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In 2007 all ECB publications feature a motif taken from the €20 banknote.

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2 Czech National Bank, Na Příkopě 28, CZ-115 03 Praha 1, Institute of Economic Studies, Faculty of Social Sciences, Charles University, Opletalova 26, CZ-110 00 Praha 1, and Institute of Information Theory and Automation, Pod vodárenskou věží 4, CZ-182 04 Praha 8, Czech Republic; e-mail: Alexis.Derviz@cnb.cz

3 Czech National Bank, Na Příkopě 28, CZ-115 03 Praha 1, Czech Republic; e-mail: Jiri.Podpiera@cnb.cz

Address
Kaiserstrasse 29
60311 Frankfurt am Main, Germany

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

Telephone
+49 69 1344 0

Website
http://www.ecb.europa.eu

Fax
+49 69 1344 6000

Telex
411 144 ecb d

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Abstract

We study both theoretically and empirically the interdependence of lending decisions in different country branches of a multinational bank. First, we model 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. A separate channel of shock propagation exists since lending decisions are influenced by delegation and precautionary motives. This can entail "contagion", i.e. parallel reactions of the loan volumes in both countries to the parent bank home country disturbance. Second, we look for the presence of lending contagion by panel regression methods in a large sample of multinational banks and their affiliates. We find that the majority of multinational banks behave in line with contagion effect. In addition, the presence of contagion seems to be related to the geographical location of subsidiaries.

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

JEL Classification: F37, G21, G28, G31

Non-Technical Summary

The 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 reasoning influences the 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 the domestic economic or financial fundamentals, can distort lending decisions within their jurisdiction. We concentrate on the latter aspect by investigating the probable causes and empirical relevance of lending contagion from the parent bank itself or economic conditions in its home country, to an affiliate in a different country. This is done both theoretically and empirically.

We set up a model that is able to highlight the interplay of home country (where the parent bank is incorporated), the host country (where the affiliate operates) and bank-specific ingredients in the optimal lending volume selection. Two properties 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 shareholder can choose to do without the manager by operating the branch herself "at arm's length", but the return on loans granted by the branch can both be lower on average than under delegated management and have a different distribution. We call the choices made by the shareholder for the branch under this hypothetical arm's length operation *substitute*.

The MNB shareholders have to select their portfolio taking into account the branch earnings net of the manager fee. Accordingly, their effective choices, including the one regarding the budget of the branch, are based on the statistics of substitute returns and not the returns achieved under delegated management. On the other hand, the actual lending volume in the branch is based on the local manager choices. We call lending contagion the outcome of the model in which the partial derivative of the branch loan volume with respect to the average return on loans in the parent bank is positive. The latter variable has been selected as a summary statistic for the disturbances affecting the operation of the MNB in its home country (cum all other foreign branches). Thus, contagion can be both positive and negative, meaning better/worse performance in the parent inducing more/less lending in the branch, respectively. Both delegation and liquidity-sensitivity can give rise to lending contagion, depending on the interplay of actual and substitute return statistics. Most importantly, <u>under delegation</u>, even if returns generated by the local manager are uncorrelated with the parent bank domicile variables (a natural special case), non-zero cross-country correlation of the shareholder's substitute returns is able to induce contagion. Although the branch manager has a local investment opportunity set, he cannot afford to also think locally. Given his fee determination rule, a co-movement of earnings in all MNB divisions under the hypothetical arm's length management by the shareholder implies that the branch gets a higher/lower budget when the parent earns more/less, even though the manager himself is able to earn on loans independently of the parent bank. In addition, contagion can be supported by <u>liquidity sensitivity</u>. To understand this, we compare the MNB actions with ones of a fictitious non-

leveraged (i.e. not deposit-taking) international investor with the same loan portfolios in different country divisions. In this hypothetical economy such an investor could trade in loans, including taking short positions, without frictions. Under many return covariance constellations, this fictitious investor would have optimally chosen to go short on the host country loans. The bank cannot do this with actual loans, but the same covariance parameters will induce lending contagion.

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 explanatory variables are home and the host country macro fundamentals (GDP growth, inflation and long-term interest rates), a measure of home-host country bilateral exchange rate volatility and a measure of credit risk management costs in the parent bank. Given the specific features of foreign bank operation in emerging countries, ridden with many unobservable and poorly measurable factors, we have concentrated on MNBs in industrial countries only. The time dimension of the sample (1999-2003) aims at covering a relatively stable landscape of MNBs without dramatic structural shifts in their ownership and capital structure.

We have created four blocks of countries in which MNBs operate: Central and Eastern Europe (Czech Republic, Hungary, Poland, and Slovakia), Old Industrial Countries (Canada, Ireland, Portugal, Switzerland, U.K. and the U.S), New Industrial Countries (Mexico, Turkey, and Korea), and Baltic Countries (Estonia, Latvia and Lithuania). We find that

- The home country macro factors aren't particularly important as a source of lending contagion, while, on the contrary, the host country ones are. It may indicate that lending contagion in liquidity-insensitive banks (i.e. those who act more or less like standard portfolio optimizers), which should stay in a relation with asset return statistics co-driven by macro fundamentals, is of subordinate importance
- In all cases, the exchange rate volatility plays an important role
- There is a statistically significant relation of credit risk costs of the parent bank with the credit growth in the branch. Two thirds of the parent banks in our sample expand/restrict lending in subsidiaries as a response to loan quality improvement/deterioration at home. The remaining banks behave inversely, as standard portfolio diversifiers.
- The regional regressions suggest that the MNBs with branches 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 which most penetrating MNBs there originate. On the contrary, parent banks that operate subsidiaries in the old industrialized, newly industrialized and Baltic countries show few signs of lending contagion.
- Among the banks prone to lending contagion, we mostly find European banks with affiliates in other European countries. Here, sensitivity to liquidity is likely to be more pronounced due to an interventionist regulatory attitude of policymakers, even though a regulatory action is often more of a rescue than a penalty for the shareholders. If this is the case, we should frequently observe precautionary rebudgeting in response to credit risk cost shocks.

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

1. Introduction

Does an internationally active bank adjust its lending portfolios across countries in accordance with conventional risk/return considerations? Or does it behave more like an octopus, who 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. It is important to know the answer if one needs to assess the impact of loan quality changes in one country on credit creation in another. In particular, it would be easier to decide whether the consequences of a shock in one country on the business sector financing in another are different in economies with a different degree of foreign-bank penetration.The are indications 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, beside the associated theoretical challenge, are of great practical importance for economies that are financially integrated with larger, external ones.

Branches and subsidiaries of foreign commercial banks are visible in financial sectors of most industrialized economies. This paper does not study the reasons for foreign bank penetration, asking instead the question about factors behind expansion or contraction of a particular bank 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 the parent bank does well) and negative (it is lent less everywhere although loan quality has deteriorated only in the parent bank's country). We therefore study and test for systematic presence of diversification as well as contagion in multinational bank (MNB) 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 MNBs 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 operation in an open economy along the branch form, that is, without separate capital requirements and with a centralized alternative to localized management. In this way, we acknowledge two stylized facts of foreign-owned bank activities in many countries: overcapitalization (i.e., slack regulatory capital constraints) and the 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 as complementary to those studies directly addressing the organizational-form aspects of international bank risks, as well as deposit insurance (Calzolari and Lóránth 2004, Dermine 2003, Lóránth and Morrison 2003).

The MNB that we have in mind faces fundamental market imperfections unkown to a textbook international investor in a frictionless market: it grants customer loans, i.e. has non-traded assets on the balance sheet. Cosequently, it faces 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 the manager-shareholder and manager-borrower interaction is present backstage. Specifically, we do not elaborate on the reasons a bank takes deposits (with which it overcomes 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, the extent to which managerial human capital is being employed would correspond to the degree to which relationship-banking features prevail in the economy. When the relationship banking degree is high, the incumbent manager usually faces very little competition from others, since his human capital is tightly linked to expertise on the current clients and loans. This link gives the manager an especially strong negotiating position vis-á-vis the bank shareholders – this circumstance is exploited in our model. At the same time, a bank is able to attract deposits only because the overall rents from improved debt collection are not entirely appropriated by the managers themselves. Part is being 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. In this way, the depositors ensure that the shareholders credibly commit to audit the managers and the latter – to monitor the borrowers. Consequently, one is able to explain why banks usually prefer deposits to other forms of external finance, such as equity.

We study what happens to the provision of credit by the bank branch in the host country if an exogenous shock to business activity occurs in the parent bank's home country. Especially, what is specific about MNB's behavior if compared to a multinational investor who is not a bank but an international portfolio optimizer handling all assets at arm's length? As outlined above, we consider a bank to be different due to two factors: *delegation* of loan management (induced by non-tradability and the presence of borrower-specific information asymmetry) and *sensitivity to the risk of failure*. For lack of established terminology in the literature (which is not particularly rich in the discussed subject), we use the term *liquidity-(in)sensitive banks* in the exposition of the model. The mentioned sensitivity is different in a bank as opposed to non-bank due to the potential for either a depositor run or a preemptive regulatory intervention.[4]

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

[4] Since we focus on the credit-creation aspects of the banking industry, explicit coverage of bank failure and closure alternatives is not essential. Therefore, we model bank shareholders and managers who only take into account a possible termination of activity for reason of a depositor run or a regulatory action as a latent threat.

excess of what the bank shareholder could do by direct involvement in the branch. Since the shareholder arm's length returns might have non-zero correlations across countries (e.g. due to common noise components, exchange rate volatility, etc.), also the branch manager lending decisions that maximize his fee, are influenced by variables outside the country of his operation. In this way, both cross-border diversification and contagion can emerge, depending on the joint statistics of returns. The manager actions confined to one country must take into account the MNB 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 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 materealizes.[5]

The analysis confirms the existence of both qualitative and quantitative differences between responses to shocks abroad by the bank with delegated branch management and the arm's-length lender. In all considered cases of MNB operation, both lending contagion and diversification follow from fully rational behavior under particular statistical properties of the risk factors. More specifically, our main findings, which seem to be robust to reasonable generalizations of the model with regard to organizational form and manager autonomy, are as follows.

1. When a standard international portfolio optimizer would diversify (i.e. shift funds to other country branches) in response to a country-specific shock to return on loans, a bank with delegated branch management might be susceptible to lending contagion, depending on the statistics of manager-specific earning ability.
2. 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.
3. Empirically, more than one-half of multinational banks with non-negligible foreign branch weight show signs of lending contagion. From the regional point of view, most contagion is found in the European MNBs with significant cross-border penetration into new EU member states from Central Europe.

Structure of the paper: Section 2 contains a literature review, Section 3 introduces the model, Section 4 presents empirical results from a panel regression of multinational bank lending, concerning the reaction of foreign branches to domestic and foreign shocks; Section 5 concludes. A proof of the main technical result is given in the Apepndix.

2. Literature review

The number of contributions to theoretical literature on international bank behavior has so far been relatively small. Clearly, substantial difficulties in creating a generally accepted theory of a bank as a specific case of financial intermediary would be exacerbated by the need to include an international aspect. An early treatment of the relations among bank organizational structure, management incentives, and credit policies can be found in Dewatripont and Tirole (1993). The model of that paper accommodated the roles of shareholder, depositor, and

[5] We are grateful to Falko Fecht for suggesting this example.

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 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 devoted to its monitoring is partially unobservable (see Diamond and Rajan, 2000). Beside 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. The message of both models can be expressed in terms of bank-internal capital market operation. For instance, one can draw parallels between Froot and Stein's (1998) projects in which a bank invests on one hand and the MNB branches to which it allocates budget, on the other hand. 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 extend this farther by tracing down 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 lending decisions of branches after the parent bank budget has been decided upon.

Extending the agency theory to multinational banks, as in Külpmann (2000), involves deepening the analysis to the level of individual divisions (branches) and their managers' optimal choices. On the cross-border risk transmission side, 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 subsume that international asset diversification is an important motive in multinational-bank decision making, which is long recognized in international finance (see, e.g., Heston and Rouwenhorst, 1994).

On the empirical side, the specific topic of foreign-bank presence in the Eastern Europe was covered by two statistical studies by de Haas and van Lelyveld (2004, 2006a), which use Bank for International Settlements' and BankScope statistics ending in 2000. Developing on earlier empirical literature mainly concerned with Latin America, these papers 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), 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 Central and Eastern Europe, 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 primarily used 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 (2006b) extends the perspective of their earlier studies to multinational banks on a global scale. There are clear affinities between their paper and the present paper both in the object of interest (determinants of lending behavior of MNB subsidiaries), the used data (bank-level financial characteristics taken from BankScope, the home and the host country economic fundamentals) and the econometric techniques (fixed effect panel regression). Similarly to our search for diversification vs. contagion, they look for substitution (from weak to strong) vs. support (of the weak by the strong) in lending patterns across subsidiaries. However, beside partial methodological differences from de Haas and van Lelyveld (2006b), 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 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 MNB-internal capital market which rationalizes both diversification and contagion (and would equally well rationalize substitution and support if we moved focus from parent-subsidiary to subsidiary-subsidiary shock transmission channel in accordance with the their vantage point). Third, we take into account inevitable structural changes in any MNB if followed for a too long number of years. Specifically, not a single MNB in their sample can be claimed to exist unchanged, without at least one major reorganization, during the time span 1992-2004 that they have chosen. On the contrary, we have preferred to choose the temporal dimension of our panel that would capture the most recent stable state of 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 de Haas and van Lelyveld (2006b), should be an important summary statistic for many cross-border frictions that influence fund flow from center to dependent units in an MNB.

Lastly, a relatively significant portion of the existing international bank models focus on related regulatory issues. Holthausen and Rønde (2004) study the impact of the home- and the 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.

3. A model of multinational bank with delegated foreign branch management

There are two countries in our model, which we call home and host. A multinational commercial 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. 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 is endowed with 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 take place, and the second when returns are realized and interest and fees are paid. The shareholder is a risk-averse expected-utility maximizer. The uncertainties at date 0 exist with regard to: returns on loans, returns on outside assets (exchange-rate adjusted in the case of the host country), and the deposit-withdrawal rates in both countries.

As a notation convention throughout this section, uppercased letters are used for the home-country variables and lowercased letters for the host country ones.

3.1 Bank Balance Sheet and Cash Flows

Let B, D, X^0, and X be, respectively, shareholder own funds (capital), deposits, cash holdings, and granted loans, for the parent bank. B is a portion of the total investment funds C. That is, if A denotes funds invested in alternative assets, and b is 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 the loans earn a risky rate of return R^L. The same lowercase 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 the excess returns on loans, deposits, and outside assets over the risk-free rate.[6] Given the home branch balance-sheet identity B+D=X^0+X, the expression for domestic branch disposable funds can be rewritten as:

$$W = XY^L + DY^D - BY^A . \tag{1}$$

Analogously for the foreign branch, let b be the capital allocated to it, d the volume of deposits there, x^0 the cash holdings and x the volume of loans. 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

$$w = xy^l + dy^d - by^a . \tag{2}$$

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 gross funds at date 1 coming from both bank branches is W^S=W+(1+τ)w, where τ is the rate of the host country currency appreciation between periods 0 and 1. From this, one shall subtract the manager fee f, which is negotiated in period 0. By using the symbols y^{*l}=(1+τ)y^l, y^{*d}=(1+τ)y^d, y^{*a}=(1+τ)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

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

Note that Q differs by the amount D+(1+τ)d from the expression for the bank 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 risks distribution) *The random variables Y^L, Y^D, y^{*l}, y^{*d}, Y^A and y^{*a} are jointly normally distributed.*[7]

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. If we denote the means of the excess returns mentioned in Assumption 1 by Z^L, Z^D, z^{*l}, z^{*d}, Z^A and z^{*a}, then

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[6] 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 when only a fraction of deposits is withdrawn and, accordingly, V is a random variable distributed around a mean value substantially below unity.

[7] As already mentioned, the exchange rate uncertainty is not being 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.

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

If Q falls below a given threshold Q^0, the bank fails (which can mean a depositor run, a forced administration or other forms of activity termination and removal of the shareholder rights), and the shareholder 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 controlled funds $\mathbf{Q}$, defined as Q if $Q \geq Q^0$ and zero otherwise. Formally, we have the expected utility equal to

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

Symbol $\mathbf{1}_{\{\mathbf{Q} \geq Q^0\}}$ 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

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

where

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

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, i.e. to prevent the problem from becoming vacuous, the asset returns contain random noises even though the latter are unaffected by the relationship-banking degree, that is, they are seemingly unrelated to the central object of our interest.

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 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 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 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 involved borrowers, 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).[8]

[8] Regardless of the specific mechanism giving the manager a debt-collecting advantage over the shareholder, qualitatively, the assumption is a standard one in the principal-agent context. One possible (but not unique) construction in the background is the following: 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 falls to zero as the human capital grows to infinity.

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

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

Of course, the lending decision $\tilde{x}$, taken by the shareholder acting alone, as well as 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*. These quantities characterize the shareholder's outside option in the bargaining game with the branch manager.

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.*

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

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

with

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

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

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 countries and the lending volume X in the home country part of the bank, which we handle as if it were managed directly.[9] Introduction of a separate delegation problem in the home country would not change the results, but make the model more complicated.

For the (off-the-equilibrium-path) case when the host country manager is not hired, the shareholder also selects the substitute loan volume $\tilde{x}$ in the foreign branch. (Recall that the

[9] This assumption is not central to the analysis, but considerably simplifies the calculations. The home country bank variables can be considered summary statistics of the management structure in which its own delegation problem is being resolved, but is not treated explicitly here.

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 $\tilde{I} = [\tilde{x}, I^S] = [\tilde{x}, X, -B, -b]$, whereas that of the manager – by the vector $[x,f]$.

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 the 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, which was chosen as a likely one at least in a relatuionship-banking environment.[10] Another reason for this choice is a considerable resulting increase in computational tractability of the model.

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

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

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.

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 manger'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.

[10] Alternatively, in Diamond and Rajan, 2000, the bargaining power is split at random between the shareholder and the manager, each of them given, with probability ½, 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.

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 $\tilde{T}$ which maximizes $\tilde{U}$. Clearly, $\tilde{T}$ does not depend on the manager-selected loan volume x (because $\tilde{U}$ does not). Strict concavity of $\tilde{U}$ implies $\frac{\partial \tilde{U}}{\partial \tilde{T}} = 0$ for the optimal choice.

The selection of x by the manager is made so that $f = F(x, \tilde{T})$ is maximized given $\tilde{T}$. 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 $\tilde{T}$, 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 shall become clear from the technical optimization results collected in the Appendix, given the equilibrium choice of $\tilde{T}$, 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.[11] The above arguments can be summarized as

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

Let n be the standard normal p.d.f., and define auxiliary functions K and L by

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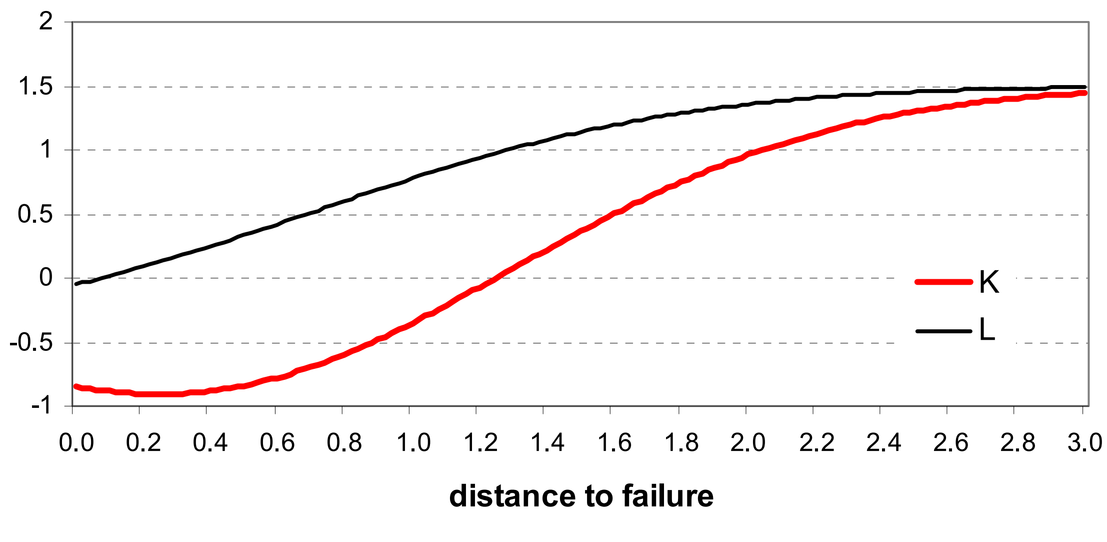
[11] Observe that the choice of x on the level which optimizes the shareholder utility is not an ex ante commitment by the branch manager, but a consequence of his own optimizing behavior. Formally, this exact result obtains only when the manager has full bargaining power. Were the bargaining power split 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.

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

An interpretation of K and L, as well as analogous functions that will appear shortly, 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 $K = -\frac{2}{\gamma}e^{\gamma SE_Q}\frac{\partial U}{\partial v}$ and $L = e^{\gamma SE_Q}\frac{\partial U}{\partial m}$. That is, values of K and L express sensitivities of the utility to, respectively, the variance and the mean of the uncertain bank funds Q.

It turns out that the shareholder preferences become perverse in the proximity of 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.

Fig. 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 γ=1.5 and wealth standard deviation σ=0.5.

Obviously, we are only interested in the results in the regular region of T-values, 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 distance to failure above the level of 1.3.

Auxiliary functions $\tilde{K}$, $\tilde{L}$ are defined by analogy with K and L:

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

To formulate the main technical statement of this section, it is necessary to introduce additional notation. The vector of mean returns of the four assets whose holdings the shareholder selects in her substitute problem, is equal to $\tilde{R} = \left[z^{*s}, Z^L, -z^{*a}, -Z^A\right]^T$. Further, let ω be the covariance matrix of the random vector of returns $\left[y^{*l}, Y^L, -y^{*a}, -Y^A\right]^T$, and we denote by ω^x the row of ω corresponding to component y^{*l} (i.e. to returns on foreign loans x). We will further need to split ω^x as follows: $\omega^x = \left[\sigma_l^2, \omega'^x\right]$. That is, ω'^x is the vector of covariances between y^{*l} and the remaining returns $[Y^L, -y^{*a}, -Y^A]$. Naturally, the corresponding covariance matrix for substitute returns $\left[y^{*s}, Y^L, -y^{*a}, -Y^A\right]^T$ is denoted by $\tilde{\omega}$. We shall assume that the covariance matrix $\tilde{\omega}$ is non-singular (this is paramount to saying that none of the assets under consideration is redundant) and put $\tilde{\Xi} = \tilde{\omega}^{-1}$. Matrix $\tilde{\Xi}$ will be partitioned so as to separate the x-row and the X-column (or the X-row and the x-column, since $\tilde{\Xi}$ is symmetric):

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

Finally, let us define function Π of two variables, distance to failure and the standard deviation of wealth, by putting

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

(Note that in this definition, parameters K and L introduced earlier are also considered functions of the named two variables.) Then the main technical result of this section can be stated as

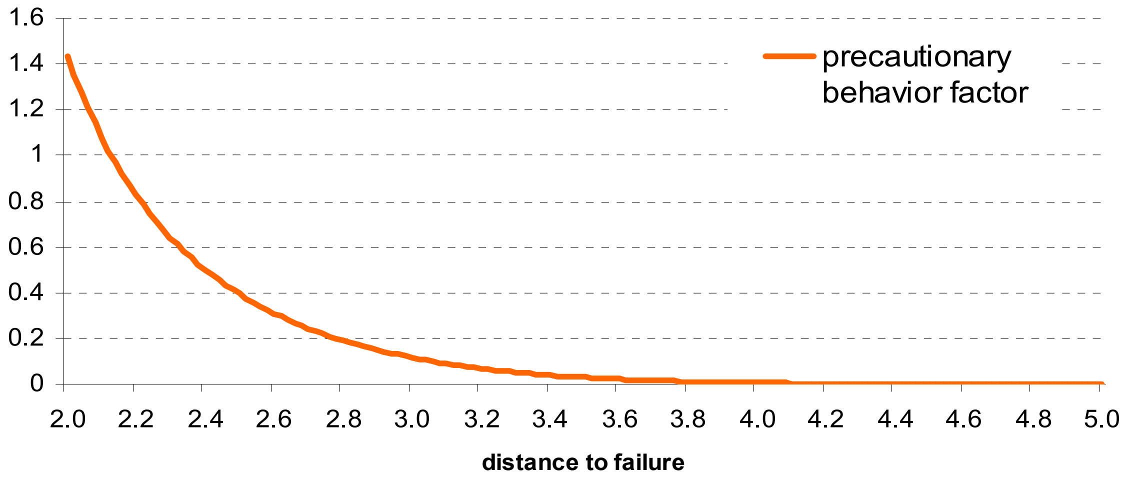
Proposition 2 *If the multinational bank with delegated management of the foreign branch is sufficiently far away from failure, then the lending volume of that branch reacts to changes in the parent bank home country mean return on loans according to*

$$\frac{\partial x}{\partial Z^L} = -\frac{\tilde{L}}{\gamma\sigma_l^2\tilde{K}}\omega'^x \cdot \tilde{\xi}'_X + \frac{X}{\gamma\sigma_l^2}\Pi\left(\tilde{T},\sigma_{\tilde{Q}}\right)\omega'^x \cdot \tilde{\Xi}' \cdot \tilde{R} - \frac{X}{\gamma\sigma_l^2}\Pi\left(T,\sigma_Q\right)z^{*l}. \tag{7}$$

To obtain an idea of the importance of the last two terms on the right hand side of (7), which appear there due to 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 $\Pi(T,\sigma_Q)$ or a similar one calculated for 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 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.

Fig. 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 γ=1.5 and wealth standard deviation σ=0.5, same as Fig.1.

As illustrated by Fig.2, the magnitude of precautionary motives behind the reaction of the branch loan volume x to Z^L-changes diminish with growing T. Therefore, an important special case of the previous proposition is an LI-bank. Recall that in Subsection 3.2 we have defined it 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 (7) 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*

$$\frac{\partial x}{\partial Z^L} \approx -\frac{1}{\gamma \sigma_l^2} \omega'^x \cdot \xi'_X . \tag{8}$$

In the LI-bank case covered by Corollary 1, the presence of contagion from the home to the 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 arm's length principle is the dependence of the risk transmission coefficient on both manager-generated and substitute covariances. More on interpretation of 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 pre-conditions for contagion in all four cases in turn.

Benchmark: arm's length LI-bank (no delegation, T=∞)
The portfolio choice of such a bank and the foreign branch lending response to Z^L-changes follow as a special case from expression (7). 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:

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

(See the Appendix for the definition of the partial covariance matrix $\tilde{\Psi}$. Its value plays no special role in the present analysis.) For contagion to take place it is necessary and sufficient that the element $\tilde{\xi}_X^x$ of the inverse covariance matrix $\tilde{\Xi}$ 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 (7), would look differently if the foreign branch were not subject to delegated management. The corresponding equation for the substitute loan volume $\tilde{x}$ can be immediately obtained from Lemma 3 in the Appendix (by multiplying equation (A3) by $\tilde{\Xi}$ from the left and taking the x-row of the resulting vector equation):

$$\frac{\partial \tilde{x}}{\partial Z^L} = \frac{\tilde{L}}{\gamma \tilde{K}}\tilde{\xi}_X^x - \frac{X}{\gamma}\Pi\left(\tilde{T}, \sigma_{\tilde{Q}}\right)\tilde{\xi}^x \cdot \tilde{R} . \quad (9)$$

This equation characterizes the lending volume reaction to the other country lending activity shock in bank branch operated by the shareholder without delegation. The reaction of this investor type in its turn consists of two parts. The first term on the right hand side of (9) represents the reaction of a standard mean/variance optimizing investor, just like in the previously discussed benchmark case (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 possibility to interprete 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 commercial 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 (9) 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 contents of equation (8) from that corollary, let us observe that $\tilde{\xi}^x_X = -\frac{\varpi'^x \cdot \tilde{\xi}'_X}{\sigma_s^2}$ (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 $\frac{1}{\gamma}\tilde{\xi}^x_X = -\frac{\varpi'^x \cdot \tilde{\xi}'_X}{\gamma\sigma_s^2}$ is replaced by $-\frac{1}{\gamma\sigma_l^2}\omega'^x \cdot \tilde{\xi}'_X$. That is, the vector ω'^x of covariances of the manager-generated returns with returns $[Y^L, -y^{*a}, -Y^A]$ on other endogenous balance sheet items resumes the place of the vector ϖ'^x of the substitute return covariances with the same random vector $[Y^L, -y^{*a}, -Y^A]$. 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, $\omega'^x \cdot \tilde{\xi}'_X$ may be also non-zero, specifically, negative, giving rise to a lending contagion effect.

Another possible interpretation of (8) 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

$$x^h = \frac{z^{*l} - \omega'^x \cdot \tilde{\Xi}' \cdot \tilde{R}}{\gamma\sigma_l^2} = \frac{z^{*l} - \left(\omega'^x \cdot \tilde{\xi}'_X\right)Z^L - \omega'^x \cdot \tilde{\xi} \cdot R^*}{\gamma\sigma_l^2} \tag{10}$$

(R^* means the subvector of $\tilde{R}$ including all components except Z^L). From the second part of (10), we derive that $-\omega'^x \cdot \tilde{\xi}'_X$ is the loading of the home country loan portfolio return in the hedging demand for the 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 (8).

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 (9)) with the general result given in (7). Observe, by construction of the inverse matrix, that

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

($\mathbf{1}^x$ denotes a vector with unity in the xth coordinate and zeros elsewhere). This means that (7) would boil down to (9) 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. $R = \tilde{R},\ \omega = \tilde{\varpi}$). However, delegated management exists exactly for the reason that it is different and attractive to the shareholder. Consequently, in the branch going from direct to delegated management, there can appear additional motives for lending contagion.

The second and the third term in (7), same as the second term in (9), 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 (9) evolves into two separate terms – the last two in (7) - 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*.

Since the last term in (7) takes positive values for meaningful values of the parameters (the bank sufficiently far away from failure), 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 when the expression $\omega'^x \cdot \tilde{\Xi}' \cdot \tilde{R}$ is positive. This is possible if the components of vector $\omega'^x \cdot \tilde{\Xi}'$ 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 a contagion from the home to the host country lending.

More generally, an interpretation of the precautionary realignment term in (7) 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 (10), 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 $\omega'^{x} \cdot \tilde{\Xi}' \cdot \tilde{R}$. So, if the said hedging considerations by the non-deposit taking manager involve a reduction in the 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 when 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, 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 from 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 volatility and positively on the trend, of the bank funds. (This corresponds to positive values of coefficients K and L that appear in (7).) According to the conducted numerical experiments, this restriction does not preclude all three coefficients on the right hand side of (7) to be 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, contagion/"octopusian" reactions observed in many multinational banks in continental Europe, might have to do with 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 operate foreign branches and/or subsidiaries with a significant weight in the total consolidated assets during the sample period 1999-2003. Our sample comprises 31 parent banks and 59 subsidiaries. Among 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 have 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 U.S.A. That is, we have restricted our sample of host countries to OECD members and otherwise fully industrialized economies. The reason is that MNB's activities in emerging and transition economies not only play a much more modest role in their total business, but are also often driven by motives and rules different from the ones valid for standard industrialized environment. Other sample selection criteria were: sufficient share of the foreign unit in the total bank assets, 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 years in the sample.

Table 1: List of parent banks

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

In order to capture the host and home country macroeconomic development, we have collected data on inflation, GDP growth, long term yields on governmental bonds, and exchange rate volatility between the parent bank country currency and the subsidiary country currency. The exchange rate volatility was measured as a standard deviation of monthly average growth rates of the exchange rate from its average annual growth rate. This measure excludes the long-term trend element of the exchange rate behavior, against which, as we presume, the MNBs 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 an impact of such an uncertainty on lending behavior.)

To measure the parent bank cost of managing credit risk of the home country loan portfolio (to be called *CR-cost* in the sequel), we have taken the ratio of loan loss reserves to total loans. We study in particular, which effect the CR-cost of 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 used indicators over 1999-2003 are presented in the 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 the credit creation on subsidiary level evolved quite dynamically, with a mean 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 attained the average of 4 percent and varied quite significantly, by 7 percent. The exchange rate volatility between the parent bank home and the subsidiary host country currencies fluctuated around the mean of 1 percent with a standard deviation of 0.7 percentage points and the maximum fluctuation reaching 3.53 per cent. Further, it follows from the descriptive statistics that the GDP growth in host countries exceeded the one in home countries by a percentage point on average. Inflation in host countries was also higher compared to home countries by 1.5 percent and, finally, the long-term interest rates were on average higher by 2 percentage points in host countries compared to home countries. In addition, the considered indicators for the host countries, along with higher average values, are more volatile than those for the home countries. This is consistent with higher returns in host countries, albeit with higher uncertainty.

Note that we do not use aggregate host country credit growth as an explanatory variable, believing that the same underlying growth factor is already contained in the GDP series. One is unlikely to find additional drivers of MNBs' credit in the countries of penetration, given that penetration does not take place but 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 have perform two types of regression: the parenthood and the region regression, respectively.

In the *parenthood* regression we have investigated the sign and significance of the relation 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 towards their subsidiary banks in reaction to the parent banks CR-cost, as follows from the theoretical model in the theoretical part of this paper, we have performed a detail regression; in which for each parent bank we have estimated a bank-specific reaction of the subsidiary to the parent bank's ratio of loan-loss reserves to total loans. Formally,

$$\Delta \ln L_{i,t} = \alpha_i + \beta_1 \Delta \ln GDP_{i,t}^{home} + \beta_2 \Delta \ln GDP_{i,t}^{host} + \beta_3 \pi_{i,t}^{home} + \beta_4 \pi_{i,t}^{host} + \beta_5 i_{i,t}^{home} + \beta_4 i_{i,t}^{host} + \gamma \sigma_{ER,i,t} + \sum_{i=1}^{31} \delta_i LLP_{i,t} + \varepsilon_t, \quad (11)$$

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

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

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

where LLP_{19} and LLP_{12} are loan-loss provisions for 19 banks and 12 banks in the respective group of positive and negative detailed regression coefficient δ in (11).

In the case of the *regional* regression, we have grouped the parent banks according to the countries where they operate subsidiaries. In this way, we have created four blocks of countries (subsidiary regions, *SR*): Central and Eastern Europe, Old Industrial Countries, New Industrial Countries, and Baltic Countries. The Central and Eastern Europe comprises the Czech Republic, Hungary, Poland, and Slovakia; the Old Industrial Countries are Canada, Ireland, Portugal, Switzerland, the U.K., and the U.S; 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:

$$\Delta \ln L_{i,t} = \alpha_i + \beta_1 \Delta \ln GDP_{i,t}^{home} + \beta_2 \Delta \ln GDP_{i,t}^{host} + \beta_3 \pi_{i,t}^{home} + \beta_4 \pi_{i,t}^{host} + \beta_5 i_{i,t}^{home} + \beta_4 i_{i,t}^{host} + \gamma \sigma_{ER,i,t} + \sum_{r=1}^{4} \delta_r SR_r * LLP_{i,t} + \varepsilon_t. \quad (13)$$

Where SR_r denotes dummy variable for the region r, $r = 1, \ldots, 4$. 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 considered variables, i.e., home as well as host key macroeconomic variables. By excluding the statistically insignificant variables we have derived the restricted specification. The overall explained variability in the data 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 (Hausman specification test, Hausman (1978) yields $\chi^2_5(2.06) = 0.85$). In the case of the regional regression we have reported 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, where an avegare bank is observed for 4.5 years. The empirical specifications (11)-(13) exhibit satisfactory explanatory power, given the type of regression.

As we can see from Table 3, the home factors turn out to be relatively unimportant, while, on the contrary, the host country economic development prove to be very influential. This finding suggests that general macroeconomic development in the home country is not a significant source of lending contagion into 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 a relation with asset return statistics co-driven by macro fundamentals, might be of subordinate importance empirically.

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 GDP growth	1.79(1.96)	-	-
Home country inflation	1.31(3.56)	-	-
Home country long-term interest rate	4.01(5.47)	-	-
Host 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 detail regression)	-17.51***(4.86)	-18.36***(4.73)	-
Group 12 (positive sign in detail 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; stars denote statistical significance as follows: *10%, **5%, and ***1%; time observations per parent bank: min 2/avg 4.5/ max 5.
[a] The intercept represents an 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.

On the contrary, the host country factors, particularly the 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 host country long-term interest rate by one percent increases the growth of loans by nearly 5 percent. A percentage increase in the exchange rate volatility reduces the credit emission 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 CR-costs of the parent bank on the credit growth in the subsidiary, we have found a statistically significant relation. This proves that not only the host country factors matter but intermediated influence of home factors through parent bank operations can be statistically verified as well. Namely, two thirds of the parent banks in our sample restrict lending in subsidiaries as a response to loan quality deterioration at home, i.e., exhibit the intra-bank lending contagion. One third of the banks behaves inversely, i.e. they increase loan issues in subsidiaries as a result of growing CR-cost at home, even though, the effect is smaller and statistically weaker than the one for the group of banks prone to contagion.

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

To what extent the results are driven by difference in regions where subsidiary banks operate, can be examined with the help of regional regressions. The results suggest that the parent banks that run their 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 EU from which most penetrating MNBs there originate. According to the popular view, the penetration itself has contributed substantially to the 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, even not all of them show signs of home-host contagion.

More generally, we may select banks with lending contagion behavior by looking at the results on individual parent banks (see outcomes of parenthood regressions in Section 4). Then, in the sublist of MNBs 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 increase, 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 MNB as a whole.) The latter effect should be considered a plausible explanation of lending contagion in the considered group of banks.

In contrast, parent banks that operate subsidiaries in the old industrialized, newly industrialized and Baltic countries behave reversally.

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 have 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 have founded our analysis upon is the hypothetical substitute decision making of a bank shareholder in case she decides to do without the manager skills and save on his fees. The substitute portfolio decisions are different from the actual decisions of the manager. The latter bases the effort and the 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 substitute earnings, the lending volume is influenced by variables outside the branch. And those, given the shareholder intertwined decisions worldwide, are cross-border interdependent. So, formally, although the investment opportunity set of the manager is strictly local (limited to the 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 the 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 operation.

The panel regression conducted on a large sample of multinational banks has shown the presence of lending contagion in 19 out of examined 31 parent banks. When one looks at the phenomenon from the point of view of the region that hosts foreign banks, the one with 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 Baltic countries).

A frequently posed question is the influence of the exchange-rate noise on the foreign-bank operation. The 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 sole strongest explanatory factor of lending contagion in banks which are prone to it. The result is robust to regional grouping of dependent units as well as inclusion of alternative macroeconomic explanatory variables for the parent bank home country.

Although we do not model the regulator explicitly, the problems discussed in the literature on multinational bank regulation 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 its 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 his 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 the 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 the supervisory policies is their ability to reduce the costs of bank managers' monitoring.

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Appendix: Proof of Proposition 2

Condition (6) defines the fee f implicitly as a function of manager's own loan volume choice x and the vector of shareholder's substitute portfolio holdings $\mathcal{J}=[X,D,B,\tilde{x},d,b,C]^{\mathrm{T}}$. 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 manger's and the shareholder's optimization problems, respectively. In other words, they satisfy the first order conditions of optimality to be spelled out below.

Let us denote by Ω the covariance matrix of the random vector $[Y^L,Y^D,-Y^A, y^{*l},y^{*d},-y^{*a},Y^A]$. 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*

$$K\gamma\Omega^x J = Lz^{*l}, \tag{A1}$$

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

Condition (A1) follows from the equality

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

A special case of (A1) 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 (A1) 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 (A1) 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:

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

The formal statement regarding the whole vector I, obtained by differentiating (A1) 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*

$$K\gamma\omega^x \frac{\partial I}{\partial Z^L} = \frac{Xn(T)}{\sigma_Q^2 K}\left[\frac{L}{\gamma\sigma_Q} - \gamma\left(N(T)T + n(T)\right)\left(1 + \frac{T}{\gamma\sigma_Q}\right)\right]z^{*l}. \qquad \text{(A2)}$$

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 ε^S=[ε^L,-ε^A,-ε^{*a}]), extraction from (A2) of the sought information about $\frac{\partial x}{\partial Z^L}$ requires a similar result on the substitute portfolio decision $\tilde{I} = \left[\tilde{x}, I^S\right]^T$ of the shareholder (the left hand side of (A2) 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.

The covariance matrix of the random substitute returns vector [Y^L, Y^D,- Y^A , $\tilde{y}^{*s}$, y^{*d}, - y^{*a},Y^A] (cf. Assumption 2) will be denoted by $\tilde{\Omega}$. We shall partition this 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 $\tilde{U}$ in (5) with respect to each component of the decision vector $\tilde{I}$ of the shareholder), we establish the following characterization of optimal $\tilde{I}$.

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

$$\tilde{K}\gamma\left(\varpi \cdot \tilde{I} + \Psi \cdot I^{0}\right) = \tilde{L}\tilde{R}. \tag{A3}$$

Equation (A3) can be differentiated w.r.t. Z^L in order to establish the sensitivity of the shareholder 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 (A3) contains Z^L as one of the components, so that the equation corresponding to (A2) 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 arms' length by the bank shareholders) is given by the equation*

$$\tilde{K}\gamma\varpi\frac{\partial \tilde{I}}{\partial Z^L} = \frac{Xn(\tilde{T})}{\sigma_{\tilde{Q}}^2 \tilde{K}}\left[\frac{\tilde{L}}{\gamma\sigma_{\tilde{Q}}} - \gamma\left(N(\tilde{T})\tilde{T} + n(\tilde{T})\right)\left(1 + \frac{\tilde{T}}{\gamma\sigma_{\tilde{Q}}}\right)\right]\tilde{R} + \tilde{L}\mathbf{1}^X. \tag{A4}$$

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 finally prove Proposition 2, one needs to separate from vector equation (A4) the components corresponding to I^S. More precisely, the immediate consequence of the definitions given in Subsection 3.4 is the following expression for $\frac{\partial I^S}{\partial Z^L}$:

$$\frac{\partial I^S}{\partial Z^L} = \frac{Xn(\tilde{T})}{\gamma\sigma_{\tilde{Q}}^2 \tilde{K}^2}\left[\frac{\tilde{L}}{\gamma\sigma_{\tilde{Q}}} - \gamma\left(N(\tilde{T})\tilde{T} + n(\tilde{T})\right)\left(1 + \frac{\tilde{T}}{\gamma\sigma_{\tilde{Q}}}\right)\right]\Xi \cdot \tilde{R} + \frac{\tilde{L}}{\gamma\tilde{K}}\xi_X'. \tag{A5}$$

Now, substituting (A5) into (A2) and rearranging terms, we arrive at the desired result •

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