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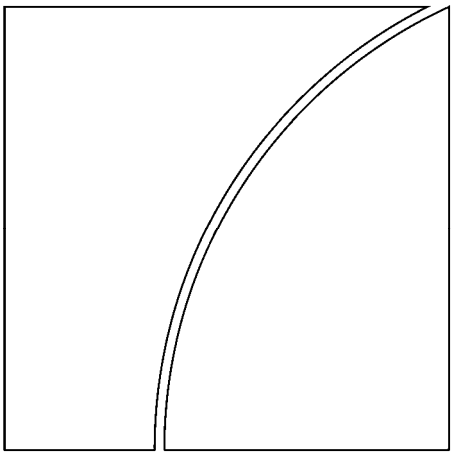

# BIS Working Papers

No 315

# The determinants of cross-border bank flows to emerging markets: new empirical evidence on the spread of financial crises

by Sabine Herrmann and Dubravko Mihaljek

Monetary and Economic Department

July 2010

JEL classification: F34, F36, G01, O57, C23

Keywords: gravity model, cross-border bank flows, financial crises, emerging market economies, spillover effects, panel data.

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CH-4002 Basel, Switzerland

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This publication is available on the BIS website (www.bis.org).



ISSN 1020-0959 (print)

ISBN 1682-7678 (online)

# The determinants of cross-border bank flows to emerging markets: new empirical evidence on the spread of financial crises

Sabine Herrmann and Dubravko Mihaljek[1]

## Abstract

This paper studies the nature of spillover effects in bank lending flows from advanced to the emerging market economies and identifies specific channels through which such effects occur. Based on a gravity model we examine a panel data set on cross-border bank flows from 17 advanced to 28 emerging market economies in Asia, Latin America and central and eastern Europe from 1993 to 2008. The empirical analysis suggests that global as well as country specific factors are significant determinants of cross-border bank flows. Greater global risk aversion and expected financial market volatility seem to have been the most important factors behind the decrease in cross-border bank flows during the crisis of 2007–08. The decrease in cross-border loans to central and eastern Europe was more limited compared to Asia and Latin America, in large measure because of the higher degree of financial and monetary integration in Europe, and relatively sound banking systems in the region. These results are robust to various specification, sub-samples and econometric methodologies.

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Keywords: gravity model, cross-border bank flows, financial crises, emerging market economies, spillover effects, panel data.

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# Contents

# 1. Introduction

The economic and financial crisis of 2007–09 marks the first major economic downturn in emerging market economies since the Asian and Russian crises of 1997–98. For quite some time, what started as a financial turbulence in August 2007 seemed to threaten financial stability primarily in the advanced economies, especially the United States and the United Kingdom. While emerging markets were exposed to some spillovers, including deleveraging of financial institutions in the advanced economies and the resulting rise of risk premia, until September 2008 their real economies continued to function quite well. Notwithstanding structural imbalances in some countries, a soft landing had been widely expected. However, after the collapse of Lehman Brothers in September 2008, liquidity tensions in money markets spread worldwide and financial stress in the emerging markets intensified. The crisis culminated in early 2009, when in addition to the financial sector the outlook for the real sector deteriorated sharply. While all emerging market countries have been affected to some degree, the impact varied significantly across and within emerging market regions.

International banks have been one of the major sources of finance for the catching-up process of the emerging market economies in recent years. It is therefore not surprising that financial linkages and in particular bank lending ties have been identified as one of the main channels of transmission of the latest crisis from advanced economies to the emerging markets (IMF, 2009a). The determinants of cross-border bank flows should therefore be carefully considered when investigating how the crisis was transmitted and why different emerging market countries were affected differently. Understanding the main factors driving cross-border bank flows is also important for financial stability in advanced economies, because of negative feedbacks of financial crises in emerging markets on banks in advanced economies. This is especially the case with banks from the euro area, which have built up significant exposures to emerging markets in Asia, Latin America and in particular central and eastern Europe.

This paper tries to clarify the nature of spillover effects in cross-border lending and to identify specific channels through which crises spread from advanced to the emerging market economies. In addition to the push and pull factors considered in the literature, we look at indicators of global and country specific financial vulnerabilities as important determinants of cross-border lending. The paper thus forms part of a small and fairly recent literature linking the determinants of cross-border bank flows and financial stress indicators (see eg Buch et al, 2009; McGuire and Tarashev, 2008; World Bank, 2008).

More specifically, we address the following set of questions: How far do banks from advanced economies readjust their cross-border loans to emerging markets in response to (i) reassessments of global risk and global financial market volatility (*the wake-up call* hypothesis); (ii) in response to their own exposure to a primary crisis country (*the common lender effect*) and the state of their own financial health; and (iii) in response to macroeconomic vulnerabilities in borrowing countries and the degree of monetary and financial integration with borrower countries.

Our empirical investigation is based on a gravity model of financial flows. The basic idea of classical gravity models is very simple: these models explain merchandise trade between pairs of countries *i* and *j* with distance between the countries and their size (Anderson, 1979). Recent gravity models (eg Frankel and Rose, 2002) are more sophisticated and include many additional variables. Martin and Rey (2004) and Portes and Rey (2005), for instance, use gravity models not only to explain trade in goods but also trade in assets.

Our data set contains some 30,500 observations on bilateral credit flows from banks in 17 advanced economies to 28 emerging market countries between 1993 and 2008. Besides this unique data set, the paper makes some methodological contributions. We estimate in addition to the standard random effects panel model a two-step Heckman selection model for panel data, following Wooldridge (1995, 2002), Mundlak (1978) and Chamberlain (1980,

1982). In order to exploit full information contained in the data on zero bilateral flows, we estimate separately the decisions whether banks in advanced economies lend to emerging markets, and how much they lend.

Our analysis suggests that global as well as country specific factors are significant determinants of cross-border bank flows. In the latest financial crisis, greater global risk aversion and expected financial market volatility seem to have been the most important channels through which spillover effects occurred. In central and eastern Europe (CEE) sound banking systems, stronger financial integration with advanced economies, and fixed exchange rate regimes have limited the decrease in cross-border bank flows compared to emerging Asia and Latin America.

The rest of the paper is organised as follows. *Chapter 2* reviews stylised facts on cross-border bank flows to emerging markets. *Chapter 3* links our approach to the existing literature. *Chapter 4* specifies the model and the data and summarises the main results. *Chapter 5* provides a comprehensive set of robustness checks. *Chapter 6* concludes.

## 2. Stylized facts on cross-border bank flows to emerging markets

By "cross-border bank flows" we understand two data sets from the BIS international banking statistics: the *external positions* and the *external loans* of BIS reporting banks vis-à-vis individual emerging market countries. About 80% of the external positions consist of standard cross-border loans from banks in country *i* to banks and the non-bank sector in country *j*. The remainder includes some other types of capital flows, such as holdings by banks in country *i* of bonds, money market instruments and equities issued by banks and the non-bank sector in country *j*. Both data series include quarterly stocks ("amounts outstanding") and flows ("changes"); the latter are adjusted for exchange rate changes.

These data series are taken from the BIS *locational* banking statistics, which comprises data on gross international financial claims and liabilities of banks resident in a given country, on banks and the non-bank sector in other countries (hence the term "cross-border"). In the alternative set of international banking data compiled by the BIS – the *consolidated* banking statistics – creditor data are reported on the nationality (ie home country) rather than residence (ie host country) basis.[2]

The main purpose of both data sets is to provide information on the role of internationally active banks in intermediating cross-border capital flows. The locational data are more relevant for countries receiving external loans, because the way they measure lending flows is consistent with the balance of payments statistics. In particular, the "external loans" correspond to the "other investment" category of capital flows in the balance of payments. This allows for better matching of cross-border bank flows and various macroeconomic and financial system characteristics in emerging markets. The consolidated data are more relevant for creditor countries, because they help assess the size of international banks' country and liquidity risk exposures.

In this paper we focus on emerging markets and therefore use the BIS locational banking statistics. Other advantages of the locational data are longer time series; availability of exchange rate adjusted data (which is particularly useful in a large panel we are using); and,

[2] For instance, Swiss banks' loans to the emerging markets are consolidated on a worldwide basis, regardless of the location (including eg Swiss bank branches in London) and reported as loans from banks in Switzerland. In the locational statistics, all cross-border loans made by banks based in Switzerland (including, eg the French banks) are reported as "Swiss", while the loans from the Swiss banks' branches in London are reported as UK loans.

most importantly, the fact that information on the flows between parent banks and their emerging market subsidiaries is not netted out, as is the case with the consolidated banking statistics.

Data in *Table 1* provide some key stylised facts on the development of cross-border bank flows to emerging markets. The external positions of BIS reporting banks vis-à-vis emerging markets (unadjusted for exchange rate changes) increased threefold between end-1994 and end-2008, and cross-border loans increased almost two and a half times. The expansion in cross-border financing was most pronounced in CEE, where external positions and cross-border loans outstanding at the end of 2008 were, respectively, 16 times and 12 times higher than at the end of 1994. The exposures of BIS reporting banks in CEE at the end of 2008 were thus the same as those in emerging Asia, which is five times larger in terms of GDP than CEE.

A comparison of external positions and cross-border loans outstanding indicates that the loans represent on average about 75% of external positions of the BIS reporting banks vis-à-vis emerging markets (77% in CEE in 2005–08; 73% in emerging market Asia; and 68% in Latin America). On a bilateral basis, European banks accounted for 65% of the outstanding stock of cross-border loans to emerging markets, US banks for 24% and Japanese banks for 10%.

In our estimates we use data on cross-border bank flows adjusted for exchange rate changes. *Figure 1* shows that emerging markets in Asia, Latin America and central and eastern Europe experienced quite different dynamics of these flows over the past 16 years. During the 1990s there were two distinct crisis episodes: the Mexican crisis of 1994–95, and the Asian and Russian crises of and 1997–99. The Mexican crisis was short-lived and affected only Latin America and partly CEE, which was at the time also going through an early phase of deep financial sector reforms. The effects of the Asian and Russian financial crises on cross-border bank flows were much bigger and lasted longer. Thailand, Indonesia, Korea, Malaysia and the Philippines were hit the hardest and experienced strong and long-lasting reductions in cross-border bank flows between Q3:1997 and Q4:1999. Latin America was strongly affected at the time by contagion from the Russian domestic debt default. Surprisingly, central and eastern Europe was less affected, despite the proximity of the Russian market.

The early 2000s were a period of muted inflows in all three regions, interrupted by occasional sharp reductions of inflows. The inflows began to pick up strongly in CEE and Asia in 2003, and in Latin America in 2006. Financial liberalisation, sophisticated new financial products, and the search for yield in an environment of low global interest rates have led internationally active banks to expand their operations in emerging markets, particularly in CEE (see Mihaljek, 2008). During 2005–08, the CEE region thus received on average over $40 billion in cross-border loans per year, emerging Asia over $20 billion and Latin America about $16 billion (*Table 1*).

The cross-border lending boom peaked in absolute terms between mid-2007 and mid-2008. The EMEs in Asia and Europe received a combined total of, respectively, $79 billion and $50 billion (in exchange rate adjusted terms) in cross-border bank inflows during the last quarter of 2007; those in Latin America received a total of $30 billion during the second quarter of 2008 (*Figure 1*). Relative to GDP, the inflows were the largest in CEE (10.8% of the region's quarterly GDP in Q4:2007); in emerging Asia and Latin America the peak inflows exceeded 4% of GDP (*Figure 2*).

Table 1

**Cross-border loans to emerging market economies[1]**

| | Amounts outstanding[2] End-period, USD billions | | Percentage changes[3] Period average | |
|---|---|---|---|---|
| | **External positions** | **Cross-border loans** | **External positions** | **Cross-border loans** |
| Vis-à-vis all 3 EME regions[4] | … | … | 8.8 | 6.7 |
| 1990-94 | 525 | 573 | 7.1 | ... |
| 1995-99 | 646 | 536 | 6.1 | –2.1 |
| 2000-04 | 809 | 607 | 3.5 | 1.6 |
| 2005-08 | 1,695 | 1,291 | 25.3 | 24.7 |
| 2009 | 1,645 | 1,206 | –17.4 | –16.5 |
| Vis-à-vis emerging Asia[4] | … | … | 9.8 | 3.8 |
| 1990-94 | 273 | 340 | 15.4 | … |
| 1995-99 | 303 | 266 | 6.7 | –6.8 |
| 2000-04 | 381 | 305 | 3.6 | 2.0 |
| 2005-08 | 679 | 519 | 22.4 | 20.4 |
| 2009 | 656 | 477 | –25.1 | –26.9 |
| Vis-à-vis Latin America[4] | … | … | 3.6 | 2.8 |
| 1990-94 | 209 | 188 | 1.8 | … |
| 1995-99 | 249 | 195 | 4.3 | 1.6 |
| 2000-04 | 210 | 149 | –2.8 | –4.7 |
| 2005-08 | 349 | 257 | 15.7 | 15.5 |
| 2009 | 345 | 234 | –13.4 | –10.3 |
| Vis-à-vis CEE[4] | … | … | 15.9 | 21.5 |
| 1990-94 | 43 | 44 | –0.4 | … |
| 1995-99 | 94 | 75 | 13.8 | 16.1 |
| 2000-04 | 217 | 153 | 16.8 | 14.2 |
| 2005-08 | 666 | 516 | 38.6 | 40.4 |
| 2009 | 644 | 494 | –10.2 | –6.8 |

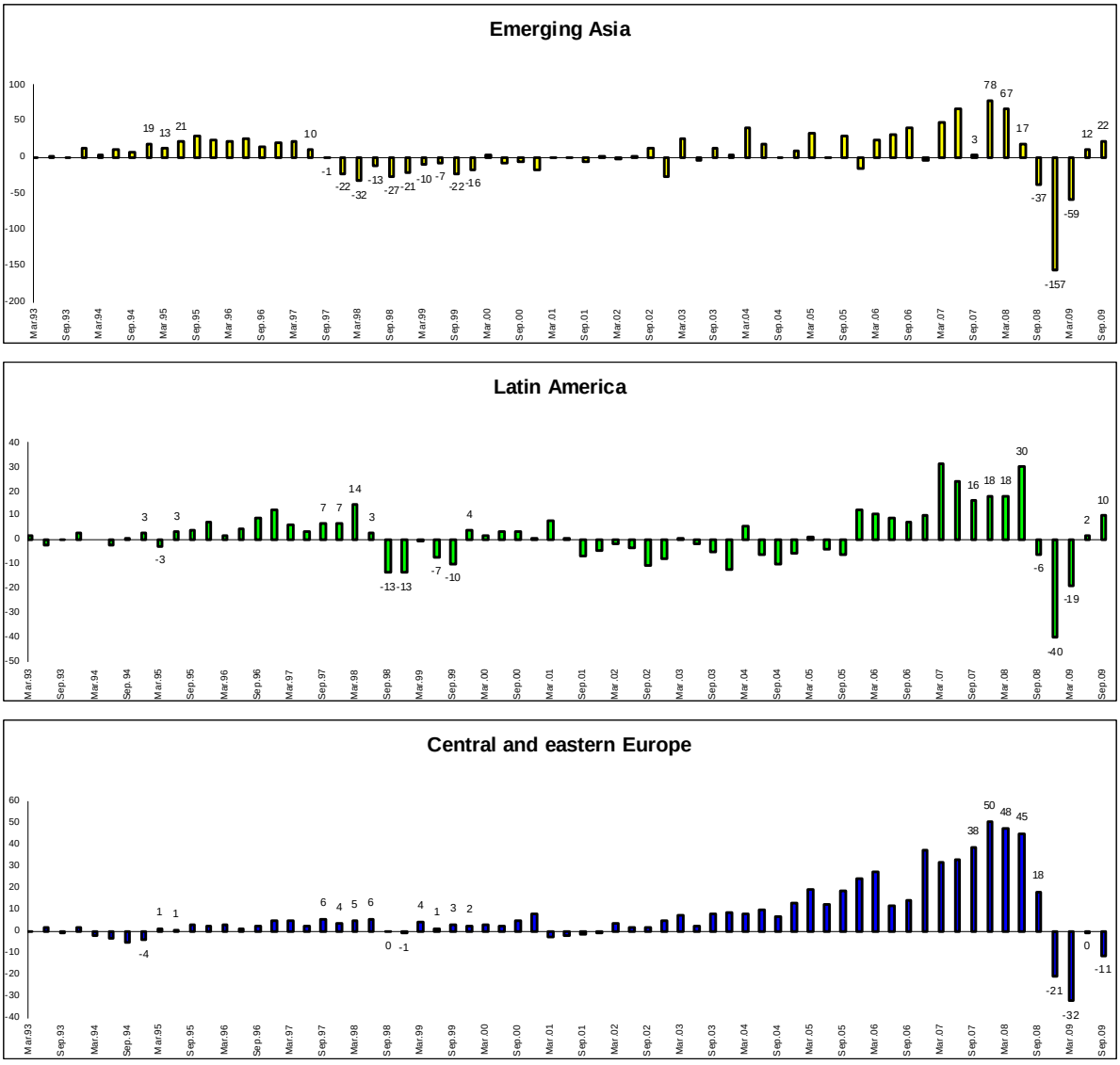
[1] External positions or cross-border loans of BIS reporting banks from 17 advanced economies vis-à-vis all sectors (banks and the non-bank sector) in emerging markets. [2] Amounts outstanding at the end of the last quarter in each period, in USD (unadjusted for exchange rate changes). For the most recent period, Q3:2009. For cross-border loans, the end of the first period is Q4:1995. [3] Four-quarter percentage changes (unadjusted for exchange rate changes), period averages. [4] Percentage changes refer to the full sample (Q1:1990–Q3:2009 for external positions, Q4:1995–Q3:2009 for cross-border loans).

Source: BIS, locational banking statistics; authors' calculations.

Figure 1

**External positions of reporting banks vis-à-vis emerging markets**

Exchange rate adjusted changes (Q/Q), in millions of US dollars




Source: BIS, locational banking statistics.

In the third quarter of 2008, disruptions in international credit markets mutated into a full-scale global financial crisis. Major international banks started to reduce their financing of banks and the non-bank sector in emerging markets. The largest reductions took place in Q4:2008 and Q1:2009 vis-à-vis emerging Asia, followed by Latin America and CEE (*Figure 1*).[3] Interestingly, banks and the non-bank sector in many smaller countries with a large share of foreign-owned banks, especially in central and eastern Europe, received additional cross-border loans during this period, indicating that foreign bank presence provided

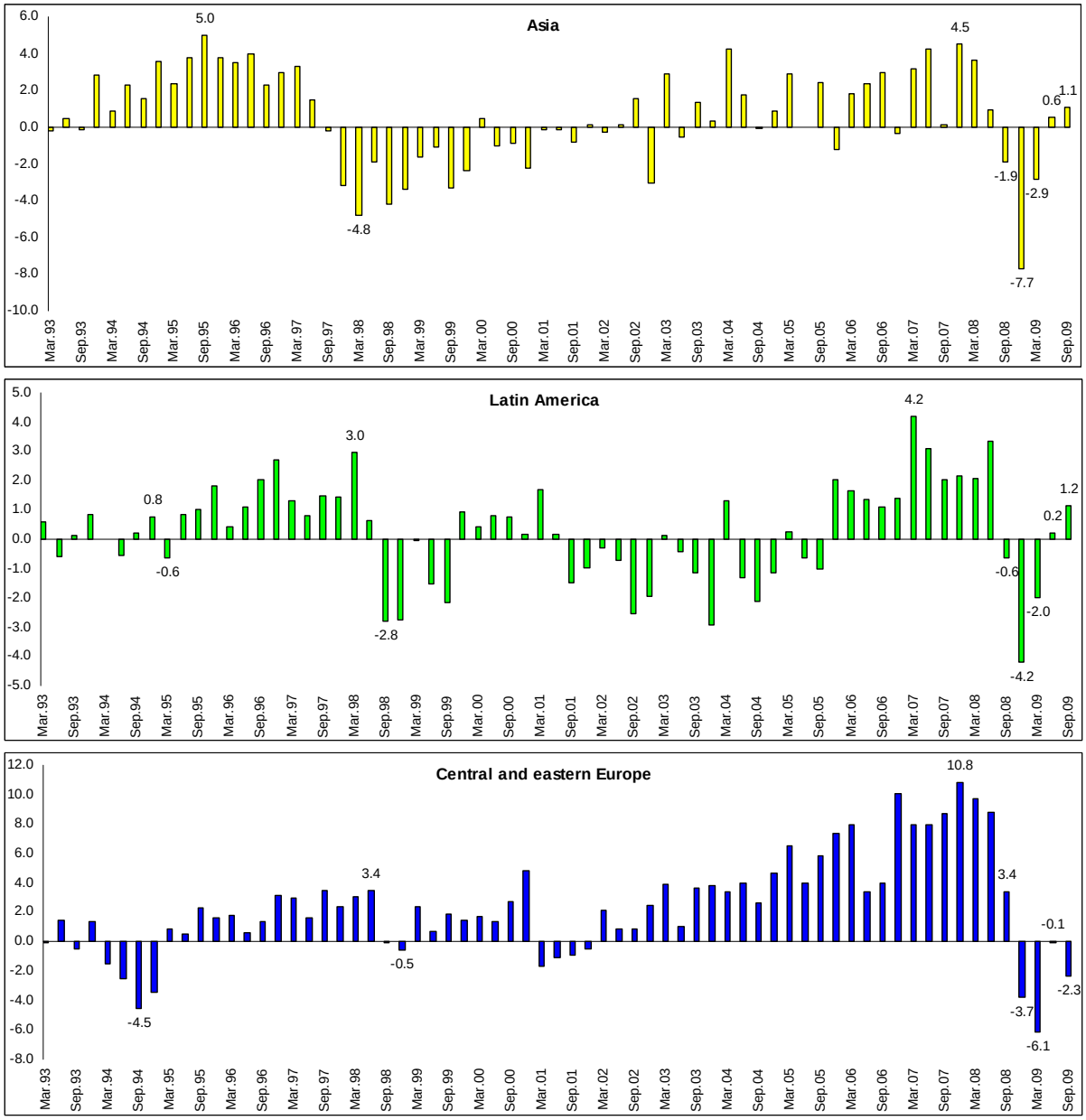
[3] At the time of writing, Q3:2009 was the latest observation available. In our regressions we used observations through Q4:2008 because other data for 2009 were not yet complete.

some stability to cross-border bank flows (see Mihaljek, 2009). In the second and third quarter of 2009, international banks for the most part resumed lending to emerging markets.

Figure 2

**External positions of reporting banks vis-à-vis emerging markets**

Exchange rate adjusted changes (Q/Q), in percent of quarterly GDP




Source: BIS, locational banking statistics; IMF, World Economic Outlook.

## 3. Cross-border bank flows and financial crises: a literature review

The early literature on the determinants of capital flows focused on the role of trade linkages in the propagation of emerging market crises (see eg Glick and Rose, 1998; Eichengreen et al, 1996). With the spread of the financial globalisation to emerging markets, the literature started to investigate how financial linkages contributed to the spread of crises. Calvo (1998)

argued that contagion spread via the balance sheet effects of international financial intermediaries. Kaminski and Reinhart (2000) found that the bank lending channel outperformed the trade channel in explaining the vulnerability of emerging markets to contagion.[4] Van Rijckeghem and Weder (2003) found that common bank lenders were a fairly robust predictor of contagion. Likewise, Kaminski, Reinhart and Vegh (2003) identified a leveraged common creditor in all episodes of international spillovers they studied. Caramazza et al (2004) and Calvo et al (2008) confirmed that strong financial linkages substantially raised the probability of contagion. For the latest crisis, the IMF (2009a) highlighted financial interconnectedness within Europe as a factor increasing the risk of adverse feedback loops.[5] In summary, the main conclusion of the literature is that "even if banks are not the immediate trigger of financial contagion, their actions certainly contribute to the spillover" (Kaminski and Reinhart, 2000, p. 79).

The literature on the determinants of cross-border bank flows focuses on the classical push and pull factors.[6] One general conclusion (see eg Jeanneau and Micu, 2002) is that both sets of factors help explain cross-border bank flows. For instance, macroeconomic conditions in host countries (Garcia-Herrero and Martinez-Peria, 2005; Hernandez et al, 2001) as well as home countries (Goldberg, 2001) were found to have a major influence on bank lending to the emerging markets. Papaioannou (2009) in addition referred to geographical, historical and institutional factors. In his model, institutional underdevelopment explained a large part of the Lucas (1990) paradox, according to which capital did not flow from rich to poor countries but rather the other way around.

So far, there has been little empirical work on the determinants of cross-border bank flows to emerging markets in periods of crises. To our knowledge, Van Rijckeghem and Weder (2003) were the first who combined the traditional push and pull factors with financial stress indicators and highlighted the importance of common lender effects. Heid et al (2004) confirmed such effects at the micro level. They also noted that a sudden increase in risk aversion played a fundamental role in explaining cross-border lending by German banks.[7] The World Bank (2008) showed that tensions in the global interbank market were associated with lower growth of bank loans during the current crisis. McGuire and Tarashev (2008) established a link between cross-border loans and measures of bank health in host countries. Buch et al (2009) examined the relationship between macroeconomic shocks and international banks' foreign assets. They found that bank responses were characterised by temporary overshooting and subsequent adjustment over several quarters.

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[4] Forbes and Chinn (2009) came to the conclusion that bilateral trade flows were nonetheless a large and significant determinant of how shocks were transmitted to the emerging markets.

[5] Hernandez et al (2001) provided empirical evidence that contagion was more important during the 1990s' than the earlier crises, and argued that one reason was stronger financial integration in the 1990s.

[6] One strand of the literature focuses on the determinants of portfolio equity investment; see eg Lane and Milesi-Ferretti (2004).

[7] There is a large literature analysing the determinants of bank lending at the micro level; for an overview see eg Bernanke (2008). One strand of this literature focuses on the impact of bank capital, especially in times of stress (see eg Gambacorta and Mistrulli, 2004). Another strand studies the impact of financial innovation (eg Scheicher and Marques-Ibanez, 2008).

# 4. Econometric estimates

## 4.1 Empirical model

Building on the existing empirical literature we first examine how far the standard gravity model helps explain changes in cross-border bank flows to the emerging market economies, and then study to what extent financial stress at the global, lender and borrower country levels affected these flows, especially in periods of financial crises. These issues have not yet been studied in the literature in sufficient detail. We also extend the literature in several other dimensions, including the data sample and the empirical model (discussed below).

Our sample covers cross-border bank flows from 17 advanced to 28 emerging market economies between 1993 and 2008.[8] The analysis is based on bilateral, country pair data from the BIS locational banking statistics (eg loans from banks located in Austria to banks and the non-bank sector in Hungary).

The dependent variable in our estimations is the change in the external position of reporting banks in an advanced economy *i* (*i* = 1, …, 17) vis-à-vis an emerging market *j* (*j* = 1, …, 28) at time *t* (*t* = Q1:1993 – Q4 :2008). The dependent variable enters our regressions as *changes* in external positions adjusted for exchange rate valuation effects in a given quarter.[9]

The dependent variable is "gross" in the sense that we do not consider changes in liabilities of banks in country *i* vis-à-vis banks and the non-bank sector in country *j*. However, it is "net" in the sense that it includes repayments of loans. If no new loans are granted and debtors make scheduled repayments of old loans, the stock of old loans will decrease during a quarter.

The empirical framework used in this paper is the **standard gravity model**. The pioneering work in this field was done by Tinbergen (1962), who linked the volume of trade between two countries in a very simple manner to the size of their economies and the distance between them. In recent years, gravity models have been also applied to financial flows. The model in this paper is related to the gravity model for asset flows used in Martin and Rey (2004). In particular, our *basic model* comprises the following variables:

$$LOANS_{ijt} = \rho_0 + \rho_1 DIST_{ij} + \rho_2 GDP_{it} + \rho_3 GDP_{jt} + \rho_4 INT\_diff_{jit} + \rho_5 GR\_diff_{jit} + \rho_6 ER_{jit} + \rho_7 X_{ijt} + \varepsilon_{ijt} \quad (1)$$

where the dependent variable *LOANS* is the (exchange-rate adjusted) change in the external position of the BIS reporting banks in country *i* vis-à-vis all sectors in the emerging market economy *j* at time *t*; *DIST* is the distance between the capitals of countries *i* and *j*; $GDP_i$ and $GDP_j$ are the respective GDPs of lender and borrower countries; *INT_diff* is the nominal interest rate differential between the borrower and lender countries; *GR_diff* is the growth differential; *ER* is the bilateral exchange rate change (units of country *j* currency per unit of

[8] The advanced economies (BIS reporting countries) in our sample are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States. The emerging market countries in Asia are: China, India, Indonesia, Korea, Malaysia, the Philippines, Taiwan, Thailand and Vietnam; in Europe: Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia and Turkey; and in Latin America: Argentina, Brazil, Chile, Columbia, Mexico, Peru and Venezuela.

[9] The exchange rate adjustment is necessary because stocks of outstanding loans, eg from Switzerland to China at end-Q1 and end-Q2 2009, are reported in US dollars. The adjustment is done by converting these USD stocks into Swiss francs using the end-Q1 and end-Q2 USD/CHF exchange rates; subtracting the end-Q1 from the end-Q2 amounts in CHF to get the change in loans during the quarter; and converting this CHF amount back into USD using the period average exchange rate.

country *i* currency, normalised to a base year); *X* is a vector of control variables; and $\varepsilon$ is a vector of error terms.

We use nominal rather than real interest rate differentials because banks make all expected profit and loss calculations when granting loans in terms of nominal rates. In addition, the choice of inflation rate to deflate the nominal interest rate – home vs. host country inflation – would be arbitrary, as international banks can decide to reinvest profits in the host country or repatriate them to the home country.

Although our dependent variable is adjusted for exchange rate changes, the adjustment in the published series does not control fully for the valuation effect. Therefore we introduce the bilateral nominal exchange rate as an additional variable in the basic gravity model. Movements in bilateral exchange rates affect all capital flows (and vice versa). However, as cross-border bank loans are only one part of the overall capital flows, and only one of many factors affecting exchange rates, potential endogeneity between cross-border bank flows and nominal exchange rates should not be a major problem.

All variables are expressed in logarithms, except interest rate and growth rate differentials and exchange rate changes, which are expressed in percentage points. Our dependent variable can take negative values: these can be observed when country *i* stops providing new loans to country *j*, or when it provides some positive but small amount relative to the repayment of loans by *j* to *i*. In order to use the logarithms for such observations we follow a method proposed by Papaioannou (2009): for negative values of the dependent variable we take the logarithm of the absolute value and assign it the negative sign. This transformation preserves the sign in the original variable and retains the symmetry between increases and decreases in cross-border bank flows.

The null hypothesis of this basic model is that one should obtain the following signs of estimated coefficients $\rho_i$:

$\rho_1 < 0$ Smaller distance between country *i* and country *j* should, ceteris paribus, increase the flow of cross-border loans from country *i* to country *j*, and vice versa. The reason is that information and monitoring costs are positively correlated with distance: despite the internet and modern telecommunications, international banking business still relies to a great extent on personal contact between the lender and the borrower. As argued by Martin and Rey (2004), the cost of travelling is higher for longer distances, cultural differences are likely to be stronger, business links weaker. The distance is the simplest proxy that captures this informational dimension of cross-border banking.

$\rho_2, \rho_3 \gtrless 0$ Generally, gravity models stipulate a positive coefficient for the size of both lender and borrower economy. However, one can argue that banks in a lender country with a larger home market are less dependent on business in foreign markets, so that $\rho_2$ could be negative. Similarly, smaller emerging markets could attract more cross-border loans than larger ones, so that $\rho_3$ could be negative. The sign of GDP coefficients therefore has to be determined empirically.

$\rho_4 > 0$ Higher interest rate in the borrower country should, ceteris paribus, increase the flow of cross-border loans from the lender country;

$\rho_5 > 0$ Stronger growth in the borrower country should, ceteris paribus, increase the flow of cross-border loans to the country;

$\rho_6 < 0$ Weaker currency in the borrower country should, ceteris paribus, reduce the flow of cross-border loans because it reduces the expected rate of return measured in lender's currency – a depreciating currency makes it more difficult for borrowers to repay their external loans. Conversely, an appreciating currency increases the expected rate of return measured in lender's currency and makes it easier for borrowers to repay their external loans; hence, it should induce additional inflows.

By analogy to gravity models of merchandise trade, this basic model can be expected to explain a large part of cross-border bank flows in normal times. In order to examine how the financial crises affect bank flows, we expand this model based on theoretical and empirical considerations discussed in Sections 2 and 3, and include four additional sets of variables that represent potential channels of transmission of the crisis.

1. In the ***global financial factors model***, the hypothesis is that major determinants of cross-border bank flows are variables determined on a global scale. Thus, we introduce two measures of the state of the global financial market: first, the S&P 100 Volatility Index (*VIX*) of the Chicago Board Options Exchange; and second, the average difference in yields between US corporate bonds and ten-year treasuries (*RISK_AVERS*). The former is widely used as an indicator of expected short-term (up to 30 days) volatility of the global financial market: a high value of the *VIX* corresponds to more volatile market expectations and hence higher cost of options to defray the volatility risk. The latter is widely used as an indicator of global risk aversion: a high yield differential between US corporate and sovereign bonds signals that risk aversion on the part of global investors has increased.

   The null hypothesis is that both indicators are negatively correlated with cross-border bank flows: higher expected global market volatility and growing risk aversion – for instance, at the start of a crisis – are expected to reduce the flow of cross-border bank loans from advanced to the emerging market economies.

2. In the ***lender exposure model***, the hypothesis is that certain characteristics of banks in lender countries strongly affect the flow of cross-border loans to emerging markets (see Van Rijckeghem and Weder, 2003). In line with Krugman (2008), who argued that the balance sheets of international financial intermediaries were a major source of spillover effects in international bank lending, we focus on the *common lender effect*, ie the proposition that financial stress in creditor country banks (eg in Spain) is determined by their exposure to the primary crisis country (eg the United States). We measure the common lender effect as:

$$CLE_{i,k} = \frac{External\ assets\ of\ BIS\ reporting\ banks\ in\ country\ \ i\ \ vs.\ primary\ crisis\ country\ k}{External\ assets\ of\ BIS\ reporting\ banks\ in\ country\ \ i\ \ vs.\ all\ countries}$$

   We distinguish three sets of primary crisis countries: Mexico during the Mexican crisis of 1994–95; Indonesia, Korea, Malaysia, Thailand and the Philippines during the Asian crisis of 1997–98; and the United States during the crisis of 2007–08. The greater the exposure of banks to the primary crisis country, the more they are expected to reduce their cross-border loans to emerging markets. Outside of these crisis periods the common lender effect is by definition zero.

   The second characteristic of banks in lender countries that strongly affects the flow of cross-border loans to the emerging markets is the state of their own health. We measure bank health (*BK_HLTH_L*) by the deviation of the banking industry subindex from the main equity price index. A positive coefficient is expected, as the banking sector under stress – eg with large non-performing loans in the home market – is normally forced to reduce its cross-border lending.

3. In the ***borrower country risk model***, the hypothesis is that cross-border bank flows respond to various risk characteristics of borrower countries, which are captured by indicators of external and domestic vulnerability. As a summary indicator of borrower country vulnerabilities we use initially general government balance (*GVT_BAL*). A higher fiscal deficit is expected to be positively correlated with the probability of default on government debt and, hence, negatively correlated with inflows of cross-border bank loans. In an extended analysis we use other vulnerability indicators to capture the risk characteristics of borrower economies.

By analogy to the lender exposure model, we use a measure of bank soundness (*BK_HLTH_B*) as an additional country specific risk factor. A stronger banking sector in the borrowing country should normally attract higher cross-border bank inflows. As in the lender exposure model, we measure bank health by the difference between the banking industry and the overall equity price index.

4. In the ***financial and monetary linkages model*** the hypotheses is that a higher degree of financial and monetary integration between the borrower and lender countries increases cross-border bank flows. We measure bilateral financial openness (*FIN_OPEN*) as the ratio of external assets and liabilities of country *j* (the borrower) vis-à-vis banks in country *i* (the lender) relative to the borrower country's GDP. We expect borrower countries that are financially more integrated with lender countries (eg the Baltic states and Sweden) to attract larger inflows than those that are not (eg Vietnam and Sweden).

   We measure the degree of monetary integration with the Reinhart-Rogoff (2004) index of exchange rate regime (*ER_REGIME*), which varies from 1 (fixed exchange rate) to 6 (free float). Borrower countries with more rigid exchange rate regimes are by definition integrated more tightly with lender countries (as the latter use major international currencies to which the emerging market currencies are pegged), so we expect them to attract larger cross-border bank inflows.

   In crisis periods we expect the positive linkage between financial openness and cross-border inflows to continue to hold. However, the positive linkage between monetary integration and cross-border bank flows cannot be assumed a priori. The tendency for fixed exchange rates to come under pressure in a crisis makes countries with fixed exchange rate regimes more vulnerable and hence more likely to experience a reduction of cross-border bank inflows.[10]

There are several potentially relevant empirical issues that could not be studied because of the lack of data. One is the maturity structure of cross-border loans. With data available on a quarterly basis, short-term flows (eg flows motivated by short-term interest rate differentials) cannot be distinguished from loans with longer maturities. Similarly, there is no information on the relative shares of new loans and repayments of maturing loans. Possible effects of capital controls on inflows of bank loans cannot be assessed because of the lack of consistent data and a large variety of capital controls. The demand for cross-border loans also depends on the schedule of external debt repayments, which is rarely available on a quarterly basis even for aggregate debt, let alone for bilateral debt.

## 4.2 Estimation results

We estimated all five models using a random effects estimator with panel-corrected standard errors (PCSE), taking into account a heteroskedastic structure of errors and correlation between countries. In addition, country specific fixed effects (for 17 advanced and 28 emerging markets) were introduced.[11] One should note that this approach is not equivalent to a de facto fixed effects model, which would include bilateral country fixed effects for 17 advanced times 28 emerging market economies.[12] The Hausman specification test indicated that there

[10] Empirical studies point to a link between exchange rate pegs and vulnerabilities such as rapid credit growth, high current account deficits and high external debt. These vulnerabilities make countries with fixed exchange rates more likely to experience a withdrawal of capital inflows in a crisis. See eg Berkmen et al (2009), Gosh et al (2010), and Gerdesmeier et al (2009).

[11] In order to avoid a near-singular matrix, some fixed effects had to be dropped (basic model: US/MX; global model: US/MX; lender model: FI/GR/NO/US/CH; risk model: US/LT; linkages model: GR/NO/CN).

[12] The disadvantage of the de facto fixed effects model is that the distance variable drops out of the equation due to a near-singular matrix.

was no systematic difference between fixed and random effects models, and thereby confirmed that the random effects estimator was efficient in our empirical framework.

We estimated the four financial stress models outlined above separately rather than jointly (ie nested in one large model) because the determinants of cross-border flows examined in these models are not completely independent of each other. For instance, indicators of bank health in lender and borrower economies are not entirely independent from global financial sector variables; and indicators of financial openness are not entirely independent from common lender effects. We then compared different models in terms of their explanatory power by looking at the coefficients of determination $R^2$ and the *F*-tests.

The estimates of five models are summarized in *Table 2*.[13] Altogether, most estimated parameters have the expected signs, are statistically highly significant, and are robust with respect to different model specifications. The low $R^2$ is not unusual in such large panels and is primarily due to the fact that we are trying to explain the (quarterly) flow data, which are by their very nature extremely volatile and often switch the sign or take on the zero value. More precisely, bilateral flows in our sample ranged from a maximum of $14.6 billion per quarter and country to a minimum of –$15.6 billion per quarter and country. The average size of a bilateral loan for the entire sample of more than 30,000 pairs of quarterly observations was $21 million, and the standard deviation was as much as $546 million. Zero flows accounted for about 20% of observations in the sample.

The main conclusions one can draw from these estimates are as follows:

- The ***basic gravity model*** shows, *first*, that cross-border bank flows decrease by about 6% for a 10% increase in the distance between the capitals of lender and borrower countries. In other words, despite considerable improvements in transportation, communication and information technology, distance still matters for cross-border bank flows. This result holds in all five models, with estimated parameters varying from –0.3 to –0.7.[14] Other empirical studies found a similar impact of the distance on capital flows (see Buch, 2005). Furthermore, the impact of the distance on bank flows seems to be comparable to its impact on trade flows.

  The *second* result also consistent across specifications is that the borrower country GDP is positively correlated with the size of cross-border bank flows. The estimated elasticity implies that a 10% higher GDP in the borrower country will increase cross-border bank flows by slightly more than 10%.

  The *third* main result of the basic gravity model is that the larger the economy of the lender country, the less its banks will engage in cross-border lending to the emerging markets. More specifically, a 10% increase in the GDP of a lender country reduces its banks' cross-border loans to EMEs by 7% on average. Cross-border flows thus follow a pattern similar to international trade – smaller countries usually trade more with the rest of the world than bigger countries.[15]

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[13] We used the panel unit root tests of Levin, Lin and Chu (2002); Breitung (2000); Im, Peasaran and Shin (2003); and the ADF test of Maddala and Wu (1999). The dependent variable and most explanatory variables were stationary. For some variables the tests showed signs of non-stationarity. However, as for large N and small T the cross-section dimension dominates, the possibility of non-stationarity can be ignored. The regressions were estimated using Eviews 6 and Stata 10.

[14] Buch (2002) argues that one should be cautious in interpreting distance in terms of information costs only. There is evidence that trade declines in distance and that the negative coefficient of distance might partly be capturing this effect. In fact, Aviat and Coeurdacier (2007) showed that controlling for trade flows reduces the impact of the distance variable drastically.

[15] See, however, the section on robustness checks, where we compare alternative estimators and find that in some cases larger lender countries provide more cross-border loans. Other studies also report a reversal of the sign for this variable when alternative estimators are used (eg Blank and Buch, 2009).

The negative coefficient on lender country GDP also supports the observation that financial centres are usually located in small countries. One should note, however, that by using the BIS locational rather than consolidated banking statistics we cannot control for third-party effects, ie bank lending by country A (eg Germany) ultimately flowing to an institution residing in country C (eg Thailand) via a financial centre in country B (eg the United Kingdom). Rather, we consider bank flows from Germany to the UK and from the UK to Thailand as separate.

The consolidated banking statistics would be more appropriate if we focused on the determinants of bank flows from the lender country perspective. However, as there are only two major financial centres in our sample (Switzerland and the United Kingdom), and we focus on the determinants of bank flows more from the borrower than from the lender country perspective, the use the locational data is appropriate. By using the locational statistics we also have a longer sample, as the consolidated data are available on a quarterly basis only since 2000. In addition, we can use data on exchange rate adjusted flows; and, most importantly, we do not lose information on the flows between parent banks and their emerging market subsidiaries, which are netted out in the consolidated statistics. Nonetheless, in one of our robustness checks we drop Switzerland and UK from the sample and show that the coefficient $\rho_3$ does not differ significantly from the above estimates.

*Fourth*, cross-border flows respond positively to interest rate and growth differentials between borrower and lender countries, and negatively to depreciation of the borrower country currency. None of these three semi-elasticities is large: a percentage point interest rate differential will induce 0.01% larger inflows; a percentage point growth differential will induce 0.04% larger inflows; and a percentage point depreciation of the borrower country currency (vis-à-vis the lender country currency) will reduce the flows by 0.02%. Nonetheless, all three estimates are statistically significant, confirming the theoretical result of Obstfeld and Rogoff (1996) that capital flows respond to relative return differentials and income growth expectations.

- In the ***global financial factors model***, the two additional variables, *VIX* and *RISK_AVERS,* are both significant at the 1% level and have the expected negative sign. This result confirms that global financial market factors – a higher degree of financial market volatility and more pronounced risk aversion on the part of global investors – have a dampening impact on cross-border lending from advanced to the emerging markets. The estimated size of coefficients is low, but as both the volatility index and the corporate bond spread display considerable variation over time, these global factors are a significant channel through which spillover effects in international bank lending occur (see also the contribution analysis below).

- The results of the ***lender exposure model*** support the view that the characteristics of lender countries such as exposure to the primary crisis country and the health of the banking sector have a major bearing on cross-border bank flows to the emerging markets. The model confirms in particular the *common lender effect*, according to which financial stress in the creditor country is determined by its exposure to the primary crisis country, which in turn reduces bank loans to emerging markets (see Van Rijckeghem and Weder, 2003). The impact of the common lender effect is confirmed for all three crises studied in this paper, but the coefficient is significant only for the Mexican and the current financial crises.

  The positive coefficient on the second lender model variable, *BK_HEALTH_L*, confirms that better health of the banking sector in lender countries increases cross-border loans to emerging markets. However, this effect is not as strong as the common lender effect.

Table 2

**Determinants of cross-border bank flows from advanced to emerging markets**
**Random effects estimator with country specific fixed effects and PCSE**

Dependent variable: log of quarterly, exchange-rate adjusted change in external position (in millions USD) of banks in country *i* vis-à-vis all sectors in country *j*

| | (1) BASIC Model | (2) GLOBAL Model | (3) LENDER Model | (4) RISK Model | (5) LINKAGES Model |
|---|---|---|---|---|---|
| DIST | –0.594 | –0.660 | –0.693 | –0.690 | –0.315 |
| | (–8.51)*** | (–3.20)*** | (–8.77)*** | (–4.64)*** | (–1.93)*** |
| GDP_B | 1.038 | 1.198 | 1.098 | 0.789 | 1.14 |
| | (10.67)*** | (12.24)*** | (8.77)*** | (6.75)*** | (9.26)*** |
| GDP_L | –0.715 | –0.972 | –0.733 | –0.656 | –0.667 |
| | (–5.14)*** | (–6.40)*** | (–3.55)*** | (–3.95)*** | (–2.96)*** |
| INT_diff | 0.011 | 0.005 | 0.012 | 0.016 | 0.015 |
| | (4.50)*** | (1.93)** | (4.30)*** | (3.82)*** | (5.19)*** |
| GR_diff | 0.044 | 0.030 | 0.046 | 0.040 | 0.049 |
| | (7.84)*** | (5.03)*** | (7.00)*** | (6.10)*** | (7.12)*** |
| ER | –0.015 | –0.011 | –0.016 | –0.028 | –0.011 |
| | (–6.76)*** | (–4.99)*** | (–6.27)*** | (–8.31)*** | (–4.49)*** |
| VIX | | –0.027 | | | |
| | | (–5.80)*** | | | |
| RISK_AVERS | | –0.002 | | | |
| | | (–4.02)*** | | | |
| CLE_US | | | –0.023 | | |
| | | | (–2.20)** | | |
| CLE_AS | | | –0.010 | | |
| | | | (–0.95) | | |
| CLE_MX | | | –0.286 | | |
| | | | (–3.88)*** | | |
| BK_HLTH_L | | | 0.001 | | |
| | | | (2.52)** | | |
| GVT_BAL | | | | 0.080 | |
| | | | | (6.59)*** | |
| BK_HLTH_B | | | | 0.006 | |
| | | | | (11.01)*** | |
| FIN_OPEN | | | | | 0.165 |
| | | | | | (10.50)*** |
| ER_REGIME | | | | | –0.380 |
| | | | | | (–9.66)*** |
| $R^2$ | 0.04 | 0.05 | 0.05 | 0.05 | 0.06 |
| F-Test | 14.75 *(0.000)* | 12.45 *(0.000)* | 13.87 *(0.000)* | 11.12 (*0.000)* | 13.23 *(0.000)* |
| N | 30,464 | 30,464 | 30,464 | 30,464 | 30,464 |
| Durbin-Watson | 2.02 | 2.03 | 2.05 | 2.08 | 2.09 |

*Note*: Standard errors in parentheses. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. PCSE = panel-corrected standard errors.

- The results of the ***borrower country risk model*** indicate that risk factors specific to the borrower country strongly affect cross-border bank flows. A percentage point higher budget deficit is on average associated with a 0.08% reduction in cross-border loans to the country. This result is in line with the empirical literature that identified high budget deficits as an early warning indicator of EME crises.[16]

  By contrast, good health of the banking sector in the borrower country helps attract cross-border inflows. For instance, if bank share prices increased by 10% relative to the overall share price index in a given quarter, the country received on average 0.06% more cross-border bank loans. One should recognise, however, that a strong standing of bank share prices relative to the overall equity price index might reflect not only the intrinsic health of the banking sector, but also the impact of foreign flows on share prices, ie a possible build-up of financial bubbles.

- According to the ***financial and monetary linkages model***, a borrower country that was 10% financially more open attracted as much as 1.7% more cross-border bank loans.[17] Similarly, countries with fixed exchange rate regimes received on average 1.9% more inflows compared to those with floating regimes.[18]

  How the financial and monetary linkages operate in a crisis is an empirical question. To the extent that lenders reduce cross-border loans and borrowers withdraw deposits from banks in advanced economies, financial openness would amplify the effects of the crisis. Likewise, to the extent that fixed exchange rate regimes come under pressure during a crisis, foreign creditors would stop lending to emerging market borrowers. In Section 5 we show, however, that financial openness and fixed exchange rate regimes both acted as factors stabilising cross-border flows during the latest crisis, especially in central and eastern Europe.

As noted above, in order to test whether it is worth adding or dropping a particular group of variables from a model we used the *F*-tests and the coefficients of determination $R^2$. The results of *F*-tests for all models show that we can reject the null-hypothesis that all slope coefficients are simultaneously zero – the specifications we have estimated are statistically highly significant. Moreover, the four models that examine additional determinants of bank flows increase the explanatory power of the basic gravity model, as indicated by slightly higher coefficients of determination relative to the basic model.

### 4.3 Contribution analysis

The contribution analysis goes beyond the identification of statistically significant determinants of cross-border bank flows and provides additional information on the economic significance of estimated parameters. In particular, the analysis quantifies the impact of global and country specific factors on observed cross-border flows, and thus enables us to assess how financial stress is effectively transmitted from advanced to the emerging market economies. The contribution of each variable is calculated by multiplying the parameter estimated in the above regressions with the average value of the corresponding variable over a given period. The contribution of each model is then the sum of the contributions of all explanatory variables included in the model.

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[16] See eg Goldstein, Kaminski and Reinhart (2000).

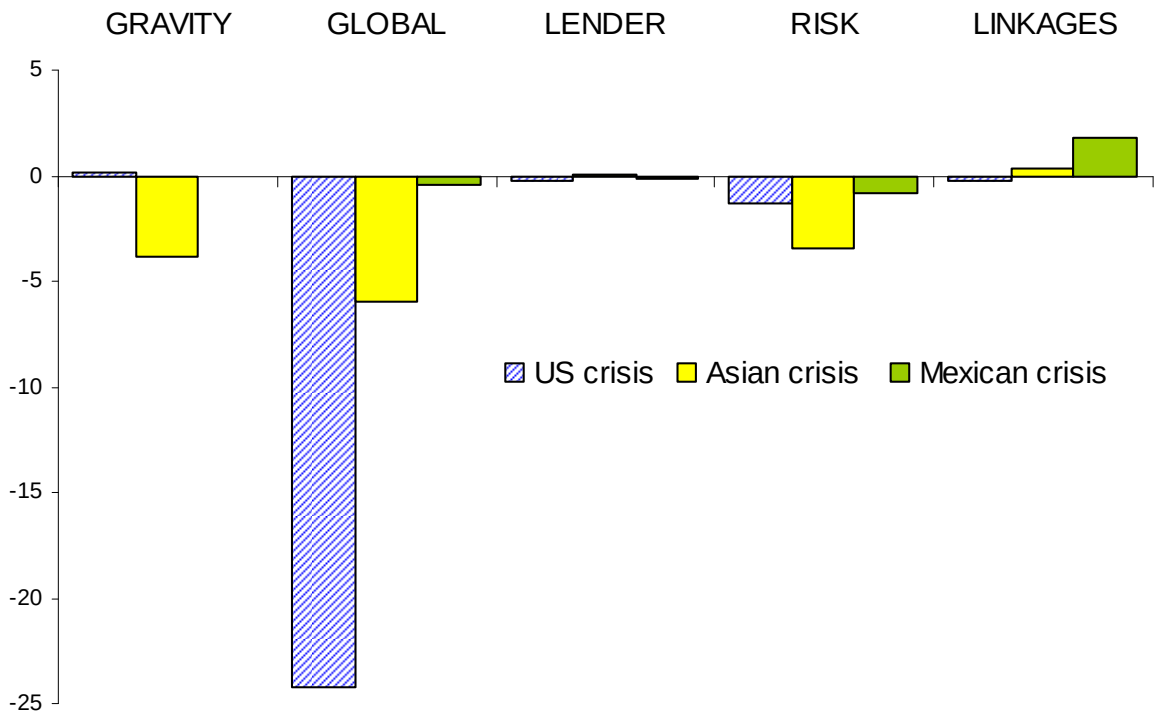
[17] Recall that financial openness is the sum of external assets and liabilities of all sectors in the borrower country vis-à-vis banks in the lender country, as a percentage of the borrower's GDP.

[18] In the Reinhart and Rogoff (2004) classification, fixed exchange rate regimes are assigned the rank 1 and floaters the rank 6; relative to the floaters the fixers would thus receive on average (1 – 6) x (–0.38) = 1.9% more cross-border bank loans.

*Figure 3* shows the percentage change in cross-border bank flows that different models explain during the three financial crises under review.[19]

Figure 3

**Contributions of five models to changes in cross-border bank flows in three crisis periods**




Note: Vertical axis is the percentage change in bilateral, quarterly cross-border bank flows (in millions of US dollars, exchange-rate adjusted) explained by the respective model during each crisis period.

Source: Authors' calculations.

In the *current crisis*, global factors seem to have been the main driver of cross-border bank flows – greater global risk aversion and higher expected global financial market volatility explain almost a quarter of the reduction in bank flows to the emerging markets between Q3:2007 and Q4:2008. The only other noticeable contribution came from borrower-specific risk factors, ie higher budget deficits in emerging markets and the declining performance of emerging market banks' equity indices.

During the *Asian crisis*, global risk factors also made the largest contribution to the reduction in cross-border bank flows. However, two other sets of variables also accounted for a significant share of the decline in cross-border bank flows: smaller growth differential in emerging markets vis-à-vis advanced economies (from the basic gravity model); and the deterioration of fiscal positions and banking sector performance in emerging markets (from the borrower country risk model).

During the *Mexican crisis*, the worsening of global financial conditions played only a small role. This is not surprising given that the crisis had its origins in only one emerging market, ie

[19] These contributions do not sum up to 100% because models are estimated by separate regressions.

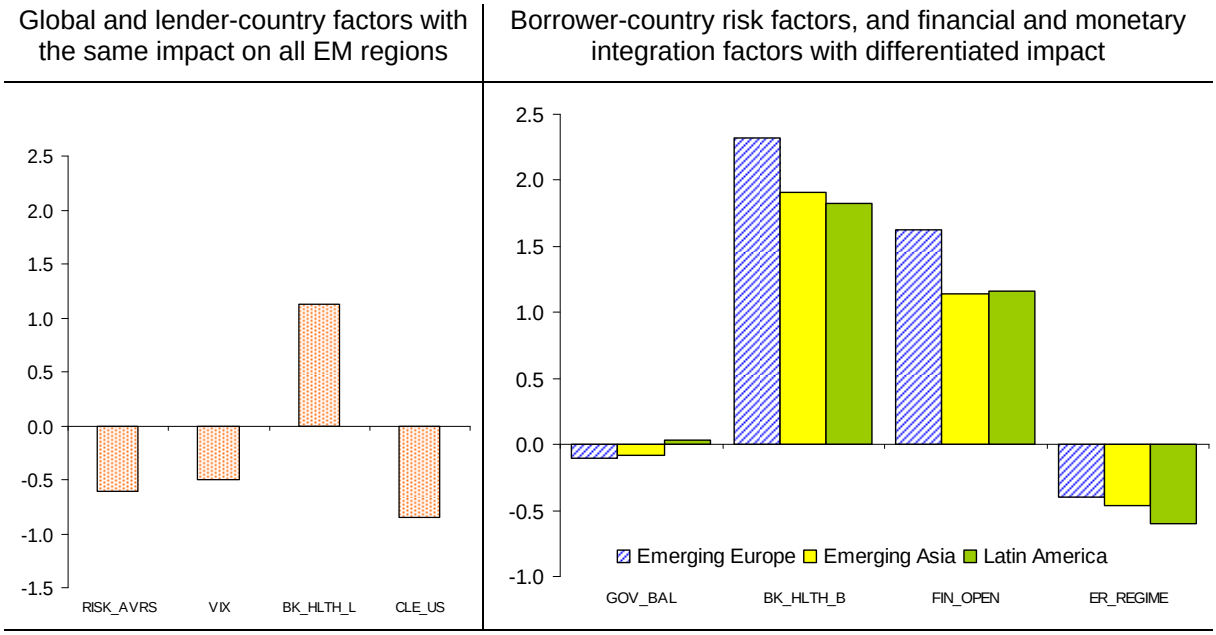
Mexico. As one might expect, the largest contribution to the withdrawal of cross-border flows came from borrower-specific risk factors – higher fiscal deficits and worse banking sector performance in emerging markets. By contrast, stronger financial and monetary integration made a slight positive contribution to bank flows during this crisis.

Next we look at the contribution of explanatory variables from our four financial stress models to bank flows during the latest financial crisis. The analysis of these models includes only the contributions of additional variables in each model compared to the basic gravity model.

Global and lender country factors had by definition the same impact across emerging market regions (*Figure 4*, left-hand panel). Greater risk aversion, expected global financial market volatility, and the exposure of lenders to the US economy (the common lender effect) contributed to a reduction in cross-border bank flows to EMEs during 2007–08. The only factor in this group that contributed to higher inflows during the crisis was the health of banking sectors in lender countries.

Figure 4

**Contribution of financial stress factors to cross-border bank flows in different emerging market regions during the current financial crisis**




Note: Vertical axis measures the change in bilateral, quarterly cross-border bank flows, in millions of US dollars (exchange-rate adjusted), explained by the respective factors during the 2007-08 financial crisis.

Source: Authors' calculations.

Turning to the contribution of borrower-country risk factors and financial and monetary integration factors, the broad picture that emerges is that central and eastern Europe experienced a less severe reduction in cross-border flows in 2007–08 than emerging Asia and Latin America (*Figure 4*, right-hand panel). This is surprising, given that countries in central and eastern Europe had more pronounced external and domestic financial vulnerabilities on the eve of the crisis. The contribution analysis points to two sets of factors that accounted for the difference.

*First*, banking sectors in central and eastern Europe were healthier: they induced higher inflows per country pair and quarter compared with banks in emerging Asia and Latin America (*Figure 4*, right-hand panel). This is probably the consequence of the high share of

foreign-owned banks – there is a strong positive correlation of 0.7 between the foreign bank share in total assets and the bank health indicator in CEE – and the fact that these banks were not heavily exposed to US toxic assets.

*Second*, greater financial openness contributed to significantly higher inflows of cross-border bank loans per country pair and quarter in central and eastern Europe compared with either emerging Asia or Latin America.

Regarding other factors in this group, fiscal positions had a small negative impact on cross-border bank inflows in CEE and Asia, and a small positive impact in Latin America. A more interesting result is the effect of exchange rate regimes on cross-border bank flows: central and eastern Europe's often less flexible regimes apparently moderated the reduction of inflows compared to the more flexible regimes in emerging Asia and Latin America.

## 5. Robustness checks

To check whether our five model estimates are robust with regard to different econometric methodologies and sample specifications we conducted five sets of checks: (i) estimates using different econometric options (time effects, dynamic instrumental variables, and the Wooldridge approach); (ii) estimates accounting for the financial centres effect; (iii) an extended analysis of country specific risk factors; (iii) analysis of regional sub-samples; and (v) analysis of different crisis periods. The overall conclusion that emerges from these checks is that the results shown in Table 2 are fairly robust to alternative econometric methodologies and sample specifications.

### 5.1 Econometric options

***Time effects***. We added period fixed effects and re-estimated the five models using a random effects estimator with country specific fixed effects and panel-corrected standard errors. This correction might be relevant because some explanatory variables show signs of trend-stationarity. The results are shown in *Table A1* in the Appendix. The inclusion of time dummies did not significantly alter the original results. The main differences are that the interest rate variable becomes statistically less significant (it is now insignificant in the global financial factors model); and the common lender effect becomes highly significant for all three crisis periods.

***Dynamic instrumental variables approach***. As an alternative estimation technique we used the instrumental variables approach proposed by Anderson and Hsiao (1981). In particular, we added a lagged dependent variable to regression equations in order to control for potential endogeneity of explanatory variables. The constant, the second lag of the endogenous variable, the exogenous variables and their first lags, and two lags of the predetermined variables, were used as instruments. *Table A2* in the Appendix shows the results.

The instrumental variables estimates are on the whole quite similar to the original ones from *Table 2*. The lagged dependent variable is significant at the 1% level in all estimated models. This points to a certain degree of persistence in bank lending flows, without, however, offering a clear explanation for it. One important difference compared to the original model is that the lender country GDP changes the sign, implying a positive link between the size of the lender economy and its cross-border bank loans. This positive link is normally found in standard gravity models of trade. Another difference is that the significance of the distance and GDP parameters (for both lender and borrower countries) diminishes significantly.

***Wooldridge approach***. Helpman, Melitz and Rubinstein (2008) pointed out that gravity models should not rely only on country samples with positive trade flows – samples with zero trade flows between countries also contained useful information. They argued that the selection bias embedded in the commonly used data sets may be substantial, and proposed

an alternative, two-step estimation method in order to exploit full information contained in the data on zero flows. Likewise, Silva and Tenreyo (2006) suggested a Poisson pseudo-maximum likelihood estimator, which is robust to different patterns of heteroskedasticity, to deal with this kind of problem.

Compared to other studies, where about half of the observations are zeros (up to 95% in some data sets), zeros account for approximately 20% of observations in our sample. Nevertheless, in order to exploit the full extent of information, we used the estimator proposed by Wooldridge (1995 and 2002), who postulated a two-step Heckman selection model for panels. This approach is based on the idea that a country will first decide *whether* it will lend to an emerging market. In the second step, it decides *how much* it will lend. In the first step we thus introduce an additional variable ("Mundlak-Chamberlain correction") in a panel probit model in order to control for fixed effects.[20] In the second step, we estimated a simple fixed effects model for all countries that engage in cross-border lending, using the inverse Mills ratio calculated from the first-step estimation.[21]

*Table A3* in the Appendix shows the results of the second-step fixed effects estimation using the Wooldridge approach. The inverse Mills ratio is significant in all models, suggesting that it was appropriate to take account of the selection bias. Nevertheless, the results after this correction are quite comparable to the original ones in *Table 2*. One difference is that we cannot calculate the distance variable in the fixed effects estimator; it has to be omitted because of a near-singular matrix. Another difference is that the coefficients on lender and borrower country GDP are higher than in the original random effects model. The coefficients on the remaining variables keep their signs and statistical significance. Thus, even after controlling explicitly for the zero flow problem, the results do not differ substantially from the original random effects estimation.

### 5.2 Financial centres effect

As noted above, the use of the locational banking statistics in a gravity model poses problems if some exposures are booked in financial centres. These problems could be addressed by shifting to the consolidated statistics, but at the expense of a shorter sample period and exchange rate adjusted data. We therefore decided to stick with the locational data and perform a robustness test by dropping two major financial centres in our data sample – Switzerland and the United Kingdom – to see whether the presence of these centres affects the results.

The results of estimates without financial centres are shown in *Table A4* in the Appendix. With the exception of lender country GDP, which becomes statistically insignificant in the first three models, estimates of other parameters are quite comparable to the original results presented in *Table 2*. This confirms that the inclusion of financial centres in our five models does not bias the results of estimates.

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[20] This procedure is based on an approach for panel probit models developed by Mundlak (1978) and Chamberlain (1980, 1982): for each exogenous variable an additional variable (deviation from its mean) is included in the Heckman first step-estimator.

[21] Mundlak (1978) proposed to calculate the inverse Mills ratio for the whole sample while Chamberlain (1980, 1982) used a more general approach allowing for a dynamic specification, and proposed to calculate time-specific inverse Mills ratios. Note that standard errors calculated by Stata under this approach are not entirely correct: in the first step, the selected estimator does not take into account model uncertainty; in the second step, it does not consider heteroscedasticity of errors.

### 5.3 Country-specific risk factors: an extended analysis

Our empirical analysis has so far come to the conclusion that country specific factors were significant determinants of cross-border bank flows. In the following, we introduce additional country specific risk factors for borrower countries following Goldstein, Kaminski and Reinhart (2000), and test how far they contribute to the transmission of financial stress.

*First*, we introduce the spread between the lending and deposit interest rates charged by commercial banks (*SPREAD_L_D*). This spread acts as a proxy for financial sector efficiency, as inefficient or loss-making banks need larger spreads to ensure profitability. The spread is expected to be negatively correlated with the dependent variable – deteriorating efficiency of the financial sector in the borrower country should go hand in hand with the reduction in cross-border bank flows to the country.

*Second*, we replace the general government balance with short-term debt as a percentage of GDP (*SHT_DBT*). This indicator points more directly to the short-term foreign liabilities of the economy as a whole, rather than a mixture of domestic and foreign liabilities of the government – emerging market governments typically finance their budget deficits from a mix of domestic and foreign sources. A higher ratio of short-term debt could indicate future liquidity problems and induce foreign lenders to reduce their cross-border loans.

*Third*, we add a foreign reserves indicator – the official foreign exchange reserves as a percentage of M2 (*FOR_RES*). Large precautionary holdings of foreign exchange reserves provide self-insurance against external payment shocks, and one would expect them to be positively correlated with cross-border loans (Aizenman, 2009; Obstfeld, Shambaugh and Taylor, 2009).

*Fourth*, we add the external current account balance in percent of GDP (*CURRENT_ ACCT*). We expect a higher current account deficit to reduce foreign bank inflows, as it signals that domestic absorption is higher than domestic saving, and, therefore, that the borrowing country may face external sustainability problems in the longer run.

*Fifth*, we add real growth rate of domestic private sector credit (*CREDIT_GR*). Rapid credit growth sustained over several years can often signal a credit boom, which is typically followed by an increase in non-performing loans. One can therefore expect foreign lenders to be more cautious in extending cross-border loans to a country experiencing a credit boom.

Again, the analysis is done with the random effects estimator. In order to avoid endogeneity stemming from the fact that higher inflows of capital lead to more pronounced current account deficits and domestic credit growth, we lag the current account and credit growth variables by one period. *Table A5* in the Appendix summarizes the results. All additional country specific risk variables are statistically highly significant. All coefficients have the expected signs, except for the current account and credit growth. The positive sign of coefficients on these variables indicates that lender country banks lent more rather than less to the emerging markets with higher current account deficits and faster credit growth. In other words, these variables did not operate as early warning indicators of external and domestic vulnerabilities, but rather as signs of buoyant demand for external financing.

Such interpretation of risk factors may have contributed to excessive lending to some emerging markets, especially the catching-up economies in CEE, where current account deficits kept on widening and credit kept on expanding for several years in the expectation of smooth convergence to the EU. Consumption smoothing is legitimate for emerging markets up to a point. However, as the recent experience of countries such as Greece, Ireland, Portugal and Spain shows, consumption smoothing is not risk-free, as the catching-up economies eventually need to generate sufficient productivity gains in order to increase domestic saving and reduce external deficits.

## 5.4 Regional samples

To assess regional differences in the determinants of cross-border bank flows we ran regressions of five models from *Table 2* separately for emerging Asia, Latin America and central and eastern Europe. The analysis was done using the random effects estimator from the original set of regressions. The results are presented in *Tables A6–A8* in the Appendix.

On the whole, the regional estimates are similar to the estimates for the full sample. For some variables we obtain less significant estimates, which is not surprising taking into account the smaller number of observations.[22] In the *basic model*, most variables have the expected signs but several (including distance) are no longer statistically significant. This suggests that the gravity model might be more relevant in studying credit flows across several regions than to an individual region.

One interesting result is that, unlike the Asian and Latin American samples, the interest rate differential is not significant in central and Eastern Europe. This suggests that interest rate differentials did not play a key role in foreign bank lending to this region. As the bulk of cross-border lending to central and eastern Europe comes from western European banks, this result suggests that "soft" aspects of lending, such as strong linkages between parent banks and their subsidiaries, are perhaps more important determinants of cross-border bank flows than the "hard" aspects such as interest rate differentials.

The financial stress variables generally keep their signs and significance in regional regressions. This suggests that spillover effects take place through similar channels in all three emerging market regions. Central and eastern Europe stands out with respect to the significance – and except the Mexican crisis – the size of the common lender. This result probably reflects the fact that major western European banks are typically heavily involved in several CEE markets at the same time, and may therefore have to reduce their exposures more or less simultaneously when a liquidity crisis forces them to de-leverage.

## 5.5 Different crisis periods

To assess differences in the determinants of cross-border bank flows in different crises, we ran separate regressions for the Mexican crisis of 1994–95, the Asian crisis of 1997–98, and the global financial crisis of 2007–08. As with regional regressions, the estimates are done using the random effects estimator. The results are presented in *Tables A9–A11* in the Appendix.

For the Mexican and Asian crises (*Tables A9 and A10*), the determinants of cross-border flows were largely the same as in the full sample, although some coefficients were less significant, especially for the Mexican crisis. This is not surprising taking into account the smaller number of observations.[23]

For the current crisis, none of the variables representing financial stress in borrower and lender countries switched the sign (*Table A11*). However, there are two major deviations from the original results. *First*, the interest rate differential is now significantly negative in all specifications, implying that higher interest rates in emerging markets relative to advanced economies *reduced* the inflows of bank credit. This suggests that emerging market interest rates properly reflected increased risk premia during the crisis. *Second*, the sign of the coefficient on lender country GDP is reversed, ie it becomes positive. Again, this positive link

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[22] The estimations include 153 cross sections for the Asian sample, 204 for the European sample, and 119 for the Latin American sample, compared to the 476 cross sections in the original full sample.

[23] The estimations include 3,808 observations in each sub-sample compared to 30,464 observations in the original full sample estimation.

is usually found in standard gravity models. Our hypothesis is that in the current crisis larger advanced economies had greater fiscal and monetary policy freedom to handle the negative effects of the crisis, and their international banks were therefore not forced to reduce cross-border loans to such an extent as banks from smaller advanced economies.

## 6. Conclusions

This paper studied the nature of spillover effects in bank lending flows from advanced to the emerging market economies and tried to identify the main determinants of such flows. Based on a gravity model, we constructed a panel data set of bilateral cross-border bank flows from 17 advanced economies to 28 emerging market countries in Asia, Latin America and central and eastern Europe. The observation period covered quarterly data from 1993 to 2008, and contained some 30,500 observations.

Based on the econometric panel analysis, we found that variables of the standard gravity model were significant determinants of international bank lending. Greater distance between lender and borrower countries and larger home markets in lender countries significantly reduced cross-border loans to the emerging markets. By contrast, larger markets in borrower countries increased the size of cross-border bank flows. Cross-border flows also responded positively to interest rate and growth differentials, and negatively to the weakening of the borrower country currency.

With respect to the transmission of financial stress, the analysis revealed that both global and country specific risk factors, in lender as well as borrower countries, were significant determinants of cross-border bank flows. This result applied to all three emerging market regions, suggesting that the spillover effects occurred through similar channels.

In particular, we found evidence that advanced economies adjusted cross-border bank loans to the emerging markets in response to a reassessment of global risk and expected global financial market volatility (in line with the wake-up call hypothesis), but also in response to their own exposure to the primary crisis country (the common lender effect). Weak performance of banks in advanced economies was associated with lower cross-border loans to EMEs. Lenders also reduced cross-border loans in response to the worsening of country-specific risk factors in emerging markets, in particular higher fiscal deficits and deteriorating banking sector performance in EMEs. By contrast, stronger financial and monetary linkages between the lender and borrower countries helped stabilise cross-border flows even in times of financial stress.

A comparison of crisis periods revealed that, in the latest financial crisis, the most important channel for spillovers in cross-border lending between advanced and emerging markets were reassessment of global risk and greater expected volatility of global financial markets. Healthier banking sectors, more rigid exchange rate regimes and stronger financial integration contributed to the stability of cross-border bank flows to central and eastern Europe compared to other emerging market regions.

# Appendix

Table A1

**Determinants of cross-border bank flows from advanced to emerging markets**

**Random effects estimator with country fixed effects/time effects and PCSE**

Dependent variable: log of quarterly, exchange-rate adjusted change in external position (in millions USD) of banks in country *i* vis-à-vis all sectors in country *j*

| | (1) BASIC Model | (2) GLOBAL Model | (3) LENDER Model | (4) RISK Model | (5) LINKAGE Model |
|---|---|---|---|---|---|
| DIST | –0.658<br>(–2.83)*** | –0.659<br>(–3.29)*** | –0.790<br>(–2.88)*** | –0.694<br>(–4.18)*** | –0.286<br>(–1.23) |
| GDP_B | 1.196<br>(9.82)*** | 1.210<br>(9.95)*** | 1.3622<br>(9.23)*** | 0.791<br>(6.08)*** | 0.826<br>(5.42)*** |
| GDP_L | –0.795<br>(–3.72)*** | –0.888<br>(–4.28)*** | –0.594<br>(–1.78)* | –0.904<br>(–4.37)*** | –1.783<br>(–6.78)*** |
| INT_diff | 0.005<br>(1.87)* | 0.004<br>(1.32) | 0.006<br>(1.87)* | 0.010<br>(2.16)** | 0.007<br>(2.35)** |
| GR_diff | 0.029<br>(4.85)*** | 0.024<br>(3.92)*** | 0.027<br>(3.93)*** | 0.029<br>(4.14)*** | 0.035<br>(4.95)*** |
| ER | –0.013<br>(–6.09)*** | –0.012<br>(–5.31)*** | –0.014<br>(–5.43)*** | –0.028<br>(–8.19)*** | –0.011<br>(–4.29)*** |
| VIX | | –0.034<br>(–3.56)*** | | | |
| RISK_AVERS | | –0.003<br>(–1.66)* | | | |
| CLE_US | | | –0.020<br>(–1.90)** | | |
| CLE_AS | | | –0.032<br>(–2.62)*** | | |
| CLE_MX | | | –0.220<br>(–2.78)*** | | |
| BK_HLTH_L | | | 0.001<br>(2.14)** | | |
| GVT_BAL | | | | 0.054<br>(4.09)*** | |
| BK_HLTH_B | | | | 0.005<br>(8.26)*** | |
| FIN_OPEN | | | | | 0.178<br>(11.14)*** |
| ER_REGIME | | | | | –0.416<br>(–10.57)*** |
| $R^2$ | 0.05 | 0.06 | 0.06 | 0.06 | 0.07 |
| N | 30,464 | 30,464 | 30,464 | 30,464 | 30,464 |
| Durbin Watson | 2.01 | 2.02 | 2.01 | 2.03 | 2.05 |

*Note*: Standard errors in parentheses. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. PCSE = panel-corrected standard errors.

Table A2

**Determinants of cross-border bank flows from advanced to emerging markets**

**IV estimator**

Dependent variable: log of quarterly, exchange-rate adjusted change in external position (in millions USD) of banks in country *i* vis-à-vis all sectors in country *j*

| | (1) BASIC Model | (2) GLOBAL Model | (3) LENDER Model | (4) RISK Model | (5) LINKAGE Model |
|---|---|---|---|---|---|
| DIST | –0.248 (–5.08)*** | –0.290 (–6.18)*** | –0.229 (–6.18)*** | –0.315 (–7.85)*** | –0.466 (–14.87)*** |
| GDP_B | 0.070 (2.49)** | 0.091 (3.30)*** | 0.054 (2.67)*** | 0.093 (4.11)*** | 0.253 (10.79)*** |
| GDP_L | 0.056 (2.14)** | 0.064 (2.54)** | 0.082 (3.24)*** | –0.063 (–3.48)*** | 0.111 (4.72)*** |
| INT_diff | 0.006 (3.18)*** | 0.005 (2.26)** | 0.008 (5.78)*** | 0.012 (6.20)*** | 0.009 (4.29)** |
| GR_diff | 0.029 (4.53)*** | 0.021 (3.29)*** | 0.029 (5.37)*** | 0.033 (6.09)*** | 0.052 (8.01)*** |
| ER | –0.015 (–6.76)*** | –0.014 (–6.16)*** | –0.016 (–6.23)*** | –0.029 (–8.34)*** | –0.014 (–5.86)*** |
| VIX | | –0.030 (–6.44)*** | | | |
| RISK_AVERS | | –0.0003 (–0.58) | | | |
| CLE_US | | | –0.0002 (–0.09) | | |
| CLE_AS | | | –0.007 (–1.72)* | | |
| CLE_MX | | | –0.003 (–0.13) | | |
| BK_HLTH_L | | | 0.001 (2.01)** | | |
| GVT_BAL | | | | 0.031 (4.10)*** | |
| BK_HLTH_B | | | | 0.002 (5.12)*** | |
| FIN_OPEN | | | | | 0.050 (4.69)*** |
| ER_REGIME | | | | | –0.161 (–5.22)*** |

*Note*: Standard errors in parentheses. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.

Table A3

**Determinants of cross-border bank flows from advanced to emerging markets**

**Wooldridge approach**

Dependent variable: log of quarterly, exchange-rate adjusted change in external position (in millions USD) of banks in country *i* vis-à-vis all sectors in country *j*

| | (1) BASIC Model | (2) GLOBAL Model | (3) LENDER Model | (4) RISK Model | (5) LINKAGE Model |
|---|---|---|---|---|---|
| DIST | 1.893<br>(7.94)*** | 1.855<br>(7.94)*** | 1.759<br>(7.69)*** | 1.389<br>(6.53)*** | 1.455<br>(8.03)*** |
| GDP_B | –1.031<br>(–4.31)*** | –1.275<br>(–5.22)*** | –1.139<br>(–4.42)*** | –0.732<br>(–2.89)*** | –0.749<br>(–2.98)*** |
| GDP_L | 0.029<br>(5.20)*** | 0.016<br>(5.20)*** | 0.021<br>(4.73)*** | 0.051<br>(5.53)*** | 0.018<br>(4.31)*** |
| INT_diff | 0.077<br>(8.48)*** | 0.077<br>(8.48)*** | 0.060<br>(6.72)*** | 0.064<br>(6.83)*** | 0.064<br>(7.09)*** |
| GR_diff | –0.022<br>(–6.75)*** | –0.022<br>(–6.75)*** | –0.020<br>(–5.95)*** | –0.035<br>(–7.65)*** | –0.012<br>(–3.67)*** |
| ER | | –0.034<br>(–3.56)*** | | | |
| VIX | | –0.003<br>(–1.66)* | | | |
| RISK_AVERS | | | –0.035<br>(–2.46)** | | |
| CLE_US | | | –0.013<br>(–1.01) | | |
| CLE_AS | | | –0.373<br>(–3.07)*** | | |
| CLE_MX | | | 0.004<br>(3.73)*** | | |
| BK_HLTH_L | | | | 0.133<br>(7.45)*** | |
| GVT_BAL | | | | 0.008<br>(10.91)*** | |
| BK_HLTH_B | | | | | 0.152<br>(7.97)*** |
| FIN_OPEN | | | | | –0.466<br>(–9.20)*** |
| $R^2$ | 0.02 | 0.04 | 0.02 | 0.03 | 0.04 |
| N | 30,464 | 30,464 | 30,464 | 30,464 | 30,464 |

*Note*: Standard errors in parentheses. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.

Table A4

**Determinants of cross-border bank flows from advanced to emerging markets**
Random effects estimator with country specific fixed effects and PCSE

**Sub-sample without financial centres (the United Kingdom and Switzerland)**

Dependent variable: log of quarterly, exchange-rate adjusted change in external position (in millions USD) of banks in country *i* vis-à-vis all sectors in country *j*

| | (1) BASIC Model | (2) GLOBAL Model | (3) LENDER Model | (4) RISK Model | (5) LINKAGES Model |
|---|---|---|---|---|---|
| DISTANCE | –0.578 | –0.579 | –0.732 | –0.637 | –0.307 |
| | (–10.23)*** | (–10.30)*** | (–4.95)*** | (–4.35)*** | (–1.88)* |
| GDP_B | 0.639 | 0.711 | 0.872 | 0.691 | 1.064 |
| | (9.61)*** | (10.64)*** | (7.04)*** | (6.53)*** | (9.39)*** |
| GDP_L | –0.031 | –0.033 | –0.220 | –0.472 | –0.428 |
| | (0.67) | (–0.80) | (–1.54) | (–3.43)*** | (–2.51)*** |
| INT_diff | 0.010 | 0.004 | 0.013 | 0.016 | 0.015 |
| | (4.05)*** | (1.35) | (3.46)*** | (3.87)*** | (5.22)*** |
| GR_diff | 0.042 | 0.028 | 0.044 | 0.040 | 0.049 |
| | (7.23)*** | (4.76)*** | (6.10)*** | (6.05)*** | (7.12)*** |
| ER | –0.016 | –0.012 | –0.017 | –0.029 | –0.011 |
| | (–7.14)*** | (–5.56)*** | (–6.42)*** | (–8.44)*** | (–4.59)*** |
| VIX | | –0.020 | | | |
| | | (–4.36)*** | | | |
| RISK_AVERS | | –0.003 | | | |
| | | (–5.44)*** | | | |
| CLE_US | | | –0.005 | | |
| | | | (–0.45) | | |
| CLE_AS | | | –0.006 | | |
| | | | (–0.45) | | |
| CLE_MX | | | –0.279 | | |
| | | | (–2.57)*** | | |
| BK_HLTH_L | | | 0.001 | | |
| | | | (2.14)** | | |
| GVT_BAL | | | | 0.079 | |
| | | | | (6.46)*** | |
| BK_HLTH_B | | | | 0.006 | |
| | | | | (11.24)*** | |
| FIN_OPEN | | | | | 0.166 |
| | | | | | (10.62)*** |
| ER_REGIME | | | | | –0.386 |
| | | | | | (–9.86)*** |
| $R^2$ | 0.03 | 0.04 | 0.02 | 0.03 | 0.04 |
| N | 26,880 | 26,880 | 26,880 | 26,880 | 26,880 |
| Durbin-Watson | 2.02 | 2.03 | 2.05 | 2.08 | 2.09 |

*Note*: Standard errors in parentheses. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. PCSE = panel-corrected standard errors.

Table A5

**Determinants of cross-border bank flows from advanced to emerging markets**
Random effect estimator with country fixed effects/time effects and PCSE

**Extended analysis of borrower country risk factors**

| Dependent variable: log of quarterly, exchange-rate adjusted change in external position (in millions USD) of banks in country *i* vis-à-vis all sectors in country *j* | |
|---|---|
| | Extended RISK Model |
| DIST | –0.688<br>(–9.46)*** |
| GDP_B | 1.247<br>(9.12)*** |
| GDP_L | –0.806<br>(–4.28)*** |
| INT_diff | 0.017<br>(3.25)*** |
| GR_diff | 0.020<br>(2.61)*** |
| ER | –0.015<br>(–4.02)*** |
| SPREAD_L_D | –0.0003<br>(–2.67)*** |
| SHT_DBT | –0.010<br>(–1.98)** |
| FOR_RES | 0.008<br>(2.74)*** |
| CUR_ACT_(t-1) | –0.037<br>(–1.88)* |
| CREDIT_GR_(t-1) | 0.006<br>(3.10)*** |
| BK_HLTH_B | 0.005<br>(8.41)*** |
| $R^2$ | 0.06 |
| N | 30,464 |

*Note*: Standard errors in parentheses. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.

To avoid a near-singular matrix, US/IN/TR/TW/VN country fixed effects had to be eliminated.

Table A6

**Determinants of cross-border bank flows from advanced to emerging markets**

Random effects estimator for **emerging Asia** with country fixed effects and PCSE

Dependent variable: log of quarterly, exchange-rate adjusted change in external position (in millions USD) of banks in country *i* vis-à-vis all sectors in country *j*

| | (1) BASIC Model | (2) GLOBAL Model | (3) LENDER Model | (4) RISK Model | (5) LINKAGE Model |
|---|---|---|---|---|---|
| DIST | –0.136<br>(–0.29) | –0.147<br>(–0.33)*** | 0.082<br>(0.17) | 0.018<br>(0.04) | –0.010<br>(–0.02) |
| GDP_B | 0.339<br>(1.45) | 0.605<br>(2.58)** | 0.530<br>(1.89)** | –0.172<br>(–0.69) | 1.067<br>(3.60)*** |
| GDP_L | –0.188<br>(0.73) | –0.550<br>(–1.99) | –0.394<br>(–1.07) | –0.206<br>(–0.73) | –0.160<br>(–0.43) |
| INT_diff | 0.051<br>(4.97)*** | 0.045<br>(4.31)*** | 0.060<br>(5.02)*** | 0.024<br>(2.28)** | 0.082<br>(6.53)*** |
| GR_diff | 0.114<br>(8.17)*** | 0.087<br>(6.15)*** | 0.117<br>(7.19)*** | 0.078<br>(5.32)*** | 0.093<br>(5.35)*** |
| ER | –0.022<br>(–4.42)*** | –0.019<br>(–3.85)*** | –0.026<br>(–4.56)*** | –0.028<br>(–5.79)*** | –0.008<br>(–1.31) |
| VIX | | –0.046<br>(–5.06)*** | | | |
| RISK_AVERS | | –0.001<br>(–1.24) | | | |
| CLE_US | | | –0.034<br>(–1.66)* | | |
| CLE_AS | | | –0.003<br>(–0.12) | | |
| CLE_MX | | | –0.294<br>(–2.56)*** | | |
| BK_HLTH_L | | | 0.004<br>(4.42)*** | | |
| GVT_BAL | | | | 0.257<br>(6.99)*** | |
| BK_HLTH_B | | | | 0.664<br>(11.57)*** | |
| FIN_OPEN | | | | | 0.158<br>(2.22)** |
| ER_REGIME | | | | | –0.605<br>(–6.14)*** |
| $R^2$ | 0.02 | 0.04 | 0.03 | 0.04 | 0.04 |
| N | 9,792 | 9,792 | 9,792 | 9,792 | 9,792 |

*Note*: Standard errors in parentheses. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. PCSE = panel-corrected standard errors.

Due to near-singular matrix the following country fixed effects had to be eliminated from the regression: Basic model: US/VN; Global model: US/VN; Lender model: GR/NO/SE/US/VN; Risk model: US/VN; Linkages model: GR/NO/US/VN.

Table A7

**Determinants of cross-border bank flows from advanced to emerging markets**

Random effects estimator for **Latin America** with country fixed effects and PCSE

Dependent variable: log of quarterly, exchange-rate adjusted change in external position (in millions USD) of banks in country *i* vis-à-vis all sectors in country *j*

| | (1) BASIC Model | (2) GLOBAL Model | (3) LENDER Model | (4) RISK Model | (5) LINKAGE Model |
|---|---|---|---|---|---|
| DIST | 0.299<br>(0.23) | –0.407<br>(–0.09) | 2.382<br>(1.65)* | –4.26<br>(–1.38) | –1.023<br>(–0.70) |
| GDP_B | 1.709<br>(6.91)*** | 1.802<br>(6.89)*** | 0.158<br>(5.50)*** | 1.065<br>(4.07)*** | 1.721<br>(6.97)*** |
| GDP_L | –1.42<br>(–4.85)*** | –1.531<br>(–4.80)** | –0.367<br>(3.50)*** | –0.932<br>(–3.13)*** | –0.283<br>(1.34) |
| INT_diff | 0.017<br>(2.98)*** | 0.007<br>(1.03) | 0.022<br>(3.07)*** | 0.013<br>(1.94)** | 0.024<br>(3.65)*** |
| GR_diff | 0.009<br>(0.92) | –0.010<br>(–1.07) | 0.007<br>(0.65) | 0.003<br>(0.28) | 0.020<br>(1.80)* |
| ER | –0.028<br>(–4.11)*** | –0.015<br>(–2.27)** | –0.029<br>(–3.81)*** | –0.029<br>(–4.24)*** | –0.008<br>(–0.99) |
| VIX | | –0.029<br>(–2.78)*** | | | |
| RISK_AVERS | | –0.002<br>(–1.63)* | | | |
| CLE _US | | | –0.004<br>(–0.21) | | |
| CLE_AS | | | –0.024<br>(–1.20) | | |
| CLE_MX | | | –0.477<br>(–2.23)** | | |
| BK_HLTH_L | | | 0.002<br>(1.93)** | | |
| GVT_BAL | | | | 0.086<br>(4.05)*** | |
| BK_HLTH_B | | | | 0.0056<br>(2.72)*** | |
| FIN_OPEN | | | | | 0.001<br>(0.01) |
| ER_REGIME | | | | | –0.255<br>(–4.10)*** |
| $R^2$ | 0.03 | 0.03 | 0.04 | 0.02 | 0.03 |
| N | 7,616 | 7,616 | 7,616 | 7,616 | 7,616 |

*Note*: Standard errors in parentheses. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. PCSE = panel-corrected standard errors.

Due to near-singular matrix the following country fixed effects had to be eliminated from the regression: Basic model: US/VE; Global model: US/VE; Lender model: GR/NO/SE/US/VE; Risk model: US/VE; Linkages model: GR/NO/US/VE.

Table A8

**Determinants of cross-border bank flows from advanced to emerging markets**

Random effects estimator for **central and eastern Europe** with country fixed effects and PCSE

Dependent variable: log of quarterly, exchange-rate adjusted change in external position (in millions USD) of banks in country *i* vis-à-vis all sectors in country *j*

| | (1) BASIC Model | (2) GLOBAL Model | (3) LENDER Model | (4) RISK Model | (5) LINKAGE Model |
|---|---|---|---|---|---|
| DIST | –0.880 (–7.83)*** | –0.880 (–7.85)*** | –0.963 (–7.77)*** | –0.967 (–7.86)*** | –0.395 (–3.83)*** |
| GDP_B | 0.919 (7.56)*** | 1.095 (8.75)*** | 0.774 (4.43)*** | 0.965 (5.97)*** | 0.793 (5.00)*** |
| GDP_L | –0.306 (–1.40) | –0.660 (–2.93)** | –0.027 (–0.08) | –0.563 (–2.02)** | –0.262 (–0.95) |
| INT_diff | 0.002 (0.51) | –0.001 (–0.49) | –0.000 (–0.01) | –0.013 (–1.57) | 0.005 (1.35) |
| GR_diff | 0.048 (5.86)*** | 0.040 (4.85)*** | 0.053 (5.60)*** | 0.061 (5.89)*** | 0.040 (3.91)*** |
| ER | –0.005 (–1.89)** | –0.003 (–1.32) | –0.003 (–1.08) | –0.031 (–3.62)*** | –0.007 (–2.23)** |
| VIX | | –0.016 (–2.39)** | | | |
| RISK_AVERS | | –0.002 (–2.39)** | | | |
| CLE _US | | | –0.024 (–1.67)* | | |
| CLE_AS | | | –0.035 (–2.87)*** | | |
| CLE_MX | | | –0.183 (–2.04)** | | |
| BK_HLTH_L | | | 0.001 (1.37) | | |
| GVT_BAL | | | | –0.015 (–0.78) | |
| BK_HLTH_B | | | | 0.002 (1.82)** | |
| FIN_OPEN | | | | | 0.185 (14.40)*** |
| ER_REGIME | | | | | –0.302 (–4.40)*** |
| $R^2$ | 0.06 | 0.06 | 0.06 | 0.04 | 0.10 |
| N | 13,056 | 13,056 | 13,056 | 13,056 | 13,056 |

*Note*: Standard errors in parentheses. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. PCSE = panel-corrected standard errors.

Due to near-singular matrix the following country fixed effects had to be eliminated from the regression: Basic model: US/TR; Global model: US/TR; Lender model: GR/NO/SE/US/TR; Risk model: US/TR; Linkages model: NO/US/TR.

Table A9

**Determinants of cross-border bank flows from advanced to emerging markets**

Random effects model for the **Mexican crisis (1994–95)** with country fixed effects and PCSE

Dependent variable: log of quarterly, exchange-rate adjusted change in external position (in millions USD) of banks in country *i* vis-à-vis all sectors in country *j*

| | (1) BASIC Model | (2) GLOBAL Model | (3) LENDER Model | (4) RISK Model | (5) LINKAGE Model |
|---|---|---|---|---|---|
| DIST | –0.459 (–2.63)*** | –0.461 (–2.65)*** | –0.546 (–2.68)*** | –0.694 (–1.70)* | –0.321 (–1.52) |
| GDP_B | –0.028 (–0.04) | 0.304 (–0.44) | –0.844 (–0.84)*** | 0.298 (0.26) | –0.070 (–0.09) |
| GDP_L | 2.461 (2.26)** | 1.547 (1.33) | 3.660 (2.11)** | 2.807 (1.52) | 2.429 (1.98)** |
| INT_diff | –0.014 (–0.87) | –0.010 (–0.64) | –0.011 (–0.47) | –0.115 (–2.09)** | –0.015 (–0.85) |
| GR_diff | 0.031 (1.91)* | 0.025 (1.50) | 0.035 (1.72)* | 0.059 (1.95)** | 0.040 (2.21)** |
| ER | –0.013 (–1.36) | –0.016 (–1.70)* | –0.002 (–0.09) | 0.009 (0.38) | –0.015 (–1.43) |
| VIX | | –0.019 (–0.27) | | | |
| RISK_AVERS | | 0.039 (2.53) | | | |
| CLE_MX | | | –2.542 (–2.12)** | | |
| BK_HLTH_L | | | –0.004 (–0.79)** | | |
| GVT_BAL | | | | 0.161 (0.81) | |
| BK_HLTH_B | | | | 0.0003 (0.03) | |
| FIN_OPEN | | | | | 0.070 (0.76) |
| ER_REGIME | | | | | –0.311 (–1.74)* |
| $R^2$ | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| N | 3,808 | 3,808 | 3,808 | 3,808 | 3,808 |

*Note*: Standard errors in parentheses. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. PCSE = panel-corrected standard errors.

Due to near-singular matrix the following country fixed effects had to be eliminated from the regression: Basic model: FR/GR/NL/PT/US/AR/BR/HR/HU/IN/LT/MX/MY/RO/VE/VN;

Global model: FR/GR/NL/PT/US/AR /BR/HR/HU/IN/LT/MX/MY/RO/VE/VN;

Lender model: FR/GR/ NL/NO/PT/SE/US/AR/BR/HR/HU/IN /LT/MX/MY/RO/VE/VN;

Risk model: FR/GR/NL/PT/US/AR/BG/BR/EE/HR/HU/IN/LT/LV/MX/MY/RO/SI/SK/VE/VN;

Linkages model: FR/GR/NL/NO/PT/US/AR/BR/HR/HU/IN/LT/MX/MY/RO/VE/VN.

Table A10

**Determinants of cross-border bank flows from advanced to emerging markets**

Random effects model for the **Asian crisis (1997–98)** with country fixed effects and PCSE

Dependent variable: log of quarterly, exchange-rate adjusted change in external position (in millions USD) of banks in country *i* vis-à-vis all sectors in country *j*

| | (1) BASIC Model | (2) GLOBAL Model | (3) LENDER Model | (4) RISK Model | (5) LINKAGE Model |
|---|---|---|---|---|---|
| DIST | –0.254 (–1.69)* | –0.253 (–1.70)* | –0.245 (–1.43) | –0.371 (–2.22)** | 0.864 (0.89) |
| GDP_B | 1.478 (3.02)*** | 2.022 (4.04)*** | 1.786 (3.18)*** | 0.300 (0.46) | 1.476 (2.63)*** |
| GDP_L | –5.352 (–4.24)*** | –0.887 (–0.586) | –5.319 (3.86)*** | –3.975 (–2.68)*** | –6.192 (–4.81)*** |
| INT_diff | 0.027 (3.39)*** | 0.024 (3.00)*** | 0.029 (3.27)*** | 0.009 (0.64) | 0.027 (3.19)*** |
| GR_diff | 0.066 (3.58)*** | 0.029 (1.55) | 0.056 (2.71)*** | 0.044 (1.95)** | 0.084 (4.24)*** |
| ER | –0.012 (–3.24)*** | –0.012 (–3.20)*** | –0.014 (–3.12)*** | –0.022 (–3.78)*** | –0.012 (–2.98)*** |
| VIX | | –0.080 (–3.07)*** | | | |
| RISK_AVERS | | –0.009 (–2.40)*** | | | |
| CLE_AS | | | –0.012 (–0.15) | | |
| BK_HLTH_L | | | 0.001 (0.461) | | |
| GVT_BAL | | | | 0.129 (1.91)** | |
| BK_HLTH_B | | | | 0.006 (2.20)** | |
| FIN_OPEN | | | | | 0.608 (3.91)*** |
| ER_REGIME | | | | | –0.256 (–2.03)** |
| $R^2$ | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| N | 3,808 | 3,808 | 3,808 | 3,808 | 3,808 |

*Note*: Standard errors in parentheses. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. PCSE = panel-corrected standard errors.

Due to near-singular matrix the following country fixed effects had to be eliminated from the regression:

Basic model: FR/NL/US/AR/LT/MX/MY/RO/VE/VN;

Global model: FR/NL/US/AR/LT/MX/MY/RO/VE/VN;

Lender model: FR/GR/NL/NO/SE/US/AR/LT/MX/MY/RO/VE/VN;

Risk model: FR/NL/US/AR/BG/LT/MX/MY/RO/SI/SK/VE/VN;

Linkages model: FR/GR/NL/US/AR/LT/MX/MY/NO/RO/VE/VN.

Table A11

**Determinants of cross-border bank flows from advanced to emerging markets**

Random effects model for the **global financial crisis of 2007–08** with country fixed effects and PCSE

Dependent variable: log of quarterly, exchange-rate adjusted change in external position (in millions USD) of banks in country *i* vis-à-vis all sectors in country *j*

| | (1) BASIC Model | (2) GLOBAL Model | (3) LENDER Model | (4) RISK Model | (5) LINKAGE Model |
|---|---|---|---|---|---|
| DIST | –1.306 | –1.301 | –1.374 | –0.332 | –01.144 |
| | (–8.69)*** | (–8.71)*** | (–8.17)*** | (–8.87)*** | (–5.60)*** |
| GDP_B | 0.942 | 0.010 | –0.635 | –0.294 | 1.826 |
| | (1.26) | (–0.01) | (–0.76) | (–0.58)*** | (1.51) |
| GDP_L | 2.482 | 2.558 | 3.414 | 0.236 | –2.354 |
| | (2.31)** | (1.90)** | (2.48)*** | (2.09)** | (–1.07) |
| IR_diff | –0.258 | –0.016 | –0.146 | –0.242 | 0.607 |
| | (–4.85)*** | (–0.26) | (–2.44)*** | (–5.12)*** | (2.20)* |
| GR_diff | 0.169 | 0.085 | 0.150 | 0.162 | 0.082 |
| | (6.61)*** | (3.18)*** | (4.88)*** | (5.81)*** | (0.92) |
| ER | –0.105 | –0.084 | –0.099 | –0.105 | –0.086 |
| | (–7.26)*** | (–5.87)*** | (–6.19)*** | (–7.45)*** | (–1.64)* |
| VIX | | –0.038 | | | |
| | | (–2.08)** | | | |
| RISK_AVERS | | –0.002 | | | |
| | | (–0.82) | | | |
| CLE_US | | | 0.089 | | |
| | | | (0.79) | | |
| BK_HLTH_L | | | 0.015 | | |
| | | | (4.87)*** | | |
| GOV_BAL | | | | 0.053 | |
| | | | | (0.60) | |
| BK_HLTH_B | | | | –0.010 | |
| | | | | (–1.91)* | |
| FIN_OPEN | | | | | 0.156 |
| | | | | | (6.89)*** |
| ER_REGIME | | | | | –0.420 |
| | | | | | (–2.64)*** |
| $R^2$ | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 |
| N | 3,808 | 3,808 | 3,808 | 3,808 | 3,808 |

*Note*: Standard errors in parentheses. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. PCSE = panel-corrected standard errors.

Due to near-singular matrix the following country fixed effects had to be eliminated from the regression: Basic model: US/VN; Global model: US/VN; Lender model: GR/NO/SE/US/VN; Risk model: US/VN; Linkages model: NO/US/VE/VN.

## List of variables

| Mnemonic | Data sources* | Variable description |
|---|---|---|
| LOANS | BIS-LBS | External positions (assets) of BIS reporting banks in country *i* vis-à-vis all sectors in emerging market country *j*, in millions of US dollars. Changes in external positions are exchange-rate adjusted by converting the relevant stocks into their original currencies using end-of-period exchange rates and subsequently converting the changes in stocks into dollar amounts using period-average exchange rates. |
| DIST | www.timeadndate.com | Distance between the capital of country *i* and country *j*, in kilometres. |
| GDP (_L, _B) | CEIC, Datastream, Eurostat, IFS, CEIC, National data | Nominal GDP (of lender and borrower countries), in millions of US dollars. |
| INT_diff | IFS | Money market interest rate differential between country *j* and country *i*, in percentage points (for HU and CN three-month interbank rates, for TW three-month money market rates). |
| GR_diff | Datastream, IFS | Real GDP growth differential between country *j* and country *i*, in percentage points. |
| ER | Datastream, IFS | Bilateral nominal exchange rate index. |
| VIX | Bloomberg | VIX Chicago Board Options Exchange S&P 100 Volatility Index, quarterly average. |
| RISK_AVERS | Moody's | Spread of corporate bonds (AAA, AA, A and BAA) over 10-year US Treasury bonds, quarterly average. |
| CLE (_MX, _AS, _US) | BIS, LBS | Common lender effect, measuring exposure of banks in a lender country to the primary crisis country (MX, five Asian crisis countries, or the US); external assets of country *i* vis-à-vis the primary crisis country, as a percentage of the total amount outstanding of external assets of country *i*. |
| BK_HLTH (_L, _B) | Datastream, IFS | Bank health indicator (of lender and borrower countries); deviation of the banking industry subindex from the main equity price index; in percent. |
| GVT_BAL | WEO | General government balance, linearly interpolated, as a percentage of country *j*'s GDP. |
| FIN_OPEN | BIS-LBS, WEO | Bilateral financial openness: sum of the external assets and liabilities of all sectors in country *j* vis-à-vis banks in BIS reporting country *i*, as a percentage of country *j*'s GDP. |
| ER_REGIME | RRI | Exchange rate regime, coarse classification codes from Reinhart and Rogoff (2004). |
| SPREAD_L_D | IFS | Spread between the main lending and deposit rates of interest, in basis points. |
| SHT_DBT | BIS, CBS, IDS, WEO | Debt with a maturity up to and including one year, plus international debt securities outstanding with a maturity of up to one year, of all BIS reporting countries vis-à-vis country *j*; as a percentage of country *j*'s GDP. |
| FOR_RES | IFS, National Data | Foreign exchange reserves, outstanding positions as a percentage of M2. |
| CUR_ACT | BOP, National Data | Current account balance as a percentage of annual GDP. For China, annual BOP data before 2001; semi-annual data after 2001 used to interpolate quarterly figures. |
| CRED_GR | IFS, National data | Real credit to the domestic private sector, annual growth rate in percent. |

*** Sources of data**

BIS-LBS: BIS locational banking statistics

BIS-CBS: BIS consolidated banking statistics

DIST: http://www.timeanddate.com/worldclock/distance.html?p1=48

IFS: International Monetary Fund, International Financial Statistics

DOT: International Monetary Fund, Direction of Trade Statistics

WEO: International Monetary Fund, World Economic Outlook

BOP: International Monetary Fund, Balance of Payments Statistics

IDS: International Debt Statistics

CEIC: Economic databases for emerging and developed markets, http://www.ceicdata.com/about_ceic.html

RRI: Reinhart-Rogoff exchange rate regime classification index, http://terpconnect.umd.edu/~creinhar/Data/ERA-Monthly%20coarse%20class.xls, http://intl.econ.cuhk.edu.hk/exchange_rate_regime/index.php?cid=11

**Advanced economies (BIS reporting countries)**: Austria (AT), Belgium (BE), Switzerland (CH), Germany (DE), Denmark (DK), Spain (ES), Finland (FI), France (FR), United Kingdom (GB), Greece (GR), Italy (IT), Japan (JP), Netherlands (NL), Norway (NO), Portugal (PT), Sweden (SE), United States (US).

**Emerging Asian economies**: China (CN), Indonesia (ID), India (IN), Korea (KR), Malaysia (MY), Philippines (PH), Taiwan (TW), Thailand (TH), Vietnam (VN).

**Central and eastern European economies**: Bulgaria (BG), Croatia (HR), Czech Republic (CZ), Estonia (EE), Hungary (HU), Latvia (LV), Lithuania (LT), Poland (PL), Romania (RO), Slovak Republic (SK), Slovenia (SI), Turkey (TR).

**Latin American economies**: Argentina (AR), Brazil (BR), Chile (CL), Colombia (CO), Mexico (MX), Peru (PE), Venezuela (VE).

The two endogenous variables – external positions and external loans of BIS reporting countries vis-à-vis emerging market economies – are taken from the BIS locational banking statistics. The locational statistics comprise data on gross international financial claims and liabilities of banks resident in a given country. The main goal of the locational statistics is to provide information on the role of banks and financial centres in the intermediation of international capital flows. The statistics includes stocks ("amounts outstanding") and flows ("changes"): the flows are exchange-rate adjusted (unadjusted flows are simply calculated as the difference between amounts outstanding). We use the locational statistics, because it is more relevant for countries receiving external loans, while the consolidated statistics is more relevant for countries giving such loans. The locational statistics also has longer data series (exchange-rate adjusted flows are available for 41 reporting countries since 1977 on a quarterly basis).

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