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Abstract

The international linkages between banks play a crucial role in today's global economy. Existing models explain these links on the basis of portfolio theory, in which banks diversify lending. These models have found only limited empirical support and do not speak to many relevant dimensions of the data. For example, they do not address heterogeneity in the degree to which banking sectors fund their foreign operations locally in foreign markets. This paper proposes an alternative theory to explain banking across borders that is based on elements of international trade theory. In the model, banking across borders arises because countries differ in their relative factor endowments and in the efficiency of their banking sectors. Based on these differences, the pattern of foreign bank asset and liability holdings emerges endogenously. This parsimonious model provides a rationale for different dimensions of heterogeneity in foreign bank activities and clarifies the interpretation of international banking data. Its predictions are consistent with observed patterns in the data.

Key words: cross-border banking, international capital flows, trade in banking services

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1 Introduction

The financial crisis in 2008/2009 highlighted the pivotal role of international financial linkages between banks in the global economy.[1] Research in the cross-border banking literature predominantly relies on portfolio theory to explain these links.[2] Portfolio models assume that financial intermediaries invest abroad in order to diversify lending. There is, however, little empirical support for diversification in the data. Aviat and Coeurdacier (2007) have found that banks invest more in countries that show a stronger positive correlation with domestic returns, a finding known as the "correlation puzzle". In addition, portfolio frameworks do not provide a rationale for the foreign liability holdings of banks and for the decisions of banks to operate cross-border or through foreign affiliates. Accordingly, these models cannot address three relevant dimensions of heterogeneity in the data. First, the extent to which banks operate through foreign affiliates varies substantially across banking sectors. Second, banking sectors differ in their foreign liability-asset gaps, a measure which has been related to the (in)stability of foreign bank operations. Third, there is considerable heterogeneity in foreign bank participation across countries, that is, foreign banks are differentially important in different countries.[3]

This paper uses elements of international trade theory to propose an alternative conceptual framework explaining why and how international bank linkages are created. In the model, countries differ in their returns to capital as well as in the efficiencies of their banking sectors.[4] These differences generate banking across borders through two mechanisms. First, banks chan-

[1] Bank linkages matter for financial contagion and the transmission of macro shocks, for example. See, e.g., Kaminsky and Reinhart (2000), Cetorelli and Goldberg (2011), Kalemli-Ozcan, Papaioannou and Perri (2013) and Cetorelli and Goldberg (forthcoming).

[2] Exceptions are de Blas and Russ (2012), Ennis (2001), and Eaton (1994). These papers are discussed as part of the literature review in more detail.

[3] Recent work by Bruno and Shin (2012) explains cyclical fluctuations in cross-border bank flows but does not address these aspects either.

[4] The model combines Heckscher-Ohlin differences in factor endowments with technological differences in the spirit of Ricardo. While it borrows these elements from the international trade literature, the model does not follow from relabeling existing theory.

nel capital to capital-scarce countries. At the same time, the more efficient banking sector expands, whereas the less efficient banking sector contracts. Thus a cross-country pattern of bank foreign asset and liability holdings emerges endogenously.

This parsimonious model makes progress in several dimensions. First of all, it delivers a tractable theory of trade in banking services that endogenously pins down the cross-country exposures of banking sectors on both the asset and the liability side of banks' balance sheets.[5] The empirical part of the paper shows that the key cross-sectional implications of the theory are consistent with the conditional correlations in the data.

The paper provides a framework to explain the three dimensions of heterogeneity, which have only been discussed from an empirical point of view: heterogeneity in the extent to which banks operate through foreign affiliates, heterogeneity in liability-asset gaps, and heterogeneity in foreign bank participation. The first type of heterogeneity is related to research by McCauley, Ruud and Wooldridge (2002) and McCauley, McGuire and von Peter (2012).[6] These researchers at the Bank for International Settlements (BIS) observe that different banking sectors follow different funding models, funding themselves to varying degrees globally or internationally. *Global banking* implies that banks raise funding abroad through foreign affiliates (FDI) and invest the capital in the same foreign market. *International banking* denotes the case in which a banking sector extends cross-border loans to foreign firms funded by domestic deposits (arms-length export). The model is able to generate these activities and to show under which conditions a banking sector engages in each of the two. The model also shows that a third activity has to be distinguished. Banks may also conduct *foreign sourcing*, which I define as raising funding abroad for investment at home.

[5]This paper also adds to the growing literature on services trade. See Francois and Hoekman (2010) for a review of recent developments in services trade research.

[6]See also McCauley, McGuire and von Peter (2010).

By defining and distinguishing different types of banking across borders, this paper also provides guidance on how to interpret international banking data. Knowledge of cross-border banking is largely based on reports of foreign positions gathered by the Bank for International Settlements or on bank-level equivalents, which national central banks collect. These statistics are complex. The model shows that consolidated banking statistics will always include *international banking*, *global banking* as well as *foreign sourcing*. In this regard, this paper helps clarify some confusion around when to use locational or consolidated statistics. For example, a gravity equation, where asset holdings increase one to one with the GDP of the source and the destination country should not always hold.[7]

In the model, banks provide intermediation services, channeling capital from depositors to firms at a cost that reflects banking sector efficiency in the economy. Entrepreneurs who borrow from intermediaries have to pay this cost plus the interest rate paid out to depositors. The interest rate is endogenously determined by the capital-labor ratio and banking sector efficiency in the economy. In the open economy, entrepreneurs have the option to borrow both from domestic and foreign banks. Banks in turn can raise deposits at home and abroad. Countries differ in relative factor endowments and banking sector efficiencies so that autarky interest rates and intermediation fees differ across countries.[8]

The model incorporates three additional elements. First, an entrepreneur who is served by a foreign bank has to pay a cost τ proportionate to the loan he takes. The lower τ is, the more freely capital can flow across borders: that is, the higher the degree of capital account openness. Second, if banks raise capital abroad, they incur cost t, which reflects the degree of banking sector liberalization. The lower the cost, the lower the barriers are to establishing a physical

[7]Aviat and Coeurdacier (2007) test predictions of a portfolio model based on the consolidated statistics, assuming that a one-to-one relationship between asset holdings and country sizes holds.

[8]This approach is similar to Ju and Wei (2010).

presence abroad. This interpretation implies that banks can extend loans cross-border/from home but can only raise deposits through foreign affiliates abroad. Finally, it is assumed that the more capital banks intermediate, the more capacity constrained and the less efficient they become.

Taking the additional cost of being served by a foreign bank into account, entrepreneurs minimize the cost of external funding, choosing the bank that offers the best combination of interest rate and service fee. When differences in efficiencies and endowments are large across countries relative to the transaction costs, trade in banking services occurs. In equilibrium, banking sectors invest and borrow across borders so that gross returns to capital and service fees are equilibrated.

The model shows under which conditions the three types of banking across borders occur. If differences in returns are large, while there are no differences in efficiencies, the banking sector of the capital abundant country engages in *international banking*, investing domestic capital abroad. As a consequence it holds foreign assets but no foreign liabilities. If differences in banking sector efficiencies are large, but endowments are similar, the more efficient banking sector engages in *global banking*, raising capital abroad and investing this capital in the foreign market. In this case the banking sector holds both foreign assets and foreign liabilities. If a capital scarce country hosts a very efficient banking sector, its banks conduct *foreign sourcing*, raising capital abroad for investment at home. Accordingly, they hold foreign liabilities but no foreign assets on their balance sheets. These three special cases illustrate how the model endogenously determines the cross-country foreign exposures of banking sectors. In general, banking sectors engage in two of the three activities simultaneously.

Beyond rationalizing participation in global banking, international banking and foreign

sourcing, the model can also explain two other dimensions of heterogeneity across countries: foreign liability-asset gaps and the degree of foreign bank participation. An extension shows that the predictions of the model are robust to allowing for interbank lending, which yields additional testable implications.

Using bank-level data from Deutsche Bundesbank and aggregated data from the Bank for International Settlements, I find that the model is consistent with key conditional correlations in the data. Conditional on country size and frictions, foreign asset and liability holdings of the source banking sector are higher when the efficiency advantage of the source relative to the destination country is larger. In addition, the ratio of foreign liabilities to foreign assets is negatively correlated with capital abundance in the source country. To test for diversification, I also include a measure of GDP growth correlations between countries in the regressions. There is tentative evidence that banks diversify their assets. When differences in endowments, differences in efficiencies, and bilateral FDI are controlled for, the diversification coefficient is negative suggesting that banks invest more in countries with less synchronized business cycles.

The model provides a framework for thinking about banking across borders that is consistent with key aspects of the data. Because it is simple but generates a rich structure, it can serve as a basis for future research and can be used to develop theory that incorporates additional features of the data, such as imperfect competition, bank heterogeneity and diversification.

In addition to contributing to the literature on cross-border banking, the analysis also relates to the literature on international capital flows and financial frictions, highlighting two particular aspects.[9] First, the transaction costs banks face matter for equilibrium bank flows and for the allocation of capital across countries. Second, the relationship between openness as well as financial development of a country and capital flows is, in general, not linear. When a capital

[9]See, for example, Mendoza, Quadrini and Ríos-Rull (2009) and Antras and Caballero (2009).

scarce country liberalizes its banking sector and domestic banks become more efficient, it can experience a capital outflow. This result depends on the market structure and the nature of the transaction costs banks face, micro-level aspects which deserve more consideration in future research.

More related literature Most papers in the cross-border banking literature either rely conceptually on portfolio theory to explain banks' international linkages (Walter (1981), Buch, Koch and Koetter (2009), Bruno and Shin (2012)) or the structure of foreign bank operations is exogenous. (for example, Dell'Ariccia and Marquez (2010), Niepmann and Schmidt-Eisenlohr (forthcoming)). There are works that discuss different internationalization strategies of banks (see Aliber (1984), Grubel (1989), Williams (1997), Berger (2007)) but only a few papers, in addition to this paper, propose alternative theoretical models that do not build on asset diversification to explain cross-border banking.

In de Blas and Russ (2012), a study of the impact of financial integration on loan pricing, firms send out loan applications randomly to a limited number of banks, also applying at foreign banks to minimize expected costs. In de Blas and Russ (2010), an earlier version, firms love variety in loans so that banks offer differentiated products just as manufacturing firms. Ennis (2001) assumes that information problems are reduced when banks operate across regions. In Eaton (1994), financial centers emerge because authorities differ in their preferences for protecting debtors as opposed to creditors and in their need for seignorage revenues. It is the only work that provides an explicit theory to predict the geography of where financial firms invest and raise funds.

The empirical literature on cross-border banking is more extensive than the theoretical contributions. Exploring the omitted effects of differences in endowments and differences in

banking sector efficiencies between countries on banks' foreign positions, this paper confirms earlier empirical findings that institutions matter (see Papaioannou (2009)) and that banks invest more in foreign countries that have higher GDP, fewer capital controls, and lower bank entry barriers and that are closer in distance and culture (see, e.g., Buch (2003); Buch (2005); Focarelli and Pozzolo (2005); Buch and Lipponer (2007); Claessens and Van Horen (2008)).[10] Bank-to-bank versus direct lending has not been investigated.

The paper is organized as follows: section 2 presents background facts, section 3 introduces the closed economy setup, section 4 studies the open economy, section 5 discusses empirical evidence, and section 6 concludes.

2 Background Facts

2.1 Aggregate facts

Banks' foreign activities are large and have been growing over time. Figure 1 shows the evolution of the aggregate foreign asset holdings of 25 BIS reporting countries. The increase in foreign assets after 1998 has been substantial both as a fraction of world GDP and compared to the increase in international trade during the same period.[11] A closer look at the data reveals that they increased to a similar extent in destination countries of every income group.

The largest part of foreign assets is held in the non-bank private sector. In 2009, the 25 reporting countries had on average 55 percent of their foreign assets in a given destination country invested in the private sector. 29 percent of foreign claims reflected assets vis-à-vis other banks and around 16 percent vis-a-vis the public sector. This sectoral split has remained

[10] See, e.g., Goldberg (2007) and Cull and Martinez Peria (2010) for a review of the empirical literature.
[11] See Committee on the Global Financial System (2010*b*).

largely stable over time.[12] Data from Deutsche Bundesbank with information on German banks in the year 2005 also provide statistics on the sectoral split of liabilities. For German banks, borrowing from foreign banks is more important than borrowing from foreign depositors: the share of bank liabilities was 61 percent in 2005 compared to non-bank-private liabilities that accounted for 29 percent of total foreign liabilities.[13]

2.2 Heterogeneity across countries

The foreign activities of banking sectors differ considerably in several respects. In the following, I review three dimensions of heterogeneity that have been discussed in the literature.

Global versus international One dimension of heterogeneity is the extent to which banking sectors engage in international and global banking. Researchers at BIS have distinguished between an international and a global funding model. In international banking, a bank raises capital in its domestic market and lends it to a foreign market. In global banking, in contrast, a bank obtains funds through foreign affiliates in a foreign market and intermediates them locally.

There is heterogeneity in the extent to which banking sectors follow the global or the international model, which is illustrated in figure 2. It shows the ratio of foreign assets that are held on the balance sheets of affiliates located in the respective destination country in total foreign assets. In terms of the language of the BIS statistics, it displays the share of local assets in foreign assets in the year 2009 of different banking sectors.[14] While Spanish banks operate mainly through foreign affiliates (more than 65 percent of all assets are held by foreign affiliates), German banks conduct international business predominantly from home;

[12]The share of assets invested in the non-bank private sector tends to be higher in lower income countries compared to high income countries.

[13]For a description of the data from BIS and Deutsche Bundesbank, see section 5.

[14]The data that underly figures 2 and 3 were kindly provided by the Bank for International Settlements.

more than 80 percent of their foreign assets are held by banks located in Germany. This difference suggests that Spanish banks engage more in global banking, while German banks do more international banking. McCauley, Ruud and Wooldridge (2002) and McCauley, McGuire and von Peter (2012) point out that banking sectors, in general, have been following increasingly the global model rather than the international model, a phenomenon they call the "globalisation of international banking".

Liability-asset gaps A related dimension of heterogeneity is the heterogeneity in foreign liability-asset gaps across banking sectors that capture how much of the foreign activities of banks are funded through liabilities in the same country. Differences in liability-asset gaps have been related to the stability of foreign bank operations. Researchers have indicated that lending that is funded locally was more stable during the recent financial crisis (see Herrero and Martinez Peria (2007), Cetorelli and Goldberg (2011), and de Haas and van Lelyveld (2011)) and that the related rollover risk is lower (see Cerutti (2013)). Under a pure global funding model, the liability-asset gap of a banking sector should be 1. Under an international funding model, it should be 0. Figure 3 shows that the ratio of assets to liabilities varies considerably across banking sectors. Figures 2 and 3 together highlight that liability-asset gaps and the degree to which banking sectors operate through foreign affiliates are correlated.

Foreign bank participation Heterogeneity can also be analyzed from the point of view of a destination country. Claessens and van Horen (2012) study variation in foreign bank participation across countries, which is measured as the share of lending by foreign banks in total lending in a given country. Figure 4 displays the varying degrees of foreign bank participation in the year 2009.[15] While foreign banks do not play a major role in advanced

[15]The figure is based on data from Claessens and van Horen (2012), which was kindly provided by the authors.

countries, they are pivotal in Emerging Europe, especially, and also in many African and Latin American countries. In Estonia, Jamaica and Zimbabwe, for example, more than 95 percent of the domestic lending is done by foreign banks.

The three dimensions of heterogeneity have been studied in the aforementioned works without relying on an explicit theoretical model and more or less in isolation. This paper presents a model that can jointly explain them.

3 The Closed Economy Model

The closed economy is endowed with capital K and labor L. Capital is owned by K capitalists. Each of them has the choice between becoming a depositor or becoming an entrepreneur at the beginning of the first period. If a capitalist decides to become a depositor, he supplies his unit of capital to a bank and receives a return on the investment in the second period, when production and consumption take place. For a depositor to be willing to invest in a bank, he has to receive at least his outside option $1 + r$, which corresponds to the financial interest rate of the economy and is endogenously determined.

If a capitalist chooses to become an entrepreneur, he uses a fixed amount of capital $z > 1$ and a flexible amount of labor ℓ to produce a single consumption good.[16] All entrepreneurs operate the same constant returns to scale technology. The production function is denoted by $F(\ell, z)$ and is assumed to be continuous, strictly increasing, and concave in ℓ. The price of the consumption good is normalized to 1.

An entrepreneur can invest a fraction y of his capital in the firm (internal capital). He supplies the rest $1-y$ to banks like depositors. Moreover, he borrows additional external capital

[16]It is possible to endogenize the capital input by adding a moral hazard problem along the lines of Ju and Wei (2010).

$x = z - y$ from banks, which act as intermediaries between depositors and entrepreneurs. Banks are perfectly competitive and collect a fee c from entrepreneurs for their services proportionate to the size of the loan x. The magnitude of c characterizes the efficiency of the banking sector in the economy.[17]

Firms are symmetric and perfectly competitive. They employ the same fixed amount of capital z and labor ℓ in equilibrium. Capital-market clearing therefore implies that the number of firms is $N = K/z$. Labor-market clearing further ensures that $\ell = L/N$. The returns to the production factors are determined by their marginal products. The gross return to capital R and the wage rate w are given by:

$$R = 1 + F_z(z, \ell) = 1 + F_z(1, z/\ell) = 1 + F_K(1, K/L) \text{ and } w = F_\ell(z, \ell) = F_L(1, K/L). \quad (1)$$

Thus the gross return to capital and the wage rate are functions of the aggregate capital-labor ratio in the economy. While labor receives the wage, the return to capital R goes to the entrepreneur, who pays the bank and, implicitly, the depositors.

Taking the gross return to capital R and the interest rate $1 + r$ as given, the entrepreneur optimally chooses how much of his capital endowment to invest in the firm and how much to deposit with banks:

$$\pi = zR - c(z - y) - (1 + r)(z - y) + (1 + r)(1 - y) \quad (2)$$

$$s.t. \;\; y \leq 1. \quad (3)$$

Because the entrepreneur can save on intermediation costs, he invests his entire capital endow-

[17] The service fee can be interpreted as the cost of monitoring as in Holmstrom and Tirole (1997). Alternatively, it can be understood as the joint cost of collecting deposits and making loans to firms.

ment of 1 in the firm and raises $z-1$ units of external capital.

With ℓ, R, and w pinned down, the financial interest rate $1+r$ remains to be determined. Because capitalists can choose freely between becoming an entrepreneur or a depositor, they must be indifferent between the two occupations in equilibrium.[18] Therefore:

$$\pi = zR - c(z-1) - (1+r)(z-1) = (1+r). \tag{4}$$

The free-entry condition can be solved for the financial interest rate, which delivers:

$$1 + r = R - c\frac{z-1}{z} = (1 + F_K(K/L)) - c\frac{z-1}{z}. \tag{5}$$

The financial interest rate in the economy is a function of endowments and of banking sector efficiency, the two objects that are allowed to differ in the open economy. The scarcer capital K is in the economy relative to labor L, the higher the gross return to capital and the higher the interest rate. The fact that entrepreneurs cannot source capital directly from depositors and that financial intermediation is costly drives a wedge between the marginal product of capital and the interest rate. In economies with a higher intermediation cost c, financial interest rates are more depressed.

[18] The service fee c that banks demand is assumed to be sufficiently small so that financial intermediation and production are beneficial in the economy.

4 The Open Economy Model

4.1 Setup

In the open economy, two countries 1 and 2 can differ in their relative endowments of capital and labor as well as in their banking sector efficiencies. Workers, entrepreneurs, and depositors are assumed to be immobile.[19] Banks, however, can lend to foreign firms, and they can raise capital from foreign depositors. Both these activities are costly. If a bank in country $j \in \{1, 2\}$ lends to firms in country $i \in \{1, 2\}$, where $i \neq j$, it incurs the additional cost τ_{ij} proportionate to the size of the loan. If a bank from country j borrows abroad, it has to pay an amount t_{ij} plus the interest rate for each unit of capital it raises from foreign depositors. While loans can be extended quite easily to firms without a foreign representation, borrowing from abroad often requires a physical presence in the foreign market.[20] In this respect, τ_{ij} and t_{ij} can broadly be seen as reflecting country i's degree of capital account liberalization and banking sector liberalization, respectively. A higher degree of capital account openness implies lower barriers for cross-border capital flows and investment, while banking sector liberalization eliminates hurdles for foreign banks to set up branches and subsidiaries and to engage in the same business as domestic banks.[21]

[19] In reality, financial investors are mobile. However, some investor capital may become mobile only through banks. This should be true in particular for deposits, which represent an important funding source for banks.

[20] Foreign banks in the U.S., for example, have to establish a subsidiary so that they can take deposits while lending can be conducted through a branch or from abroad. Moreover, a local affiliate may be needed to run a retail business, which requires more frequent interactions with customers, the installation of cash machines and the like.

[21] There may be synergies between borrowing from depositors and lending to firms in the same country, which could be accommodated in the model. For example, a physical presence abroad may not only allow banks to raise foreign deposits but may also facilitate lending to firms in that country. Here, it is assumed that the costs are additive. If a bank from country j lends capital raised in the foreign country to firms in the foreign country, the total cost an entrepreneur in country i has to pay is $c_j + \tau_{ij} + 1 + r_i + t_{ij}$.

4.2 International banking, global banking, and foreign sourcing

Entrepreneurs choose between the services of foreign and domestic banks, maximizing profits by minimizing the cost of external capital. Taking intermediation fees, interest rates, and the transaction costs τ and ϕ as given, an entrepreneur in country $i \in \{1, 2\}$ compares the costs of the following four options. First, he can choose to use a domestic bank that raises capital at home. In this case, he pays $c_i + 1 + r_i$ per unit of capital borrowed. Second, he may be served by a foreign bank that takes deposits in its home country, which implies paying:

$$c_j + \tau_{ij} + 1 + r_j. \tag{6}$$

Third, he could use a bank from country j that sources capital in country i. He then pays:

$$c_j + \tau_{ij} + 1 + r_i + t_{ij}. \tag{7}$$

Finally, he has the option to borrow from a domestic bank that sources capital in country j:

$$c_i + 1 + r_j + t_{ji}. \tag{8}$$

The four options are illustrated in figure 5. Each of them is reflected differently in the foreign assets and liabilities on the balance sheets of the two banking sectors. Option 1 corresponds to purely *domestic banking*. If entrepreneurs in country i prefer domestic banks that raise capital at home, banking sector j operates only at home. Its foreign assets A_{ij} and foreign liabilities LI_{ij} are zero. The other three options, in contrast, each correspond to a specific type of banking across borders.

If entrepreneurs choose the second option, banking sector j engages in *international banking*: banks from country j lend domestic capital to firms in country i. Consequently, banking sector j holds positive foreign assets A_{ij} but no foreign liabilities LI_{ij} on its balance sheet.

If entrepreneurs in country i prefer the third option, banking sector j does *global banking*. Then banks from country j raise capital in country i and invest that capital in firms in country i. All foreign assets are financed by foreign capital; therefore $A_{ij} = LI_{ij}$.

The fourth option is denoted as *foreign sourcing*. In this case, banking sector i borrows abroad for investment at home. This process is just the opposite of international banking. As a consequence, banking sector i holds no foreign assets but only foreign liabilities, $L_{ji} > 0$.

When banks engage in the different activities, banking sectors expand or contract in size and capital flows across borders. It is assumed that banking sectors become capacity constrained as they expand. The monitoring cost that banking sector j incurs increases with the volume of foreign deposits D_{ij} it intermediates.[22] Precisely:

$$c_j(D_{ij}) = a_j(1 + \frac{D_{ij}}{K_j})^{\gamma}, \tag{9}$$

where $\gamma > 0$.[23] The exogenous cost parameter a_j indicates inversely the efficiency of banking sector j. The more banking sector j borrows abroad reflected in D_{ij}, the higher the service fee that it demands from entrepreneurs. The functional form implies that the expansive capacity of a banking sector is positively related to the size of the domestic capital endowment. Larger banking sectors can absorb more foreign deposits, ceteris paribus. Note that D_{ij} can be nega-

[22]It is assumed that the efficiency of a banking sector responds to the volume of foreign deposits it intermediates. Alternatively, efficiency could decline in the total volume. However, the total volume changes with international capital flows. To see this, note that the deposits that banking sector j intermediates are given by $D_j = D_{ij} + K_j - (K_j - K_{ij})/z$, where the last term corresponds to firm capital in the economy. As capital flows, the number of entrepreneurs versus depositors within a country adjusts, and the volume changes. For tractability, this effect is switched off.

[23]A specific form is assumed for illustrative purposes. It is only required that c_j strictly increases in D_{ij}.

tive.[24] In this case, banking sector i intermediates deposits of country j, making banking sector j's intermediation costs decline.

Banking across borders can also lead to a reallocation of capital, which affects the gross returns to capital in the two countries. Let K_{ij} denote the capital flow from country j to country i. It consists of the capital K_{ij}^{j} that banking sector j channels from country j to country i as well as the capital K_{ij}^{i} that banking sector i raises in country j and lends to firms in country i so that $K_{ij} = K_{ij}^{j} + K_{ij}^{i}$. Thus:

$$R_i = 1 + F_K\left(1, \frac{K_i + K_{ij}}{L_i}\right). \tag{10}$$

K_{ij} can be negative, which implies that the direction of the capital flow is reversed.[25] The more capital flows into country i and is used in production there, the lower the gross return to capital R_i. At the same time, the gross return to capital R_j increases.

If banking sectors engage in banking across borders, not only monitoring costs and returns to capital change; interest rates change, as well. This is because:

$$1 + r_j = R_j(K_{ij}) - c_j(D_{ij})\frac{z-1}{z}. \tag{11}$$

The three different activities imply different adjustments in monitoring costs, returns to capital and interest rates. When banking sector j engages in international banking, capital relocates. The return to capital and, hence, the interest rate decline in country i and, at the same time, rise in country j. Monitoring costs, in contrast, remain unchanged.

[24] In the next section, it is shown that only one banking sector takes deposits abroad in equilibrium so that it is possible to define $D_{ji} = -D_{ij}$.

[25] Capital always flows in one direction in equilibrium as shown in the next section. Therefore, I can set $K_{ji} = -K_{ij}$.

Under global banking, capital flows are zero. Therefore, capital returns remain the same but monitoring costs adjust. When banking sector j engages in global banking, the interest rate decreases in country j while it increases in country i. With foreign sourcing by banking sector j, both things happen at the same time: the gross return to capital decreases in country j and the monitoring cost of banking sector j rises. Therefore, country j's interest rate goes down (vice versa in country i).

In each case, banking across borders becomes less attractive to foreign entrepreneurs the more banking sectors engage in it. This is the key mechanism that ensures that an equilibrium exists.

4.3 Equilibrium definition

The equilibrium of the open economy is determined by two variables: the cross-border capital flow K_{ij} and foreign deposits D_{ij}. Equilibrium foreign assets and liabilities of the two banking sectors are functions of these two variables and are pinned down simultaneously. An equilibrium in the open economy corresponds to a situation in which the capital flow K_{ij} and foreign deposits D_{ij}, as well as the implied service fees and interest rates in the two countries, are consistent with the choice of the entrepreneurs.

The preferences of entrepreneurs in country i are indicative of the preferences of entrepreneurs in j. As summarized in lemmas 1 and 2, we can exclude the possibility that entrepreneurs in the two countries choose option 2 or options 3 and 4 at the same time.[26]

Lemma 1 *The two banking sectors cannot both engage in international banking at the same time. Therefore, capital always flows in one direction.*

[26]The result that capital always flows in one direction would change if a portfolio motive were included in the model. With risk-averse capitalists and shocks that are less than perfectly correlated across countries, both banking sectors would always hold positive foreign assets and liabilities.

Proof. If $c_i + \tau_{ji} + 1 + r_i \leq c_j + 1 + r_j \Rightarrow c_j + \tau_{ij} + 1 + r_j + > c_i + 1 + r_i$. ■

Lemma 2 *The two banking sectors cannot both engage in global banking or foreign sourcing at the same time. Therefore, only one banking sector takes foreign deposits.*

Proof. If $1 + r_i \geq 1 + r_j + t_{ji} \Rightarrow 1 + r_i + t_{ij} > 1 + r_j$. ■

Using lemma 1 and lemma 2, the equilibrium is defined as follows:

Definition 1 *An equilibrium in the open economy is characterized by the cross-border capital flow K_{ij}, which consists of the capital that is channeled across borders by banking sector i K_{ij}^i and by banking sector j K_{ij}^j, and the depositor capital of country i that is intermediated by banking sector j D_{ij} for which the following conditions hold:*

1. *Capitalists in each country are indifferent between becoming entrepreneurs and depositors (free entry).*

2. *Capital markets clear.*

3. *Labor markets clear.*

4. *Entrepreneurs choose optimally between domestic and foreign banks and domestic and foreign capital, maximizing profits.*

5. *The cross-border capital flow K_{ij} and the implied gross-returns to capital in the two countries are consistent with the demand for foreign banking services and foreign capital.*

6. *Foreign deposits D_{ij} and resulting intermediation fees in the two countries are consistent with the demand for foreign banking services and foreign capital.*

Six conditions determine the equilibrium as stated in definition 1. Free entry, capital-market clearing and labor-market clearing are required as in the closed economy. The free-entry condition pins down the interest rate $1 + r_j$. As before, it is a function of the marginal product of capital and banking sector efficiency in country j (see equation 11). Capital-market clearing implies that $(K_i + K_{ij}) = N_i z$ for $i, j \in \{1, 2\}, i \neq j$. Under labor-market clearing, $L_i = N_i z$ for $i \in \{1, 2\}$ must hold.

The fourth condition reflects profit maximization: entrepreneurs choose optimally among domestic banking, international banking, global banking, and foreign sourcing. The fifth and sixth condition demand that interest rates and service fees implied by the decisions of the entrepreneurs must coincide with those that they take as given when choosing between banks and funding sources.

The paper focuses on interior solutions in which both banking sectors operate and intermediate deposits locally at home.[27] Thus banks engage in the different foreign activities in addition to domestic borrowing and lending. In an interior equilibrium, entrepreneurs must be either indifferent between domestic and foreign banks and/or domestic and foreign capital or they prefer domestic banks and/or domestic capital.

International banking data contain information on the foreign assets and liabilities of banks or banking sectors in different countries. In the following, I therefore characterize the equilibrium in terms of these variables that map into the three activities (international banking, global banking and foreign sourcing), focussing on the perspective of banking sector j and deriving predictions regarding its foreign positions as functions of source country j and destination coun-

[27] Equilibrium foreign deposits D_{ij} must be smaller than the total depositor capital in country i, which is $K_i - N_i$, and larger than $K_j - N_j$. In general, this requires an assumption about country sizes and monitoring cost parameters. However, for any country size and cost parameters a sufficiently high γ guarantees an interior solution.

try i characteristics. The results of comparative statics can then be brought directly to the data.

4.4 Equilibrium and comparative statics

The equilibrium always exists and is unique. It corresponds to one of the cases described in the next proposition. Details of the proof are given in appendix A.

Proposition 1 *The equilibrium always exists and is unique. It corresponds to one of the following cases where* $i, j \in \{1, 2\}$ *and* $i \neq j$*:*

1. *No trade:* $A_{ij} = LI_{ij} = A_{ji} = LI_{ji} = 0$, $\frac{LI_{ij}}{A_{ij}} = \{\}$.
2. *International banking* j*:* $A_{ij} > 0$, $LI_{ij} = A_{ji} = LI_{ji} = 0$, $\frac{LI_{ij}}{A_{ij}} = 0$.
3. *Foreign sourcing* j*:* $A_{ij} = A_{ji} = LI_{ji} = 0$, $LI_{ij} > 0$, $\frac{LI_{ij}}{A_{ij}} = \{\}$.
4. *International and global banking* j*:* $A_{ij} > 0$, $LI_{ij} > 0$, $A_{ji} = LI_{ji} = 0$, $\frac{LI_{ij}}{A_{ij}} < 1$.
5. *Foreign sourcing and global banking* j*:* $A_{ij} > 0$, $LI_{ij} > 0$, $A_{ji} = LI_{ji} = 0$, $\frac{LI_{ij}}{A_{ij}} \geq 1$.
6. *International banking* j *and foreign sourcing* i*:* $A_{ij} > 0$, $LI_{ij} = 0$, $LI_{ji} > 0$, $A_{ji} = 0$, $\frac{LI_{ij}}{A_{ij}} = 0$.

Proof. See appendix A. ■

Figure 6 is useful in illustrating the different equilibrium cases and shows when each of them occurs. It displays the equilibrium case as a function of differences in endowments $\Delta(K/L) = K_j/L_j - K_i/L_i$ and of differences in banking sector efficiencies $\Delta a = a_i - a_j$ between countries. As $\Delta(K/L)$ increases, country j becomes more capital abundant relative to country i. As Δa goes up, banking sector j gets relatively more efficient.

In a region where endowments and banking sector efficiencies are very similar in the two countries, entrepreneurs prefer domestic banks and domestic capital at autarky interest rates, given positive transaction costs, and there is no trade.

Consider now what happens as $\Delta(K/L)$ increases, that is, as country j becomes capital abundant relative to country i. Then, banking sector j engages in international banking in equilibrium. It lends domestic capital to foreign firms to equilibrate gross returns to capital between countries. As $\Delta(K/L)$ declines, implying that country j becomes capital scarce, banking sector i does international banking in turn.

Next, let Δa increase, so that banking sector j becomes more efficient than banking sector i. Start from the right corner of the graph where country j is capital abundant relative to country i. Then banking sector j not only engages in international banking but also in global banking. In addition to investing in firms in country i to reap higher returns to capital, banking sector j also intermediates foreign capital locally because it can offer lower fees than local banks. As $\Delta(K/L)$ declines, the equilibrium transitions from international banking and global banking to foreign sourcing and global banking. Instead of exporting capital, banking sector j now imports capital in addition to engaging in global banking. As $\Delta(K/L)$ declines further, banking sector j channels more and more capital back home. At some point, the banking sector no longer engages in global banking but only in foreign sourcing. The foreign deposits that banking sector j invests at home are so large that the service fees charged increase to the extent that it can no longer offer attractive conditions to firms in country i. As country j becomes even capital scarcer relative to country i, banking sector j no longer manages to channel capital across borders on its own. Then banking sector i engages simultaneously in international banking (case 6).

While differences in endowments determine the direction of the capital flow, relative banking sector efficiencies determine which banking sector channels capital across borders and to what extent. With stark differences in banking sector efficiencies but relatively small differences in endowments, expansionary capacity still remains so that the more efficient banking sector also intermediate foreign deposits and engages in global banking. Put differently, international banking arises from differences in factor endowments, whereas global banking is driven by differences in banking sector efficiencies.[28] (Pure global banking corresponds to the area where the equilibrium transitions from case 4 to 5.) In general, however, the two driving forces of banking across borders work together, and banks may engage simultaneously in different activities. Foreign sourcing occurs if the capital-scarce country hosts a relatively efficient banking sector.

Figure 6 illustrates how differences in efficiencies and differences in endowments determine which type of banking across borders banking sectors engage in and implicitly shows how the foreign assets and liabilities of the two banking sectors vary across equilibrium types. For complete results of the comparative statics one also needs to analyze how assets and liabilities change at the margin within an equilibrium type. All effects go in the same direction. Combining the results of comparative statics within and across equilibrium cases yields the following propositions:

Proposition 2 *Foreign assets A_{ij} weakly increase in the difference in relative endowments $\Delta(K/L) = K_j/L_j - K_i/L_i$ and in the difference in banking sector efficiencies $\Delta a = a_i - a_j$.*

Proof. See appendix A. ■

Proposition 3 *Foreign liabilities LI_{ij} weakly decrease in the difference in relative endowments*

[28]This point is also illustrated by means of the simpler model discussed in appendix B, where $\gamma = 0$, which implies that monitoring costs are constant in the open economy.

$\Delta(K/L) = K_j/L_j - K_i/L_i$ *and weakly increase in the difference in banking sector efficiencies* $\Delta a = a_i - a_j$.

Proof. See appendix A. ■

The larger the capital endowment of country j is relative to country i, the larger foreign assets held by banking sector j are in country i. Ceteris paribus, banking sector j needs to invest more capital abroad until interest rates adjust to make entrepreneurs indifferent between domestic and foreign capital and banks. Following the same logic, foreign liabilities of banking sector j decrease in the capital abundance of country j. As $\Delta(K/L)$ increases, the interest rate in country j goes down relative to the one prevailing in country i. Therefore, banking sector j is less likely to raise deposits in country i and foreign liabilities LI_{ij} are smaller.

The effects of Δa on assets and liabilities go in the same direction. The more efficient banking sector j is relative to banking sector i, the more it expands abroad, both by investing and by taking deposits in the foreign market. Therefore, both foreign assets and liabilities increase in the efficiency advantage of banking sector j over i.

Comparative statics can also be conducted with respect to the foreign liability-asset gap, measured as the ratio of foreign liabilities to foreign assets L_{ij}/A_{ij}. The gap shows whether a banking sector imports or exports capital and is, at the same time, a measure of the relative importance of the different activities. The closer the ratio L_{ij}/A_{ij} is to 1, the more foreign assets are financed by foreign liabilities, indicating that banks engage mostly in global banking. The ratio gets small and is below 1 as banking sector j mostly exports capital and engages in international banking. It grows large and exceeds 1 if banking sector j mostly imports capital and foreign sourcing is its main activity.

The more capital abundant country j is relative to country i, the more foreign assets banking sector j finances with domestic liabilities. The ratio L_{ij}/A_{ij} therefore decreases in $\Delta(K/L)$. The effect of differences in efficiencies Δa depends on whether a banking sector is a capital importer or a capital exporter. The ratio increases in Δa if the equilibrium capital flow K^*_{ij} is positive and decreases in the variable if $K^*_{ij} < 0$. To see this, note that $LI/A_{ij} = D^*_{ij}/(D^*_{ij} + K^*_{ij})$.[29]

Proposition 4 *The ratio of foreign liabilities to foreign assets LI_{ij}/A_{ij} weakly decreases in the difference in relative endowments $\Delta(K/L) = K_j/L_j - K_i/L_i$. It increases in the difference in efficiencies Δa if $K^*_{ij} > 0$ and decreases in Δa if $K^*_{ij} < 0$.*

Proof. See appendix A. ■

The model also allows me to study the effects of capital account and banking sector liberalization on banks' foreign positions. Intuitively, assets and liabilities of banking sector j in country i increase if capital accounts and banking sectors are liberalized in country i. Financial liberalization abroad reduces the disadvantage that banking sector j faces in raising deposits and lending to entrepreneurs in country i compared to local banks. If country j reduces impediments to capital account transactions and bank entry barriers, the effect is opposite. Foreign assets A_{ij} and foreign liabilities LI_{ij} decrease as banking sector j become more exposed to foreign competition.

An additional assumption is needed for assets to decrease in t_{ij} and increase in t_{ji}. To understand why, consider the equilibrium in which banking sector j engages in international and global banking. As t_{ij} goes down, banking sector j takes more deposits in country i and D^*_{ij} increases. As a result, intermediation costs and interest rates in the two countries change, affecting the equilibrium capital flow, which goes down.[30] Foreign assets are the sum

[29] Asterisks denote the equilibrium values of D_{ij} and K_{ij}, respectively.
[30] See the section 4.5 for model implications of capital flows.

of deposits and the capital flow, $A_{ij} = D^*_{ij} + K^*_{ij}$. For assets to increase as country i liberalizes, foreign deposits must increase more than the capital flow declines or $|\frac{dD^*_{ij}}{dt_{ij}}| = |\frac{dD^*_{ij}}{dt_{ji}}| > |\frac{dK^*_{ij}}{dt_{ij}}| = |\frac{dK^*_{ij}}{dt_{ji}}|$. Note that for any parameter combination, there exists a sufficiently high z such that the condition is satisfied.

Proposition 5 *Foreign assets A_{ij} and liabilities LI_{ij} weakly decrease in impediments to capital account transactions in the host country τ_{ij}. Foreign liabilities weakly decrease in bank entry barriers in the host country t_{ij}. Foreign assets weakly decrease in bank entry barriers in the host country t_{ij} for sufficiently high z.*

Proof. See appendix A. ■

Proposition 6 *Foreign assets A_{ij} and liabilities LI_{ij} weakly increase in impediments to capital account transactions in the home country τ_{ji}. Foreign liabilities weakly increase in bank entry barriers in the home country t_{ji}. Foreign assets weakly increase in bank entry barriers in the home country t_{ji} for sufficiently high z.*

Proof. See appendix A. ■

4.5 Discussion

The proposed model of trade in banking services delivers close theoretical equivalents of endogenous objects observed in international banking data. This is fruitful in several regards.

Explaining heterogeneity The model can explain the three dimensions of cross-country heterogeneity in banking across borders discussed in section 2. It rationalizes banking sectors' choices to follow the global or the international funding model and points out that a third

funding model, namely foreign sourcing, can be distinguished. According to the theory, banking sectors of capital-abundant countries with intermediate banking sector efficiencies engage mostly in international banking. Countries that have very efficient banking sectors but endowments similar to those in other countries engage mainly in global banking.[31] Variation in foreign liability-asset gaps, which have been related to the stability of foreign bank operations, is explained accordingly.

Foreign bank participation, analyzed empirically in Claessens and van Horen (2012), also has a theoretical counterpart in the model. Measured as the share of lending conducted by foreign banks in total lending in a given country, it can be defined as:

$$FBP_{ij} = \frac{\text{foreign loans}}{\text{total loans}} = \frac{A_{ij}}{K_i + K_{ij}^*}. \tag{12}$$

The model predicts that countries that are investment targets and host relatively inefficient banking sectors exhibit particularly high degrees of foreign bank participation.

Gravity relationship and banking statistics Several works in the international finance literature use international banking data to estimate gravity equations.[32] Okawa and van Wincoop (2012) show that a gravity relationship is not robust theoretically in international portfolio models. This paper gives an additional argument for why a one-to-one relationship between foreign assets and size should not hold. The fact that banks also engage in global banking (i.e., they expand abroad by raising capital in the host market) weakens the link

[31]The "globalization of international banking" discussed in McCauley, Ruud and Wooldridge (2002) can be explained within the framework of the model if banking sector liberalization preceded capital account liberalization. Banking sector liberalization is actually a more recent phenomenon than capital account liberalization, starting around 1995 when the General Agreement on Trade and Services (GATS) came into force. See e.g. Chinn and Ito (2008).

[32]See Aviat and Coeurdacier (2007), Buch, Koch and Koetter (2009), and Brüggemann, Kleinert and Prieto (2011).

between the size of the source country and foreign asset holdings and makes the size of the destination market matter more, creating an asymmetric relationship.[33] Such an asymmetry should show up especially in consolidated banking data, which include the claims of foreign affiliates and therefore reflect all three activities, international banking, global banking and foreign sourcing.

Capital flows The model also predicts international capital flows.[34] They are the sum of the activities of both banking sectors.[35] The framework highlights, in particular, three aspects. First, the costs that financial intermediaries face when operating abroad affect capital flows in non-trivial ways. Second, capital account and banking sector liberalization have a differential effect on capital flows. Third, the relationship between financial development (in terms of increased banking sector efficiency) and capital flows is, in general, not linear.

In the model, capital should flow from the capital-abundant to the capital-scarce country to equalize gross returns to capital and maximize world production. However, financial frictions in the form of intermediation costs and transaction costs from lending and borrowing across borders lead to substantial deviations from this rule. In equilibrium, capital is allocated such that the country with lower banking sector efficiency employs more capital in domestic production than equalization of marginal products of capital would prescribe. In other words, too much capital is flowing into the financially underdeveloped country. This happens because, in equilibrium, entrepreneurs must be indifferent between domestic and foreign banks. A high monitoring fee must be offset by a high interest rate and vice versa.

[33] In the simpler version of the model discussed in appendix B, an explicit equation for assets is derived that illustrates this point.

[34] Bank flows are an important component of international capital flows. See, for example, Milesi-Ferretti and Tille (2011). The theory also applies more generally to nonbank financial intermediaries that borrow and lend abroad.

[35] Gross flows are equal to net flows. Gross flows are determined because channeling capital across border is costly and prevents any round-tripping of funds.

As banking sectors liberalize and monitoring costs adjust, capital flows out of the financially underdeveloped country, and marginal products of capital become more equal. Thus banking sector liberalization in country i decreases the capital flow K_{ij}^*. Capital account liberalization, in contrast, increases it. When cross-border lending becomes less costly, banks channel more capital to the capital-scarce country. To the best of my knowledge, this paper is the first to analyze banking sector liberalization separately from capital account liberalization. The theory shows that the distinction matters given that the two types of financial liberalization have differential effects as summarized in proposition 7.

Proposition 7 *The equilibrium capital flow K_{ij}^* weakly decreases in impediments to capital account transactions τ_{ij}. It weakly increases in bank entry barriers t_{ij}.*

Proof. The proof follows immediately from the comparative statics results within and across equilibria derived in the proofs of propositions 5 and 6. ■

The relationship between the levels of banking sector efficiency and capital flows is complex and, in general, not linear. Figure 6 is a useful illustration of that relationship. Start from a situation in which banks in country j engage in international banking, i.e. $K_{ij}^* > 0$. As Δa goes down, banking sector j becomes relatively less efficient and is therefore able to channel less capital across borders. As a consequence, K_{ij}^* decreases. At some point, the no-trade equilibrium occurs, and the capital flow is zero. As banking sector efficiency in country j declines even more, the local interest rate declines. As a consequence, country j becomes more attractive as a funding market for banking sector i. With a sufficiently low interest rate in country j, banking sector i starts to engage in foreign sourcing, and K_{ij}^* becomes positive again. These results depend on the market structure and the way costs are modeled.[36] More

[36]If banks were reaping the entire gross return to capital instead of the entrepreneurs, they would always allocate capital such that gross returns equalize.

broadly, these results argue for a closer investigation of the vehicles of international capital flows and the nature of financial frictions.

4.6 Interbank lending

The model assumes that banks borrow directly from foreign depositors and abstracts from the fact that banks may also extend loans to and obtain funding from other banks. In the data, interbank lending and borrowing are important components of foreign bank lending and borrowing (see section 2).

The model can be reinterpreted to accommodate interbank lending. Assume that banks do not borrow directly from depositors but that they raise foreign funding only through foreign banks. Then the cost of cross-border borrowing corresponds to the cost of borrowing from foreign banks. The variable D_{ij} also needs to be reinterpreted. D_{ij} now stands for the deposits that banks in country j raise from banks in country i and, at the same time, for the loans that banks in country i extend to banks in country j. Banking sector i does not shrink in size when banking sector j obtains foreign funding because it still intermediates all the local deposits. Convexity in D_{ij} thus implies that the monitoring cost of banking sector j increases, the more firms it monitors and lends to. In this way, the original model can be used as a model of international interbank lending, the setup of which is illustrated in figure 7.[37]

How do the predictions of the model change? Instead of liabilities towards foreign private consumers, banking sector j now has liabilities toward foreign banks in country i. Otherwise, the original predictions regarding foreign liabilities are identical.

An additional prediction concerning banks' foreign asset positions can be derived. Banks in

[37] Interbank lending is typically motivated by liquidity risk sharing between banks. See, for example, the treatment in Freixas and Rochet (2008). The extended model provides an additional explanation for international interbank lending.

country i now hold not only domestic assets, but also potentially foreign assets A^B_{ji} in banks in country j, where $D_{ij} = A^B_{ji}$. Hence, under the alternative interpretation of the model, foreign assets A^B_{ji} increase in the efficiency advantage of banking sector j relative to banking sector i. The following corollary holds:

Corollary 1 *Foreign assets in the banking sector A^B_{ij} weakly increase in the difference in relative endowments $\Delta(K/L) = K_j/L_j - K_i/L_i$ and weakly decrease in the difference in banking sector efficiencies $\Delta a = a_i - a_j$.*

Proof. Follows directly from proposition 3. ■ In equilibrium type 6 (defined in proposition 1), where banking sector j engages in foreign sourcing while banking sector i does international banking, banking sector j now holds foreign assets both in the private sector and in the banking sector in country i. These two positions change in opposite directions as banking sector i becomes more efficient:

Corollary 2 *The ratio of foreign assets in the banking sector to foreign assets in the private sector $\frac{A^B_{ij}}{A^F_{ij}}$ weakly decreases in the difference in banking sector efficiencies $\Delta a = a_i - a_j$.*

Proof. Follows directly from proposition 2 and 3. ■ This discussion shows that the predictions of the model are robust to allowing for interbank lending. To be able to pin down and differentiate between interbank borrowing/lending and direct borrowing/lending, one would have to make assumptions about the differential costs of the two activities. This is left for future research.

5 Patterns in the Data

The theoretical model predicts how foreign bank asset and liability holdings vary with differences in factor endowments and differences in banking sector efficiencies. Following the literature (see Buch, Koch and Koetter (2009), Aviat and Coeurdacier (2007), Papaioannou (2009)), I run gravity type regressions including proxies for these two key variables to show that the model is consistent with the observed conditional correlations in the data.[38]

5.1 Data and specification

Two different sources of information on bank exposures are used in the analysis. The first dataset draws on information from the Consolidated Banking Statistics maintained by the Bank for International Settlements. The statistics provide information on the aggregate foreign assets and liabilities of around 25 reporting source countries in a large number of destination countries and show variation in i and j. The second dataset is based on the so-called Auslandsstatus-Report provided by Deutsche Bundesbank, which collects information on the foreign activities of all German banks around the globe.[39] It varies along the bank k and destination country i dimension. Regressions are based on the observed assets and liabilities towards the foreign non-bank private sector.[40]

[38] While the model also makes precise predictions about the effects of capital account liberalization and banking sector liberalization on foreign assets and liabilities, the empirical part does not investigate these explicitly. The reason is twofold. On the one hand, it is hard to distinguish sharply between barriers that matter only for domestic versus foreign banks. On the other hand, measures of bank entry barriers and impediments to cross-border lending are highly correlated.

[39] See Buch, Koch and Koetter (2011) for details on this data source.

[40] The information on foreign assets and liabilities from the BIS statistics is limited compared to the data obtained from Bundesbank. In the BIS sample, foreign assets are proxied by the international claims vis-à-vis the nonbank private sector. These exclude the claims of foreign affiliates denoted in the currency of the host market. Foreign liabilities comprise the liabilities of foreign affiliates in local currency, which may, to only a very limited extent, represent the aggregate foreign liabilities of a banking sector. They constitute about 16 percent of total foreign assets. In contrast, the Bundesbank data capture the complete consolidated positions of the reporting banks, including the claims and liabilities of affiliates in all currencies. When data from Bundesbank are used, foreign assets are proxied by the claims of bank k (excluding derivatives and securities) on the nonbank

In the model, differences in the returns to capital across countries arise from differences in factor endowments. The empirical exercise stays as close as possible to the model and uses human-capital adjusted differences in capital-labor ratios across countries as a proxy for return differences. Because observed contemporaneous capital-labor ratios are endogenous to international capital flows, they are lagged by five years. The main specification also includes a measure of property rights protection and GDP per capita to control for additional factors that affect country-level productivity.

To measure the efficiency of banking sectors, I employ a proxy from the Financial Structure Database provided by the World Bank (see Beck, Demirgüç-Kunt and Levine (2009)): a country's ratio of overhead costs to total assets. This measure is calculated from bank-level data and corresponds to the unweighted average of the ratio of overhead costs to total assets over all banks in a given country. Overhead costs collect the cost of renting and maintaining office space, computers and the like and are independent of the cost of capital, thereby preserving the distinction between funding and monitoring costs in the model. Because contemporaneous values are endogenous to the operations of foreign banks, in particular, because the efficiency measure is calculated by including also information on foreign banks, the variable is also lagged by five years.

Differences in efficiencies and endowments are computed as log differences, which allows me to interpret estimated coefficients as elasticities. Δ stands for the difference in variables between countries i and j, not for differences over time. Explicitly, $\Delta \log(K/L_{ij}) = \log(K/L_j) - \log(K/L_i)$ and $\Delta \log(\mathrm{a}_{ij}) = \log(a_i) - \log(a_j)$.

private sector in country i. Foreign liabilities are the liabilities of bank k in that sector.

Variants of the following regression are estimated:

$$\begin{aligned} \log(y_{ij[k]}) &= \delta_1 \Delta \log(a_{ij}) + \delta_2 \Delta \log(K/L_{ij}) \\ &+ X'_j\beta_j + [X'_i\beta_i] + X'_{ij}\beta_{ij} + \alpha_i + [\alpha_k] + \epsilon_{ij[k]}. \end{aligned} \tag{13}$$

The dependent variable consists of either the foreign assets, liabilities, or the ratio of liabilities to assets of bank k from country j in country i. It is regressed on the measures of differences in endowments and differences in banking sector efficiencies. In addition, recipient country i, source country j, and bilateral country variables are included. The controls can be grouped as follows: variables that proxy frictions (distance and other standard gravity variables, measures of banking sector and capital account openness), controls for the size of the banking market (GDP and the ratio of private credit by deposit money banks and other financial institutions over GDP), measures of development and institutional quality (GDP per capita, the degree of property rights protection), and other controls (a dummy for systemic banking crisis).[41]

When bank-level data are used (Bundesbank sample), bank-fixed effects (α_k) are included. When regressions are based on country-level data (BIS sample), they incorporate recipient-country-fixed effects (α_i). The interest lies in the signs of the efficiency and the endowment coefficients δ_1 and δ_2. Table 1 summarizes the relationships that should hold according to propositions 2, 3, and 4.

The period underlying the empirical analysis is the year 2005.[42] After merging information from different data sources and excluding offshore centers, the asset and liability samples comprise around 82 destination countries. The BIS datasets include information on about 20

[41] Detailed information on variables and data sources can be found in the data appendix.

[42] While BIS data are available for other years, Bundesbank data are available to me only for 2005.

source countries.[43] Summary statistics are displayed in tables 2 and 3.[44]

Figure 8 shows the overhead costs and capital-labor ratios in the year 2000 for the different countries in the sample. The two variables are correlated, but there is still substantial variation. Latin American and Eastern European countries exhibit particularly high overhead costs.

5.2 Results

Tables 4, 5 and 6 shows the regression results. Coefficients in odd columns are obtained from the BIS data, coefficients in even columns from the Bundesbank (BBK) sample. In the former case, standard errors are clustered on source countries, in the latter case on recipient countries, which corresponds to the most conservative choice. In both tables, asterisks denote the significance of the coefficients as usual. The endowment and the efficiency coefficients have daggers as superscripts, which indicate the significance levels obtained from one-sided tests.[45]

Assets Consider table 4 that shows the regression results for foreign assets. Proposition 2 predicts that foreign assets A_{ij} are larger the larger the efficiency advantage of banking sector j is and the more capital-abundant country j is relative to country i. Accordingly, the efficiency coefficient δ_1 and the endowment coefficient δ_2 should both be positive.

Baseline results are presented in columns (1) and (2). The efficiency coefficients obtained from the two datasets are significantly greater than zero. A positive efficiency coefficient in column (1) suggests that source countries with lower overhead costs hold larger assets abroad. Equivalently, the estimate of δ_1 in column (2) indicates that banks invest more in countries

[43] More information on included source and recipient countries can be found in the data appendix.

[44] Both datasets are confidential. Minimum and maximum values of $\log(\text{assets}_{ik})$ and $\log(\text{liabilities}_{ik})$ cannot be reported.

[45] If the respective coefficient is expected to be positive, two (one) daggers indicate that the hypothesis that the coefficient is smaller or equal zero can be rejected at a 5 percent (10 percent) significance level. If the sign is predicted to be negative, the underlying null hypothesis is that the coefficient is greater or equal to zero.

whose banking sectors are less efficient. The endowment coefficients are also positive and in line with the model but are not significant at standard significance levels.[46] Results become stronger when private credit over GDP is controlled for, which is a more adequate measure of the size of the banking market than the log of GDP alone (see columns (3) and (4)).[47]

The signs of the other coefficients in table 4 are in line with expectations. The magnitudes of the dummies that proxy information costs and the estimated effects of distance are similar to those reported in related studies.[48]

According to portfolio theory, banks should invest in different countries to diversify (see, e.g., Martin and Rey (2004)). To account for this, the correlation in GDP growth between countries i and j is added as a regressor in columns (5) and (6). The signs and significance of the endowment and efficiency coefficients remain basically unchanged. The coefficient that indicates diversification is negative when estimated on the German data. It is positive on the BIS data in line with findings in Aviat and Coeurdacier (2007). Results regarding the correlation puzzle are therefore mixed.

Columns (7) and (8) of table 4 account for a follow-your-customer motive.[49] The regressions include the log of the three-year lagged FDI stock of country j in country i.[50] This measure should be correlated with the financing needs of firms from country j operating in country i

[46]This partly reflects the conservative choice of the standard errors. In the Bundesbank sample, for instance, clustered standard errors implicitly assume that all bank-country observations where the recipient country is the same contain informational value of one observation. See Wooldridge (2003).

[47]This measure accounts for the fact that some countries have more market based than bank based financial systems. Endogeneity is no concern here. When BIS data is used, the issue does not arise. In addition, the share of all German banks in total lending in any of the destination country is negligible (below 0.25 percent).

[48]The dummy for systemic banking crisis in the source country does not appear in Columns (1) and (3) as there was no banking crisis in the set of source countries in 2005.

[49]Evidence in line with the follow-your-customer hypothesis is presented in, e.g., Goldberg and Saunders (1981) and Grosse and Goldberg (1991). Seth, Nolle and Mohanty (1998) find that once banks are established, they also start serving customers from countries other than their home country.

[50]There is an obvious reversed-causality problem: FDI stocks may be affected by how much money firms are able to borrow from their home banks. Therefore, lagged values (three-year lags) are used. The quality of the FDI data obtained from the Organisation for Economic Cooperation and Development (2011) to complement the BIS sample are problematic. There are many missing observations in the data. The three-year lag is the one that preserves the largest number of observations.

and therefore with the volume of lending that arises because banks serve their domestic clients abroad. Firms that are active abroad are likely to operate in locations with cheap labor, that is, with low capital-labor ratios.[51] At the same time, they come mostly from developed countries, where banking sector efficiency is high. Controlling for FDI thus checks whether results are robust to this alternative story, despite the fact that differences in endowments and differences in banking sector efficiencies interact with FDI.

Columns (7) and (8) of tables 4 indicate a strong, positive relationship between foreign direct investment and banks' foreign positions. The signs of the estimated efficiency coefficients remain unaffected by the introduction of the additional control variable. While standard errors become larger, the efficiency coefficient remains significantly positive at a 5 percent significance level based on the Bundesbank data (column (8)). Note that the larger standard errors are also due to a considerable reduction in sample size as FDI data are not available for all destination countries. The magnitudes of the endowment coefficients go down as one might expect as FDI is highly correlated with capital-labor ratios. Interestingly, when FDI is controlled for, the diversification coefficients obtained from the two datasets are both negative, taking very similar values. In column (8), the estimated coefficient is significantly negative at a 10 percent significance level, which is tentative evidence that banks diversify their loan portfolios. This indicates that diversification may only become apparent after controlling for additional drivers of banking across borders.

Liabilities According to proposition 3, foreign liabilities LI_{ij} should increase in the efficiency advantage of banking sector j relative to i. Table 5 is consistent with this hypothesis. The efficiency coefficients are all highly significant and positive. Conditional on size, frictions and

[51] Differences in labor costs drive vertical FDI, e.g., in Hanson, Mataloni and Slaughter (2005).

institutional quality, banking sectors that are more efficient raise more funds in countries that host less efficient banking sectors.

The model also predicts that liabilities decrease in the capital abundance of country j relative to i. The BIS data only capture the local liabilities of foreign affiliates so that the corresponding endowment coefficients may not be meaningful. When Bundesbank data are used (in odd columns), δ_2 is negative, consistent with the theoretical prediction, but standard errors are large.

Columns (5) and (6) control for diversification. The correlation coefficients are not significant at standard significance levels, providing no evidence for diversification of funding sources. Columns (7) and (8) include the stock of FDI as regressor.[52] The results show that FDI has a strong positive effect on the foreign liabilities of banking sectors similar to the effect on foreign assets. The efficiency and endowment coefficients are barely affected by the inclusion of the two additional variables.

Liabilities over Assets Proposition 4 states that the ratio of foreign liabilities to foreign assets decreases in the capital abundance of the source country relative to the destination country. Table 6 presents evidence on this claim. Because the dependent variable is a ratio, it should be normalized with respect to size. Therefore, the variables related to economic size (GDP and private credit over GDP) are excluded in the regressions.[53]

The estimated effect of endowment differences on the ratio of foreign liabilities to foreign assets is negative for both samples. This indicates that countries with higher capital-labor ratios have relatively more assets than liabilities in foreign countries. Also banks hold relatively

[52]The presence of a follow-your-customer motive should less problematic for results on liabilities: if banks follow their customers, they should also hold more liabilities in capital-scarcer countries.

[53]Signs of the coefficients do not change when the full set of controls is included.

more assets than liabilities in countries with lower capital-labor ratios. While the endowment coefficient was insignificant in the previous regressions, it is highly significant now that the ratio is used as the dependent variable. Relative factor endowments may be correlated with other, partly unobserved country characteristics that determine bank lending and borrowing across borders. The ratio indirectly controls for these factors.

The theory also predicts that the effect of efficiency differences on the ratio of liabilities to assets is positive for capital-exporting and negative for capital-importing countries. Because source countries in the BIS data include net capital importers and exporters, it is unclear what sign to expect. Germany, in contrast, clearly exports capital through the banking sector.[54] The positive coefficient in column (2) is therefore in accordance with the model. Columns (3) to (6) control for diversification and FDI, which does not affect the results qualitatively.

Several other specifications are estimated to check robustness. Overhead costs and capital labor ratios are lagged by an alternative number of years;[55] absolute differences of K/L and a and BIS data for other years are used in the regressions.[56] I also employ differences in net interest rate margins to measure relative banking sector efficiencies. These checks do not alter the conclusions. The presented conditional correlations, which are predicted by the presented theory, are robust features of the data.

It is instructive to quantify the effects of endowments and efficiency differences on bank assets. The following numbers are based on the estimate presented in column (2) of table 4 and in column (2) of table 6, implying an efficiency coefficient of 0.25 and an endowment coefficient of -0.68. If the German banking sector (54th percentile in 2000) was as efficient as the Spanish

[54] In 2000, it was among the ten most capital-abundant countries in the world, according to the human-capital-adjusted-capital-labor ratio used in this paper.

[55] As expected, regression results tend to become stronger with longer lags and weaker with shorter lags.

[56] Unreported results are available on demand.

(34th percentile in 2000), as measured by the ratio of overhead costs to total assets of the two banking sectors, then bank asset holdings of German banks would increase by around 9 percent. If Spain (85th percentile) had the same capital-labor ratio as Germany (93rd percentile), the liability-asset gap of Spanish banks would show a 15 percent increase. These quantifications suggest that banking sector efficiencies and relative factor endowments are major determinants of banks' foreign positions.

Accounting for bank-to-bank lending As argued in section 3.4, the model can also be interpreted as a model of international interbank lending. The theory does not provide a rationale for why banks may borrow from foreign consumers instead of from foreign banks. The two types of borrowing are isomorphic in the model. Consequently, I check whether the results regarding banks' foreign liabilities and the ratio of foreign liabilities to foreign assets are robust to adding the exposures towards foreign banks.

Table 7 shows the results that are obtained based on bank-level data from Deutsche Bundesbank. When liabilities toward the foreign non-bank private sector plus the foreign banking sector are used as the dependent variable, the endowment and the efficiency coefficient are both insignificant (column (1)).[57] This may be due to the fact that interbank lending and borrowing is also driven by other factors, such as liquidity risk sharing. The results regarding the liability-asset gap, however, go through. Even when accounting for interbank lending and borrowing, the results in column (2) suggest that banks fund less of their foreign activities locally the capital scarcer the destination country is.

The model with interbank lending provides an additional implication (see corollary 2). More efficient banking sectors should engage more in direct lending relative to interbank lending

[57] When 10-year lagged differences in endowments and efficiencies are used, the efficiency coefficient is highly significant.

abroad the less efficient the banking sector in the destination country is. To check for this in the data, I regress the ratio of foreign bank assets to foreign non-bank private assets on the controls as before. Column (3) of table 7 is based on aggregate data from BIS, column (4) on bank-level data from Deutsche Bundesbank. Both columns shows negative efficiency coefficients that are smaller than zero at a 10 percent significance level in line with corollary 2.

Altogether the results based on gravity regressions indicate that the model is consistent with key conditional correlations. Based on two different datasets, the efficiency coefficients have the signs that are predicted by the theory and are highly significant throughout. Conditional on frictions, size and differences in institutions, more efficient banking sectors engage more in countries that host less efficient banking sectors by both lending and borrowing abroad. At the same time, the results show that liability-asset gaps are correlated with relative capital-labor ratios in the predicted way.[58] The more capital abundant a country, the more of its foreign assets are financed with domestic capital. Even when accounting for bank-to-bank lending in the empirical exercise, results support the model. Together this is strong evidence that the model captures relevant patterns in the data.

6 Conclusions

Banking across borders has received growing attention over the past years both from researchers and policy makers.[59] The structure of international bank linkages is key, for example for the transmission of shocks, but there is little theory to explain why and how the structure

[58]The empirical results suggest that banks, on average, channel capital from capital-abundant countries to firms in capital-scarcer countries. As recently found by Alfaro, Kalemli-Ozcan and Volosovych (2011), capital flows downstream in the private sector. The authors report that capital, however, does flow upstream if sovereign capital is included. In line with these findings, the results become weaker if total assets and total liabilities are used as dependent variables, which include the positions toward the banking sector and the public sector.

[59]See Allen et al. (2011) and Committee on International Economic Policy and Reform (2012) for example.

is created. Existing works largely rely on portfolio models to explain banks' international linkages. However, these models do not address relevant dimensions of heterogeneity across banking sectors and countries in the data, such as heterogeneity in the reliance on global versus international funding models, in liability-asset gaps, and in foreign bank participation.

This paper provides a framework to explain banking across borders that can speak to this heterogeneity and thereby merges different perspectives on the subject. Using elements of international trade models, the theory predicts bilateral foreign bank asset and liability holdings between countries based on differences in returns to capital and differences in banking sector efficiencies as well as transaction costs. The presented model is parsimonious and reduced to the minimal ingredients, yet it yields rich predictions and is consistent with the observed conditional correlations in the data. It can serve as a basis and provides ample scope for future research.

I have outlined how the model could be modified to incorporate interbank lending. Diversification and imperfect competition could also be integrated to match more features of the data. Finally, it will be instructive to extend the model to allow for an analysis of the benefits of banking across borders together with the potential risks.

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A Proofs

A1: Proof of proposition 1

An equilibrium is a pair K_{12}, D_{12} for which the five conditions as stated in Definition 1 hold. In an interior equilibrium, where banking sectors in both countries engage in domestic banking, the following conditions must hold for $i, j \in \{1, 2\}$ and $i \neq j$:

$$c_i + 1 + r_i \leq c_j + \tau_{ij} + 1 + r_j \tag{A.1}$$

$$c_i + 1 + r_i \leq c_j + \tau_{ij} + 1 + r_i + t_{ij} \tag{A.2}$$

$$1 + r_j \leq 1 + r_i + t_{ij} \tag{A.3}$$

$$c_j + 1 + r_j \leq c_i + \tau_{ji} + 1 + r_i \tag{A.4}$$

$$c_j + 1 + r_j \leq c_i + \tau_{ji} + 1 + r_j + t_{ji} \tag{A.5}$$

$$1 + r_i \leq 1 + r_j + t_{ji}, \tag{A.6}$$

where

$$c_j(D_{ij}) = a_j(1 + \frac{D_{ij}}{K_j})^{\gamma}, \tag{A.7}$$

$$1 + r_j(D_{ij}, K_{ij}) = R_j(K_{ij}) - c_j(D_{ij})\frac{z-1}{z} = 1 + F_K\left(1, \frac{K_j - K_{ij}}{L_j}\right) - c_j(D_{ij})\frac{z-1}{z}, \tag{A.8}$$

and $K_{ij} = -K_{ji}$, $D_{ij} = -D_{ji}$. Otherwise, entrepreneurs in one country would all prefer foreign banks and/or foreign capital and there would be no domestic banking in one of the two countries. In addition to the conditions above, capital flows K_{12} and foreign deposits D_{12} must be consistent with entrepreneurial demand.

I illustrate the logic using an example. Assume that an equilibrium with international

banking by banking sector 2 prevails, defined as the case where banks in country 2 raise deposits at home and lend to firms in country 1. What are the conditions that have to be met? For international banking by banking sector 2 to occur, condition A.1 must hold with equality where $i = 1$ and $j = 2$, i.e. firms in country 1 must be indifferent between domestic banking and international banking. International banking implies that capital flows from country 2 to country 1. At the same time, banks do not intermediate foreign deposits, hence $D_{12} = 0$. Therefore, the capital flow K_{12} that solves Equation A.1, assuming $D_{12} = 0$, must be positive. Moreover, conditions A.2 to A.6 must hold at $D_{12} = 0$ and $K_{12} > 0$.

The proof of proposition 1 proceeds in four steps. First, the different equilibrium cases are characterized. One can then show that the equilibrium cases are mutually exclusive and that one of them always occurs. Finally, an interior equilibrium always results for sufficiently high values of γ.

Step 1 Conditions A.1 to A.6 are not independent. If one or several of the conditions hold with equality, this implies that other conditions must hold as inequalities or with equality:

- From Lemma 1: If condition A.1 holds as equality, condition A.4 cannot hold with equality.
- From Lemma 2: If condition A.2 or A.3 holds with equality, then conditions A.5 and A.6 must hold as inequalities.
- It is easy to see that if conditions A.1 and A.3 both hold with equality, then condition A.2 holds with equality as well.
- In an equilibrium, condition A.2 must always hold together with conditions A.1 and A.3. Too see this note that $c_i = c_j + \tau_{ij} + t_{ij} \Rightarrow c_i + 1 + r_i > c_j + \tau_{ij} + 1 + r_j$ if $1 + r_j < 1 + r_i + t_{ij}$.

- If conditions A.1, A.2 and A.3 hold with equality, A.4 to A.6 must hold as inequalities. To see this note that if $1 + r_j = 1 + r_i + t_{ij}$ and $c_i = c_j + \tau_{ij} + t_{ij} \Rightarrow 1 + r_i < 1 + r_j$ and $c_j < c_i \Rightarrow 1 + r_i < 1 + r_j + t_{ji}$ and $c_j < c_i + \tau_{ji}$.

- If conditions A.1 and A.6 both hold with equality, then all other conditions must be inequalities using lemma 1 and 2 plus the the other two points made above.

- The same arguments apply symmetrically where condition A.1 swaps with A.4, condition A.2 with A.5 and A.3 with A.6.

Combining the arguments from above, the following 11 equilibrium cases can be distinguished:[60]

1. No trade: All six conditions hold at $K^*_{ij} = D^*_{ij} = 0$.

2. International banking j: Condition A.1 holds with equality at $K_{ij} = K^*_{ij} > 0$ while all other conditions also hold. K^*_{ij} is determined by:

$$c_i + 1 + r_i = c_j + \tau_{ij} + 1 + r_j \rightarrow \frac{c_i}{z} + R_i = \frac{c_j}{z} + R_j + \tau_{ij}, \tag{A.9}$$

   where $D^*_{ij} = 0$. The liabilities of banking sector j in country i LI_{ij} are zero: $LI_{ij} = D^*_{ij} = 0$. The foreign assets of banking sector j held in country i correspond to the equilibrium capital flow: $A_{ij} = K^*_{ij} > 0$.

3. Foreign sourcing j: Condition A.3 holds with equality, while all other conditions also hold at $D^*_{ij} = -K^*_{ij} > 0$. D^*_{ij} solves:

$$1+F_K\left(1, \frac{K_j + D_{ij}}{L_j}\right) - c_j(D_{ij})\frac{z-1}{z} = 1+F_K\left(1, \frac{K_j - D_{ij}}{L_j}\right) - c_i(D_{ij})\frac{z-1}{z} + t_{ij}. \tag{A.10}$$

[60] Asterisks denote equilibrium values.

$A_{ij} = 0$ and $LI_{ij} = D^*_{ij} > 0$.

4. International banking and global banking j: Conditions A.1, A.2 and A.3 hold together at $D^*_{ij} > 0$ and $K^*_{ij} > 0$. All other conditions hold as inequalities. D^*_{ij} is determined by:

$$c_i = c_j + \tau_{ij} + t_{ij}. \tag{A.11}$$

Given D^*_{ij}, K^*_{ij} is the solution to:

$$1 + r_j = 1 + r_i + t_{ij} \rightarrow R_j - c_j z/(z-1) = R_i - c_i z/(z-1) + t_{ij}. \tag{A.12}$$

$A_{ij} = K^*_{ij} + D^*_{ij} > 0$, $LI_{ij} = D^*_{ij} > 0$, $A_{ij} > LI_{ij}$.

5. Foreign sourcing and global banking j: Conditions A.1, A.2 and A.3 hold together at $D^*_{ij} > 0$ and $K^*_{ij} \leq 0$. All other conditions hold as inequalities. D^*_{ij} is determined by:

$$c_i = c_j + \tau_{ij} + t_{ij}. \tag{A.13}$$

Given D^*_{ij}, K^*_{ij} is the solution to:

$$1 + r_j = 1 + r_i + t_{ij} \rightarrow R_j - c_j z/(z-1) = R_i - c_i z/(z-1) + t_{ij}. \tag{A.14}$$

$A_{ij} = K^*_{ij} + D^*_{ij} > 0$, $LI_{ij} = D^*_{ij} > 0$, $A_{ij} \leq LI_{ij}$. The case where $K^*_{ij} = 0$ corresponds to pure global banking.

6. Foreign sourcing j, international banking i: Conditions A.1 and A.6 both hold with equality at $D^*_{ij} = K^{j*}_{ji} > 0$ and $K^*_{ij} = -(D^*_{ij} + K^{i*}_{ji}) < 0$. All other conditions hold as

inequalities. D^*_{ij} is determined by:

$$c_j + t_{ij} = c_i + \tau_{ji}. \tag{A.15}$$

Given D^*_{ij}, K^*_{ij} is the solution to:

$$1 + r_j = 1 + r_i + t_{ij} \tag{A.16}$$

$A_{ij} = 0$ and $LI_{ij} = D^*_{ij} > 0$.

7. International banking i: Case 2 where $i = j$ and $j = i$.

8. Foreign sourcing i: Case 3 where $i = j$ and $j = i$.

9. International banking and global banking i: Case 4 where $i = j$ and $j = i$.

10. Foreign sourcing and global banking i: Case 5 where $i = j$ and $j = i$.

11. Foreign sourcing i, international banking j: Case 6 where $i = j$ and $j = i$.

Step 2 The eight cost functions are strictly monotone in K_{ij} and D_{ij}. Therefore, each equilibrium case implies unique values of K_{ij} and D_{ij}. In addition, the different equilibrium cases are mutually exclusive. Therefore, the equilibrium is unique.

To see that the different equilibria are mutually exclusive, start with case 2 and assume that the equilibrium corresponds to international banking by banking sector j.

Excluding case 1: Autarky implies $D_{ij} = K_{ij} = 0$. International banking implies $c_i(D_{ij} = 0) + 1 + r_i((D_{ij} = 0), K^*_{ij}) = c_j(D_{ij} = 0) + 1 + r_j((D_{ij} = 0), K^*_{ij}) + \tau_{ij}$ where $K^*_{ij} > 0 \Rightarrow c_i(D_{ij} = 0) + 1 + r_i((D_{ij} = 0), K_{ij} = 0) > c_j(D_{ij} = 0) + 1 + r_j((D_{ij} = 0), K_{ij} = 0) + \tau_{ij}$ because

$\partial(1+r_i)/\partial K_{ij} < 0$ and $\partial(1+r_j)/\partial K_{ij} > 0$. Condition A.1 is violated at $K_{ij} = D_{ij} = 0$.

Excluding case 3: Foreign sourcing by banking sector j (case 3) implies $D_{ij} = -K_{ij} > 0$. Equilibrium case 2 implies $1 + r_j(K^*_{ij} > 0) \leq 1 + r_i(K^*_{ij} > 0) + t_{ij} \Rightarrow 1 + r_j(K_{ij} < 0) < 1 + r_i(K_{ij} < 0) + t_{ij}$. Condition A.3 does not hold at $D_{ij} = -K_{ij} > 0$.

Excluding case 4 and 5: Cases 4 and 5 imply $D_{ij} > 0$. International banking implies $c_i(D_{ij} = 0) \leq c_j(D_{ij} = 0) + \tau_{ij} + t_{ij} \Rightarrow c_i(D_{ij} > 0) < c_j(D_{ij} > 0) + \tau_{ij} + t_{ij}$ because $\partial c_i/\partial D_{ij} < 0$ and $\partial c_j/\partial D_{ij} > 0$. Condition A.2 does not hold at $D_{ij} > 0$.

Excluding case 6: Case 6 implies $K_{ij} < 0$. International banking implies $1 + r_j(K^*_{ij} > 0) \leq 1 + r_i(K^*_{ij} > 0) + t_{ij} \Rightarrow 1 + r_j(K_{ij} < 0) < 1 + r_i(K_{ij} < 0) + t_{ij}$. Hence, condition A.6 does not hold for $K_{ij} < 0$.

The other five equilibrium cases can be excluded using similar arguments. The proof for the other cases follows equivalently.

Step 3 If 10 of the 11 equilibrium cases are excluded as the equilibrium, then the remaining case must be the equilibrium. An equilibrium always exists.

Assume that equilibrium cases 2 to 11 do not correspond to the equilibrium. Given that equilibrium cases 4 and 9 are excluded, $c_j \leq c_i + \tau_{ji} + t_{ji}$ and $1 + r_j \leq 1 + r_i + t_{ij}$ as well as $c_i \leq c_j + \tau_{ij} + t_{ij}$ and $1 + r_i \leq 1 + r_j + t_{ji}$ at $D_{ij} = K_{ij} = 0$. If the first two or the last two conditions did not hold, then equilibrium 4 and 9 would result. As cases 1 and 7 are also excluded, $c_i + 1 + r_i \leq c_j + \tau_{ij} + 1 + r_j$ and $c_j + 1 + r_j \leq c_i + \tau_{ji} + 1 + r_i$ at $K_{ij} = D_{ij} = 0$. This implies that all conditions of the no-trade equilibrium hold.

The proofs for the other cases are equivalent.

Step 4 An interior equilibrium results if $K_i - N_i < D_{ij}^* < K_j - N_i$. The condition implies that the foreign deposits that banking sector j (banking sector i) intermediates are smaller than the depositor capital in the foreign country, i.e. the banking sector of the foreign country intermediates domestic deposits in equilibrium. In general, D_{ij}^* is the solution to $c_i(D_{ij}) - c_j(D_{ij}) = k$, where k corresponds to some parameter value depending on the equilibrium case. D_{ij}^* therefore depends on the curvature of the cost function. $\partial c_j/\partial D_{ij} = a_j\gamma/K_j(1+D_{ij}/K_j)^{\gamma-1}$. As $\gamma \to \infty \Rightarrow \partial c_j/\partial D_{ij} \to \infty$ and, equivalently, $\partial c_i/\partial D_{ij} \to -\infty$. Hence, the larger γ, the smaller the change in D_{ij} that is required to equilibrate monitoring costs in the two countries and the smaller D_{ij}^*. For a sufficiently high γ, the equilibrium is always interior.

A2: Proof of propositions 2 to 4

Comparative statics within and across equilibria have to be derived for the different equilibrium cases that were established in the proof to proposition 1. In the following, equilibrium cases 1 to 6 and 11 are analyzed. Other comparative statics can be inferred due to symmetry.

Step 1 For derivatives within equilibria, assume that the equilibrium case continues to prevail. Using implicit function theorems, it is easy to obtain the derivatives of K_{ij}^* and D_{ij}^* with respect to $\Delta(K/L)$ and Δa, which combined imply the derivatives of A_{ij}, LI_{ij} and LI_{ij}/A_{ij}.

- No trade: The derivatives are zero.

- International banking j: K_{ij}^* is the solution to $R_i - R_j - (c_j - c_i)z - \tau_{ij} = 0$ where $D_{ij} = 0$. Differentiating both sides with respect to $\Delta(K/L)$ delivers: $\frac{\partial(R_i-R_j)}{\partial\Delta(K/L)} + \frac{\partial(R_i-R_j)}{\partial K_{ij}}\frac{dK_{ij}^*}{d\Delta(K/L)} = 0 \Rightarrow \frac{dK_{ij}^*}{d\Delta(K/L)} = -\frac{\partial(R_i-R_j)}{\partial\Delta(K/L)} / \frac{\partial(R_i-R_j)}{\partial K_{ij}}$. $\frac{\partial(R_i-R_j)}{\partial K_{ij}} < 0$ and $\frac{\partial(R_i-R_j)}{\partial\Delta(K/L)} > 0 \Rightarrow \frac{dK_{ij}^*}{d\Delta(K/L)} = \frac{dA_{ij}}{d\Delta(K/L)} > 0$.

Equivalently, $\frac{dA_{ij}}{d\Delta a} = \frac{dK^*_{ij}}{d\Delta a} > 0$. Other derivatives are zero.

- Foreign sourcing j: $\frac{dLI_{ij}}{d\Delta(K/L)} = \frac{dD^*_{ij}}{d\Delta(K/L)} < 0$. $\frac{dLI_{ij}}{d\Delta a} = \frac{dD^*_{ij}}{d\Delta a} > 0$. Other derivatives are zero.

- International banking and global banking j: $\frac{dK^*_{ij}}{d\Delta(K/L)} > 0$. $\frac{dK^*_{ij}}{d\Delta a} = 0$. $\frac{dLI_{ij}}{d\Delta(K/L)} = \frac{dD^*_{ij}}{d\Delta(K/L)} = 0$. $\frac{dLI_{ij}}{d\Delta a} = \frac{dD^*_{ij}}{d\Delta a} > 0$. As $A_{ij} = K^*_{ij} + D^*_{ij}$, $\frac{dA_{ij}}{d\Delta(K/L)} > 0$ and $\frac{dA_{ij}}{d\Delta a} > 0$. Moreover, $\frac{d\frac{LI_{ij}}{A_{ij}}}{d\Delta(K/L)} > 0$. $\frac{d\frac{LI_{ij}}{A_{ij}}}{d\Delta a} = \frac{d\frac{D^*_{ij}}{D^*_{ij}+K^*_{ij}}}{d\Delta a} > 0$ because $K^*_{ij} > 0$.

- Foreign sourcing and global banking j: $\frac{d\frac{LI_{ij}}{A_{ij}}}{d\Delta a} \leq 0$ because $K^*_{ij} \leq 0$. Other derivatives are the same as for case 4.

- Foreign sourcing j, international banking i: $\frac{dD^*_{ij}}{d\Delta(K/L)} = \frac{dLI_{ij}}{d\Delta(K/L)} = 0$. $\frac{dD^*_{ij}}{d\Delta a} = \frac{dLI_{ij}}{d\Delta a} > 0$. Other marginal effects are zero.

- Foreign sourcing i, international banking j: $\frac{dD^*_{ij}}{d\Delta a} > 0$ and $\frac{dK^*_{ij}}{d\Delta a} = 0 \Rightarrow \frac{dA_{ij}}{d\Delta a} > 0$. $\frac{dK^*_{ij}}{d\Delta(K/L)} > 0$ and $\frac{dD^*_{ij}}{d\Delta(K/L)} = 0 \rightarrow \frac{dA_{ij}}{d\Delta(K/L)} > 0$. Other marginal effects are zero.

Step 2 In the following, assume that the equilibrium corresponds to a specific equilibrium case and consider how conditions A.1 to A.6 change as $\Delta(K/L)$ increases and decreases to obtain the transitions across equilibria.

No trade: As $\Delta(K/L)$ increases, $1 + r_i(K_{ij} = 0)$ goes up relative to $1 + r_j(K_{ij} = 0)$. Therefore, conditions A.2, A.3, A.4 and A.5 continue to hold. At the same time, conditions A.1 and A.6 relax so the equilibrium can transition to cases 2 and 8. By symmetry, the equilibrium can transition to cases 7 and 3 as $\Delta(K/L)$ decreases.

International banking j: As $\Delta(K/L)$ increases, the international banking equilibrium remains. Because $c_i(D_{ij} = 0) - c_j(D_{ij} = 0) = 1 + r_j(D_{ij} = 0, K^*_{ij}) - 1 + r_i(D_{ij} = 0, K^*_{ij}) + \tau_{ij}$ continues to hold, all inequalities continue to hold. Consider a decrease in $\Delta(K/L)$. The equi-

Table A.1: Transitions across equilibria for $\Delta(K/L)$ and Δa

Equilibrium case	$\Delta(K/L)\uparrow$	$\Delta(K/L)\downarrow$
1. no trade	2, 8	7, 3
2. international banking j	-	1
3. foreign sourcing j	1, 5	6
4. int. banking and gl. banking	-	5
5. for. sourcing and gl. banking	4	3
6. for. sourcing j, int. banking i	3	-
11. for. sourcing i, int. banking j	-	8

Equilibrium case	$\Delta a\uparrow$	$\Delta a\downarrow$
1. no trade	2, 3	7, 8
2. int. banking j	4	11, 1
3. foreign sourcing j	5	1, 6
4. int. banking and gl. banking	-	2
5. for. sourcing and gl. banking	-	3
6. for. sourcing j, int. banking i	3	7
11. for. sourcing i, int. banking j	2	8

librium capital flow K_{ij}^* decreases. At some point, $c_i+1+r_i(K_{ij}^*=0)=c_j+\tau_{ij}+1+r_j(K_{ij}^*=0)$, a situation which corresponds to the no trade equilibrium.

Other transitions can be inferred equivalently. Table A.1 summarizes the transitions for $\Delta(K/L)$ and Δa. Combining results within and across equilibria shows that foreign assets A_{ij} weakly increase in $\Delta(K/L)$. Foreign liabilities LI_{ij} weakly decrease in $\Delta(K/L)$. Foreign assets A_{ij} and foreign liabilities weakly increase in Δa. The ratio of foreign liabilities to foreign assets LI_{ij}/A_{ij} weakly decreases in $\Delta(K/L)$. The ratio weakly increases in Δa if $K_{ij}^*>0$ and decreases in Δa if $K_{ij}^*<0$.

A3: Proof of proposition 5 and 6

Comparative statics within and across equilibria have to be derived for the different equilibrium cases that were established in the proof to proposition 1. In the following, equilibrium cases 1 to 6 and 11 are analyzed. Other comparative statics can be inferred due to symmetry.

Table A.2: Transitions across equilibria for $\Delta\tau_{ij}$ and Δt_{ij}

Equilibrium case	$\tau_{ij} \uparrow$	$\tau_{ij} \downarrow$
1. no trade	-	2
2. int. banking j	1, 11	4
3. foreign sourcing j	-	5
4. int. banking and gl. banking	2	-
5. for. sourcing and gl. banking	3	-
6. for. sourcing j, int. banking i	-	-
11. for. sourcing i, int. banking j	8	-,2

Equilibrium case	$t_{ij} \uparrow$	$t_{ij} \downarrow$
1. no trade	-	3
2. int. banking j	-	4
3. foreign sourcing j	1	5
4. int. banking and gl. banking	2	-
5. for. sourcing and gl. banking	3	-
6. for. sourcing j, int. banking i	7	-, 3
11. for. sourcing i, int. banking j	-	-

Step 1 For derivatives within equilibria, assume that the equilibrium case continues to prevail. Using implicit function theorems, it is easy to obtain the derivatives of K^*_{ij} and D^*_{ij} with respect to τ_{ij}, t_{ij}, τ_{ji} and t_{ji}, which together imply the derivatives of A_{ij} and LI_{ij}.

- No trade: The derivatives are zero.
- International banking j: $\frac{dA_{ij}}{d\tau_{ij}} < 0$. The other derivatives are zero.
- Foreign sourcing j: $\frac{dLI_{ij}}{dt_{ij}} < 0$. The other derivatives are zero.

- International banking and global banking j: $\frac{dD^*_{ij}}{d\tau_{ij}} = \frac{dLI_{ij}}{d\tau_{ij}} < 0$. $\frac{dK^*_{ij}}{d\tau_{ij}} = 0$. $\Rightarrow \frac{dA_{ij}}{d\tau_{ij}} = \frac{dD^*_{ij}}{d\tau_{ij}} + \frac{dK^*_{ij}}{d\tau_{ij}} < 0$. $\frac{dD^*_{ij}}{dt_{ij}} = \frac{dLI_{ij}}{dt_{ij}} < 0$. To determine the sign of $\frac{dK^*_{ij}}{dt_{ij}}$, consider the two equilibrium conditions $c_i = c_j + \tau_{ij} + t_{ij}$ and $R_j - R_i = (c_j - c_i)\frac{z-1}{z} + t_{ij}$. In equilibrium, the change in $c_i - c_j$ implied by t_{ij} must equal the change in t_{ij}. Therefore, $d(R_j - R_i) = d(c_j - c_i)\frac{z-1}{z} + dt_{ij} = dt_{ij}(1 - \frac{z-1}{z}) > 0 \Rightarrow \frac{dK^*_{ij}}{dt_{ij}} > 0$.

  The sign of the following derivative remains to be determined:

$$\frac{dA_{ij}}{dt_{ij}} = \underbrace{\frac{dD^*_{ij}}{dt_{ij}}}_{<0} + \underbrace{\frac{dK^*_{ij}}{dt_{ij}}}_{>0}. \tag{A.17}$$

  The sign depends on the magnitude of the two derivatives in the last expression. For a sufficiently large z, the derivative is always negative. As z goes to infinity, $z/(z-1) \to 1$. Thus, $d(R_j - R_i) = dt_{ji}(1 - \frac{z-1}{z}) \to 0 \Rightarrow \frac{dK^*_{ij}}{dt_{ij}} \to 0$.

- Foreign sourcing and global banking j: Same derivatives as equilibrium case 4.

- Foreign sourcing j, international banking i: The equilibrium conditions imply $d\tau_{ji} = d(c_j - c_i) \Rightarrow \frac{dD^*_{ij}}{d\tau_{ji}} = \frac{dLI_{ij}}{d\tau_{ji}} > 0$. Also $dt_{ij} = d(c_i - c_j) \Rightarrow \frac{dD^*_{ij}}{dt_{ij}} = \frac{dLI_{ij}}{dt_{ij}} < 0$. Other marginal effects are zero.

- Foreign sourcing i, international banking j: Consider the equilibrium conditions $c_i + t_{ji} = c_j + \tau_{ij}$ and $R_i - R_j = (c_i - c_j)\frac{z-1}{z} + t_{ji}$, where the expressions for the interest rates were substituted in. The first condition implies $d\tau_{ij} = d(c_i - c_j) \Rightarrow \frac{dD^*_{ji}}{d\tau_{ij}} > 0$. Moreover, $d(R_i - R_j) = d(c_i - c_j)\frac{z-1}{z} = d\tau_{ij}\frac{z-1}{z} > 0 \Rightarrow \frac{dK^*_{ij}}{d\tau_{ij}} < 0$. If K^*_{ij} goes down while D^*_{ji} goes up, K^{j*}_{ij} must go down because $K^*_{ij} = D^*_{ji} + K^{j*}_{ij} \Rightarrow \frac{dK^{j*}_{ij}}{d\tau_{ij}} = \frac{dA_{ij}}{d\tau_{ij}} < 0$.

  Next, $dt_{ji} = d(c_j - c_i) \Rightarrow \frac{dD^*_{ji}}{dt_{ji}} < 0$. In addition, $d(R_i - R_j) = dt_{ji}/z \Rightarrow \frac{dK^*_{ij}}{dt_{ji}} < 0$. As z grows large, $d(R_i - R_j) = dt_{ji}/z \to 0 \Rightarrow \frac{dK^*_{ij}}{dt_{ji}} \to 0$. $K^*_{ij} = D^*_{ji} + K^{j*}_{ij} \Rightarrow dK^{j*}_{ij}/dt_{ji} =$

$dK^*_{ij}/dt_{ji} - dD^*_{ji}/dt_{ji}$. For sufficiently high z, the required decrease in K^*_{ij} is smaller than the decrease in D^*_{ij}, and K^{j*}_{ij} goes up: $\frac{dK^{j*}_{ij}}{dt_{ji}} = \frac{dA_{ij}}{dt_{ji}} > 0$ for sufficiently high z.

Step 2 Transitions across equilibria for τ_{ij} and t_{ij} are summarized in Table A.2.

Combining the comparative statics results within and across equilibria shows that foreign assets A_{ij} and foreign liabilities LI_{ij} weakly decrease in τ_{ij} and weakly decrease in t_{ij} for sufficiently large z. Foreign assets A_{ij} and foreign liabilities LI_{ij} weakly increase in τ_{ji} and weakly increase in t_{ji} for sufficiently large z.

B Model with Constant Service Fees ($\gamma = 0$)

If $\gamma = 0$, $a_j = c_j$ is constant for $j \in \{1, 2\}$.

Capital account liberalization Assume $\tau_{12} = \tau_{21} = 0$ and $t_{12} = t_{21} \to \infty$. Capital accounts are perfectly liberalized while the costs of taking foreign deposits are prohibitively high. Then, entrepreneurs effectively compare the cost of using banking sector 1, which is $c_1 + 1 + r_1$, with the cost of being serviced by banking sector 2, $c_2 + 1 + r_2$. The equilibrium capital flow K_{12}^* must be such that entrepreneurs in the two countries are indifferent between domestic and foreign banks, which implies:

$$
\begin{aligned}
c_1 + 1 + r_1 &= c_2 + 1 + r_2 && \text{(B.1)} \\
\Rightarrow (c_2 - c_1) &= (R_1 - R_2)z && \text{(B.2)} \\
\Rightarrow (a_2 - a_1) &= \left(1 + F_K\left(1, \frac{K_1 + K_{12}}{L_1}\right)\right) - \left(1 + F_K\left(1, \frac{K_2 - K_{12}}{L_2}\right)\right) z, && \text{(B.3)}
\end{aligned}
$$

where the expression for the interest rate is substituted in. In equilibrium a low service fee is offset by a high financial interest rate and vice versa. The banking sector that exports capital holds positive foreign assets on its balance sheet: $A_{ij} = \max\{K_{ij}^*, 0\}$ for $i, j \in \{1, 2\}$ and $j \neq i$. Foreign liabilities are zero, $L_{ij} = 0$ for $i, j \in \{1, 2\}$ and $j \neq i$.

Banking sector liberalization Assume $\tau_{12} = \tau_{21} = 0$ and $t_{12} = t_{21} = 0$. Under perfect competition, interest rates equalize. With constant monitoring costs, the more efficient banking sector takes over the intermediation business of the less efficient banking sector. Capital is

allocated such that gross returns to capital equalize, which implies:

$$K_{12}^* = \left(\frac{K_2}{L_2} - \frac{K_1}{L_1}\right)\frac{L_2 L_1}{L_2 + L_1} = \Delta\left(\frac{K}{L}\right)\frac{L_2 L_1}{L_2 + L_1}. \tag{B.4}$$

Without any transaction costs of banking across borders, only the net cross-border capital flow is determined, but foreign assets and liabilities represent gross positions if $\Delta a \neq 0$. If $a_i > a_j$ where $i, j \in \{1, 2\}$ and $j \neq i$, banking sector j is the only one operating in equilibrium. Its foreign liabilities LI_{ij} equal total depositor capital in country i:

$$LI_{ij} = D_{ij}^* = K_i - N_i = K_i - (K_{ij}^* + K_i)/z. \tag{B.5}$$

Its foreign assets A_{ij} correspond to its foreign liabilities plus the capital flow K_{ij}:

$$A_{ij} = D_{ij}^* + K_{ij}^* = (K_i + K_{ij}^*)\frac{z-1}{z} = \left(K_i + \left(\frac{K_j}{L_j} - \frac{K_i}{L_i}\right)\frac{L_j L_i}{L_j + L_i}\right)\frac{z-1}{z}. \tag{B.6}$$

The last expression shows that a standard gravity equation for foreign bank assets does not hold in general. The ratio of foreign liabilities to foreign assets is:

$$\frac{LI_{ij}}{A_{ij}} = \frac{K_i(z-1) - K_{ij}^*}{(K_i + K_{ij}^*)(z-1)}. \tag{B.7}$$

If $\Delta(K/L) = 0$, $K_{ij}^* = 0$ and hence $\frac{LI_{ij}}{A_{ij}} = 1$. Banking sector j engages only in global banking if there are no differences in endowments.

If $\Delta a = 0$, it is not determined to what extent the two banking sectors engage in foreign sourcing or international or global banking; only the net capital flow is fixed.

C Data Appendix

Consolidated Banking Statistics: Assets are proxied by international claims vis-à-vis the nonbank private sector, liabilities by local liabilities in local currency, both on an immediate borrower basis.

Auslandsstatus-Report: Consolidated assets and liabilities toward the nonbank private sector are the cross-border claims and liabilities of the parent bank plus those of its branches and subsidiaries as of June 2005. Assets exclude derivatives and securities. When the ratio of liabilities to assets is used, assets vis-à-vis the non-bank private sector in country i also include securities and derivatives. The data is averaged over 12 months. The sample includes commercial banks, state banks, savings banks, cooperative central banks, and cooperative savings banks.

$\mathbf{\Delta}\log(\mathbf{K/L_{ijt}})$: The adjustment for human capital follows Hall and Jones (1999):

$$H_i = e^{\phi(E_i)} L_i, \tag{C.1}$$

where L_i stands for the labor force and E_i are average years of schooling. The function $\phi(E)$ is the efficiency of a unit of labor with E years of schooling relative to one with no schooling ($\phi(0) = 0$). As in Hall and Jones (1999), it is assumed that $\phi(E)$ is piecewise linear, with a slope of 0.134 up to four years of schooling, a slope of 0.101 for the years of schooling between four and eight, and 0.068 for any year beyond that. Data on average years of schooling for the population aged over 25 come in five-year frequencies from Barro and Lee (2010). Linear interpolation is used to generate missing data. Capital stocks and data on the labor force are

from Penn World tables 6.2.[61] Denoting the capital stock of country i by K_i, the proxy for differences in rates of return to capital is precisely calculated as:

$$\Delta \log(K/L)_{ijt} = \log(K_{j\ t-5}/H_{j\ t-5}) - \log(K_{i\ t-5}/H_{i\ t-5}). \tag{C.2}$$

Financial freedom: The index provided by the Heritage Foundation is used to measure barriers to foreign bank entry as in Buch and Lipponer (2007) for example.[62]

Openness: Capital account openness is proxied by the Chinn & Ito Index documented in Chinn and Ito (2008).

Gravity controls: Bilateral distance and the dummies for contiguity, colonial relationship, common official language, common border, common legal system and common currency come from datasets provided by CEPII (see Mayer and Zignago (2005); Head, Mayer and Ries (2010)).

Dummy for systemic banking crisis: Information collected by Laeven and Valencia (2008) is used to construct a dummy variable that takes value 1 if there was a banking crisis in a country in 2005.

Additional variables: GDP in current U.S. dollars, GDP per capita in current U.S. dollars, GDP growth, and population are from the World Development Indicators. Growth correlations are the correlations between GDP growth of the source and recipient country over the period 2000-2004. Information on property rights is from the Heritage Foundation. The variable private credit of deposit money banks and other financial institutions over GDP is from the Financial Structure Data Base provided by the World Bank (see Beck, Demirgüç-Kunt and Levine (2009)).

[61] Capital stocks for the base year 2000, which are not publicly available yet, were kindly provided by Penn World Tables.

[62] See http://www.heritage.org/index/financial-freedom.

FDI stocks: When the BIS dataset is used, information on stocks of FDI is from the OECD's International Direct Investment Statistics. Stocks for Germany are from Deutsche Bundesbank.

Source countries j:[63] Australia, (Austria), Belgium, Brazil, Canada, (Chile), Denmark, (Finland), France, Germany, Greece, India, Ireland, Italy, Japan, (Mexico), (Panama), Portugal, Spain, Sweden, Switzerland, the Netherlands, Turkey, the United Kingdom, the United States of America.

Recipient countries i:[64] Algeria, Argentina, Australia, Austria, Bangladesh, Belgium, (Benin), Bolivia, Botswana, Brazil, (Burundi), Cameroon, Canada, Chile, China, Colombia, (Republic of Congo), Costa Rica, Ivory Cost, Cyprus, Denmark, (Ecuador), Egypt, El Salvador, France, (Gabon), Germany*, Ghana, Guatemala, Haiti, Honduras, Hungary, India, Indonesia, (Iran), Ireland, Israel, Italy, Japan, Jordan, Kenya, Republic of Korea, Kuwait, (Malawi), (Mali), Malaysia, Malta, Mauritania, Mexico, Morocco, (Mozambique), Nepal, the Netherlands, (Nicaragua), (Niger), Norway, Pakistan, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, (Romania), (Rwanda), Saudi Arabia, Senegal, Sierra Leone, South Africa, Spain, (Sri Lanka), (Swaziland), Sweden, Switzerland*, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Arab Emirates, the United Kingdom, the United States of America, Uruguay, Venezuela, Zambia, Zimbabwe.

[63] Source countries that are not included in the liability sample are in parentheses.

[64] Recipient countries that are not included in the BIS liability sample (Bundesbank sample) are in parentheses (indicated with asterisks).

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Table 1: Expected signs

Dependent variable	Δa	$\Delta(K/L)$
assets	positive	positive
liabilities	positive	negative
$\frac{\text{liabilities}}{\text{assets}}$	ambiguous	negative

Table 2: Summary statistics for BIS samples

Dependent Variable	Assets				Liabilities			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
$\log(\text{assets}_{ik})$	4.49	2.84	-1.39	12.75	-	-	-	-
$\log(\text{liabilities}_{ik})$	-	-	-	-	5.84	3.22	-1.39	13.37
$\Delta \log(c_{ij})$	.208	.859	-2.49	2.99	.043	.822	-2.18	2.43
$\Delta \log(K/L_{ij})$	.978	1.30	-2.57	4.89	.704	1.10	-2.56	4.51
log (FDI_{ij})	6.37	2.59	-1.19	12.45	7.63	2.01	1.39	12.45
financial freedom_j	69.65	20.58	30	90	72.24	20.82	30	90
growth correlation_{ij}	.342	.500	-.960	1.00	.476	.448	-.885	.996
openness_j	2.08	.960	-1.13	2.53	2.21	.798	-1.13	2.53
$\frac{\text{private credit}_i}{\text{GDP}_i}$	1.17	.442	.153	1.88	1.29	.451	.184	1.88
property rights_j	79.68	15.22	30	90	81.89	12.47	50	90
$\log(\text{distance}_{ij})$	8.47	.913	5.15	9.86	8.23	1.10	5.15	9.83
common currency_{ij}	.060	.237	0	1	.114	.318	0	1
contiguity_{ij}	.041	.198	0	1	.077	.267	0	1
common legal system_{ij}	.320	.467	0	1	.352	.478	0	1
common language_{ij}	.153	.360	0	1	.187	.391	0	1
colony_{ij}	.063	.244	0	1	.126	.332	0	1
log (GDP_j)	27.46	1.25	23.46	30.16	27.92	1.23	25.98	30.16
log (GDP per capita_j)	10.13	1.02	6.64	10.82	10.32	.787	6.64	10.82
	Number of Observations = 1,374				Number of Observations = 491			

Table 3: Summary statistics for Bundesbank samples

Dependent Variable	Assets				Liabilities			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
$\log(\text{assets}_{ik})$	2.81	3.34	-	-	-	-	-	-
$\log(\text{liabilities}_{ik})$	-	-	-	-	3.35	2.40	-	-
$\Delta \log(c_{ij})$	-.259	.591	-1.87	1.12	-.242	.637	-1.87	1.12
$\Delta \log(K/L_{ij})$	-14.15	.817	10.01	14.88	13.98	0.896	10.01	14.88
growth correlation_{ij}	.572	.425	-0.857	0.986	.474	.467	-.857	.986
financial freedom_i	65.68	19.86	10	90	62.64	21.17	10	90
openness_i	1.75	1.18	-1.81	2.53	1.55	1.27	-1.81	2.53
$\frac{\text{private credit}_i}{\text{GDP}_i}$	.990	.529	.0244	1.97	.889	.545	.024	1.97
propertyrights_i	71.37	20.36	10	90	67.27	22.65	10	90
banking crisis_i	.003	.052	0	1	.004	.066	0	1
$\log(\text{distance}_{ij})$	7.53	1.29	5.16	9.71	7.77	1.28	5.16	9.71
common currency_{ij}	.388	.487	0	1	.282	.450	0	1
contiguity_{ij}	.258	.438	0	1	.199	.399	0	1
common legal system_{ij}	.088	.283	0	1	.065	.247	0	1
common language_{ij}	.107	.310	0	1	.071	.257	0	1
colony_{ij}	.025	.156	0	1	.030	.171	0	1
log (GDP_i)	26.88	1.67	20.83	30.16	26.54	1.70	20.83	30.16
log (GDP per capita_i)	9.72	1.20	5.31	11.09	9.46	1.33	5.31	11.09
	Number of Observations = 16,662				Number of Observations = 38,172			

Table 4: Results: assets

assets	BIS (1)	BBK (2)	BIS (3)	BBK (4)	BIS (5)	BBK (6)	BIS (7)	BBK (8)
$\Delta \log(a_{ij})$	**0.579††**	**0.248††**	**0.568††**	**0.325†††**	**0.573††**	**0.339†††**	**0.257**	**0.311††**
	(0.324)	**(0.145)**	**(0.318)**	**(0.126)**	**(0.322)**	**(0.126)**	**(0.359)**	**(0.137)**
$\Delta \log(K/L_{ij})$	1.199	0.121	1.465	0.0159	1.450	0.00932	0.685	-0.0807
	(1.129)	(0.259)	(1.168)	(0.175)	(1.156)	(0.169)	(1.489)	(0.197)
growth correlation$_{ij}$					**0.358††**	**-0.104**	**-0.343**	**-0.354†**
					(0.214)	**(0.212)**	**(0.404)**	**(0.252)**
log(FDI$_{ij}$)							0.397***	0.214*
							(0.0537)	(0.115)
financial freedom$_j$	-0.00715		-0.0111		-0.0116		-0.0298**	
	(0.0145)		(0.0127)		(0.0125)		(0.0112)	
financial freedom$_i$		0.0101**		0.00559		0.00525		0.001000
		(0.00500)		(0.00503)		(0.00502)		(0.00617)
openness$_j$	0.479		0.344		0.335		0.203	
	(0.501)		(0.561)		(0.561)		(0.738)	
openness$_i$		-0.0611		-0.0219		-0.0163		-0.0110
		(0.0726)		(0.0583)		(0.0581)		(0.0825)
$\frac{\text{private credit}_j}{\text{GDP}_j}$			0.644		0.671		0.137	
			(0.721)		(0.718)		(0.989)	
$\frac{\text{private credit}_i}{\text{GDP}_i}$				0.826***		0.832***		0.853***
				(0.233)		(0.233)		(0.212)
property rights$_j$	0.0295		0.0254		0.0248		0.0274	
	(0.0222)		(0.0228)		(0.0228)		(0.0317)	
property rights$_i$		0.00885		-0.00160		-0.000602		-0.00196
		(0.00712)		(0.00604)		(0.00612)		(0.00728)
banking crisis$_i$		-0.514*		-0.237		-0.281		-0.344
		(0.265)		(0.253)		(0.246)		(0.340)
log(GDP$_j$)	0.801***		0.755***		0.742***		0.282	
	(0.142)		(0.177)		(0.180)		(0.220)	
log(GDP$_i$)		0.511***		0.452***		0.453***		0.298*
		(0.0749)		(0.0653)		(0.0655)		(0.154)
log(GDP per capita$_j$)	-0.830		-0.956		-0.941		0.955	
	(0.853)		(0.806)		(0.799)		(1.589)	
log(GDP per capita$_i$)		0.0299		-0.0595		-0.0578		-0.101
		(0.200)		(0.137)		(0.135)		(0.175)
log(distance$_{ij}$)	-1.377***	-0.0856	-1.386***	-0.123*	-1.368***	-0.127**	-0.612***	-0.0766
	(0.172)	(0.0738)	(0.167)	(0.0656)	(0.163)	(0.0638)	(0.166)	(0.0601)
common currency$_{ij}$	0.0705	0.861***	0.0692	0.791***	-0.0001	0.828***	0.364	0.897***
	(0.357)	(0.298)	(0.365)	(0.251)	(0.374)	(0.275)	(0.296)	(0.255)
contiguity$_{ij}$	-0.747**	0.408	-0.705**	0.321	-0.747**	0.314	-0.185	0.323
	(0.310)	(0.291)	(0.311)	(0.311)	(0.306)	(0.309)	(0.297)	(0.251)
common legal system$_{ij}$	-0.0686	0.293	-0.0247	0.135	-0.0104	0.137	0.152	0.0965
	(0.179)	(0.486)	(0.150)	(0.430)	(0.149)	(0.426)	(0.125)	(0.425)
common language$_{ij}$	0.461	0.0253	0.437	0.448	0.428	0.413	-0.224	0.253
	(0.293)	(0.475)	(0.295)	(0.437)	(0.288)	(0.429)	(0.223)	(0.453)
colony$_{ij}$	1.411***	-0.197	1.410***	0.250	1.437***	0.273	1.312***	0.181
	(0.278)	(0.306)	(0.300)	(0.366)	(0.289)	(0.367)	(0.224)	(0.313)
Observations	1,374	16,662	1,374	16,662	1,374	16,662	656	15,173
R-squared	0.699	0.461	0.702	0.465	0.703	0.465	0.791	0.490

Note: Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. ††† (††) [†]: the H_0 that the coefficient is smaller/greater than or equal to 0 is rejected at the 1% (5%) [10%] significance level. BIS regressions include recipient-country-*i* -fixed effects. BBK regressions include bank-*k*- fixed effects.

Table 5: Results: liabilities

liabilities	BIS (1)	BBK (2)	BIS (3)	BBK (4)	BIS (5)	BBK (6)	BIS (7)	BBK (8)
$\Delta \log(a_{ij})$	**0.951†††**	**0.325†††**	**0.883†††**	**0.353†††**	**0.870†††**	**0.333†††**	**0.650†††**	**0.282††**
	(0.198)	**(0.111)**	**(0.289)**	**(0.121)**	**(0.265)**	**(0.121)**	**(0.209)**	**(0.165)**
$\Delta \log(K/L_{ij})$	0.761	-0.108	1.212	-0.118	1.182	-0.110	0.308	-0.143
	(0.888)	(0.310)	(1.055)	(0.240)	(0.989)	(0.240)	(0.757)	(0.344)
growth correlation$_{ij}$					-0.617	0.131	0.801	-0.0107
					(0.650)	(0.215)	(0.747)	(0.297)
$\log(FDI_{ij})$							0.706***	0.206
							(0.0996)	(0.144)
financial freedom$_j$	0.0206**		0.00918		0.00953		0.0148*	
	(0.00979)		(0.0124)		(0.0110)		(0.00768)	
financial freedom$_i$		0.0147***		0.0112**		0.0116**		0.00522
		(0.00507)		(0.00532)		(0.00549)		(0.00743)
openness$_j$	0.954***		0.714*		0.728**		1.422***	
	(0.288)		(0.344)		(0.324)		(0.419)	
openness$_i$		-0.0218		0.0140		0.00869		0.0373
		(0.121)		(0.0855)		(0.0842)		(0.100)
$\frac{\text{private credit}_j}{\text{GDP}_j}$			1.283		1.283		-1.127*	
			(0.974)		(0.928)		(0.590)	
$\frac{\text{private credit}_i}{\text{GDP}_i}$				0.893***		0.885***		0.984***
				(0.279)		(0.278)		(0.293)
property rights$_j$	0.0182		0.0115		0.0105		0.0707***	
	(0.0180)		(0.0352)		(0.0332)		(0.0225)	
property rights$_i$		0.00652		-0.00441		-0.00583		-0.0114
		(0.00691)		(0.00639)		(0.00724)		(0.00791)
banking crisis$_i$		-0.0398		0.389		0.441*		0.412
		(0.216)		(0.242)		(0.258)		(0.324)
$\log(GDP_j)$	1.227***		1.143***		1.172***		0.484**	
	(0.110)		(0.165)		(0.172)		(0.175)	
$\log(GDP_i)$		0.540***		0.518***		0.516***		0.324**
		(0.0552)		(0.0550)		(0.0552)		(0.149)
log(GDP per capita$_j$)	-1.044*		-1.271*		-1.194*		-3.043***	
	(0.571)		(0.680)		(0.623)		(0.859)	
log(GDP per capita$_i$)		-0.131		-0.210		-0.211		-0.0926
		(0.266)		(0.197)		(0.190)		(0.237)
$\log(distance_{ij})$	-1.175***	0.0652	-1.222***	0.0360	-1.272***	0.0396	-0.535	0.119
	(0.186)	(0.0909)	(0.236)	(0.0834)	(0.260)	(0.0829)	(0.360)	(0.0872)
common currency$_{ij}$	0.186	0.471*	0.271	0.422*	0.320	0.373	-0.151	0.292
	(0.443)	(0.259)	(0.499)	(0.247)	(0.509)	(0.268)	(0.533)	(0.301)
contiguity$_{ij}$	0.356	0.100	0.293	-0.0250	0.275	-0.0208	0.262	0.00329
	(0.458)	(0.357)	(0.425)	(0.417)	(0.430)	(0.420)	(0.405)	(0.385)
common legal system$_i$	0.816**	-0.149	0.872**	-0.302	0.898**	-0.305	0.630	-0.461
	(0.319)	(0.528)	(0.404)	(0.489)	(0.407)	(0.495)	(0.419)	(0.531)
common language$_{ij}$	0.0721	0.469	0.00117	0.990	-0.00400	1.037*	-0.0236	1.006
	(0.457)	(0.602)	(0.574)	(0.601)	(0.572)	(0.613)	(0.428)	(0.649)
colony$_{ij}$	2.149***	-0.164	2.236***	0.333	2.161***	0.304	0.606	0.272
	(0.383)	(0.447)	(0.380)	(0.429)	(0.363)	(0.446)	(0.355)	(0.394)
Observations	491	39,556	491	38,172	491	38,172	369	33,668
R-squared	0.622	0.406	0.630	0.423	0.631	0.424	0.701	0.459

Note: Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. ††† (††) [†]: the H_0 that the coefficient is smaller/greater than or equal to 0 is rejected at the 1% (5%) [10%] significance level. BIS regressions include recipient-country-*i* -fixed effects. BBK regressions include bank-*k*-fixed effects.

Table 6: Results: liabilities/assets

$\frac{\text{liabilities}}{\text{assets}}$	BIS	BBK	BIS	BBK	BIS	BBK
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \log(a_{ij})$	-0.0491	0.614***	-0.0221	0.515**	0.241	0.635***
	(0.393)	(0.199)	(0.397)	(0.200)	(0.186)	(0.226)
$\Delta \log(K/L_{ij})$	**-3.667††**	**-0.681††**	**-3.557††**	**-0.605††**	**-1.671††**	**-0.611†**
	(2.005)	**(0.364)**	**(1.963)**	**(0.344)**	**(0.865)**	**(0.393)**
growth correlation$_{ij}$			0.608	0.531*	1.551*	0.796*
			(0.744)	(0.311)	(0.799)	(0.430)
$\log(FDI_{ij})$					0.370***	-0.146*
					(0.0978)	(0.0732)
financial freedom$_j$	0.00872		0.00937		0.0213**	
	(0.0183)		(0.0190)		(0.00967)	
financial freedom$_i$		-0.0136*		-0.0127*		-0.00981
		(0.00724)		(0.00703)		(0.00899)
openness$_j$	0.864		0.817		0.625	
	(0.579)		(0.587)		(0.543)	
openness$_i$		-0.0421		-0.0570		-0.157
		(0.144)		(0.131)		(0.158)
property rights$_j$	-0.0465		-0.0457		0.00413	
	(0.0395)		(0.0414)		(0.0196)	
property rights$_i$		0.00640		-0.000220		0.00405
		(0.00673)		(0.00785)		(0.0108)
banking crisis$_i$		-0.166		0.0958		-0.195
		(0.364)		(0.404)		(0.373)
log(GDP per capita$_j$)	1.882		1.771		-2.127*	
	(1.317)		(1.329)		(1.087)	
log(GDP per capita$_i$)		-0.485		-0.456*		-0.386
		(0.302)		(0.269)		(0.272)
log(distance$_{ij}$)	-0.0381	0.217	-0.00556	0.239	-0.0218	0.295*
	(0.231)	(0.169)	(0.243)	(0.165)	(0.203)	(0.149)
common currency$_{ij}$	0.353	-0.325	0.299	-0.535**	-0.273	-0.471
	(0.512)	(0.234)	(0.485)	(0.232)	(0.569)	(0.287)
contiguity$_{ij}$	1.004*	-0.928**	1.000*	-0.899**	0.588*	-0.754*
	(0.487)	(0.409)	(0.483)	(0.412)	(0.287)	(0.400)
common legal system$_{ij}$	0.475	-0.171	0.452	-0.199	0.371	-0.243
	(0.316)	(0.260)	(0.313)	(0.266)	(0.341)	(0.246)
common language$_{ij}$	0.273	1.542***	0.270	1.777***	-0.0821	1.707***
	(0.437)	(0.391)	(0.439)	(0.414)	(0.444)	(0.435)
colony$_{ij}$	0.378	1.492***	0.461	1.404***	-0.164	1.335***
	(0.461)	(0.440)	(0.419)	(0.437)	(0.215)	(0.430)
Observations	488	17,384	488	17,384	366	16,054
R-squared	0.385	0.325	0.388	0.326	0.527	0.347

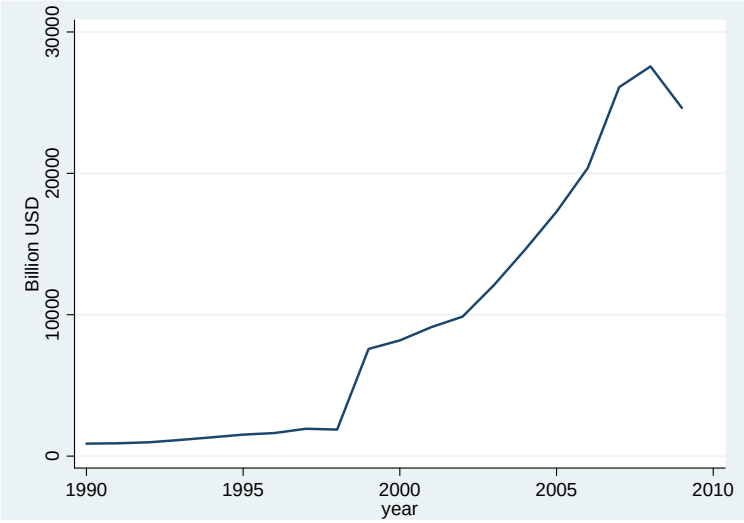
Note: Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. ††† (††) [†]: the H_0 that the coefficient is smaller/greater than or equal to 0 is rejected at the 1% (5%) [10%] significance level. BIS regressions include recipient-country-*i* -fixed effects. BBK regressions include bank-*k*-fixed effects.

Table 7: Accounting for interbank lending

	liabilities	$\frac{\text{liabilities}}{\text{assets}}$	$\frac{\text{bank assets}}{\text{private assets}}$	
	BBK	BBK	BIS	BBK
	(1)	(2)	(3)	(4)
$\Delta \log(a_{ij})$	**0.157**	0.475**	**-0.326†**	**-0.510†**
	(0.127)	(0.210)	**(0.252)**	**(0.351)**
$\Delta \log(K/L_{ij})$	**0.163**	**-0.895††**	-1.203	1.262**
	(0.248)	**(0.433)**	(0.766)	(0.532)
financial freedom$_j$			-0.00333	
			(0.00899)	
financial freedom$_i$	0.0121**	-0.0136		-0.00366
	(0.00531)	(0.00910)		(0.00607)
openness$_j$			0.113	
			(0.362)	
openness$_i$	0.0281	-0.0203		0.194
	(0.0797)	(0.147)		(0.119)
$\frac{\text{private credit}_j}{\text{GDP}_j}$			-0.565	
			(0.447)	
$\frac{\text{private credit}_i}{\text{GDP}_i}$	0.872***			
	(0.270)			
property rights$_j$			-0.0183	
			(0.0123)	
property rights$_i$	-0.00892	0.00690		0.00901
	(0.00689)	(0.00963)		(0.0168)
banking crisis$_i$	0.535**	0.295		-1.360***
	(0.250)	(0.454)		(0.470)
$\log(GDP_j)$			-0.176	
			(0.103)	
$\log(GDP_i)$	0.511***			
	(0.0540)			
log(GDP per capita$_j$)			0.997	
			(0.640)	
log(GDP per capita$_i$)	0.00858	-0.633*		0.618*
	(0.198)	(0.338)		(0.340)
log(distance$_{ij}$)	0.0217	0.313	0.252*	-0.177***
	(0.0756)	(0.242)	(0.138)	(0.0589)
common currency$_{ij}$	0.619**	-1.107***	0.336	0.654
	(0.262)	(0.401)	(0.299)	(0.635)
contiguity$_{ij}$	-0.217	-0.867*	0.204	-0.257
	(0.396)	(0.474)	(0.368)	(0.683)
common legal system$_{ij}$	-0.307	-1.560***	0.000771	1.839***
	(0.518)	(0.410)	(0.133)	(0.366)
common language$_{ij}$	1.041	1.892***	-0.106	-0.330
	(0.633)	(0.414)	(0.215)	(0.797)
colony$_{ij}$	0.463	1.544***	-0.431**	0.309
	(0.406)	(0.444)	(0.180)	(0.768)
Observations	38531	21,286	1,124	4,630
R-squared	0.452	0.310	0.400	0.378

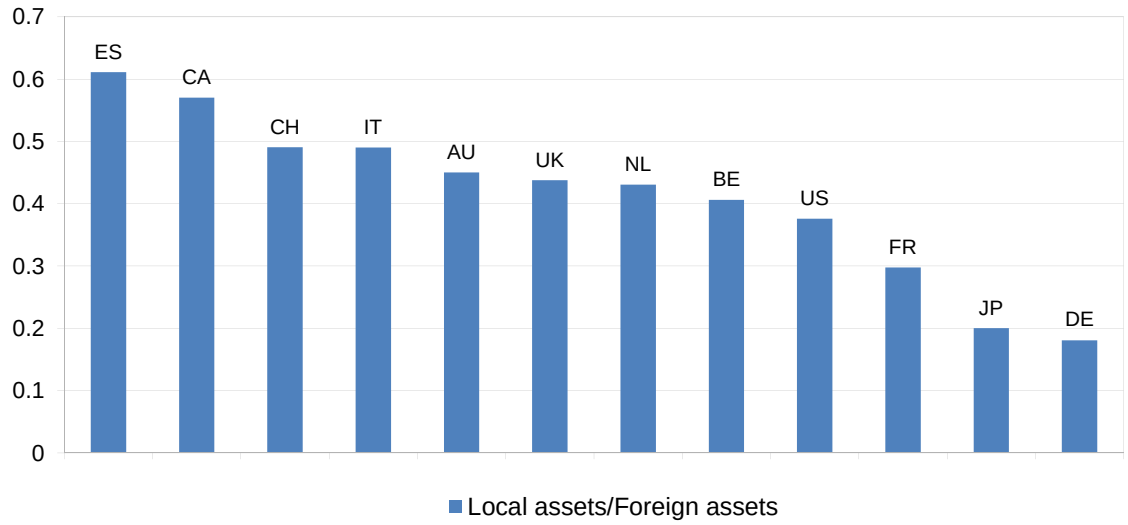
Note: Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. ††† (††) [†]: the H_0 that the coefficient is smaller/greater than or equal to 0 is rejected at the 1% (5%) [10%] significance level. BIS regressions include recipient-country-*i* -fixed effects. BBK regressions include bank-*k* -fixed effects.

Figure 1: Evolution of foreign assets over time, 1990-2009



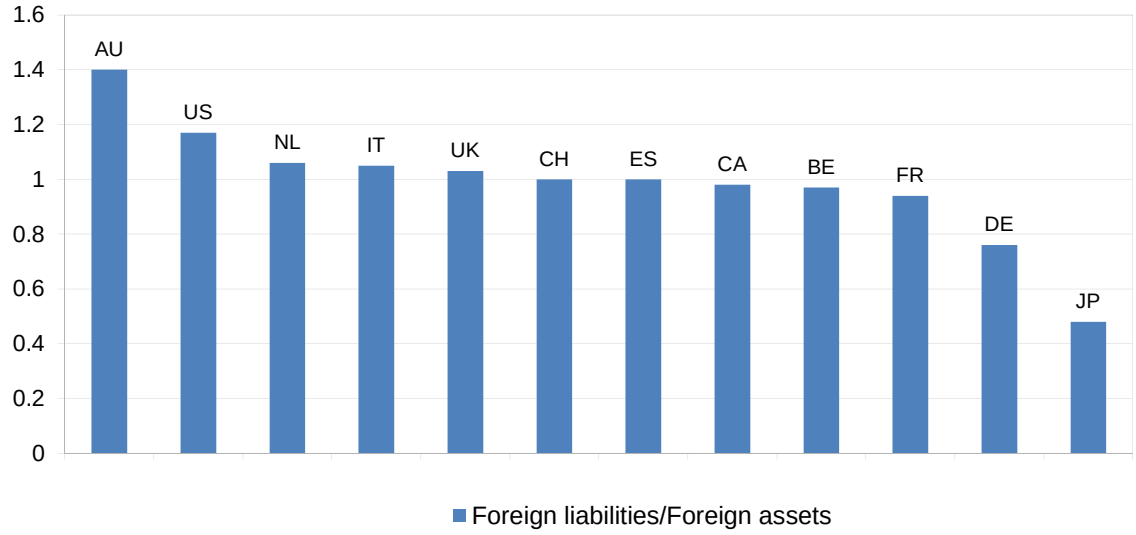
Note: The graph shows the evolution of the aggregate foreign assets of 25 BIS reporting countries over time. There is a break in the series in 1998.

Figure 2: Heterogeneity in international and global banking, 2009



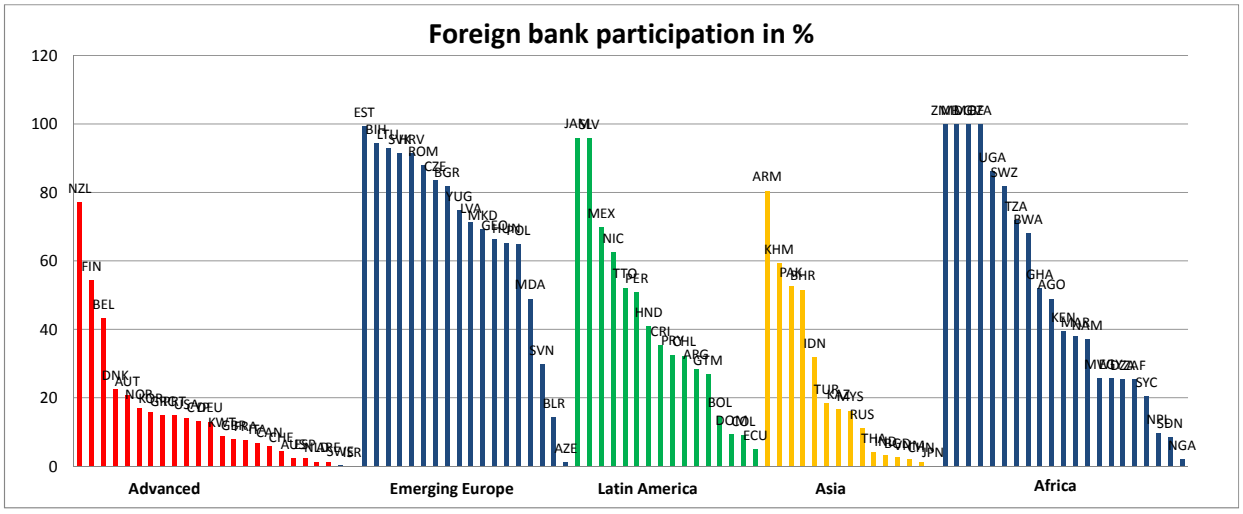
Note: Banking sectors differ in the degree to which they engage in global and international banking, reflected in the degree to which they operate through foreign affiliates. The graph shows the share of foreign assets that are held on the balance sheets of foreign affiliates located in the respective host market (local assets) for different banking sectors in the year 2009. For a detailed description of the underlying data, see Committee on the Global Financial System (2010*a*) and McGuire and Peter (2009).

Figure 3: Heterogeneity in foreign liability-asset gaps, 2009



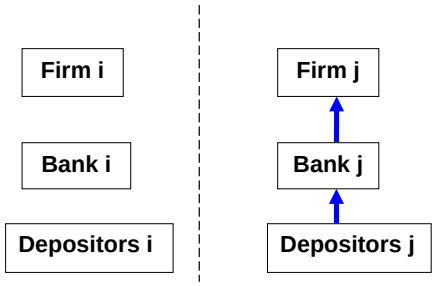
Note: Banking sectors differ with respect to their liability-assets gaps, that is, the foreign assets that banks hold in a given market are matched to varying degrees by foreign liabilities. The graph shows the ratio of foreign liabilities to foreign assets for different banking sectors in the year 2009. For a detailed description of the underlying data, see Committee on the Global Financial System (2010*a*) and McGuire and Peter (2009).

Figure 4: Heterogeneity in foreign bank participation, 2009

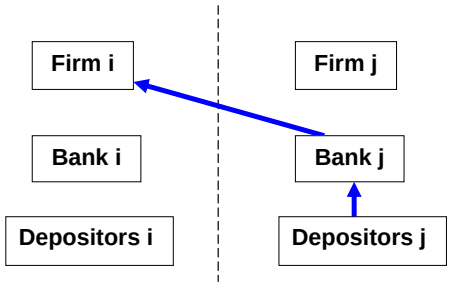


Note: Countries differ in foreign bank participation. The graph displays the share of lending by foreign banks in total domestic lending for different countries in the year 2009. For information on the underlying data, see Claessens and van Horen (2012).

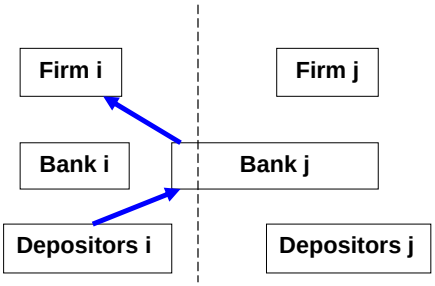
Figure 5: Four banking activities



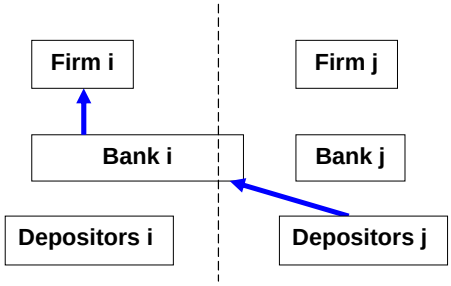
Panel 1: Domestic Banking



Panel 2: International Banking

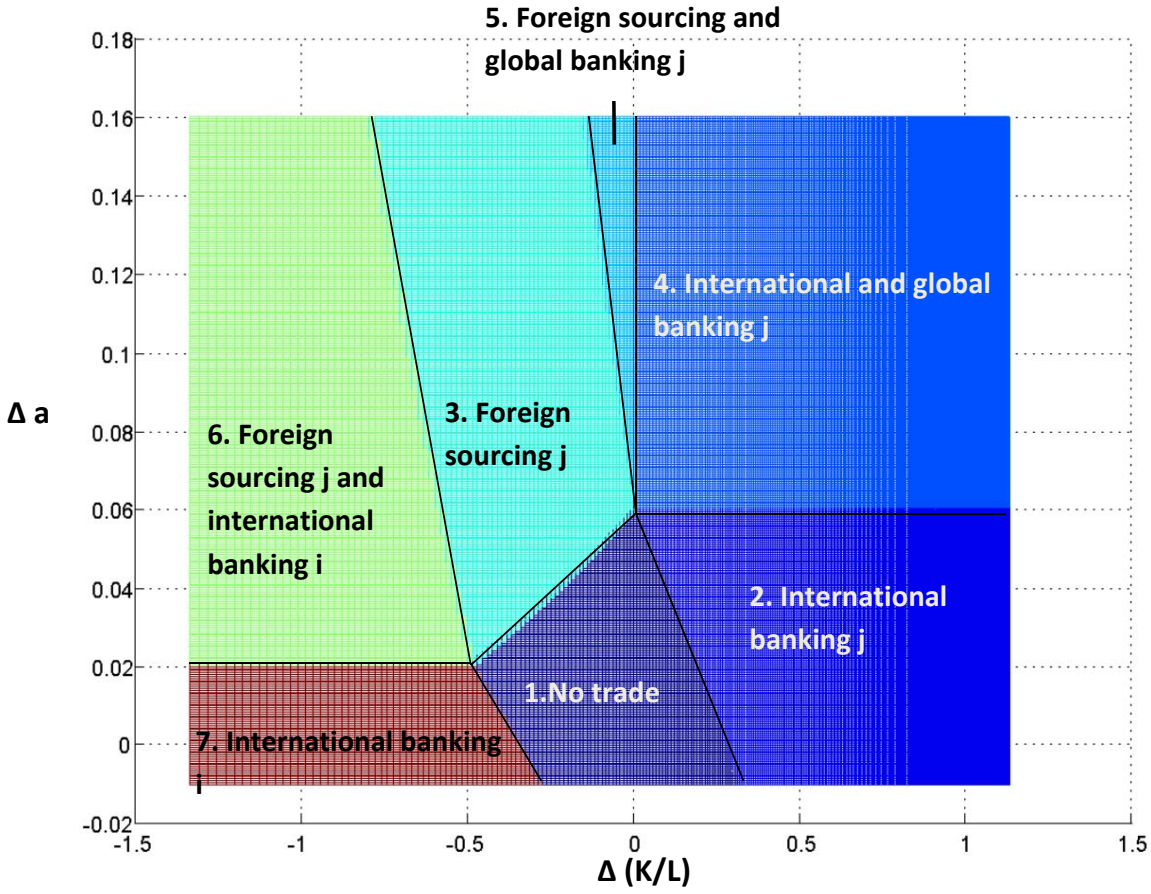


Panel 3: Global Banking



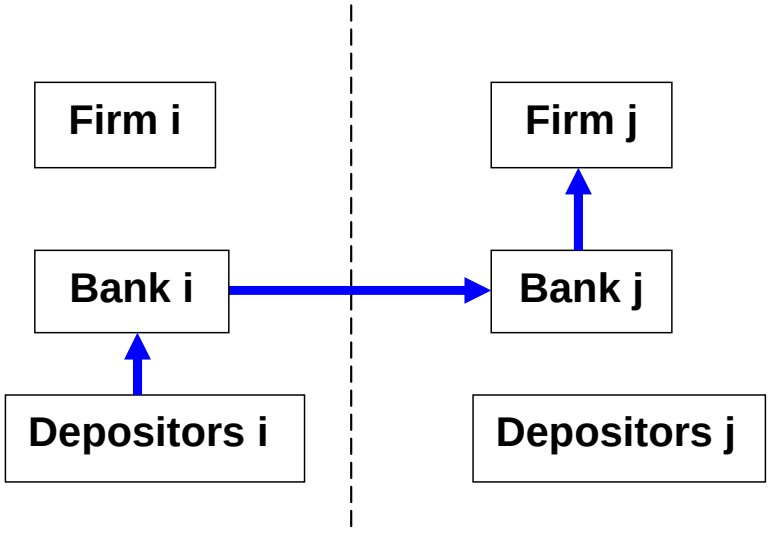
Panel 4: Foreign Sourcing

Figure 6: Equilibrium types



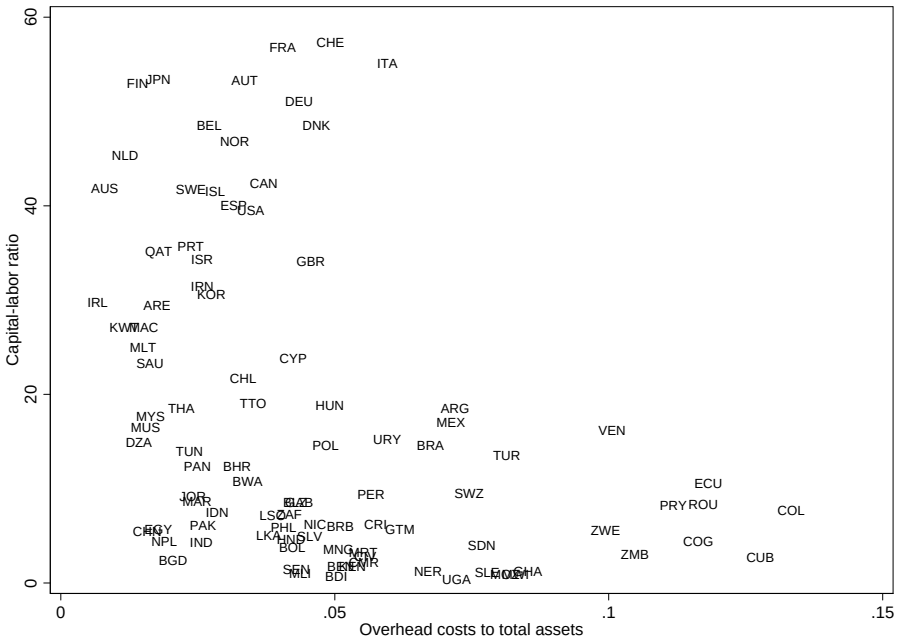
Note: The graph shows how the equilibrium type changes as the parameter values of Δa and $\Delta(K/L)$ vary. The following parameters are chosen for the numerical example: $\tau_{ij} = \tau_{ji} = 0.02$, $t_{ij} = t_{ji} = 0.04$, $K_i = 20$, $K_j = 20$, $L_j = 10$, $L_i \in [6, 23]$, $a_i \in [0.22, 0.4]$, $a_j = 0.25$, $z = 3$, $\gamma = 4$. The production function is Cobb-Douglas with a labor share of 0.3.

Figure 7: Bank-to-bank lending



$$A^{B}_{ji}>0,\ LI_{ij}>0$$

Figure 8: Overhead costs and capital-labor ratios across countries, 2000



Note: The graph shows for each country in the sample the respective the ratio of overhead costs to total assets (x-axis) of the domestic banking sector and its human-capital adjusted capital-labor ratio (y-axis).