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Banking across borders

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(Federal Reserve Bank of New York)

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Non-technical summary

Banks have substantially expanded their activities across borders over the past two decades in several ways. They have invested more domestic capital in foreign countries, a cross-border operation defined as *international banking*. Moreover, they have, to a much larger extent, intermediated capital locally through branches and subsidiaries in foreign markets, an activity called *global banking*. While growth in banking across borders has been similar in many countries, there has been significant heterogeneity in the extent to which banking sectors engage in international versus global banking. The reasons for these differences have remained largely unexplored.

In this paper, I develop a model of banking across borders that can explain these facts and replicate major patterns in the data. In the model, countries differ in relative factor endowments and in banking sector efficiencies. These differences lead to trade in banking services when countries become integrated. The model shows that international banking is driven by differences in factor endowments, whereas global banking arises from differences in banking sector efficiencies. Banks' foreign asset and liability positions are a result of the two driving forces working together.

In the empirical part of the paper, I test key implications of the theory concerning the cross-country pattern of banks' foreign positions. To that end, I draw on data on foreign asset and liability holdings from the Bank for International Settlements that vary across source countries and recipient countries. In addition, data from Deutsche Bundesbank is used that provide details on the foreign positions of German banks in a large number of recipient countries. Evidence from both sources strongly supports the model.

Specifically, the results indicate that more efficient banking sectors lend more and borrow more in countries that host less efficient banking sectors. In addition, banks from capital-abundant countries invest more in the private sector in capital-scarcer countries. Thus, the cross-country pattern of international and global banking appears to be driven by real factors with potential benefits to home and host countries.

Nicht-technische Zusammenfassung

Grenzüberschreitende Bankgeschäfte haben in den vergangenen 20 Jahren signifikant zugenommen. Zum einen investieren Banken heute mehr inländisches Kapital im Ausland, ein Geschäft, das als *International Banking* bezeichnet wird. Zum anderen operieren Banken in fremden Märkten vermehrt durch Tochtergesellschaften und Filialen. Diese Form von Aulandsaktivität, *Global Banking* genannt, beinhaltet, dass Banken im Ausland sowohl Kapital investieren, als auch aufnehmen. Während in vielen Ländern ähnliche Entwicklungen stattgefunden haben, gibt es erhebliche Unterschiede im Hinblick auf das Ausmaß, mit dem Banken International Banking und Global Banking betreiben. Die Gründe für diese Unterschiede wurden bislang wenig erforscht.

In diesem Papier entwickle ich ein Allgemeines Gleichgewichtsmodell, das diese Zusammenhänge erklärt und in der Lage ist andere relevante Strukturen in den Daten zu replizieren. Im Modell unterscheiden sich Länder im Bezug auf ihre Kapitalausstattungen und im Bezug auf die Effizienz ihrer Bankensektoren. Wenn Banken grenzüberschreitend Geschäfte tätigen dürfen, führen diese Unterschiede zum Handel von Finanzdienstleistungen. Insbesondere zeigt das Modell, dass International Banking von Unterschieden in der Faktorausstattung zwischen Ländern herrührt, wohingegen Global Banking auftritt, wenn Länder sich in der Effizienz ihrer Bankensektoren unterscheiden. Diese beiden Triebkräfte wirken im Allgemeinen zusammen und bestimmen gemeinsam die Auslandspositionen von Banken.

Im empirischen Teil des Papiers teste ich grundlegende Vorhersagen des Modells. Dabei verwende ich Daten der Bank für Internationalen Zahlungsausgleich, die über die Quellenländer und Empfängerländer variieren. Außerdem benutze ich Informationen über die Auslandsforderungen und -verpflichtungen deutscher Banken, die bei der Deutschen Bundesbank vorliegen. Die empirische Evidenz aus den beiden Datensätzen bestätigt die Hypothesen des entwickelten Modells. In Übereinstimmung mit der Theorie weisen die Ergebnisse insbesondere daraufhin, dass effizientere Bankensektoren mehr Kapital in Länder mit weniger effizienten Bankensektoren verleihen und aufnehmen. Andererseits investieren Banken aus Ländern mit höherer Kapitalausstattung mehr in Länder, die ärmer an Kapital sind. Dies deutet darauf hin, dass die ausländischen Geschäfte von Banken im Querschnitt von realen Faktoren bestimmt werden und dass sie möglicherweise Wohlfahrtsgewinne für Quellen- und Empfängerländer mit sich bringen.

Banking across Borders*

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Abstract

Banking across borders has risen substantially over the past two decades. Yet there is significant heterogeneity in the international and global activities of banks across countries. This paper develops and tests a theoretical model that explains this variation from an international trade theory perspective. In the model, banking across borders arises from differences in factor endowments and differences in banking sector efficiencies between countries. The paper shows how these differences determine banks' foreign asset and liability holdings as well as foreign direct investment in the banking sector. It highlights the differential effects of capital account and banking sector liberalization on banks' foreign positions and international capital flows. The model is consistent with major stylized facts on cross-border banking. The data strongly support its cross-sectional predictions.

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

JEL classification: F21, F23, F34, G21

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1 Introduction

Banks have substantially expanded their activities across borders over the past two decades in several ways. They have invested more domestic capital in foreign countries, a cross-border operation defined as *international banking*. Moreover, they have, to a much larger extent, intermediated capital locally through branches and subsidiaries in foreign markets, an activity called *global banking*. While growth in banking across borders has been similar in many countries, there has been significant heterogeneity in the extent to which banking sectors engage in international versus global banking.¹ The reasons for these differences have remained largely unexplored.

In this paper, I develop a model of banking across borders that can explain these facts and replicate major patterns in the data. In contrast to most models in the cross-border banking literature, which build on portfolio theory, the framework introduced here takes an international trade theory perspective. I model Heckscher-Ohlin endowment differences and Ricardian technology differences, which lead to trade in banking services in the open economy general equilibrium framework presented. In particular, the model shows that differences in factor endowments across countries drive international banking, whereas differences in banking sector efficiencies lead to global banking. Banks' foreign asset and liability positions are a result of the two driving forces working together. I find strong support for the cross-sectional predictions of the theory in the data. Beyond its relevance for banking and trade, this research also contributes to the literature on financial frictions and capital flows and relates back to the international finance and portfolio literature.

In the model, banks provide intermediation services. They channel 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 financial interest rate is endogenous in the model and depends on the capital-labor ratio and on 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.² When two countries differ in relative factor endowments and in banking sector efficiencies, interest rates and intermediation fees differ in the two markets. This variation gives rise to trade in banking services as entrepreneurs seek to minimize the costs of external capital.

The model incorporates three additional elements. First, an entrepreneur who is served by a foreign bank has to pay an additional 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 liberalization. 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 presence in the foreign market.³ Finally, the more banks intermediate foreign capital, the more capacity constrained and the less efficient they become.

In an equilibrium in the open economy, capital flows and banking sectors expand to equilibrate gross returns to capital and banking sector efficiencies in the two countries.

¹Section 2 presents these stylized facts in detail.

²Depositors and firms are immobile, but banks can operate abroad and channel capital across borders.

³Banks maintain their efficiency when operating abroad but incur additional costs.

The direction of equilibrium capital flows depends on relative factor endowments. Differences in banking sector efficiencies in turn determine which banking sector channels capital across borders and to what extent, either by lending domestic capital to firms abroad (international banking) or by borrowing foreign capital for investment at home (foreign sourcing). If differences in banking sector efficiencies are large relative to differences in factor endowments, the more efficient banking sector also engages in global banking, that is, it both borrows and lends in the foreign market, replacing the local banking sector. The lower the frictions, (that is, the lower the impediments are to capital account transactions and foreign bank entry) the more efficiently capital is allocated, and the smaller the efficiency differences are across countries in equilibrium.

I derive predictions of foreign bank asset and liability holdings, objects that are observed in international banking data. The empirical part of the paper tests in particular three key implications of the theory. First, foreign assets and liabilities of the source banking sector are an increasing function of the efficiency advantage of the source country relative to the recipient country. Second, foreign assets increase and foreign liabilities decrease in the capital abundance of the source country relative to the recipient country. Third, the ratio of foreign liabilities to foreign assets decreases in the relative capital abundance of the source country. The empirical analysis is based on two different datasets. I use information on foreign asset and liability holdings from the Bank for International Settlements (BIS) that varies across source countries and recipient countries. In addition, I draw on data from Deutsche Bundesbank that contain information on the foreign positions of German banks in a large number of recipient countries. Evidence from both sources strongly supports the three hypotheses.

My research goes beyond the cross-border banking context and delivers also novel insights to the international finance and international macroeconomic literature. If countries differ in banking sector efficiencies, a gravity relationship for bank assets, where foreign assets increase one to one with the gross domestic product (GDP) of the source and the recipient country, does not hold: as banking sectors engage in global banking, the link between domestic market size and foreign asset holdings is weakened. This result is in line with complementary work by [Okawa and van Wincoop \(2012\)](#), who find that a symmetric gravity relationship is not robust in portfolio models.⁴

The theory also shows that who channels capital across borders matters for the allocation of capital. In the model, banks face transaction costs and differ in their efficiencies. When banking sectors are closed, the financially underdeveloped country attracts more capital than equalization of marginal products of capital prescribes. As banking sectors are liberalized, the capital flow reverses, and capital is allocated more efficiently. I also find that the relationship between financial development and capital flows is, in general, not linear. As banking sector efficiency increases in one country, equilibrium capital flows can go down. These results depend on the market structure and the nature of the transaction costs that intermediaries face, suggesting that these microlevel aspects deserve more consideration in future research.

The paper contributes to the current policy debate on cross-border banking (see e.g. [Committee for International Economic Policy and Reform \(2012\)](#)). In line with the model, the empirical results indicate that banking sector efficiencies play an economically impor-

⁴See also [Martin and Rey \(2004\)](#) and [Portes and Rey \(2005\)](#) in this context.

tant role in determining bank investment and funding. In addition, banks from capital-abundant countries invest more in the private sector in capital-scarcer countries.⁵ Thus, the cross-country pattern of international and global banking appears to be driven by real factors with potential benefits to home and host countries.⁶

More related literature Adding more broadly to the growing literature on services trade,⁷ I propose a new theory of international and global banking.⁸ Only a few theoretical papers suggest an alternative to portfolio models to explain cross-border banking.⁹ In [de Blas and Russ \(2012\)](#), firms send out loan applications randomly to a limited number of banks, also applying at foreign banks to minimize expected costs.¹⁰ [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.

Portfolio models of cross-border banking assume that banks invest abroad to diversify their assets. The empirical part addresses the related correlation puzzle discussed in [Aviat and Coeurdacier \(2007\)](#) and [Buch, Koch, and Koetter \(2009\)](#). The authors report that banks invest more in countries that exhibit higher return correlations, opposite of what portfolio theory prescribes. In contrast, I find evidence that banks diversify lending when controlling for factor endowments, banking sector efficiencies and follow-your-customer motives.

Regarding the literature on international capital flows and financial frictions, this paper relates to [Mendoza, Quadrini, and Ríos-Rull \(2009\)](#) and [Antras and Caballero \(2009\)](#), for example. As in these works, differences in financial sector development induce capital flows, here in the form of differences in banking sector efficiencies similar to [Ju and Wei \(2010\)](#). While many papers study the effect of capital account liberalization and financial integration, my research is, to the best of my knowledge, the first work to consider the additional, distinct effects of banking sector liberalization and trade in financial services on capital flows.

Exploring the omitted effects of differences in endowments and differences in banking sector efficiency between countries, this paper confirms earlier empirical findings that institutions matter for foreign bank assets (see [Papaioannou \(2009\)](#)) and that banks engage 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 \(2003\)](#); [Focarelli and Pozzolo \(2005\)](#); [Buch and Lipponer \(2007\)](#)).¹¹

⁵This is in line with recent findings by [Alfaro, Kalemli-Ozcan, and Volosovych \(2011\)](#) that private capital flows downstream.

⁶A growing strand of the literature analyzes the implications of multinational banking for regulation (see, e.g., [Calzolari and Lóránth \(2010\)](#)) and financial stability (see, e.g., [Cetorelli and Goldberg \(2012\)](#); [de Haas and van Lelyveld \(2006\)](#)).

⁷See [Francois and Hoekman \(2010\)](#) for a review of recent developments in services trade research.

⁸Early works that discuss the internationalization strategies of banks are [Aliber \(1984\)](#), [Grubel \(1989\)](#) and [Williams \(1997\)](#).

⁹[Dell’Ariccia and Marquez \(2010\)](#) investigate the organizational choice of banks abroad, taking the foreign operations of banks as given.

¹⁰In [de Blas and Russ \(2010\)](#), an earlier version, banks offer differentiated products just as manufacturing firms.

¹¹See, e.g., [Goldberg \(2007\)](#) and [Cull and Martínez Peria \(2010\)](#) for a review of the empirical literature.

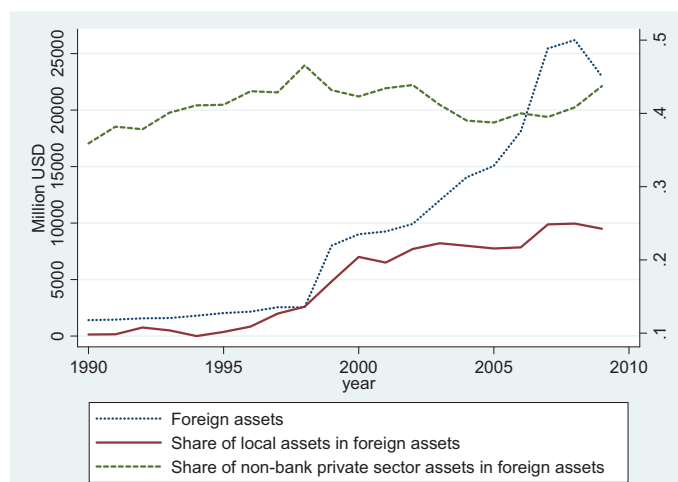
The paper is organized as follows: [Section 2](#) presents stylized facts, [Section 3](#) introduces the closed economy setup, [Section 4](#) studies the open economy, [Section 5](#) discusses the empirical analysis, and [Section 6](#) concludes.

2 Stylized Facts

A model of international and global banking should be able to account for the following five facts:

1. **Expansion:** Banks' foreign activities have risen substantially.
2. **From international to global:** The importance of global banking has increased relative to international banking over time.
3. **Heterogeneity:** There is heterogeneity in international and global banking across countries.
4. **Net capital flows:** Some banking sectors are capital importers; some are exporters.
5. **Two types of openness:** Banking sector and capital account liberalization have differential effects on the foreign operations of banks.

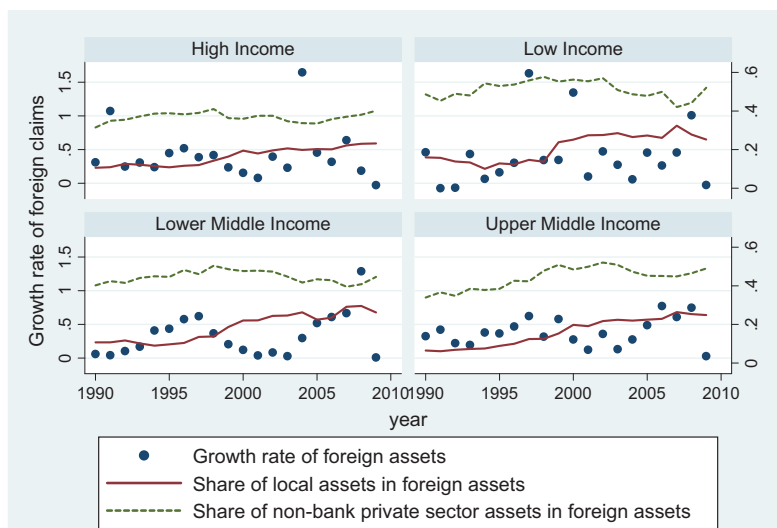
Figure 1: Evolution of foreign assets over time, 1990-2009



Note: The graph shows the evolution of foreign asset holdings of 25 BIS reporting countries over time. The solid line depicts the U.S. dollar valued average foreign assets (y -axis on the left). They include the claims of all banks whose headquarters are in one of the BIS reporting countries in a large set of foreign countries. The dashed line is the ratio of local claims to foreign assets (y -axis on the right). The dotted line shows the ratio of assets invested in the nonbank private sector to foreign assets (y -axis on the right). There is a break in the series in 1998.

First, over the past two decades, the foreign asset holdings of banks have risen significantly.¹² Figure 1 shows the evolution of average bilateral asset holdings for a group of 25 source countries and a large set of recipient countries (dotted line).¹³ Foreign positions rose after 1998, while the share of assets invested in the nonbank private sector (dashed line) has been mostly stable, averaging around 40 percent.¹⁴ These asset holdings increased in countries from every income group, as can be seen from Figure 2, which displays similar growth rates across recipient groups.

Figure 2: Evolution of foreign assets across recipient income groups, 1990-2009



Note: The figure shows that developments have been similar across recipient income groups. The solid line depicts the average ratio of local assets to foreign assets of BIS reporting countries held in high-income, upper-middle-income, lower-middle-income and low-income countries (y -axis on the right). The dashed line shows the average ratio of assets invested in the nonbank private sector to foreign assets (y -axis on the right) in those countries. The points correspond to the average yearly growth rates of foreign assets (y -axis on the left) for each group.

The second stylized fact is that banks are increasingly raising and lending funds abroad through foreign affiliates rather than extending cross-border loans. The literature distinguishes two different forms of banking across borders: *international banking* and *global banking*. In international banking, a bank raises capital in its domestic market and lends it to a foreign market (similar to exporting). In global banking, in contrast, a bank raises funds in a foreign market and lends them to the same (foreign) market (mostly through

¹²Bruno and Shin (2012) argue that part of the expansion in banks' foreign activities was due to an increase in the balance sheet capacity of banks, i.e., in global liquidity, as a result of lower perceived risk. Their research, however, does not address the observed heterogeneity in foreign positions across banking sectors and the increased importance of FDI for the foreign operations of banks.

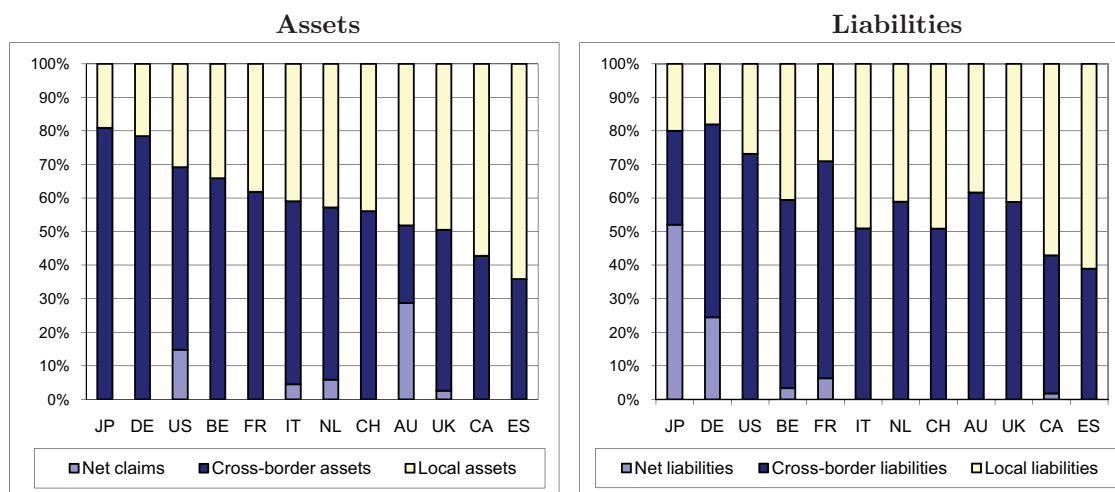
¹³While Figure 1 plots the average U.S. dollar value of bilateral foreign assets, the increase in foreign assets has been substantial even as a fraction of world GDP or compared to the increase in international trade during the same period. See Committee on the Global Financial System (2010b).

¹⁴The empirical part of this paper focuses on assets and liabilities in the private sector.

FDI).

The solid line in [Figure 1](#) shows the share of local assets (local currency) in foreign assets, that is, the share of foreign assets held through affiliates in the host market in the currency of the host market. This share has been increasing since the mid-1990s, which indicates that banks operate more and more through branches and subsidiaries abroad. Global banking has become relatively more important than international banking over time.¹⁵

Figure 3: Modes of foreign bank operations



Note: The modes of international operations differ between countries. The panel on the left shows foreign assets of different banking sectors split into foreign assets on the balance sheets of banks located in the home country or a third country (cross-border assets) and on the balance sheets of affiliates located in the respective host market (local assets). The panel on the right shows the equivalent split for foreign liabilities. If foreign liabilities are larger than foreign assets, a banking sector has net claims. It has net liabilities if foreign assets are larger than foreign liabilities. For a detailed description of the data construction, see [Committee on the Global Financial System \(2010a\)](#) and [McGuire and Peter \(2009\)](#).

Third, there is substantial heterogeneity in international and global banking across banking sectors. [Figure 3](#) shows foreign assets and liabilities of different banking sectors split into assets and liabilities on the balance sheets of banks located in the home country or a third country (cross-border assets) and on the balance sheets of affiliates located in the respective recipient country (local assets).¹⁶ While Spanish banks, for example, operate mainly through foreign affiliates (more than 65 percent of all assets are held by foreign affiliates), Japanese banks conduct international business predominantly from home; more than 80 percent of all foreign assets are held by banks located in Japan. This

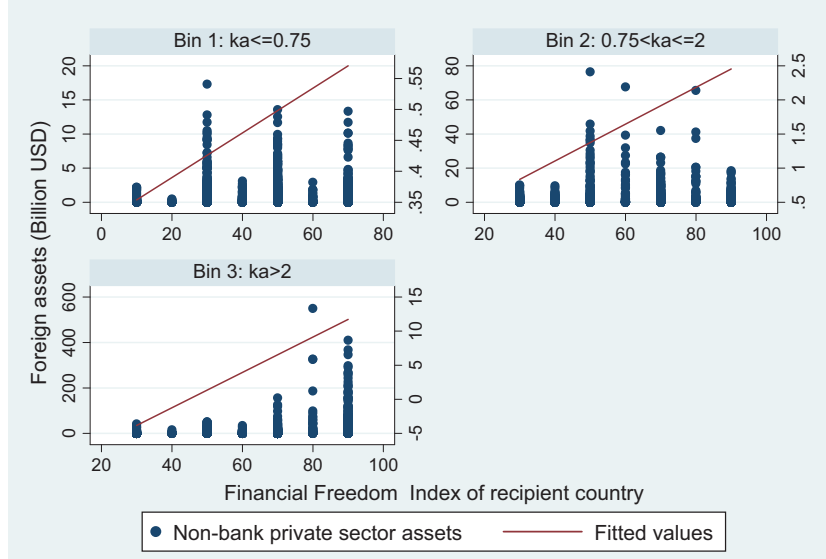
¹⁵[McCauley, Ruud, and Wooldridge \(2002\)](#) were the first to argue that there has been a move from international banking toward global banking, a phenomenon they call the “globalisation of international banking”. See also [McCauley, McGuire, and von Peter \(2010\)](#) and [McCauley, McGuire, and von Peter \(2012\)](#).

¹⁶The data that underly the two graphs in [Figure 3](#) were kindly provided by the Bank for International Settlements.

difference suggests that Spanish banks engage more in global banking, while Japanese banks do more international banking.¹⁷

Figure 3 also illustrates the fourth stylized fact: some banking sectors are net lenders; some are net borrowers. The German banking sector, for example, is a net exporter of capital as it holds net claims. The U.S. banking sector, in contrast, is a net importer of capital as its foreign liabilities exceed its foreign assets.

Figure 4: Foreign assets as a function of capital account openness and financial freedom



Note: The figure shows foreign assets (international claims vis-à-vis the nonbank private sector) of BIS reporting countries as a function of financial freedom of the recipient country for increasing degrees of capital account openness of the recipient country (measured by the Chinn & Ito Index). The upper-left panel collects recipient countries for which the Chinn & Ito Index takes values below or equal to 0.75. The upper-right panel includes recipient countries whose index is between 0.75 and 2. In the lower-left panel, recipient countries have index values that are greater than 2. The line is obtained from fitting a linear regression (y -axis on the right). Note that the range of the y -axes differs across panels.

Finally, banking sector and capital account liberalization have differential effects on foreign bank assets. Figure 4 plots the amount of foreign bank assets for a large set of country pairs as a function of Financial Freedom (left y -axis), which measures the openness of the banking sector in the recipient country. In each panel, the degree of capital account openness of the recipient country varies, increasing from left to right. Note that the range of the y -axes is different in each panel. The figure indicates that for the same degree of financial freedom, a reduction in restrictions to capital account transactions in the recipient country increases foreign asset holdings. At the same time, banks hold more assets in countries that exhibit lower bank entry barriers; this positive effect is higher, the more open these countries are to financial flows. The model presented

¹⁷Note that the notion of international banking includes carry trade, in which banks trade assets in order to exploit interest rate differentials across countries.

in this paper can accommodate and explain these five facts simultaneously.

3 Closed Economy

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.¹⁸ 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 $x = z - y$ 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.¹⁹

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:

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

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:

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

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

Because the entrepreneur can save on intermediation costs, he invests his entire capital endowment of 1 in the firm and raises $z - 1$ units of external capital.

¹⁸It is possible to endogenize the capital input by adding a moral hazard problem along the lines of [Ju and Wei \(2010\)](#).

¹⁹The 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.

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.²⁰ Therefore:

$$\pi = zR - c(z - 1) - (1 + r)(z - 1) = (1 + r). \quad (4)$$

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

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

The financial interest rate in the economy is a function of endowments and of banking sector efficiency. 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.

4 Open Economy

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.²¹ 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.²² 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 (FDI) and to engage in the same business as domestic banks.²³ Entrepreneurs choose between domestic and foreign banks and implicitly between domestic and foreign capital, taking these costs into account.

²⁰The service fee c that banks demand is assumed to be sufficiently small so that financial intermediation and production are beneficial in the economy.

²¹In 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.

²²Foreign 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, running a retail business arguably requires more frequent interactions with customers, the installation of cash machines and the like.

²³There may be synergies between borrowing from depositors and lending to firms in the same country, for example, if a physical presence abroad not only allows banks to raise foreign deposits but also facilitates

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.²⁴ Precisely:

$$c_j(D_{ij}) = a_j \left(1 + \frac{D_{ij}}{K_j}\right)^\gamma, \quad (6)$$

where $\gamma > 0$.²⁵ The exogenous cost parameter a_j reflects inversely the efficiency of banking sector j . This factor, together with the extent of borrowing abroad D_{ij} , determines the service fee that banking sector j demands from entrepreneurs. 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 negative.²⁶ In this case, banking sector i intermediates deposits of country j , making banking sector j 's intermediation costs decline.

If banks engage in banking across borders, capital can relocate. This 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:

$$R_j = 1 + F_K \left(1, \frac{K_j - K_{ij}}{L_j}\right). \quad (7)$$

K_{ij} can be negative, which implies that the direction of the capital flow is reversed.²⁷

International banking data contain information on the foreign assets and liabilities of banks or banking sectors in different countries. In the following, I therefore focus on the perspective of banking sector j and derive predictions regarding its foreign positions as functions of source country j and recipient country i characteristics. The results of comparative statics can then be brought directly to the data.

4.2 International banking, global banking, and foreign sourcing

Entrepreneurs choose between the services of foreign and domestic banks in the open economy, maximizing profits by minimizing the cost of external capital. Taking intermediation fees and interest rates in the two countries as given, an entrepreneur in country

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

²⁴It 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.

²⁵A specific form is assumed for illustrative purposes. It is only required that c_j strictly increases in D_{ij} .

²⁶In the next section, it is shown that only one banking sector takes deposits abroad in equilibrium so that it is possible to define $D_{ji} = -D_{ij}$.

²⁷Capital always flows in one direction in equilibrium as shown in the next section. Therefore, it is convenient to define $K_{ji} = -K_{ij}$.

$i \in \{1, 2\}$ 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:

$$c_j + \tau_{ij} + 1 + r_j. \quad (8)$$

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

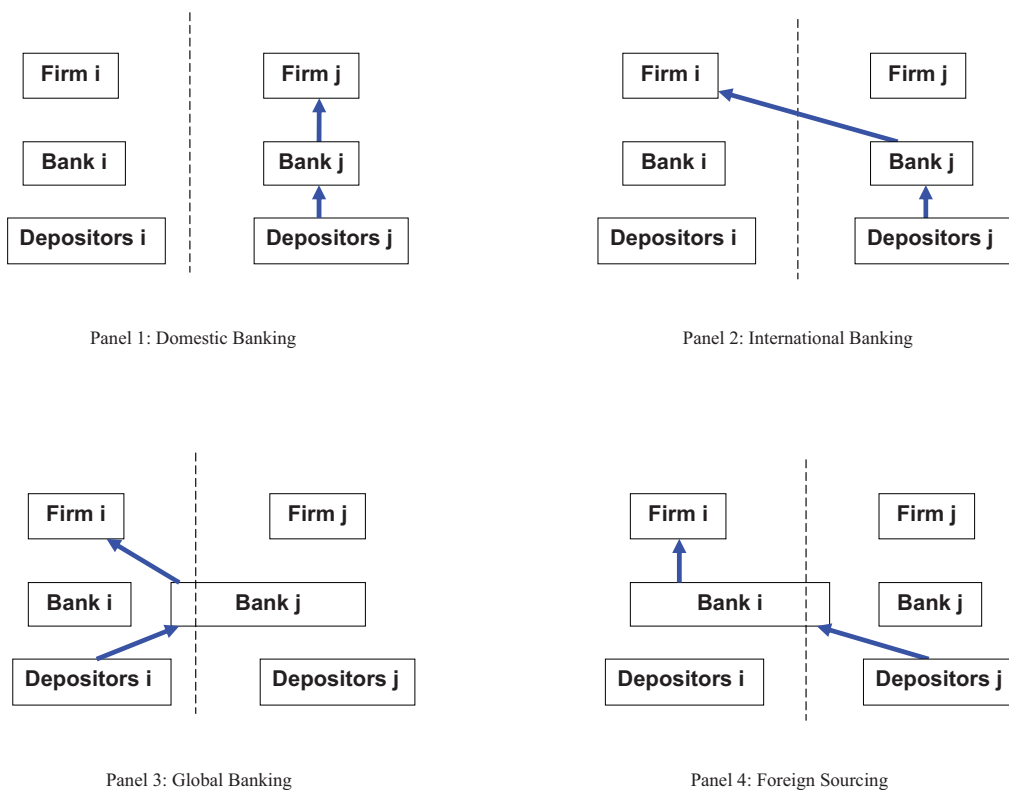
$$c_j + \tau_{ij} + 1 + r_i + t_{ij}. \quad (9)$$

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

$$c_i + 1 + r_j + t_{ji}. \quad (10)$$

The four options are illustrated in Figure 5. Each of them has different implications for capital flows and for the extent to which banking sectors expand or contract. They are also reflected differently in the foreign assets and liabilities on the balance sheets of the two banking sectors.

Figure 5: Four banking activities



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 . While monitoring costs remain unchanged because $D_{ij} = 0$, capital relocates. As capital is exported from j to i , the gross return to capital increases in country j and decreases in country i . Under *international banking*, 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 . The implied capital flow is zero because capital is intermediated locally, but service fees change as banking sector j intermediates foreign deposits. 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. Through *foreign sourcing*, both intermediation costs and gross returns to capital in the two countries are affected. As banking sector i expands by taking foreign deposits, its monitoring cost goes up while the cost abroad declines. At the same time, capital flows from country j to country i .

4.3 Equilibrium definition

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.²⁸

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

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:*

²⁸The 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.

1. *Capitalists in each country are indifferent between becoming entrepreneurs and depositors (free entry).*
2. *Entrepreneurs choose optimally between domestic and foreign banks and domestic and foreign capital, maximizing profits.*
3. *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.*
4. *Foreign deposits D_{ij} and resulting intermediation fees in the two countries are consistent with the demand for foreign banking services and foreign capital.*
5. *Capital markets clear.*
6. *Labor markets clear.*

Free entry and capital-market 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 but now also adjusts as banking sectors engage in banking across borders:

$$1 + r_j = R_j(K_{ij}) - c_j(D_{ij})\frac{z-1}{z} = 1 + F_K\left(1, \frac{K_j - K_{ij}}{L_j}\right) - c_j(D_{ij})\frac{z-1}{z}. \quad (11)$$

Under capital-market clearing, $(K_i + K_{ij}) = N_i z$ for $i, j \in \{1, 2\}, i \neq j$. Labor-market clearing implies that $L_i = N_i z$ for $i \in \{1, 2\}$.

The second condition reflects profit maximization: entrepreneurs choose optimally among domestic banking, international banking, global banking, and foreign sourcing. The third and fourth 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.

In the model, marginal products of capital and monitoring costs and therefore interest rates adjust with banking across borders. When a banking sector expands by intermediating foreign capital, its monitoring cost increases. When it exports capital, the domestic interest rate goes up while the foreign interest rate declines. Therefore, international banking, global banking, and foreign sourcing become less attractive to foreign entrepreneurs, the more banking sectors engage in these activities. Through this mechanism, banking across borders is endogenously limited. The paper focuses on interior solutions in which both banking sectors operate and intermediate deposits locally at home.²⁹ In an equilibrium, entrepreneurs are therefore either indifferent between domestic and foreign banks and/or domestic and foreign capital or they prefer domestic banks and/or domestic capital.

²⁹Equilibrium 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.

4.4 Equilibrium

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.

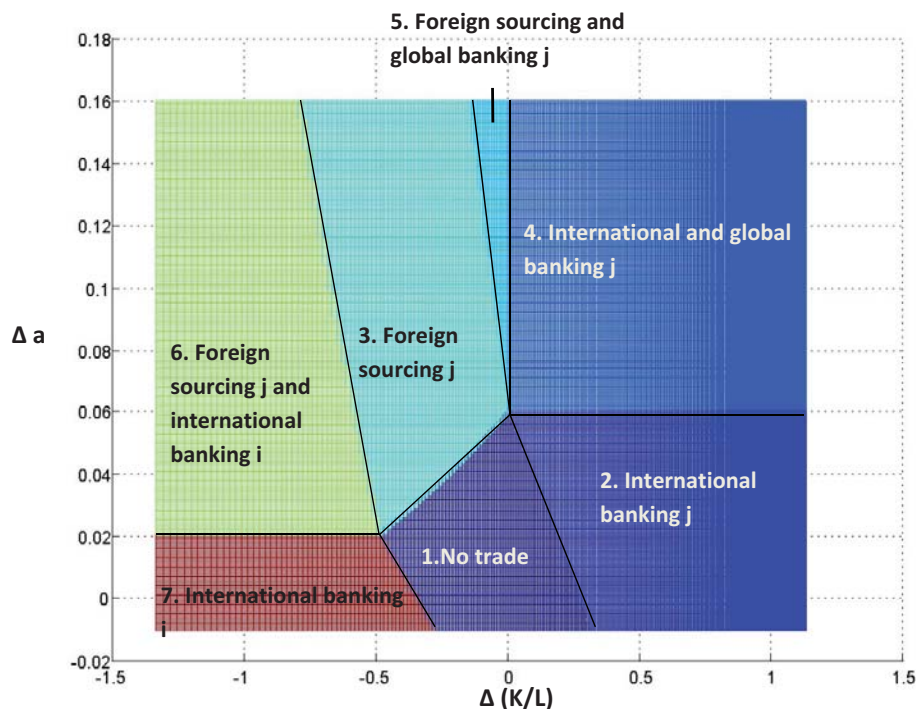
In a region where endowments and banking sector efficiencies are very similar in the two countries, entrepreneurs prefer domestic banks and domestic capital at autarky interest rates, given positive transaction costs, and there is no trade.

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, which implies 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).

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.

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 intermediates foreign deposits locally in the foreign market 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.³⁰ (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. Then banks may engage simultaneously in different activities.

³⁰This 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.

Foreign sourcing occurs if the capital-scarce country hosts a relatively efficient banking sector.

The ratio of foreign liabilities to foreign assets $\frac{LI_{ij}}{A_{ij}}$ is a measure of the relative importance of the different activities and indicates, at the same time, whether a banking sector imports or exports capital. The closer the ratio 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. The ratio grows large and exceeds 1 if banking sector j mostly imports capital and foreign sourcing is its main activity.

4.5 Comparative statics

Figure 6 indicates implicitly how foreign assets and liabilities of banking sector j behave across equilibria as relative endowments and banking sector efficiencies change. For complete results of the comparative statics, I also need 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 $\Delta(K/L) = K_j/L_j - K_i/L_i$ 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 . As the interest rate rises abroad compared to home, banking sector j is less likely to raise deposits in country i and foreign liabilities LI_{ij} decrease.

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 ratio of foreign liabilities to foreign assets L_{ij}/A_{ij} . The more capital abundant country j is relative to country i , the more domestic capital banking sector j invests abroad, that is, the more foreign assets are financed by domestic liabilities. The ratio 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 $LI/A_{ij} = D_{ij}^*/(D_{ij}^* + K_{ij}^*)$.³¹

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 reduces the disadvantage that banking sector j faces in raising deposits and lending to entrepreneurs in country i compared to domestic 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.

It turns out that 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.³² Foreign assets are the sum 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](#). ■

³¹Asterisks denote the equilibrium values of D_{ij} and K_{ij} , respectively.

³²See the [Section 4.7](#) for model implications of capital flows.

4.6 Discussion

The model shows how differences in factor endowments and differences in banking sector efficiencies lead to banking across borders in the open economy and map into three distinct forms: international banking, global banking, and foreign sourcing. Foreign asset and liability holdings of banks, which are the objects that are observed in international banking data, reflect the extent to which banks engage in the three activities and therefore the degree to which the two driving forces are at work.

Consider again the five stylized facts discussed earlier. The model can produce a rise in foreign assets as documented in [Figure 1](#) through gradual capital account and banking sector liberalization (fact 1: expansion). Fact 2, the increased importance of foreign affiliate activity, is explained if capital account liberalization preceded banking sector liberalization, which is often the case.³³ Banking sector liberalization triggers global banking.

The model can also generate heterogeneity in international and global banking consistent with [Figure 3](#) (facts 3 and 4). It predicts that 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.

Finally, the model establishes a relationship in line with [Figure 4](#). Banking sector liberalization has no effect if capital accounts are not sufficiently open. To illustrate this finding, consider the case in which the capital-scarce country has the more efficient banking sector and $1 + r_i = 1 + r_j$ in autarky. With closed capital accounts but open banking sectors, nothing happens in the open economy.

There are several other observations to make. [Okawa and van Wincoop \(2012\)](#) have shown that a gravity relationship is not robust in international portfolio models. This paper gives an additional argument for why a one-to-one relationship between foreign assets and size does not hold.³⁴ The fact that banks also expand abroad by raising capital in the host market weakens the link between the size of the source country and foreign asset holdings and makes the size of the host market matter more, creating an asymmetric relationship.³⁵

[Claessens and van Horen \(2012\)](#) documented that countries differ substantially in foreign bank participation, measured as the share of lending conducted by foreign banks in total lending in a given country. In the model, foreign bank participation can be defined as:

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

This measure simply takes the perspective of the recipient country instead of the source

³³Banking sector liberalization is 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 \(2008\)](#).

³⁴[Brüggemann, Kleinert, and Prieto \(2011\)](#), in contrast, derive a gravity equation for bank loans in a partial equilibrium model in which the demand for bank loans and interest rates are exogenous.

³⁵Such an asymmetry should hold in particular for data on consolidated bank assets that include the claims of foreign affiliates and hence global banking. In the simpler version of the model discussed in [Appendix B](#), an explicit equation for assets is derived that illustrates this point.

country. The model predicts that countries that are investment targets and host relatively inefficient banking sectors exhibit particularly high degrees of foreign bank participation.³⁶

4.7 Capital flows

The model also predicts international capital flows.³⁷ They are the sum of the activities of both banking sectors. In contrast to many international macromodels, the model in this paper pins down gross capital flows. The fact that channeling capital across borders is costly prevents any round-tripping of funds.

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 have to be indifferent between domestic and foreign banks. A high monitoring fee must be offset by a high interest rate and vice versa.³⁸

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.

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

³⁶While current market shares of foreign banks average 20 percent in OECD countries, the importance of foreign bank activity is much higher for emerging markets (45 percent) and developing countries where the market share is around 50 percent.

³⁷Bank 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.

³⁸The simpler model discussed in Appendix B also highlights this point.

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.³⁹ More broadly, these results argue for a closer investigation of the vehicles of international capital flows and the nature of financial frictions.

5 Empirics

5.1 Empirical strategy

The theoretical model predicts how foreign bank asset and liability holdings vary with differences in relative factor endowments and differences in banking sector efficiencies across countries (see again propositions 2, 3, and 4).⁴⁰ In this section, I test these cross-sectional implications using two different datasets.⁴¹ The first one is based on 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 recipient countries and show variation in i and j . The second dataset, which uses information from the so-called Auslandsstatus-Report provided by Deutsche Bundesbank, varies along the bank k and recipient country i dimension.⁴² The report collects data on the foreign activities of all German banks around the globe.

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. Moreover, claims cannot be distinguished by asset class.⁴³ 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. In contrast, the Bundesbank data capture the complete consolidated positions of the reporting banks, including the claims and liabilities of affiliates in all currencies.⁴⁴

³⁹If banks were reaping the entire gross return to capital instead of the entrepreneurs, they would always allocate capital such that gross returns equalize.

⁴⁰While 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.

⁴¹Both datasets are confidential. Therefore, information on single observations cannot be reported.

⁴²See [Buch, Koch, and Koetter \(2011\)](#) for details on this data source.

⁴³Local claims in local currency constitute about 16 percent of total foreign assets. Information from other BIS statistics indicates further that about two-thirds of the assets are loans and deposits (see [Aviat and Coeurdacier \(2007\)](#)).

⁴⁴When data from Bundesbank are used, foreign assets are proxied by the claims of bank k (excluding derivatives and securities) on the nonbank private sector in country i . Foreign liabilities are the liabilities of bank k in that sector.

In the model, factor endowments drive capital flows. This is a long run-view and certainly too simple to explain cross-border bank lending and borrowing fully in the data. Capital-labor ratios should be seen more generally as a placeholder for all sorts of factors that make countries an attractive investment location for banks. The empirical exercise, however, 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.⁴⁵ 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 to control for additional factors that affect country-level productivity.

I employ two measures of banking sector efficiency, both contained in 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 and its net interest rate margin. Both measures are calculated from bank-level data. The first measure, the variable *overhead*, is 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. The proxy therefore preserves the sharp distinction between funding costs and the costs of providing banking services in the theoretical model.

The second measure often used in the literature, the net interest rate margin, is the average of the accounting value of banks' net interest revenues as a share of their total earning assets.⁴⁶ In contrast to overhead costs over total assets, the net interest rate margin is a blurred measure of efficiency because it includes the markup and is thus directly affected by the degree of competition in the banking market. To correct for this, I also include information on the concentration of the source and the recipient banking sector in the regressions.

Contemporaneous values of a country's average overhead costs and net interest rate margin are endogenous to the operations of foreign banks, in particular, because both measures are calculated by including also information on foreign banks. The efficiency measures as well as the concentration variable are therefore 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 $\Delta \log(a_{ij}) = \log(a_i) - \log(a_j)$.

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 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. In particular, the regression controls for capital account openness and bank entry barriers as

⁴⁵For more information see [Appendix C](#).

⁴⁶See, e.g., [Schmidt-Eisenlohr \(2011\)](#) for research that uses this measure to proxy bank efficiency.

well for country-pair-specific transaction and information costs.⁴⁷ 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 signs that are predicted by propositions 2, 3, and 4.

Table 1: Expected signs

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

As in most cross-country regressions, omitted variable bias is a concern. Standard remedies such as including both source- and recipient-country-fixed effects or within estimation do not provide a solution here.⁴⁸ In particular, within estimates are not meaningful because lagged values are employed to solve endogeneity issues. [Equation 13](#) is therefore estimated on the cross-section. The fact that the same qualitative results are obtained from two different datasets that exploit two different types of variation and that the results hold both for the intensive and for the extensive margin as discussed in [Section 5.3](#) attenuates potential concerns.

The period underlying the empirical analysis is 2005.⁴⁹ After merging information from different data sources and excluding offshore centers as recipients, the asset and liability samples comprise around 82 recipient countries. The BIS datasets include information on about 20 source countries.⁵⁰ Summary statistics are displayed in [Table 2](#) and [Table 3](#).⁵¹

⁴⁷When assets or liabilities are the regressands, X_{ij} consists of the log of distance, a dummy for colonial relationship, contiguity and dummies for a shared official language, currency, and legal system. X_i and X_j comprise the log of population and the log of GDP, a dummy for systemic banking crisis as well as measures of property rights, banking sector, and capital account openness. Detailed information on control variables and data sources can be found in [Appendix C](#).

⁴⁸The endowment and the efficiency coefficient cannot be estimated on the cross-section when source-country and recipient-country-fixed effects are controlled for because log differences are a linear combination of characteristics of country i and country j .

⁴⁹While BIS data are available for other years, Bundesbank data are available to me only for 2005.

⁵⁰More information on included source and recipient countries can be found in the [Appendix C](#).

⁵¹Minimum and maximum values of $\log(\text{assets}_{ik})$ and $\log(\text{liabilities}_{ik})$ cannot be reported as this information is confidential.

Table 2: Summary statistics for BIS samples

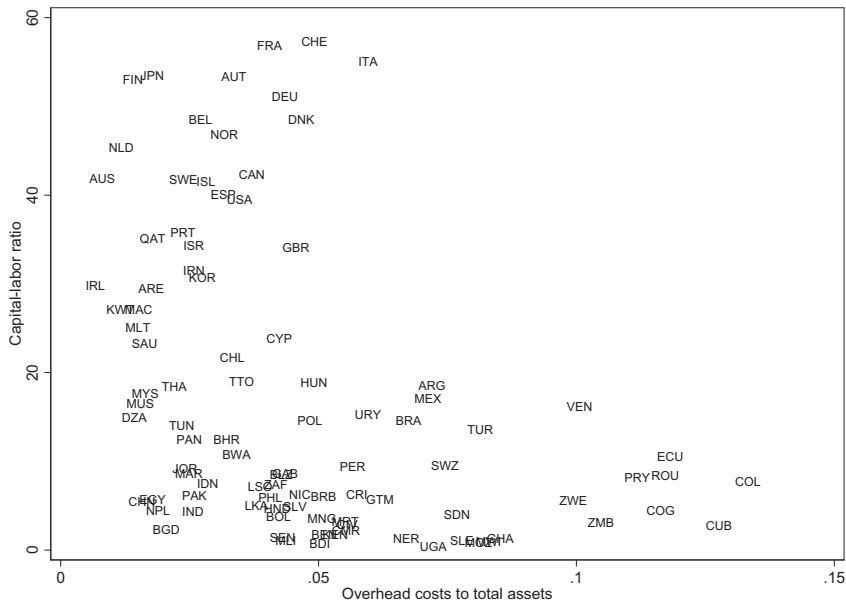
Dependent Variable Variable	Assets				Liabilities			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
$\log(\text{assets}_{ij})$	4.55	2.84	-1.39	12.75	-	-	-	-
$\log(\text{liabilities}_{ij})$	-	-	-	-	5.85	3.22	-1.39	13.37
$\Delta \log(K/L_{ij})$.95	1.28	-2.57	4.886	.707	1.10	-2.56	4.51
$\Delta \log(a_{ij})$.186	.854	-2.49	2.99	.041	.823	-2.18	2.43
financial freedom _j	69.63	20.57	30	90	72.20	20.82	30	90
financial freedom _i	54.30	21.85	10	90	57.96	21.88	10	90
openness _j	2.07	.964	-1.13	2.53	2.21	.799	-1.13	2.53
openness _i	1.02	1.49	-1.81	2.53	1.32	1.39	-1.81	2.53
property rights _j	79.66	15.24	30	90	81.88	12.47	50	90
property rights _i	56.57	23.93	10	90	63.80	23.07	10	90
banking crisis _i	.014	.118	0	1	.008	.090	0	1
$\log(\text{distance}_{ij})$	8.46	.920	5.15	9.86	8.22	1.10	5.15	9.83
common currency _{ij}	.061	.240	0	1	.114	.318	0	1
contiguity	.042	.200	0	1	.078	.268	0	1
common legal system _{ij}	.323	.478	0	1	.351	.478	0	1
common language _{ij}	.151	.358	0	1	.186	.389	0	1
colony _{ij}	.061	.239	0	1	.127	.333	0	1
$\log(\text{GDP}_j)$	27.46	1.25	23.46	30.16	27.92	1.22	25.98	30.16
$\log(\text{GDP}_i)$	25.43	2.04	20.83	30.16	26.44	1.84	20.83	30.16
$\log(\text{population}_j)$	17.33	1.48	14.99	20.81	17.60	1.38	15.24	20.81
$\log(\text{population}_i)$	16.70	1.67	12.58	20.99	17.23	1.52	12.58	20.99
	Number of Observations = 1336				Number of Observations = 490			

Table 3: Summary statistics for Bundesbank samples

Dependent Variable Variable	Assets				Liabilities			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
$\log(\text{assets}_{ik})$	2.99	3.43	-	-	-	-	-	-
$\log(\text{liabilities}_{ik})$	-	-	-	-	3.35	2.40	-	-
$\Delta \log(K/L_{ij})$	-10.17	.844	-10.95	-6.07	-10.01	.913	-10.95	-6.07
$\Delta \log(a_{ij})$	-3.41	.598	-5.00	-2.02	-3.39	.641	-5.00	-2.02
financial freedom _i	64.25	20.72	10	90	61.45	21.77	10	90
openness _i	1.69	1.24	-1.81	2.53	1.49	1.33	-1.81	2.53
property rights _i	69.89	21.30	10	90	66.01	23.24	10	90
banking crisis _i	.003	.053	0	1	.004	.065	0	1
$\log(\text{distance}_{ij})$	7.59	1.29	5.16	9.71	7.81	1.27	5.16	9.71
common currency _{ij}	.370	.483	0	1	.272	.445	0	1
contiguity	.247	.431	0	1	.192	.394	0	1
common legal system _{ij}	.083	.277	0	1	.069	.243	0	1
common language _{ij}	.102	.302	0	1	.069	.253	0	1
colony _{ij}	.024	.154	0	1	.029	.167	0	1
$\log(\text{GDP}_i)$	26.85	1.69	20.83	30.16	26.53	1.74	20.83	30.16
$\log(\text{population}_i)$	17.19	1.41	12.58	20.99	17.12	1.43	12.58	20.99
	Number of Observations = 18904				Number of Observations = 41806			

Figure 7 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.

Figure 7: Overhead costs and capital-labor ratios across countries, 2000



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

5.2 Regression results

Table 4 shows the regression results based on overhead costs as a proxy for banking sector efficiency. Table 5 displays coefficients when differences in net interest rate margins are used instead. Results in odd columns are obtained from the BIS data, results 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.⁵²

⁵²If 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.

Table 4: Baseline results: overhead costs

	assets		liabilities		liabilities/assets	
	BIS (1)	BBK (2)	BIS (3)	BBK (4)	BIS (5)	BBK (6)
$\Delta \log(a_{ij})$	0.575 ^{††} (0.329)	0.174 [†] (0.120)	0.948 ^{††} (0.300)	0.319 ^{††} (0.108)	-0.135 (0.371)	0.515 ^{††} (0.202)
$\Delta \log(K/L_{ij})$	1.162 (1.138)	0.233 (0.244)	0.703 (0.988)	-0.0996 (0.305)	-3.185 ^{††} (1.837)	-0.749 ^{††} (0.364)
financial freedom _j	-0.00795 (0.0147)		0.0202 (0.0159)		-0.000513 (0.0152)	
financial freedom _i		0.00777 (0.00503)		0.0146 ^{**} (0.00499)		-0.0113 (0.00713)
openness _j	0.475 (0.509)		0.952 ^{**} (0.299)		0.942 (0.670)	
openness _i		-0.0105 (0.0728)		-0.0147 (0.119)		-0.0452 (0.153)
property rights _j	0.0302 (0.0224)		0.0171 (0.0376)			
property rights _i		0.00289 (0.00699)		0.00613 (0.00674)		
banking crisis _i		-0.641 ^{**} (0.203)		-0.0213 (0.211)		
$\log(\text{distance}_{ij})$	-1.385 ^{**} (0.173)	-0.0867 (0.0764)	-1.176 ^{**} (0.225)	0.0599 (0.0899)		
common currency _{ij}	0.0612 (0.359)	0.774 ^{**} (0.293)	0.192 (0.516)	0.477 [*] (0.256)	0.346 (0.384)	-0.571 ^{**} (0.237)
contiguity _{ij}	-0.759 ^{**} (0.312)	0.448 (0.278)	0.358 (0.445)	0.127 (0.354)	0.941 ^{**} (0.373)	-1.174 ^{**} (0.404)
common legal system _{ij}	-0.0542 (0.186)	0.106 (0.530)	0.818 [*] (0.394)	-0.129 (0.527)	0.571 [*] (0.296)	0.148 (0.148)
common language _{ij}	0.462 (0.294)	0.160 (0.495)	0.0755 (0.553)	0.456 (0.601)	0.141 (0.491)	1.488 ^{**} (0.419)
colony _{ij}	1.431 ^{**} (0.280)	-0.245 (0.287)	2.144 ^{**} (0.369)	-0.189 (0.443)	0.526 (0.540)	1.345 ^{**} (0.463)
$\log(\text{GDP}_j)$	0.0142 (0.857)		0.240 (0.755)			
$\log(\text{GDP}_i)$		0.703 ^{**} (0.204)		0.417 (0.260)		
$\log(\text{GDP per capita}_j)$					1.136 (1.097)	
$\log(\text{GDP per capita}_i)$						-0.511 [*] (0.279)
$\log \text{ population}_j$	0.790 (0.855)		0.986 (0.682)			
$\log \text{ population}_i$		-0.206 (0.205)		0.127 (0.261)		
Observations	1,336	18,904	490	41,806	487	18,557
R^2	0.697	0.491	0.621	0.411	0.372	0.341

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

Table 5: Baseline results: net interest rate margin

	assets		liabilities		liabilities/assets	
	BIS (1)	BBK (2)	BIS (3)	BBK (4)	BIS (5)	BBK (6)
$\Delta \log(\text{net interest margin}_{ij})$	1.525 ^{††} (0.345)	0.339 ^{††} (0.174)	1.238 ^{††} (0.272)	0.429 ^{††} (0.139)	-0.806 ^{††} (0.288)	0.291 (0.211)
$\Delta \log(K/L_{ij})$	1.243 (1.412)	0.222 (0.258)	-1.613 ^{††} (0.900)	-0.0852 (0.290)	-1.283 [†] (0.874)	-0.861 ^{††} (0.398)
concentration _j	0.379 (1.476)		3.771* (2.079)		-2.607** (0.659)	
concentration _i		-0.644 (0.487)		0.156 (0.605)		0.861 (0.673)
financial freedom _j	0.00524 (0.0188)		0.0240 (0.0170)		0.0132 (0.0092)	
financial freedom _i		0.00574 (0.00447)		0.0137** (0.00490)		-0.1386 (0.00988)
openness _j	0.648 (0.515)		1.530** (0.339)		0.175 (0.357)	
openness _i		-0.0602 (0.0741)		0.00467 (0.101)		0.0533 (0.1383)
property rights _j	0.0147 (0.0196)		-0.0188 (0.0347)			
property rights _i		0.00645 (0.00660)		0.00764 (0.00653)		
banking crisis _i		-0.829** (0.238)		0.115 (0.310)		
$\log(\text{distance}_{ij})$	-1.430** (0.177)	-0.135* (0.0708)	-1.008** (0.235)	0.0517 (0.111)		
common currency _{ij}	-0.0649 (0.329)	0.840** (0.264)	0.267 (0.538)	0.450* (0.242)	0.853** (0.403)	-0.832** (0.245)
contiguity _{ij}	-0.684** (0.294)	0.323 (0.256)	0.492 (0.432)	0.0314 (0.369)	0.911** (0.367)	-1.298** (0.610))
common legal system _{ij}	0.0800 (0.187)	0.0535 (0.505)	0.864** (0.381)	-0.0644 (0.521)	0.587** (0.260)	0.269 (0.302)
common language _{ij}	0.239 (0.235)	0.297 (0.459)	0.0508 (0.607)	0.648 (0.582)	0.102 (0.385)	1.651** (0.677)
colony _{ij}	1.494** (0.254)	-0.193 (0.267)	1.829** (0.466)	-0.0385 (0.406)	0.725** (0.306)	1.700** (0.641)
$\log(\text{GDP}_j)$	-0.200 (0.675)		1.505** (0.513)			
$\log(\text{GDP}_i)$		0.709** (0.209)		0.455* (0.258)		
$\log(\text{GDP per capita}_j)$					0.805 (0.554)	
$\log(\text{GDP per capita}_i)$						-0.595* (0.390)
$\log(\text{population}_j)$	1.209* (0.636)		0.237 (0.520)			
$\log(\text{population}_i)$		-0.252 (0.218)		0.118 (0.235)		
Observations	1,319	18,879	488	41,739	485	18542
R-squared	0.719	0.494	0.621	0.412	0.436	0.337

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

Assets Consider columns (1) and (2) of Table 4 and Table 5 that show 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 i . Accordingly, the efficiency coefficient δ_1 and the endowment coefficient δ_2

are both expected to be positive.

The efficiency coefficients obtained from the two datasets and from the two efficiency measures are significantly greater than zero. A positive efficiency coefficient in column (1) suggests that source countries with lower overhead costs and net interest rate margins, respectively, hold larger assets abroad. Equivalently, the estimate of δ_1 in column (2) indicates that banks invest more in countries 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.⁵³

Liabilities According to proposition 3, foreign liabilities LI_{ij} should increase in the efficiency advantage of banking sector j relative to i . Columns (3) and (4) of Table 4 and Table 5 strongly support this hypothesis. The efficiency coefficients are all highly significant and positive. Banking sectors that are more efficient raise more funds in countries that host less efficient banking sectors.

The model also shows that liabilities decrease in the capital abundance of country j relative to i . The BIS data are unable to capture the aggregate liabilities of a banking sector because liabilities are only local liabilities held by foreign affiliates so that the endowment coefficients in column (3) in both tables may not be meaningful. When Bundesbank data are used (column (4)), δ_2 is negative in both tables, consistent with the theoretical prediction. Respective standard errors are large, however.

The signs of the other coefficients in columns (1)-(4) of Table 4 and Table 5 are in line with expectations. In particular, asset and liability holdings increase in financial freedom of the recipient country as expected from propositions 5. The magnitude of the other dummies that proxy information costs and the estimated effects of distance are similar to coefficients reported in related studies.⁵⁴

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 recipient country. Columns (5) and (6) of Table 4 and Table 5 present evidence on this claim. Because the dependent variable is a ratio, it should be normalized with respect to size, transaction costs and other factors that affect lending and borrowing symmetrically. Therefore, distance and the variables related to economic size (GDP and population) are excluded in the regressions. GDP per capita is included to control for systematic differences in the activities of banks across recipient countries.⁵⁵

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

⁵³This 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).

⁵⁴The 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.

⁵⁵Signs of the coefficients do not change when the full set of controls is included.

liabilities to assets 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. This may be the reason why it is hard to identify the predicted effects on levels. The ratio of liabilities to assets measures relative quantities and, as argued before, indirectly controls for factors that affect investment and funding alike. The specification delivers strong evidence for the relevance of capital-labor ratios in determining relative foreign positions.

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, is clearly a capital exporter. 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. The positive coefficient in column (6) in both tables is in accordance with the model.

The variation across BIS source countries in foreign asset and liability holdings is well explained. Even without fixed effects, the R^2 is around 60 percent supporting the interpretation of [Figure 3](#) along the lines of the model. The efficiency and endowment coefficients have the signs that are predicted by the theory. Evidence on banking sector efficiencies as the driving force of banking across borders is particularly strong. The results suggest that more efficient banking sectors engage more in countries that host less efficient banking sectors by both lending and borrowing abroad. At the same time, relative asset and liability positions are determined by capital-labor ratios. The more capital abundant a country, the more its banking sector finances foreign assets with domestic capital.

Quantifications It is instructive to quantify the effects of endowments and efficiency differences on bank assets and liabilities. The following numbers are based on the estimates presented in column (2) of [Table 4](#) for assets and in column (4) for liabilities, implying an efficiency coefficient of 0.17 and 0.32 and an endowment coefficient of 0.23 and -0.01, respectively. If the German banking sector (54th percentile in 2000) was as efficient as the Dutch (5th 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 33 percent. Foreign liabilities would increase by 63 percent. If Brazil had the same capital-labor ratio as Spain (60th percentile versus 85th percentile in 2000), foreign assets of Brazilian banks would show a 40 percent increase. Their foreign liabilities would decline by 17 percent. These quantifications clearly suggest that banking sector efficiencies and relative factor endowments are major determinants of banks' foreign positions.

5.3 Robustness

In this section, several robustness checks are discussed. First, competing theories are excluded as an explanation for the empirical findings. Then evidence is provided that the theoretical predictions are also supported by the behavior of the extensive margin.

The literature has argued that banks follow their customers abroad.⁵⁶ Firms that are

⁵⁶Evidence in line with the follow-your-customer hypothesis is presented in, e.g., [Goldberg and Saunders](#)

active abroad are likely to operate in locations with cheap labor, that is, with low capital-labor ratios.⁵⁷ At the same time, they come mostly from developed countries, where banking sector efficiency is high. The estimation results on assets could therefore simply reflect the fact that banks serve domestic clients in foreign countries. The presence of a follow-your-customer motive is less problematic for results on liabilities: if banks follow their customers, they should also hold more liabilities in capital-scarcer countries.

To account for follow-your-customer effects, the log of the stock of foreign direct investment from country j to country i is included in the regressions. This measure should be correlated with the financing needs of firms from country j operating in country i and therefore with the volume of lending that arises because banks serve their domestic clients abroad. 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.⁵⁸ Columns (1) to (4) of [Table 6](#) display the results when overhead costs are used to proxy efficiency. Columns (5) to (8) show the same regressions that include differences in net interest rate margins and concentration instead. As before, odd columns are based on BIS data, even columns on Bundesbank data.

The coefficients on FDI indicate a strong, positive relationship between foreign direct investment and banks' foreign positions in all eight columns. With the exception of the endowment coefficient in column (5), the signs of the efficiency and endowment coefficients remain unaffected by the introduction of the additional control variable. The significance of the efficiency coefficient goes down in the asset regressions. Note that this effect is also due to a considerable reduction in sample size as FDI data are not available for all recipient countries. Especially in columns (1) and (2), where efficiency differences are proxied by overhead costs, standard errors are large. However, efficiency coefficients remain significantly positive at a 10 percent significance level in columns (5) and (6) where differences in net interest rate margins measure relative bank efficiencies. Results on the effect of efficiency differences on liabilities are essentially unchanged. Thus, the follow-your-customer motive is relevant for the pattern of foreign asset and liability holdings but explains only part of the variation.⁵⁹

According to portfolio theory, banks should invest and borrow in different countries to diversify (see, e.g., [Martin and Rey \(2004\)](#)). To account for diversification, equation [13](#) is estimated controlling for the correlation in GDP growth between countries i and j in addition to accounting for FDI. Columns (1) to (8) of [Table 7](#) report the results. The signs of the endowment and efficiency coefficients remain the same when the additional control variable is included. As before, results on the effect of efficiency differences are stronger when banking sector efficiency is proxied by the net interest rate margin.

The correlation puzzle documented by [Aviat and Coeurdacier \(2007\)](#) and [Buch et al. \(2009\)](#), who work with BIS data and Bundesbank data, respectively, is attenuated. Columns

(1981) and [Grosse and Goldberg \(1991\)](#).

⁵⁷Differences in labor costs drive vertical FDI, e.g., in [Hanson, Mataloni, and Slaughter \(2005\)](#).

⁵⁸The 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.

⁵⁹The presence of firms from the home country in a foreign market may give banks an advantage in expanding to that market. However, once established, banks also start to serve customers from countries other than their home country. See [Seth, Nolle, and Mohanty \(1998\)](#).

Table 6: Controlling for a follow-your-customer motive

	assets		liabilities		assets		liabilities	
	BIS (1)	BBK (2)	BIS (3)	BBK (4)	BIS (5)	BBK (6)	BIS (7)	BBK (8)
$\Delta \log(a_{ij})$	0.271 (0.363)	0.0813 (0.133)	0.588 ^{††} (0.216)	0.222 [†] (0.146)				
$\Delta \log(\text{net interest margin}_{ij})$					1.053 ^{††} (0.579)	0.267 [†] (0.181)	1.047 ^{††} (0.321)	0.404 ^{††} (0.181)
$\Delta \log(K/L_{ij})$	0.662 (1.333)	0.168 (0.320)	0.416 (0.856)	-0.126 (0.461)	-0.586 (1.336)	0.166 (0.330)	-1.143 (0.934)	-0.128 (0.384)
$\log(\text{FDI}_{ij})$	0.409** (0.0585)	0.324** (0.102)	0.722** (0.109)	0.306** (0.146)	0.376** (0.507)	0.294** (0.105)	0.686** (0.110)	0.347** (0.148)
concentration _j					2.924 (1.798)		2.803 (1.805)	
concentration _i						-0.154 (0.502)		0.784 (0.696)
financial freedom _j	-0.0286** (0.0109)		0.00577 (0.00654)		-0.0282** (0.0132)		0.00828 (0.00910)	
financial freedom _i		0.00127 (0.00567)		0.00644 (0.00678)		0.000041 (0.00526)		0.00400 (0.00628)
openness _j	0.259 (0.492)		1.105** (0.326)		0.427 (0.453)		1.379** (0.345)	
openness _i		0.0313 (0.0821)		0.0415 (0.132)		0.00292 (0.0804)		0.0936 (0.108)
property rights _j	0.0292 (0.0244)		0.0482** (0.0194)		0.0152 (0.0186)		0.0251 (0.0216)	
property rights _i		-0.00495 (0.00867)		-0.000934 (0.00926)		0.0000793 (0.00768)		0.00265 (0.00850)
banking crisis _i		-0.673** (0.219)		-0.0512 (0.308)		-0.788** (0.217)		0.134 (0.308)
$\log(\text{distance}_{ij})$	-0.579** (0.192)	-0.0294 (0.0810)	-0.648* (0.336)	0.137 (0.118)	-0.583** (0.169)	-0.0416 (0.0817)	-0.579 (0.350)	0.186 (0.139)
common currency _{ij}	0.295 (0.265)	0.590* (0.325)	0.107 (0.537)	0.231 (0.292)	0.329 (0.265)	0.661** (0.323)	0.183 (0.574)	0.179 (0.256)
contiguity _{ij}	-0.201 (0.313)	0.402* (0.239)	0.155 (0.391)	0.108 (0.296)	-0.173 (0.307)	0.351 (0.236)	0.185 (0.368)	0.0794 (0.309)
common legal system _{ij}	0.130 (0.131)	0.0599 (0.556)	0.676 (0.406)	-0.262 (0.579)	0.142 (0.173)	0.0590 (0.534)	0.755* (0.420)	-0.120 (0.564)
common language _{ij}	-0.162 (0.234)	0.0435 (0.530)	-0.0583 (0.431)	0.374 (0.657)	-0.181 (0.240)	0.108 (0.490)	-0.173 (0.525)	0.420 (0.615)
colony _{ij}	1.240** (0.278)	-0.461 (0.284)	0.690* (0.364)	-0.354 (0.427)	1.154** (0.213)	-0.371 (0.279)	0.535 (0.368)	-0.185 (0.389)
Observations	648	17,144	368	36,688	644	17,144	366	36,688
R^2	0.787	0.517	0.695	0.446	0.806	0.517	0.698	0.448

Note: Clustered standard errors in parentheses. ** p<0.05, * p<0.1. †† (†): the H_0 that the coefficient is smaller/greater or equal 0 is rejected at a 5% (10%) significance level. BIS regressions include recipient-country- i -fixed effects. BBK regressions include bank- k -fixed effects. Estimates on the log of GDP and population are suppressed.

Table 7: Controlling for diversification

	assets		liabilities		assets		liabilities	
	BIS (1)	BBK (2)	BIS (3)	BBK (4)	BIS (5)	BBK (6)	BIS (7)	BBK (8)
$\Delta \log(a_{ij})$	0.264 (0.355)	0.180 (0.141)	0.602 ^{††} (0.219)	0.206 [†] (0.148)				
$\Delta \log(\text{net interest margin}_{ij})$					1.054 ^{††} (0.578)	0.364 ^{††} (0.175)	1.037 ^{††} (0.344)	0.388 ^{††} (0.178)
$\Delta \log(K/L_{ij})$	0.601 (1.283)	0.141 (0.300)	0.491 (0.853)	-0.121 (0.467)	-0.580 (1.354)	0.122 (0.300)	-1.366 (1.096)	-0.124 (0.389)
growth correlation _{ij}	-0.339 (0.372)	-0.504 [†] (0.354)	0.470 (0.739)	0.0826 (0.398)	-0.0641 (0.363)	-0.528 [†] (0.330)	0.699 (0.860)	0.101 (0.390)
log(FDI _{ij})	0.412** (0.0589)	0.361** (0.111)	0.717** (0.105)	0.300** (0.148)	0.378** (0.0534)	0.342** (0.113)	0.671** (0.110)	0.339** (0.146)
concentration _j					2.886 (1.929)		3.405 (2.232)	
concentration _i						-0.0454 (0.489)		0.777 (0.683)
financial freedom _j	-0.0290** (0.0106)		0.00579 (0.00683)		-0.0281* (0.0134)		0.00657 (0.0102)	
financial freedom _i		-0.000801 (0.00550)		0.00682 (0.00718)		-0.00258 (0.00491)		0.00449 (0.00660)
openness _j	0.254 (0.491)		1.108** (0.324)		0.424 (0.459)		1.435** (0.369)	
openness _i		0.0652 (0.0972)		0.0361 (0.139)		0.0532 (0.102)		0.0851 (0.111)
property rights _j	0.0293 (0.0233)		0.0504** (0.0209)		0.0152 (0.0186)		0.0244 (0.0218)	
property rights _i		0.00139 (0.00809)		-0.00202 (0.0112)		0.00614 (0.00698)		0.00147 (0.00993)
banking crisis _i		-0.989** (0.337)		0.000923 (0.358)		-1.039** (0.288)		0.185 (0.351)
log(distance _{ij})	-0.592** (0.188)	-0.0247 (0.0817)	-0.622* (0.353)	0.135 (0.113)	-0.586** (0.168)	-0.0398 (0.0893)	-0.523 (0.378)	0.185 (0.135)
common currency _{ij}	0.356 (0.279)	0.792** (0.326)	0.0331 (0.508)	0.198 (0.312)	0.339 (0.291)	0.833** (0.336)	0.0757 (0.582)	0.144 (0.292)
contiguity _{ij}	-0.203 (0.313)	0.397 (0.245)	0.181 (0.408)	0.106 (0.295)	-0.173 (0.306)	0.318 (0.247)	0.232 (0.388)	0.0813 (0.311)
common legal system _{ij}	0.128 (0.130)	0.0762 (0.514)	0.664 (0.409)	-0.265 (0.587)	0.142 (0.172)	0.0968 (0.498)	0.742* (0.422)	-0.125 (0.572)
common language _{ij}	-0.143 (0.240)	-0.215 (0.515)	-0.0788 (0.431)	0.417 (0.700)	-0.180 (0.240)	-0.107 (0.466)	-0.179 (0.525)	0.461 (0.640)
colony _{ij}	1.204** (0.289)	-0.392 (0.289)	0.736* (0.375)	-0.366 (0.451)	1.148** (0.218)	-0.256 (0.283)	0.583 (0.364)	-0.205 (0.419)
Observations	648	17,144	368	36,688	644	17,144	366	36,688
R ²	0.788	0.517	0.695	0.446	0.806	0.518	0.699	0.448

Note: Clustered standard errors in parentheses. ** p<0.05, * p<0.1. †† (†): the H₀ that the coefficient is smaller/greater or equal 0 is rejected at a 5% (10%) significance level. BIS regressions include recipient-country-*i*-fixed effects. BBK regressions include bank-*k*-fixed effects. Estimates on the log of GDP and population are suppressed.

(1), (2), (5), and (6) where foreign assets are the dependent variable display negative correlation coefficients throughout. The coefficients in columns (2) and (6) are significantly negative at a 10 percent significance level, which is tentative evidence that banks diversify their loan portfolios. Columns (3), (4), (7), and (8), where regressions are run on liabilities, show positive, insignificant correlation coefficients throughout, and provide no evidence that banks diversify also across funding sources.

The model predicts that not only the intensive margin but also the extensive margin responds to differences in endowments and differences in banking sector efficiencies. Missing observations and zeros are confounded in the BIS data, but Bundesbank data can be used to estimate a discrete choice model. The estimation of a probit model, where the dependent dummy variable takes value 1 if a given bank k has positive foreign assets or foreign liabilities in country i and zero otherwise, also supports the predictions of the model: banks are more likely to hold positive foreign assets and liabilities in countries with lower banking sector efficiencies. Conclusions are the same when the net interest rate margin is used instead of overhead costs. Overall, estimated coefficients are similar to those obtained for the intensive margin.⁶⁰

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 et al. \(2011\)](#), 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.

⁶⁰The results of the estimations are displayed in table 8. Columns (1) and (3) show the results for assets; column (2) and (4) for liabilities. The last two columns include FDI stocks as a control variable. Standard errors are clustered as before.

Table 8: Effects on the extensive margin: probit model

	assets (1)	liabilities (2)	assets (3)	liabilities (4)
$\Delta \log(a_{ij})$	0.260 ^{††} (0.0614)	0.329 ^{††} (0.0847)	0.199 ^{††} (0.0879)	0.208 ^{††} (0.106)
$\Delta \log(K/L_{ij})$	-0.0255 (0.154)	-0.212 [†] (0.162)	0.0709 (0.269)	-0.111 (0.327)
$\log(\text{FDI}_{ij})$			0.241 ^{**} (0.0750)	0.208 ^{**} (0.0965)
financial freedom _{<i>i</i>}	0.00582 [*] (0.00311)	0.00756 ^{**} (0.00358)	0.000 (0.00389)	0.00287 (0.00504)
openness _{<i>i</i>}	0.00717 (0.0547)	0.00943 (0.0598)	0.0235 (0.0652)	0.00654 (0.0753)
property rights _{<i>i</i>}	0.00793 ^{**} (0.00371)	0.0110 ^{**} (0.00412)	0.00401 (0.00605)	0.00541 (0.0753)
banking crisis _{<i>i</i>}	-0.260 ^{**} (0.106)	-0.312 ^{**} (0.147)	-0.430 ^{**} (0.173)	-0.414 [*] (0.241)
$\log(\text{distance}_{ij})$	-0.0904 (0.0621)	-0.126 (0.0978)	-0.00308 (0.0640)	-0.0413 (0.106)
common currency _{<i>ij</i>}	0.608 ^{**} (0.187)	0.336 [*] (0.188)	0.482 ^{**} (0.219)	0.128 (0.223)
contiguity _{<i>ij</i>}	-0.0215 (0.176)	-0.132 (0.273)	0.0415 (0.158)	-0.0474 (0.258)
common legal system _{<i>ij</i>}	-0.246 (0.401)	-0.698 (0.428)	-0.310 (0.416)	-0.849 [*] (0.472)
common language _{<i>ij</i>}	0.577 (0.513)	0.771 (0.718)	0.406 (0.527)	0.710 (0.767)
colony _{<i>ij</i>}	0.345 [*] (0.185)	0.712 ^{**} (0.283)	0.0884 (0.190)	0.453 (0.295)
$\log(\text{GDP}_i)$	0.334 ^{**} (0.142)	0.282 [*] (0.148)	0.208 (0.175)	0.258 (0.190)
$\log(\text{population}_i)$	0.0606 (0.142)	0.196 (0.143)	-0.0235 (0.0652)	-0.0107 (0.210)
Observations	156,348	168,474	86,784	93,456
Pseudo R^2	0.470	0.486	0.419	0.436

Note: Clustered standard errors in parentheses. ** p<0.05, * p<0.1. †† (†): the H_0 that the coefficient is smaller/greater or equal 0 is rejected at a 5% (10%) significance level. Estimated bank-fixed effects are not reported.

Several other specifications are estimated. Overhead costs and capital labor ratios are lagged by an alternative number of years;⁶¹ absolute differences of K/L and a and BIS data for other years are used in the regressions.⁶² These checks do not alter the conclusion that both differences in rates of return to capital and differences in banking sector efficiencies across countries are major determinants of foreign bank assets and liabilities and affect

⁶¹As expected, regression results tend to become stronger with longer lags and weaker with shorter lags.

⁶²Unreported results are available on demand.

them in the way the model prescribes.

6 Conclusions

Banking across borders has been on the rise over the past 20 years. While developments have been similar in many countries, the patterns of international and global banking have been heterogeneous across pairs of countries. This paper provides a model of trade in banking services based on first principles to explain this variation. The model can account for five major stylized facts on cross-border banking and is supported by empirical evidence from two different data sources. The findings suggest that, as a complement to the traditional portfolio theory, a trade and investment perspective can be fruitful for the study of international and global banking.

The paper also shows that financial frictions which, in the model, take the form of intermediation costs, impediments to capital account transactions, and bank entry barriers affect capital flows in complex ways. In particular, the relationship between financial sector development and capital flows turns out to be nonlinear. More research on the exact nature of financial frictions and on the role of financial intermediaries as vehicles for international capital flows is called for.

Finally, the model, together with the empirical results, alludes to the benefits of banking across borders. As banks channel capital to countries where it is scarce and expand into less financially developed countries, they play a natural role in the global economy.

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 $i \neq j$:

$$c_i + 1 + r_i \leq c_j + \tau_{ij} + 1 + r_j \quad (\text{A1})$$

$$c_i + 1 + r_i \leq c_j + \tau_{ij} + 1 + r_i + t_{ij} \quad (\text{A2})$$

$$1 + r_j \leq 1 + r_i + t_{ij} \quad (\text{A3})$$

$$c_j + 1 + r_j \leq c_i + \tau_{ji} + 1 + r_i \quad (\text{A4})$$

$$c_j + 1 + r_j \leq c_i + \tau_{ji} + 1 + r_j + t_{ji} \quad (\text{A5})$$

$$1 + r_i \leq 1 + r_j + t_{ji}, \quad (\text{A6})$$

where

$$c_j(D_{ij}) = a_j \left(1 + \frac{D_{ij}}{K_j}\right)^\gamma, \quad (\text{A7})$$

$$1 + r_j(D_{ij}, K_{ij}) = R_j(K_{ij}) - c_j(D_{ij}) \frac{z-1}{z} = 1 + F_K \left(1, \frac{K_j - K_{ij}}{L_j}\right) - c_j(D_{ij}) \frac{z-1}{z}, \quad (\text{A8})$$

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 A1 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 A1, assuming $D_{12} = 0$, must be positive. Moreover, conditions A2 to A6 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 A1 to A6 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 A1 holds as equality, condition A4 cannot hold with equality.

- From Lemma 2: If condition A2 or A3 holds with equality, then conditions A5 and A6 must hold as inequalities.
- It is easy to see that if conditions A1 and A3 both hold with equality, then condition A2 holds with equality as well.
- In an equilibrium, condition A2 must always hold together with conditions A1 and A3. To 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 A1, A2 and A3 hold with equality, A4 to A6 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 A1 and A6 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 A1 swaps with A4, condition A2 with A5 and A3 with A6.

Combining the arguments from above, the following 11 equilibrium cases can be distinguished:⁶³

1. No trade: All six conditions hold at $K_{ij}^* = D_{ij}^* = 0$.
2. International banking j : Condition A1 holds with equality at $K_{ij} = K_{ij}^* > 0$ while all other conditions also hold. K_{ij}^* is determined by:

$$c_i + 1 + r_i = c_j + \tau_{ij} + 1 + r_j \rightarrow \frac{c_i}{z} + R_i = \frac{c_j}{z} + R_j + \tau_{ij}, \quad (\text{A9})$$

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 A3 holds with equality, while all other conditions also hold at $D_{ij}^* = -K_{ij}^* > 0$. D_{ij}^* solves:

$$1 + F_K \left(1, \frac{K_j + D_{ij}}{L_j} \right) - c_j(D_{ij}) \frac{z-1}{z} = 1 + F_K \left(1, \frac{K_j - D_{ij}}{L_j} \right) - c_i(D_{ij}) \frac{z-1}{z} + t_{ij}. \quad (\text{A10})$$

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

4. International banking and global banking j : Conditions A1, A2 and A3 hold together at $D_{ij}^* > 0$ and $K_{ij}^* > 0$. All other conditions hold as inequalities. D_{ij}^* is determined by:

$$c_i = c_j + \tau_{ij} + t_{ij}. \quad (\text{A11})$$

Given D_{ij}^* , K_{ij}^* is the solution to:

$$1 + r_j = 1 + r_i + t_{ij} \rightarrow R_j - c_j z / (z - 1) = R_i - c_i z / (z - 1) + t_{ij}. \quad (\text{A12})$$

$A_{ij} = K_{ij}^* + D_{ij}^* > 0$, $LI_{ij} = D_{ij}^* > 0$, $A_{ij} > LI_{ij}$.

⁶³Asterisks denote equilibrium values.

5. Foreign sourcing and global banking j : Conditions [A1](#), [A2](#) and [A3](#) hold together at $D_{ij}^* > 0$ and $K_{ij}^* \leq 0$. All other conditions hold as inequalities. D_{ij}^* is determined by:

$$c_i = c_j + \tau_{ij} + t_{ij}. \quad (\text{A13})$$

Given D_{ij}^* , K_{ij}^* is the solution to:

$$1 + r_j = 1 + r_i + t_{ij} \rightarrow R_j - c_j z / (z - 1) = R_i - c_i z / (z - 1) + t_{ij}. \quad (\text{A14})$$

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

6. Foreign sourcing j , international banking i : Conditions [A1](#) and [A6](#) both hold with equality at $D_{ij}^* = K_{ji}^{j*} > 0$ and $K_{ij}^* = -(D_{ij}^* + K_{ji}^{i*}) < 0$. All other conditions hold as inequalities. D_{ij}^* is determined by:

$$c_j + t_{ij} = c_i + \tau_{ji}. \quad (\text{A15})$$

Given D_{ij}^* , K_{ij}^* is the solution to:

$$1 + r_j = 1 + r_i + t_{ij} \quad (\text{A16})$$

$A_{ij} = 0$ 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 [A1](#) 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 [A3](#) 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 [A2](#) 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 A6 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 $\gamma \rightarrow \infty \Rightarrow \partial c_j / \partial D_{ij} \rightarrow \infty$ and, equivalently, $\partial c_i / \partial D_{ij} \rightarrow -\infty$. 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, $\frac{d^{LI_{ij}}_{A_{ij}}}{d\Delta(K/L)} > 0$. $\frac{d^{LI_{ij}}_{A_{ij}}}{d\Delta a} = \frac{d^{D_{ij}^*}_{D_{ij}^* + K_{ij}^*}}{d\Delta a} > 0$ because $K_{ij}^* > 0$.
- Foreign sourcing and global banking j : $\frac{d^{LI_{ij}}_{A_{ij}}}{d\Delta a} \leq 0$ 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 A1 to A6 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 A2, A3, A4 and A5 continue to hold. At the same time, conditions A1 and A6 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 equilibrium 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.

Table A1: 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

Other transitions can be inferred equivalently. [Table A1](#) 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.

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.

Table A2: Transitions across equilibria for τ_{ij} and t_{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	-	-

- 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:

$$\frac{dA_{ij}}{dt_{ij}} = \underbrace{\frac{dD_{ij}^*}{dt_{ij}}}_{<0} + \underbrace{\frac{dK_{ij}^*}{dt_{ij}}}_{>0}. \quad (\text{A17})$$

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, $z/(z-1) \rightarrow 1$. Thus, $d(R_j - R_i) = dt_{ij}(1 - \frac{z-1}{z}) \rightarrow 0 \Rightarrow \frac{dK_{ij}^*}{dt_{ij}} \rightarrow 0$.

- 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 $d\tau_{ij} = d(c_i - c_j) \Rightarrow \frac{dD_{ij}^*}{d\tau_{ij}} > 0$. 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_{ij}^{j*} must go down because $K_{ij}^* = D_{ji}^* + K_{ij}^{j*} \Rightarrow \frac{dK_{ij}^{j*}}{d\tau_{ij}} = \frac{dA_{ij}}{d\tau_{ij}} < 0$. 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, $d(R_i - R_j) = dt_{ji}/z \rightarrow 0 \Rightarrow \frac{dK_{ij}^*}{dt_{ji}} \rightarrow 0$. $K_{ij}^* = D_{ji}^* + K_{ij}^{j*} \Rightarrow dK_{ij}^{j*}/dt_{ji} = dK_{ij}^*/dt_{ji} - dD_{ji}^*/dt_{ji}$. For sufficiently high z , the required decrease in K_{ij}^* is smaller than the decrease in D_{ji}^* , and K_{ij}^{j*} goes up: $\frac{dK_{ij}^{j*}}{dt_{ji}} = \frac{dA_{ij}}{dt_{ji}} > 0$ for sufficiently high z .

Step 2 Transitions across equilibria for τ_{ij} and t_{ij} are summarized in [Table A2](#).

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 $t_{12} = t_{21} \rightarrow \infty$. 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:

$$c_1 + 1 + r_1 = c_2 + 1 + r_2 \quad (\text{B1})$$

$$\Rightarrow (c_2 - c_1) = (R_1 - R_2)z \quad (\text{B2})$$

$$\Rightarrow (a_2 - a_1) = \left(1 + F_K \left(1, \frac{K_1 + K_{12}}{L_1}\right)\right) - \left(1 + F_K \left(1, \frac{K_2 - K_{12}}{L_2}\right)\right)z, \quad (\text{B3})$$

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:

$$K_{12}^* = \left(\frac{K_2}{L_2} - \frac{K_1}{L_1} \right) \frac{L_2 L_1}{L_2 + L_1} = \Delta \left(\frac{K}{L} \right) \frac{L_2 L_1}{L_2 + L_1}. \quad (\text{B4})$$

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 :

$$LI_{ij} = D_{ij}^* = K_i - N_i = K_i - (K_{ij}^* + K_i)/z. \quad (\text{B5})$$

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

$$A_{ij} = D_{ij}^* + K_{ij}^* = (K_i + K_{ij}^*) \frac{z-1}{z} = \left(K_i + \left(\frac{K_j}{L_j} - \frac{K_i}{L_i} \right) \frac{L_j L_i}{L_j + L_i} \right) \frac{z-1}{z}. \quad (\text{B6})$$

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:

$$\frac{LI_{ij}}{A_{ij}} = \frac{K_i(z-1) - K_{ij}^*}{(K_i + K_{ij}^*)(z-1)}. \quad (\text{B7})$$

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.

$\Delta \log(\mathbf{K}/\mathbf{L}_{ijt})$: The adjustment for human capital follows [Hall and Jones \(1999\)](#):

$$H_i = e^{\phi(E_i)} L_i, \quad (\text{C1})$$

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 6.2.⁶⁴ Denoting the capital stock of country i by K_i , the proxy for differences in rates of return to capital is precisely calculated as:

$$\Delta \log(K/L)_{ijt} = \log(K_{j\ t-5}/H_{j\ t-5}) - \log(K_{i\ t-5}/H_{i\ t-5}). \quad (\text{C2})$$

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.⁶⁵

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.

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 :⁶⁶ 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 :⁶⁷ 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,

⁶⁴Capital stocks for the base year 2000, which are not publicly available yet, were kindly provided by Penn World Tables.

⁶⁵See <http://www.heritage.org/index/financial-freedom>.

⁶⁶Source countries that are not included in the liability sample are in parentheses.

⁶⁷Recipient countries that are not included in the BIS liability sample (Bundesbank sample) are in parentheses (indicated with asterisks).

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.

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