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Internal capital markets and lending by multinational bank subsidiaries

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ABSTRACT

We use new panel data on the intra-group ownership structure and the balance sheets of 45 of the largest multinational bank holdings to analyze what determines the credit growth of their subsidiaries. We find evidence for the existence of internal capital markets through which multinational banks manage the credit growth of their subsidiaries. Multinational bank subsidiaries with financially strong parent banks are able to expand their lending faster. As a result of parental support, foreign bank subsidiaries also do not need to rein in their credit supply during a financial crisis, while domestic banks need to do so.

1. Introduction

In this paper, we analyze two interrelated questions. First, we ask whether multinational banks operate an internal capital market across national boundaries. By an internal capital market we mean that parent banks allocate scarce capital to their subsidiaries. A multinational bank would not operate such a market in the absence of capital market frictions (Stein, 1997). Rather, subsidiaries would attract sufficient liabilities to finance profitable investment projects themselves. However, if capital markets are not functioning perfectly, it can be advantageous for parent banks with better access to external funding to internally allocate capital to subsidiaries in order to manage their lending growth.

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Whether a bank operates an internal capital market or not is important because such a market creates financial linkages between subsidiaries.

The second and related issue we analyze concerns the consequences that the operation of an internal capital market by multinational banks may have for the countries involved. We ask whether the presence of multinational bank subsidiaries means that economic shocks are more easily transmitted across borders. In addition we want to know whether multinational bank subsidiaries 'cut and run' during a financial crisis or whether they, on the contrary, provide a stable source of credit (in particular when compared to domestic banks).

We contribute to the research on the existence and the ramifications of internal capital markets in several ways. As regards the existence of internal capital markets, we make two contributions. First, we examine whether banks operate internal capital markets across national boundaries. Empirical evidence on internal capital markets within banks only exists for the United States. Houston et al. (1997) show that the credit growth of a subsidiary is negatively correlated with the loan growth in other US subsidiaries of the bank holding. Dahl et al. (2002) show that such correlated credit growth patterns are due to equity flows between the parent bank and its subsidiaries. Ashcraft (2004) demonstrates that banks that are affiliated with a multi-bank holding company are less likely to experience financial distress and recover more quickly in case of such distress because of capital injections by the parent company. We extend this line of research to multinational banks.[1]

Second, our detailed information on intra-bank ownership allows us to analyze whether particular types of multinational bank subsidiaries are more closely integrated into internal capital markets than others. We distinguish between greenfield subsidiaries and takeover subsidiaries as well as between subsidiaries that are geographically close to their parent bank and those that are further away. Earlier empirical research treated bank subsidiaries as a homogenous group and ignored the potential differences between subsidiary types.

We also contribute to the research on the effects of multinational banking. Earlier research shows that lending by multinational banks tends to transmit home country financial shocks (Peek and Rosengren, 1997, 2000a; Van Rijckeghem and Weder, 2000, 2001) but to dampen host country financial shocks (Peek and Rosengren, 2000b; De Haas and Van Lelyveld, 2006). Multinational bank lending also tends to be influenced by the home country business cycle (Martinez Peria et al., 2002; Morgan and Strahan, 2004). We improve on this work in two ways. First, most studies limit themselves to multinational bank linkages between one specific home region (United States, Japan or Western Europe) and one specific host region (Latin America or central and eastern Europe). Our approach differs in that we do not make an ex ante distinction between home and host regions but acknowledge that countries can be home and host country at the same time. We also use a more comprehensive country sample that better reflects the current state of bank globalization:

- Our dataset includes 45 multinational banks from 18 home countries with 194 subsidiaries across 46 countries. Most parent banks (83 per cent) and subsidiaries (73 per cent) are based in Europe, partly reflecting the eastward expansion of many European banks after the fall of the Berlin Wall. Only about 14 per cent of all parent banks and subsidiaries are based in North America. North American banks are relatively domestically oriented, whereas European banks are on average more internationalized (IMF, 2007).
- The number of multinational bank subsidiaries in Africa and Asia is limited as many countries in these regions still have limitations on majority foreign bank ownership. Latin America is host to some 5 per cent of all subsidiaries in our dataset, mainly of Spanish origin.
- The time dimension (1991–2004) of our dataset reveals that banking systems have become increasingly globalized over time. Not only did the number of multinational banks increase, individual banks also became more globalized as measured by the number of foreign subsidiaries, especially through foreign takeovers.

[1] National regulatory constraints may also influence multinational bank lending. However, we expect that such constraints are more important for the initial entry decision of a multinational bank than for the credit expansion once the bank has entered a country. Focarelli and Pozzolo (2005) analyze the determinants of banks' foreign expansion while we analyze what determines their lending once they have established subsidiaries.

A second improvement of our empirical approach compared to existing studies is that we use bank-level information on intra-bank linkages rather than aggregate bank lending data. Van Rijckeghem and Weder (2000, 2001) find that multinational banks adjust credit lines to third countries in reaction to losses in a crisis country. However, the authors use aggregate Bank for International Settlements (BIS) data and therefore cannot measure intra-bank linkages at the bank level. Peek and Rosengren (2000a), in their study of multinational bank lending in Latin America, rely on aggregated BIS data as well. Our bank-level data allow us to more precisely attribute empirical findings to banks' internal capital markets rather than to more general cross-country correlations.

We find that subsidiaries of stronger parent banks grow faster and that parent banks trade off lending across countries. As a result of parental support, foreign bank subsidiaries do not typically rein in their lending during a financial crisis, while domestic banks are forced to do so. These findings are in line with earlier empirical results for specific regions, but are based on a much broader sample of home and host countries and on bank-level rather than aggregated data. Our findings are also the first to show that banks not only operate internal capital markets at the national but also at the international level. Greenfield subsidiaries and remote subsidiaries are most closely integrated into such internal capital markets.

A limitation of our empirical approach is that we cannot track the actual transactions within internal capital markets and therefore cannot fully ascertain that the bank lending patterns we find are caused by equity flows between parent banks and their subsidiaries (as Dahl et al. (2002) showed for bank holdings in the USA). However, on the basis of a number of innovative robustness tests we are able to rule out the most likely alternative explanations for the lending patterns we observe.

The remainder of this paper is structured as follows. In Section 2 we develop our theoretical predictions. Section 3 discusses the data we use, after which Section 4 explains our estimation methodology. Sections 5 and 6 present the empirical results and Section 7 concludes.

2. Some theoretical predictions on multinational bank lending

We use the model by Morgan et al. (2004) to develop three priors with regard to lending by multinational bank subsidiaries that are part of an internal capital market. In this incentive model, which is a two-country version of the model by Holmström and Tirole (1997), multinational banks are capital constrained and risk neutral. They rebalance their international credit portfolio in reaction to financial or real-economic country-specific shocks. A financial shock originates in the multinational bank itself and wipes out part of its capital or reduces its funding base. In the case of a Spanish bank with a Brazilian subsidiary, a costly fraud case in the Spanish head office that wipes out part of its capital would constitute a home country financial shock. Similar losses in the Brazilian subsidiary would be a host country financial shock. Real-economic shocks are changes in the investment opportunities in a country that originate outside of the banking system. For instance, in the above example, a sharp contraction in economic growth in Brazil would be a host country real-economic shock, whereas a cyclical downturn in Spain would be a home country real shock.

In the Morgan et al. (2004) model, multinational banks re-allocate capital between countries in reaction to shocks to ensure that the return on capital remains equal in both countries. The internal capital market is the mechanism to do so, and the operation of this market has two main implications. First, the parent bank helps ailing subsidiaries that are hit by a financial shock by allocating additional capital. This is the support effect. Parental support implies that the presence of multinational banks can dampen financial shocks in the host country. A Brazilian subsidiary that is hit by a large fraud case will be able to replenish its capital base with the help of its Spanish parent. The parent bank may also provide intra-bank loans to its subsidiary in case the funding base of the latter is squeezed during a systemic banking crisis in Brazil.

Second, the multinational bank re-allocates capital among its subsidiaries in reaction to real-economic shocks that change the profitability of lending in a country. We call this the substitution effect. The substitution effect implies that multinational banks sharpen business cycles as they use their internal capital market to shift capital from low-return countries to high-return countries. In reaction to an economic downturn in Brazil, a Spanish parent bank may decide to re-allocate capital from its

Brazilian subsidiary to the Spanish headquarters, where it can be used more profitably. Based on this theoretical framework we derive the following three predictions:

1. Lending by multinational bank subsidiaries is negatively (positively) related to the business cycle in the home country and in countries where other subsidiaries operate (host country);
2. Lending by multinational bank subsidiaries does not decrease during systemic banking crises in the host country, whereas the opposite is true for domestic banks;
3. Multinational bank subsidiaries that belong to a financially strong banking group expand their lending faster than subsidiaries that belong to a financially weaker banking group.

The first prior reflects the substitution effect: parent banks use their internal capital market to let subsidiaries in fast-growing economies expand lending faster compared with subsidiaries in more slowly developing economies. Note that also lending by domestic banks may be positively related to the local business cycle. We nevertheless expect this positive relationship to be less strong than for multinational bank subsidiaries, as most domestic banks only operate in the host country and therefore cannot switch easily to foreign lending alternatives.

The second and third priors reflect the support effect: subsidiaries can count on capital and liquidity support from their parent bank in times of need, whereas domestic banks cannot. The third prior reflects that subsidiaries of financially strong parent banks are expected to grow faster (all else equal) because they can rely on more capital support than subsidiaries of weak parents.

3. Data and descriptive statistics

Our sample of multinational banks is based on the Top 1000 of the world's largest banks (asset rank) as published by *The Banker*. From the 150 largest banks on this list we identified banks with more than one significant foreign bank subsidiary. This resulted in a sample of 45 bank holdings, for which we then identified—on the basis of BankScope, banks' websites, and correspondence with banks—all subsidiaries of which the assets account for 0.5 per cent or more of the parent bank's assets in 2004 and that are at least 50 per cent owned by the parent bank. We therefore limit ourselves to relatively large subsidiaries in which the parent has a controlling stake.[2] For each significant subsidiary (level 1) we also check whether it owns sub-subsidiaries (level 2) that are larger than 0.5 per cent of the ultimate bank holding (level 0). If this is not the case, we include consolidated data for the level 1 subsidiaries. If it is, we include unconsolidated data for the level 1 subsidiary and separately include consolidated data for the sub-subsidiary. Multinational banks not only operate foreign subsidiaries but also foreign branches. Since we focus on internal capital markets, we are mainly interested in foreign subsidiaries as these are legally independent affiliates that require a separate capitalization.

If parent banks are the result of a merger or acquisition in year t we include them from year $t + 1$ onwards. We disregard banks for which we have less than three consecutive years of data (all Chinese and most Japanese banks). For each subsidiary we trace back in which year t it became part of the holding. For the greenfield subsidiaries we use data from year t onwards, whereas we include subsidiaries that result from a takeover from $t + 1$.[3] Table A1 in Appendix A provides a list of all banks. As a double check on database quality, we contacted each parent bank asking for confirmation that the subsidiaries we identified were indeed those considered as material by the bank itself. We also asked for the dates when non-greenfield subsidiaries were acquired. Fig. 1 shows a graphical representation of our sample. In a typical year, a parent bank in our sample owns on average 4.3 subsidiaries. The proportion of the assets owned by takeover subsidiaries, greenfields, and parents remains stable over time with on average shares of 4 per cent, 20 per cent and 76 per cent in our sample, respectively.

[2] We include commercial banks, savings banks, cooperative banks, mortgage banks, and long-term credit banks and exclude investment banks, securities houses, state banks, and non-bank credit institutions.

[3] We exclude multinational bank subsidiaries in Luxembourg and Switzerland as the activities of subsidiaries in these countries are mainly driven by the deposit supply of (foreign) residents rather than by local macroeconomic developments or parent banks' influence.

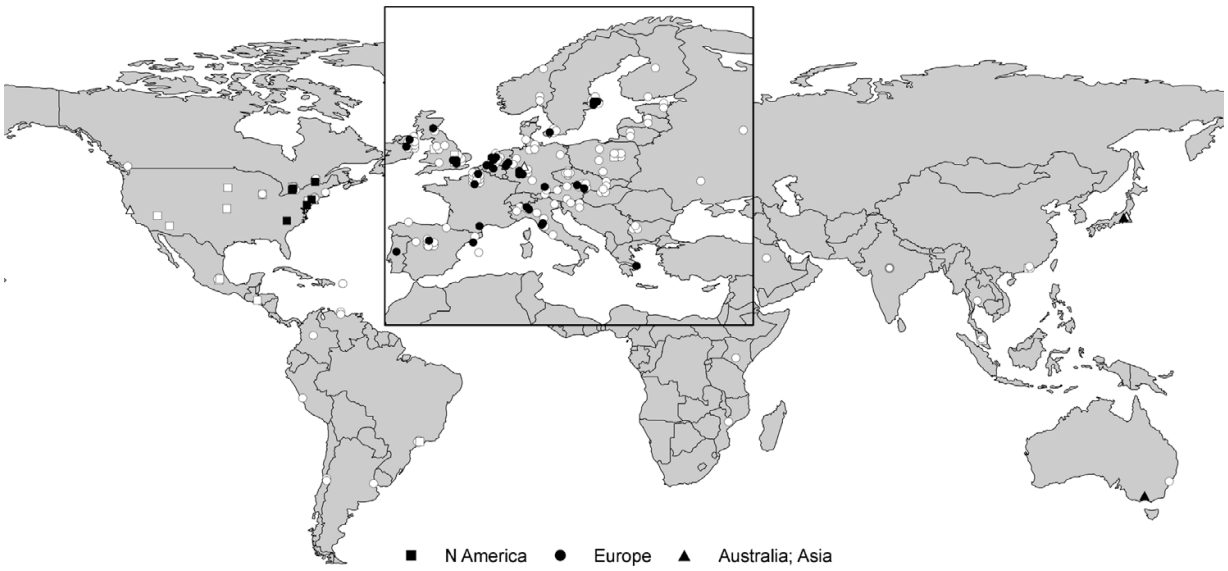

Fig. 1. Location of parent banks (black) and subsidiaries (white) (2004).

We obtain financial data on all parent banks and subsidiaries from Bureau van Dijk's BankScope database. Our sample period is 1991–2004, but the panel is unbalanced as we do not have data for all years for each bank. Because not all banks report in the same currency we convert all financial variables into US dollars.

Our dependent variable is the percentage growth of gross loans. Alternatively, one could choose the percentage growth of (book) capital as a dependent variable that captures parent bank influence. We choose to focus on lending growth rather than capital growth because many multinational banks operate internal capital markets for (unobservable) risk capital in addition to book capital. De Haas and Naaborg (2006) use structured interviews with bank managers of multinational banks to analyze how banks manage the lending of foreign subsidiaries. They find that typically banks set credit growth targets for their subsidiaries and then support these—to the extent necessary—through liquidity assistance and book capital support. In addition, however, banks use economic capital models and minimum rate of return requirements to influence subsidiaries' ability to reach their credit growth targets. The results indicate that parent banks do not always need to move book capital in order to steer subsidiaries' lending. They can also manage lending more directly by setting credit growth targets and allocating risk capital. To capture the joint effect of these mechanisms, we use subsidiaries' credit growth as our outcome variable. To construct our gross credit growth variable, we add loan loss reserves to net loans. This corrects for changes in (net) loans that are not due to changes in banks' output of new loans, but are caused by changes in loan loss provisioning.

We check for outliers and remove observations with implausible values for one or more variables. To control for mergers and acquisitions we also remove observations where absolute loan growth exceeds 75 per cent. This data cleansing reduces the number of observations by 13 per cent.[4] (Table B1 in Appendix B) summarizes the statistical characteristics of our data. Subsidiaries have on average a higher solvency, expressed as total equity to total assets, than parent banks. Subsidiaries also experience somewhat faster credit growth than parent banks, which may contribute to their lower profitability.

4. Estimation approach and methodology

We estimate three types of regressions to test the predictions of Section 2. In all cases the dependent variable is the credit growth of subsidiary *i* and the independent variables comprise host country variables and financial characteristics of subsidiary *i* itself. The first regression—(1)—is the basic model where we treat the subsidiary as if it operates on a stand-alone basis. Credit growth is solely determined by subsidiary-specific variables and host country macroeconomic variables, including a crisis dummy (predictions 1 and 2).

In the second regression—(2)—we add financial characteristics of the parent bank to test for support effects (prediction 3), while in the third regression—(3)—we test whether lending growth of a subsidiary is affected by variables related to other subsidiaries in the banking group. These variables include (weighted) macroeconomic variables related to the countries where the other subsidiaries are based (prediction 1) and variables measuring the (weighted) financial situation of these subsidiaries. We remain agnostic about the sign of the coefficients for the variables related to other subsidiaries. In case of strong substitution effects, we would expect negative signs as parent banks re-allocate capital from weak to more profitable subsidiaries. In case support effects dominate, we would expect a positive relationship as financially strong subsidiaries improve the condition of the whole group, thus benefiting other subsidiaries. The three regression types can be summarized as follows:

$$\Delta L_{it} = \alpha_1 + \gamma_1 \Delta L_{it-1} + \sum_{k=1}^{l} \beta_k HOST_{k,it} + \sum_{k=l+1}^{m} \beta_k SUB_{k,it} + \varepsilon_{it}, \quad (1)$$

[4] We also ran estimations in which we only excluded observations where loan growth exceeded 100 per cent. This reduced our dataset by only six per cent. Our results stayed the same in terms of both the signs of the estimated coefficients and their statistical significance.

$$\Delta L_{it} = \alpha_2 + \gamma_2 \Delta L_{it-1} + \sum_{k=m+1}^{n} \beta_k HOST_{k,it} + \sum_{k=n+1}^{p} \beta_k SUB_{k,it} + \sum_{k=p+1}^{q} \beta_k PARENT_{k,it} + \varepsilon_{it}, \quad (2)$$

$$\Delta L_{it} = \alpha_3 + \gamma_3 \Delta L_{it-1} + \sum_{k=q+1}^{r} \beta_k HOST_{k,it} + \sum_{k=r+1}^{s} \beta_k SUB_{k,it} + \sum_{k=s+1}^{u} \beta_k OTHCO_{k,it} + \sum_{k=u+1}^{v} \beta_k HOME_{k,it} + \sum_{k=v+1}^{w} \beta_k OTHSU_{k,it} + \varepsilon_{it} \quad (3)$$

where

- ΔL_{it} (ΔL_{it-1}) is the percentage credit growth of subsidiary i in year t ($t-1$ if lagged)
- α_1, α_2 and α_3 are intercept terms; γ_1, γ_2 and γ_3 are coefficients and β_k are coefficient vectors
- $HOST_{it}$ is a matrix of host country macroeconomic variables
- SUB_{it} is a matrix of characteristics related to bank subsidiary i
- $PARENT_{it}$ is a matrix of characteristics related to the parent bank holding of subsidiary i
- $HOME_{it}$ is a matrix of home country macroeconomic variables
- $OTHCO_{it}$ is a matrix of (weighted) macroeconomic variables related to the other countries where the bank holding operates (excluding the home country)
- $OTHSU_{it}$ is a matrix of (weighted) characteristics related to other subsidiaries of the parent bank
- ε_{it} is the idiosyncratic error, $\varepsilon_{it} \sim \text{IID}(0, \sigma_\varepsilon^2)$
- $i = 1, \ldots, N$ where N is the number of bank subsidiaries in the sample
- $t = 1, \ldots, T_i$ where T_i is the number of years in the sample for bank subsidiary i.

HOST (*HOME*) are host country (home country) macroeconomic variables that reflect the attractiveness of expanding credit in a host country (home country): GDP growth (+), the unemployment rate (−), the nominal exchange rate against the US dollar (+), and inflation (−) (expected sign for the host country variables in parentheses). Banks will expand lending if GDP growth is high and unemployment and inflation are low.[5] We also include a crisis dummy, *HOSTCRIS* (*HOMECRIS*), which takes on the value of '1' for years in which the host (home) country experienced a banking crisis. The dummy is based on Caprio and Klingebiel (2002) and Carstens et al. (2004). For 2004, we constructed it on the basis of publications in print and on the internet. We expect that multinational bank lending will not slow during a systemic banking crisis, because subsidiaries are supported by their parents (prediction 2).

Similarly, *OTHCO* includes variables measuring the (weighted) macroeconomic development in the other countries of operation of the parent bank. These variables reflect the (relative) attractiveness of lending in other countries and proxy for the opportunity costs of expanding credit in a particular host country. For each year, we weigh the values for each country where a significant subsidiary is present with the size of the particular subsidiary relative to the sum of all subsidiaries of the same parent in our sample. For instance, for HSBC Brazil we construct an *OTHCO* GDP growth variable that measures the weighted average growth rate of all countries where HSBC operates except Brazil and the United Kingdom. If the HSBC subsidiary in Canada would be twice as large as the one in Ireland, Canadian GDP growth would count twice as much as Irish GDP growth.[6] Finally, the *OTHCRIS* dummy is '0' in all years

[5] To the extent that host country inflation increases the nominal value of loan portfolios there would be a positive effect of inflation on credit growth. However, as we convert our data to US dollars inflationary effects should disappear to the extent that PPP holds. We also include the nominal exchange rate to ensure that our results for the other macroeconomic variables are not driven by residual exchange rate fluctuations.

[6] If there were several subsidiaries in a host country, we would calculate the *OTHCO* macroeconomic variables on the basis of the other host countries only. For instance, when constructing the *OTHCO* GDP growth variable for one of several Mexican subsidiaries of the same parent bank, we do not include Mexican GDP growth in the weighted *OTHCO* GDP variable. This would, by construction, lead to multicollinearity between this variable and the Mexican GDP growth variable (which is included as a separate determinant).

except for those years in which there was a banking crisis in one or more other countries of the banking group.[7]

SUB consists of subsidiary-specific variables (expected signs in parentheses). We include solvency (equity to assets (±)) and liquidity (liquid assets to total assets (±)) to measure risk aversion and capital/liquidity constraints. On the one hand, high capital and liquidity ratios may reflect that a bank is risk-averse and expands credit only slowly. Undercapitalized bank subsidiaries may also be prone to moral hazard and rapidly expand (risky) lending (Black and Strahan, 2002). Both effects imply a negative relationship between bank capital and loan growth. On the other hand, high capital and liquidity ratios may be a sign of non-binding liability constraints that enable banks to expand lending. The sign of the coefficients for these variables is therefore indeterminate. Second, we include loan loss provisions to net interest revenue (−) as a proxy for the general financial condition of the bank as well as its willingness to take on risk. Peek and Rosengren (2000b) find that parent banks' non-performing loans have an even more significant impact on host-country lending than parent banks' capitalization. An increase reflects that higher interest margins only partially compensate for higher credit risk. We therefore expect a negative effect on loan growth. Third, we include the return on equity (+) and the net interest margin (−) as bank performance indicators. Finally, *PARENT* includes the same bank-specific variables for the parent bank of each subsidiary, whereas *OTHSUB* consists of (weighted) variables for the other subsidiaries of the bank holding (including those in the home country).[8] Throughout the paper, we report Wald F-statistics. These consistently confirm that the explanatory variables related to the parent bank or to the other subsidiaries are jointly significant.

To take into account that different types of subsidiaries may be integrated into the parent bank's internal capital market to varying degrees, we create an ownership dummy that is '1' for greenfields and '0' for takeovers. We expect that greenfields are more strongly integrated in the multinational bank holding than acquired banks. In a separate set of estimations we use this dummy to construct interaction terms with the variables that measure the characteristics of the parent bank and of other subsidiaries. In doing so, we test whether substitution and support effects are indeed stronger for greenfields than for acquired banks.

We use three estimation methodologies: fixed effects and two dynamic GMM panel-data estimators. The choice for fixed effects estimations is based on Hausman tests, which consistently show that fixed effects are preferred over random effects because the determinants of credit growth are correlated with the bank-specific effects. However, in a dynamic context the lagged dependent variable may depend on the panel-level effects and lead to an inconsistent estimator when the time dimension is limited (Nickell, 1981). To get around this potential inconsistency problem we also report two GMM estimators which have as additional advantages that they require no distributional assumptions and allow for heteroscedasticity of unknown form. We first report the results of the GMM difference estimator, where the instruments consist of lags of the levels of the explanatory and dependent variables (Hansen, 1982; Arellano and Bond, 1991). In addition we report the GMM system estimator (Arellano and Bover, 1995; Blundell and Bond, 1998).

To test whether the instruments are valid, we perform the Hansen's *J* test for overidentifying restrictions. If we cannot reject the null, the model is supported. This is the case throughout the paper (see *p*-values in the tables). We also report the outcomes of the Arellano and Bond (1991) test for autocorrelation of order 1 and 2. These consistently show that we cannot reject the null hypothesis of no second-order autocorrelation (since the estimator is in first differences, first-order autocorrelation does not imply inconsistent estimates). We use robust estimators to correct for heteroscedasticity. An assumption underlying our panel analysis is that the series are stationary. We test the validity of this assumption in a number of ways, but as our time dimension is limited so is the discriminating power of the tests (Table B2 in Appendix B). Some of the tests also require the panel to be balanced and enforcing this requirement means dropping many subsidiaries. We conclude that the variables are

[7] This dummy is constructed by averaging for each year the '0' and '1' scores for the other countries where the parent bank has subsidiaries (weighted with the size of the respective subsidiaries). The *OTHCRIS* dummy is then assigned the value '1' if the weighted value equals or exceeds 0.25 and the value '0' otherwise.

[8] In this case, contrary to the macroeconomic *OTHCO* variables, we also include information on other subsidiaries in the same host country and on any separate subsidiaries in the home country (see Footnote 6).

Table 1
Does lending by multinational bank subsidiaries depend on conditions of the parent bank and of other subsidiaries within the same banking group? Dependent variable: credit of multinational bank subsidiaries (in percent).

	(1) FE	(2) GMM diff.	(3) GMM system	(4) FE	(5) GMM diff.	(6) GMM system	(7) FE	(8) GMM diff.	(9) GMM system
Subsidiary characteristics									
Credit growth	0.07	0.11	0.31	0.04	0.08	0.25	0.07	0.09	0.19
(lagged)	[0.05]**	[0.03]**	[0.00]***	[0.27]	[0.19]	[0.00]***	[0.08]*	[0.16]	[0.03]**
Weakness	−0.00	0.00	0.00	0.00	0.00	0.00	−0.03	−0.04	−0.03
	[0.96]	[0.86]	[0.91]	[0.86]	[0.62]	[0.73]	[0.55]	[0.51]	[0.64]
Profitability	0.25	0.15	0.27	0.25	0.17	0.27	0.12	0.00	0.02
	[0.00]***	[0.10]*	[0.01]***	[0.00]***	[0.05]**	[0.00]***	[0.38]	[0.98]	[0.87]
Liquidity	−0.52	−0.51	−0.20	−0.46	−0.49	−0.37	−0.39	−0.40	−0.41
	[0.00]***	[0.00]***	[0.05]**	[0.00]***	[0.01]***	[0.00]***	[0.01]***	[0.03]**	[0.00]***
Solvency	−1.08	−0.92	−1.06	−1.06	−0.79	−1.03	−1.05	−0.62	−1.31
	[0.00]***	[0.02]**	[0.00]***	[0.00]***	[0.04]**	[0.00]***	[0.01]***	[0.09]*	[0.00]***
Host country characteristics									
GDP growth	1.49	1.43	1.40	1.70	1.60	1.46	1.82	2.02	2.16
	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.01]***	[0.00]***	[0.00]***	[0.00]***
Unemployment	−1.00	−0.84	0.21	−1.48	−1.24	−0.24	−1.93	−1.62	−0.82
	[0.02]**	[0.08]*	[0.50]	[0.01]***	[0.07]*	[0.60]	[0.00]***	[0.00]***	[0.02]**
Exchange rate	0.03	0.04	0.01	0.03	0.04	0.02	0.03	0.03	0.02
[US$]	[0.08]*	[0.12]	[0.46]	[0.06]*	[0.08]*	[0.15]	[0.11]	[0.17]	[0.08]*
Crisis dummy	−1.49	−1.96	1.78	0.74	−0.79	−2.07	−0.05	3.50	1.71
	[0.71]	[0.71]	[0.71]	[0.88]	[0.88]	[0.69]	[0.99]	[0.60]	[0.85]
Parent bank characteristics									
Weakness				−0.07	−0.13	−0.26			
				[0.35]	[0.09]*	[0.09]*			
Profitability				−0.20	−0.22	−0.76			
				[0.20]	[0.30]	[0.04]**			
Liquidity				−0.50	−0.56	−0.38			
				[0.00]***	[0.01]***	[0.05]**			
Interest margin				6.27	7.94	2.08			
				[0.00]***	[0.00]***	[0.08]*			
Characteristics home country and other subsidiaries									
GDP growth							−2.13	−2.62	−3.16
							[0.00]***	[0.00]***	[0.01]***
Weakness (other subs.)							−0.06	−0.14	−0.06
							[0.45]	[0.11]	[0.77]
Profitability							0.19	0.21	0.11
							[0.07]*	[0.01]***	[0.66]
Liquidity							−0.15	−0.28	−0.22
							[0.30]	[0.05]**	[0.32]
Solvency							−0.08	−0.60	0.82
							[0.88]	[0.16]	[0.16]
Crisis other countries							−13.17	−16.62	−24.15
							[0.23]	[0.21]	[0.42]
Constant	28.01	25.97	10.44	26.81	22.00	33.15	41.48	45.32	32.67
	[0.00]***	[0.00]***	[0.01]***	[0.00]***	[0.01]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***
Observations	967	763	967	905	703	905	677	524	677
No. banks	194	183	194	194	182	194	147	139	147
No. instruments			177			177			177
R^2_{within}	0.12			0.15			0.15		
Hausman	0.00			0.00			0.00		
AB test AR1		0.00	0.00		0.00	0.00		0.00	0.00
AB test AR2		0.66	0.27		0.48	0.19		0.85	0.59

(*continued on next page*)

Table 1 (*continued*)

	(1) FE	(2) GMM diff.	(3) GMM system	(4) FE	(5) GMM diff.	(6) GMM system	(7) FE	(8) GMM diff.	(9) GMM system
Wald				0.00	0.00	0.04	0.11	0.10	0.02
Hansen *J*		0.81	0.80		0.95	0.96		0.98	0.79

Notes: *p*-values in brackets. 'GMM diff.' and 'GMM system' refer to estimations using the Arellano and Bond (1991) difference panel-data estimator (robust) and the Arellano and Bover (1995) system panel-data estimator (robust), respectively. 'Hausman': *p*-value of the Hausman specification test. 'AB test AR1(2)': *p*-value of the Arellano–Bond test that average autocovariance in residuals of order 1 (order 2) is 0. 'Wald': *p*-value of the Wald *F*-test that parameters associated with parent bank/other subsidiaries variables are jointly 0. 'Hansen *J*': *p*-value of the Hansen *J* test for overidentifying restrictions, which is asymptotically distributed as χ^2 under the null of instrument validity.

* Significance at 10%.

** Significance at 5%.

*** Significance at 1%.

neither all stationary (Hadri, 2000 test) nor non-stationary (Pesaran, 2003 test). The Taylor and Sarno (1998) test indicates that the series are *I*(0).

A final caveat is that a number of regressors may to some extent be endogenous. GMM, which is an instrumental variables technique with lagged values of the variables as instruments, partially mitigates concerns about reverse causality. In addition, subsidiaries are typically relatively small when compared to the multinational bank holding as a whole. The average subsidiary accounts for about 10 per cent of its parent bank's assets, as our sample contains the world's largest banks which in many cases also have significant non-financial operations and equity participations. Reverse causality is therefore less likely to be an issue for the regressors that measure the impact of characteristics of the parent bank or of other subsidiaries.

5. Empirical results

5.1. Basic empirical results

We first estimate the basic model in which multinational bank subsidiaries' credit growth depends on lagged credit growth, subsidiary characteristics, and host country characteristics (Table 1, columns 1–3). Experimenting with various macroeconomic variables leads us to include GDP growth and the unemployment rate, as these turn out to be robust determinants of credit growth. Contrary to what one might expect, economic growth and the unemployment rate are not strongly correlated over time and across countries in our sample. We also include crisis dummies and the nominal exchange rate.[9]

Table 1 shows that profitable subsidiaries expand credit faster and relatively solvent and liquid subsidiaries more slowly. Our conjecture is that relatively solvent and liquid banks are more risk averse and grow lending more slowly because they invest more in liquid assets. In contrast, undercapitalized subsidiaries with insured liabilities (or the expectation of a parental bail-out) will grow relatively fast (Vihriälä, 1996; Black and Strahan, 2002). Subsidiaries also grow faster when economic growth is high and unemployment is low in the host country (confirming prediction 1).

Next we find that multinational bank subsidiaries do not reduce their lending when the host country is hit by a systemic banking crisis. This may be because parent banks give financial support to such subsidiaries. Section 6.1 provides estimation results for a benchmark group of domestic banks, which show that lending by domestic banks—that lack parent bank support—is affected negatively by local banking crises. We therefore find a remarkable difference between multinational bank subsidiaries and unaffiliated domestic banks that confirms prediction 2.

Columns 4–6 show similar estimations, but now including parent bank characteristics. Our earlier results do not change: subsidiaries grow faster when they are profitable, when they have low solvency

[9] See Footnote 5. Excluding the nominal exchange rate does not significantly change the economic or statistical significance of any of the results.

and liquidity levels, and when local economic growth is high. This model shows that the balance-sheet structure of the parent bank matters as well. Subsidiaries of highly liquid parent banks tend to grow more slowly. Multinational banks with an active market for intra-bank loans will have more intra-group debt on their balance sheet and, all else equal, retain a smaller cushion of liquid assets (cash, government securities). These findings are in line with support effects (prediction 3). Subsidiaries of parent banks that enjoy high net interest margins tend to grow faster, while we also find weak evidence (10 per cent level) that subsidiaries of weaker parent banks grow slower. The positive effect of net interest margin implies that better performing parent banks support their subsidiaries more. In case substitution effects would dominate, we would have found a negative coefficient.

We include parent bank interest margin and not parent bank solvency because both variables are highly correlated (0.8) and thus cannot be included simultaneously. When we include parent bank solvency instead of net interest margin, we also find a positive coefficient while the coefficients for all other variables stay the same. However, the positive impact of parent bank solvency is statistically less significant (10 per cent level at most). One explanation for this is that parent banks tend to hold substantial amounts of capital in excess of minimum regulatory capital requirements (e.g. Gambacorta and Mistrulli, 2004). Such capital cushions make parent bank capital a less binding constraint on intra-bank lending. In addition, as we argued in Section 3, parent banks do not need to move book capital to steer subsidiaries' credit growth. This is a second reason why bank capital, compared to net interest margin, may be a less strong indicator of the willingness and ability of parent banks to manage the credit growth of their foreign subsidiaries.

Thirdly, we estimate regressions which include (weighted) variables related to the other subsidiaries of the multinational bank (columns 7–9).[10] We again find that subsidiaries' credit growth is positively related to the host country business cycle and negatively to their own liquidity and solvency. However, profitability is no longer a significant determinant of credit growth.[11] Instead, we find that when other subsidiaries in the same group are relatively profitable, this positively influences the credit supply of a subsidiary (this result is not significant in the system GMM regression). If substitution effects would dominate, one would find a negative relationship between other subsidiaries' profitability and credit growth. Support effects are apparently more important: parent banks can shore up a subsidiary more when other subsidiaries are doing well. This support effect also dominates the influence of subsidiaries' *own* profitability. We also find that GDP growth in the home country exerts a negative influence on subsidiaries' credit growth. This is in line with parent banks that trade off lending opportunities in various countries (substitution effect, prediction 1).

Support effects may depend on the exposure that a parent bank has to a particular host country. Parent banks may only support large subsidiaries that could pose a threat to the whole group or lead to systemic problems in the host country (and thus result in high reputational costs). To test whether this is the case we interact our main regressors with two measures of subsidiary importance: the size of the subsidiary as a proportion of the parent bank's balance sheet and the market share of the subsidiary in total host-country lending. We do not find any significant and robust results (results available upon request from the authors). Parent support is as important for small subsidiaries as it is for large ones.

5.2. Greenfield versus takeover multinational bank subsidiaries

We expect that subsidiaries formed as a result of a takeover are relatively independent as they may not yet be fully integrated into the bank holding. In contrast, greenfield subsidiaries—which are built up from scratch by the parent—may be more closely integrated into the bank holding and its internal capital market (De Haas and Van Lelyveld, 2006). To test this, we re-estimate the empirical models and

[10] Because of the high (0.6) correlation between other subsidiaries' interest margin and other subsidiaries' solvency we only include the latter. We include home country GDP growth but not the weighted GDP growth in the other countries of operation because both growth rates are highly correlated.

[11] In these estimations the number of banks is smaller because we remove subsidiaries in the same country as the parent bank. For these subsidiaries the home and the host country coincide and we have to exclude them to prevent artificial multicollinearity between home country variables and host country variables.

Table 2
Are greenfield subsidiaries more closely integrated into multinational bank groups than subsidiaries that are the result of a take-over? Dependent variable:credit growth of multinational bank subsidiaries (in per cent).

	(1) FE	(2) GMM Diff.	(3) GMM system	(4) FE	(5) GMM diff.	(6) GMM system	(7) FE	(8) GMM diff.	(9) GMM system
Subsidiary characteristics									
Credit growth (lagged)	0.07	0.11	0.29	0.04	0.08	0.22	0.07	0.08	0.20
	[0.05]**	[0.03]**	[0.00]***	[0.26]	[0.10]*	[0.01]***	[0.08]*	[0.22]	[0.04]**
Weakness	−0.12	−0.12	0.02	−0.12	−0.11	0.01	−0.04	−0.05	−0.05
	[0.05]**	[0.08]*	[0.74]	[0.07]*	[0.15]	[0.78]	[0.44]	[0.44]	[0.46]
Weakness/greenfield interaction	0.13	0.13	−0.01	0.13	0.12	−0.00	0.14	0.12	0.00
	[0.05]**	[0.07]*	[0.87]	[0.05]**	[0.15]	[0.95]	[0.12]	[0.19]	[0.78]
Profitability	0.23	0.20	0.23	0.24	0.21	0.21	0.15	0.05	0.02
	[0.01]***	[0.05]**	[0.03]**	[0.01]***	[0.05]**	[0.04]**	[0.27]	[0.74]	[0.98]
Liquidity	−0.52	−0.50	−0.28	−0.46	−0.40	−0.48	−0.38	−0.44	−0.54
	[0.00]***	[0.00]***	[0.04]**	[0.00]***	[0.02]**	[0.00]***	[0.01]***	[0.01]***	[0.00]***
Solvency	−1.07	−0.92	−1.29	−1.03	−0.91	−1.04	−0.99	−0.72	−1.34
	[0.00]***	[0.01]***	[0.00]***	[0.00]***	[0.01]***	[0.00]***	[0.01]***	[0.05]**	[0.00]***
Host country characteristics									
GDP growth	−0.49	0.11	2.06	−0.61	−0.07	1.86	0.41	0.34	2.71
	[0.51]	[0.86]	[0.01]***	[0.43]	[0.93]	[0.01]***	[0.62]	[0.62]	[0.01]***
GDP/greenfield interaction	2.38	1.63	−0.54	2.75	2.02	−0.25	1.73	2.20	−0.67
	[0.00]***	[0.04]**	[0.51]	[0.00]***	[0.03]**	[0.76]	[0.05]**	[0.00]***	[0.53]
Unemployment	−0.98	−0.74	0.13	−1.42	−1.21	−0.68	−1.90	−1.72	−0.87
	[0.02]**	[0.10]*	[0.68]	[0.01]***	[0.06]*	[0.07]*	[0.00]***	[0.00]***	[0.03]**
Exchange rate [US$]	0.02	0.03	0.01	0.02	0.03	0.02	0.02	0.03	0.03
	[0.15]	[0.11]	[0.01]**	[0.14]	[0.11]	[0.00]***	[0.20]	[0.11]	[0.00]***
Crisis dummy	−1.73	−0.63	−3.51	0.46	1.39	−9.77	−0.55	4.51	−1.22
	[0.66]	[0.90]	[0.62]	[0.92]	[0.77]	[0.20]	[0.93]	[0.50]	[0.88]
Parent bank characteristics									
Weakness (other subs.)				−0.06	−0.10	−0.36			
				[0.42]	[0.22]	[0.01]***			
Profitability				−0.14	0.19	−1.03			
				[0.36]	[0.34]	[0.00]***			
Liquidity				−0.53	−0.50	−0.26			
				[0.00]***	[0.01]***	[0.26]			
Interest margin				6.54	5.98	1.97			
				[0.00]***	[0.00]***	[0.17]			

Characteristics home country and other subsidiaries									
GDP growth							−2.23	−2.48	−2.70
							[0.00]***	[0.00]***	[0.02]**
Weakness							−0.06	−0.14	0.05
							[0.41]	[0.10]*	[0.81]
Profitability							0.19	0.22	−0.02
							[0.05]**	[0.01]***	[0.94]
Liquidity							−0.14	−0.24	−0.31
							[0.33]	[0.08]*	[0.11]
Solvency							−0.07	[−0.50]	0.67
							[0.89]	[0.25]	[0.25]
Crisis other countries							−12.45	−16.24	−17.65
							[0.26]	[0.20]	[0.56]
Constant	29.69	25.50	13.81	26.98	25.13	42.66	41.22	45.74	36.47
	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***
Observations	967	763	967	905	703	905	677	524	677
No. banks	194	183	194	194	182	194	147	139	147
No. instruments			139			139			116
R^2_{within}	0.13			0.16			0.16		
Hausman	0.00			0.00			0.00		
AB test AR1		0.00	0.00		0.00	0.00		0.00	0.00
AB test AR2		0.66	0.32		0.45	0.21		0.82	0.57
Wald				0.00	0.00	0.03	0.10	0.00	0.07
Hansen *J*		0.94	0.22		0.88	0.42		0.98	0.67

Notes: *p*-values in brackets. 'GMM diff.' and 'GMM system' refer to estimations using the Arellano and Bond (1991) difference panel-data estimator (robust) and the Arellano and Bover (1995) system panel-data estimator (robust), respectively. 'Hausman': *p*-value of the Hausman specification test. 'AB test AR1(2)': *p*-value of the Arellano–Bond test that average autocovariance in residuals of order 1 (order 2) is 0. 'Wald': *p*-value of the Wald *F*-test that parameters associated with parent bank/other subsidiaries variables are jointly 0. 'Hansen *J*': *p*-value of the Hansen *J* test for overidentifying restrictions, which is asymptotically distributed as χ^2 under the null of instrument validity. 'Ownership' is a dummy variable which takes on the values of 0 (1) for takeovers (greenfields).

* Significance at 10%.

** Significance at 5%.

*** Significance at 1%.

interact the main determinants with an ownership dummy which is '1' for greenfields and '0' for takeovers. We do not include the dummy separately since we are interested in the impact of ownership on the strength of substitution and support effects and not in the separate impact of ownership type on credit growth. Moreover, bank ownership is a time-invariant, bank-specific variable and the fixed effects in our FE estimations already capture its influence. To keep the regressions parsimonious (and conserve degrees of freedom in the GMM estimations) we omit insignificant interaction terms. Table 2 provides the results.

As before, lending by multinational bank subsidiaries is sensitive to profitability (+), liquidity (−) and solvency (−), as well as to home country GDP growth (−). Subsidiaries grow faster when other subsidiaries in the same group are relatively profitable and this effect dominates the impact of the subsidiary's own profitability. We also confirm that subsidiaries of parent banks with high interest margins, low liquidity, and stronger balance sheets (lower loan loss provisions to net interest revenues) grow faster. We find weak evidence (10 per cent confidence level) that lending by takeover subsidiaries is sensitive to the weakness of their balance sheet but lending by greenfield subsidiaries is not. This is in line with a stronger role of the parent bank in the case of greenfields compared to takeovers.

We also find that host country GDP growth only matters for greenfield subsidiaries. Lending by takeovers is less strongly correlated with the local business cycle, perhaps because these banks have not yet been well integrated into the parent bank and substitution effects are less important.[12]

5.3. The influence of geographical distance

The influence of parent bank characteristics and economic developments in the home country on subsidiaries' credit growth may depend on the distance between the parent bank and a subsidiary. If the incentives of subsidiary managers are not aligned with those of the parent bank, internal agency costs hamper the operation of an internal capital market. Such costs increase with distance if parent bank's senior management finds it difficult to manage junior management in far-away places (Rajan et al., 2000). Greater intra-bank distances may also lead to more lost or distorted information within the bank. Operating an internal capital market may therefore be more difficult in geographically complex banks where there is a large distance between the parent bank and the various subsidiaries.[13]

However, contrary to the above, Carlin et al. (2006) point out that a larger distance between parent and subsidiary may allow organizations to operate an internal capital market on a more objective basis since there is less room for local managers to lobby the headquarters. Banks with distant subsidiaries may be less liable to internal agency costs if they use formally structured decision-making mechanisms that reduce foreign managers' opportunities to evade the financial discipline of the internal capital market. Berger and DeYoung (2001) show that bank holdings which choose to be geographically dispersed are banks that are relatively good at controlling distant affiliates. Senior management of expanding banks may also, at least temporarily, focus on recently purchased remote subsidiaries while exercising less control over nearby subsidiaries that have been part of the holding for longer (Berger and DeYoung, 2001). For these reasons, geographically distant subsidiaries may be more strongly integrated into an internal capital market.

To empirically analyze the importance of geographical distance, we interact all macroeconomic variables and parent bank characteristics with a measure of the geographical distance between the parent bank and the subsidiary. As in Table 2 and in line with Carlin et al. (2006) we do not include distance as a separate determinant as we are only interested in the effect of distance on the influence of the parent bank and not so much in the separate effect distance may have on credit growth. We calculate distance on the basis of the latitude and longitude co-ordinates of both banks using the great circle distance formula. Regression results showed that especially the interaction term between host country GDP growth and geographical distance is significantly positive and robust. The strong positive link between subsidiary lending and the host country business cycle (procyclicality) turns out to be mainly caused by remote subsidiaries. Table 2 already showed that greenfields drive the procyclical

[12] The GMM system estimations fail to detect a significant difference between greenfields and takeovers.

[13] A related literature finds that there are not only agency costs associated with monitoring geographically complex financial institutions, but also with managing financial conglomerates that engage in a diverse set of activities (Laeven and Levine, 2007).

Table 3
Does geographical distance determine the level of foreign subsidiaries' integration within multinational bank groups? Dependent variable: credit growth of multinational bank subsidiaries (in per cent).

	(1) FE	(2) GMM Diff.	(3) GMM system	(4) FE	(5) GMM diff.	(6) GMM system	(7) FE	(8) GMM diff.	(9) GMM system
Subsidiary characteristics									
Credit growth	0.07	0.11	0.29	0.05	0.07	0.23	0.08	0.10	0.20
(lagged)	[0.03]**	[0.04]**	[0.00]***	[0.20]	[0.23]	[0.00]***	[0.06]*	[0.13]	[0.02]**
Weakness	−0.00	−0.00	−0.00	0.00	0.00	0.00	−0.03	−0.05	−0.01
	[0.86]	[0.97]	[0.89]	[0.97]	[0.83]	[0.92]	[0.53]	[0.49]	[0.83]
Profitability	0.26	0.16	0.22	0.27	0.19	0.23	0.15	0.05	0.09
	[0.00]***	[0.05]**	[0.02]**	[0.00]***	[0.02]**	[0.01]***	[0.28]	[0.75]	[0.52]
Liquidity	−0.52	−0.51	−0.21	−0.45	−0.48	−0.34	−0.39	−0.35	−0.32
	[0.00]***	[0.00]***	[0.05]**	[0.00]***	[0.01]***	[0.00]***	[0.01]***	[0.06]*	[0.02]**
Solvency	−1.02	−0.83	−1.13	−0.96	−0.60	−1.14	−0.97	−0.57	−1.30
	[0.00]***	[0.02]**	[0.00]***	[0.01]***	[0.10]*	[0.00]***	[0.02]**	[0.10]*	[0.00]***
Host country characteristics									
GDP growth	−0.92	−1.25	3.75	−1.22	−1.94	3.08	−0.53	0.25	3.34
	[0.26]	[0.18]	[0.00]***	[0.17]	[0.07]*	[0.01]***	[0.64]	[0.85]	[0.02]**
GDP/greenfield	1.77	1.59	−1.81	2.12	2.21	−0.80	1.55	1.55	−0.08
interaction	[0.02]**	[0.05]**	[0.13]	[0.01]***	[0.01]***	[0.45]	[0.08]*	[0.04]**	[0.94]
GDP/distance	0.15	0.21	−0.16	0.17	0.23	−0.14	0.14	0.06	−0.18
interaction	[0.03]**	[0.01]**	[0.07]*	[0.03]**	[0.01]**	[0.11]	[0.10]*	[0.66]	[0.20]
Unemployment	−1.04	−0.90	0.06	−1.41	−1.07	−0.41	−2.00	−1.57	−1.01
	[0.01]***	[0.06]*	[0.85]	[0.01]**	[0.10]*	[0.37]	[0.00]***	[0.00]***	[0.00]***
Exchange rate	0.02	0.03	0.01	0.02	0.03	0.02	0.03	0.02	0.02
[US$]	[0.19]	[0.16]	[0.37]	[0.17]	[0.14]	[0.17]	[0.14]	[0.21]	[0.06]*
Crisis dummy	−1.46	−2.17	2.32	1.42	−0.26	−0.53	3.81	2.46	4.68
	[0.71]	[0.68]	[0.64]	[0.77]	[0.96]	[0.93]	[0.54]	[0.72]	[0.59]
Parent bank characteristics									
Weakness				−0.08	−0.14	−0.23			
				[0.28]	[0.06]*	[0.10]*			
Profitability				−0.12	−0.09	−0.74			
				[0.45]	[0.66]	[0.04]**			
Liquidity				−0.53	−0.62	−0.33			
				[0.00]***	[0.00]***	[0.10]*			
Interest margin				5.72	6.56	2.73			
				[0.01]***	[0.00]***	[0.07]*			
Characteristics home country and other subsidiaries									
GDP growth							−1.51	−2.35	−3.67
							[0.09]*	[0.05]**	[0.01]***
Weakness (other subs.)							−0.07	−0.14	−0.18
							[0.33]	[0.11]	[0.37]
Profitability							0.19	0.21	0.08
							[0.05]**	[0.01]***	[0.74]
Liquidity							−0.15	−0.27	−0.21
							[0.28]	[0.06]*	[0.34]
Solvency							−0.09	−0.54	0.84
							[0.84]	[0.21]	[0.15]
Crisis other countries							−10.77	−15.08	−34.44
							[0.33]	[0.25]	[0.25]
Constant	29.82	28.42	11.56	28.70	25.33	30.71	42.00	43.20	32.95
	[0.00]***	[0.00]***	[0.01]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***
Observations	967	763	967	905	703	905	674	523	674
No. banks	194	183	194	194	182	194	146	138	146
No. instruments			177			177			137
R^2_{within}	0.13			0.16			0.17		
Hausman	0.00			0.01			0.00		

(*continued on next page*)

Table 3 (*continued*)

	(1) FE	(2) GMM Diff.	(3) GMM system	(4) FE	(5) GMM diff.	(6) GMM system	(7) FE	(8) GMM diff.	(9) GMM system
AB test AR1		0.00	0.00		0.00	0.00		0.00	0.00
AB test AR2		0.56	0.18		0.67	0.78		0.23	0.45
Wald				0.00	0.00	0.06	0.10	0.00	0.06
Hansen *J*		0.85	0.87		0.88	0.98		0.90	0.88

Notes: *p*-values in brackets. 'GMM diff.' and 'GMM system' refer to estimations using the Arellano and Bond (1991) difference panel-data estimator (robust) and the Arellano and Bover (1995) system panel-data estimator (robust), respectively. 'Hausman': *p*-value of the Hausman specification test. 'AB test AR1(2)': *p*-value of the Arellano–Bond test that average autocovariance in residuals of order 1 (order 2) is 0. 'Wald': *p*-value of the Wald *F*-test that parameters associated with parent bank/other subsidiaries variables are jointly 0. 'Hansen *J*': *p*-value of the Hansen *J* test for overidentifying restrictions, which is asymptotically distributed as χ^2 under the null of instrument validity. 'Ownership' is a dummy variable which takes on the values of 0 (1) for takeovers (greenfields). 'Distance' is the geographical distance between a subsidiary and its parent bank measured on the basis of the latitude and longitude co-ordinates of both banks using the great circle distance formula.

* Significance at 10%.

** Significance at 5%.

*** Significance at 1%.

lending of multinational bank subsidiaries. This leads to the question whether greenfield subsidiaries are on average more distant than subsidiaries that are the result of a takeover. This turns out to be the case: foreign greenfields are on average 773 km further away from their parent banks than foreign takeovers (although this difference is not statistically significant).

We now test whether it is mainly ownership type or distance that determines how strongly a subsidiary is integrated into the parent bank's internal capital market. Table 3 shows regressions similar to those in Table 2, but now also including the interaction term between host country GDP growth and geographical distance.

It transpires that the positive association between subsidiary lending and host country growth is driven by both the greenfield effect and the distance effect. Greenfield subsidiaries are not just more tightly managed because they are on average further away. Again, these results only hold for the fixed effects and the difference GMM estimations.

6. Robustness

The empirical results in Section 5 show that lending by multinational bank subsidiaries is partly determined by developments in other parts of the group. However, the results may to some extent also be caused by other mechanisms that do not reflect *intra-bank* relationships. For instance, macroeconomic developments in the home country may affect the lending of a multinational bank subsidiary in a host country because of more general economic linkages between both countries. Such linkages may also influence domestic bank lending.

As an example, if economic growth in Spain picks up, Spanish firms that operate in both Spain and Latin America may expand their domestic activities at the expense of their Latin American operations. To the extent that this shift in focus reduces their demand for credit in Latin America, lending by Spanish bank subsidiaries and domestic banks in Latin America will decrease. We would then observe a negative correlation between Spanish GDP growth and lending by all types of banks in Latin America. One cannot attribute this correlation to an active involvement of Spanish parent banks in the credit *supply* of their foreign subsidiaries. It would rather reflect an autonomous reaction of these subsidiaries and/or domestic banks to changes in credit *demand* that follow from macroeconomic linkages. To analyze to what extent our results are driven by such general linkages between countries, we perform two robustness tests.

6.1. Domestic banks as a benchmark

As a first robustness test we re-estimate the regressions of Table 1 for a benchmark group of the five largest domestically-owned banks in each host country (Table 4). These domestic banks are

Table 4
Robustness test: are domestic banks influenced by similar variables as multinational bank subsidiaries? Dependent variable: credit growth of domestic banks (in per cent).

	(1) FE	(2) GMM Diff.	(3) GMM system	(4) FE	(5) GMM diff.	(6) GMM system	(7) FE	(8) GMM diff.	(9) GMM system
Domestic bank characteristics									
Credit growth	0.04	0.03	0.07	−0.00	−0.05	0.04	0.07	0.11	0.18
(lagged)	[0.10]*	[0.43]	[0.39]	[0.98]	[0.31]	[0.65]	[0.08]*	[0.08]*	[0.04]**
Weakness	0.00	0.00	0.01	0.00	−0.00	−0.01	−0.03	−0.04	−0.00
	[0.68]	[0.85]	[0.54]	[0.89]	[0.90]	[0.76]	[0.58]	[0.60]	[0.90]
Profitability	0.44	[0.31]	0.18	0.52	0.34	0.30	0.18	0.09	0.08
	[0.00]***	[0.00]***	[0.09]*	[0.00]***	[0.01]***	[0.07]*	[0.17]	[0.56]	[0.60]
Liquidity	−0.23	−0.49	−0.45	−0.31	−0.38	−0.29	−0.41	−0.29	−0.40
	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.01]***	[0.02]**	[0.00]***	[0.10]*	[0.00]***
Solvency	−0.64	−1.49	−0.13	−0.87	−0.91	−0.47	−1.04	−0.64	−1.29
	[0.01]***	[0.02]**	[0.67]	[0.01]***	[0.23]	[0.24]	[0.01]***	[0.06]*	[0.00]***
Host country characteristics									
GDP growth	1.17	1.41	1.99	0.75	0.94	1.35	1.61	1.62	1.79
	[0.00]***	[0.00]***	[0.00]***	[0.01]***	[0.01]***	[0.01]***	[0.00]***	[0.00]***	[0.00]***
Unemployment	−0.97	−0.16	0.41	−0.60	−0.31	0.10	−1.86	−1.49	−0.72
	[0.00]***	[0.75]	[0.44]	[0.19]	[0.65]	[0.86]	[0.00]***	[0.00]***	[0.04]**
Exchange rate	−0.01	−0.01	−0.01	−0.01	−0.01	−0.01	0.02	0.01	0.02
[US$]	[0.03]**	[0.02]**	[0.32]	[0.07]*	[0.16]	[0.17]	[0.40]	[0.62]	[0.08]*
Crisis dummy	−6.93	−5.90	−7.57	−10.74	−8.72	−17.06	4.14	4.46	3.14
	[0.00]***	[0.02]**	[0.08]*	[0.00]***	[0.01]***	[0.00]***	[0.50]	[0.57]	[0.76]
Foster parent bank characteristics									
Weakness				0.00	−0.05	0.06			
				[0.97]	[0.51]	[0.78]			
Profitability				−0.12	−0.04	0.01			
				[0.48]	[0.84]	[0.98]			
Liquidity foster				−0.13	0.04	−0.01			
				[0.40]	[0.85]	[0.98]			
Interest margin				3.09	8.09	2.58			
				[0.13]	[0.08]*	[0.40]			
Characteristics foster home country and other subsidiaries foster parent bank									
GDP growth foster home							−1.76	−2.20	−2.26
							[0.01]***	[0.01]***	[0.02]**
Weakness (other subs.)							0.03	−0.00	0.07
							[0.66]	[0.99]	[0.65]
Profitability							0.31	0.35	0.31
							[0.13]	[0.12]	[0.33]
Liquidity							−0.13	−0.30	−0.21
							[0.46]	[0.11]	[0.40]
Solvency							−0.01	−0.49	0.59
							[0.99]	[0.42]	[0.46]
Crisis other countries							−6.54	−10.57	−12.38
							[0.37]	[0.25]	[0.40]
Constant	21.30	27.95	9.71	19.84	5.16	7.44	35.33	36.14	25.13
	[0.00]***	[0.00]***	[0.08]*	[0.00]***	[0.64]	[0.47]	[0.00]***	[0.00]***	[0.01]***
Observations	1465	1241	1465	1033	822	1033	687	534	687
No. banks	179	175	179	178	173	178	147	139	147
No. instruments			137			137			137
R^2_{within}	0.13			0.13			0.14		
Hausman	0.00			0.01			0.00		
AB test AR1		0.00	0.00		0.00	0.00		0.00	0.00
AB test AR2		0.77	0.25		0.57	0.56		0.67	0.82

(*continued on next page*)

Table 4 (*continued*)

	(1) FE	(2) GMM Diff.	(3) GMM system	(4) FE	(5) GMM diff.	(6) GMM system	(7) FE	(8) GMM diff.	(9) GMM system
Wald				0.42	0.55	0.63	0.11	0.07	0.09
Hansen *J*		0.88	0.80		0.78	0.67		0.80	0.80

Notes: *p*-values in brackets. 'GMM diff.' and 'GMM system' refer to estimations using the Arellano and Bond (1991) difference panel-data estimator (robust) and the Arellano and Bover (1995) system panel-data estimator (robust), respectively. 'Hausman': *p*-value of the Hausman specification test. 'AB test AR1(2)': *p*-value of the Arellano-Bond test that average autocovariance in residuals of order 1 (order 2) is 0. 'Wald': *p*-value of the Wald *F*-test that parameters associated with foster parent bank/other subsidiaries variables are jointly 0. 'Hansen *J*': *p*-value of the Hansen *J* test for overidentifying restrictions, which is asymptotically distributed as χ^2 under the null of instrument validity.

* Significance at 10%.

** Significance at 5%.

*** Significance at 1%.

similar to the multinational bank subsidiaries; the main difference is that they have higher loan loss provisions to net interest revenue ratios, indicating a weaker loan portfolio (see Appendix B).

The first two columns of Table 4 show the re-estimation of the basic model, in which credit growth only depends on the bank's characteristics and on local economic developments. Domestic bank lending depends on profitability, liquidity, solvency, and the local business cycle in much the same way as lending by multinational bank subsidiaries does. However, lending by domestic banks tends to be somewhat less procyclical (lower sensitivity to host country growth) than lending by multinational bank subsidiaries (in line with prediction 1).

Another interesting difference is that domestic bank lending decreases substantially during local banking crises. While the size of the coefficient differs somewhat across estimation methods, on average a domestic bank reduces its loan growth by 9.6 per cent during a financial crisis year. As lending by domestic banks in our sample increased on average by 10.8 per cent per year, this means that domestic banks virtually halt their credit expansion during crisis periods. This stands in contrast to the results in Table 1, which show that lending by multinational bank subsidiaries is not sensitive to banking crises. Apparently, subsidiaries can rely on parental support during a financial crisis, a form of support that is not available to domestic banks. This finding confirms our second prediction and is in line with results reported by De Haas and Van Lelyveld (2006) for a sample of transition countries.

An alternative though related explanation for this finding is that multinational bank subsidiaries are able to keep up lending not because they actually get parental support but because they could receive it if necessary. The mere *potential* for parental support means that depositors may view multinational bank subsidiaries as a safe haven during crisis periods, resulting in a deposit inflow that allows such subsidiaries to continue lending. We test for this by running regressions in which we explain deposit growth of multinational bank subsidiaries by the same bank-specific characteristics, macroeconomic variables, and crisis dummy (results available on request). The results show that weaker subsidiaries (higher loan loss provisions to net interest revenue) can increase their deposits much less than stronger subsidiaries (1 per cent level significance). We also find evidence, although only at the 10 per cent level, that during crisis periods subsidiaries see their deposits increase. However, these effects are not robust to the inclusion of parent bank variables (which are not significant either). While multinational bank subsidiaries experience some additional deposit inflows during crises, this effect is not large enough to explain the strong difference between domestic banks and multinational bank subsidiaries as regards their lending sensitivity to crisis periods.

We also check whether domestic bank lending is influenced by developments in the home countries of their foreign competitor banks. If we were to find such influences, this would imply that our earlier results for multinational bank subsidiaries do not only reflect intra-bank linkages but also broader international economic relationships. To analyze this issue we link each domestic bank to a 'foster parent bank'. For each host country we create a set of foster parent banks that includes all the parent banks of the multinational bank subsidiaries that operate in that host country. When this number is less than five, we add banks from the same home countries. We then randomly assign one

Table 5
Robustness test: are multinational banks influenced by developments in non-related 'foster' parent banks? Dependent variable: credit growth of multinational bank subsidiaries (in per cent).

	(1) FE	(2) GMM diff.	(3) GMM system	(4) FE	(5) GMM diff.	(6) GMM system
Subsidiary characteristics						
Credit growth(lagged)	0.02	0.05	0.16	0.05	0.05	0.24
	[0.67]	[0.45]	[0.10]*	[0.34]	[0.53]	[0.06]*
Weakness	−0.00	0.00	0.01	−0.07	−0.08	−0.08
	[0.96]	[0.95]	[0.57]	[0.30]	[0.28]	[0.33]
Profitability	0.30	0.25	0.27	0.10	0.03	−0.08
	[0.00]***	[0.00]***	[0.01]***	[0.54]	[0.88]	[0.73]
Liquidity	−0.46	−0.39	−0.20	−0.37	−0.35	−0.35
	[0.00]***	[0.04]**	[0.09]*	[0.02]**	[0.08]*	[0.03]**
Solvency	−1.21	−0.72	−0.99	−1.43	−0.68	−1.23
	[0.01]***	[0.34]	[0.01]***	[0.03]**	[0.43]	[0.08]*
Host country characteristics						
GDP growth	0.84	0.76	1.14	1.02	1.19	1.75
	[0.05]**	[0.17]	[0.04]**	[0.05]**	[0.04]**	[0.01]***
Unemployment	−0.88	−0.65	0.13	−1.16	−1.23	−0.39
	[0.21]	[0.45]	[0.80]	[0.15]	[0.16]	[0.50]
Exchange rate [US$]	0.00	0.01	0.00	−0.00	0.01	0.01
	[0.94]	[0.67]	[0.88]	[0.94]	[0.77]	[0.65]
Crisis dummy	−7.79	−8.33	−9.08	−10.47	−6.97	−9.64
	[0.19]	[0.06]*	[0.18]	[0.11]	[0.11]	[0.29]
Foster parent bank characteristics						
Weakness	−0.08	−0.08	−0.08			
	[0.23]	[0.13]	[0.58]			
Profitability	−0.12	−0.18	−0.36			
	[0.51]	[0.34]	[0.31]			
Liquidity	−0.36	−0.36	−0.41			
	[0.13]	[0.19]	[0.14]			
Interest margin	4.21	3.34	−0.04			
	[0.13]	[0.35]	[0.99]			
Characteristics home country and other subsidiaries foster parent bank						
GDP growth				−1.88	−2.60	−3.22
				[0.03]**	[0.00]***	[0.01]***
Weakness (other subs. foster bank)				−0.09	−0.12	−0.09
				[0.33]	[0.16]	[0.60]
Profitability				0.35	0.36	0.30
				[0.12]	[0.11]	[0.45]
Liquidity				−0.01	0.00	−0.07
				[0.95]	[0.98]	[0.77]
Solvency				−0.78	−0.91	0.03
				[0.21]	[0.15]	[0.97]
Crisis other countries				−4.81	−6.19	−4.43
				[0.75]	[0.70]	[0.90]
Constant	30.33	26.73	27.66	43.58	40.84	32.82
	[0.00]***	[0.04]**	[0.0]***	[0.00]***	[0.00]***	[0.02]**
Observations	635	481	635	456	340	456
No. banks	149	141	149	111	106	111
No. instruments		136	136		121	121
R^2_{within}	0.12			0.15		
Hausman	0.00			0.00		
AB test AR1		0.00	0.00		0.00	0.01
AB test AR2		0.71	0.60		0.21	0.58

(*continued on next page*)

Table 5 (*continued*)

	(1) FE	(2) GMM diff.	(3) GMM system	(4) FE	(5) GMM diff.	(6) GMM system
Wald	0.56	0.41	0.67	0.06	0.05	0.04
Hansen *J*		0.78	0.68		0.56	0.34

Notes: *p*-values in brackets. 'GMM diff.' and 'GMM system' refer to estimations using the Arellano and Bond (1991) difference panel-data estimator (robust) and the Arellano and Bover (1995) system panel-data estimator (robust), respectively. 'Hausman': *p*-value of the Hausman specification test. 'AB test AR1(2)': *p*-value of the Arellano–Bond test that average autocovariance in residuals of order 1 (order 2) is 0. 'Wald': *p*-value of the Wald *F*-test that parameters associated with foster parent bank/other subsidiaries variables are jointly 0. 'Hansen *J*': *p*-value of the Hansen *J* test for overidentifying restrictions, which is asymptotically distributed as χ^2 under the null of instrument validity.

* Significance at 10%.

** Significance at 5%.

*** Significance at 1%.

of these foster parent banks to each domestic bank. As the results of a single random assignment are not representative, we estimate each model a thousand times.

Table 4 reports the mean estimated coefficients and *p* values of these thousand runs in columns 3–6. Since no real ownership linkages exist between the domestic banks and their foster parent banks, any results that would point to a sensitivity to the foster parent bank's characteristics (columns 3 and 4) or to the characteristics of other subsidiaries of the foster parent bank (columns 5 and 6) cannot be explained by an internal capital market and must therefore be attributed to more general macroeconomic linkages.

The results show that domestic banks are not sensitive to the liquidity and net interest margin of their foster parent banks. We also find that whereas lending by multinational bank subsidiaries is sensitive to profitability changes in other subsidiaries of their parent bank, domestic banks are not sensitive to the profitability of the foster parent subsidiaries. These results imply that our earlier results for lending by multinational bank subsidiaries indeed point to internal capital market effects. However, we also find strong evidence that lending by domestic banks is negatively related to the business cycle in the home countries of their foreign competitor banks. This means that our earlier findings on substitution effects are at least partly due to more general macroeconomic linkages between home countries and host countries (that also influence the lending of domestic banks, though via credit demand rather than credit supply).

6.2. Linking multinational bank subsidiaries to foster parent banks

As a second robustness test we randomly link each multinational bank subsidiary to a foster parent bank from the same home country. For each host country the set of foster parent banks again consists of approximately five large banks. We include additional home country banks if there are not enough real parent banks from the same home country. For instance, since we only have one Danish parent bank in our dataset, we add four large Danish banks to our set of Danish foster parent banks. Appendix B shows that the average foster parent bank is similar to the average real parent bank, although foster parent banks are on average smaller. As a single random allocation of foster parent banks to subsidiaries is not representative, we estimate each model a thousand times. Table 5 reports the mean estimated coefficients and *p* values of these thousand runs. We expect our earlier results to become insignificant as lending by a multinational bank subsidiary should not depend on what is happening to *other* banks in the home country of its real parent bank.

Comparing Table 5 with our earlier results in Table 1 shows that lending by multinational bank subsidiaries is negatively related to the business cycle in the home country of the foster parent bank. This is logical as, by construction, the foster parent bank is located in the same country as the real parent bank, and we know—see Table 1—that there exists a strong negative link between the home country business cycle of the parent bank and subsidiary lending. More importantly, we find that lending by multinational bank subsidiaries is sensitive to the liquidity and interest margin of the real parent bank (Table 1) but not of the foster parent bank in the same home country. Moreover, while lending by

multinational bank subsidiaries depends on profitability changes in other subsidiaries of the real parent bank, this effect disappears if we link subsidiaries to foster parent banks. These results further strengthen our claim that our earlier empirical findings reflect intra-bank linkages in the form of an internal capital market.

7. Summary and conclusions

We examine whether multinational banks operate an internal capital market and, if so, whether the presence of financially integrated banks exposes countries to foreign economic developments. We analyze how multinational bank lending is influenced by the macroeconomic situation in the host country and in the home country, and by the financial characteristics of the subsidiary itself, those of the parent bank, and those of other subsidiaries. This is the first paper to analyze these micro and macro determinants of multinational bank lending within an integrated empirical framework.

Our findings indicate that multinational banks manage the credit growth of their subsidiaries. In particular, we find strong proof of support effects. Subsidiaries of strong parent banks—that have high net interest margins or low loan loss provisioning to net interest revenue—grow faster. Subsidiaries of parent banks that keep less liquid assets on their balance sheets are able to grow faster as well. If other subsidiaries in the same banking group are relatively profitable this also positively influences subsidiary lending. Finally, we find that during systemic banking crises, multinational bank subsidiaries keep lending, whereas domestic banks are forced to sharply restrict their credit supply. Robustness tests add further credibility to the claim that our findings do not reflect macroeconomic linkages but intra-bank capital management. As Houston et al. (1997) did for national bank holdings in the US, we provide evidence for the operation of internal capital markets at the international level.

We find weaker empirical support for substitution effects. We show that, in line with substitution effects, multinational bank subsidiaries expand lending faster when economic growth in their home country decreases. Likewise, we find that high host country growth stimulates credit growth, although this effect is limited to greenfield and remote subsidiaries. However, our robustness tests show that domestic bank lending is also procyclical (though somewhat less so) and also negatively related to economic growth in the home countries of foreign competitor banks. So while our findings are in line with substitution effects, they may also partly reflect macroeconomic linkages between countries.

Our findings imply that openness to multinational bank subsidiaries can benefit host countries. Since the pace of multinational bank lending is partly determined abroad, the *aggregate* credit supply in the host country becomes more stable and less strongly correlated with the local business cycle. We find that multinational banks provide a stabilizing factor during local financial turmoil in particular. Diversity in bank ownership therefore contributes to credit stability, allowing firms with binding credit constraints to optimize investments and households to better smooth consumption over time.

An important caveat is that the above interpretation of our results presumes that parent banks operate an internal capital market because they are better able to attract liquidity and raise capital than individual subsidiaries. If parent banks themselves experience problems with raising funds, they may no longer be able to support subsidiaries. Lending by foreign subsidiaries may even be scaled back in order to free up capital for the parent bank, leading to contagion from home to host countries.

Indeed, the global financial crisis is currently testing the resilience of the support effects documented in this paper. Multinational banks have so far continued to support their foreign subsidiaries. For instance, in Kazakhstan, cross-border foreign bank credit to domestic banks has dried up and the latter consequently had to rein in their own lending. Multinational bank subsidiaries were much less affected. ATF Bank, a mid-sized Kazakh bank owned by the Italian UniCredit group, for instance obtained credit lines and capital injections from its parent bank. In Latvia, multinational bank subsidiaries continued to receive funding from their parent banks, while Parex Bank, the second-largest bank and the only domestic bank left in the country, suffered a run on its deposits, forcing the government to step in. Both examples illustrate that lending by multinational bank subsidiaries tends to be more stable than cross-border foreign bank lending (see also Peek and Rosengren, 2000a).

For countries that plan to open up their banking system, it may thus make sense to not only permit cross-border foreign bank lending, but to also allow committed multinational banks to establish or buy local subsidiaries. When doing so, countries should ideally encourage entry from a variety of

home countries. Diversified multinational bank ownership is preferred to highly concentrated foreign ownership as the latter implies an overreliance on intra-bank support from one or a very small number of foreign parent banks.

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Appendix A. Overview of the multinational banks in the dataset

Table A1
List of multinational banks and their subsidiaries that are in the sample.

	Name bank holding	Home country	Subsidiaries	Host countries
1	ABN Amro Holding	Netherlands	5	AU, BR, FR, NL, US
2	Allied Irish Bank	Ireland	2	PL, UK
3	Banca Intesa	Italy	11	HR, FR, HU, IE, IT, PE, SK
4	Banco Bilbao V. Argentaria	Spain	9	AR, CL, CO, MX, PE, PT, ES, US, VE
5	Banco Comercial Português	Portugal	2	MZ, PL
6	Banco Popular Español	Spain	8	FR, ES
7	Banco Santander	Spain	11	BR, CL, DE, MX, ES, US, VE
8	Bank of America	USA	2	HK, US
9	Bank of Ireland	Ireland	1	UK
10	Bank of Montreal	Canada	2	IE, US
11	Barclays Bank	UK	1	ES
12	Bayerische HVB	Germany	9	CZ, HU, PL, RU, AT
13	BNP Paribas	France	4	FR, US
14	Caja de Barcelona	Spain	2	FR, ES
15	Citicorp	USA	8	BR, CA, MY, MX, PL, US
16	Commerzbank	Germany	4	DE, NL, PL
17	Danske Bank	Denmark	1	NO
18	Deutsche Bank	Germany	6	DE, IT, ES, US
19	Dexia	Belgium	7	BE, FR, DE, IT, NL, ES
20	Dresdner Bank	Germany	1	DE
21	DZ Bank	Germany	4	DE, IE
22	Erste Bank	Austria	8	CZ, HU, AT, SK
23	FöreningsSparbanken	Sweden	5	EE, LV, LT, SE
24	Fortis Bank	Belgium	3	BE, FR, NL
25	Monte dei Paschi di Siena	Italy	3	FR, IT
26	HBOS	UK	4	IE, UK
27	HSBC Holdings	UK	12	BR, CA, FR, DE, HK, IN, MY, SA, UK, US
28	ING Bank	Netherlands	5	BE, CA, FR, NL, PL
29	KBC Bank	Belgium	7	BE, CZ, DE, HU, IE, PL
30	MBNA Corp	USA	3	CA, UK, US
31	Mitsubishi Tokyo Group	Japan	4	JP, US
32	National Australia Bank	Australia	2	NZ, UK
33	National Bank of Greece	Greece	4	BG, CA, CY, US
34	Nordea Bank	Sweden	6	DK, FI, NO, SE
35	Rabobank Group	Netherlands	1	IE
36	Raiffeisen Zentralbank	Austria	8	BG, HR, CZ, PL, RU, SI, UA, SK
37	Royal Bank of Canada	Canada	2	UK, US

Table A1 (*continued*)

	Name bank holding	Home country	Subsidiaries	Host countries
38	Royal Bank of Scotland	UK	5	UK, US
39	Scotiabank	Canada	4	SV, MX, UK, US
40	SEB	Sweden	5	EE, DE, LV, LT, SE
41	Standard Chartered	UK	4	KE, MY, TH, UK
42	Société Générale	France	7	AU, CA, CZ, FR, DE
43	UBS	Switzerland	1	UK
44	UniCredit Group	Italy	5	BG, IE, IT, PL
45	WGZ Bank	Germany	2	DE, IE

Notes. Country abbreviations: AR = Argentina, AT = Austria, AU = Australia, BE = Belgium, BG = Bulgaria, BR = Brazil, CA = Canada, CL = Chile, CO = Colombia, CY = Cyprus, CZ = Czech Republic, DE = Germany, DK = Denmark, EE = Estonia, ES = Spain, FI = Finland, FR = France, HK = Hong Kong, HR = Croatia, HU = Hungary, IE = Ireland, IN = India, IT = Italy, JP = Japan, KE = Kenya, LV = Latvia, LT = Lithuania, MX = Mexico, MY = Malaysia, MZ = Mozambique, NL = The Netherlands, NO = Norway, NZ = New Zealand, PE = Peru, PL = Poland, PT = Portugal, RU = Russia, SA = Saudi Arabia, SE = Sweden, SI = Slovenia, SK = Slovak Republic, SV = El Salvador, TH = Thailand, UA = Ukraine, UK = United Kingdom, US = United States of America, VE = Venezuela.

Appendix B. Statistical annex

Table B1
Definitions, data sources, and summary statistics of the main variables.

Variable	Definition	Data source	Bank type	Mean	Median	Standard deviation	Obs.
Loan growth	Percentage growth of gross credit (net loans plus loan loss reserves)	BankScope	Parent	11.1	9.2	14.1	387
			Subsidiary	12.3	10.2	21.4	1240
			Domestic	10.8	9.6	20.7	1798
			Foster parent	11.3	9.4	16.6	409
Bank size	Total assets (million US$)	BankScope	Parent	274,012	184,828	25,570	387
			Subsidiary	28,520	6260	7486	1240
			Domestic	26,144	4088	9468	1798
			Foster parent	127,646	39,828	22,661	409
Bank solvency	Total equity/total assets (%)	BankScope	Parent	5.3	4.8	2.6	387
			Subsidiary	7.8	6.8	5.4	1240
			Domestic	8.6	7.4	5.8	1798
			Foster parent	5.4	5.4	1.9	409
Bank liquidity	Liquid assets/total assets (%)	BankScope	Parent	17.0	15.6	9.7	387
			Subsidiary	17.1	14.4	15.0	1240
			Domestic	18.9	16.9	14.2	1798
			Foster parent	16.6	14.1	13.0	409
Bank interest margin	Interest income earned on assets less interest expense paid on liabilities/total assets (%)	BankScope	Parent	2.4	2.3	1.2	387
			Subsidiary	3.1	2.7	2.4	1240
			Domestic	4.0	3.1	4.2	1798
			Foster parent	2.4	2.4	1.1	409
Bank profitability	Return on equity (%)	BankScope	Parent	13.8	14.7	7.6	387
			Subsidiary	12.7	12.5	11.4	1240
			Domestic	10.5	10.2	11.0	1798
			Foster parent	11.2	12.1	9.7	409

(*continued on next page*)

Table B1 (*continued*)

Variable	Definition	Data source	Bank type	Mean	Median	Standard deviation	Obs.
Bank weakness	Loan loss provisions/net interest revenue (%)	BankScope	Parent	18.4	15.2	16.9	387
			Subsidiary	17.6	12.7	43.3	1240
			Domestic	27.2	15.6	163.5	1798
			Foster parent	24.2	15.1	18.3	409
Geographical distance	Distance between parent bank and subsidiary in kilometers calculated using the great circle distance formula	www.tageo.com for latitude and longitude coordinates		2,970	637	4283	1234
GDP growth	Yearly change in GDP (%)	IMF, EBRD, Datastream	Home countries	2.5	2.5	1.6	387
			Host countries	2.9	2.8	2.3	1212
Unemployment	Unemployment rate (%)	IMF, EBRD, Datastream	Home countries	7.8	7.4	3.1	387
			Host countries	8.4	7.7	4.1	1212
Crisis dummy	Yearly dummy variable which is '1' in case of banking crisis and '0' otherwise	Caprio and Klingebiel (2002), Carstens et al. (2004)	Home countries	0.03	0.00	0.17	387
			Host countries	0.06	0.00	0.24	1240

Notes. Macroeconomic data taken from IMF International Financial Statistics (IFS), Transition Reports of the European Bank for Reconstruction and Development (EBRD), IMF World Economic Outlook, and Datastream.

Table B2
Stationarity tests.

	Solvency	Liquidity	Interest margin	Profitability	Weakness
Hadri (2000)*	*I*(1)	*I*(1)	*I*(1)	*I*(1)	*I*(1)
Pesaran (2003)	*I*(1)	*I*(0)	*I*(0)	*I*(0)	*I*(0)
Taylor and Sarno (1998)	*I*(0)	*I*(0)	*I*(0)	*I*(0)	*I*(0)

* Based on a balanced sub-panel as required by the Hadri (2000) panel unit root test.

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