit if the foreign regulator intervenes in the foreign unit. Hence, if the additional effects in both the extensions are of small importance, the home regulator would still like to take the opposite decision of the foreign regulator, while the foreign regulator is inclined to take the same decision as the home regulator. Thus, in this case regulatory decisions tend to cyclically affect each other and this generates the impossibility of pure strategy equilibria for reasonable parameter values. On the contrary, when the MNB's profits and gambling have a large impact on the home regulator's activity, she tends to intervene less, given no intervention abroad. Thus, a region of multiple equilibria appears in both extensions, where regulatory decisions reinforce each other. Softer regulation triggers softer regulation, and tougher regulation triggers tougher regulation.

Our paper belongs to a growing literature on multinational banks. Repullo (2001) addresses the problem of limited supervisory information about a MNB's foreign activities and draws conclusions on cross-border takeovers. Besides the clearly different focus on takeovers, Repullo's paper only considers branch- MNBs, and studies the interaction of supervisory activities performed by national regulators. Holthausen and Rønde (2002) examine informational problems in branch represented MNBs, and show that the first best closure decisions cannot be implemented if national regulators have private local knowledge, due to divergent national interests. Acharya (2002) studies the interaction between two regulatory tools: capital requirements and closure policy, and draws conclusions on the cross-border harmonization of capital requirements while allowing for different closure policies for national regulators. He shows that when banks operate across borders, lack of overall harmonization gives rise to spillovers from more to less forbearing regimes in terms of closure policy. Dell'Ariccia and Marquez (2001) study independent domestic regulators who care about domestic banks' profits and financial stability. They analyse regulators' incentives to coordinate their policies when banks undertake cross-border activities and reach conclusions similar to Acharya's paper. Our contribution to this literature is to compare regulatory behavior under the two main representation forms adopted by MNBs, and to analyse the effect of information on regulators' activities.

Bebchuk and Guzman (1999) focus on the effects of the legal regime governing transnational bankruptcies. They show that the bankruptcy regime does not only affect the distribution of assets in bankruptcy, but has an ex-ante effect on the allocation of investment. They argue that a "universality" regime in which all creditors are treated equally leads to no distortion. Loranth and Morisson (2003) examine the role of capital adequacy requirements on project selections in branch and subsidiary MNBs, and show that capital requirements set optimally for national banks result in underinvestment by multinational banks. Our paper is different from the two previous papers in that we are mainly concerned with regulators' incentives to take prudential actions under different information, rather than on project selection. Moreover, while we focus on closure policies, they examine the role of bankruptcy codes and capital requirements on project selection. Dalen and Olsen (2003) study the issue of lack of coordination among national regulators in case the MNB is represented with subsidiaries. They show that independent national regulation works to lower capital adequacy requirements, but this is offset by the bank's response with an increase of asset quality. Finally, the international dimension of bank's activities and the involvement of several national regulators links our paper to the literature on multinational enterprises regulation, as in Calzolari (2001) and (2004), that deal with public utility firms regulation.

The rest of the paper is organized as follows. The next section presents the base model. Section 3 analyses and compares regulators' incentive to intervene under the two representations. Section 4 extends the base model to regulators also caring about MNB's profit. Section 5 considers the role of active bank's manager that may gamble for resurrection Section 7 concludes. All the proofs are in the Appendix.

2 The base model

Consider a MNB incorporated in country h (the home country) and also represented in country f (the foreign country). The MNB operates with two units, one in each country.

Investment Opportunities. At $t = 0$ the bank raises one unit of deposits in each country. Deposits are fully insured and pay an interest rate that is normalized to zero. Each unit $i = f, h$ has access to a risky project i that requires one unit of investment. At $t = 0$ with probability p project i can either pay R at a future date $t = 2$, or 0 with probability $1 - p$. A project can be liquidated at $t = 1$, yielding $L \in [0, 1)$.

We assume that ex ante projects have a positive NPV, that is,

Assumption 1 $pR + (1 - p)L > 1$.

Moreover, (i) depositors in one country can be reimbursed with $t = 2$ returns of a successful project, but (ii) if one of the projects is liquidated, the MNB is not able to reimburse depositors in both countries, independently of the other project's realization. That is,

Assumption 2 (i) $R > 1$, (ii) $R + L < 2$.

Assumption 2 (ii) also implies that a single successful project does not allow to reimburse all depositors.

The MNB is run by a bank manager who has no incentive to stop projects before the termination date $t = 2$.[6] This generates the need for regulation.

Representation form and liability. We examine two representation forms for the foreign unit: subsidiary and branch. The representation form defines a liability structure for the MNB, and implies an allocation of the supervisory powers between national regulators.

A foreign *subsidiary* is incorporated as a separate entity in the foreign country. As a consequence, if the foreign subsidiary is insolvent (i.e. assets in the subsidiary fall short of liabilities), the mother bank is shielded by limited liability. However, if the mother bank is insolvent, once foreign depositors are paid out, residual assets in the subsidiary must be used to pay home depositors.

If the foreign unit is set up as a *branch* of the mother bank, each unit (the mother bank and the branch) is fully liable for the losses of the other unit. Thus, insolvency occurs if total assets in the two countries fall short of total liabilities, and bankrupt MNB's assets are allocated according to the single entity doctrine, i.e. depositors in both countries are treated equally.

Bank Supervision. Bank regulators perform two tasks: prudential regulation and deposit insurance. Prudential regulation comprises (early) intervention at $t = 1$ on

[6] A wage scheme related to the MNB's performance (profit), or the presence of managers' private benefits induce this kind of behaviour. For the contract theory explanation see Dewatripont and Tirole (1994), among the others.

the unit under the regulator's jurisdiction. The regulator is also in charge of insuring depositors. Thus if a MNB's unit becomes insolvent, the regulator covers the shortfall between liabilities and assets. Regulators are assumed to minimize costs. In Section 4 we will discuss the possibility that regulators also care about MNB's profits.

With a *branch-organized MNB* (branch-MNB hereafter) the home regulator performs both prudential regulation and deposit insurance in the two countries.[7] At $t = 1$, for any unit the regulator decides whether to intervene or not (i.e. letting the project continue) in the unit. Intervention implies liquidation of the unit's ongoing project, and yields a liquidation value L at $t = 1$.[8] Intervention in both units can be thought of as closure of the branch-MNB, yielding liquidation value $2L$. At $t = 2$ returns are realised for those projects where the regulator has not intervened, and if bank's assets fall short of liabilities, the regulator covers the shortfall.

With a *subsidiary-organized MNB* (subsidiary-MNB hereafter), each national regulator can adopt prudential measures over the bank's local unit and insures local depositors. Regulators' decisions are assumed to be taken non-cooperatively. At $t = 1$ each regulator can decide to intervene or not over the local unit. In case she intervenes, the local project is liquidated and yields L returns. At $t = 2$ returns are realised for projects which have not been intervened upon. If the assets of the local bank's units fall short of its liabilities, the regulator in charge covers the shortfall.

In what follows we will refer to the regulator in charge by her location. Thus, we call the single regulator of a branch MNB as the *home regulator*, as well as the regulator of the home unit in case the MNB takes the subsidiary representation form. Instead, the regulator of the foreign unit in subsidiary represented MNBs will be addressed as the *foreign regulator*.

Finally, we will denote with I the decision to intervene in a project by the regulator in charge, and with O the decision not to intervene and keep the project open. By convention, for any pair of decisions, the first letter will refer to project h and the second

[7]The current EU regulation follows the principle of home country supervision. Hence, the competent authority of supervising the bank is the country where the bank has received its license. Supervisory responsibilities cover the activities which are carried out in the form of branches throughout the EU or by cross-border supply of services.

[8]Intervention in general can be thought of as conservatorship, or ring-fencing, as an attempt to protect the assets of the mother bank or the branch, or to limit the exposure of the bank to certain categories of risk. Alternatively, it can also be understood as asset restrictions imposed by the regulator, or assets restructuring in one unit of the bank.

to project f; for example (I, O) means that the regulator in charge intervenes on unit h, whilst the one in charge of unit f keeps that unit open.

Information Structure. At $t = 0$, the regulators share the same priors p about the projects. At $t = 1$ regulators may obtain a signal about the prospects of the local unit and we assume that any information acquired by a regulator at $t = 1$ is shared with the other regulator. Hence, given the signal on project i, at $t = 1$ regulators' beliefs on the success probability of project i become p_i. A favorable signal for project i is one such that $p_i \geq p$, and the inequality is reversed for unfavorable signals. At $t = 2$ all information about project returns becomes public.

Timing

- At $t = 0$: Deposits are collected in both countries and invested in risky projects.
- At $t = 1$: The regulators exchange the information they learned about the local unit of the MNB. Each regulator decides whether to intervene in the project of the unit under her jurisdiction.
- At $t = 2$: Payoffs are realized, and depositors are repaid.

3 Regulatory activity and representation form

In this section we study the prudential activity of regulator(s) under branch and subsidiary representation.

3.1 Subsidiary represented MNB

At $t = 2$ returns are realised so that no strategic interaction takes place between regulators. If the local unit is solvent, no closure occurs. Otherwise, the regulator in charge withdraws the license from the local unit and covers the shortfall between assets and liabilities.

As for the $t = 1$ decisions, limited liability of the home unit makes it impossible for the foreign regulator to recover some of her intervention costs with assets located in the home unit. Hence, the home regulator's decision leaves the foreign regulator's payoff unaffected. If the foreign regulator keeps the foreign unit open, with probability p_f the project succeeds and she does not have to pay anything. Thus, she prefers to intervene in the foreign subsidiary if the liquidation value L is larger than the expected cost reduction she can obtain by leaving the subsidiary open p_f.

Instead, the home regulator can recover some of her intervention costs if the foreign unit is kept open and gives return at $t = 2$. If the home regulator lets her unit continue at $t = 1$, and the home project gives no returns at $t = 2$, she is entitled to all the remaining foreign assets after foreign depositors have been reimbursed. Thus, she bears a cost of $(1 - (R - 1))$. Similarly, if at $t = 1$ she intervenes in the home unit, her deposit reimbursement cost $(1 - L)$ will be reduced from the residual assets in the foreign unit. Hence, clearly the optimal decision for the home regulator depends on the decision of her foreign counterpart.

Lemma 1 formally describes the equilibria of the regulation game.

Lemma 1 *In subsidiary MNBs there exists a unique equilibrium in pure strategies in the regulation game. The equilibrium decisions are described by the following non empty regions in the probabilities space* $(p_h, p_f) \in [0, 1]^2$,

$$\begin{array}{ll} (I, I) \equiv \{p_i \leq L, i = h, f\} & (O, O) \equiv \{p_h > \delta_h,\ p_f > L\} \\ (O, I) \equiv \{p_h > L \geq p_f\} & (I, O) \equiv \{\delta_h \geq p_h, p_f > L\} \end{array}$$

where $\delta_h \equiv \frac{L}{1-p_f(R-1)}$.

The following picture describes the regulators' decisions in the probability space.

Figure 1 here: Regulators' decisions with subsidiary-MNB

As simple inspection shows, in general the home regulator tends to be tougher than the foreign counterpart. In fact, for the same prospects concerning the two project (i.e. for p_h, p_f along the 45° degree line), either the two regulators' decisions coincide (i.e. (I, I) or (O, O)), or the home regulator's equilibrium strategy is intervention in the home unit for a continuation decision of the foreign regulator. Moreover, the picture shows that whenever the foreign regulator does not intervene in the local unit, the home regulator tends to be tougher with the home unit. In fact, either her decision is unaffected, or she prefers intervention for values of p_h for which otherwise, with intervention in the the foreign unit, she would have not intervened in the home unit. The explanation for these two results lies in the foreign unit being liable for losses in the home unit. If the foreign regulator does not intervene in the local unit, the home regulator can benefit from the residual assets in the foreign unit. Thus, her expected cost for any decision will be lower now. However the reduction in expected cost will be higher when she intervenes than when she does not. This happens because when she intervenes she benefits surely, while in the event of continuation she benefits only upon failure from the foreign assets. Therefore the home unit can avoid intervention for more favourable signals when the foreign regulator does not intervene in the foreign unit.

Effect of more precise information on decisions

Regulators do update their knowledge about banks under their supervision over time. Thus, it is worthwhile to study how decisions change after receiving more precise information on the different units of the MNB.

A more favourable signal on the home project (i.e. a signal such that $p_h > p$) always induces both regulators to be more lenient on the units they are empowered over (see figure 1). Clearly, the home regulator expects smaller costs with letting the home unit continue. Moreover, the foreign regulator's decision is unaffected as she cannot benefit from any home-located residual asset. Things are different when we consider the effect of a more favourable signal on the foreign project (i.e. a signal such that $p_f > p$) . Clearly, a more favourable foreign signal induces a more lenient behavior on the foreign regulator. Instead, the home regulator may be inclined to change her decision from continuation to intervention as shown by the increasing boundary separating decision (O, O) from (I, O) in figure 1.

Proposition 1 *In case signals affect decisions, a more favourable signal about the home unit induces softer regulation. A more favourable signal on the foreign unit induces the home regulator to be tougher, while a less favourable signal induces her to be softer on the home unit.*

The reason is related to what has been discussed in Lemma 1. If the home regulator intervenes in the home project, she surely incurs the cost $(1 - L)$. However, with probability p_f she recovers $(R - 1)$ from a possibly succeeding foreign project. Instead, if she let project h continue, she can use foreign resources only if the home project fails. Thus, their value in expected term is $(1 - p_h)p_f(R - 1)$. Consider now a situation where the regulator is indifferent between intervening or not project h, i.e.

$$-(1 - L) + p_f(R - 1) = -(1 - p_h)\left[1 - p_f(R - 1)\right]$$

or $L = A$,where $A \equiv 1 - p_f(R-1) - (1-p_h)[1 - p_f(R-1)]$. Then a good news about project f has a stronger impact on the payoff associated to intervention than on no intervention. Thus, it may induce intervention in the home unit.[9]

Finally, Lemma 1 and Proposition 1 allow us to state the following Corollary.

Corollary 1 *(i) Ceteris paribus, with subsidiary representation the home regulator is tougher than the foreign one. (ii) Softer foreign regulation induces tougher home regulation.*

By proposition 1, in a subsidiary-MNB, good news on the foreign unit may make the home regulator tougher on the home unit. Instead, good news on the home unit leaves the foreign regulator unaffected. Hence, for identical prospects $p_h = p_f$ it may well be the case that the foreign regulator does not, and the home does intervene in the local unit. For result (ii) in Corollary 1, recall that a softer foreign decision requires a higher p_f. However, this implies that the assets that the home regulator can expect from the foreign unit are higher when she intervenes in the home unit than when she keeps it open.

In section 4 we show that even if the regulator cares for MNB's profits, the proposition still stands for fairly reasonable parameter values.

3.2 Branch represented MNB

In the case of branch representation at the final date $t = 2$, if the MNB's total assets are sufficient to pay back depositors, the home regulator does not intervene. Otherwise, she withdraws the license from the MNB, and pays the difference between the total liabilities and the total assets of the MNB. At $t = 1$ the home regulator's has to decide whether to intervene or not in any of the two units.

By joint liability of the MNB's units, decisions concerning a given unit affect decisions over the other unit. Clearly, if the regulator intervenes in unit j, unit i can only rely on its own assets. In this case, the branch regulator takes into consideration that a successful project in unit i not only pays out depositors in country i, but also reduces

[9] Note that the foreign resources the home regulator can seize are "truncated" in case of success of the home project. Clearly, the foreign regulator cannot recover any resource from the home unit and the reasoning does not apply to her behavior.

the regulator's cost in country j by $(R-1)$.[10] Thus, the regulator prefers intervention if the liquidation value L is larger than the expected return $p_i R$. If p_j is close to zero, having unit j open has substantially no effect on the decision concerning unit i, so that the trade off is essentially the one discussed previously. On the contrary, if the prospects on project j are good (i.e. p_j is high), then the trade off for the decision on unit i is different. As units are jointly liable, when unit j is open, the regulator can reduce her cost in country i with the residual assets in country j. However, as discussed in the case of a subsidiary-MNB, this cost reduction has a stronger impact on the payoff associated to intervention than to the payoff associated to an open decision. Thus, the higher is p_j the larger is the value of p_i which makes the home regulator prefer no intervention over unit i.

Lemma 2 *The optimal decisions are described by the following non empty regions in the probabilities space* $(p_h, p_f) \in [0,1]^2$,

$$\begin{array}{ll} (I,I) \equiv \left\{\frac{L}{R} \geq p_i, i = h, f\right\} & (O,O) \equiv \{p_i > \varphi_i, i = h, f\} \\ (O,I) \equiv \left\{p_h > \max\left\{\frac{L}{R}, p_f\right\}, \varphi_f \geq p_f\right\} & (I,O) \equiv \left\{p_f > \max\left\{\frac{L}{R}, p_h\right\}, \varphi_h \geq p_h\right\} \end{array}$$

where $\varphi_i \equiv \frac{L}{R-2(R-1)p_j}$.

The following picture describes the regions presented in the Lemma 2.

Figure 2 here: Regulator's decisions with branch-MNB

If the prospects for both projects are very low, then the optimal decision is to close the MNB. This happens in (the black) region (I,I). If project f has low probability of success whilst project h has sufficiently high probability of success, then the optimal decision turns out to be (O,I) (the dashed area with vertical lines). Similarly, if project h has low probability of success whilst project f has sufficiently high probability of success, then the optimal decision turns out to be (I,O) (the dashed area with horizontal lines). When the projects' prospects are similar and not too bad, the regulator may prefer to leave both units open with decision (O,O) (the white area). Finally, the regulator's decision process is symmetric with respect to the two projects. Hence, along the 45°

[10] Recall that whenever the regulator intervenes, assets in the local unit fall short of liabilities, thus she incurs a cost.

degrees lines, either the decisions are the same, or, otherwise, the regulator is indifferent between (I, O) and (O, I).

Effect of more precise information on decisions

Simple inspection shows that if the regulator receives a good signal on unit i (i.e. p_i increases), then she never turns an open decision into intervention in that unit. Interestingly, this is not necessarily true for the decision concerning the other unit. In fact, consider in figure 2 a case where for given priors decision (O, O) is optimal. Then, for sufficiently good prospects about project i and a given constant p_j, the regulator may prefer to intervene unit j. Conversely, bad news on a project may induce the regulator to be softer, keeping both units alive.

Proposition 2 *Signals improving the prospect of a given project induce the regulator to be softer on that unit but tougher on the other unit. Similarly, worsening prospects induce the regulator to be tougher on the given unit but softer on the other one.*

Clearly, this result relates to what has been discussed for the home subsidiary in Proposition 1, and is a direct consequence of boundary φ_i being an increasing function of p_j. A higher p_j lowers the expected cost of the regulator on the other unit for each possible decision. However, reduction of those costs is higher for intervention than for continuation.[11] Thus, if p_j becomes larger, a higher p_i is needed to convince the regulator about no intervention.

3.3 A comparison of Regulation with Subsidiary and Branch-MNBs

We now compare prudential regulation taking place at $t = 1$ under the two representation forms. We argue that regulatory decisions in branch and subsidiary represented MNBs differ because of two main reasons:

(1) *The amount of assets available to compensate depositors upon intervention.* The foreign regulator of a subsidiary-MNB cannot take any asset located in the home country, due to the limited liability of the mother bank towards the foreign unit. Thus, she bears the whole cost of an intervention in the foreign unit. Instead, the home regulator of a

[11] If the regulator intervenes in the home unit uniquely, she surely incurs the cost $1 - L$ and from the foreign unit she can expect $p_f(R - 1) - (1 - p_f)$. On the contrary, leaving project h open, she can expect the same payoff from the foreign unit uniquely if the home project fails i.e. with probability $(1 - p_h) \leq 1$.

subsidiary-MNB and the home regulator in branch MNBs can benefit from the (residual) assets located in the other country.

(2) *Regulators' responsibilities towards (foreign) depositors.* In subsidiary-MNBs national regulators are not responsible for claims of the other country's depositors, and local depositors are senior for the local assets. Instead, the home regulator in branch MNBs performs the deposit insurance function in both countries.

The next proposition illustrates how these two differences affect the regulation activity faced by the MNB's units.

Proposition 3 .

- *The **home unit** is subject to (weakly) softer regulation with branch rather than subsidiary representation.*

- *The **foreign unit** is subject to (weakly) softer regulation with branch rather than subsidiary representation if* $p_h \leq \max\{L, 1/2\}$, *and to (weakly) tougher regulation if* $p_h \geq \max\{L, 1/2\}$.

For a given decision in unit j, let us first analyse how the regulator in charge would act on the other unit i. In subsidiary MNBs, if the regulator in charge intervenes in unit j, the regulator of the other unit i bears no responsibility towards depositors located in the other country. Thus, in her decision she compares the liquidation value L from intervention with the expected cost saving p_i from no intervention. Instead, the regulator of a branch-MNB takes into account that she may be able to reduce the cost arising from the liquidated unit j (i.e. $(1-L)$) if she lets unit i continue (i.e. $p_h(R-1)-(1-p_h)$ in expected terms). Thus, she compares L with $p_iR(>p_i)$. Hence, we can state that with intervention in a given unit, the regulator in charge for the other unit is softer under branch than under subsidiary representation.

We now compare regulators' behaviour towards a given unit for no intervention in the other unit. Assume first that no intervention takes place in the foreign unit. From the previous analysis we know that independently of the representation form a higher p_f reduces the expected cost associated with the home unit, and it has a stronger impact on the payoff associated to intervention as opposed to no intervention in the home unit. However, with branch representation there is an additional counteracting effect: the home regulator' s responsibility towards foreign depositors upon failure. With branch-MNBs the regulator takes into account that by not intervening in the home unit she may be able to reduce the cost of foreign failure. Indeed, the (expected) cost of foreign failure is $-(1-p_f)$ in case she intervenes in the home unit, and $-(1-p_f)[(1-p_h)+p_h(2-R)]$ in case she does not intervene. As the former is larger than the latter, the home regulator tends to be softer with the home unit when the MNB is branch rather than subsidiary represented.[12] The two points just discussed give us the first statement in Proposition 3: regulators' decisions either coincide for the home unit in the two representations (when p_h is sufficiently large, intervention is optimal in any case, whilst no intervention is preferred if p_h is sufficiently small), or intervention occurs under subsidiary but not under branch representation (this explains the "weakly" qualifier in the text of the Proposition).

Let us turn now to the second point in Proposition 3. We have argued above that for no intervention in the home unit, regulation is softer on the foreign unit under branch representation than subsidiary representation. Clearly, if p_h is very small (i.e. $p_h \leq L/R$), intervention takes place in the home unit independently of the representation form. In this case the home regulator is then softer than the foreign regulator towards the foreign unit as long as p_f is neither too small nor too large; otherwise decisions coincide for the two representations (leading to intervention for small p_f and no intervention for high p_f). Importantly, this is also the case when there is no intervention in the home unit.[13] The foreign regulator cannot expect any assets from the home unit, as a consequence her decision does not depend on p_h. Thus, she simply compares the expected cost saving from no intervention in the foreign unit p_f with the liquidation value L. Instead, the home regulator's decision rule depends on the decision for the home unit. In this respect we have shown that better prospects for the home project makes the home regulator of a branch-MNB tougher on the foreign unit. This is described by function φ_f being increasing in p_h (Proposition 2), and taking a smaller (larger) value than L for low (high) values of p_h, so that φ_f and L cross once at $p_h = 1/2$. Thus, for $L/R < p_h \leq 1/2$ no intervention is optimal at home and the home regulator is softer than the foreign one provided that p_f does not take extreme values. (Otherwise decisions coincide as in the previous discussion). Instead, for sufficiently high values of

[12] This can also be verified by noticing that in figure 1 and 2 the two boundaries φ_h and δ_h take the same value for $p_f = 1$ and for any other value of p_f we have $\varphi_h > \delta_h$.

[13] This possibility arises only if $L \leq 1/2$, as explained in the proof.

p_h (i.e. $p_h \geq \max\{L, 1/2\}$) the increasing function φ_f is higher than L so that the home regulator becomes now tougher than the foreign regulator, as long as p_f does not assume extreme values. (Otherwise decisions coincide with the two representations).

The intuition for these results can be summarized as follows. The home regulator's behaviour towards the foreign unit is shaped by two considerations in comparison with that of the foreign regulator: the possibility of reducing foreign losses by home assets and the possibility of subsidizing home losses from foreign assets. Obviously, the first effect pushes the regulator towards a tougher, while the second effect towards a softer behaviour on the foreign unit. The balance of these two effects changes with the prospects for the home unit(i.e. with p_h). When p_h is small, intervention is likely at home and the prevailing effect is the second one, making the home regulator softer on the foreign unit. As p_h increases, the first effect becomes stronger, ultimately making the home regulator tougher on the foreign unit.

4 Regulation with bank's lobbying

Propositions 1 and 2 show that when regulators are uniquely concerned by regulatory costs, better prospects concerning a given unit tend to induce a stricter regulatory attitude towards the other MNB's unit, both with branch and subsidiary representation. We also know that this is a direct consequence of the regulator's payoff being uniquely affected by costs. We now assume that regulators not only care about intervention costs, but they also care about MNB's profit. More precisely, regulator i attributes a value α_i to the total MNB's profit, i.e. to the profit the bank earns in any of the countries. Regulators may be concerned by the MNB's profit for several reasons. The profit weight α_i may be a positive function of country i citizens' share in ownership of the MNB, and the regulator may care about profits paid by the bank to local citizens. Alternatively, even if the MNB is completely foreign owned, successful lobbying activity may induce the regulator to watch over the MNB's profits, particularly in cases of imperfect delegation to regulators with private agendas.[14] MNB's earnings may be also relevant in cases of financial instability of the local banking sector. Finally, regulators may be concerned by the possibility that the MNB "flies" away in case it earns too small profits.

[14]Calzolari (2004), Grossman and Helpman (1994), Feenstra and Lewis (1991) use this interpretation for regulators' profit weighting in social welfare functions.

With subsidiary representation, when the foreign regulator cares about MNB's profits, her decision is affected by the home regulator's decision, contrary to the case with $\alpha_f = 0$. For $\alpha_f > 0$, by not intervening in the foreign unit the foreign regulator benefits from MNB's profits if the home regulator does not intervene and the MNB generates positive profits. With any other pair of decisions the foreign regulator cannot benefit from profits as the bank makes losses. Hence, when the foreign regulator cares for MNB's profit, she is also induced to be softer when the home regulator does not intervene in the home unit. On the contrary, from the previous analysis we already know that the home regulator is induced to be tougher for no intervention abroad, and this holds as long as she cares more for closure costs than for MNB's profits (i.e. $\alpha_h < 1$).

Thus, with profit weights $\alpha_h < 1$ and $\alpha_f > 0$ regulators' decisions tend to cyclically affect each other. Assume, for example, that the home regulator prefers to intervene in the home unit. We know that the foreign regulator is induced by this decision to intervene in the foreign unit, but this decision may convince the home regulator that she is better off by not intervening in the home unit. However, this may make the foreign regulator softer, turning her decision from intervention to no intervention, and so on. Clearly, there is no real dynamics in the regulators' decision game. But, the cyclical pattern of decisions generates the impossibility of a pure strategy equilibrium for certain parameter values. This result takes place for intermediate values of p_h and p_f , otherwise both regulators would either prefer to intervene or not to intervene at all, independently of the decision of their counterpart. Hence, we have the following Lemma:

Lemma 3 *With subsidiary representation, as long as $\alpha_h < 1$ and $\alpha_f > 0$, there exists a no-pure-strategy region for intermediate values of p_h and p_f. Instead, if $\alpha_h > 1$ and $\alpha_f > 0$, there exists a multiple equilibria region with decisions (I, I) and (O, O) for intermediate values of p_h and p_f.*

The Lemma also shows that when the home regulator cares more for profit than closure cost, a softer decision by her foreign counterpart induces her also to be softer. This implies first that the no-pure strategy equilibria region vanishes, and second that a region with multiple equilibria appears. As we have discussed, each regulator's decision reinforces the same decision by the other regulator. If one decides to intervene in the local unit, the other may also be induced to take the same decision and (I, I) prevail. However, the same could happen when one regulator decides not to intervene in the local unit, so that for the same set of parameters decisions (O, O) prevails. For the same reason discussed above, this result takes place for intermediate values of p_h and p_f .

Clearly, these two effects do not take place with regulation of a branch-represented MNB where a larger weight to the MNB's profits induces the home regulator to act in a softer manner, unambiguously .

The next proposition summarizes the effects of larger profit weights on regulatory decisions on both representation forms.

Proposition 4 *.*

(i) A larger α_h induces softer regulators' strategies, both under subsidiary and branch representation.

(ii) If $\alpha_h < 1$, a larger α_f induces the home regulator to be tougher and the foreign regulator to be softer. On the contrary, if $\alpha_h \geq 1$, a larger α_f induces softer regulatory decisions with both representation forms.

The first result with branch representation implies that in figure 2 the areas with corresponding decisions (I, I), (O, I) and (I, O) shrink, whilst area (O, O) enlarges when the home regulator is more concerned about MNB's profits. With subsidiary representation the analysis is more complex, due to the existence of regions of multiple equilibria as well as regions of no-pure-strategies equilibria. However, one can look at the effects of profit weights on regulators' strategies. A larger α_h unambiguously induces regulators to take softer decisions under both representation forms.[15] The effect of a larger α_f, on the contrary, is ambiguous. In fact, if the foreign regulator cares more about the MNB's profit, she tends to be softer. If her strategy is affected, it changes from intervention (also when uniquely mix strategies equilibria exist) to no intervention. However, the home regulator is induced to be tougher in case $\alpha_h < 1$. In fact, we already know that as long as $\alpha_h < 1$, a softer foreign regulatory decision tends to make the home regulator tougher; hence the result follows. This reasoning is not true any more when $\alpha_h \geq 1$, as we know that in this case the home regulator is softer when the foreign regulator does not intervene in the foreign unit.

[15] When no pure strategy equilibria exist with subsidiary representation, a larger α_h (weakly) increases the probability that each regulator assigns to the decision of keeping the local unit alive. Note that this does not imply that the decisions realized in such a mix strategy equilibrium are softer than in the case with smaller α_h.

We conclude this section by briefly discussing how our previous results on the effect of more precise information on decisions are affected by regulators also caring about MNB's profits. First, Propositions 1 and 2 can be no longer stated as such due to multiple equilibria and the possibility of the non-existence of pure strategies equilibria. However, one can look at a regulator's decision for a given decision by the other regulator, as we discussed in the previous section. In this respect, we then have that better prospects for a given unit tend to make the regulator in charge of that unit softer. Moreover, the foreign regulator of a subsidiary represented MNB is induced to a softer decision when she learns that the home unit is safer. However, as in the previous analysis, as long as her profit weight is smaller than one, the home regulator may be induced to be tougher on the home unit when she receives better news from the other unit. This possibility vanishes in case she puts a larger weight on the profit than on the closure costs. Note, however, that it is difficult to argue that bank regulators can be induced to care more about MNB's profit than costs associated to bank's closure.

Second, consider the case where the foreign regulator only cares about her intervention costs (i.e. $\alpha_f = 0$). Clearly, a sufficiently large α_h may induce the home regulator to be softer than the foreign one, thus inverting the result in Corollary 1. Finally, comparing regulatory strategies under the two organisational forms we can conclude that as long as $\alpha_f = 0$, profit weighting by the home regulator does not qualitatively affect the results in Proposition 3. On the contrary, this is not the case when the foreign regulator also cares for the MNB's profit (i.e. $\alpha_f > 0$). The reason is, again, the presence of a no-pure-strategy equilibria region which makes the comparison of the decisions with the two representation forms ambiguous.

5 Regulation with international funds shifting by the MNB

We now slightly modify our base model to account for an active role of bank's managers that have aligned interests with shareholders. A well recognized issue in MNB regulation is the MNBs' ability to shift internal resources across countries. Hence, we introduce the possibility that, in the absence of any regulatory intervention, the manager can shift resources across units. More precisely, at $t = 1$ the manager privately learns whether a project is good or bad, and decides about whether to refinance a bad project.[16] A good project yields intermediate returns r at $t = 1$, along with final returns R at $t = 2$; a bad project can be refinanced between $t = 1$ and $t = 2$. If a bad project is refinanced, it pays final returns R at $t = 2$ with probability $q < p$, and zero returns otherwise. If it is not refinanced, it yields zero returns at $t = 2$.[17] For the sake of simplicity we assume that the cost of refinancing is r. Finally, as in the base model, if a regulator intervenes on a project the liquidation value is L.

While internal resource shifting may be optimal for shareholders, this may be undesirable from an efficiency point of view. Clearly, our analysis on resource shifting becomes interesting exactly when this activity is socially undesirable. Thus, Assumptions 1 and 2 are now replaced by the following:

Assumption 1' (i) $p(r + R) + (1 - p)L > 1$; (ii) $.qR - r < L$;

Assumption 2' (i) $R > 1$; (ii) $r + R + L < 2$.

Assumption 1'(i) states that projects have a positive NPV as of $t = 0$; Assumption1'(ii) states that it is efficient to liquidate a bad project rather than refinancing. Assumption 2' implies that, as in the base model, (i) depositors in one country can be reimbursed with $t = 2$ returns of a good project, and (ii) with one project liquidated the MNB is unable to reimburse depositors in both countries, independently of the other project's realization.

We assume that regulators do not observe whether a project yields intermediate returns, thus they face the same information problem as in the base model. However, by intervening at $t = 1$ they can prevent the manager from shifting resources across units.

Consider the case when no regulatory intervention takes place at $t = 1$. The next lemma summarizes the bankers' behaviour under the two organisational forms.

Lemma 4 *A branch-MNB always refinances a bad project; A subsidiary-MNB always refinances a bad domestic project, and refinances a bad foreign project if and only if*

$$q(R - 1) > r. \tag{1}$$

[16] Bank managers typically have superior information with respect to regulators.

[17] Hence, with respect to the base model unsuccessful projects here have a "second" chance which is conditional on internal resource shifting. Note also that although returns are not intrinsically correlated, interdependence is introduced by the behavior of the bank's manager.

Consider a branch-MNB with one bad project. Liquidating a bad project would not yield sufficient funds to repay depositors even if the other project is good (Assumption $2\,(ii)$). Because units are jointly liable under branch representation, the entire MNB will fail and shareholders get zero. Instead, if the banker gambles, there is a chance that the bank will rebound and its shareholders receive a positive payoff. Thus, it is always optimal to gamble. Since the branch organization pools assets and liabilities of the two units, the banker treats a bad project in the same way independently of its location. Instead, when the MNB is represented by a subsidiary, the banker treats a bad project at home and abroad differently. If the home project is bad, the banker faces the same incentives as before. As the foreign unit is liable for the home unit's unsettled claims, the only way to avoid failure is to gamble. Instead, the home unit is shielded from losses incurred by the foreign unit. Thus, the banker is ready to refinance a bad foreign project only if the expected net return $q(R-1)$ exceeds the injected resources r.

We now analyse bank regulation under the two representation form. In what follows we assume that condition (1) is satisfied so that, bad projects are always refinanced, regardless of the representation form and location.

Similarly to the case when regulators care about the MNB's profit, the foreign regulator's decision is affected by the home regulator's decision. When no intervention takes place in the home unit the foreign regulator might not incur any cost even with a bad foreign unit. In fact, if after being refinanced the foreign project pays out, the foreign regulator does not have to reimburse depositors. This is clearly impossible if the home regulator intervenes. Thus, *ceteris paribus*, she becomes softer when the home regulator does not intervene than when the home regulator does in the home unit.

As for the home regulator, the effect of bank manager's gambling is ambiguous. On the one hand, she does not have to incur any cost if the gamble pays out. On the other hand, gambling reduces the available residual assets from the other unit by r. As a consequence, when R, r are small, the home regulator can expect few assets from the foreign unit. Instead, by no intervention in the home unit, although she loses r, she might not incur any cost when q is high. Thus, she becomes softer when the foreign regulator does not intervene in the foreign unit. Hence, whenever $L\,(R-1) \leq q\,(2-R)\,(1-L)-r$, boundary δ_h in figure 1 becomes a decreasing function of p_h. In this case, for intermediate values of p_h and p_f softer foreign regulation results in softer home regulation and vice versa, and a region of multiple equilibria appears with decisions (I, I) and (O, O). (Otherwise regulators would either prefer to intervene or not to intervene independently of the other regulator's decision) This is different with respect to the base model, where softer foreign regulation induced tougher home regulation, in the absence of gambling (see Corollary 1).

On the contrary, when q is small and R and r are large (i.e. $L(R-1) > q(2-R)(1-L) - r$), gambling is not profitable for the home regulator. Thus softer foreign regulation leads to tougher home regulation. As for the foreign regulator, the only way to benefit from the home unit is to let the MNB gamble. Softer home regulation still results in softer foreign regulation, and tougher home regulation leads to tougher foreign regulation. However, as we have shown, when intervention in the foreign unit takes place, it may become optimal for the home regulator to change her decision to no intervention. This in turn changes the best response of the foreign regulator, who becomes now softer; and this may induce the home regulator to become tougher. Hence, for intermediate values of p_h and p_f, this feature of the model generates the possibility of the non-existence of a pure strategy equilibrium, exactly as we have shown in Section 4.

The next proposition summarizes our findings with respect to the base model.

Proposition 5 *With subsidiary representation, for intermediate values of p_h and p_f, if $L(R-1) \geq q(2-R)(1-L) - r$ there exists a no-pure-strategy region. Otherwise there exists a region of a multiple equilibria with decisions (I, I) and (O, O).*

A larger q and a smaller r induce more lenient regulation for both branch and subsidiary representation, in case they affect decisions (this simply comes from the impact of q and r on the relevant boundaries for decisions, i.e. φ_i and δ_i). The effects of q and r can be also large enough so that signals improving (worsening) the prospect of a given project induce the regulators to be softer (tougher). This exactly corresponds to the case when gambling may be beneficial for the regulator, and is similar to what we discussed in the previous section when $\alpha_h \geq 1$ and $\alpha_h > 0$.

Comparing the home regulator's behaviour under the two organisational form, we can conclude that regulation of the home unit remains softer in branch than in subsidiary MNBs. This does not come as a surprise, as the softer behaviour in branch MNBs comes from being responsible for depositors in both countries as opposed to being responsible only for home depositors in subsidiary MNBs. As for comparing decisions over the foreign unit under the two organisational forms, the main difference with respect to the base model is that the foreign regulator's optimal decision is now a function of the home regulator's decision. Regulators may act dissimilarly due to differences in the net gain from gambling, and due to the different responsibility towards depositors located in the other country. When the home unit is open under branch but not under subsidiary representation, the area where the branch regulator is softer shrinks or expands (with respect to the base model) depending on whether gambling is beneficial or not for the home regulator. Finally, when the home unit is open under both organisations, it is possible to show that regulation on the foreign unit is tougher under branch than under subsidiary organisation.

6 Conclusions

In this paper we analyze the effects of the representation form on the prudential regulation of a MNB. We show that different organizational forms generate very different regulatory responses for the same level of information. We argue that the liability structure between bank units and regulator's responsibility towards foreign depositors play a crucial role in explaining these differences. We find that the information available on a given unit has unexpected effects on the regulatory decisions for the other unit, generally inducing more intervention when better prospects become known. In subsidiary MNBs the home regulator is tougher than the foreign one, and independently of representation no intervention in a unit tends to induce tougher regulation on the other unit. Branch representation leads to softer regulation for the home unit than subsidiary representation, while regulation of the foreign unit can be softer or tougher depending on the prospect of the home unit. In particular, for good prospect of the home unit the foreign one faces tougher regulation in branch than in subsidiary representation, and the opposite holds for bad prospects.

In our base model regulators minimize intervention cost, arising from their deposit insurance function. We extend this model, allowing regulators to care also about the MNB's profits (due for example to lobbying activity by the MNBs), and introduce the possibility of inefficient bank gambling. As a consequence of the interaction among national regulations, both extensions show the emergence of either no pure strategy equilibria or multiple equilibria in the case of subsidiary representation.

In this paper the information regulators receive is exogenous. In ongoing research we are analyzing regulators' incentives to collect information under the two representation forms. There information arises as the result of monitoring, and monitoring incentives are determined by the costs regulators incur for a given decision at a given level of information. Rather than analyzing the problem in a signalling game where the two regulators might exchange information untruly, it seems more realistic to assume that regulators do not lie each other, yet can be vague when sharing information. In this context, strategic behavior on monitoring may well appear in the form of postponing information acquisition on the local unit.

One of the alleged reasons for the MNB's choice of a given representation form is the different regulatory regime the bank faces (Houpt, 1999, Calzolari and Loranth, 2001). This can be studied within our setting, by adding a decision step prior to the one on investing: anticipating the regulatory response, the MNB decides whether to be represented by subsidiaries or branches. We leave this interesting issue for future analysis.

Finally, our understanding of the complex issues concerning the regulation of MNBs is still rudimentary and in this paper we have mainly performed a positive analysis in a very stylized model. Comprehending the way MNBs act and the regulatory response is a first step for a more ambitious normative analysis on the socially optimal organization and regulation of MNBs.

7 Appendix

In this appendix we will refer to regulators' decisions with $d^i \in \{I, O\}$, where $d^i = I$ means that the regulator in charge of unit i intervenes on that unit and $d^i = O$ that she leaves it open. By convention, the first letter in any pair of decisions (d, d') will refer to project h and the second to project f, i.e. for (d, d) we have $d^h = d$ and $d^f = d'$.

Proof. of Lemma 1.

The following matrix represents the normal form representation of the $t = 1$ regulation game (in each cell the top payoff relates to the foreign regulator and the bottom to the home regulator).

	$d^f = I$	$d^f = O$
$d^h = I$	$-(1-L)$ $-(1-L)$	$-(1-p_f)$ $-(1-L)+p_f(R-1)$
$d^h = O$	$-(1-L)$ $-(1-p_h)$	$-(1-p_f)$ $-(1-p_h)\left[p_f(1-(R-1))+(1-p_f)\right]$

As for the payoffs in the cell associated to decisions (O, O), if the home project fails (with probability $(1-p_h)$) and the foreign project succeeds (probability p_f), the home regulator can recover some of her costs. In fact, in case the home project fails, the home regulator is entitled to all the foreign assets left after foreign depositors are reimbursed $(R-1)$, and bears a cost of $1-(R-1)$. Foreign regulator's payoffs are similar except that when the foreign project fails and the home succeeds, the foreign regulator cannot expect any resources from the mother bank..

Necessary conditions for a pair of decisions to be a (pure strategies) Nash equilibrium can be now simply derived from the previous matrix. Uniqueness is guaranteed by the foreign regulator having a dominant strategy. Finally, we need to check that all the regions associated with different pair of decisions are non empty. $\delta_h = \frac{L}{1-p_f(R-1)}$ takes value $L/(2-R)$ with $L < L/(2-R) < 1$ for $p_f = 1$ so that regions (I, O) and (O, O) are non empty. Regions (I, I) and (O, I) are trivially non empty. ■

Proof. of Proposition 1.

First note that δ_h is an increasing function of p_f, whilst all the other boundaries defining the regions with different decisions in Lemma 1 do not depend on p_h nor on p_f. Hence, the proof comes from simple inspection of figure 1. Fixing the level of p_i and increasing p_j with $i, j = h, f$ and $i \neq j$, one can check how regulators decisions are affected by signals that affect the probability of success of any project. ■

Proof. of Corollary 1.

One has simply to verify how the two regulators act when $p_h = p_f$, i.e. along the $45°$ line in figure 1. As long as $p_h = p_f \leq L$ the both prefer to intervene on the local unit. Moreover, boundary δ_h takes value L at $p_f = 0$, takes value $L/(2-R)$ with $L \leq L/(2-R) \leq 1$ at $p_f = 1$ and finally it is an increasing function of p_f. Hence, δ_h crosses the $45°$ line once. This suffices to show that there are values of p_h and p_f with $p_h = p_f$ such that equilibrium decisions are (I, O). Finally, for the remaining values $p_h = p_f$ equilibrium decisions are (O, O). ■

Proof. of Lemma 2. At $t = 1$, the home regulator's payoffs associated to available decisions are summarized in the following table.

	$d^f = I$	$d^f = O$
$d^h = I$	$-2(1-L)$	$-(1-L) + p_f(R-1) - (1-p_f)$
$d^h = O$	$-(1-L) + p_h(R-1) - (1-p_h)$	$-[(1-p_h)p_f + (1-p_f)p_h](2-R)+$ $-(1-p_h)(1-p_f)2$

Decisions (I, O) or (O, I) correspond to intervention in one of the units of the bank at $t = 1$. If the regulator intervenes in unit i, the MNB will be unable to payback depositor at $t = 2$ (Assumption 2). Moreover, if the regulator does not intervene in the other unit j and this unit ends up with a successful project (with probability p_j), the total assets of the bank will be $R + L < 2$. Thus, the regulator incurs a cost of $2 - (R + L)$. On the contrary, if unit j ends up in a bad state (with probability $1 - p_j$), the bank's total assets will be L from unit i. When both units are allowed to proceed, the regulator has to reimburse all depositors if both projects turn to be bad, with an expected cost equal to $(1 - p_h)(1 - p_f)2$. Alternatively, one of the two project may turn to succeed while the other fails (with probability $(1 - p_i)p_j$). In this case the regulator's cost amounts to $(2 - R)$.

From these payoffs on can simply calculate the boundaries L/R and $\varphi_i \equiv \frac{L}{R-2(R-1)p_j}$ for probabilities p_h and p_f that give rise to the regions in the Lemma.

We now show that the regions in the Lemma are non empty. Consider first decision (I, I). For this decision to be optimal it must be that $-2(1-L) \geq -(1-L) + p_i(R-1) - (1-p_i)$ for $i = h, f$ and $-2(1-L) \geq -[(1-p_h)p_f + (1-p_f)p_h](2-R) - (1-p_h)(1-p_f)2$. However, this second condition is implied by the first so that it is simply needed that $p_i \leq \frac{L}{R}$. Moreover, region (I, I) is non-empty because $L < R$. For decision (O, I) to be optimal it must be that the payoff associated to (I, I) is smaller, i.e. $p_h > \frac{L}{R}$, as well as that associated to (O, O), i.e. $p_f \leq \varphi_f = \frac{L}{R-2(R-1)p_h}$ and that associated with (I, O), i.e. $p_h \geq p_f$. By symmetry, for decision (I, O) to be optimal it must be $p_f > \frac{L}{R}$, $p_h \leq \varphi_h = \frac{L}{R-2(R-1)p_f}$ and $p_h \leq p_f$ Moreover, note that the condition $p_h \leq \varphi_h$ can be rewritten as $p_f \leq \varphi'_h = \frac{Rp_h - L}{2p_h(R-1)}$. Boundaries φ'_h and φ_f are both increasing and may intersect at $p_h = c_\pm \equiv \frac{R \pm \sqrt{R^2 - 8L(R-1)}}{4(R-1)}$ if the discriminant in $c_\pm$ is positive, i.e. $L \leq \frac{R^2}{8(R-1)}$. This is always the case because $L + R \leq 2$ by assumption 2 (ii) which also implies that $c_+ > 1$ and then the two curves φ'_h and φ_f intersect only once in the $[0, 1]^2$ space of probabilities (p_h, p_f).

Finally, regions do not intersect so that there is no indifference for decisions except along the 45° degrees lines where either the decisions are the same, or, otherwise, the regulator is indifferent between (I, O) and (O, I). ■

Proof. of Proposition 2.

The proof is based on the analysis of the boundaries defining the optimal decision which are presented in Lemma 2. Clearly, with respect to the boundary L/R a higher (lower) p_i can only induce a decision change from $d^i = I$ to $d^i = O$, if any. On the contrary, φ_i is increasing in p_j and this implies that with a higher p_j the home regulator needs to face a higher p_i in order to take decision $d^i = O$. Hence, ceteris paribus, if a change of p_j affects the home regulator's decision at all it induces a change from $d^i = I$ to $d^i = O$. ■

Proof. of Proposition 3.

For the same values of the parameters, we need to compare the decisions that the home and the foreign regulator would take with subsidiary or branch representation. Note first that φ_h and φ_f cross each other at $p_h = c_-$ which is smaller than L iff $L < 1/2$ and $\varphi_f = L$ for $= 1/2$, with φ_f increasing in p_h.

Case $L \leq 1/2$. Consider first decisions concerning the home unit. For $p_f \geq L$ decisions coincide with the two representation forms except for $p_h \in [\delta_h, \varphi_h]$ where the home unit is intervened with subsidiary and kept open with branch representation. For $p_f < L$, note that $L \leq 1/2$ implies that φ_h and φ_f cross each other in the area $\{p_i \leq L, i = h, f\}$ which corresponds to decisions (I, I) for subsidiary-MNB. Hence, either decisions coincide with the two representations or, if $p_f \leq \max\{p_h, \varphi_h\}$ and $p_h \in [L/R, L]$, they are O and I respectively for branch- and subsidiary-MNB

Consider now decisions for the foreign unit. For $p_h \geq 1/2$, so that $\varphi_f \geq L$, either the foreign unit is kept open for both representations or the decision is I and O respectively for branch and subsidiary-MNB if $p_f \in \left[L, \varphi_f\right]$. On the contrary, for $p_h < 1/2$ either decisions coincide for both representations, or the decision is I and O respectively for subsidiary and branch-MNB if $p_f \in \left[\min\left\{\varphi_f, p_h\right\}, L\right]$ for $p_h \in [L/R, L]$ and $p_f \in [L/R, L]$ for $p_h < L/R$.

Case $L > 1/2$. Note that $L > 1/2$ implies that φ_h and φ_f cross each other in the area $\{p_i > L, i = h, f\}$. Consider decisions concerning the home unit. For $p_f \geq L$ decisions coincide with the two representation forms except for $p_h \in [\min\{\delta_h, p_f\}, \varphi_h]$ where the home unit is intervened with subsidiary and kept open with branch representation. For $p_f < L$, either the home unit is intervened with the two representations or, if $p_f \leq p_h$ and $p_h \in [L/R, L]$, they are O and I respectively for branch- and subsidiary-MNB

Consider now decisions for the foreign unit. For $p_h \geq L$, so that $\varphi_f \geq L$, either the foreign unit is kept open for both representations or the decision is I and O respectively for branch and subsisdiary-MNB if $p_f \in \left[L, \min\left\{\varphi_f, p_h\right\}\right]$. On the contrary, for $p_h < L$ either decisions coincide for both representations, or the decision is I and O respectively for subsidiary and branch-MNB if $p_f \in [\max\{L/R, p_h\}, L]$. ■

Proof. of Lemma 3. Let δ_i be the boundary such that for $p_i \geq (<)\delta_i$ regulator i keeps the local unit alive (intervenes on it) if the other regulator does not intervene on the other unit. We have $\delta_h = \frac{L}{1-(R-1)\left[p_f(1-\alpha_h)-\alpha_h\right]}$ increasing in p_f as long as $\alpha_h \leq 1$ and $\delta_f = \frac{L}{1+(R-1)p_h\alpha_f}$ decreasing in p_h and smaller than L for any $\alpha_f > 0$. Similarly, let δ_i' be the boundary such that for $p_i \geq (<)\delta_i'$ regulator i keeps the local unit alive (intervenes on it) if the other regulator intervenes on the other unit. We have that $\delta_h' = \frac{L}{1+(R-1)\alpha_h} < L$ for any $\alpha_h > 0$ and $\delta_f' = L$.

Then, if $\alpha_h < 1$, then $\delta_h' \leq \delta_h$ and δ_h is increasing in p_f; if $\alpha_f > 0$, then $\delta_f \leq \delta_f'$ and δ_f is decreasing in p_h. Hence, as long as $\alpha_h < 1$and $\alpha_f > 0$ there exists a non empty region

$$\left\{(p_h, p_f) : p_f \in \left[\delta_f, \delta_f'\right], p_h \in [\delta_h', \delta_h]\right\}$$

such that there are no pure strategy equilibria.

Moreover, if $\alpha_h > 1$ $\delta_h' > \delta_h$ and δ_h is decreasing in p_f. Hence, there exists a non empty region

$$\left\{(p_h, p_f) : p_f \in \left[\delta_f, \delta_f'\right], p_h \in [\delta_h, \delta_h']\right\}$$

with multiple equilibria (I, I) and (O, O). ■

Proof. of Proposition 4. (i) Consider first subsidiary representation. If $\alpha_f = 0$, the no-pure-strategies-equilibria area is empty. In this case a larger α_h increases δ_h and also reduces δ_h' so that the result applies. If on the contrary, $\alpha_f > 0$, the no-pure-strategies-equilibria area is non empty. Equilibrium mixed strategies in this area are

$$\sigma_h = \frac{L-p_f}{(R-1)p_h p_f \alpha_f}$$
$$\sigma_f = \frac{p_h[1+(R-1)\alpha_h]-L}{(R-1)p_h p_f(1-\alpha_h)}$$

where σ_i is the probability assigned to the decision to keep the unit i alive by regulator i. Then we have that $\frac{\partial \sigma_h}{\partial \alpha_h} = 0$ and $\frac{\partial \sigma_f}{\partial \alpha_h} = \frac{Rp_h - L}{(R-1)p_h p_f (1-\alpha_h)^2} > 0$ where the sign comes from the fact that the no pure strategies area requires $p_h \geq \frac{L}{1+(R-1)\alpha_h}$ which implies that $Rp_h \geq L$ because $\frac{L}{1+(R-1)\alpha_h} \geq \frac{L}{R}$. Hence, in this case, we have the effect illustrated for the analysis of $\alpha_f = 0$ and, moreover, a larger α_h (weakly) increases the probability that in the mixed strategy equilibrium an open decision is taken by a given regulator.

Consider now branch representation. Studying the effect of α_h on the boundaries defining the regions associated with different decisions gives the result. In fact, we now have,

$$\varphi_i \equiv \frac{L}{R - 2(R-1)\, p_j (1-\alpha_h)}$$

and φ_i is increasing in p_j as long as $\alpha_h \leq 1$ and decreasing otherwise. Moreover, $\frac{\partial \varphi_i}{\partial \alpha_h} \geq 0$ for $1 \geq \alpha_h$ and $\frac{\partial \varphi_i}{\partial \alpha_h} \leq 0$ for $1 < \alpha_h$.

(ii) Clearly, α_f matters uniquely with subsidiary representation. If $\alpha_h < 1$, for any $\alpha_f > 0$ the no-pure-strategy-equilibrium region is non empty. This region is larger and the region with decisions (O, I) is smaller, the larger is α_f whilst all the other regions are unaffected. Hence, we have that a pure strategy equilibrium with decisions (O, I) is substituted by a mixed strategy equilibrium whose realization can be any pair of decisions. So, if decisions are affected, the home regulator becomes tougher and the foreign regulator becomes softer. Moreover, we have that $\frac{\partial \sigma_h}{\partial \alpha_f} < 0$ and $\frac{\partial \sigma_f}{\partial \alpha_f} = 0$. Hence, the larger α_f the less probable is that the home regulator leaves the home unit open in the mixed strategy equilibrium. Finally, if $\alpha_h \geq 1$, the no-pure-strategies-equilibrium region is empty and inspection of the boundaries that define the regions gives the result. In fact, either a decisions (O, I) are transformed into (O, O) or decisions (I, I) into (O, O).
■

Proof. of Proposition 5. Let δ_i and δ_i' be the boundaries as in the proof of Lemma 3, where now $\delta_h = \frac{L - p_f[q(2-R)-r]}{1-p_f[q(2-R)+R-1]}$, $\delta_f = \frac{L-qp_h}{1-qp_h}$ and $\delta_h' = \delta_f' = L$. δ_f is decreasing in p_h for any q and δ_h is increasing in p_f if $r \geq q(2-R)(1-L) - L(R-1)$ and decreasing otherwise. Moreover, $\delta_f \leq \delta_f'$, $\delta_h \geq \delta_h'$ if $r \geq q(2-R)(1-L) - L(R-1)$ and $\delta_h \leq \delta_h'$ otherwise.

Hence, if $r \geq q(2-R)(1-L) - L(R-1)$ there exists a non empty region

$$\left\{(p_h, p_f) : p_f \in \left[\delta_f, \delta_f'\right], p_h \in \left[\delta_h', \delta_h\right]\right\}$$

such that there are no pure strategy equilibria, otherwise there exists a non empty region

$$\left\{(p_h, p_f) : p_f \in \left[\delta_f, \delta'_f\right], p_h \in \left[\delta_h, \delta'_h\right]\right\}$$

with multiple equilibria (I, I) and (O, O). ■

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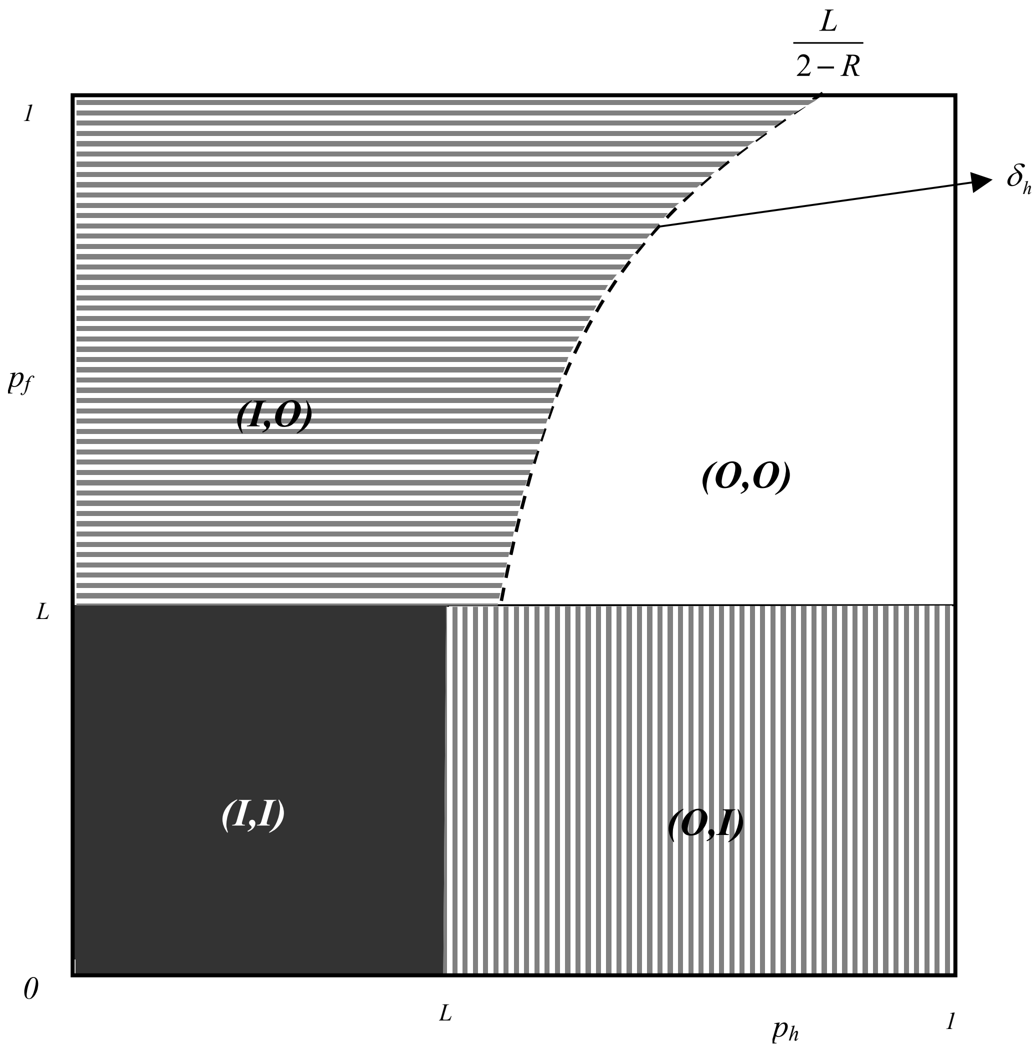

Figure 1: Regulators' decisions with subsidiary-MNB

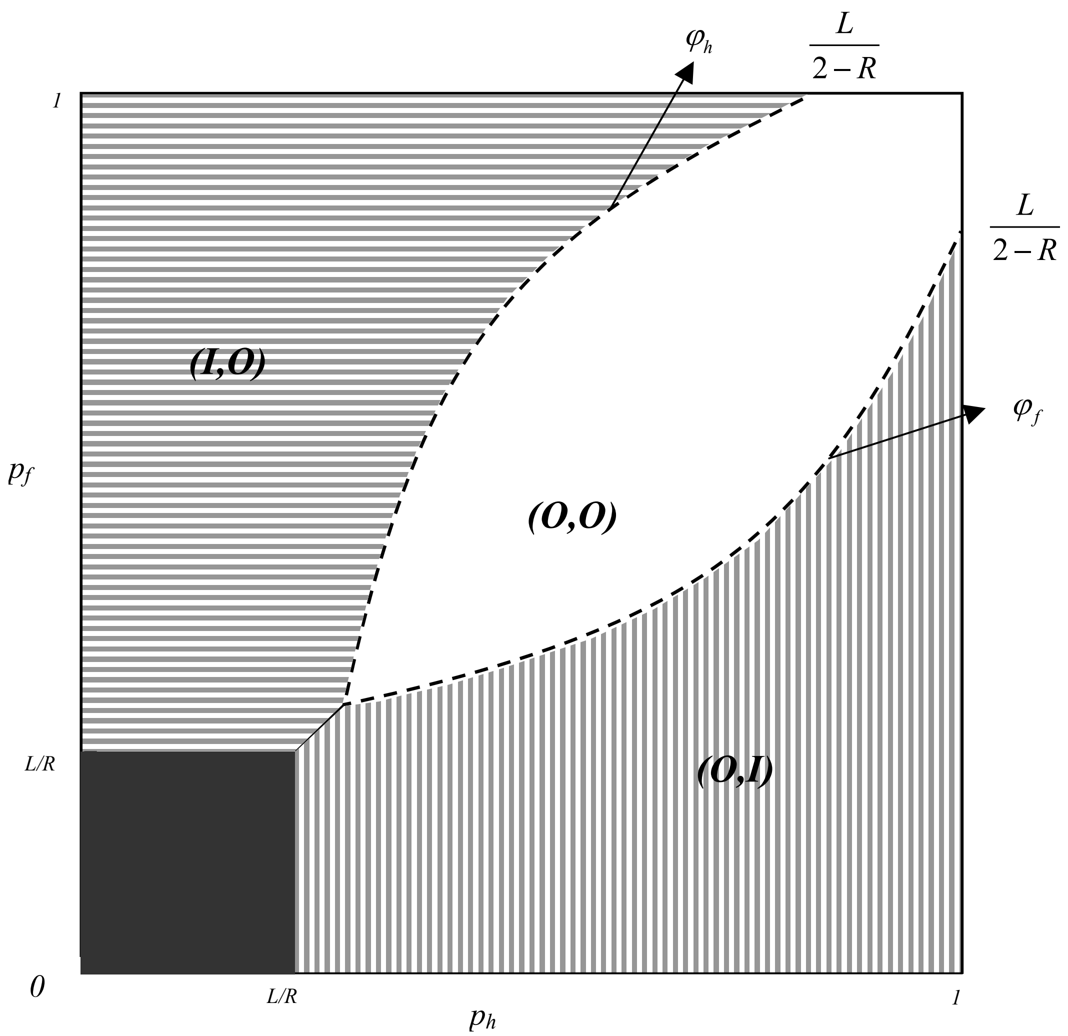

Figure 2: Regulator's decisions with branch-MNB