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Alexis Derviz, Jiří Podpiera

Cross-Border Lending Contagion in Multinational Banks

Alexis Derviz and Jiří Podpiera *

Abstract

We study the interdependence of lending decisions in different country branches of a multinational bank. This is done both theoretically and empirically. First, we formulate a model of a bank that delegates the management of its foreign unit to a local manager with non-transferable skills. The bank differs from other international investors due to a liquidity threshold which induces a depositor run and a regulatory action if attained. Therefore, lending decisions are influenced by delegation and precautionary motives. We then show that these two phenomena create a separate channel of shock propagation, a function of bank shareholder and manager incentives. The workings of this channel can lead to either “contagion”, meaning parallel reactions of the loan volumes in both countries to the parent bank home country disturbance, or standard “diversification”, when the reactions of a standard international portfolio optimizer within the two country units go in opposite directions. In particular, it can happen that the impact of an exogenous shock on credit has a different sign in the “relationship” as opposed to the “arm’s-length” banking environment. Second, we construct a large sample of multinational banks and their branches/subsidiaries and look for the presence of lending contagion by panel regression methods. We obtain mixed results concerning contagion depending on the parent bank home country and the host economy of cross-border penetration. While the majority of multinational banks behave in line with the contagion effect, more than one-third do not. In addition, the presence of contagion seems to be related to the geographical location of subsidiaries.

JEL Codes: F37, G21, G28, G31.

Keywords: Delegation, diversification, lending contagion, multinational bank, panel regression.

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Nontechnical Summary

The present paper investigates the question of cross-border shock transmission in loan provision by an internationally active bank. Understanding the driving forces behind lending policies by a multinational bank (MNB) in individual countries of operation is important both theoretically and politically. Regulators in the country of incorporation of the parent bank are often concerned about destabilizing spillovers on it from foreign country units. These concerns are motivated by the fact that MNBs usually belong to the leading institutions of the banking sector on the national level and are systemically important. The same concerns often surface in the reasoning of rating agencies: it is known that an MNB sometimes suffers a downgrade when considered “overstretched” by foreign bank acquisitions. Conversely, policymakers in countries where MNBs play an important role may fear that a shock affecting the parent bank, although totally unrelated to domestic economic or financial fundamentals, can distort lending decisions within their jurisdiction.

The paper focuses on the latter aspect, in that it investigates the probable causes and empirical relevance of lending contagion from the parent bank itself, or economic conditions in its home country, to a branch/subsidiary in a different country. (We use the word “branch” throughout, given that even most subsidiaries in the proper sense that we have come across and included in our sample, are both small relative to the parent bank and overcapitalized.) Opposite to contagion is *diversification*, when funds are moved to well-performing branches from less successful ones in accordance with the usual logic of portfolio optimization. The analysis is conducted both theoretically and empirically.

We propose a model that highlights the interplay of the home country (where the parent bank is incorporated), the host country (where the branch operates) and bank-specific ingredients in the optimal lending volume selection. Two distinct features of a bank as opposed to other types of international investors are taken to be responsible for specific features of loan provision in an MNB branch: *liquidity-sensitivity* in the face of uncertain leverage provided by depositors and *delegation* to a local manager with non-transferable ability to earn interest on host country loans. The model shows that both delegation and liquidity-sensitivity can give rise to lending contagion, depending on the covariances found in return statistics across the items appearing on the MNB balance sheet.

The empirical part of the paper looks for evidence of cross border lending contagion in a comprehensive sample of multinational banks worldwide. This is done by means of several fixed effect panel regressions. The dependent variable in all cases is the annual growth of loans in a host country branch. The home and host country macro fundamentals (GDP growth, inflation and long-term interest rates) are among the explanatory variables. The list of the latter is completed with a home-host country bilateral exchange rate volatility measure and a measure of credit risk management costs in the parent bank. The exchange rate volatility proves to be most important in all specifications of the empirical model. This fact is easily explainable by the contribution exchange rate uncertainty makes to mutual correlations of the foreign branch balance sheet realizations, seen from the parent bank viewpoint.

Altogether, although we have found both types of MNB lending behavior, i.e. diversification and contagion, in our sample of banks, the contagion effect dominates. And the geographical location of the branch seems to play a role in this phenomenon.

1. Introduction

Do internationally active banks adjust their lending portfolios across countries in accordance with conventional risk/return considerations? Or is there a different mechanism which makes the bank behave more like an octopus, which normally spreads out more than one tentacle when on the move. It also withdraws not just one hit tentacle, but all of them at once, when reacting to an outside shock. The answer is highly important if one wishes to assess the impact of loan quality changes in one country on credit creation in another. In particular, one could be better able to decide whether the consequences of a shock in one country on the real sector financing in another are different in economies with a high degree of foreign-bank penetration. One is inclined to believe that multinational banks provide an additional credit shock transmission medium beyond the standard financial markets, which fact could be an issue of concern for bank regulators. In short, the mentioned questions, besides the associated theoretical challenge, are of great practical importance for economies that are financially integrated with larger, external ones.

Branches and subsidiaries of foreign banks are visible in the financial sectors of most industrialized economies. This paper does not study the reasons for foreign bank penetration, asking instead about the factors behind the expansion or contraction of a particular bank's operation in a given host country.

Standard portfolio-optimization theory derives wealth allocation across assets and their pricing from statistics of exogenous random factors. If a structural-uncertainty parameter of an economy changes, investor portfolios are shifted to reflect the new equilibrium prices of risk. Thus, if an international investor decides between assets in two different countries, a shock—either positive or negative—to the asset-return pattern in one country usually calls for wealth reallocation across countries. This is the usual consequence of *diversification* of an international portfolio. However, it often happens that a multinational bank cross-subsidizes between controlled units in different countries in reaction to changes in loan quality in one country unit. For an outside observer, the effect looks like cross-border *contagion* between lending volumes. This contagion can be both positive (lending increases everywhere when important divisions do well) and negative (less is lent everywhere although loan quality has deteriorated in just one country division). We find diversification as well as contagion to be systematically present in multinational bank behavior. In the theoretical part of the paper, we show that both effects can be a consequence of fully rational behavior (and not just boundedly rational aberration, as the first impression might suggest). In the empirical part, we establish the relative extent of lending contagion vs. diversification in a large sample of multinational banks in industrial countries.

Our theoretical arguments are applicable to both standard organizational forms of foreign-bank presence, branches and subsidiaries. Nevertheless, for our purposes it is easier to think of the foreign bank operating in an open economy in branch form, that is, without separate capital requirements and with a centralized alternative to localized management. In this way, we acknowledge two stylized facts visible in foreign-owned bank activities in many economies: overcapitalization (i.e., slack regulatory capital constraints) and a gradually increasing weight of branch-based presence. Both observations indicate that the legal structure may not be the prime factor of relevance. Accordingly, our analysis can be considered complementary to those papers directly addressing the organizational-form aspects of bank risks (Calzolari and Lóránth 2004, Dermine 2003, Lóránth and Morrison 2003).

The multinational bank (MNB) that we have in mind faces fundamental market imperfections caused by the fact that it is a bank and not a textbook international investor in a frictionless market. What makes it different is the presence of twin principle-agent phenomena. One is between the bank manager and the borrower, in which the manager is the principal; the other is between the shareholder and the manager, in which the manager is the agent. These make up the core of the banking business according to the theory developed by Diamond (1984) and Diamond and Rajan (2000, 2001). We formulate a “reduced-form” model of an MNB which delegates the operation of a foreign branch to a local manager. Delegation is optimal because the manager possesses specific, non-transferable human capital that allows him to collect debt better than an outside creditor. The agency-theoretic background of Diamond and Rajan (2000, 2001) is implicit, meaning that the principal-agent aspects of manager-shareholder and manager-borrower interactions are present backstage. Specifically, we do not elaborate on the reasons a bank takes deposits (thereby overcoming the hold-up problem in the Diamond-Rajan theory), taking this feature as given. Nevertheless, we do include a solvency constraint that stems from this bank-specific form of leverage.

In a more detailed model of the above category, delegation would be optimal because the manager would possess specific, non-transferable human capital allowing him to collect debt better than an outside creditor. The extent to which this managerial human capital is being employed corresponds to the degree to which relationship-banking features prevail in the economy. At the same time, a bank is able to attract deposits—and therewith extend the scale of its operation beyond the limits of its own available funds—only because the rents from improved debt collection are not entirely appropriated by the managers themselves. Part is turned over to the shareholders and depositors, since the former have the ability to audit the manager-run bank, reducing the manager’s exclusive control over the proceeds from the loan portfolio. At the same time, the depositors’ position allows them to threaten the shareholders and managers with a run on the bank if an audit is not carried out and the human capital not supplied, as such would imply that the resulting revenues are insufficient to repay depositors’ claims. In this way, the depositors ensure that the shareholders credibly commit to audit the managers and the latter commit to monitor the borrowers. Accordingly, one is able to explain why banks usually prefer deposits to other forms of external finance, such as equity.

We want to know what happens to the provision of credit by the bank branch in one country if an exogenous shock to real economic activity occurs in the other. Specifically, what is specific about an MNB’s behavior as compared to a multinational investor who is not a bank but an international portfolio optimizer handling all assets at arm’s length?

Given the focus of this paper on the credit-creation aspects of the banking industry, explicit coverage of bank failure and closure alternatives is not essential. Hence, there are no bankruptcies in our model. Otherwise, after a formal description of bank asset and liability transformation under bankruptcy, one would have to conduct the very same analysis of deposit collection and lending under the new owners and managers. Therefore, we model banks and bank managers whose preferences only include termination of activity for reason of a depositor run or a regulatory action as a latent threat.

The agency mechanism that influences lending behavior sensitivity to other country variables in our model works through the fee that a manager obtains for employing his specific human capital.

This fee appropriates (most of) the surplus from the earnings the manager delivers in excess of what the bank shareholder could do by direct involvement in the branch. Since the shareholder's arm's length returns might have non-zero correlations across countries (e.g. due to common noise components, exchange rate volatility, etc.), the branch manager's lending decisions, to the extent they are made to maximize the fee, are also influenced by variables outside his country of operation. In this way, both cross-border diversification and contagion can emerge, depending on the joint statistics of returns. The manager's actions confined to one country must take into account the MNB's performance in all other countries. For example, assume the shareholder extracts higher/lower returns under an arm's length operation abroad at the same time as at home, whereas the hired manager's performance in the foreign branch is completely independent of the parent bank's performance. Then, in the "low return state of nature", the shareholder earns less abroad in net terms due to a high fee paid to the manager. The foreign branch may then obtain a low budget. Therefore, in this state of nature, a loan volume reduction both at home and abroad is likely and lending contagion occurs.¹

The analysis confirms the existence of both qualitative and quantitative differences between responses to shocks abroad by the bank dependent on manager human capital and the arm's-length lender. Our main findings are as follows:

1. Both lending contagion and diversification are fully rational behavioral patterns.
2. When a standard international portfolio optimizer would diversify (i.e., shift funds to other country branches) in response to a country-specific shock to the return on loans, a bank with delegated branch management might be susceptible to lending contagion, depending on the statistics of manager-specific earning ability.
3. If the loan portfolio performance implications of delegation are weak, lending contagion can still take place in banks with tight liquidity constraints; this precautionary motive for octopusian behavior can be present under particular cross-asset covariance structures of the bank balance sheet.
4. Empirically, more than one-half of multinational banks with at least one foreign branch of non-negligible weight, show signs of lending contagion. From the regional point of view, most contagion is found in European multinational banks with significant cross-border penetration into new EU member states from Central Europe.

The rest of this paper is organized as follows. Section 2 contains a literature review. Section 3 introduces the model. Section 4 presents the main empirical results of a panel regression of multinational bank lending, concerning the reaction of foreign branches to domestic and foreign shocks. Section 5 concludes.

2. Literature Review

The existing literature on the relations between bank organizational structure, management incentives, and credit policies is strongly influenced by the work of Dewatripont and Tirole (1993). These authors created a model that accommodated the roles of shareholder, depositor, and regulator. The principal conclusion is that regulation exists because small, dispersed claim holders on a bank (i.e., the depositors) are unable to coordinate their effort well enough to enforce

¹ We are grateful to Falko Fecht for suggesting this example.

adequate management decisions. However, the approach of Dewatripont and Tirole is not bank specific (i.e., it can be equally applied to any profit-seeking enterprise with decisions delegated to managers). The literature directly addressing the special role of banks exploits the information asymmetry between entrepreneur and investor. Diamond (1984) explains the existence of banks via their role as delegated monitors of risky investment. This idea was further developed to explain the necessity of financial intermediaries in the form of banks in an environment where not just entrepreneurial effort but also the effort given to its monitoring is partially unobservable (see Diamond and Rajan 2000). Besides that, the systemic specificity of banks and other credit institutions from the macroeconomic point of view requires a structured analysis of bank financing and investment decisions. A widely recognized unified approach to capital budgeting by financial institutions was offered by Froot and Stein (1998).

The latter paper, although it does not deal with multinational banking directly, contains a number of tangency points with our modeling approach. For instance, one can draw parallels between Froot and Stein's (1998) projects in which a bank invests, and branches to which an MNB allocates budget. Both models work with concave preferences over the bank's end of period wealth, cost of finance (capital and external funds such as deposits), as well as non-diversifiable earnings risks. Froot and Stein (1998) carry their analysis to the point of showing that the bank-wide risk aversion (a function of the balance sheet) co-determines the value of, and budget allocation to, individual non-tradable investment projects in its portfolio. We go much farther than that, by tracing budget allocation across branches directly to the interplay of delegation and risk-management factors in an MNB. Additionally, we are able to make predictions about the lending decisions of branches after the parent bank budget has been decided upon. Nevertheless, the message of both models can be expressed in terms of bank-internal capital market operation.

The existing models of bank risk management often make use of an advanced form of information asymmetry called "capture" (see, e.g., Dell'Ariccia and Marquez 2004). "Borrower capture" means the inability of a finance-seeking entrepreneur to communicate project-quality information credibly to anyone but the "house bank." Similarly, "intermediary capture" occurs if a bank seeking to attract depositors and outside equity providers is unable to credibly communicate the quality of its investment portfolio to anyone but the incumbent majority shareholder. Sometimes, the existence of capture in theoretical models leads to surprising results when the interplay with regulatory policies is considered. (For instance, bank-share ownership can become more risky as a result of tightening capital requirements, as in the model by Morrison and White (2004). This paper adds another element—the regulator's own reputation and its significance for the equilibrium resource allocation in the financial-services market—to the discussion.) An important object of study is the probability of a depositor run or bank failure (or, more generally, the occurrence of financial crises) in a dynamic perspective. These models are concerned with the long-term sustainability of loan and deposit markets rather than the outcome of a single strategic encounter between financial-service providers and suppliers. In this vein, Repullo (2004) studies the existence of "prudent" versus "gambling" equilibria as a function of regulatory requirements and the impact on the credit conditions. Another recent contribution to this line of literature is Monnet and Quintin (2004), in which not just the current state but also the historical path of the financial markets determines their size and structure in the next period.

The extension of the discussed framework to multinational banks, as in Külpmann (2000), involves deepening the analysis to the level of individual divisions (branches) and their managers'

optimal choices within a multinational bank. Alternatively, Chan-Lau and Chen (2002) derive a dependence of the financial crisis (a reversal in the credit supply) in an open economy on the extent of frictions in the financial sector relative to the economic fundamentals. These and related papers assume that international asset diversification is an important motive in multinational-bank decision making, which has long been recognized in the literature on international finance (see, e.g., Heston and Rouwenhorst (1994)). Altogether, the number of contributions to the theoretical literature on international bank behavior has so far been relatively small.

The specific topic of foreign-bank presence in the CEE region was covered by two empirical studies by de Haas and van Lelyveld (2003, 2004), which use Bank for International Settlements and BankScope statistics ending in 2000. Building on earlier empirical literature mainly concerned with Latin America, these reports distinguish between the “pull factor” and the “push factor” associated with foreign-bank penetration. The former corresponds to the reduction in credit by foreign banks in reaction to economic downturns and financial crises in the host country (and its expansion during booms), while the latter deals with reaction to the home-country situation of the parent bank. There is a positive push effect when home-country disturbances result in a credit contraction by foreign units (the parent bank is concerned with balance-sheet repair). A negative push factor is present when home difficulties lead foreign units to lend more (the parent bank follows the standard portfolio-diversification logic). For the CEE region, de Haas and van Lelyveld find that the pull factor is absent: foreign banks did not cut credit during host-country troubles. On the other hand, they do find a negative push effect: there is a significant negative relationship between home-country economic growth and host-country credit by foreign banks. This finding is supported by informal evidence from other sources. Given that the workings of the push factor have implications for both macroeconomic and financial stability, the model to be developed here will be used primarily to study the spillover of home-country shocks through dependent bank units in the host country.

The newest paper by de Haas and van Lelyveld (2006)—to be referred to as HaasLel06 below—extends the perspective of their earlier studies to multinational banks on a global scale. There are clear affinities between HaasLel06 and our paper both in the object of interest (determinants of lending behavior of MNB subsidiaries), the data used (bank-level financial characteristics taken from BankScope, and home and host country economic fundamentals) and the econometric techniques applied (fixed effect panel regression). Similarly to our search for diversification vs. contagion, HaasLel06 look for substitution (from weak to strong) vs. support (of the weak by the strong) in lending patterns across subsidiaries. However, besides partial methodological differences from HaasLel06, our approach contains a number of substantially distinctive features. First, we concentrate on banks in OECD countries only, following the conjecture that MNB penetration into developing countries happens on the basis of a different set of criteria and decision patterns (among other things, lending revenue assessment and credit risk management call for less standard procedures than those applicable in legally stable developed economies). Therefore, parent banks that only expanded into emerging countries are not present in our sample. Second, we come up with an explicit decision-theoretic foundation for the MNB-internal capital market which rationalizes both diversification and contagion (and would equally well rationalize substitution and support if we moved the focus from the parent-subsidiary to the subsidiary-subsidiary shock transmission channel in accordance with the HaasLel06 vantage point). Third, we take into account the inevitable structural changes in any MNB if followed for too many years. Specifically, not a single MNB in the HaasLel06 sample can be claimed to have existed

unchanged, without at least one major reorganization, during the 1992–2004 time span that they chose. On the contrary, we have chosen the temporal dimension of our panel that captures the most recent stable state of the MNB landscape in industrialized countries. This has resulted in a sample covering the years 1999–2003. Fourth, we acted on the assumption (strongly confirmed by the outcome) that exchange rate volatility, completely left out in HaasLel06, should be an important summary statistic for many cross-border frictions that influence fund flows from the center to dependent units in an MNB.

Recently, international bank-regulation issues have also received attention. Holthausen and Rønde (2004) study the impact of home- and host-country supervisor information exchange on bank-closure decisions. Lóránth and Morrison (2003) examine the role of national deposit insurance and evaluate its impact on the decision making of multinational banks. They also link the result about cross-border investment choices to the existence of a multinational bank channel for financial contagion. Calzolari and Lóránth (2004) extend the analysis to include a welfare-optimizing regulator and show how the regulatory stance is influenced by the chosen representative form (branch vs. subsidiary) of the foreign bank. Morrison and White (2004) endow the regulator with an additional ability (besides bank-licensing and capital-adequacy requirements)—asset auditing—and examine the impact of this additional tool on the phenomena of adverse selection and moral hazard in the banking sector. Their model allows for multiple equilibria, some of which entail a crisis of confidence in the banking sector and a corresponding welfare-reducing decrease in project financing.

Although we do not model the regulator explicitly, the problems discussed in this last strain of literature have a direct bearing on this paper. By focusing on risk grouping in accordance with the country of origin, we are able to concentrate the analysis on international financial intermediaries co-existing with national regulators. In our approach, the capture effect is studied as a friction between entrepreneurs, banks, and investors of individual countries. One of the consequences of our model is a case for a regulatory policy that facilitates the bank portfolio audit for shareholders and depositors. In this way, the domestic banking regulator may support an equilibrium with a high degree of specific manager human capital in multinational bank branches under its jurisdiction. Suppose there is a sudden reversal in the credit-creation process owing to a real or financial disturbance in the home country of the parent bank. If too many host-country borrowers depend on loans from the foreign-controlled bank, this reversal will have a macro-impact, with possible subsequent implications for the financial health of the real sector, that is, financial stability. The domestic regulator is not in a position to change the behavior of the incumbent foreign-controlled bank. However, a proper regulatory stance can encourage the entry of other banks able to provide the missing funds. In this respect, we suggest that one key criterion of supervisory policies is their ability to reduce bank managers' monitoring costs.

3. A Model of a Multinational Bank with Delegated Foreign Branch Management

There are two countries in our model, which we call home and host. A multinational bank has its headquarters in the home country, whose unit of account is the global numéraire (we think of the home country as representing a big economy). The bank has a branch in the host country. There is one general investment opportunity (global portfolio) and another opportunity to grant non-traded

loans in each of the two countries. There is also a risk-free money-market deposit opportunity in each country. The bank is owned by a representative shareholder, who has C units of capital to invest. She can, in addition to investing her own funds in either of these assets, collect deposits from the public. Each branch covers with its services a specific segment of the deposit market within the country, and attracts a fixed amount of deposits. Let the volume of deposits be D in the home country (in global units) and d in the host country (in its own units of account). Some deposits may be withdrawn upon the payment of interest due to an unspecified liquidity shock.

To perform the loan and deposit business, the shareholder usually hires a manager for the foreign branch. The branch manager possesses an endowment of non-transferable human capital, allowing him to collect a rate of return on the loans in excess of the baseline arm's-length rate that can be extracted from the same borrowers by an outside investor in the market. He is remunerated by a fee paid out of the branch's proceeds.

There are two periods, the first when the capital allocation, deposit collection, and lending takes place, and the second when returns are realized and interest and fees paid. The shareholder is a risk-averse expected-utility maximizer. The uncertainties at date 0 exist with regard to six variables, three in each country: return on loans, return on outside assets (exchange-rate adjusted in the case of the host country), and deposit/withdrawal rate.

3.1 Bank Balance Sheet and Cash Flows

The general notational convention to be employed throughout the paper is the use of upper-case letters for the home-country variables and lower-case letters for the host country ones.

Let B , D , X^0 , and X be, respectively, shareholder own funds (capital), deposits, cash holdings, and loans granted, for the home-country branch. B is a portion of the total investment funds C . That is, if A denotes funds invested in alternative assets, and b the budget of the foreign country branch, then $C=A+B+b$. Therefore, the rate of return, R^A , on outside global assets $A=C-B-b$ can be regarded as the opportunity cost of bank capital. The interest rate on deposits is R^D , and the random deposit/withdrawal rate at date 1 is V . Cash earns the risk-free money-market rate of return, R^0 , whereas loans earn a risky rate of return R^L . The same lower-case symbols denote the corresponding values for the foreign country.

The period-1 domestic disposable wealth or funds of the bank shareholder net of the opportunity cost of capital are equal to:

$$W = X^0(1 + R^0) + X(1 + R^L) - D(R^D + V) - B(1 + R^A).$$

Let $Y^L=R^L-R^0$, $Y^D=1+R^0-R^D-V$, $Y^A=R^A-R^0$ be, respectively, the excess returns on loans, deposits, and outside assets over the risk-free rate.² Given the home branch balance-sheet identity $B+D=X^0+X$, the expression for domestic branch disposable funds can be rewritten as:

² If all deposits were claimed back at date 1, we would have $V=1$ and $Y^D=R^0-R^D$. However, we should think of a typical case where only a fraction of deposits is withdrawn and, accordingly, V is a random variable distributed around a mean value substantially below unity.

$$W = XY^L + DY^D - BY^A. \quad (1)$$

Analogously, let b be the capital allocated to the foreign branch. The disposable funds of the foreign branch in period 1 are given by $w = x^0(1+r^0) + x(1+r^l) - d(r^d + v) - b(1+r^a)$, where r^a is the return on outside assets recalculated in the host country currency. By defining excess returns in the same way as for the home country, we get

$$w = xy^l + dy^d - by^a. \quad (2)$$

Note that equation (2) is in the host country units. To keep the model complexity under control, we do not model exchange rate risks in detail. Instead, we simply assume that the shareholder's gross funds at date 1 coming from both bank branches are $W^S = W + (1+\tau)w$, where τ is the rate of host country currency appreciation between periods 0 and 1. From this, we shall subtract the manager fee f , which is negotiated in period 0. By using the symbols $y^{*l} = (1+\tau)y^l$, $y^{*d} = (1+\tau)y^d$, $y^{*a} = (1+\tau)y^a$ to denote the excess returns in the home country units, we can summarize the period-1 funds of the shareholder by the expression

$$Q = XY^L + DY^D - BY^A + xy^{*l} + dy^{*d} - by^{*a} + C(1+R^A) - f. \quad (3)$$

Note that Q differs by the amount $D+(1+\tau)d$ from the expression for the bank's end-of-period-1 earnings. Since the bank's control of the deposits not withdrawn in period 1, unless there is a failure, continues into further periods, quantity Q —and not the earnings—serves as a measure of solvency. This is also the quantity over which bank shareholder preferences will be formed.

Assumption 1 (Exogenous risk distribution) *The random variables Y^L , Y^D , y^{*l} , y^{*d} , Y^A , and y^{*a} are jointly normally distributed.*³

We will denote the means of the above excess returns by Z^L , Z^D , z^{*l} , z^{*d} , Z^A , and z^{*a} , and the deviations from the mean (which are normal random variables with zero means) by ε^S , ε^D , ε^{*l} , ε^{*d} , and ε^{*a} . By Z , we denote the column vector $[Z^L, Z^D, -Z^A, z^{*l}, z^{*d}, -z^{*a}, Z^A]^T$, and by ε the column vector $[\varepsilon^L, \varepsilon^D, -\varepsilon^A, \varepsilon^{*l}, \varepsilon^{*d}, -\varepsilon^{*a}, \varepsilon^A]^T$. The covariance matrix of ε will be denoted by Ω .

3.2 Shareholder Preferences

In view of Assumption 1, the level of bank funds Q as seen in period 0 is a normally distributed random variable. Let us denote the mean and variance of Q by, respectively, μ_Q and σ_Q^2 . Clearly,

$$\mu_Q = XZ^L + DZ^D - BZ^A + xz^{*l} + dz^{*d} - bz^{*a} + C(1+r^0 + Z^A) - f,$$

³ As already mentioned, exchange rate uncertainty is not modeled separately. Otherwise, the normality of excess returns y^{*a} , y^{*d} , and y^{*l} would not be the most natural assumption. However, a more realistic representation of the exchange rate risks would lead to more complex calculations without affecting the qualitative implications of the model.

and $\sigma_Q^2 = \varepsilon^T \cdot \Omega \cdot \varepsilon$. If Q falls below a given threshold Q^0 , the bank fails (which can mean a depositor run, forced administration or other forms of activity termination and removal of shareholder rights), and the shareholder's funds are reduced to zero. In our model, disposable funds fall below Q^0 when earnings from loans and alternative assets are insufficient to compensate for the withdrawal of deposits. Thus, failure is a consequence of illiquidity.

The bank shareholder has negative exponential utility U with absolute risk aversion parameter γ over future realizations of random variable Q , defined as controlled funds Q if $Q \geq Q^0$ and zero otherwise. Formally, we have the expected utility equal to

$$U = E\left[\left(e^{-\gamma Q^0} - e^{-\gamma Q}\right)\mathbf{1}_{\{Q \geq Q^0\}}\right].$$

Symbol $\mathbf{1}_{\{Q \geq Q^0\}}$ stands for the indicator random variable of the event $\{Q \geq Q^0\}$. The constant term $\exp(-\gamma Q^0)$ normalizes the utility at failure to zero. Negative exponential utility has been selected for the sake of explicitness and ease of computation, although qualitatively similar results—albeit with a messier algebra—are obtainable for more general forms of the utility function.

Given the normality assumption, it can be easily seen that

$$U = e^{-\gamma Q^0} - N\left(\frac{\mu_Q - \gamma \sigma_Q^2 - Q^0}{\sigma_Q}\right) e^{-\gamma \mu_Q + \frac{\gamma^2 \sigma_Q^2}{2}} = e^{-\gamma Q^0} - N(T) e^{-\gamma SE_Q}, \quad (4)$$

where

$$T = \frac{\mu_Q - \gamma \sigma_Q^2 - Q^0}{\sigma_Q}, \quad SE_Q = \mu_Q - \frac{\gamma}{2} \sigma_Q^2$$

and N is the standard normal cumulative distribution function. SE_Q is the well-known expression for the certainty-equivalent of normally distributed wealth Q under absolute risk aversion γ .

The risk-aversion assumption for the bank shareholder is used to generate non-trivial demands for different assets and allows one to analyze portfolio shifts in response to shocks. For the same reason, the asset returns contain random noises even though the latter are unaffected by the degree of relationship banking, that is, they are seemingly unrelated to the central object of our interest. All the same, non-zero variances are needed in the present setting to prevent the problem from becoming vacuous.

We have chosen to express the “risk-adjusted distance from failure” T of the bank through the balance sheet (“accounting”) liquidity variable Q . Naturally, from the regulatory perspective, the actual propensity to fail would be better captured by a capital adequacy measure. On the contrary, bank runs by depositors are often triggered by actual or perceived illiquidity. One could imagine setting up a formal mechanism in the model which would connect both aspects. However, we have opted for simplicity and analytical tractability to the detriment of realism in our definition of the failure threshold. Qualitatively, for the big and well-established international banks we consider, capital adequacy is not a direct issue of concern, although varying levels of internally

measured accounting liquidity might have an impact on budgeting decisions. Altogether, we believe that the chosen distance-to-failure measure reflects the needed link from earnings to safety, and this is all that is required from the present model.

The factor $N(T)$ in (4) distinguishes the expected utility of a bank from that of a conventional mean/variance-optimizing investor. When T is sufficiently big, its value is close to unity and the bank shareholder's preferences are almost the same as those of an unconstrained investor. As the critical value represented by T decreases, the banker's expected utility gradually approaches zero. Under similar circumstances, a conventional certainty equivalent-maximizing investor utility would fall under zero. That is, in our model the Diamond-Rajan understanding of a bank as a financial institution with specific liquidity rules is reflected in the corrective term $N(T)$ in an otherwise standard certainty-equivalent portfolio optimization problem. This definition mimics our stylized knowledge of the consequences of a regulatory intervention in a bank deemed illiquid: unless the depositors themselves initiate a bank run, the regulator removes the shareholders and uses available funds plus deposit insurance to compensate the depositors. Consequently, tight regulation or, more generally, high sensitivity to the pre-conceived distance-to-failure (meaning high Q^0) actually creates a lower bound on the expected utility of the bank shareholder in this model. The banks for which value $N(T)$ is significantly lower than one will be called *liquidity-sensitive* (LS). The opposite case, when $N(T)$ is almost unity, will be dubbed *liquidity-insensitive* (LI).

As mentioned in the introduction, we only consider multinational banks organized in a branch form, i.e., there are no a priori failure triggers based on a lower limit value of W or w separately. (Such a limit exists only for the bank as a whole.) Formally, the analysis of a subsidiary form would go along similar lines, but the expected utility derived by the shareholder from the random variable Q would have to be calculated differently. Qualitatively, the results of the analysis would not change. We maintain the branch understanding of the foreign unit operation in view of the empirically observed prevailing overcapitalization of foreign subsidiaries in our sample.

3.3 Shareholder-Manager Interaction

In the sequel, variables with tildes stand for the quantities generated by the shareholder in the hypothetical case when she chooses not to hire a local manager for the host country branch.

If the loan portfolio represented by x were held by an outside investor without any particular knowledge of, or relationship with, the borrowers involved, the date-1 excess return on it would be \tilde{y}^s with mean z^s . This would also be the return attainable to the shareholder, had she decided to operate the branch at arm's length. The branch manager can do better than that, which is reflected in the fact that his mean excess return z^{*l} is higher than $E[\tilde{y}^{*s}] = z^{*s}$ (here, exchange rate influences are included, so that all quantities are in the home country units).⁴ Our concept of informational frictions in the loan market utilizes the effect of *biased* information (errors in the perceived mean values) rather than *imprecise* information (higher than efficient variances).

⁴ One can think of the "true" potential return on x as an unobservable value. By employing his human capital, the branch manager obtains a noisy signal about the potential return. The signal is biased, but the bias decreases with human capital. Note the difference of this interpretation and the one utilized by many microfinance models, where the signals are unbiased and only their precision varies. Our understanding is closer to the discrete version of Girsanov's probability: better signals mean a more precise knowledge of the drift, whereas the diffusion magnitude stays the same.

If the manager is hired, he chooses the volume x of loans to be extended by the branch. The funds generated in period 1 are then given by (3). If the manager is not hired, the shareholder, by her direct engagement with the branch, can generate the period-1 funds equal to

$$\tilde{Q} = XY^L + DY^D - BY^A + \tilde{x}\tilde{y}^{*s} + d\tilde{y}^{*d} - b\tilde{y}^{*a} + C(1 + R^A),$$

Of course, the lending decision \tilde{x} taken by the shareholder acting alone, as well as the foreign branch funds so attained, \tilde{w} , would be different from the ones following from the manager's decisions (plain symbols with no tildes). We shall call the hypothetical value \tilde{x} the shareholder's *substitute lending choice*, and the maximal utility thus attained her *substitute utility*.

Concerning the interaction of substitute management uncertainties with the previously defined ones, we make an assumption similar to Assumption 1 above, with the same caveat regarding the exchange rate risks:

Assumption 2 *The random variables Y^L , Y^D , \tilde{y}^{*s} , y^{*d} , Y^A , and y^{*a} are jointly normally distributed.*

Accordingly, we define the vector of the shareholder's substitute mean excess returns $\tilde{Z} = [Z^L, Z^D, -Z^A, z^{*s}, z^{*d}, -z^{*a}, Z^A]^T$ and the substitute deviations from the mean returns $\tilde{\varepsilon} = [\varepsilon^L, \varepsilon^D, -\varepsilon^A, \varepsilon^{*s}, \varepsilon^{*d}, -\varepsilon^{*a}, \varepsilon^A]^T$ with the covariance matrix $\tilde{\Omega}$.

Under the above assumption, the substitute utility of the shareholder is given by the expression analogous to (4):

$$\tilde{U} = e^{-\gamma Q^0} - N\left(\frac{\mu_{\tilde{Q}} - \gamma\sigma_{\tilde{Q}}^2 - Q^0}{\sigma_{\tilde{Q}}}\right) e^{-\gamma\mu_{\tilde{Q}} + \frac{\gamma^2\sigma_{\tilde{Q}}^2}{2}} = e^{-\gamma Q^0} - N(\tilde{T})e^{-\gamma SE_{\tilde{Q}}} \quad (5)$$

with

$$\mu_{\tilde{Q}} = XZ^L + DZ^D - BZ^A + \tilde{x}z^{*s} + dz^{*d} - bz^{*a} + C(1 + r^0 + Z^A),$$

$$\sigma_{\tilde{Q}}^2 = \tilde{\varepsilon}^T \cdot \tilde{\Omega} \cdot \tilde{\varepsilon},$$

$$\tilde{T} = \frac{\mu_{\tilde{Q}} - \gamma\sigma_{\tilde{Q}}^2 - Q^0}{\sigma_{\tilde{Q}}}, \quad SE_{\tilde{Q}} = \mu_{\tilde{Q}} - \frac{\gamma}{2}\sigma_{\tilde{Q}}^2.$$

The shareholder-manager interaction in period 0 will be defined as a simultaneous-move game.

The shareholder determines the budget shares B and b available for both branches and the lending volume X in the home country branch, which we assume she manages directly.⁵ For the (off-the-equilibrium-path) case where the manager is not hired, she also selects the substitute loan volume \bar{x} in the foreign branch. (Recall that the deposit volumes D and d as well as the total funds available for investment in the MNB, C , are given exogenously.) The potential manager selects the fee for the use of his human capital in the host country branch.

Thus, the strategy space of the shareholder is parameterized by the vector $\tilde{I} = [\bar{x}, I^S] = [\bar{x}, X, -B, -b]$, whereas that of the manager is parameterized by the scalar f .

We associate the manager's special skills with his knowledge about the repayment ability of the set of borrowers that comprise the loan portfolio of the branch. Put differently, managers have an enhanced ability to collect on debt because they act in a relationship-banking environment. In such a case, their ability to extract rents is substantial, which is reflected in the following assumption.

Assumption 3 *The host country branch manager has full bargaining power over the parent bank shareholder. Therefore, he is able to negotiate a fee such that the shareholder's utility achieved with the help of his services is equal to her substitute utility plus one cent. In other words, the shareholder is indifferent between keeping and dismissing the manager who receives fee f .*

Any fee higher than the one defined in Assumption 3 would see the manager dismissed, since the shareholder would do better acting in his place herself. A lower fee would be suboptimal for the manager unless he was exposed to competition from others with human capital linked to the same loan portfolio, which is highly improbable. Altogether, Assumption 3 is just one of the many existing ways to describe the shareholder-manager negotiation outcome, and was chosen for its computational tractability.⁶

Assumption 3 means that the equilibrium fee which the manager is able to negotiate is implicitly characterized by the equality

$$U(x, I^S, f) = \tilde{U}(\tilde{I}). \quad (6)$$

The solution for $f = F(x, \tilde{I})$ following from the Implicit Function Theorem is unique due to strict concavity of the utility functions U and \tilde{U} . Naturally, of all the combinations (x, f) that satisfy (6), the manager chooses the one with the highest f .

⁵ This assumption is not central to the analysis, but considerably simplifies the calculations. The generic case that we have in mind is of a bank which is well established at home but is also engaged in more recent activity abroad. So, its lending in the home country will be considered the core business under full shareholder control, relative to which the foreign activities are tailored.

⁶ For instance, in Diamond and Rajan, 2000, the bargaining power is split at random between the shareholder and the manager, each of them given, with probability $\frac{1}{2}$, the right to make a take-it-or-leave-it offer to the other. In this paper, we do not explore the potential game-theoretic ramifications of the manager-shareholder relation any further.

We are now able to define the equilibrium outcome of the shareholder-manager bargaining game as a pair (\tilde{x}, J) of scalar \tilde{x} and vector $J=[x, X, -B, -b, D, d, C]^T=[I, I^0]^T=[x, I^S, I^0]^T$ in which, given the levels $I^0=[D, d, C]^T$ of exogenous balance sheet items,

x maximizes the manager's fee defined by condition (6), given the shareholder's choice of I^S

$\tilde{I} = [\tilde{x}, I^S]^T = [\tilde{x}, X, -B, -b]^T$ maximizes the shareholder's substitute expected utility.

The shareholder, knowing that she will effectively earn substitute utility \tilde{U} anyway, decides rationally upon the X -, \tilde{x} -, B -, and b -levels as if counting on the negative negotiation outcome with the manager, meaning that she selects \tilde{I} which maximizes \tilde{U} . Clearly, \tilde{I} does not depend on the manager-selected loan volume x (because \tilde{U} does not). Strict concavity of \tilde{U} implies $\frac{\partial \tilde{U}}{\partial \tilde{I}} = 0$ for the optimal choice.

The selection of x by the manager is made so that $f = F(x, \tilde{I})$ is maximized given \tilde{I} . Since fee negotiation results in (6) for any choices of x , (6) is an identity along the x -dimension. By taking its partial x -derivative, one gets

$$\frac{\partial U}{\partial x} + \frac{\partial U}{\partial f} \frac{\partial F}{\partial x} = 0.$$

Thanks to strict concavity of U , F has a single maximum w.r.t. x for every value of \tilde{I} , and this maximum is given by the first order condition $\frac{\partial F}{\partial x} = 0$. Thus, the usual Envelope Theorem

argument demonstrates that also $\frac{\partial U}{\partial x} = 0$ in equilibrium. As will become clear from the results of the next subsection, given the equilibrium choice of \tilde{I} , the manager's choice of x is also utility-maximizing for the bank shareholder as long as the bank is not too close to failure.⁷ The above arguments can be summarized as

Proposition 1 *For sufficiently liquid banks (meaning that the distance to failure T is big enough so that shareholder utility U is growing in the mean μ_Q of disposable wealth and decreasing in its variance σ_Q^2), the manager's equilibrium choice of lending volume in the foreign branch*

⁷ Observe that the choice of x on the level which optimizes the shareholder utility is not an ex ante commitment by the branch manager, but a consequence of his own optimizing behavior. Formally, this exact result obtains only when the manager has full bargaining power. Were the bargaining power split between the shareholder and the manager, x would be described by a more complex set of conditions, even though qualitatively it would be a function of the same variables and, for a broad class of specifications, the dependences would have the same signs. Our chosen specification has the advantage of producing easier formulae. More generally, it allows us to avoid detailed treatment of the manager's hidden actions (including loan volume choice), unobserved effort (use of human capital) and other attributes of principal-agent modeling.

maximizes the shareholder's utility given her equilibrium substitute choice of portfolio. The maximum is unique and is given by the internal solution to the first order condition $\frac{\partial U}{\partial x} = 0$.

We will make the notion of “being not too close to failure” more precise in the next subsection.

3.4 Optimal lending

Manager's choice

Condition (6) defines the fee f implicitly as a function of the manager's own loan volume choice x and the vector of the shareholder's substitute portfolio holdings $\mathcal{J} = [X, D, -B, \bar{x}, d, -b, C]^T$. As was argued in the previous subsection, in the range of bank wealth values relevant for our analysis (i.e., not too close to failure) both x and \mathcal{J} are given by internal solutions to the manager's and the shareholder's optimization problems, respectively. In other words, they satisfy the first order conditions of optimality.

Let n be the standard normal probability density function, and define auxiliary functions K and L by

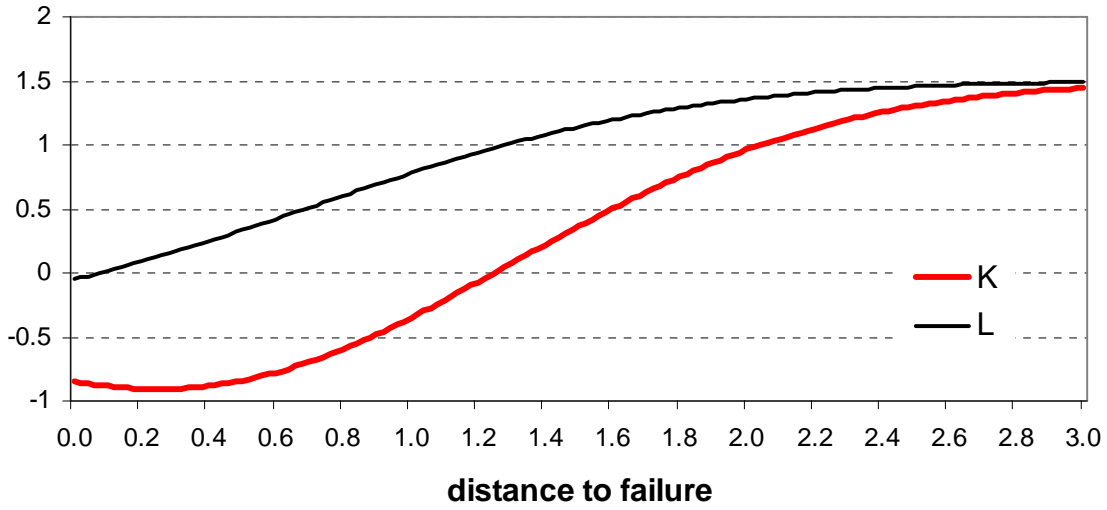
$$K = \gamma N(T) - \left(2 + \frac{T}{\gamma \sigma_Q} \right) \frac{n(T)}{\sigma_Q}, \quad L = \gamma N(T) - \frac{n(T)}{\sigma_Q}.$$

An interpretation of K and L , as well as analogous functions that will appear in subsequent results, can be given as follows. Formally, if one considers $m = \mu_Q$ and $v = \sigma_Q^2$ as independent variables and

the shareholder utility U as a function of m and v , then it can be checked that $K = -\frac{2}{\gamma} e^{\gamma S E_Q} \frac{\partial U}{\partial v}$

and $L = e^{\gamma S E_Q} \frac{\partial U}{\partial m}$. That is, the values of K and L express the sensitivities of the utility to, respectively, the variance and the mean of the uncertain bank funds Q .

It turns out that the shareholder's preferences become perverse in the proximity of the failure trigger. Namely, for too small values of the distance to failure T , the utility is increasing in the variance variable (i.e., $K < 0$); it can also become marginally decreasing in the mean wealth variable ($L < 0$). An example is given in Fig. 1. The reason is the existence of the cut-off value of Q below which the outside utility of zero is guaranteed. As is usual under such circumstances, in the neighborhood of this cut-off value, the shareholder prefers high-risk gambles and may even prefer failure to continuation with a tiny positive mean wealth.

Figure 1: Bank Shareholder Utility Sensitivities to the Final Wealth Mean and Variance

Note: The graph shows the dependence of K and L on T for the risk aversion parameter $\gamma=1.5$ and wealth standard deviation $\sigma=0.5$.

Obviously, we are only interested in the results in the regular region of the values of T , where the shareholder prefers higher mean wealth to lower and is genuinely risk-averse. Therefore, “not too close to failure” will mean the requirement of positive K and L . In the example shown in Fig. 1 this would mean a distance to failure above the level of 1.3.

The manager’s optimal choice of x can be characterized by the following result, obtainable directly by calculating the partial x -derivative of (4).

Lemma 1 *If the bank is sufficiently far away from failure (meaning that (4) has an internal maximum with respect to portfolio choices J), then the optimal lending volume selected by the foreign branch manager is characterized by*

$$K\gamma\Omega^x J = Lz^{*l}, \quad (7)$$

where Ω^x is the row of Ω corresponding to component x of J .

Condition (7) follows from the equality

$$\frac{\partial U}{\partial x} = e^{-\gamma SE_Q} (Lz^{*l} - K\gamma\Omega^x J).$$

A special case of (7) holds for an LI-bank (e.g. when the failure threshold Q^0 is sufficiently low). Then the ratio L/K would be almost unity and (7) would correspond to optimizing the certainty equivalence SE_Q with respect to x , as with any other liquidity-unconstrained optimizing investor. This is an immediate consequence of the standard negative exponential utility maximization results.

The ultimate objective of the conducted formal analysis is to calculate the impact on host country branch lending x of the change in the home country mean loan returns Z^L . Therefore, the next step is to calculate the sensitivity of condition (7) to the change in Z^L . To formulate the result, we need to split the covariance matrix Ω into blocks corresponding to the partition $[I, I^0]^T$ of J into endogenous and exogenous balance sheet items:

$$\Omega = \begin{bmatrix} \omega & \Psi \\ \Psi^T & \Lambda \end{bmatrix}.$$

We denote by ω^x the row of ω corresponding to component x of I .

The formal statement regarding the whole vector I , obtained by differentiating (7) w.r.t. Z^L , is given by

Lemma 2 *The partial derivative w.r.t. Z^L of the portfolio decisions of the international bank with delegated management of the foreign branch is given by the equation*

$$K\gamma\omega^x \frac{\partial I}{\partial Z^L} = \frac{Xn(T)}{\sigma_Q^2 K} \left[\frac{L}{\gamma\sigma_Q} - \gamma(N(T)T + n(T)) \left(1 + \frac{T}{\gamma\sigma_Q} \right) \right] z^{*l}. \quad (8)$$

As $\omega^x \frac{\partial I}{\partial Z^L} = \sigma_l^2 \frac{\partial x}{\partial Z^L} + \omega'^x \frac{\partial I^S}{\partial Z^L}$ (ω'^x is the row vector of covariances between ε^{*l} and the three-dimensional row vector $\varepsilon^S = [\varepsilon^L, -\varepsilon^A, -\varepsilon^{*a}]$), extraction from (8) of the sought information about $\frac{\partial x}{\partial Z^L}$ requires a similar result for the substitute portfolio decision $\tilde{I} = [\tilde{x}, I^S]^T$ of the shareholder

(the left hand side of (8) contains the so far unknown quantity $\frac{\partial I^S}{\partial Z^L}$). So, we next need to analyze the shareholder's substitute portfolio problem.

Shareholder's choices

We define auxiliary functions \tilde{K} , \tilde{L} by analogy with K and L :

$$\tilde{K} = \gamma N(\tilde{T}) - \left(2 + \frac{\tilde{T}}{\gamma\sigma_{\tilde{Q}}} \right) \frac{n(\tilde{T})}{\sigma_{\tilde{Q}}}, \quad \tilde{L} = \gamma N(\tilde{T}) - \frac{n(\tilde{T})}{\sigma_{\tilde{Q}}}.$$

The vector of mean returns of the four assets whose holdings the shareholder selects in her substitute problem, is equal to $\tilde{R} = [z^{*s}, Z^L, -Z^A, -z^{*a}]^T$. We also need to introduce the partition of the covariance matrix by analogy with the same partition defined earlier for Ω :

$$\tilde{\Omega} = \begin{bmatrix} \tilde{\omega} & \tilde{\Psi} \\ \tilde{\Psi}^T & \Lambda \end{bmatrix}.$$

Now, proceeding in the same way as when deriving the result of Lemma 1 (i.e., differentiating \bar{U} in (5) with respect to each component of the decision vector \tilde{T} of the shareholder), we establish the following characterization of optimal \tilde{T} .

Lemma 3 *If the bank is sufficiently far away from failure, then the optimal substitute portfolio choice of the shareholder is characterized by*

$$\tilde{K}\gamma(\bar{\omega} \cdot \tilde{T} + \bar{\Psi} \cdot I^0) = \tilde{L}\tilde{R}. \quad (9)$$

Equation (9) can be differentiated w.r.t. Z^L in order to establish the sensitivity of the shareholder's substitute decisions to the home country return on bank loans, that is, derive the missing expression for $\frac{\partial I^S}{\partial Z^L}$. Note that vector \tilde{R} on the right hand side of (9) contains Z^L as one of the components, so that the equation corresponding to (8) of Lemma 2 will have an extra term. The exact result is as follows.

Lemma 4 *The partial derivative w.r.t. Z^L of the substitute portfolio decisions of the international bank (i.e., the foreign branch is managed at arm's length by the bank shareholders) is given by the equation*

$$\tilde{K}\gamma\bar{\omega} \frac{\partial \tilde{T}}{\partial Z^L} = \frac{Xn(\tilde{T})}{\sigma_{\bar{\omega}}^2 \tilde{K}} \left[\frac{\tilde{L}}{\gamma\sigma_{\bar{\omega}}} - \gamma(N(\tilde{T})\tilde{T} + n(\tilde{T})) \left(1 + \frac{\tilde{T}}{\gamma\sigma_{\bar{\omega}}} \right) \right] \tilde{R} + \tilde{L}\mathbf{1}^X. \quad (10)$$

In the above equation, $\mathbf{1}^X$ denotes a 4-dimensional column vector with coordinate X equal to unity and the remaining components equal to zero.

To formulate the final result of this section, we need to separate from vector equation (10) the components corresponding to I^S . More precisely, assume that the covariance matrix $\bar{\omega}$ is non-singular (this is paramount to saying that none of the assets under consideration is redundant) and put $\bar{\Xi} = \bar{\omega}^{-1}$. Matrix $\bar{\Xi}$ will be partitioned so as to separate the x -row and the X -column (or the X -row and the x -column, since $\bar{\Xi}$ is symmetric):

$$\bar{\Xi} = \begin{bmatrix} \bar{\xi}^x \\ \bar{\Xi}' \end{bmatrix} = \begin{bmatrix} \bar{\xi}_X^x & \bar{\xi}'^x \\ \bar{\xi}_X' & \bar{\xi} \end{bmatrix}.$$

The immediate consequence of these definitions is the following expression for $\frac{\partial I^S}{\partial Z^L}$:

$$\frac{\partial I^S}{\partial Z^L} = \frac{Xn(\tilde{T})}{\gamma\sigma_{\bar{\omega}}^2 \tilde{K}^2} \left[\frac{\tilde{L}}{\gamma\sigma_{\bar{\omega}}} - \gamma(N(\tilde{T})\tilde{T} + n(\tilde{T})) \left(1 + \frac{\tilde{T}}{\gamma\sigma_{\bar{\omega}}} \right) \right] \bar{\Xi} \cdot \tilde{R} + \frac{\tilde{L}}{\gamma\tilde{K}} \bar{\xi}_X'. \quad (11)$$

Now, substituting (11) into (8) and rearranging terms, we arrive at the following result.

Proposition 2 *If the multinational bank with delegated management of the foreign branch is sufficiently far away from failure, then the lending volume of that branch reacts to changes in the parent bank home country mean return on loans according to*

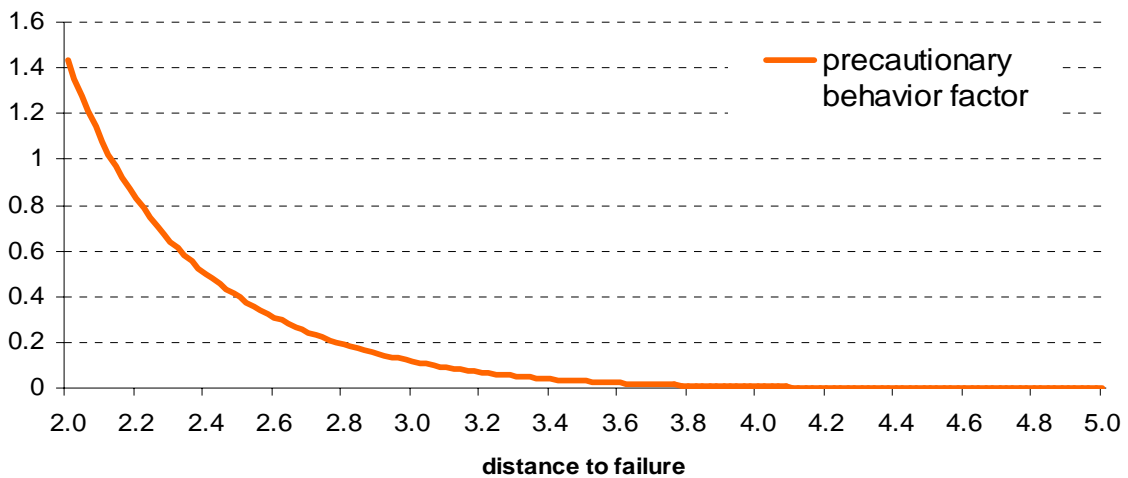
$$\begin{aligned} \frac{\partial x}{\partial Z^L} = & -\frac{\tilde{L}}{\gamma\sigma_i^2\tilde{K}}\omega'^x \cdot \tilde{\xi}'_x + \frac{Xn(\tilde{T})}{\gamma\sigma_i^2\sigma_\varrho^2\tilde{K}^2} \left[\gamma(N(\tilde{T})\tilde{T} + n(\tilde{T})) \left(1 + \frac{\tilde{T}}{\gamma\sigma_\varrho} \right) - \frac{\tilde{L}}{\gamma\sigma_\varrho} \right] \omega'^x \cdot \tilde{\Xi}' \cdot \tilde{R} \\ & - \frac{Xn(T)}{\gamma\sigma_i^2\sigma_\varrho^2K^2} \left[\gamma(N(T)T + n(T)) \left(1 + \frac{T}{\gamma\sigma_\varrho} \right) - \frac{L}{\gamma\sigma_\varrho} \right] z^{*l}. \end{aligned} \quad (12)$$

To obtain an idea of the importance of the last two terms on the right hand side of (12), which appear there due to the precautionary behavior of both the branch manager and the shareholder, let us observe that parameters of the bank portfolio enter those terms with either multiplier

$$\Pi = \frac{n(T)}{\sigma_\varrho^2 K^2} \left[\gamma(N(T)T + n(T)) \left(1 + \frac{T}{\gamma\sigma_\varrho} \right) - \frac{L}{\gamma\sigma_\varrho} \right],$$

or a similar one, calculated with substitute variables. This multiplier is positive in the range of relevant values of T (i.e., those corresponding to a sufficient distance from failure, that is, for which $K>0, L>0$). It grows rapidly to plus infinity as K declines (i.e., as the bank becomes less sensitive to wealth variability) and also falls rapidly to zero as the bank becomes liquidity-insensitive (i.e., T grows to infinity). Naturally, our analysis of the precautionary motives behind lending contagion behavior only makes sense in the intermediate region of distance to failure values. Fig. 2 below illustrates the behavior of the “precautionary factor” Π for a range of T -values between 2 and 5.

Figure 2: Loading of Precautionary Behavior Factors as a Function of Distance to Failure



Note: The graph shows the dependence of Π on T for the risk aversion parameter $\gamma=1.5$ and wealth standard deviation $\sigma=0.5$, the same as Fig. 1.

As illustrated by Fig. 2, the magnitude of the precautionary motives behind the reaction of the branch loan volume x to Z^L -changes diminishes with growing T . Therefore, an important special case of the previous proposition is an LI-bank. Recall that we have defined this in 2.2 as a bank with a sufficiently slack solvency constraint, i.e., one in which the risk-adjusted distances from failure T and \tilde{T} are both big enough. Then, the last two terms on the right hand side of (12) become very small, whereas functions K , L , \tilde{K} and \tilde{L} all get close to either $\gamma N(T)$ or $\gamma N(\tilde{T})$. We can then state the special case of Proposition 2 as

Corollary 1 *As the solvency constraint of the multinational bank with delegated management of the foreign branch becomes more slack (quantities T and \tilde{T} grow towards infinity), the reaction of the lending volume by the foreign branch to the parent bank home country mean return on loans becomes approximately equal to*

$$\frac{\partial x}{\partial Z^L} \approx -\frac{1}{\gamma \sigma_l^2} \omega'^x \cdot \tilde{\xi}_x'. \quad (13)$$

In the LI-bank case covered by Corollary 1, the presence of contagion from home to host country branch lending is determined by the covariance structure of the relevant returns within and across countries. What distinguishes the bank with branch management delegation from financial companies operating on the arm's length principle is the dependence of the risk transmission coefficient on both manager-generated and substitute covariances. More on interpretation of the results follows.

3.5 Discussion

We have characterized a multinational bank as a two-branch investor with two specific features: delegation of the foreign branch management and preference-sensitivity to an illiquidity threshold. Accordingly, the contagion in the lending decisions by branches can be related to either or both of these features. Altogether, depending on the presence of delegation/arm's length management in an LI/LS-bank, there are four cases to distinguish. We comment on the pre-conditions for contagion in all four cases in turn.

Benchmark: arm's length LI-bank (no delegation, $T=\infty$)

The portfolio choice of such a bank and the foreign branch lending response to Z^L -changes follow as a special case from expression (9). When both bank branches are run directly by the shareholder and the bank is of LI type (value \tilde{T} large enough), the ratio $\frac{\tilde{L}}{\tilde{K}}$ is close to unity and the portfolio adjustment simply answers to the need to optimize the certainty equivalent of its risky return. So, the sign of the reaction is determined by the covariance structure:

$$I = \frac{1}{\gamma} (\Xi \cdot \tilde{R} - \gamma \tilde{\Psi} \cdot I^0), \quad \frac{\partial \bar{x}}{\partial Z^L} = \frac{1}{\gamma} \tilde{\xi}_x^x.$$

For contagion to take place it is necessary and sufficient that the element $\tilde{\xi}_x^x$ of the inverse covariance matrix Ξ be positive. In a hypothetical case of tradable loan portfolios, lending

contagion would be present for all international liquidity-unconstrained portfolio optimizers (such as hedge funds) and have nothing to do with the specifics of banking business.

LS-bank without delegation

Our principal result, equation (12), would look different if the foreign branch were not subject to delegated management. The corresponding equation for the substitute loan volume \tilde{x} can be immediately obtained by multiplying (10) by $\tilde{\Xi}$ from the left and taking the x -row of the resulting vector equation:

$$\frac{\partial \tilde{x}}{\partial Z^L} = \frac{\tilde{L}}{\gamma \tilde{K}} \tilde{\xi}_X^x - \frac{Xn(\tilde{T})}{\gamma \sigma_Q^2 \tilde{K}^2} \left[\gamma (N(\tilde{T})\tilde{T} + n(\tilde{T})) \left(1 + \frac{\tilde{T}}{\gamma \sigma_Q} \right) - \frac{\tilde{L}}{\gamma \sigma_Q} \right] \tilde{\xi}^x \cdot \tilde{R}. \quad (14)$$

This equation characterizes the lending volume reaction to the other country lending activity shock in the bank branch operated by the shareholder without delegation. The reaction of this investor type in turn consists of two parts. The first term on the right hand side of (14) represents the reaction of a standard mean/variance optimizing investor, just like in the previously discussed benchmark case (recall that it originates in Z^L being one of the components of mean returns vector \tilde{R}).

The second term can be both positive and negative, depending on the exact covariance structure of returns. One way of interpreting it is by referring to the previously discussed benchmark case as well. Let us imagine a benchmark arm's length international LI-investor which is not a bank (does not take deposits) and has no initial capital ($C=0$). In particular, there are no short-selling constraints for any of the assets. Then, the scalar product $\tilde{\xi}^x \cdot \tilde{R}$ is proportional to this benchmark investor's holdings \bar{x} of shares in the host country loan portfolio. We conclude that the second term on the right hand side of (14) would contribute to lending contagion if and only if the optimal behavior of the benchmark investor would require going *short* on the host country loan portfolio (i.e., both $\tilde{\xi}^x \cdot \tilde{R}$ and \bar{x} are negative). In a bank, going short on customer loans, which are not traded, is impossible, but the same motive will surface in the form of lending contagion.

LI-bank with delegation

This is the case covered by Corollary 1. To interpret the content of equation (13) from that corollary, let us observe that $\tilde{\xi}_X^x = -\frac{\tilde{\omega}'^x \cdot \tilde{\xi}_X'}{\sigma_s^2}$ (a consequence of the inverse matrix definition).

When an LI-bank without delegation (the benchmark case discussed earlier) hires a manager for its foreign branch, the term $\frac{1}{\gamma} \tilde{\xi}_X^x = -\frac{\tilde{\omega}'^x \cdot \tilde{\xi}_X'}{\gamma \sigma_s^2}$ is replaced by $-\frac{1}{\gamma \sigma_l^2} \omega'^x \cdot \xi_X'$. That is, the vector

ω'^x of covariances of the manager-generated returns with random vector \mathcal{E}^S (which consists of returns on other bank balance sheet items) takes the place of the vector $\tilde{\omega}'^x$ of the substitute return covariances with the same random vector \mathcal{E}^S . As a result, cross-border risk transmission can take place as a specific consequence of management delegation. In particular, manager-generated covariances might be zero across countries (one can think of manager expertise with locally limited relevance), so that $\omega'^x \cdot \xi_X' = 0$. However, substitute covariances are generated by the multinational bank shareholder directly; therefore, they are generically non-zero. Accordingly, $\omega'^x \cdot \xi_X'$ may be also non-zero, specifically, negative, giving rise to a lending contagion effect.

Another possible interpretation of (13) is indirect, based upon comparison of bank and non-bank investor behavior. To discuss it in this and the following case, we shall consider a hypothetical international non-bank liquidity-unconstrained investor of the hedge fund type (meaning that it is not leveraged by the deposits D and d and can raise an arbitrary amount of initial funds to invest; the constraint in the form of finite C -level will then disappear from its decision problem) who employs a manager to operate the host country asset portfolio. The manager has the same specific human capital with regard to the loan portfolio as in the bank case. He has full bargaining power vis-à-vis the investment fund shareholder and negotiates a fee according to the same principles as the bank branch manager discussed earlier.

The manager so defined will pick the number x^h of the host country loan portfolio shares given by

$$x^h = \frac{z^{*l} - \omega'^x \cdot \tilde{\Xi}' \cdot \tilde{R}}{\gamma \sigma_l^2} = \frac{z^{*l} - (\omega'^x \cdot \tilde{\xi}'_x) Z^L - \omega'^x \cdot \tilde{\xi} \cdot R^*}{\gamma \sigma_l^2} \quad (15)$$

(R^* means the subvector of \tilde{R} including all components except Z^L). From the second part of (15), we derive that $-\omega'^x \cdot \tilde{\xi}'_x$ is the loading of the home country loan portfolio return in the hedging demand for host country loans. If this loading is positive (i.e., under delegated fund management, the hedging demand for host country loans depends positively on the home country loan returns), there would also exist lending contagion motives in a multinational *bank* with delegation, as expressed by (13).

LS-bank with delegation

This is the most general case, formally described by Proposition 2. In order to interpret the effects of sensitivity to the distance to failure on the lending contagion motives, we shall compare the earlier discussed case of an LS-bank without delegation (equation (14)) with the general result given in (12). Observe, by construction of the inverse matrix, that

$$\tilde{\xi}^x = \frac{1}{\sigma_s^2} (\mathbf{1}^x - \tilde{\omega}'^x \cdot \tilde{\Xi}')$$

($\mathbf{1}^x$ denotes a vector with unity in the x th coordinate and zeros elsewhere). This means that (12) would boil down to (14) if the statistics of loan returns generated by the branch manager were the same as the ones generated by the shareholder as the substitute manager (i.e., $R = \tilde{R}$, $\omega = \tilde{\omega}$). However, delegated management exists exactly for the reason that it is different and attractive to the shareholder. Consequently, in a branch going from direct to delegated management, there can appear additional motives for lending contagion.

The second and third terms in (12), the same as the second term in (14), represent a reaction which can only be significant under moderate values of risk-adjusted distances to failure T and \tilde{T} . The typical value of the coefficient by the scalar product $\tilde{\xi}^x \cdot \tilde{R}$ becomes negative with decreasing \tilde{T} . We might call this element of portfolio adjustment, which is specific to LS-banks as opposed to other types of portfolio optimizers, *precautionary capital rebudgeting*.

When direct management is replaced by delegation, the second term on the right hand side of (14) evolves into two separate terms—the last two in (12)—which we could dub *precautionary rebudgeting under delegation*. The first of them, involving the mean returns other than the branch own return, might be called *precautionary realignment*, whereas the second one, involving only the mean return z^{*l} on the loans granted by the branch manager, could be called *precautionary tuning* or *precautionary parallelism*.

It can be checked directly that the expression in square brackets in the last term in (12) takes positive values for meaningful values of the parameters. This means that precautionary tuning does not induce contagion. This is intuitive: one should not expect an increasing mean return on the host country loans exercise any other than a dampening influence on possible sources of contagious behavior.

Precautionary realignment contributes to contagion every time the expression $\omega'^x \cdot \Xi' \cdot \tilde{R}$ is positive. This is possible if the components of vector $\omega'^x \cdot \Xi'$ have the right signs and magnitudes. For instance, if the component corresponding to Z^L is positive, the one corresponding to $-Z^A$ is negative and their absolute values dominate those of the remaining components, the result is contagion from home to host country lending.

More generally, an interpretation of the precautionary realignment term in (12) can be given by comparing an LS-bank with delegation to an international investment fund (a non-deposit taking institution) with delegation, as in the previous case. The first part of (15), which describes the host country division manager choice of share number in the loan portfolio, shows that this number is given by the standard “Sharpe ratio” term $\frac{z^{*l}}{\gamma\sigma_l^2}$ less the hedging term proportional to $\omega'^x \cdot \Xi' \cdot \tilde{R}$.

So, if the said hedging considerations by the non-deposit taking manager involve a reduction in host country lending compared to the Sharpe ratio benchmark, then, in a bank branch (which does not decide on lending volumes on the basis of standard hedging procedures, let alone cross-border ones), the same hedging term determines the sensitivity to the home country lending performance and contributes to contagion.

Note that the precautionary realignment effect can only be significant in situations where the bank as a whole is sensitive to the risk-adjusted distance to failure (involving both the substitute level \tilde{T} and the actual one T). That is, precautionary rebudgeting under delegation, the same as under direct arm’s length shareholder management, disappears in LI-banks (with low awareness of distance to failure).

The distance to failure measure T which we apply in the model to the bank funds is, actually, a variant of the Sharpe ratio. More precisely, this is a Sharpe ratio in which mean excess returns are measured against the failure trigger Q^0 and which is, in addition, risk-adjusted by the term $-\gamma\sigma_Q$. It would be useful to have some idea about reasonable values of T so that we could decide whether LS-banks or LI-banks would prevail if we decided to use this measure of liquidity. Clearly, failure trigger values for individual banks are unobservable. Returning to the discussion following Lemma 4 in Subsection 3.4, we observe that for our purposes it can only make sense to consider values of T for which the bank shareholder utility depends negatively on the volatility and positively on the trend of the bank funds. (This corresponds to positive values of coefficients K and L that appear in our theoretical results.) According to the numerical experiments conducted, this restriction does not preclude all three coefficients on the right hand side of (12) from being of

comparable magnitudes, meaning a significant precautionary motive for lending contagion that can only be present in LS-banks. Overall, we conjecture that LS-banks should be dominant, even though moderate *T*-values by no means imply an actual danger of insolvency. What we consider probable is that even in a perfectly sound bank, LS-considerations may play a prominent role in shareholder preferences and decisions.

As will become clear in the empirical part of this study, one can detect multinational banks both with and without signs of contagious behavior. The above model explains these differences in cross-border shock transmission within the sample by two factors. First, banks relying on delegated branch management can differ qualitatively from banks who manage international loan portfolios at arm's length. Second, banks as such, if they face highly adverse alternatives to continued operation in the proximity of a hypothetical insolvency boundary, can exhibit contagious behavior even under conditions of full solvency. Therefore, the contagion/"octopusian" (cf. Introduction) reactions observed in many multinational banks in continental Europe might have to do with the highly interventionist attitude of bank regulators.

4. Empirical Evidence on Cross-Border Lending Contagion

4.1 Data Description

In the empirical part we investigate a large set of parent banks worldwide that operated foreign branches and/or subsidiaries with a significant weight in total consolidated assets during the sample period 1999–2003. Our sample comprises 31 parent banks and 59 subsidiaries. Of the top ten largest banks in the world in terms of total assets (as of 2005), our sample covers all important subsidiary-operating banks: Mitsubishi-UFJ Financial Group, Citigroup, Mizuho Financial Group, HSBC Holdings, BNP Paribas, Royal Bank of Scotland, and Bank of America. The complete list of parent banks under consideration is given in Table 1.

The parent banks under consideration have branches and subsidiaries in many countries. We looked at branches and subsidiaries in Canada, the Czech Republic, Estonia, Hungary, Ireland, Korea, Latvia, Lithuania, Mexico, Poland, Portugal, Slovakia, Switzerland, Turkey, the United Kingdom, and the USA. That is, we restricted our sample of host countries to OECD members and otherwise fully industrialized economies. The reason is that multinational bank activities in emerging and transition economies not only occupy a much more modest role in their total business, but also are often driven by motives and rules different from the ones valid for a standard industrialized environment. The other sample selection criteria were: a sufficient share of the foreign unit in total bank assets, a sufficiently prominent presence of the foreign unit in the host country commercial banking sector, the parent company of a foreign-owned bank being a commercial bank itself, and the existence of the parent and dependent units without major reorganizations for the majority of the years in the sample.

Table 1: List of parent banks

1	<i>Allied Irish Banks</i>	17	Crédit Lyonnais
2	American Express Company	18	<i>Erste Bank</i>
3	<i>Banca Intesa</i>	19	Foereningssparbanken - Swedbank
4	Banco Bilbao Vizcaya Argentaria	20	GE Capital International Financing Corp.
5	<i>Banco Comercial Portugues</i>	21	<i>HSBC Holdings</i>
6	Banco de Sabadell	22	ING Groep
7	Banco Santander Central	23	<i>MBNA Corporation</i>
8	<i>Bank of America Corporation</i>	24	<i>Merrill Lynch & Co.</i>
9	Bank of Ireland	25	Mitsubishi Tokyo Financial Group
10	Royal Bank of Scotland	26	Mizuho Corporate Bank
11	<i>Barclays Bank</i>	27	<i>National Australia Bank</i>
12	<i>Bayerische Hypo und Vereinsbank</i>	28	<i>Raiffeisen-Holding Niederoesterreich-Wien</i>
13	<i>BNP Paribas</i>		
14	<i>CERA (KBC)</i>	29	<i>Skandinaviska Enskilda Banken</i>
15	<i>Citigroup</i>	30	<i>Société Générale</i>
16	<i>Commerzbank</i>	31	<i>Unicredito Italiano</i>

In order to capture host and home country macroeconomic developments, we collected data on inflation, GDP growth, long-term yields on government bonds, and exchange rate volatility between the parent bank country currency and the subsidiary country currency. Exchange rate volatility was measured as the standard deviation of the monthly average growth rates of the exchange rate from the average annual growth rate. This measure excludes the long-term trend element of exchange rate behavior, against which, as we presume, multinational banks are able to protect themselves at a low cost (and also excludes cases of fully anticipated policy-driven trends as in crawling peg regimes, e.g. in Hungary and Poland). So, we only analyze the role of short-term exchange rate uncertainty on the decisions concerning lending abroad. (Recall that the model of Section 3 predicts that such uncertainty will impact on lending behavior.)

To measure the parent bank cost of managing the credit risk of the home country loan portfolio (to be called *CR-cost* in what follows), we take the ratio of loan loss reserves to total loans. We study in particular the effect that the CR-cost of the parent bank can have on the lending volume in the subsidiary bank, controlling for macroeconomic variables and bank specific decisions.

The data used in the analysis originate from the BankScope database. The descriptive statistics for the indicators over 1999–2003 are presented in Table 2.

Table 2: Descriptive statistics

	mean	std. dev.	min	max
Growth of subsidiary's total loans	22.78	57.95	-56.72	648.1
Parent bank loan loss reserves to total loans ratio	0.039	0.069	0.005	0.56
Exchange rate volatility	0.97	0.701	0.0	3.53
GDP growth				
home country	2.7	2.07	-1.1	11.1
host country	3.5	2.58	-1.7	11.1
Inflation				
home country	2.24	1.19	-0.9	5.8
host country	3.63	3.23	-1.1	15
Long-term interest rate				
home country	4.82	0.86	0.99	6.25
host country	7.22	4.55	3.0	24.1

From the table it is apparent that credit creation at the subsidiary level evolved quite dynamically, with the mean rate of growth of total loans reaching nearly 23 percent. Nevertheless, the variance of the rate of growth was very high. The ratio of loan loss reserves to total loans averaged 4 percent and varied quite significantly, by 7 percent. The exchange rate volatility between the parent bank home and subsidiary host country currencies fluctuated around a mean of 1 percent with a standard deviation of 0.7 percentage points, with the maximum fluctuation reaching 3.53 per cent. Moreover, it follows from the descriptive statistics that GDP growth in the host countries exceeded that in the home countries by one percentage point on average. Inflation was also 1.5 percent higher in the host countries than in the home countries, and, finally, long-term interest rates were 2 percentage points higher on average in the host countries than in the home countries. In addition, the indicators for the host countries, as well as showing higher average values, are more volatile than those for the home countries. This is consistent with higher returns in the host countries, albeit with higher uncertainty.

Note that we do not use aggregate host country credit growth as an explanatory variable. According to the verification that we conducted, the same underlying growth factor is to a large extent already contained in the GDP series. One is unlikely to find additional drivers of MNB credit growth in the countries of penetration, given that penetration takes place only into economies with a clear borrowing demand growth potential.

4.2 Estimation results

The estimation was carried out using the fixed effects estimator, where the fixed effects represent the autonomous decision of every subsidiary bank in terms of its credit creation. We ran two types of regression: parenthood and regional regression.

In the *parenthood* regression we investigated the sign and significance of the relationship between CR-cost in the parent bank and lending growth in the subsidiary. In order to address the issue of possibly different behavior of parent banks toward their subsidiary banks in reaction to the parent banks' CR-cost, as follows from the theoretical model in the first part, we performed a detailed

regression in which for each parent bank we estimated the bank-specific reaction of the subsidiary to the parent bank's ratio of loan loss reserves to total loans. Formally,

$$\Delta \ln L_{i,t} = \alpha_i + \beta_1 \Delta \ln GDP_{i,t}^{\text{home}} + \beta_2 \Delta \ln GDP_{i,t}^{\text{host}} + \beta_3 \pi_{i,t}^{\text{home}} + \beta_4 \pi_{i,t}^{\text{host}} + \beta_5 i_{i,t}^{\text{home}} + \beta_6 i_{i,t}^{\text{host}} + \gamma \sigma_{ER,i,t} + \sum_{i=1}^{31} \delta_i LLP_{i,t}, t_i + \varepsilon_t, \quad (16)$$

where L denotes the volume of credit granted, α_i is the fixed effect of subsidiary i , GDP represents the gross domestic product of the respective country (host or home), π denotes inflation (host or home), i is the long-term interest rate (host or home), σ_{ER} is the standard deviation of the exchange rate between the home and host country, and, finally, LLP stands for loan loss provisions. Terms ε represent i.i.d. disturbances.

We grouped the parent banks that turned out to have the same sign of the bank-specific coefficient and performed a two-group regression, namely, groups with a negative and positive effect on lending in the subsidiary bank as a result of a parent bank CR-cost surge, as follows:

$$\Delta \ln L_{i,t} = \alpha_i + \beta_1 \Delta \ln GDP_{i,t}^{\text{home}} + \beta_2 \Delta \ln GDP_{i,t}^{\text{host}} + \beta_3 \pi_{i,t}^{\text{home}} + \beta_4 \pi_{i,t}^{\text{host}} + \beta_5 i_{i,t}^{\text{home}} + \beta_6 i_{i,t}^{\text{host}} + \gamma \sigma_{ER,i,t} + \delta_1 LLP_{19} + \delta_2 LLP_{12} + \varepsilon_t. \quad (17)$$

where LLP_{19} and LLP_{12} are the loan loss provisions for, respectively, the 19 banks and 12 banks in the groups of positive and negative detailed regression coefficient δ in (16).

In the case of the *regional* regression, we grouped the parent banks according to the countries where they operate subsidiaries. In this way, we created four blocks of countries (subsidiary regions, SR): Central and Eastern Europe, Old Industrial Countries, New Industrial Countries, and Baltic Countries. Central and Eastern Europe comprises the Czech Republic, Hungary, Poland, and Slovakia; the Old Industrial Countries are Canada, Ireland, Portugal, Switzerland, the UK, and the USA; the New Industrial Countries are represented by Mexico, Turkey, and Korea; and the Baltic Countries include Latvia, Lithuania, and Estonia. Thus, we estimate the following relation:

$$\Delta \ln L_{i,t} = \alpha_i + \beta_1 \Delta \ln GDP_{i,t}^{\text{home}} + \beta_2 \Delta \ln GDP_{i,t}^{\text{host}} + \beta_3 \pi_{i,t}^{\text{home}} + \beta_4 \pi_{i,t}^{\text{host}} + \beta_5 i_{i,t}^{\text{home}} + \beta_6 i_{i,t}^{\text{host}} + \gamma \sigma_{ER,i,t} + \sum_{r=1}^4 \delta_r SR_r * LLP_{i,t} + \varepsilon_t. \quad (18)$$

The results of the estimations are displayed in Table 3. In the parenthood regression, we tested an unrestricted model containing the entire set of the variables considered, i.e., home as well as host key macroeconomic variables. By excluding the statistically insignificant variables we derived the restricted specification. The overall variability in the data explained by our model remains unaffected by the exclusion of the redundant variables. Nevertheless, the coefficient estimates in the restricted specification became more efficient without substantial changes in parameter values (the Hausman specification test, Hausman (1978), yields $\chi^2_5(2.06) = 0.85$). In the case of the

regional regression we report the restricted specification only. The choice of the fixed effects model was confirmed by high correlations of residuals with covariates, and plain ordinary least squares were rejected by the F-test. We did not opt for a dynamic specification, as the serial autocorrelation in the error term turned out to be very low ($DW = 1.99$). The low past dependence might be related to the relatively short time span used, as the average bank is observed for 4.5 years. The empirical specifications (16)–(18) exhibit satisfactory explanatory power, given the type of regression.

Table 3: Fixed-effects regressions

	parenthood regression		regional regression
	unrestricted	restricted	restricted
Intercept ^{a)}	14.82(24.18)	35.82*** (12.4)	22.6** (11.35)
Home country GDP growth	1.79(1.96)	-	-
Home country inflation	1.31(3.56)	-	-
Home country long-term interest rate	4.01(5.47)	-	-
Host country GDP growth	-1.28(1.07)	-	-
Host country inflation	-3.94*** (1.41)	-3.24*** (1.31)	-3.57*** (1.35)
Host country long-term interest rate	4.99*** (1.02)	4.82*** (0.99)	4.99*** (1.01)
Exchange rate volatility	-8.9** (4.55)	-7.22* (4.35)	-7.09* (4.4)
Parent's loan loss reserves to total loans ratio:			
Group 19 (negative sign in detailed regression)	-17.51*** (4.86)	-18.36*** (4.73)	-
Group 12 (positive sign in detailed regression)	10.26* (5.76)	9.42* (5.67)	-
Number of subsidiary banks/parent banks	59/31	59/31	-
Central and Eastern Europe ^{b)}	-	-	-17.81*** (5.56)
Old Industrialized Countries ^{c)}	-	-	-0.36 (5.36)
New Industrialized Countries ^{d)}	-	-	26.10 (18.14)
Baltic Countries ^{e)}	-	-	21.29 (77.21)
Sigma u/sigma e/rho	1.64/0.29/0.97	1.67/0.29/0.97	1.68/ 0.3/ 0.97
Correlation of residuals with covariates	-0.937	-0.941	-0.937
Hausman specification test	-	$\chi^2_5(2.06) = 0.85$	-
DW	1.99	1.994	1.98
Favor fixed-effects vs. plain OLS	F(58,196)=3.94	F(58,200)=4.37	F(58,199)=4.42
R-square: within/between/overall	0.21/ 0.71/ 0.32	0.19/ 0.71/ 0.33	0.18/ 0.62/ 0.28

Note: annual data 1999–2003; 264 observations; standard errors in parenthesis; time observations per parent bank: min 2/avg 4.5/max 5. ^{a)} The intercept represents the average over the set of fixed effects.

^{b)} The Czech Republic, Slovakia, Poland, and Hungary. ^{c)} Canada, Ireland, Portugal, Switzerland, the United Kingdom, and the United States. ^{d)} Mexico, Turkey, and Korea; ^{e)} Latvia, Lithuania, and Estonia.

As we can see from Table 3, the home factors turn out to be relatively unimportant, while, on the contrary, host country economic developments prove to be very influential. This finding suggests that general macroeconomic developments in the home country are not a significant source of lending contagion to the host country. This might indicate that lending contagion in liquidity-

insensitive banks (i.e., those who act more or less like standard portfolio optimizers, cf. Subsection 3.5), which should stay in relation to asset return statistics co-driven by macro fundamentals, might be of subordinate importance empirically.

On the contrary, the host country factors, particularly inflation, long-term yields, and exchange rate volatility, play an important role. An increase in host country inflation by one percent decreases the growth of total loans in a branch/subsidiary in that country by roughly 3 percent. Also, an increase in the host country long-term interest rate by one percent increases the growth of loans by nearly 5 percent. A percentage increase in exchange rate volatility reduces lending by 7 percent. The latter result promotes the exchange rate to the role of the variable with the most sizeable influence.

Finally, when testing the impact of the CR-costs of the parent bank on credit growth in the subsidiary, we found a statistically significant relation. This proves that not only do host country factors matter, but the intermediated influence of home factors through parent bank operations can be statistically verified as well. Specifically, two-thirds of the parent banks in our sample restrict lending in their subsidiaries in response to a loan quality deterioration at home, i.e., they exhibit intra-bank lending contagion. One-third of the banks behave inversely, i.e., they increase lending in their subsidiaries as a result of growing CR-cost at home, although the effect is smaller and statistically weaker than that for the group of banks prone to contagion.

In the multinational bank list in Table 1, parent banks that reduce lending in their branches and subsidiaries in the case of a parent bank CR-cost shock are featured in *italics*. Conversely, the remaining banks, featured in **boldface**, behave more like conventional cross-border portfolio diversifiers.

To what extent the results are driven by differences in the regions where the subsidiary banks operate can be examined with the help of regional regressions. The results suggest that the parent banks that run subsidiaries in Central and Eastern Europe typically show signs of intra-bank lending contagion. This is not very surprising, given the high degree of economic integration of this region with the euro area, from where most of the penetrating MNBs there originate. According to the popular view, the penetration itself has contributed substantially to credit growth due to technology and know-how transfer into the dependent units. However, our analysis was not designed to look for lending contagion in the credit growth figures as such, but rather in the deviations from the growth trend caused by parent bank-related factors. And, indeed, coming to the same region each MNB behaved somewhat differently. Nevertheless, the majority, if not all of them, show signs of home-host contagion.

On the contrary, parent banks that operate subsidiaries in the old industrialized, newly industrialized and Baltic countries behave differently. More generally, we can select banks with lending contagion behavior by looking at the results for individual parent banks (see the outcomes of the parenthood regressions in Section 4). Then, in the sublist of multinational banks prone to lending contagion, we mostly find European banks with dependent units in other European countries. In those, sensitivity to liquidity (the LS-effect of Section 3) is likely to be more pronounced (meaning that outside intervention due to an increasing probability of illiquidity is more likely to happen there than in other jurisdictions). For instance, relatively “easy” intervention triggers, as a result of the dominant interventionist regulatory attitude of

policymakers in Europe, should put most of these banks in the LS-category in our terminology. That is, we would often observe precautionary rebudgeting in response to CR-cost shocks—specifically, precautionary realignment. (Recall that we call *precautionary realignment* the impact on the host country branch lending volume sensitivity to the home country lending return, coming from asset characteristics available to the multinational bank as a whole.) The latter effect should be considered a likely explanation of lending contagion in the group of banks considered.

5. Conclusion

This paper introduced a model of a multinational bank dependent on the specific human capital of the foreign branch management. The model is applied to a risk-averse bank shareholder operating a domestic branch herself and employing a manager with specific skills in the foreign country. We investigated the reaction of the foreign country branch to a shock happening to asset returns in the home country, and compared it to the reaction to the same shock of a bank acting as an arm's-length investor. The key notion that we founded our analysis upon is the hypothetical substitute decision making of a bank shareholder in case she decides to do without the manager's skills and save on his fees. The substitute portfolio decisions are different from the actual decisions of the manager. The latter bases his effort and lending choices on the intention to stay marginally more attractive to the shareholder than her own substitute management of the branch.

Since the manager's fee derives from his ability to outperform the shareholder's substitute earnings, the lending volume is influenced by variables outside the branch. And those, given the shareholder's intertwined decisions worldwide, are cross-border interdependent. So, formally, although the investment opportunity set of the manager is strictly local (limited to host country lending), he is forced to think "globally". This is the agency phenomenon able to produce lending contagion.

Quantitative differences in the shock response in an international portfolio-optimizing environment with and without the agency problems have been found, as expected. More importantly, we have found that there might also be qualitative differences. That is, if the country is foreign to the shock, the latter can have opposite impacts on credit creation in an arm's-length bank branch than in a branch with delegated management. In the model, this happens only on condition of a bank with a high sensitivity to the distance to failure in terms of a modified Sharpe ratio of its assets. The factor responsible for this phenomenon is manager sensitivity to possible termination of the parent bank's operation.

The panel regression conducted on a large sample of multinational banks has shown the presence of lending contagion in 19 out of the 31 parent banks examined. When one looks at the phenomenon from the point of view of the region that hosts the foreign banks, the one with a significant contagion effect is Central and Eastern Europe. In view of our theoretical analysis, one might conjecture that the foreign banks operating there are most likely to rely on delegated management. (Indeed, in most cases, penetration meant taking over pre-existing institutions with some business history.) In other cases, inconclusive or diversification-favoring estimation results could be explained by adherence of the parent banks to arm's length management principles (newly industrialized countries) or close proximity of the home and host country bank loan

markets with little space for managerial capture effect, and the small relative size of the controlled foreign units (as in the Baltic countries).

A frequently posed question is the influence of exchange rate noise on foreign bank operation. This issue is not considered in full detail, but the model suggests that, as with any other external shock, branches of tightly regulated banks are more sensitive to exchange rate volatility than branches of financial institutions resembling other types of international investors. Empirically, the exchange rate uncertainty between the home and the host economies is the strongest explanatory factor of lending contagion in banks which are prone to it. The result is robust to the regional grouping of dependent units as well as the inclusion of alternative macroeconomic explanatory variables for the parent bank home country.

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