EUROPEAN CENTRAL BANK

WORKING PAPER SERIES
NO. 431 / JANUARY 2005

ECB-CFS RESEARCH NETWORK ON CAPITAL MARKETS AND FINANCIAL INTEGRATION IN EUROPE

REGULATION OF MULTINATIONAL BANKS

A THEORETICAL INQUIRY

by Giacomo Calzolari
and Gyongyi Loranth

EUROPEAN CENTRAL BANK

WORKING PAPER SERIES

NO. 431 / JANUARY 2005

ECB-CFS RESEARCH NETWORK ON CAPITAL MARKETS AND FINANCIAL INTEGRATION IN EUROPE

REGULATION OF MULTINATIONAL BANKS

A THEORETICAL INQUIRY [1]

by Giacomo Calzolari [2]

and Gyongyi Loranth [3]

In 2005 all ECB publications will feature a motif taken from the €50 banknote.

This paper can be downloaded without charge from http://www.ecb.int or from the Social Science Research Network electronic library at http://ssrn.com/abstract_id=647943.

1 We are extremely grateful to Denis Gromb for valuable comments. We have benefited from the comments of Erik Berglof, Mike Burkart, Vittoria Cerasi, Alejandro Cunat, Gabriella Chiesa, Roman Inderst, Colin Mayer an seminar participants at ENTE "Luigi Einaudi", Financial Markets Group, Oxford Said Business School, University of Bologna, University of Milano Bicocca and SITE Stockholm School of Economics. This paper previously circulated with the title "On the Regulation of Multinational Banks". The usual disclaimer applies.

2 Corresponding author: Department of Economics, University of Bologna, Piazza Scaravilli 2, 40126, Bologna, Italy; tel.: +39 051 209 5516; fax: +39 051 209 8040; e-mail: calzolari@economia.unibo.it

3 London Business School, Regent´s Park, London NW1 4SA, United Kingdom; e-mail: gloranth@london.edu

ECB-CFS Research Network on
“Capital Markets and Financial Integration in Europe”

This paper is part of the research conducted under the ECB-CFS Research Network on “Capital Markets and Financial Integration in Europe”. The Network aims at stimulating top-level and policy-relevant research, significantly contributing to the understanding of the current and future structure and integration of the financial system in Europe and its international linkages with the United States and Japan. After two years of work, the ECB Working Paper Series is issuing a selection of papers from the Network. This selection is covering the priority areas “European bond markets”, “European securities settlement systems”, “Bank competition and the geographical scope of banking activities”, “international portfolio choices and asset market linkages” and “start-up financing markets”. It also covers papers addressing the impact of the euro on financing structures and the cost of capital.

The Network brings together researchers from academia and from policy institutions. It has been guided by a Steering Committee composed of Franklin Allen (University of Pennsylvania), Giancarlo Corsetti (European University Institute), Jean-Pierre Danthine (University of Lausanne), Vítor Gaspar (ECB), Philipp Hartmann (ECB), Jan Pieter Krahnen (Center for Financial Studies), Marco Pagano (University of Napoli “Federico II”) and Axel Weber (CFS). Mario Roberto Billi, Bernd Kaltenhäuser (both CFS), Simone Manganelli and Cyril Monnet (both ECB) supported the Steering Committee in its work. Jutta Heeg (CFS) and Sabine Wiedemann (ECB) provided administrative assistance in collaboration with staff of National Central Banks acting as hosts of Network events. Further information about the Network can be found at http://www.eu-financial-system.org.

The joint ECB-CFS Research Network on "Capital Markets and Financial Integration in Europe" aims at promoting high quality research. The Network as such does not express any views, nor takes any positions. Therefore any opinions expressed in documents made available through the Network (including its web site) or during its workshops and conferences are the respective authors' own and do not necessarily reflect views of the ECB, the Eurosystem or CFS.

© European Central Bank, 2005

Address
Kaiserstrasse 29
60311 Frankfurt am Main, Germany

Postal address
Postfach 16 03 19
60066 Frankfurt am Main, Germany

Telephone
+49 69 1344 0

Internet
http://www.ecb.int

Fax
+49 69 1344 6000

Telex
411 144 ecb d

All rights reserved.

Reproduction for educational and non-commercial purposes is permitted provided that the source is acknowledged.

The views expressed in this paper do not necessarily reflect those of the European Central Bank.

The statement of purpose for the ECB Working Paper Series is available from the ECB website, http://www.ecb.int.

ISSN 1561-0810 (print)
ISSN 1725-2806 (online)

CONTENTS

Abstract 4

Non-technical summary 5

1 Introduction 7

2 The base model 11

3 Prudential regulation and representation form 13

3.1 Subsidiary represented MNB 13

3.2 Branch represented MNB 15

3.3 Comparing prudential regulation between subsidiary and branch-MNBs 16

4 Regulation with bank's lobbying 19

5 International fund shifting and regulation 20

6 Information acquisition 22

7 Conclusions 25

References 26

Appendix 28

Figures 35

European Central Bank working paper series 38

Abstract

This paper examines prudential regulation of a multinational bank (MNB hereafter) and shows how regulatory intervention depends on the liability structure and insurance arrangements for non local depositors (i.e. on the representation form for foreign units). Shared liability among the MNB's units gives higher incentives for regulatory intervention than when units are legally separate entities. Cross-border deposit insurance provides lower incentives to intervene than when the regulator only has to compensate local depositors. We study the impact of shared liability and deposit insurance arrangements on regulators' incentives to monitor and acquire information on MNB's activities. Furthermore, by describing regulatory intervention and monitoring we also draw implications on the MNB's preferences over the form representation for foreign units, and discuss the effects of regulators' behavior on both MNB's lobbying and international resources shifting.

Keywords: Multinational Banks, Prudential Regulation, Representation Form, Subsidiary, Branch.

JEL classification: L51, F23, G21, G28.

Non-technical summary

The rapid expansion of multinational banks (MNBs hereafter) represents a source of new concerns for regulators. MNBs can easily take advantage of ill-harmonized national supervisions. At the same time, regulation of a MNB in one country may well affect the behavior of the bank and regulators in other countries. This paper provides a simple framework to examine disciplining regulatory actions performed by independent national authorities in a multinational bank setting.

Under current regulatory arrangements, branches of MNBs are supervised by the regulator of the country of original incorporation ("home regulator"), who is also in charge of insuring foreign depositors. Subsidiary-represented MNBs are supervised instead by both home and foreign regulators, which have independent regulatory power over the locally incorporated subsidiaries. Depositors are normally insured by the local deposit insurance scheme.

We examine prudential regulation of a MNB, and discuss the extent to which regulatory intervention depends on the representation form for foreign units, *i.e.* on the liability structure and insurance arrangements for non local depositors. We argue that national regulators' incentives to intervene in a bank unit will be affected by the assets available to compensate depositors upon intervention, and on the regulators' responsibilities towards depositors located in foreign countries.

In particular, shared liability between the MNB's unit reduces the cost of intervention in any of the units in comparison with the scenario in which units are legally separate, since the regulator can reduce the cost of intervention in a given unit with assets of the other. At the same time responsibility to insure depositors in both countries decreases incentives to intervene in a given unit as compared with the case in which the regulator only has to compensate local depositors. On the basis of these considerations we show the following:

1. When the MNB is set up *via* a subsidiary, the home unit regulator has a stronger incentive in restructuring MNB's activities than the foreign regulator. This occurs because the home regulator both benefits from the foreign unit's (residual) assets, and is shielded from foreign losses. No such effect is in place for the foreign regulator.

2. Home units fall under softer regulation in branch MNBs than with subsidiary MNBs. This is a consequence of different regulatory re-

sponsibility towards foreign depositors: the home regulator can access foreign assets regardless of the representation form, whereas she has to repay foreign depositors only when facing a branch MNB. Home assets (possibly available only if the home unit is not intervened) are therefore more valuable in branch MNBs than with subsidiary representation.

3. We compare the likelihood of intervention under the two representation forms, and show that when the home unit's activities are not very safe, branch representation is preferred by the MNB as it induces more lenient regulation over all units.

4. We study regulators' incentives to collect information on the MNB's activities. We argue that when regulators decide whether to collect information on the bank's unit, strategic behavior for monitoring may well appear in the form of postponing information acquisition on the local unit.

5. We show that with the subsidiary representation form the foreign regulator has got more incentives to monitor foreign units than the home regulator regarding the home unit.

6. In general, incentives to monitor are maximal with a branch rather than with a subsidiary represented MNBs.

1 Introduction

Multinational banking activities have significantly expanded as barriers to both international capital flows and to foreign market entry have decreased. [1] A multinational bank (MNB hereafter), consisting of a home bank and a number of foreign located banks, can easily take advantage of ill-harmonized national supervisions. Furthermore, regulation of a MNB in one country may well affect the behavior of the bank and regulators in other countries. As such, the rapid expansion of MNBs represents a source of new concerns for regulators. This paper provides a simple framework to examine disciplining regulatory actions performed by independent national authorities in a multinational bank setting.

Bank expansion abroad occurs in many ways, mostly importantly with representation by way of branches and subsidiaries.[2] Representation form defines a liability structure between units, and implies a regulatory structure for the MNB. The bank constitutes a single legal entity when business abroad is conducted via branches, on the contrary, subsidiaries are separately incorporated and capitalized entities. The home bank therefore shares joint liability with the branches for their losses, while is shielded by limited liability from the subsidiary's losses. At the same time the subsidiary's assets stand against home losses, as it is the case with branches. Representation form also defines the competency of different regulators, affecting their incentives to collect information and take disciplining regulatory actions (i.e. their incentives to intervene). Branches are supervised by the regulator of the country of original incorporation ("home regulator"), who is also in charge of insuring depositors (independently of their location). Subsidiary MNBs, on the contrary, are jointly supervised by the home and foreign regulators. The foreign regulator has independent regulatory power over the locally incorporated subsidiary and depositors are normally insured by the local deposit insurance scheme.[3]

In this paper, we analyse regulators' incentives to collect information and take disciplining regulatory actions in the MNB's units and we relate this analysis to the MNB's representation form. Furthermore, we examine regulators' responsiveness to information available on the MNB's activities. We take an MNB that operates in two countries, and conducts business in the foreign country either via branches or via subsidiaries. The MNB collects money from depositors in the two countries and invests it locally. In our model, troubled banks are too slow to cut their losses because they are protected by limited liability. They therefore keep alive projects that should be liquidated. Due to deposit insurance, the bank' s ultimate creditors are the taxpayers. This

[1] By 1996, the total assets held by US banks 'overseas units was twice that in 1992, exceeding 1.1 trillion. In 2000, foreign banks accounted for almost 10 percent of US deposits (Buch and Golder 2001). In 2001, foreign banks located in the US accounted for 20 percent of total banks' assets in the US, and 26 percent of total business loans in the US (Federal Reserve Board, 2002). In emerging markets the surge of multinational banks 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. In certain Latin American countries, as of 2000, almost 50 percent of total bank assets are controlled by foreign banks (IMF, 2000). For more details, see Calzolari and Loranth (2001).

[2] Other representation forms exist (e.g. correspondent banks, representative offices and agencies). We limit attention to branches or subsidiaries because these representations allow banks to perform the full range of banking activities.

[3] For more details see Houpt 1999 and Bain et al. 2003.

generates the need for regulation, so that the authority 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, alternatively, might allow continuation of bad projects.

In our base model we assume that regulators only care about costs coming from their deposit insurer function. The trade-off the regulator faces is as follows: early intervention yields a sure cost that might be avoided by waiting until the investment matures and gives sufficient returns to pay out depositors. Waiting, however, might lead to no returns and a substantially higher cost for the regulator.

We show that a material difference exists in the likelihood of intervention in branch and in subsidiary MNBs. This difference arises from (1) the difference in assets available to compensate depositors upon intervention; and (2) the differences in regulators' responsibilities towards depositors located in the other country. Shared liability among the MNB's unit gives higher incentives for regulatory intervention than when units are legally separate, since the regulator can reduce the cost of intervention in a given unit with assets of the other. At the same time, however, responsibility to insure depositors in both countries decreases incentives to intervene in a given unit as compared when the regulator only has to compensate local depositors. In fact, when insuring both countries' depositors, intervention in a given unit eliminates the possibility for the regulator to (partially) cover potential losses of the other unit, thus making intervention more costly.

On the base of these considerations we obtain several implications concerning regulators' behavior.

First, when the MNB is setup *via* subsidiary, the home unit regulator is tougher than the foreign unit regulator (i.e. the home regulator intervenes in the home unit for a larger parameter set than the foreign regulator in the unit abroad). This occurs because the home unit regulator both benefits from the (residual) asset of the foreign unit and is shielded from foreign losses. No such effect is in place for the foreign regulator. Furthermore, the subsidiary's liability over home losses implies that softer foreign regulation (i.e. no intervention) induces tougher regulation at home.

Second, home banks fall under softer regulation in branch MNBs in comparison with subsidiary MNBs. This is a consequence of different regulatory responsibility towards foreign depositors. In fact, the home regulator can access foreign assets independent of the representation form. On the contrary, she has to repay foreign depositors only when facing a branch MNB,so that, to this purpose, home assets (possibly available only if the home unit is not intervened) are more valuable than with subsidiary representation.

Third, we find that intervention in the foreign unit in branch MNBs is more likely if the prospects on the home unit look good than if they look bad. This is the result of two forces. The shared liability between the MNB's unit reduces the cost of intervention in any of the units. However, intervening in a given unit eliminates the possibility of using that unit to subsidize losses in the other unit, thereby increasing the expected cost of reimbursing depositors. The first effect pushes the regulator towards tougher behavior, while the second towards a softer behavior on a branch. The balance of these two effects changes as prospects for the home unit changes. When

prospects for the home unit are poor, intervention is likely at home and only the second effect is relevant, making the home regulator softer on the foreign unit. As home prospects improve, the first effect becomes stronger and the result follows. Note that, the home and the foreign units are symmetric for the regulator of a branch MNB so that better or worse prospects about the other unit have the same effect on the decision concerning the home unit. Furthermore, being based on units joint liability, it clearly also applies to the decision concerning the home bank in case of subsidiary MNB. Hence, we can generalize the result and state that good news (better prospects) for any unit leads to stricter regulation on the other unit, as long as units are jointly liable for their losses. This implies that irrespective of the MNB's representation, good news about the foreign unit leads to more regulatory intervention in the home unit.

Furthermore, given that in subsidiary represented MNBs the decision of the foreign regulator is independent of the home prospects (the home bank is shielded by limited liability from the subsidiary losses), it also follows that the subsidiary faces softer regulation than the branch for good home prospects and tougher regulation for bad home prospects.

The above comparison of regulatory intervention in the two units lends to the representation form choice by the MNB since the different regulatory regime the bank faces is allegedly an input in making that decision (Houpt, 1999, Calzolari and Loranth, 2001). By comparing the likelihood of intervention under the two representation forms we can show that when the home unit's project is not very good (not very safe), the branch representation is preferred as it induces more lenient regulation over all units. When this is not the case, the relative safety of home project with respect to the foreign project drives the decision. When the former is safer, the banker prefers subsidiary representation, otherwise, the reverse is true.

We then extend the base model in two directions. First, we examine what happens to regulators' behavior if they also care about the MNB's profits (e.g. as a consequence of lobbying by the MNB). Second, we assign an active role to bank managers, assuming that in the absence of intervention they gamble for resurrection. More precisely, by inefficiently shifting resources between units, the MNB may expect profit even from a bad unit. Joint liability in branch MNBs means that failure of any unit will bring down the other unit. Thus, a well performing unit has incentives to inject funds into a poorly performing unit. For subsidiary MNBs, however, the home unit can let a foreign unit fail without failing itself. The home unit therefore has lower incentives to keep it unduly afloat.[4]

In both extensions, contrary to the base model, the foreign regulator of the subsidiary is now affected by the home regulator's decision. No intervention at home allows the MNB to gamble, i.e. for a good home unit to sink funds into a bad foreign unit. This increases the probability that the foreign regulator incurs no cost if she does not intervene in the local unit. Thus, the foreign regulator is induced to being softer. We show that with both extensions if the additional effects have limited impact on regulator's payoff, then the home regulator prefers to take the opposite decision of the foreign regulator as in the base model, 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

[4] This 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.

other, which 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 payoffs, she tends to intervene less often, given no intervention abroad. A region of multiple equilibria then appears in both extensions, where softer regulation triggers softer regulation, and tougher regulation triggers tougher regulation.

Finally, we study regulators' incentives to collect information on the MNB's activities. We add a preceding stage to the game, where regulators decide whether to collect information on the bank's unit. Strategic behavior for monitoring may well appear in the form of postponing information acquisition on the local unit. We show that with subsidiary representation the foreign regulator has more incentives to monitor the foreign unit than the home regulator does the home unit. Further, incentives to monitor are maximal with a branch rather than with a subsidiary MNB.

Related literature Our paper belongs to a growing literature on MNB regulation. Calzolari and Loranth (2001) provide a general introduction to the issue. Repullo (2001) addresses limited supervisory information about MNB's foreign activities and draws conclusions on cross-border takeovers. 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 capital requirements and closure policy. He argues that the cross-border harmonization of capital requirements with divergent closure policies leads to a regression towards the most forbearing closure regime. Dell'Ariccia and Marquez (2001) reach similar conclusions to Acharya's paper. Dalen and Olsen (2003) study the lack of coordination among national regulators when the MNB is represented with subsidiaries. They show that independent national regulation lowers capital adequacy requirements which is offset by an increase of bank asset quality. Finally, Harr and Rønde (2004) examine optimal capital requirements for branches and subsidiaries in a model where the bank's asset choice depends both on exogenous factors and on the representation form.[5]

With respect to this literature, our contribution is to analyze and compare regulators' incentives to take disciplining regulatory actions and to monitor under branches and subsidiaries.

The rest of the paper is organized as follows. Section 2 presents the base model. Section 3 analyzes and compares regulators' incentive to intervene under the two representations. Section 4 extends the base model to regulators who also care about the MNB's profit. Section 5 considers the role of active bank managers that may gamble for resurrection. Section 6 deals with information acquisition. Section 7 concludes. All proofs are in the Appendix.

[5] See also Calzolari (2001) and (2004) for an analysis of multinational enterprises regulation in the context of public utilities.

2 The base model

Consider a MNB incorporated in country h (the home country) and 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 that requires one unit of investment. At $t = 0$ project i is successful with probability p, in which case it pays R at $t = 2$. It fails with probability $(1 - p)$, paying 0. 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 a given country are fully paid back if the local project is successful, but (ii) if one project is liquidated or fails, the MNB cannot reimburse depositors in both countries, independently of the other project's realization.[6] That is,

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

The MNB is run by a bank manager with preferences to carry out projects in both countries, and having no incentive to stop projects before the termination date $t = 2$. This is so even if the manager learns by $t = 1$ that a project will fail at $t = 2$. For example, a wage scheme related to the MNB's performance (profit) and the presence of managerial private benefits induce this manager's behavior. Hence, manager's preferences to continue inefficient projects calls for bank regulation.[7]

Bank Regulation. In the base model regulators perform two tasks: prudential regulation and deposit insurance. Prudential regulation comprises of (early) intervention at $t = 1$, indicated as I. This is tantamount to liquidation of the unit's ongoing project. Intervention, more generally, can be thought of as conservatorship, or ring-fencing, as an attempt to protect the assets of a given unit, or to limit the exposure of the MNB to certain categories of risk. It can also be understood as asset restrictions imposed by the regulator, or assets restructuring. Alternatively, the regulator may decide not to intervene in a project, which we will indicate with O (for open).

Regulators are assumed to minimize the costs from their deposit insurer function.[8] In Section 4 we will discuss the model extension whereby regulators also care about the MNB's profits.

[6] This is to avoid uninteresting behavior of regulators.

[7] For a contract theory explanation see Dewatripont and Tirole 1994, among the others. Also note that anticipating regulators' decisions, the manager may prefer to run only one project. However, our aim is to study a MNB active in both countries. To this end, we implicitly assume information available at $t = 0$ induces the manager to run both projects, even if at a later date new information may make this decision suboptimal. This will be discussed in Section 5.

[8] The FDIC has been given this type of objective function by the FDICIA in 1992. The act mandated a least-cost resolution method and prompt resolution approach to problems and failing banks. The Financial Service Authority (FSA) in the UK shares a similar mission. In the academic literature this objective function has been used by Mailath and Mester (1994), Repullo (2000, 2001), among others.

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

A foreign *subsidiary* is a separately incorporated entity in the foreign country. Subsidiaries and the home bank share liability for the home banks' losses, but the home bank is not liable for the losses of the subsidiary. More precisely, in case of home failure all remaining assets in a solvent foreign unit - after foreign depositors are paid out - should be used against home liabilities. No such transfer is legally required from a solvent home unit to an insolvent foreign unit. With a subsidiary-organized MNB (subsidiary-MNB hereafter), each national regulator performs prudential regulation over the MNB's local unit and insures local depositors. Regulators' decisions are assumed to be taken non-cooperatively.

Branches can be thought of as extensions of the mother bank. As such, insolvency occurs when the total assets of the MNB fall short of total liabilities. With a branch-organized MNB (branch-MNB hereafter) the home regulator performs prudential regulation and deposit insurance in both countries. Intervention in both units can be thought of as closure of the MNB, yielding liquidation value $2L$.[9]

In what follows we refer to the regulator in charge by her location. Thus, we refer to the single regulator of a branch MNB as well as that of the home unit in subsidiary MNBs as the *home regulator*. We call the regulator of the foreign unit in subsidiary MNBs *foreign regulator*. Furthermore, by convention, for any pair of decisions, the first letter refers to unit h and the second to unit f, e.g. (I, O) means that the regulator in charge of unit h intervenes, whilst the one in charge of unit f does not.

The following table summarizes the regulators' activities over the MNB's units according to the representation form, as well as the liability structure.

	Branch MNB			**Subsidiary MNB**		
	Regulation	*Deposit insurance*	*Cross-liability*	*Regulation*	*Deposit insurance*	*Cross-liability*
Home unit	Home Regulator	Home Regulator	Liable for foreign unit	Home Regulator	Home Regulator	Not Liable for foreign unit
Foreign unit	Home Regulator	Home Regulator	Liable for home unit	Foreign Regulator	Foreign Regulator	Liable for home unit

Table 1: Representation, Supervision and Liability with Branch- and Subsidiary-MNBs

Information Structure. At $t = 0$, the regulators and the bank share the same view about the projects' prospects. They therefore both hold p as the probability of success. In order to have

[9] The current EU regulation follows the principle of home country supervision. Hence, the competent authority 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. See the Second EU Banking Coordination Directive issued in 1989 and made effective on January 1, 1993.

a sensible analysis with a MNB, we assume p is such that the bank manager prefers to invest in both units independent of the representation form. At $t = 1$ regulators may obtain a signal about the local unit's prospects and we assume that any information acquired by a regulator at $t = 1$ is shared with the other regulator. Given this signal on project i, at $t = 1$ the regulators' beliefs on the success probability of project i become p_i. A favorable signal for project i means that $p_i \geq p$, while the inequality is reversed for unfavorable signals. At $t = 2$ all information about project returns becomes public.

In this base model, information acquisition is an exogenous process. We will endogenize it in Section 6 by investigating the regulators' incentives to monitor a bank's units.

We summarize our base model with the following,

Timing

- At $t = 0$: The bank collects deposits in both countries and invests them in risky projects.
- At $t = 1$: Regulators exchange any information they have learned about the local unit. Regulators decide whether to intervene in the project of the unit under their jurisdiction.
- At $t = 2$: Payoffs are realized and depositors are repaid.

3 Prudential regulation and representation form

The trade-off for a cost-minimizing regulator of a single unit bank is as follows: early intervention at $t = 1$ leads to a sure (intervention) cost of $(1 - L)$. This might be avoided by waiting until the unit's project matures (if it yields returns R). Waiting until $t = 2$, however, might yield no returns, and a regulatory cost of 1 (i.e. returning the initial deposit). The regulator therefore compares the liquidation value L with the probability of success for a given unit p_i.[10] This basic trade-off will change in a multi-unit setup due to the joint liability between the MNB's units.

3.1 Subsidiary represented MNB

At $t = 2$ no strategic interaction takes place between regulators. If the local unit is solvent, the regulator in charge incurs no cost. Otherwise, she covers the shortfall between available assets and liabilities.

At $t = 1$ limited liability of the home unit makes it impossible to reduce foreign asset shortfall with assets located in the home unit. Hence, the home regulator's decision leaves the foreign regulator's payoff unaffected. It follows that the foreign regulator has a dominant strategy: she prefers intervention in the subsidiary if the liquidation value L is larger than the expected cost reduction obtained by leaving the subsidiary open p_f.

The situation is different for the home regulator. If the foreign unit is successful at $t = 2$, the home regulator could reduce her intervention cost, $(1 - L)$, with assets from the foreign unit, once

[10] Intervention at $t = 1$ leads to $(1 - L)$. No intervention results in no cost with probability p_f, and cost of 1 with probability $(1 - p_f)$.

foreign depositors are repaid. Intervention in the foreign unit, however, leaves no foreign assets that can be transferred to the home unit . Hence, the optimal decision for the home regulator depends on the foreign regulator. More precisely, if the foreign regulator intervenes, home intervention is optimal if $p_h \leq L$. If the foreign regulator does not intervene, the home regulator intervenes if the liquidation value L is larger than $p_h - p_h p_f(R-1)$ or, $p_h \leq \delta_h$ where $\delta_h \equiv \frac{L}{1-p_f(R-1)}$.

It is immediate to see that the home regulator tends to be tougher with the home unit (i.e. to close it more often or for a larger set of parameters) when the foreign regulator does not intervene in the subsidiary. If the foreign regulator does not intervene in the subsidiary, the home regulator benefits from the residual assets of a successful subsidiary. Her expected cost for any decision will be lower now. However, the reduction in expected cost is higher when she intervenes $p_f(R-1)$ than when she does not $(1-p_h)p_f(R-1)$. When she intervenes, conditional on the foreign project being successful, she will benefit from the foreign assets. If she prefers continuation for the home unit, she benefits only upon failure. The combination of the regulators' decisions allows us to draw the following pictures where we describe the unique (pure strategy) equilibrium decisions for any pair of probabilities (p_h, p_f).

For the same prospects concerning the two projects (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 intervenes while the foreign regulator does not. The reason, as explained before, lies in the subsidiary's joint liability with the home unit for home losses. This leads to the following proposition: (where softer regulation implies keeping a given unit open, while the reverse holds for tougher regulation).

Proposition 1 (Interacting Regulators with Subsidiary MNB) *With subsidiary representation, (i) softer foreign regulation induces tougher home regulation; (ii) ceteris paribus, the home regulator is tougher than the foreign one.*

A more favorable signal on the home project (i.e. $p_h \geq p$) always induces the home regulator to be more lenient. Clearly, the home regulator expects smaller costs in letting the home unit continue. Moreover, the foreign regulator's decision is unaffected, as she cannot benefit from any home-located residual asset. Similarly, a more favorable signal on the foreign project (i.e. $p_f \geq p$) induces more lenient behavior from the foreign regulator. The home regulator may, however, change her decision from continuation to intervention in this case, as shown by the increasing boundary δ_h separating decisions (O, O) from (I, O) in figure 1.

Proposition 2 (Effect of Information with Subsidiary MNB) *In case newly available information at $t = 1$ affects decisions, a more favorable signal on the foreign unit induces the home regulator to be tougher. In all other cases, favorable signals induce softer regulation. The effects of signals are reversed when they are unfavorable.*

Better foreign prospects make it more likely that the home regulator can reduce her cost both if she intervenes, or if the home unit project gives no returns. However, good news about project f has a stronger impact on the payoff associated with intervention than with no intervention. Therefore, it may induce intervention in the home unit.[11] Since, the foreign regulator cannot recover any resource from the home unit, this information effect does not apply to her behavior.

In section 4 we show that even if the home regulator cares about the MNB's profits, the proposition still stands as long as she values profit less than costs.

3.2 Branch represented MNB

With a branch MNB, the home regulator, if necessary, pays the difference between the total liabilities and the total assets of the MNB at $t = 2$. At $t = 1$ the home regulator's decision comprises of intervention in one, both or none of the two units.

Joint liability of the MNB's units means that decisions concerning a given unit affect decisions about the other unit, and the regulator internalizes the cost of intervention in any unit being in charge of depositors in both countries. If the regulator intervenes in unit j, unit i can only rely on its own assets. Furthermore, a successful project in unit i not only pays back depositors in country i, but also reduces the regulator's cost in country j by $(R-1)$.[12] Thus, she prefers intervention if the liquidation value L is larger than the expected return $p_i R$.

If p_j is close to zero, intervening in j or not has essentially the same effect on the decision concerning unit i. This decision is different when p_j is sufficiently larger than zero. As units are jointly liable, the regulator can reduce her intervention cost in country i with the residual assets in country j if j is allowed to continue and subsequently successful. The better the prospects on unit j, the higher p_i is needed to avoid intervention in unit i.[13] The reason is the same as for the home regulator's decision in a subsidiary represented MNB. If the regulator intervenes in unit i, she incurs a cost $(1-L)$, and can expect $p_j(R-1)-(1-p_j)$ from unit j . With no intervention, the same payoff from the foreign unit can only be expected if project i fails, with probability $(1-p_i) \leq 1$. This is why when unit j is kept open, unit i is also kept open only if $p_i \geq \varphi_i \equiv \frac{L}{R-2(R-1)p_j}$, where φ_i is increasing in p_j. Hence, if $p_i \geq \varphi_i$ for both units (i.e. $i = h, f$) no intervention takes place at all. For $p_j > L/R$ but $p_i < \varphi_i$ (together with $p_j > p_i$, see the previous note) intervention occurs in unit i while no intervention takes place in unit j.

The following figure describes the regions with associated optimal decisions for all values of success probabilities (p_h, p_f).

[11] Note that the foreign resources the home regulator can seize are "truncated" in case of success of the home project for regulators are cost minimizers in this base model.

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

[13] We are implicitly considering $p_j \geq p_i$, since if $p_j < p_i$ the regulator would never close unit i and leave open unit j.

If prospects for both projects p_h and p_f are very low, the optimal decision is to close the MNB. This happens in (the black) region (I, I). If project f has low probability of success while project h has sufficiently high probability of success, the optimal decision turns out to be (O, I) (the dashed area with vertical lines). Similarly, if project h has low probability of success while project f has sufficiently high probability of success, the optimal decision is (I, O) (the dashed area with horizontal lines). When the projects' prospects are similar and sufficiently good, the regulator may prefer to leave both units open with decision (O, O) (the white area). The regulator's decision process is symmetric with respect to the two projects. Hence, along the 45° degree lines, either the decisions are the same, or, the regulator is indifferent between (I, O) and (O, I).

As units are jointly liable in branch MNBs, new information on a given unit always affects the regulator's costs associated with the decisions over the other unit. Proposition 3 summarizes the information effect on a branch-MNB.

Proposition 3 (Effect of Information with Branch MNB) *Signals improving the prospect of a given project induce the regulator to be softer on that unit but tougher on the other. Similarly, poorer prospects induce the regulator to be tougher on the given unit but softer on the other.*

This result is a direct consequence of boundary φ_i being an increasing function of p_j. The intuition for this result is the same we gave for the behavior of the home regulator in subsidiary represented MNBs. A higher p_j lowers the regulator's expected cost on the other unit for each possible decision. However, the reduction of those costs is higher with intervention than with continuation.

3.3 Comparing Prudential Regulation between Subsidiary and Branch-MNBs

We now compare prudential regulation taking place at $t = 1$ under the two representation forms. As we have discussed, regulatory decisions in branch versus 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 access the assets located in the home country. Thus, she bears the full cost of an intervention in the foreign unit. The home regulator of a subsidiary-MNB, and that in a branch MNB, however, can benefit from the (residual) assets located in the foreign country.

(2) *Regulators' responsibilities towards foreign depositors.* In subsidiary-MNBs national regulators are only responsible for claims in their country, and local depositors are senior for local assets. For branch MNBs, however, the home regulator performs the deposit insurance function in both countries.

These differences lead to the following proposition:

Proposition 4 (Subsidiary and Branch: Comparison of Regulations) *The **home unit** is subject to (weakly) softer regulation with branch than subsidiary representation. The **foreign unit** is subject to (weakly) softer regulation with branch than subsidiary representation if* $p_h \leq \max\{L, 1/2\}$, *and to (weakly) tougher regulation otherwise.*

We first analyze the regulator's decision about unit i when *intervention* occurs in unit j. 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 country j. Thus, the regulator of unit i compares the liquidation value L from intervention in i with the expected cost saving p_i from no intervention. The regulator of a branch-MNB, however, knows that she may be able to reduce the cost arising from the liquidated unit j (i.e. $1-L$) with the assets of unit i (i.e. thus obtaining an additional $p_h(R-1)-(1-p_h)$). Thus, she compares L with p_iR ($> p_i$). Hence, for intervention in a given unit, the regulator in charge for the other unit is softer under branch than subsidiary representation.

Assume now that *no intervention* takes place in the *foreign unit.* We analyze the decision concerning the *home unit.* The home regulator under both representation forms can access foreign residual assets. Differences in decisions uniquely come from the home regulator's responsibility for foreign depositors in a branch MNB. In this case the (expected) cost of *foreign* failure for the regulator is $(1-p_f)$ when she intervenes in the home unit, and $(1-p_f)\left[(1-p_h)+p_h(2-R)\right]$ when she does not. As intervention is more costly than no intervention, the home unit faces softer regulation in branch than in subsidiary represented MNBs.[14] These give us the first statement in Proposition 4.[15]

Turning to the foreign unit, we know that the foreign regulator of a subsidiary cannot expect any assets from the home unit. Consequently, her decision does not depend on the prospects of the home unit p_h. Thus, she simply compares the expected cost saving from no intervention in the foreign unit p_f with its liquidation value L.

The home regulator's behavior towards the branch, however, is shaped by two considerations : the possibility of reducing foreign losses with home assets and the possibility of subsidizing home losses with foreign assets. The first effect pushes the regulator to be tougher, while the second effect to be softer 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 latter, making the home regulator softer on the foreign unit. As p_h increases, the former effect becomes stronger, ultimately making the home regulator tougher on the branch.

Choice of representation form Proposition 4 gives clear indications of an MNB's preference over organizational form. When the home unit is *not sufficiently safe* (i.e. $p_h \leq \max\{L, 1/2\}$), the bank prefers to set up a branch for its foreign operations. The intuition is that the banker has a bias for continuation. Only in this case the MNB might pay profits. Further, he knows that he can expect softer regulation for both units under branch rather than subsidiary representation.

When the home unit is *relatively safe* (i.e. $p_h > \max\{L, 1/2\}$), countervailing forces affect the banker's representation choice. In our model a branch MNB always enjoys more lenient regulation

[14] This can abe 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 $\varphi_h > \delta_h$ for any other value of p_f.

[15] When p_h is sufficiently large, intervention is optimal with any representation. For p_h is sufficiently small, no intervention is preferred. For intermediate values of p_h intervention occurs under subsidiary but not under branch representation. This explains the "weakly" qualifier in the text of the Proposition.

at home. A foreign branch, however, faces a tougher regulation than a foreign subsidiary for a relatively safe home unit. This difference in favour of the subsidiary increases as the home unit gets safer. A simple inspection of Figures 1 and 2 show how safety differences between the two units alter regulatory behavior depending on the representation form: if $p_f \geq p_h$ the home unit faces tougher regulation if the MNB is represented by a subsidiary, while the foreign unit faces the same decision irrespective of the representation form. If $p_f \leq p_h$ the home unit faces the same decision for both forms while the branch is subject to tougher regulation than a subsidiary. Branch representation is, therefore, preferred when the foreign project is safer than the home project while subsidiary representation is preferred when the home project is safer.

Corollary 1 (Bank's Choice of Representation) *If the home project is not sufficiently safe (i.e. $p_h \leq \max\{L, 1/2\}$) the banker prefers branch representation. If, however, the home project is sufficiently safe, and safer than the foreign one (i.e. $p_f \leq p_h$), the banker prefers subsidiary representation. She prefers branch representation otherwise.*

A "single passport" scheme exists in Europe (EEC, 1989), which attempts to limit protective barriers to entry by allowing any home EU bank to establish branches elsewhere in the EU. Notwithstanding this legislation, many banks have preferred expansion via subsidiaries within the EU (Dermine, 2002). Similarly, subsidiaries of EU and US banks dominate in both Latin America and Eastern Europe, where banks have a free choice between branch and subsidiary structure. Clearly, our stylized model fails to consider other important factors in banks' representation choice (see Ursacki and Vertinsky 1992 and Blandon 1999). However, it still provides an explanation for such behavior if we assume that banks originating from the EU and the US hold a quite safe portfolio of projects at home and that projects available in Latin America and Eastern Europe on average are less safe. Further, branches are more common within Asia. There is also evidence suggesting that Asian banks prefer branches for expansion outside Asia.[16] This follows our prediction that branches are more common when the home investment is not sufficiently safe.

Project selection In the base model the bank is active at $t = 0$ in both countries because the information available at the investment stage optimally induces this scenario. It immediately follows that if a bank prefers to be active in both countries (thus being a MNB), then independent of the representation form, it undertakes safer projects (i.e. projects with higher probability of success) than a national bank, being active in only one of the two countries. The shared liability between a MNB's units reduces the intervention cost for the regulator. This leads to tougher behavior than that would be implied by limited liability between units. Hence, the bank chooses to be a MNB uniquely if the probabilities of success in both projects are high enough.[17] Extending this argument we see that with subsidiary representation the foreign unit undertakes safer projects than the home one (with branch-MNB decisions being symmetric). Moreover, comparing the two

[16] Japanese banks, for example, seemingly preferred branches in their expansion into the US and the EU. See the BIS Report (2001) on the activities of multinational banks in emerging markets.

[17] This holds true *a fortiori* if the bank owned funds to run risky projects.

representation forms, subsidiary representation implies safer home projects but less safe foreign projects than branch representation.

4 Regulation with bank's lobbying

Each regulator i may also care about the MNB's profit, attributing a weight α_i to the total MNB's profit. This can occur for several reasons. The weight α_i may relate to profits paid by the bank to local citizens and to their (partial) ownership of the bank. 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).[18] Finally, a MNB's earnings may be relevant when the local banking sector is financially unstable.

Clearly, with *branch representation*, a larger weight on the MNB's profits unambiguously induces the home regulator to be softer towards both units. When the home regulator is more concerned about the MNB's profits, the areas with corresponding decisions (I, I), (O, I) and (I, O) shrink, while area (O, O) enlarges.

With *subsidiary representation*, when the foreign regulator cares about the MNB's profits, her decision is affected by the home regulator's decision. Intervention in any of the MNB units results in no profit. Thus, no intervention at home induces the foreign regulator to be softer (i.e. intervene for a smaller set of parameters); a strategy that enables him to benefit from the MNB's profit. The home regulator, though, behaves tougher when the foreign regulator is softer (i.e. she does not intervene in the foreign unit), as long as she cares more about closure costs than the MNB's profits (i.e. $\alpha_h < 1$).

Thus, with a subsidiary-MNB and profit weights $\alpha_h < 1$ and $\alpha_f > 0$, the regulators' decisions cyclically affect each other. Assume, for example, that the home regulator prefers to intervene in the home unit. This induces the foreign regulator to intervene in the foreign unit, which, in turn, may make the home regulator change her decision to non-intervention. The cyclical pattern means that a pure strategy equilibrium for intermediate values of p_h and p_f cannot exist.

If, however, the profit weight are such that $\alpha_h > 1$ and $\alpha_f > 0$, then each regulator's decision reinforces the same decision by the other regulator. This implies that the no-pure strategy equilibria region vanishes, and a region with multiple equilibria appears where both regulators decide to intervene or not for the same set of parameters. The determining factor is the 'other' regulator's decision.[19]

The following Proposition summarizes how profit weights affect regulators' strategies.

Proposition 5 (Effect of Profits on Regulation) *(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*

[18] Grossman and Helpman (1994), Feenstra and Lewis (1991) and Calzolari (2004) use this interpretation for regulators' profit weighting in social welfare functions. Here we do not consider the possibility that regulators assign different weights to profits earned in different countries.

[19] These effects leading to either a multiple-equilibria region or a region with no pure strategies for intermediate values of p_h and p_f. Otherwise, both regulators would either prefer to intervene or not to intervene at all, independent of their counterpart's decision.

the home regulator to be tougher and the foreign regulator to be softer. If $\alpha_h \geq 1$, a larger α_f induces softer regulatory decisions for both representation forms.

As one would expect, any regulator is softer when she values the bank's profits more. Less obvious, however, is how this softer behavior may affect the other regulator under subsidiary representation. A lager α_f increases the no-pure-strategy region by reducing the (O, I) region. This means that a decision to keep the home unit open may reverse as is the case when $\alpha_h < 1$.

As for the comparison of regulation between branches and subsidiaries, consider the case where the foreign regulator only cares about her intervention costs (i.e. $\alpha_f = 0$). A sufficiently large α_h may induce the home regulator to be softer than the foreign one, inverting Proposition 1. Further, as long as $\alpha_f = 0$, profit weighting by the home regulator does not qualitatively affect Proposition 4. This is no longer the case when the foreign regulator also cares for the MNB's profit (i.e. $\alpha_f > 0$), the reason being the no-pure-strategy equilibria region which makes comparisons ambiguous.

This additional concern for profits may also affect our results with regard to information. Propositions 2 can no longer be stated as such due to multiple equilibria and the no-pure strategies equilibria. However, one can look at how a given decision by one regulator affects the other. Similar to the base model we find that (i) favorable information on a given unit makes the regulator in charge softer towards the unit; (ii) as long as $\alpha_h < 1$ (both in branch and subsidiary forms), the home regulator responds with tougher behavior to better news from the foreign unit. This result flips in case she puts a larger weight on the profit than the closure costs.

5 International fund shifting and regulation

We now modify our base model. Let bank managers have an active role and interests aligned with shareholders. We look at the MNBs' ability to shift internal resources across countries and assume this can happen in the absence of any regulatory intervention. More precisely, at $t = 1.5$ the manager privately learns whether a project is good or bad. A good project yields intermediate returns r at $t = 1.5$, along with final returns R at $t = 2$. A bad project can be refinanced at $t = 1.5$, so that it pays final returns R at $t = 2$ with probability $q < p_i$, and zero returns if it is not refinanced.[20] 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 independent of the project type.

While internal resource shifting may be optimal for shareholders, it may be socially inefficient. Our analysis becomes interesting exactly when this is the case so that we will assume $qR - r < L$. As in the base model we continue to assume both that projects have a positive NPV (i.e. $p(r + R) + (1 - p)L > 1$ with $R > 1$) and that depositors cannot be reimbursed in both countries if at least one project is liquidated (i.e. $r + R + L < 2$).

[20] Unsuccessful projects here have a "second" chance which is conditional on internal resource shifting. Note that although returns are not intrinsically correlated, interdependence is introduced by the behavior of bank manager's behavior.

We further assume that regulators do not observe intermediate returns, thus they face the same information problem as in the base model, and the ring-fencing pursued with intervention at $t = 1$ prevents 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' behavior under the two organizational forms.

Lemma 1 (MNB Decision on Refinancing Bad Projects) *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*

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

With a branch-MNB, liquidating a bad project would not yield sufficient funds to repay all depositors even if the other project is good. Since units are jointly liable under branch representation, the entire MNB will fail and shareholders get zero payoff. Instead, if the banker gambles, the bank might rebound and its shareholders receive a positive payoff. Thus, it is always optimal for the manager to gamble.[21] In subsidiary MNBs 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 foreign failure is to gamble as well. Since, the home unit is shielded from foreign losses, the banker will refinance a bad foreign project only if the expected net return $q(R-1)$ exceeds the injected resources r.

How does inefficient resource shifting impact regulation? In what follows we assume that condition (1) is satisfied so that bad projects are always refinanced, regardless of the representation form and project location. This avoids differences in regulations that are driven by banker's behavior.

Let us consider first subsidiary MNBs. The foreign regulator becomes softer when no intervention occurs in the home unit and she has no longer a dominant decision. Indeed, no intervention at home enables the bank to shift resources from a successful home unit to refinance an unsuccessful foreign unit, so that the foreign regulator might not incur any cost.

The bank manager's gambling has an ambiguous effect on the home regulator. She does not have to incur any cost if the gamble pays out. However, gambling reduces the available residual assets from the other unit by r. Recall that in the base model a larger p_f induces the home regulator to be tougher. This means that a larger p_h is required to offset the effect of a larger p_f (i.e. boundary δ_h is increasing). This is also the case when q and r are small.

If r is large, then a good project has procured more intermediate resources which can be lost through shifting/gambling. A larger p_f then more strongly affects the home regulator's payoff from intervention. Thus, we have that a larger r makes δ_h more positively related to p_h (i.e. larger p_h is required to offset increases in p_f). On the contrary, a larger probability of success q means that a refinanced bad home project succeeds with a greater probability. Hence, the payoff of decision O for the home unit is increased by a larger q so that function δ_h becomes less positively related to p_h, possibly even becoming a negative function of it.[22] In this latter case, good news on the foreign

[21] Since the branch organization pools assets and liabilities of the two units, the banker treats a bad project the same, independent of its location.

[22] In the Appendix we show that δ_h is decreasing in p_h if $L(R-1) + r \leq q(2-R)(1-L)$.

project tend to make the home regulator softer with the home unit. In fact, for intermediate values of p_h and p_f, softer foreign regulation results in softer home regulation and vice versa. A region of multiple equilibria again appears with decisions (I, I) and (O, O).

When q is small and r is large, δ_h becomes an increasing function of p_h (i.e. $L(R-1) > q(2-R)(1-L) - r$) and softer foreign regulation leads to tougher home regulation. However, softer home regulation results in softer foreign regulation (the foreign regulator benefits from the home unit if she lets the MNB gamble). Hence, similar to Section 4, the model generates the possibility of no-pure strategy equilibria for intermediate values of p_h and p_f.

With a branch-MNB, the home regulator faces a similar trade-off to that of the home regulator in subsidiary MNBs. However, due to her deposit insurer function in both countries she is more likely to benefit from gambling than the home regulator of a subsidiary MNB, i.e. φ_i $(i = f, h)$ becomes a decreasing function of p_j for a larger set of parameters.

Proposition 6 (Effect of International Funds Shifting on Regulation) *(i) A larger q and a smaller r induce softer home regulation under both representation forms and softer regulation of the foreign branch. (ii) The foreign subsidiary receives softer regulation when q is large and the home unit is kept open.*

We can conclude that regulation of the home unit remains softer in branch than in subsidiary MNBs. The softer behavior in branch MNBs comes from responsibility to depositors in both countries. The foreign unit, however, differs with respect to the base model in that the foreign regulator's optimal decision is now a function of the home regulator's decision. Regulation of the foreign unit may differ among representation forms according to the net gain from gambling, and the different responsibility towards depositors located in the other country. When the home unit is open, regulation of the foreign unit is tougher under branch than under subsidiary representation. Thus, our base model result carries over. This follows from the different access capability to home assets in the absence of gambling for the home regulator (in branches) and for the foreign regulator (in subsidiaries). When the home unit is open under branch but not under subsidiary MNBs, for large q and small r, intervention is less likely in the foreign unit under branches, as the home regulator in branch MNBs is likely to benefit from the bank's resource shifting.

6 Information acquisition

In this final section we investigate regulators' incentives to acquire information on the units' prospects. We do this by adding an information acquisition stage to the base model. More precisely, before deciding whether to intervene in $t = 1$, each regulator can pay a cost c to obtain a signal and update the prospects on the unit she regulates.[23] We assume that signals are perfectly informative so that once information has been acquired on project i, then either $p_i = 1$ or $p_i = 0$. Finally, at the intervention stage $t = 1$, all available information is truthfully shared by the regulators.

[23] For the sake of simplicity, a regulator has not the authority to investigate a unit for which she is not responsible. Equivalently, the cost of such information is excessively large.

This is clearly a strong simplification of the regulators' complex monitoring task. Acquiring information on a foreign branch can be extremely difficult and signals may be far from perfect. Furthermore, since regulators' interests most likely differ, they may try to conceal relevant information. Nevertheless, we believe our simplified information game can shed some light on regulators' monitoring incentives. In fact, the advantage that national authorities have in acquiring information on local activities is partially captured by costs that are differentiated by location of the investigated unit and the investigating regulator. Further, credibility is invaluable for bank regulators, drastically limiting their willingness to conceal or misrepresent information. Regulators, in fact, are more likely to strategically delay acquiring local information, in case this affects other regulators' behavior in a desirable manner. We believe that delays in information acquisition is crucial in drawing a balance between centralized and decentralized MNB supervision.

We define the *value of information* on a given unit as the difference between the regulator's expected payoff with and without the information. We can then prove the following result:

Proposition 7 (MNB Representation and Information Acquisition) *(i) Under subsidiary representation, the value of information is larger for the foreign regulator than for the home regulator. The former has more incentives to monitor.*

(ii) Information is more valuable when the MNB is branch rather than subsidiary represented.

Results from Proposition 7 are presented in Figure 3. This Figure describes different monitoring decisions for different values of the ex-ante success probability p of the projects and the cost of information acquisition c. The bold lines represent the value of information with subsidiary representation and, together with c, identify regions associated with different monitoring decisions. Thin lines (partially overlapping the bold lines) identify those regions of branch representation. Note that, information is most valuable for intermediate values of p.[24] Moreover, for low values of p, the optimal decision is to intervene. The value of information here is therefore increasing in p both for subsidiary and branch representation. In fact, the role of information acquisition here is to save intervention costs when the investigated project turns out to be successful (i.e. a "type-1" error is avoided). Clearly, these gains are larger the larger is p. However, when p is high, such that the decision at $t = 1$ is not to intervene, valuable information may reveal that the project is unsuccessful (thus avoiding a "type-2" error). In this case, the value of information is increasing in $(1 - p)$ and decreasing in p.

Consider first subsidiary representation. Recall that the foreign regulator at $t = 1$ has a dominant strategy (intervene if and only if $p_f \leq L$) and that her decision is unaffected by the information available on the home subsidiary. If she monitors, she can save $p(1 - L)$ for $p \leq L$ (discovering a successful project she thought would fail) and $L(1 - p)$ for $p > L$ (discovering a

[24] Indeed, if the prior p is either very small or very large, both regulators know that the information obtained with monitoring is easily predictable.

failing project she thought would succeed). Moreover, the home regulator anticipates at $t = 0$ that her foreign counterpart's decision at $t = 1$ will not depend on the information available to date on the home project. Hence, the decision whether or not to monitor the home subsidiary at $t = 0$ is not affected by any influence over the foreign regulator's decision at $t = 1$. This implies that none of the regulators engages in strategic monitoring.

A second important feature in monitoring subsidiary-MNBs is that the home regulator perceives foreign monitoring as a *substitute* for home monitoring. Indeed, the value of information for the home regulator is smaller when the foreign regulator monitors her unit. To understand this, assume that $p \leq L$ so that each regulator intervenes at $t = 1$. The value of information for home regulator is clearly $p(1 - L)$ if the foreign regulator does not monitor. If the foreign regulator does monitor, however, the home regulator knows that she can seize residual assets if the foreign project is found to be good, and kept open. In this case, the value of information to the home regulator is $(1 - p)\left[-1 + L + p(R - 1)\right] - \left[-1 + L + p(R - 1)\right]$. Hence, expected foreign residual assets are ex-ante more valuable to a home regulator who does not monitor. If she does monitor she can obtain these assets only if she discovers that the home unit will fail, so that ex-ante the assets value $(1 - p)p(R - 1)$ instead of $p(R - 1)$ with no monitoring. Hence, the value of information turns out to be $p(1 - L) - p^2(R - 1)$, smaller than the value when the foreign regulator does not monitor. This reasoning extends to when $p > L$, and clearly relates to the information effect discussed in Section 2. Monitoring has a similar effect to discovering that the home project is safer, implying that the home regulator can expect less resources from abroad.[25]

This reasoning does not apply to the monitoring incentives of the foreign regulator, as she cannot seize any residual assets from the home unit and her incentives to monitor are unaffected by home monitoring activity. Moreover, the ability to seize residual assets from the foreign unit reduces the value of information for the home regulator. This holds true for any foreign monitoring decision (our previous discussion shows that this effect is stronger when the foreign regulator does rather than does not monitor). This clearly implies not only that foreign monitoring substitutes for home monitoring, but also that the foreign regulator has stronger incentives to monitor than the home counterpart (she is unable to recover residual assets from the home unit), as stated in result (i) of Proposition 7.

Monitoring certain units can also act as a substitute for monitoring others also in branch-MNBs. Hence, with this representation form as well there are parameters configurations such that the (home) regulator prefers to monitor only one of the two units (see in Figure 3 regions defined by thin lines).

Part (ii) of Proposition 7 compares monitoring between the two representation forms. Figure 3 shows that either monitoring activities coincide with branch and subsidiary representation or a branch-MNB is subject to more intense monitoring. When comparing the two representation

[25] The complete argument is complicated by the effect foreign monitoring has on home regulator's decision at $t = 1$. Clearly, when the home regulator monitors, her decision at $t = 1$ is unaffected by the information available on the foreign unit. When she does not monitor, her decision at $t = 1$ depends on p_f, as we have discussed in Proposition 2. However, we know that discovering a high (low) p_f induces tougher (softer) home regulation and this reinforces the substitutability effect of foreign monitoring on home monitoring.

forms we have several *countervailing effects* occurring. Consider first a case where, for the same level of information, the decisions at $t = 1$ coincide for the two representation forms. We can identify two effects. First, the larger are (residual) assets a regulator may expect from other units, the smaller is the value of information (a shared liability effect). Clearly, this effect is stronger under branch representation than subsidiary. Second, with branch representation the regulator in charge centralizes the monitoring decisions and internalizes all possible gains from monitoring, thus increasing its value (an internalization effect). Result (ii) states that the second effect always prevails over the first one. To see this, consider again the case with a low value of p, i.e. $p \leq L/R$. For this case, independent of representation, the regulator in charge intervenes on a given unit at $t = 1$, unless she monitors at $t = 0$. For the home regulator of a branch-MNB, the value of information on a given unit is $p(R - L)$ when she decides not to monitor the other unit. Indeed, this is what she can save by monitoring and then deciding not to intervene on that unit when she realizes that its project is successful. With subsidiary-MNB, the value of information for both regulators when the counterpart does not monitor is $p(1 - L)$ $(\leq p(R - L))$.[26] Now, consider a case where the foreign unit is kept open. In branch-MNBs, the value of information on the home unit is now $p(R - L) - 2p^2(R - 1)$. For subsidiary-MNB it is now $p(1 - L) - p^2(R - 1)$ and we have two countervailing effects at play. With branch representation, the negative effect of shared liability on the value of information (second term in the two above expressions) is larger, as well as the positive internalization effect (first term in the two expressions). The latter systematically outweighs the former effect as Proposition 7 states. We have applied this reasoning assuming that, for the same level of information, regulators' decisions at $t = 1$ coincide for the two representations. However, as emphasized in Proposition 4, decisions need not coincide with the two representation forms for the same level of information. This introduces an additional effect that complicates the analysis, which, as proven in the appendix, reinforces the higher value of information with branch rather than with subsidiary representation.[27]

7 Conclusions

In this paper we analyze regulation of a multinational bank with a very simple and stylized model. However, our setting turns out to be versatile enough to deal with several important issues of MNBs regulation.

We show that different organizational or representation 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 induced by a particular representation form play a crucial role in explaining these differences. We find that the information available on a

[26] Here only the second effect is at play as there are no residual assets expected from the other unit.

[27] With a branch-MNB there is complementarity in monitoring if $\alpha_h \geq 1$. In general, with the extensions of the base model discussed in Sections 4 and 5, the monitoring analysis becomes cumbersome. Interestingly, we have verified that more monitoring may take place with subsidiary than with branch thus reversing result (ii) in the Proposition. In this case, an additional effect is the possibility regulators strategically decide to monitor (or not to monitor) to affect the other regulator's decision at $t = 1$.

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. With these indications concerning regulatory attitude towards the two representation forms, our model also provides some indications about the banker's preferences over the representation form.

In our base model regulators minimize intervention cost, arising from their deposit insurance function. We extend this setting, 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 or international resource shifting. We find a rich sets of results in a subsidiary setup, where depending on the profit weights (and on the desirability of gambling from the regulator's point of view) regulators' decision may either reinforce or cyclically affect each other.

Finally, we study regulators' monitoring activity and show that with subsidiary representation the foreign regulator has more incentives to monitor than the home regulator and incentives to monitor are maximal with a branch in comparison with a subsidiary MNB.

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. Understanding the way MNBs act and the regulatory responses is a first step for a more ambitious normative analysis on the socially optimal organization and regulation of MNBs. This is left for future research.

References

[1] Acharya, V., 2003, "Is the International Convergence of Capital Adequacy Regulation Desirable?", Journal of Finance, 58(6), 2745-2781.

[2] Bain, E., J. Fung and I. Harper, 2003, "Multinational Banking: Historical, Empirical and Case Perspectives", In *Handbook of International Banking*. A.W. Mullineux and V. Murinde (eds.). UK and USA: Edward Elgar

[3] Blandon, J. G., 1999, "The choice of the form of representation in multinational banking: evidence from Spain", Working paper University Pompeu Fabra, n. 271.

[4] Buch C. M. and S.M. Golder, 2001, "Foreign versus domestic banks in Germany and the US: a tale of two markets?", *Journal of Multinational Financial Management*, 11: 341-361.

[5] BIS Papers, 2001, "The banking industry in the emerging market economies: competition, consolidation and systemic stability", No.4.

[6] Calzolari, G., 2001, "Theory and practice of regulation facing multinational enterprises", *Journal of Regulatory Economics*, 20 (2):191-211.

[7] Calzolari, G., 2004, "Incentive Regulation of Multinational Enterprises", forthcoming in *International Economic Review*.

[8] Calzolari G. and G. Loranth, 2001, 5. "On the Regulation of Multinational Banks", *Rivista di Politica Economica*, 4: 275-304, reprinted in *Antitrust, Regulation and Competition: Theory and Practice*, L. Lambertini Ed., Palgrave Macmillan, 2003.

[9] Dalen, D.M. and T. Olsen, 2003, "Strategic regulation of a multi-national banking industry", mimeo, Norwegian School of Economics and Business Administration.

[10] Dell'Ariccia, G. and R. Marquez, 2001,"Competition among Regulators and Credit Market Integration", mimeo, R.H. Smith School of Business.

[11] Dewatripont, M. and J. Tirole, 1994, "A theory of Debt and Equity: Diversity of Securities and Manager-Shareholder Congruence", *Quarterly Journal of Economics*, 109(4), p. 1027-1054.

[12] European Central Bank, 1999, Possible effects of EMU on the EU banking systems in the medium to long term, available at http://www.ecb.int/pub/pdf/emubnk.pdf

[13] Federal Reserve Board, 2002, Structure and share data for U.S. offices of foreign banks, available at http://www.federalreserve.gov/releases/iba/

[14] Feenstra, R. and T. Lewis, "Negotiated trade restrictions with private political pressure", *Quarterly Journal of Economics* 56 (1991), 1287-1307.

[15] Grossman, G. and E. Helpman, "Protection for sale", *American Economic Review* 84 (1994), 883-850.

[16] Harr T. and T. Rønde, 2004, "Branch or Subsidiary? Capital Regulation of Multinational Banks", mimeo, University of Copenhagen

[17] Holthausen C. and T. Rønde, 2002, "Cooperation in international banking supervision: a political economy approach", mimeo, University of Copenhagen.

[18] Houpt, J.V., 1999, "International activities of U.S. banks and in U.S. banking markets", *Federal Reserve Bulletin*, September: 599-615

[19] Institute of International Bankers, 2001, Global Survey 2001, available at http://www.iib.org/global/2001/GS2001.pdf

[20] International Monetary Found, 2000, World Economic and Financial Surveys, International Capital Markets: developments, prospects, and key policy issues, available at http://www.imf.org/external/pubs/ft/icm/2000/01/eng/

[21] Kahn, C. and A. Winton, 2003, "Moral Hazard and Optimal Subsidiary Structure for Financial Institutions", WP. No.0307, Carlsson School of Management, University of Minnesota.

[22] Mailath and M. Mester, 1994, "A Positive Analysis of Bank Closure," *Journal of Financial Intermediation*, 3: 272-299.

[23] Repullo, R., 2000,"Who should Act as Lender of Last Resort? An Incomplete Contracts Model", *Journal of Money, Credit and Banking,* 32:580-605.

[24] Repullo, R., 2001, "A model of takeovers of foreign banks", *Spanish Economic Review*, 3:1-21.

[25] Ursacki, T. and I. Vertinsky, 1992, Choice of entry timing and scale of foreign banks in Japan and Korea, *Journal of Banking and Finance*, 16: 405-421.

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 Proposition 1. For this proof we first need an intermediate Lemma. ■

Lemma 2 *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 $\delta_h \equiv \frac{L}{1-p_f(R-1)}$.

Proof of Lemma 2. 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. This concludes the proof of the Lemma.

We can now go back to the statement of the Proposition. 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 Proposition 2. First note that δ_h is an increasing function of p_f. On the contrary, all the other boundaries defining the regions with different decisions in Lemma 2 do not depend on p_h nor on p_f. Hence, the proof can be obtained 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 adapted to signals that affect the probability of success of any project. ■

Proof of Proposition 3.
For this proof we first need an intermediate Lemma. ■

Lemma 3 *The optimal decisions are described by the following non empty regions in the probabilities space* $(p_h, p_f) \in [0,1]^2$,

$$(I, I) \equiv \left\{\tfrac{L}{R} \geq p_i, i = h, f\right\} \qquad (O, O) \equiv \{p_i > \varphi_i, i = h, f\}$$
$$(O, I) \equiv \left\{p_h > \max\left\{\tfrac{L}{R}, p_f\right\}, \varphi_f \geq p_f\right\} \qquad (I, O) \equiv \left\{p_f > \max\left\{\tfrac{L}{R}, p_h\right\}, \varphi_h \geq p_h\right\}$$

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

Proof of Lemma 3. 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). This concludes the proof of the Lemma.

We can now go back to the statement of the Proposition. The proof is based on the analysis of the boundaries defining the optimal decision which are presented in Lemma 3. 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 $d^i = O$ to $d^i = I$. ■

Proof of Proposition 4. 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 $p_h = c_-$ (Proof of Lemma 3) which is smaller than L iff $L < 1/2$. Furthermore, $\varphi_f = L$ for $p_h = 1/2$, 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 $p_f \in [L, \varphi_f]$. 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 $p_f \in [\min\{\varphi_f, p_h\}, L]$ for any $p_h \in [L/R, L]$, and if $p_f \in [L/R, L]$ for any $p_h < L/R$.

Case $L > 1/2$. Note that $L > 1/2$ implies 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 $p_h \in [L/R, L]$, decisions 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 subsidiary-MNB if $p_f \in [L, \min\{\varphi_f, p_h\}]$. 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 Proposition 5.

(i) Consider first **subsidiary representation**. 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 $\delta_h = \frac{L}{1-(R-1)[p_f(1-\alpha_h)-\alpha_h]}$ 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 $\delta'_f = L$.

This shows that 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

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

such that there are no pure strategy equilibria. Moreover, if $\alpha_h > 1$ then $\delta'_h > \delta_h$ and δ_h is decreasing in p_f. Hence, there exists a non empty region

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

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

Now, if $\alpha_f = 0$, the no-pure-strategies-equilibria area is empty. In this case a larger α_h reduces both δ_h and δ'_h so that the result applies: if decisions are affected, they are turned either from (I, O)

into (O,O) or from (I,I) into (O,I). 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 in the no-pure-strategies area we have $p_h \geq \frac{L}{1+(R-1)\alpha_h}$ which implies that $Rp_h \geq L$ because $\frac{L}{1+(R-1)\alpha_h} \geq \frac{L}{R}$. Hence, in this case the reasoning discussed for $\alpha_f = 0$ applies and, in addition, a larger α_h (weakly) increases the probability that in the mixed strategy equilibrium an open decision is taken by a given regulator. Finally, with $\alpha_h \geq 1$ a larger α_h increases the multiple equilibria region and this obtains by reducing the region with a decision (I,I).

Consider now **branch representation**. Studying the effect of α_h on the boundaries defining the regions associated with different decisions simply 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) are transformed into (O,O). ■

Proof of Lemma 1. The proof is trivial and omitted. ■

Proof of Proposition 6. Consider first a subsidiary-MNB. Let δ_i and δ'_i be the boundaries as in the proof of Proposition 5, 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, $\delta_f \leq \delta'_f$ and $\delta_h \geq \delta'_h$ if $r \geq q(2-R)(1-L) - L(R-1)$, whilst $\delta_h \leq \delta'_h$ 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 if $r < q\,(2-R)\,(1-L) - L\,(R-1)$ there exists a non empty region

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

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

Now consider the home subsidiary. We have that δ_h is decreasing in q and increasing in r (whilst δ'_h is independent of the two). Hence, a larger q and a smaller r may transform equilibrium decisions (I, O), or a mixed strategy equilibrium, or multiple equilibria (I, I) and (O, O), into the unique pure strategy equilibrium (O, O) thus making regulation of the home unit softer.

Consider now the foreign subsidiary. As we have stated $\delta_f \leq \delta'_f$, so that when the home unit is kept open, the foreign regulator is softer with the foreign subsidiary than when the home unit is intervened. Furthermore, r affects neither δ_f nor δ'_f. Finally, δ_f is a decreasing function of q (and δ'_f is independent of it), thus proving that a larger q induces softer foreign regulation.

We are now left with branch-MNB. The boundary functions are in this case,

$$\varphi_i \equiv \frac{L + p_j\,[r - q(2-R)]}{R - 2p_j\,(R-1) + q(2-R)(1-2p_j)}$$

for $i, j = h, g$ and $i \neq j$. We then have that φ_i is increasing in r and decreasing in q and it is increasing in p_j if and only if

$$(r - q(2-R))(q(2-R) + R) + L2(q + (R-1)(1-q)) \geq 0. \tag{2}$$

We then have that if $r \geq q\,(2-R)\,(1-L) - L\,(R-1)$ is satisfied so that δ_h is increasing in p_f, then (2) is satisfied also so that φ_i is increasing in p_j. On the contrary, the reverse is not true. ■

Proof of Proposition 7. To prove the results we need to identify, for any pattern of decisions that is admissible when no information is available (i.e. $p_h = p_f = p$, along the 45° lines in Figures 1 and 2), all the cases that induce different decisions when information is acquired at least on one unit.

Consider first **subsidiary representation**. First, for the foreign regulator we can identify only two cases delimited by $p \in [0, L]$ and $p \in (L, 1]$. In the first region the value of the information is $p(1-L)$ and in the second region it is $L(1-p)$. As for the home regulator, on the contrary, we identify three regions: $p \in [0, L]$, $p \in (L, L/(2-R)]$ and $p \in (L/(2-R), 1]$ where the value of information respectively is $p(1-L) - p^2(R-1)$, $L - 2pL + p^2(2-R)$ and $L(1-p)$. Moreover, being $p(1-L) \geq p(1-L) - p^2(R-1)$ and $L(1-p) \geq L - 2pL + p^2(2-R)$ in the relevant regions, we have that either monitoring decisions coincide or the foreign regulator monitors and the home regulator does not monitor.

Consider now **branch-representation**. The reasoning is similar as with subsidiary except for the fact that now we have four relevant regions $p \in [0, L/]$, $p \in (L/R, c_-]$, $p \in (c_-, L/(2-R)]$ and $p \in (L/(2-R), 1]$ where c_- is calculated in the proof of Lemma 3. The value of information on one unit in the four regions is respectively as follows: $p[R - L - 2p(R-1)$, $L(1-2p) - p^2(R-2)$ in both

the second and third region and $L(1-p)$ in the fourth region. Similarly, the value of information acquired for both units at the same time is $p(R-L)$, $(1-p)pR$, $L-p^2(2-R)$ and $L(1-p)$. This allows to draw Figure 3 for the branch case.

Finally, the comparison of monitoring under the two representation forms simply comes from comparing, in all the above regions, the value of information for one unit in the branch representation with the value of information of the home regulator with subsidiary representation and, similarly, the value of two pieces of informations in the branch case with the value of information for the home regulator in the subsidiary case. ■

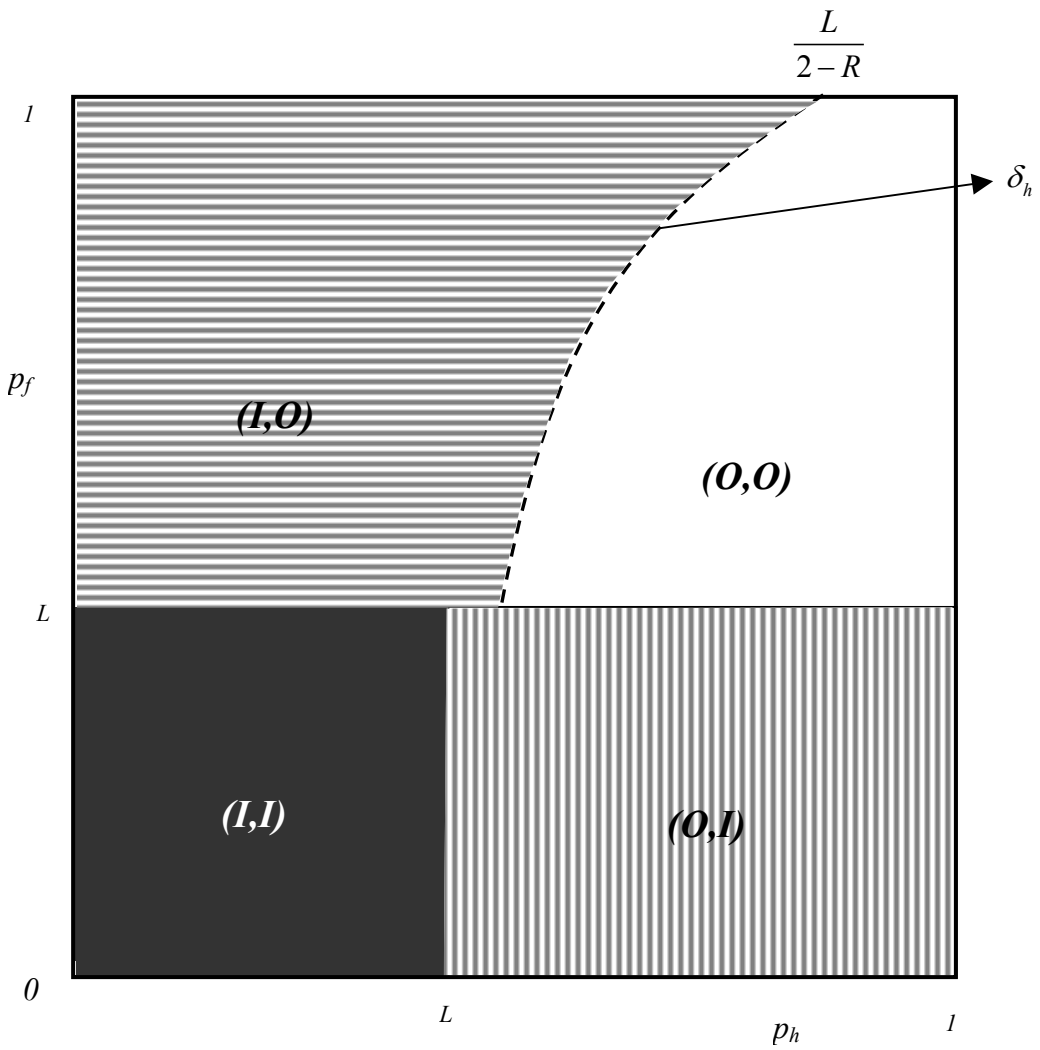

Figure 1: Regulators' decisions with subsidiary-MNB

(decisions of the form *(home decision, foreign decision)*, where *I*=intervention, *O*=no intervention)

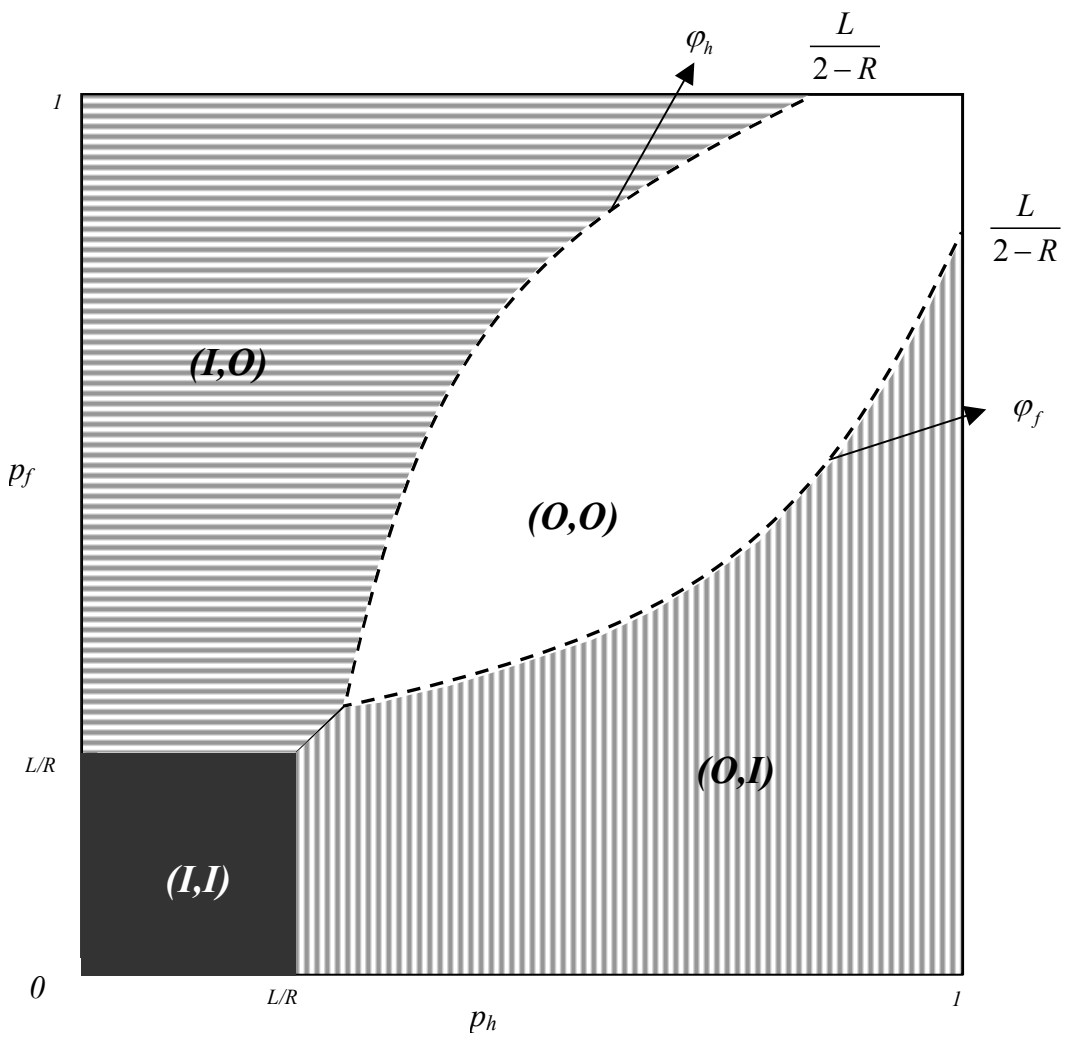

Figure 2: Regulator's decisions with branch-MNB

(decisions of the form *(home decision, foreign decision)*, where *I*=intervention, *O*=no intervention)

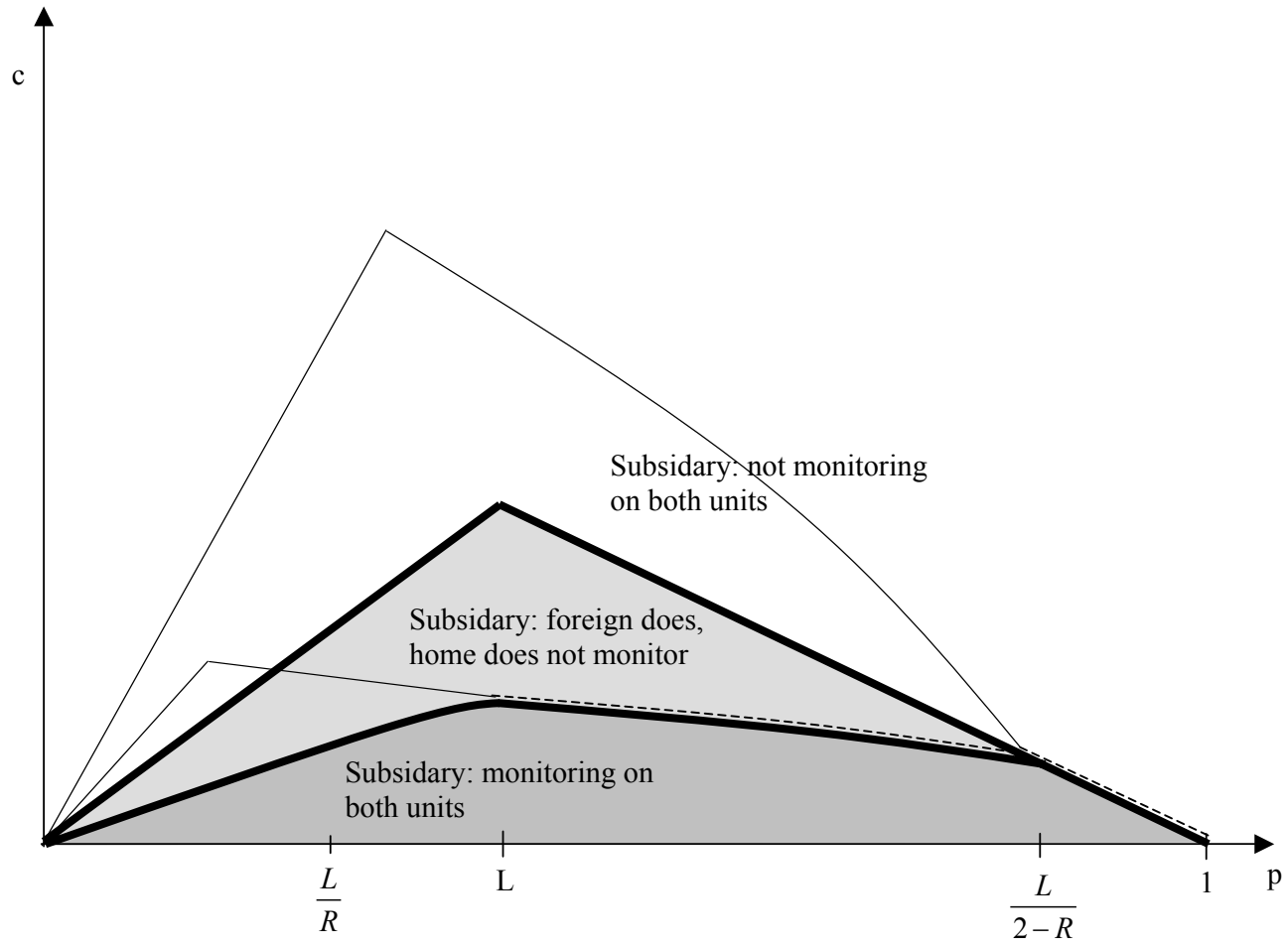

Figure 3: Monitoring activity, branch v/s subsidiary

(bold lines for subsidiary-, thin lines for branch- MNB)

European Central Bank working paper series

For a complete list of Working Papers published by the ECB, please visit the ECB's website (http://www.ecb.int)

395 "Fiscal sustainability and public debt in an endogenous growth model" by J. Fernández-Huertas Moraga and J.-P. Vidal, October 2004.

396 "The short-term impact of government budgets on prices: evidence from macroeconomic models" by J. Henry, P. Hernández de Cos and S. Momigliano, October 2004.

397 "Determinants of euro term structure of credit spreads" by A. Van Landschoot, October 2004.

398 "Mergers and acquisitions and bank performance in Europe: the role of strategic similarities" by Y. Altunbas and D. Marqués Ibáñez, October 2004.

399 "Sporadic manipulation in money markets with central bank standing facilities" by C. Ewerhart, N. Cassola, S. Ejerskov and N. Valla, October 2004.

400 "Cross-country differences in monetary policy transmission" by R.-P. Berben, A. Locarno, J. Morgan and J. Valles, October 2004.

401 "Foreign direct investment and international business cycle comovement" by W. J. Jansen and A. C. J. Stokman, October 2004.

402 "Forecasting euro area inflation using dynamic factor measures of underlying inflation" by G. Camba-Méndez and G. Kapetanios, November 2004.

403 "Financial market integration and loan competition: when is entry deregulation socially beneficial?" by L. Kaas, November 2004.

404 "An analysis of systemic risk in alternative securities settlement architectures" by G. Iori, November 2004.

405 "A joint econometric model of macroeconomic and term structure dynamics" by P. Hördahl, O. Tristani and D. Vestin, November 2004.

406 "Labour market reform and the sustainability of exchange rate pegs" by O. Castrén, T. Takalo and G. Wood, November 2004.

407 "Banking consolidation and small business lending" by E. Takáts, November 2004.

408 "The great inflation, limited asset markets participation and aggregate demand: FED policy was better than you think" by F. O. Bilbiie, November 2004.

409 "Currency mismatch, uncertainty and debt maturity structure" by M. Bussière, M. Fratzscher and W. Koeniger, November 2004.

410 "Do options-implied RND functions on G3 currencies move around the times of interventions on the JPY/USD exchange rate? by O. Castrén, November 2004.

411 "Fiscal discipline and the cost of public debt service: some estimates for OECD countries" by S. Ardagna, F. Caselli and T. Lane, November 2004.

412 "The real effects of money growth in dynamic general equilibrium" by L. Graham and D. J. Snower, November 2004.

413 "An empirical analysis of price setting behaviour in the Netherlands in the period 1998-2003 using micro data" by N. Jonker, C. Folkertsma and H. Blijenberg, November 2004.

414 "Inflation persistence in the European Union, the euro area, and the United States" by G. Gadzinski and F. Orlandi, November 2004.

415 "How persistent is disaggregate inflation? An analysis across EU15 countries and HICP sub-indices" by P. Lünnemann and T. Y. Mathä, November 2004.

416 "Price setting behaviour in Spain: stylised facts using consumer price micro data" by L. J. Álvarez and I. Hernando, November 2004.

417 "Staggered price contracts and inflation persistence: some general results" by K. Whelan, November 2004.

418 "Identifying the influences of nominal and real rigidities in aggregate price-setting behavior" by G. Coenen and A. T. Levin, November 2004.

419 "The design of fiscal rules and forms of governance in European Union countries" by M. Hallerberg, R. Strauch and J. von Hagen, December 2004.

420 "On prosperity and posterity: the need for fiscal discipline in a monetary union" by C. Detken, V. Gaspar and B. Winkler, December 2004.

421 "EU fiscal rules: issues and lessons from political economy" by L. Schuknecht, December 2004.

422 "What determines fiscal balances? An empirical investigation in determinants of changes in OECD budget balances" by M. Tujula and G. Wolswijk, December 2004.

423 "Price setting in France: new evidence from survey data" by C. Loupias and R. Ricart, December 2004.

424 "An empirical study of liquidity and information effects of order flow on exchange rates" by F. Breedon and P. Vitale, December 2004.

425 "Geographic versus industry diversification: constraints matter" by P. Ehling and S. B. Ramos, January 2005.

426 "Security fungibility and the cost of capital: evidence from global bonds" by D. P. Miller and J. J. Puthenpurackal, January 2005.

427 "Interlinking securities settlement systems: a strategic commitment?" by K. Kauko, January 2005.

428 "Who benefits from IPO underpricing? Evidence form hybrid bookbuilding offerings" by V. Pons-Sanz, January 2005.

429 "Cross-border diversification in bank asset portfolios" by C. M. Buch, J. C. Driscoll and C. Ostergaard, January 2005.

430 "Public policy and the creation of active venture capital markets" by M. Da Rin, G. Nicodano and A. Sembenelli, January 2005.

431 "Regulation of multinational banks: a theoretical inquiry" by G. Calzolari and G. Loranth, January 2005.