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* Views expressed are those of the author and do not necessarily reflect official positions of De Nederlandsche Bank.

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Abstract

This paper develops and tests a theoretical model that allows for the endogenous decision of banks to engage in international and global banking. *International banking*, where banks raise capital in the home market and lend it abroad, is driven by differences in factor endowments across countries. In contrast, *global banking*, where banks intermediate capital locally in the foreign market, arises from differences in country-level bank efficiency. Together, these two driving forces determine the foreign assets and liabilities of a banking sector. The model provides a rationale for the observed rise in global banking relative to international banking. Its key predictions regarding the cross-country pattern of foreign bank asset and liability holdings are strongly supported by the data.

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

JEL-Codes: F21, F23, F34, G21

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1 Introduction

Banks have substantially expanded their activities across borders over the past two decades. This has happened in two ways. First, banks have invested more domestic capital in foreign countries, an operation which is defined as *international banking*. Second, they have to a much larger extent intermediated capital locally in foreign markets, an activity which is denoted as *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 this have remained largely unexplored. This paper presents a theoretical model based on first principles which can explain these facts.

In the model, banks are the vehicles of international capital flows and provide intermediation services. When countries differ in their factor endowments and in banking technology, global and international banking both arise endogenously. The analysis reveals that *international banking* is driven by differences in rates of return to capital across countries. In contrast, *global banking* arises from differences in country-level bank efficiency. Together, the two driving forces determine the foreign asset and liability holdings of a banking sector. These key predictions, regarding the cross-country pattern of foreign asset and liability holdings, are strongly supported by the empirical evidence presented.

By providing a model that matches stylized facts and that is supported by the data, this paper proposes a new answer to the question why banking across borders occurs. It complements the portfolio view of international banks, where foreign bank activities result from a motive to diversify lending.² While most of the recent research focus has been on the risks of international and global banking,³ this paper shows how the liberalization of banking across borders can foster the efficient allocation of capital and can increase aggregate banking sector efficiency.

In the model, symmetric entrepreneurs produce a single consumption good under constant returns to scale using capital and labor. Markets for production factors are perfectly competitive. As a non-standard element, there are financial frictions, which stem from two facts. First, the amount of external funds that an entrepreneur can raise and thus the size of a single firm are limited due to moral hazard. Second, entrepreneurs cannot obtain external financing from investors directly. Instead banks act as intermediaries channeling capital from depositors to firms. For this service, they collect an exogenous fee, which characterizes the efficiency of the banking sector in the economy.

¹Section 2 presents these stylized facts in detail.

²Aviat and Coeurdacier (2007) and Buch, Koch, and Koetter (2009) test the portfolio model empirically. They find contrasting empirical evidence detecting a “correlation puzzle”.

³See e.g. Cetorelli and Goldberg (2010), Loranth and Morrison (2007).

These financial frictions drive a wedge between the gross return to capital (which is equal to one plus the marginal product of capital (MPK) under perfect competition) and the financial interest rate (that is, the expected gross return net of costs). The lower the efficiency of a country's banking sector, the more depressed its financial interest rate relative to its marginal product of capital.

When two countries integrate that differ with respect to their relative endowments of capital and labor and their banking sector efficiency, banking across borders occurs. As a consequence of differences in endowments and differences in efficiency, the service fee and the autarky financial interest rate vary between domestic and foreign banks. When entrepreneurs have a choice between raising capital from domestic or foreign banks, they prefer banks that demand a low interest rate and a low service fee. Banks therefore have an advantage if they are located in a capital abundant country, which gives them access to cheap capital, and if they are more efficient.

The volume of trade in banking services can be either measured in terms of the fees that a banking sector collects from foreigners or in terms of the foreign assets that it has on its aggregate balance sheet. The exact magnitude of differences in efficiency and differences in endowments between countries determines which banking sector exports banking services and holds foreign assets. *Ceteris paribus*, a country's foreign asset holdings are higher, the higher its efficiency advantage and the more capital abundant it is relative to the foreign country. Banking across borders enhances the efficient allocation of capital between countries and improves overall banking sector efficiency.

Two phases of integration are considered: capital account liberalization and subsequent banking sector liberalization. When capital accounts are liberalized, banks are allowed to raise capital in the domestic market and lend it to the foreign market but they cannot raise capital from foreign depositors. As a consequence, trade in banking services is limited and differences in banking sector efficiency across countries cannot be fully exploited. This is because the banking services exporting country necessarily exports capital at the same time. The interest rate therefore rises in the exporting country and declines in the importing country with the volume of trade. In equilibrium, advantages in terms of efficiency of one banking sector are offset by a higher financial interest rate and vice versa until entrepreneurs are indifferent between domestic and foreign banks.

When banking sectors are liberalized, banks are also allowed to raise capital in foreign markets. This eliminates any advantage for banks located in a capital abundant country. As a result, only banking sector efficiency matters for trade in banking services. The conflict between equalizing marginal products of capital and exploiting differences in banking sector efficiency disappears. Without any limiting force, the most efficient banking sector takes over the entire market and its foreign asset holdings expand.

While under capital account liberalization all banking across borders is *international banking*, banking sector liberalization allows banks to engage also in *global banking*. International banking is defined as the case where banks raise capital in the home market and lend it to a foreign market. In contrast, global banking denotes the case where banks raise capital abroad and intermediate it locally in the foreign market. This paper will employ these definitions throughout. *Banking across borders* is used to refer to both types of activities.⁴ The relative importance of global and international banking depends on the efficiency and endowment characteristics of the integrating countries. The analysis shows that while international banking occurs if there are differences in endowments between countries, global banking arises from differences in the efficiency of banking sectors. Thus the two driving forces trigger two different activities and imply different internationalization strategies for banks. Together they determine the aggregate foreign assets and liabilities of a banking sector.

The empirical analysis of this paper finds strong support for the model based on information on foreign bank assets and liabilities from the Consolidated Banking Statistics of the Bank for International Settlements comprising a set of 25 mostly developed source countries and 90 recipient countries. Differences in endowments are proxied by differences in lagged capital-labor ratios. As a measure for bank efficiency, the lagged average ratio of overhead costs to total assets of a country's banking sector is employed. The regression results confirm three key implications of the model: (i) foreign assets are positively correlated with the relative capital abundance and banking sector efficiency of the source country; (ii) capital raised in a host market is larger the relatively more efficient the banking sector of the home country; and (iii) the extent to which foreign assets are financed by foreign liabilities decreases with the relative capital abundance of the source country. Comparative statics show that differences in endowments and in banking sector efficiency across countries are major determinants of foreign bank asset and liability holdings. A 10% decrease in the overhead costs of the source country relative to the recipient country increases foreign asset holdings by approximately 4.1%. At the same time, an increase in the source country's capital-labor ratio of 10% increases foreign assets by 3.5%.

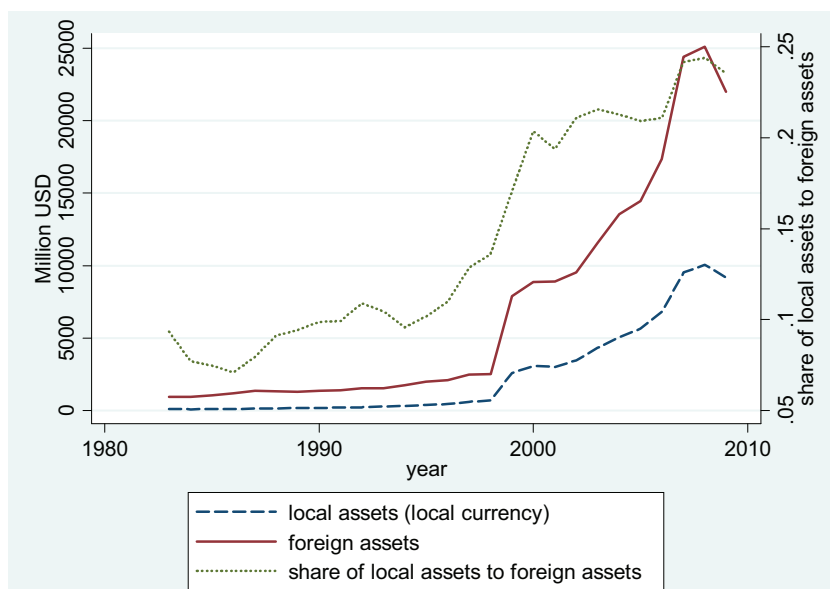
In an extension, bank-to-bank lending as opposed to direct bank-to-firm lending is studied within the framework of the model. The related empirical findings that banking sectors engage more in bank-to-firm than in bank-to-bank lending in countries where the banking sector is relatively less efficient and where barriers to capital account transactions are low suggest further avenues for research.

⁴There is no common usage of terms in the literature. The distinction between international and global banking is also found e.g. in McCauley, Ruud, and Wooldridge (2002).

2 Stylized Facts

There are six facts which a model of international and global banking should be able to match. First, there has been an enormous rise in the foreign asset holdings of banks over the past two decades. Second, banks have been operating increasingly through foreign affiliates. Figure 1 shows the evolution of average bilateral asset holdings for a group of 25 source countries and a large set of recipient countries (solid line).⁵ The dotted line illustrates that the share of local assets (local currency) in foreign assets, i.e. the share of foreign assets held through affiliates in the host market in the currency of the host market, has been steadily increasing over time.⁶ Targets of the expansion were countries from all income groups, which can be seen from Figure 2.

Figure 1: Evolution of foreign assets over time



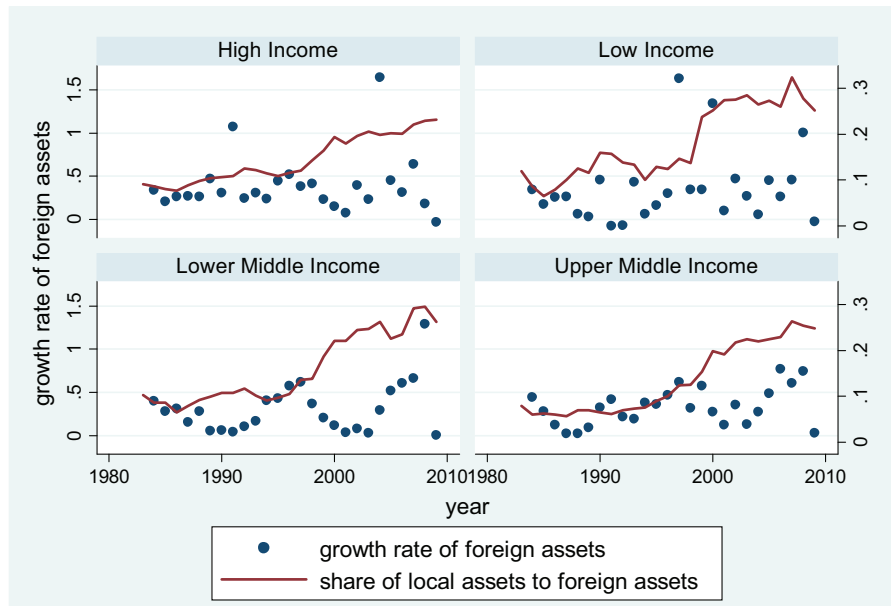
The graph shows the evolution of foreign asset holdings of BIS reporting countries over time. The solid line depicts the USD valued average foreign assets (y-axis on the left). They include the claims of all banks whose headquarters are in one of the BIS reporting countries towards a large set of foreign countries. The dashed line shows the USD value of average assets on the balance sheets of foreign affiliates towards residents of the host market which are denoted in the currency of the host market (local assets, y-axis on the left). These are included in foreign assets. The dotted line is the ratio of local claims to foreign assets (y-axis on the right). There is a break in the series in 1998.

Third, an increasing fraction of international bank business consists of intermediating capital

⁵While the figure plots the average USD 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).

⁶Researchers at BIS have pointed this out: e.g. McCauley, Ruud, and Wooldridge (2002) and McCauley, McGuire, and von Peter (2010).

Figure 2: Evolution of foreign assets across recipient income groups



The figure shows that developments have been similar across recipient income groups. The 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 points correspond to the average yearly growth rates of foreign assets in those countries (y-axis on the left).

locally in foreign markets. 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).⁷ The graphs illustrate that local assets of foreign affiliates are approximately matched by local liabilities. Foreign affiliates intermediate foreign capital to a large extent locally within the foreign market. The literature distinguishes two different forms of banking across borders: *international banking* and *global banking*. International banking denotes the case where a bank raises capital in its domestic market and lends it to a foreign market. Global banking, in contrast, describes the situation in which a bank raises funds in a foreign market and lends them to the same (foreign) market. In this context, the increase in activities by foreign affiliates reflects an increased importance of global banking relative to international banking.⁸

Forth, the modes of international operations differ considerably across source countries, which is also apparent from Figure 3. While Spanish banks operate mainly through foreign affiliates (more than 65% of all assets are held by foreign affiliates), Japanese banks conduct international business

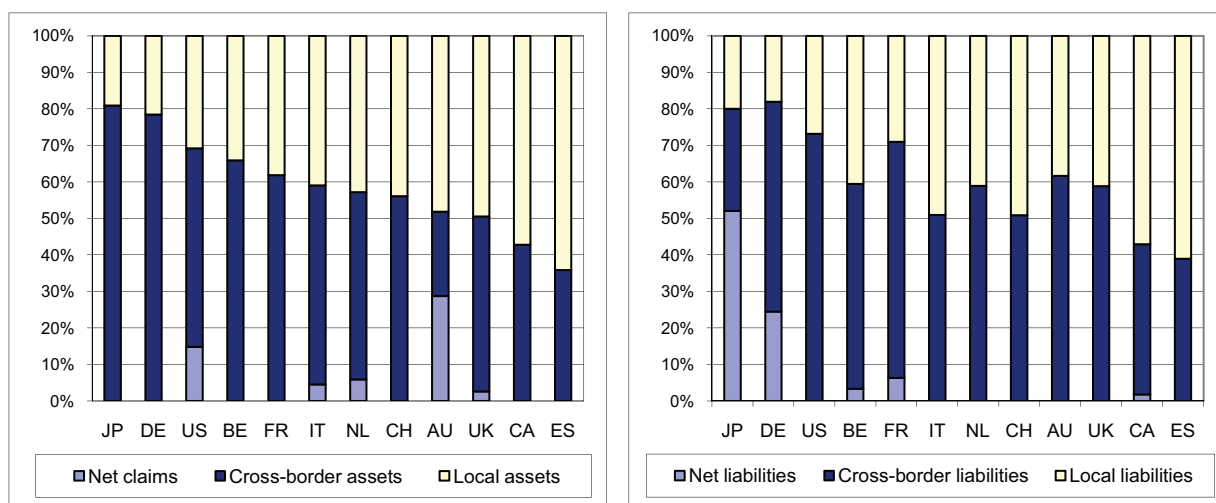
⁷The data that underlies the two graphs in Figure 3 was kindly provided by the Bank for International Settlements.

⁸McCauley, Ruud, and Wooldridge (2002) were the first to argue that there has been a move from international towards global banking, a phenomenon they call the "globalisation of international banking".

predominantly from home; more than 80% of all foreign assets are held by banks located in Japan. Given the arguments made before, this suggests that the extent to which banking sectors engage in global banking versus international banking is heterogeneous across countries: Spanish banks engage more in global banking, while Japanese banks do more international banking.⁹

Figure 3 also illustrates the fifth 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. It has more foreign assets than foreign liabilities. The US banking sector, in contrast, is a net importer of capital as its foreign liabilities exceed its foreign assets.

Figure 3: Modes of foreign bank operations



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).

Finally, banking sector and capital account liberalization in the recipient country have differential effects on foreign bank assets. Figure 4 plots the level of foreign bank assets for a large set of country pairs as a function of Financial Freedom, 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. It increases from the left to the right.¹⁰ Note that the range of the y-axis is different in each panel. The figure indicates that for the same level of financial freedom, a reduction in restrictions to capital

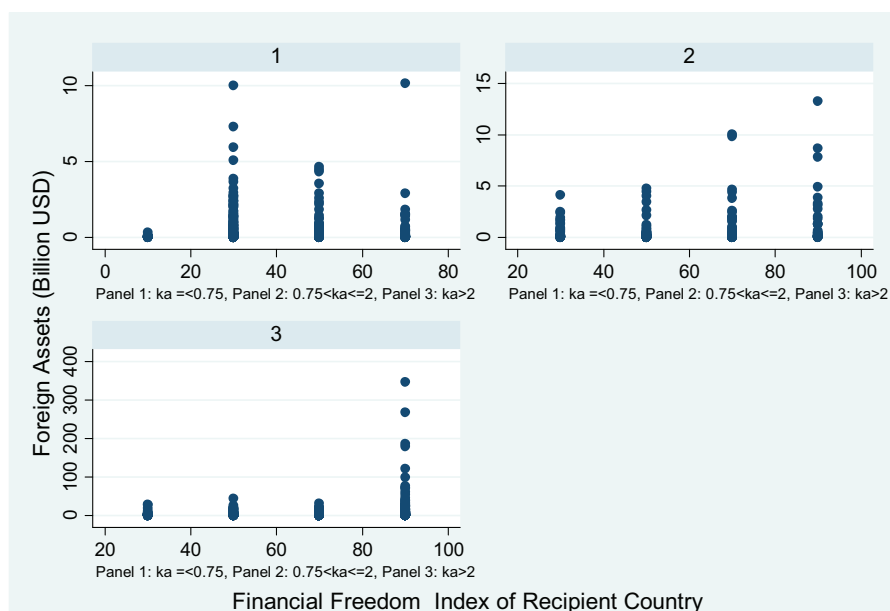
⁹This interpretation of the data underlies the assumption that global banking requires a physical presence abroad and mainly occurs through foreign affiliates while international banking can be more easily conducted from the home country. Note that the notion of international banking includes carry trade where banks trade assets in order to exploit interest rate differentials across countries.

¹⁰The sample is the cross-section of the year 2005 as described in the empirical part of this paper.

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 to financial flows.

The model presented in this paper can accommodate and explain these six facts simultaneously: the surge in foreign asset holdings and in activities by foreign affiliates; the increased importance of global banking relative to international banking; heterogeneity in the extent of international and global activities across banking sectors; the pattern of net bank-intermediated capital imports and exports and the differential effects of capital account and banking sector liberalization.

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



The figure shows foreign assets (international claims vis-a-vis the non-bank private sector) of BIS reporting countries in 2005 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 (1) collects recipient countries for which the Chinn & Ito Index takes values below or equal to 0.75. The upper right panel (2) includes recipient countries whose index is between 0.75 and 2. In the lower left panel (3) recipient countries have index values that are greater than 2. Note that the range of the y-axis differs across panels.

3 Literature

The existing literature has focused on several different aspects of banking across borders. A large strand of the literature analyzes the implications of multinational banking for regulation¹¹ and financial

¹¹See e.g. Calzolari and Loranth (2010) and Loranth and Morrison (2007).

stability.¹² In this context, several papers study the role of internal capital markets for multinational banks (see Cetorelli and Goldberg (2009), de Haas and van Lelyveld (2010)). Cerutti, Dell’Ariccia, and Martinez Peria (2007) and Dell’ariccia and Marquez (2010) investigate the organizational choice of banks. Lehner (2009), Buch, Koch, and Koetter (2009) and Blas and Russ (2010) are concerned with the modes of foreign bank entry.

Only few theoretical papers, however, explore the determinants of banking across borders.¹³ Most models derive positive foreign asset holdings by banks from a motive to diversify the lending portfolio (e.g. Buch (2003), Buch, Koch, and Koetter (2009)). Ennis (2001) assumes that information problems are reduced when banks operate across regions. In Blas and Russ (2010), firms borrow from abroad as they randomly obtain a cheaper cost draw.

This paper also relates to the international finance and portfolio literature (see e.g. Martin and Rey (2004), Portes and Rey (2005), Aviat and Coeurdacier (2007)). It shows that a gravity relationship for bank assets, where foreign assets increase one to one with the GDP of the source and the recipient country, does not hold in general: when banking sectors engage in global banking, the link between domestic market size and foreign asset holdings is weakened. This is also in contrast to a recent paper by Brueggemann, Kleinert, and Prieto (2011), who obtain a gravity equation for foreign bank loans in a partial-equilibrium model where a country’s interest rate and its demand for bank loans are exogenous.

More broadly, this paper adds to the growing literature on services trade.¹⁴ It also relates to works on international capital flows and financial frictions. The theoretical framework builds on Ju and Wei (2010) who are concerned with circular capital flows, a topic outside the scope of this paper. In their paper, financial underdevelopment of a country is circumvented in that capital leaves a country as investor capital and reenters as production FDI. In Antras and Caballero (2009) in contrast, trade in goods helps alleviate financial frictions. Here, it is trade in banking services that allows more capital to flow into less financially developed countries suggesting that with banking sector liberalization, the mechanisms presented in the above papers become less important.

Many papers investigate the factors that determine foreign bank entry, the mode of bank entry and the consequences of bank entry for host countries empirically. A review of the literature is provided by Goldberg (2007) and by Cull and Martinez-Peria (2010). The empirical relations which are derived explicitly from the theoretical model, however, have not been investigated before. Confirming earlier

¹²Navaretti, Calzolari, Pozzolo, and Levi (2010) and Cetorelli and Goldberg (2010) for example discuss the role of multinational banks during the recent financial crisis.

¹³Early works that discuss the internationalization strategies of banks are Aliber (1984) and Grubel (1989). See Williams (1997) for a literature review on two opposing theories: eclectic versus internationalization theory.

¹⁴See Francois and Hoekman (2010) for a review of recent development in services trade research.

empirical findings that institutions matter for foreign bank assets (see Papaioannou (2009)) and that banks engage more in foreign countries that have higher GDPs, fewer capital controls, lower bank entry barriers and that are closer in terms of distance and culture (see e.g. Buch (2003), Focarelli and Pozzolo (2005), Buch and Lipponer (2007)), this paper examines the omitted effects of differences in endowments and differences in banking sector efficiency between countries on bilateral foreign asset and liability holdings.

4 Closed Economy

The theoretical model builds on the framework presented in Ju and Wei (2010), who are concerned with circular capital flows, a topic outside the scope of this paper. They show that savings leave a country and enter again as production FDI when domestic financial institutions and corporate governance are poor. This paper instead studies trade in banking services. It uses the closed economy structure of Ju and Wei (2010) to allow banks to serve foreign markets and to act as vehicles for international capital flows. As an additional innovation, this paper distinguishes between banking sector and capital account liberalization and explores their differential effects on international and global banking.

The closed economy is endowed with capital K and labor L . Both factors are employed in the production of a single consumption good, which is produced under constant returns to scale and the price of which is normalized to 1. The production function is denoted by $F(l, z)$, where l and z are labor and capital input, respectively. $F(l, z)$ is assumed to be continuous, increasing and concave in both arguments and the same for all firms. Firms are perfectly competitive and labor is supplied inelastically.

Capital is owned by K capitalists. Each of them has the choice between becoming a depositor or an entrepreneur in 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, where 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 which is endogenously determined.

If a capitalist chooses to become an entrepreneur, he invests a fraction of his own capital y in his firm (internal capital) and raises x units of external capital from banks, which act as intermediaries between depositors and entrepreneurs. Banks are perfectly competitive and collect a fee c from entrepreneurs for their services. This fee is proportionate to $z = x + y$, the total capital employed by

a firm. Its magnitude characterizes the efficiency of the banking sector in the economy.¹⁵

Under perfect competition and constant returns to scale the size of a firm is typically indeterminate. Here, financial frictions limit the amount of external capital a single entrepreneur can raise and therefore the total capital that a firm employs to z . Financial frictions arise from a moral hazard problem on the side of the entrepreneur as formulated in Holmstrom and Tirole (1997): the success probability of a firm depends on the effort level exerted by the entrepreneur, which is not observable by outsiders.

The entrepreneur can choose between two different ways of running the firm. The “good” option has a high success probability λ and yields zero private benefits. The “bad” option yields positive private benefits $b > 0$, but has a lower probability of success λ^L . Only the good option with zero private benefits is economically viable so no depositor is willing to invest in a firm if he cannot be sure that the entrepreneur exerts effort. Therefore, for investment to take place the moral hazard problem must be resolved and in equilibrium only the good option is implemented. An entrepreneur chooses the good option only if it is profitable for him to do so, i.e. if $\lambda R^E \geq \lambda^L R^E + b$, where R^E is the return to the entrepreneur per unit of capital that the firm employs.

Faced with the described frictions, entrepreneurs maximize profits. Taking as given the financial interest rate r and the gross return on capital R , an entrepreneur solves the following problem:

$$\underbrace{\max}_{x,y,z,R^E} I = z\lambda R^E + (1+r)(1-y) \quad (1)$$

$$s.t. \quad y \leq 1 \quad (BC^E) \quad (2)$$

$$z \leq x + y \quad (RC) \quad (3)$$

$$(\lambda(R - R^E) - c)z \geq (1+r)x \quad (PC^D) \quad (4)$$

$$R^E \geq \frac{b}{\lambda} \quad (IC^E) \quad (5)$$

where λ^L is set equal to zero for convenience. The entrepreneur maximizes his income by choosing how much of his own capital y to invest in the firm (the residual capital is deposited with a bank) and how much external capital x to raise. He further decides on the overall size of the firm z as well as on his per-unit return R^E . He faces four constraints. (BC^E) is his budget constraint. He cannot invest more capital y in the firm than he owns. (RC) is the resource constraint. The capital input z cannot exceed the internal capital plus the external capital that he obtains. (PC^D) is the participation constraint of depositors, who have to receive at least $(1+r)$ per unit of capital supplied. The expression on

¹⁵The 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.

the left hand side of Condition (4) is the return that is left after the entrepreneur has received his income $R^E z$ and after the total service fees cz have been paid to the bank. Finally, (IC^E) is the incentive-compatibility constraint of the entrepreneur, which characterizes the moral hazard problem and puts a lower bound on the per unit return R^E .

All constraints bind in equilibrium. The proof is stated in the Appendix A. It is optimal for the entrepreneur to invest all his funds in the firm. Furthermore, $R^E = b/\lambda$, i.e. he sets his own return to the minimum as prescribed by the incentive-compatibility constraint and raises the capital input z to the maximum. The size of the firm is then:

$$z = 1 + x = \frac{1 + r}{(1 + r) + b + c - \lambda R}, \quad (6)$$

and the entrepreneur's income:¹⁶

$$I = \frac{(1 + r)b}{1 + r + b + c - \lambda R}. \quad (7)$$

The higher intermediation costs and the higher the interest the entrepreneur has to pay, the lower his income.

In order to obtain the equilibrium, the gross return to capital R , the wage rate w and the interest rate r remain to be determined. Firms are perfectly competitive and symmetric. As a result, they all employ the same amount of capital and labor. With capital market clearing the number of firms is therefore $N = K/z$. Labor market clearing further ensures that $l = L/N$. Under perfect competition, the returns to the production factors are determined by their marginal products. Given that the firm succeeds, the gross return to capital R and the wage rate w are given by:

$$R = (1 + F'_z(1, z/l)) = (1 + F'_K(1, K/L)) \quad \text{and} \quad w = F'_L(1, K/L). \quad (8)$$

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

Capitalists have the endogenous choice between becoming entrepreneurs or depositors. To become an entrepreneur, a capitalist has to pay a start-up fee f , which he finances by borrowing.¹⁷ Free entry

¹⁶ $(1 + r) + b + c - \lambda R$ could be negative, which would imply that the entrepreneur wants to borrow infinitely. In equilibrium, however, an entrepreneur always borrows a finite amount of capital because the equilibrium interest rate is given by $1 + r = \lambda R - c - b + \frac{b}{1+f}$, which implies that $1 + r + c + b - \lambda R > 0$.

¹⁷Capital for the start-up fee comes from outside financiers. This assumption improves tractability as the capital employed in production in the economy remains constant with varying interest rates and is equal to the aggregate capital endowment. The key mechanism of the model remains the same when entrepreneurs finance the start-up cost from their capital endowment.

implies that, in equilibrium, capitalists must be indifferent between the two occupations.¹⁸ Hence:

$$U^E = \frac{(1+r)b}{(1+r)+b+c-\lambda R} - (1+r)f = (1+r) = U^D. \quad (9)$$

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

$$1+r = \lambda R - c - b + \frac{b}{1+f}. \quad (10)$$

Besides private benefits and the entry cost, the financial interest rate in the economy is a function of endowments and of banking sector efficiency. Given that the gross return to capital is a function of the aggregate capital labor ratio, the interest rate can be expressed as:

$$1+r = \lambda(1 + F_K(K/L)) - c - \beta, \quad (11)$$

where $\beta = bf/(1+f)$, which is the capital share that the entrepreneur receives. The scarcer capital in the economy relative to labor, 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 lower banking sector efficiency, financial interest rates are more depressed. At the same time, the leverage and hence the size of firms is smaller.

5 Open Economy

In the open economy, there are two countries i and j which differ with respect to their relative endowments of capital and labor and banking sector efficiency. Endowments of capital are denoted by K_i^a and K_j^a , respectively. As the autarky financial interest rate r^a is a function of K^a/L and c , it also varies between countries. Therefore banks in country i and country j offer different service fees and interest rates, which generates trade in banking services.

Two different phases of symmetric liberalization are considered. In the first phase, countries open up their economies for capital flows. Then banks are able to lend capital to foreign firms, but they are not allowed to take deposits in the foreign country. In the second phase, banking sectors are liberalized in addition, which also allows banks to intermediate the capital of foreign depositors.¹⁹

¹⁸The entry cost f , private benefits b and the service fee c that banks demand are assumed to be sufficiently small so that $\lambda R/(1+f) < \lambda R - c - bf/(1+f)$ and financial intermediation is beneficial.

¹⁹Barriers to bank entry increase the cost of establishing foreign affiliates for banks. The model, however, does not consider explicitly whether banks establish a physical presence or not. It rather assumes that if banking sectors are not

This is in line with the process of liberalization that could be observed in many countries. While restrictions on capital account transactions have been constantly reduced since the 1990s,²⁰ banking sector openness has not been following a clear trend. Selected countries have gone through substantial banking sector reform however. For example, Mexico removed all restrictions to the entry of foreign banks in 1997.²¹

5.1 Capital account liberalization

Under capital account liberalization, banks are allowed to engage in cross-border lending but they cannot take deposits abroad. They channel capital from domestic depositors to firms located in the home or the foreign country. Workers, entrepreneurs and depositors are assumed to be immobile.²² Trade in the consumption good is free so capital gains can be repatriated without costs. To focus on the more interesting aspects of the model, the case where banking sectors are equally efficient is not considered explicitly.

Banks incur an additional cost τ when operating abroad, i.e. banks lose in terms of efficiency when serving foreign firms.²³ The service fee that a bank from country j demands from entrepreneurs in country i is $c_j + \tau_{ij}$. Equivalently entrepreneurs from country j have to pay $c_i + \tau_{ji}$ for the services of banks from country i . Banks with higher domestic service fees also face higher transaction costs, i.e. $\tau(c) \geq 0$ and $\tau'(c) > 0$. In particular, the following assumption is made:²⁴

$$\tau_{ji} > \underline{\tau} \text{ and } \tau_{ij} = 0 \text{ if } \Delta c = c_i - c_j > 0, \quad (12)$$

$$\tau_{ij} > \underline{\tau} \text{ and } \tau_{ji} = 0 \text{ if } \Delta c = c_i - c_j < 0.$$

liberalized, banks cannot take deposits in foreign markets. The model thus interprets barriers to bank entry as harming the deposit and retail business more than lending and investment activities. Arguably, extending loans is easier across borders than running a retail business, which requires more frequent interaction with customers, the installation of cash machines etc.. Moreover, banks are often not allowed to refinance themselves abroad without a physical presence in the host market.

²⁰The Chinn & Ito index, which measures the de facto openness of countries with respect to capital transactions, increased from an average of 0.53 in 1995 to 0.62 in 2000 taking a value of 0.85 in 2005 for a group of 90 countries. For more information on the index and the sample of countries, see the empirical part of this paper.

²¹While the index of Financial Freedom, which measures the openness of banking sectors for entry, improved for Mexico from 30 points in 1995 to 70 in 2005, it has been largely stable in the aggregate at around 53 points.

²²In reality, a share of financial investors is mobile, too. However, some investor capital may only become mobile through banks. This should in particular be true for deposits, which represent an important funding source for banks.

²³Alternatively, one could model the transaction cost as a cost of channeling capital across borders. In this case τ would be proportionate to x and not to z .

²⁴An assumption on the relative magnitude of the additional cost from operating across borders is necessary to prove the existence of an equilibrium in the open economy with capital account liberalization. If $\Delta c > 0$, $\tau_{ji} - \tau_{ij}$ has to be sufficiently large. For convenience, the transaction cost of the more efficient banking sector is set to zero. The exact value of the threshold $\underline{\tau}$ is stated in the Appendix. The intuition is the following: with increasing firm size, the interest rate weighs relatively more than the monitoring cost in the maximization problem of the entrepreneur. Therefore, $I_{ij} = I_{ii}$ does not imply $I_{ji} < I_{jj}$, which is a necessary condition for an equilibrium where only the more efficient banks go international. In order for $I_{ij} = I_{ii}$ to imply $I_{ji} < I_{jj}$, Assumption 12 is required.

In the closed economy, entrepreneurs must deal with their domestic banks. In the open economy, they have a choice. The start-up cost f is assumed to be financed by financiers at the local interest rate²⁵ but external capital can be raised from domestic or foreign banks. With heterogeneity in endowments and in banking sector efficiency, the interest rate banks can offer and the service fee they require differ across banking sectors. Firms in both countries choose the bank that offers the better conditions, i.e. the combination of interest rate and service fee that maximizes their income.

The income of an entrepreneur in country i that borrows from a bank in country j is obtained by solving the following maximization problem:

$$\underbrace{\max}_{x_{ij}, y_{ij}, z_{ij}, R^E} I_{ij} = z_{ij} \lambda R^E + (1 + r_i)(1 - y_{ij}) \quad (13)$$

$$s.t. \quad y_i \leq 1 \quad (14)$$

$$z_{ij} \leq x_{ij} + y_{ij} \quad (15)$$

$$(\lambda(R_i - R^E) - c_j - \tau_{ij})z_{ij} \geq (1 + r_j)x_{ij} \quad (16)$$

$$R^E \geq \frac{b}{\lambda} \quad (17)$$

When borrowing from a bank and implicitly from depositors in country j , the entrepreneur has to pay the interest rate of country j and the foreign service fee c_j . He also has to cover the transaction cost τ_{ij} . Solving the problem yields:²⁶

$$I_{ij} = \frac{(1 + r_j)b}{1 + r_j + b + c_j + \tau_{ij} - \lambda R_i}. \quad (18)$$

He compares this to the income that he receives when using a domestic bank to source external capital, which is correspondingly:

$$I_{ii} = \frac{(1 + r_i)b}{1 + r_i + b + c_i - \lambda R_i}. \quad (19)$$

For entrepreneurs in country j , we have equivalently:²⁷

$$I_{ji} = \frac{(1 + r_i)b}{1 + r_i + b + c_i + \tau_{ji} - \lambda R_j}, \quad (20)$$

²⁵As an alternative, one could assume that firms borrow at the interest rate that the bank they use as intermediary offers. The mechanism would go through. The formulation chosen increases analytical tractability.

²⁶This is the solution as long as $1 + r_j < \lambda R_i - c_j$. Only this solution to the maximization problem is relevant for the equilibrium analysis. In equilibrium the condition is always satisfied. See the Appendix for details.

²⁷This is the solution as long as $1 + r_i < \lambda R_j - c_i$. Only this solution to the maximization problem is relevant for the equilibrium analysis. In equilibrium the condition is always satisfied. See the Appendix for details.

and

$$I_{jj} = \frac{(1 + r_j)b}{1 + r_j + b + c_j - \lambda R_j}. \quad (21)$$

Before analyzing the equilibrium more formally, the economic intuition is provided. In the moment where countries open up, autarky interest rates prevail, but entrepreneurs have the choice between domestic and foreign banks. Their incomes under the different options are given by the previous four equations and depend on the prevailing interest rate and banking sector efficiency in each country. It is never the case that entrepreneurs in both countries prefer foreign banks at the same time. Therefore, trade is always one directional and in equilibrium banks from only one country expand abroad.

Three different cases exist: (i) entrepreneurs in both countries prefer banks from country j at autarky interest rates. Then banks from country j export banking services (**export case**). (ii) There is no trade in banking services because entrepreneurs in each countries prefer domestic banks at autarky interest rates (**no-trade case**). (iii) Entrepreneurs in both countries prefer banks from country i at autarky interest rates. Then country i exports banking services, country j imports them (**import case**).

Which case prevails depends on who has the absolute advantage in providing banking services and on the magnitude of this advantage as well as on how capital and labor are distributed across countries. Entrepreneurs in both countries prefer banks with low interest rates and low service fees. Therefore, the lower the financial interest rate in country j , i.e. the more capital abundant it is, and the lower the service fee of its banks relative to country i , the more likely it is that country j becomes the exporter of banking services in the open economy and the larger its exports.

The mechanism that determines the equilibrium with trade in banking services is as follows. Entrepreneurs demand the services of foreign banks if these offer the best overall conditions. However, foreign banks become less attractive as providers of external funds as the volume of trade in banking services increases. This is because whenever banking services are exported, capital is also exported, which affects the allocation of capital between countries. The interest rate in the banking services exporting country rises, while it declines in the importing country. The equilibrium is determined by the cross-border capital flow that makes banks in both countries equally attractive. Low service fees are then offset by a high financial interest rate and vice versa.

If banks invest domestic capital in foreign firms, this implies a cross-border capital flow K_{ij} . In the following, bars on top of variables are used to denote equilibrium values in the open economy with capital account liberalization. $\bar{K}_{ij} > 0$ indicates that capital flows from country j to country i in equilibrium and vice versa if $\bar{K}_{ij} < 0$. Banks that export capital hold foreign assets on their balance

sheets. Aggregate foreign assets of banks from country j invested in firms in country i are denoted by Ω_{ij} .²⁸ As banks can only raise capital from domestic depositors, any capital invested in foreign firms crosses the border. Therefore, there is a correspondence between equilibrium foreign assets and the equilibrium capital flow. With $\bar{K}_{ij} > 0$, banks from country j hold foreign assets $\bar{\Omega}_{ij} = \bar{K}_{ij}$. Foreign assets of banks from i are zero, hence $\bar{\Omega}_{ji} = 0$. If $\bar{K}_{ij} < 0$, $\bar{\Omega}_{ji} = -\bar{K}_{ij}$ and $\bar{\Omega}_{ij} = 0$. Once the equilibrium capital flow \bar{K}_{ij} and thus foreign assets $\bar{\Omega}_{ij}$ and $\bar{\Omega}_{ji}$ are determined, trade in banking services, i.e. the total service fees paid by firms in one country to banks from another country, are also pinned down.

Definition 1 *An equilibrium in the open economy with capital account liberalization is characterized by the capital flow \bar{K}_{ij} for which the following conditions are satisfied:*

1. *Entrepreneurs are indifferent between using foreign and home banks to raise external capital or prefer their domestic banks: $\bar{I}_{ii} \geq \bar{I}_{ij}$ and $\bar{I}_{jj} \geq \bar{I}_{ji}$.*
2. *Capital markets clear: $\bar{N}_j \bar{z}_j = K_j^a - \bar{K}_{ij}$ and $\bar{N}_i \bar{z}_i = K_i^a + \bar{K}_{ij}$.*
3. *Labor markets clear: $\bar{N}_j \bar{l}_j = L_j$ and $\bar{N}_i \bar{l}_i = L_i$.*
4. *Capitalists in each country are indifferent between becoming entrepreneurs and depositors: $\bar{U}_j^B = \bar{U}_j^D$ and $\bar{U}_i^B = \bar{U}_i^D$.*
5. *Capital flows are consistent with the demand for banking services.*

The equilibrium in the open economy with capital account liberalization exists.²⁹ If $\Delta c > 0$, a sufficient condition for uniqueness is:³⁰

$$\left(\lambda - (c_i - c_j) \frac{b}{1+f} \frac{1}{\lambda} \frac{1}{(R_j - R_i)^2} \right) \frac{\partial R_i}{\partial K_{ij}} + \left((c_i - c_j) \frac{b}{1+f} \frac{1}{\lambda} \frac{1}{(R_j - R_i)^2} \right) \frac{\partial R_j}{\partial K_{ij}} > 0 \text{ for } R_j > R_i. \quad (22)$$

If $\Delta c < 0$, then i and j are reversed in the above expression. The condition requires a weak assumption on the production function.³¹

²⁸Here, foreign bank assets correspond to the cross-border capital flow. However, when banking sectors are liberalized subsequently and banks are also allowed to raise capital from foreign depositors, foreign assets do not coincide with the cross-border capital flow anymore. It is therefore necessary to define foreign assets separately. Moreover, foreign bank assets, not capital flows, are observed in the data.

²⁹Only interior solutions where entrepreneurs, depositors and banks exist in both countries are considered. An interior solution requires that $\bar{N}_i < K_i^a$ and $\bar{N}_j < K_j^a$. As firm capital cannot relocate, economies must have enough own capital so that firms can absorb the foreign (external) capital.

³⁰See the Appendix for the derivation.

³¹The condition is not very restrictive and will in general hold. To see this note that if $\Delta c > 0$, $\frac{\partial R_i}{\partial K_{ij}} < 0$ and $\frac{\partial R_j}{\partial K_{ij}} > 0$, while $|\frac{\partial R_i}{\partial K_{ij}}| < |\frac{\partial R_j}{\partial K_{ij}}|$ for the segment where $R_j > R_i$.

Proposition 1 *There exists an equilibrium in the open economy with capital account liberalization characterized by the equilibrium capital flow \bar{K}_{ij} . It is unique under Condition 22.*

Proof. See Appendix A. ■

Proposition 2 *Assume $\Delta c \neq 0$. Then three different equilibrium cases can be distinguished:*

(i) **Export case:** *Country j exports banking services to country i . Banks from country j hold positive foreign assets $\bar{\Omega}_{ij} = \bar{K}_{ij} > 0$. The banking sector of country i does not operate abroad, $\bar{\Omega}_{ji} = 0$. Entrepreneurs in country i are indifferent between domestic and foreign banks, while entrepreneurs in country j prefer their home banks.*

(ii) **No-trade case:** *There is no trade. Foreign asset holdings of banks in both countries are equal to zero, $\bar{\Omega}_{ij} = \bar{\Omega}_{ji} = \bar{K}_{ij} = 0$.*

(iii) **Import case:** *Country j imports banking services from country i . The banking sector of country i holds positive foreign assets $\bar{\Omega}_{ji} = -\bar{K}_{ij} > 0$. Banks from country j do not operate abroad, $\bar{\Omega}_{ij} = 0$. Entrepreneurs in country j are indifferent between domestic and foreign banks, while entrepreneurs in country i prefer their home banks.*

In all three cases, the country with the more efficient banking sector employs less capital in production. Its gross return to capital and its interest rate are higher than in the other country.

Proof. See Appendix A. ■

Figure 6 illustrates the export case in detail for a situation where $\Delta c > 0$. The upper panel shows the income of an entrepreneur in country i when drawing on the services of domestic (dashed line) and foreign banks (solid line) as a function of the capital flow K_{ij} . The panel below illustrates the income curves of an entrepreneur in country j . The two lower panels depict the interest rates of country i (dashed) and country j (solid) and their respective gross returns to capital again as functions of the capital flow K_{ij} .

Country j hosts the more efficient banks and has a relatively high capital-labor ratio reflected in a low gross return to capital R_j . As a consequence, firms in both countries prefer banks from country j at autarky interest rates (when $K_{ij} = 0$). As banks from country j export banking services and hence capital, capital flows from j to i , raising the interest rate and the gross return to capital in country j and lowering them in country i . The economy moves from $K_{ij} = 0$ (autarky) to the right ($K_{ij} > 0$) until point A is reached, which corresponds to the equilibrium. In that point, entrepreneurs from country i are indifferent between domestic banks and foreign banks. Here, domestic banks demand a high service fee and offer a low interest rate, while foreign banks are more efficient but require a higher interest on capital. This is a general feature of the equilibrium. The country with an absolute

advantage in providing banking services employs less capital in domestic production and has a higher equilibrium interest rate.³²

Entrepreneurs in country j prefer their domestic banks at point A. The indifference point of an entrepreneur in country j does not coincide with the one of an entrepreneur in country i , i.e. the capital flow K_{ij} that solves $I_{jj} = I_{ji}$ is different from the solution to $I_{ij} = I_{ii}$.³³ For entrepreneurs in country j to be indifferent, K_{ij} must be larger. Intuitively, with the additional cost τ_{ji} that entrepreneurs in country j incur, the financial interest rate r_i prevailing in country i must be lower to make them indifferent between domestic and foreign banks. Even if transaction costs for banks in both countries were zero, indifference points would not coincide; with $\tau_{ij} = \tau_{ji} = 0$, $I_{ij} = I_{ii}$ does not imply $I_{jj} = I_{ji}$. This is because the exact tradeoff a firm faces is affected by changes in the allocation of capital between countries. The higher the gross return to capital R , the relatively more weight an entrepreneur puts on the interest rate as compared to the fee for banking services. Assumption 12 excludes cases where $I_{ij} > I_{ii}$ and $I_{ji} > I_{jj}$, i.e. entrepreneurs in country i never prefer banks from j when entrepreneurs from j prefer banks from i . Point A never lies to the right of point B.

Why are points to the right of A not an equilibrium? For all $K_{ij} > A$, capital must flow from j to i as $K_{ij} > 0$. This capital flow is, however, not consistent with the demand for banking services because entrepreneurs from country i prefer domestic banks at the implied interest rates.

A decline in $\Delta(K^a/L)$, shifts all curves in the graphs to the left. Country j becomes capital scarcer relative to country i and the equilibrium capital flow goes down. At some point the no-trade case occurs. It corresponds to a situation where the indifference point of an entrepreneur in country j (Point A) lies to the left and where the indifference point of an entrepreneur in country i (Point B) lies to the right of the y-axis, where $K_{ij} = 0$. Then there is no trade in banking services because the autarky financial interest rate of country i is not low enough to make up for the high service fees plus transaction costs its banks require. Similarly, for entrepreneurs in country i , banks from country j demand too high an interest rate to be attractive. As $\Delta(K^a/L)$ declines even further, the equilibrium switches from the no-trade equilibrium to the import case. When both indifference points A and B lie to the left of the y-axis, entrepreneurs in both countries prefer banks from country i at $K_{ij} = 0$ and in equilibrium country j imports banking services.

From these considerations it is clear that $\bar{\Omega}_{ij}$ weakly increases in $\Delta(K^a/L) = K_j^a/L_j - K_i^a/L_i$. The more capital abundant country j relative to country i ceteris paribus, the lower r_j^a and the more

³²With capital account liberalization, more capital flows into the financially underdeveloped country than MPK equalization would prescribe. The fact that the domestic banking sector is less efficient increases the demand for foreign bank-intermediated capital.

³³Indifference points of entrepreneurs coincide if $\Delta c = 0$. In this case, only net foreign asset positions and the net capital flow are determined.

capital must flow from country j to country i to raise the interest rate of country j to \bar{r}_j . The same logic applies when $\Delta(K^a/L)$ is fixed, but Δc varies. The larger the absolute efficiency advantage of banks from country j , i.e. the larger Δc , the larger the equilibrium spread in interest rates between countries ($\bar{r}_j - \bar{r}_i$ goes up). Therefore, for the same $\Delta(K^a/L)$, more capital is exported from country j to country i . $\bar{\Omega}_{ij}$ weakly increases in $\Delta c = c_i - c_j$.

Proposition 3 *Assume $\Delta c \neq 0$. Then equilibrium foreign assets $\bar{\Omega}_{ij}$ increase weakly in the difference in capital endowments $\Delta(K^a/L) = K_j^a/L_j - K_i^a/L_i$ and in the difference in banking sector efficiency $\Delta c = c_i - c_j$.³⁴*

Proof. See Appendix A. ■

When countries differ in their relative endowments of capital and labor or in banking sector efficiency, capital account liberalization leads to banking across borders. It occurs so as to equilibrate those differences. However, so long as banking sectors are closed, there is a trade-off between allocating capital efficiently between countries and exploiting differences in banking sector efficiency. The country with the more efficient banking sector employs more capital than MPK equalization would prescribe. At the same time, the expansion of the banking sector with an absolute efficiency advantage is limited. Only if countries were equally efficient in providing banking services ($\Delta c = 0$) would gross returns to capital and also interest rates be equalized between countries.³⁵ By assumption, banks are engaged only in *international banking* raising capital from domestic depositors and lending it to foreign firms.

5.2 Banking sector liberalization

With banking sector liberalization, barriers to the operations of banks in foreign markets are eliminated. Banks are not only able to lend to domestic and foreign firms, but they can also intermediate capital of domestic and foreign depositors.³⁶ As a consequence, the interest rate a bank can offer is not connected to the interest rate that prevails in its home country anymore. Banks compete for firms as clients and deposits across borders. Entrepreneurs, as before, decide whether to raise external capital from foreign or domestic banks choosing the bank that offers the best combination of service fee and interest rate.

³⁴The case where $\Delta c = 0$ is excluded. If $\Delta c = 0$, gross foreign assets $\bar{\Omega}_{ij}$ are indeterminate.

³⁵To see this, note that if $c_i = c_j$, entrepreneurs demand the services of the banking sector that offers the lower interest rate. In equilibrium $1 + r_i = 1 + r_j$, which implies $\lambda R_i = \lambda R_j$.

³⁶Banking sector liberalization is isomorphic to the case where investors, i.e. investor capital becomes mobile. Therefore, not only the effects of regulatory reform, but also those of technological progress, which reduces informational frictions and the cost of capital mobility, can be understood within the framework of the model.

With banks being able to raise capital also in the foreign market, foreign assets do not correspond to the cross-border capital flow anymore. Banks can also invest capital from foreign depositors in foreign firms. Capital is then intermediated locally within the foreign market. Therefore, in contrast to before, the equilibrium capital flow does not fully determine equilibrium foreign assets. \tilde{K}_{ij} , $\tilde{\Omega}_{ij}$ and $\tilde{\Omega}_{ji}$ now jointly characterize the equilibrium.³⁷ A tilde on top of variables denotes equilibrium values in the open economy with banking sector liberalization.

Definition 2 *An equilibrium in the open economy with banking sector liberalization is characterized by the cross-border capital flow \tilde{K}_{ij} , the assets held by banks from country j in country i $\tilde{\Omega}_{ij}$ and the assets held by banks from country i in country j $\tilde{\Omega}_{ji}$ for which the following conditions hold:*

1. *Entrepreneurs choose those banks as suppliers of external capital that maximize their income.*
2. *Depositors invest their capital in those banks that pay the highest interest rate.*
3. *Capital markets clear: $\tilde{N}_j \tilde{z}_j = K_j^a + \tilde{K}_{ij}$ and $\tilde{N}_i \tilde{z}_i = K_i^a + \tilde{K}_{ij}$.*
4. *Labor markets clear: $\tilde{N}_j \tilde{l}_j = L_j$ and $\tilde{N}_i \tilde{l}_i = L_i$.*
5. *Capitalists in each country are indifferent between becoming entrepreneurs and depositors: $\tilde{U}_j^B = \tilde{U}_j^D$ and $\tilde{U}_i^B = \tilde{U}_i^D$.*

As banks have the possibility to take deposits in both countries, they raise capital in the market where the interest rate is lowest. At the same time, depositors, who have to invest their capital in banks that operate in their domestic market, lend their capital to those banks that offer the highest interest rate. Under perfect competition, it follows that, in equilibrium, interest rates must be equal across countries:

$$\tilde{r}_i = \tilde{r}_j. \quad (23)$$

Intuitively, banking sector liberalization eliminates any funding advantage for banks that are located in a capital abundant country. When all banks offer the same financial interest rate independently of the capital flow K_{ij} , the service fee is the only factor that matters for the decision of the entrepreneurs, who demand the services of the banks with the lower service fees.³⁸ As there is no force that limits the expansion of the more efficient banking sector,³⁹ the less efficient banking sector ceases to operate.⁴⁰

³⁷With banking sector liberalization, gross asset positions are determined as long as $\Delta c \neq 0$. However, $\forall \Delta c$ only the net capital flow is determined.

³⁸The assumption that the more efficient banking sector has zero transaction costs ensures that it is always preferred by entrepreneurs in both countries when interest rates are the same.

³⁹Only interior solutions are considered. This requires that $\tilde{N}_i < K_i^a$ and $\tilde{N}_j < K_j^a$.

⁴⁰Under convex costs of banking across borders, the model would have an interior solution where the low-efficiency banking sector would shrink with banking sector liberalization, but would continue to operate in equilibrium.

With entrepreneurs in both countries paying the same service fees, interest rate equalization requires that the gross returns to capital are also equalized between countries. The equilibrium capital flow \tilde{K}_{ij} depends only on the distribution of endowments between countries and is the solution to:

$$F_{j,K} \left(1, \frac{K_j^a - \tilde{K}_{ij}}{L_j} \right) = F_{i,K} \left(1, \frac{K_i^a + \tilde{K}_{ij}}{L_i} \right). \quad (24)$$

Proposition 4 *The equilibrium in the open economy with banking sector liberalization exists and is unique. The banking sector with an absolute efficiency advantage takes over the entire market. The less efficient banking sector ceases to operate. The capital flow \tilde{K}_{ij} is such that marginal products of capital are equalized between countries.*

Proof. Omitted. ■

Next, the equilibrium is characterized in more detail and explicit solutions to \tilde{K}_{ij} , $\tilde{\Omega}_{ij}$ and $\tilde{\Omega}_{ji}$ are given. Assuming that production functions are symmetric across countries, the equilibrium capital flow \tilde{K}_{ij} is obtained from Equation (23) as:

$$\tilde{K}_{ij} = \left(\frac{K_j^a}{L_j} - \frac{K_i^a}{L_i} \right) \frac{L_j L_i}{L_j + L_i}. \quad (25)$$

It is the larger, the larger $\Delta(K^a/L) = \frac{K_j^a}{L_j} - \frac{K_i^a}{L_i}$, i.e. the larger differences in autarky capital-labor ratios between countries.

In order to pin down foreign asset holdings, consider the case where $\Delta c = c_i - c_j > 0$. Then banks from country j take over the entire market and intermediate the capital of depositors in both countries. Foreign assets held by banks from country i in country j $\tilde{\Omega}_{ji}$ are equal to zero. The aggregate foreign assets held by banks from country j in country i , in turn, consist of the capital that is intermediated locally in the foreign market plus the depositor capital that originates from country j and is invested in country i . With $K_i^a + \tilde{K}_{ij}$ capital being employed in country i , we have:

$$\tilde{\Omega}_{ij} = \frac{K_i^a + \tilde{K}_{ij}}{\tilde{z}} \tilde{x}, \quad (26)$$

where \tilde{x} and \tilde{z} denote the external capital per firm and the size of a firm in equilibrium, respectively. Subscripts are dropped because values are the same in both countries. Given that \tilde{K}_{ij} is an increasing function of differences in autarky capital-labor ratios, foreign asset holdings also increase in $\Delta(K^a/L)$. The more efficient banking sector intermediates capital locally in the foreign market but it also invests domestic capital in foreign firms; the more the capital scarcer the foreign country relatively to the

home country. At the same time expression 26 points out that a standard gravity equation for foreign bank assets does not hold in general, but that the relationship is asymmetric. 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.

For the analysis presented in the next subsection, it is convenient to consider also the liability side of the aggregate balance sheet of country j 's banking sector. Banks from country j intermediate funds of depositors in country i . These constitute foreign liabilities for them, which are denoted by Ψ_{ij} . Equilibrium foreign liabilities $\tilde{\Psi}_{ij}$ are equal to the total capital that country i is endowed with minus the capital owned by firms in country i , which is equivalent to the number of firms. Hence:

$$\tilde{\Psi}_{ij} = K_i^a - \frac{K_i^a + \tilde{K}_{ij}}{\tilde{z}}. \quad (27)$$

As banks from country i are not active, $\tilde{\Psi}_{ji} = 0$.

Foreign assets $\tilde{\Omega}_{ij}$ increase in the capital flow \tilde{K}_{ij} and are therefore larger, the larger the difference in relative capital endowments between countries. Moreover, foreign assets and liabilities are positive if country j has an absolute efficiency advantage and zero otherwise. The next proposition summarizes this.

Proposition 5 *Assume $\Delta c \neq 0$. Then equilibrium foreign assets $\tilde{\Omega}_{ij}$ weakly increase in the difference in capital endowments $\Delta(K^a/L)$ and in the difference in banking sector efficiency Δc . Foreign liabilities $\tilde{\Psi}_{ij}$ weakly increase in the difference in banking sector efficiency Δc .⁴¹*

Proof. See Appendix A. ■

It is useful to compare the equilibrium under banking sector liberalization with the one under capital account liberalization. If countries do not differ with respect to the efficiency of their banking sectors (if $\Delta c = 0$), but only with respect to their capital-labor ratios, banking sector liberalization has essentially no effect. To see this note that the equilibrium conditions under the two cases are the same. With differences in banking sector efficiency, however, the banking sector with an absolute efficiency advantage expands, while the less efficient banking sector contracts. Focus on the case where a country with inefficient banks is endowed with a lot of capital relative to labor. In this case, its banks may be competitive under capital account liberalization because they are able to offer a very low interest rate. With banking sector liberalization, however, this funding advantage goes away. In turn, the more efficient banking sector, which could not access capital abroad, starts taking foreign

⁴¹The case where $\Delta c = 0$ is excluded from the considerations. If $\Delta c = 0$, then $\tilde{\Omega}_{ij}$, $\tilde{\Omega}_{ji}$ as well as $\tilde{\Psi}_{ij}$ and $\tilde{\Psi}_{ji}$ are indeterminate.

deposits and is thereby able to expand. It takes over the lending and deposit business of the foreign less efficient banking sector. This mechanism provides a rationale for the additional expansionary effect of banking sector liberalization observed in the data.

International versus global banking Under capital account liberalization, banks could only engage in *international banking* lending domestic capital to foreign firms. With banking sector liberalization, in contrast, banks are also able to engage in *global banking*. They can raise capital from depositors in a foreign market and lend it to the same market. The extent to which they engage in each of the two activities depends on how large differences in endowments are between countries and whether banking sectors vary in efficiency.

The share of foreign liabilities to foreign assets measures the extent to which banks intermediate capital locally abroad. The higher the share, the greater the importance of global banking relative to international banking. If $\Delta c > 0$, foreign assets $\tilde{\Omega}_{ij}$ are given by Equation 26 and foreign liabilities $\tilde{\Psi}_{ij}$ by Equation 27. Then:

$$\frac{\tilde{\Psi}_{ij}}{\tilde{\Omega}_{ij}} = \frac{K_i^a - \frac{K_i^a + \tilde{K}_{ij}}{\tilde{z}}}{\frac{K_i^a + \tilde{K}_{ij}}{\tilde{z}} \tilde{x}} = \frac{K_i^a \tilde{x} - \tilde{K}_{ij}}{K_i^a \tilde{x} + \tilde{K}_{ij}}. \quad (28)$$

From this, the next proposition follows.

Proposition 6 *Assume that country j hosts the more efficient banking sector, i.e. $\Delta c > 0$. Then the ratio of foreign liabilities to foreign assets $\frac{\tilde{\Psi}_{ij}}{\tilde{\Omega}_{ij}}$ decreases in the difference in capital endowments $\Delta(K^a/L)$.*

Proof. See Appendix A. ■

The larger differences in endowments, the more important international banking. When endowments are similar between countries, foreign liabilities closely match foreign assets and global banking plays a bigger role. The model therefore rationalizes heterogeneity in international and global banking across countries. Consider two stark cases. First assume $\Delta K^a/L = 0$. Then $\tilde{K}_{ij} = 0$ and the ratio takes value 1. Foreign assets invested in country i are entirely covered by foreign liabilities. There is global banking only. Next, assume $\Delta c = 0$ instead. In this case the ratio is not determined. With an arbitrarily small cost of operating abroad, however, banks channel capital from one country to the other so as to allocate capital efficiently, but they do not engage in cross-border activities beyond what is necessary to equate interest rates.⁴² They either do not raise deposits abroad or they do not

⁴²To see this assume that transporting capital across borders is costly. Per unit of capital ϕ units of capital have to be paid. Assume $\Delta c = 0$ and $r_i^a > r_j^a$. Then in equilibrium: $r_i = r_j + \phi$. Entrepreneurs from country i import capital from country j until interest rates are equalized up to ϕ . Entrepreneurs in country j prefer to borrow capital domestically in equilibrium because $r_i + \phi > r_j$ as $r_i + \phi + \phi > r_i + \phi$.

hold foreign assets. Therefore:

Corollary 1 *International banking occurs if $\Delta(K^a/L) \neq 0$. Global banking occurs if $\Delta c \neq 0$.*

The ratio $\frac{\tilde{\Psi}_{ij}}{\tilde{\Omega}_{ij}}$ can be greater than 1. In this case the net capital flow $\tilde{K}_{ij} < 0$ and foreign liabilities are greater than foreign assets. Because country j is capital scarce, it channels some of the capital raised abroad back to its domestic firms. Banks from country j finance foreign activities entirely with foreign capital and there is "reversed" international banking. Think of the US and Argentina. The US may import depositor capital from Argentina through its own banks (net imports), but may, at the same time, extend loans to Argentinean entrepreneurs because these prefer US banks, which might be more efficient.

The analysis reveals that in an integrated world, the pattern of foreign bank asset and liability holdings is determined by efficiency and endowment characteristics across countries. Banking across borders enhances the efficient allocation of capital and exploits differences in banking sector efficiency across countries.⁴³ The model matches the stylized facts discussed in the beginning of this paper. It shows that capital account liberalization and banking sector liberalization lead to an increase in foreign asset holdings, but differentially so. It gives an explanation for why global banking has become more important over time: when banking sectors vary in efficiency, banking sector liberalization leads to a rise of global banking relative to international banking. The model also rationalizes heterogeneity across country pairs in global and international bank activities. It predicts that global banking occurs mainly between countries that exhibit stark differences in banking sector efficiency. International banking, in contrast, is more important between country pairs with dissimilar capital-labor endowments. If both factors matter, foreign bank lending is largest. Finally, whether a country is a net exporter or a net importer of bank intermediated capital depends on how capital abundant it is relative to other countries.

6 Empirics

The empirical part of this paper tests three key hypotheses of the model.

⁴³Improvements in aggregate banking sector efficiency are likely to occur not only through the entry of foreign and more efficient banks as in the model, but also through increased competition and selection. The literature has found that foreign banks are among the most efficient banks in developing countries and that domestic banks in developing countries become more efficient as a result of foreign bank entry (see e.g. Demirguc-Kunt and Huizinga (1998), Claessens, Demirguc-Kunt, and Huizinga (2001), Clarke, Cull, D'Amato, and Molinari (1999)). The data used in the empirical analysis is also supportive of these effects. Average overhead costs to total assets fell from an average of 0.063 in 1995 to 0.055 in 2005 for the group of upper middle income countries, which is consistent with the increased penetration of foreign banks in Eastern Europe and Latin America during this period.

Testable implication A *Foreign assets of banks from country j invested in firms in country i are positively correlated with $\Delta(K^a/L) = K_j^a/L_j - K_i^a/L_i$ and $\Delta c = c_i - c_j$.*

Foreign assets should be higher, the more capital abundant country j and the more efficient the banking sector of country j relative to country i (see Propositions 3 and 5).

Testable implication B *Foreign liabilities of banks from country j towards depositors in country i are positively correlated with $\Delta c = c_i - c_j$.*

If banking sectors are liberalized, the more efficient banking sector expands. Therefore, deposits raised by banks from country j in country i are higher if the banking sector of country j is more efficient than the one of country i (see Proposition 5).

Testable implication C *The ratio of foreign liabilities to foreign assets held by banks from country j in country i is negatively correlated with $\Delta(K^a/L) = K_j^a/L_j - K_i^a/L_i$.*

The ratio of foreign liabilities to foreign assets is a function of endowments. Given that banks from country j have an efficiency advantage over banks from country i , the share of loans/assets that are funded through deposits raised locally in country i decreases with the relative capital abundance of country j (see Proposition 6).

The empirical analysis is split into two parts. First, implication A is tested based on data on foreign bank assets. In a separate section, evidence on the validity of testable implications B and C is provided using additional information on foreign liabilities.

6.1 Results on testable implication A

6.1.1 Empirical strategy, data and variables

The baseline regression to test implication A is as follows:

$$\begin{aligned} \log(\text{assets}_{ijt}) &= \delta_1 \Delta \log(K/L_{ijt}) + \delta_2 \Delta \log(c_{ijt}) \\ &+ \delta_3 \text{openness to foreign bank entry}_{it} \\ &+ X'_{jt} \beta_j + X'_{it} \beta_i + X'_{ij} \beta_{ij} + [\alpha_t + \alpha_i + \alpha_j] + \epsilon_{ijt}. \end{aligned} \tag{29}$$

The dependent variable measures assets held by banks from source country j in recipient country i at time t . The right hand side variables of the regression can be categorized broadly into four groups. The first group comprises the two key variables of interest, which measure differences in endowments and differences in banking sector efficiency between countries. Both enter the regression as log differences,

which allows to interpret coefficients as elasticities.⁴⁴ Δ stands for the difference in variables between countries i and j , not for differences over time. Explicitly, $\Delta \log(K/L_{ijt}) = \log(K/L_{jt}) - \log(K/L_{it})$ and $\Delta \log(c_{ijt}) = \log(c_{it}) - \log(c_{jt})$. From testable implication A, both coefficients δ_1 and δ_2 are expected to be positive. The higher the capital endowment of country j relative to country i , the larger foreign asset holdings of country j in country i . Moreover, the more efficient the banking sector in country j relative to country i , the larger the participation in lending of banks from country j in country i . The regression also includes a proxy for barriers to bank entry in the recipient country. Banking sector liberalization should increase bank asset holdings of country j in recipient country i , i.e. $\delta_3 > 0$.

The second group of variables, subsumed under X_{ijt} , consists of country-pair specific variables that proxy transaction and information costs: the log of distance, a dummy for colonial relationship and dummies for a shared official language, currency and legal system. The third and fourth group collect source country (X_{it}) and recipient country variables (X_{jt}), which comprise the log of population and the log of GDP, a dummy for systemic banking crisis as well as measures of financial openness and of institutional quality.⁴⁵

One of the biggest challenges in testing implication A is to find good proxies for rates of return to capital and banking sector efficiency for a large set of countries. According to the theory, foreign asset holdings are driven by differences in marginal products of capital between countries at autarky capital-labor ratios. These are not observable however. Observed contemporaneous capital-labor ratios, in turn, are endogenous to international capital flows and therefore to foreign bank assets. The strategy pursued in this paper is to proxy differences in rates of return to capital by differences in 10-year lagged capital-labor ratios. These are obtained from the Penn World Tables 6.2 and are adjusted for differences in human capital following Hall and Jones (1999).⁴⁶ This is close to what the theory prescribes, but attenuates endogeneity and reverse causality concerns. In order to control for factors that affect country-level productivity, proxies for institutional quality are added. The main specification includes a measure of property rights protection.⁴⁷

The preferred measure of banking sector efficiency comes from the Financial Structure Database provided by the World Bank (see Beck, Demirguc-Kunt, and Levine (2000)). It is the variable *overhead*, which is based on bank-level data and computed as the unweighed average of overhead

⁴⁴The coefficients are estimated using log differences because this facilitates their interpretation. Results are qualitatively the same if absolute difference are used.

⁴⁵Detailed information on control variables and data sources can be found in the Data Appendix.

⁴⁶For more information see the Data Appendix.

⁴⁷In the theoretical model, institutional quality is captured by the parameter λ which reflects the success probability of the firm. Ju and Wei (2010) interpret λ as a country's degree of property rights protection. Empirically, institutions have been shown to matter for bank flows by Papaioannou (2009).

costs to total assets over all banks resident in a given country. Overhead costs collect the cost of renting and maintaining office space, computers etc. 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 of the theoretical model.⁴⁸ However, it includes foreign owned banks, which implies that contemporaneous values of a country's average overhead costs are endogenous to the operations of foreign banks and thus to foreign bank asset holdings in that country. To address endogeneity and reverse causality concerns in this context, the variable is also lagged by ten years. Therefore, past differences in capital-labor ratios and in banking sector efficiency are to explain current foreign bank asset holdings, which relies on the presumption that convergence and adjustments take time.

Information on foreign bank assets and liabilities comes from the Consolidated Banking Statistics (CBS) maintained by the Bank for International Settlements (BIS). Foreign bank assets are proxied by the so-called international claims vis-a-vis the non-bank private sector. These assets comprise the consolidated claims of all deposit taking corporations whose headquarters are located in country j towards residents of country i with one exception: they exclude the claims of foreign affiliates denoted in the currency of the host market, which constitute about 16% of total foreign assets.⁴⁹ Claims cannot be distinguished by asset class, but information from other BIS statistics indicates that about two thirds of the assets are loans and deposits (see Aviat and Coeurdacier (2007)).

Omitted variable bias is a key issue in most cross-country regressions. A standard remedy is to include both source country and recipient country fixed effects in the cross-sectional analysis or to only exploit the time variation in the data. The endowment and the efficiency coefficient, however, cannot be estimated on the cross-section when source country and recipient country fixed effects are controlled for at the same time.⁵⁰ Furthermore, within estimates are not meaningful as 10-year lagged values are employed in order to solve the endogeneity issue of contemporaneous differences in MPKs and contemporaneous differences in banking sector efficiency.⁵¹ Also, the model is designed to explain long-run developments and the cross-sectional variation in the data. Equation 29 is therefore estimated on the cross-section where source and recipient country fixed effects are included separately. As a check, it is also estimated on the pooled dataset where source country and recipient country fixed

⁴⁸It is also close to the notion of efficiency that emerges in a framework with two-sided moral hazard as formulated in Holmstrom and Tirole (1997). There the lower the monitoring cost c of a bank, the larger its lending volume for a fixed amount of equity capital.

⁴⁹A breakdown by sector is not available for total foreign assets. See the Data Appendix for more details.

⁵⁰Note that log differences are a linear combination of characteristics of country i and country j . When the log of differences in efficiency and of differences in endowments is used, variation in the data is not enough to estimate the coefficients.

⁵¹An IV approach is also taken to estimate the efficiency coefficient. Exports of ICT services serve as the instrument. The estimated efficiency coefficient is significantly larger. For details see the Online Appendix available under <http://www.eui.eu/Personal/Researchers/Niepmann/OnlineAppendix>.

effects (plus year fixed effects) can be accounted for simultaneously.

The CBS data is reported on a quarterly basis in current \$US. For the analysis, yearly averages are taken. After merging data from the different sources and excluding non-positive observations⁵² as well as offshore centers as recipients, the panel dataset comprises a set of 25 source and 90 recipient countries, which cover all income groups. It spans the period from 1999 until 2007 and yields 8,163 observations.⁵³ For the cross-sectional analysis, the year 2005 is chosen. It is the most recent year for which the Schindler Index (see Schindler (2009)), a measure of capital account openness, is available and provides 1,249 observations. Summary statistics are provided in the Data Appendix.

6.1.2 Evidence from simple statistics

Table 1: 4 Bins

# Bin	Parameters	Expected asset levels	Expected marginal effects	
			$\Delta(K/L_{ij})$	Δc_{ij}
Bin 1	$\Delta(K/L_{ij}) \geq 0, \Delta c_{ij} \geq 0$	large	positive	positive
Bin 2	$\Delta(K/L_{ij}) < 0, \Delta c_{ij} > 0$	intermediate	positive	positive
Bin 3	$\Delta(K/L_{ij}) > 0, \Delta c_{ij} < 0$	intermediate	positive (zero)	zero (positive)
Bin 4	$\Delta(K/L_{ij}) < 0, \Delta c_{ij} < 0$	zero	zero	zero

The theoretical model developed in this paper identifies two reasons why banking across borders occurs. First, if a country's banks are more efficient than those in a given recipient country, they expand abroad by intermediating capital locally in the foreign market. Second, if a country is capital abundant, its banks invest in capital scarce countries where the return to capital is higher. Asset holdings of a country in a given recipient country are therefore expected to be larger, the more efficient the banking sector of the source country and the more capital abundant the source country relative to the recipient country. Simple statistics already suggest a strikingly strong relationship in line with these predictions.

In Figure 5 country pairs are grouped into four bins with different characteristics. The bars reflect the average foreign bank assets for each bin in 2005.⁵⁴ Bin 1 collects country pairs for which $\Delta(K/L_{ij}) > 0$ and $\Delta c_{ij} > 0$, i.e. the source country is relatively capital abundant and has the more efficient banking sector than the recipient country. In Bin 2, $\Delta(K/L_{ij}) < 0$ and $\Delta c_{ij} > 0$ and vice versa in Bin 3. Bin 4 includes country pairs where the source country is relatively capital scarce and

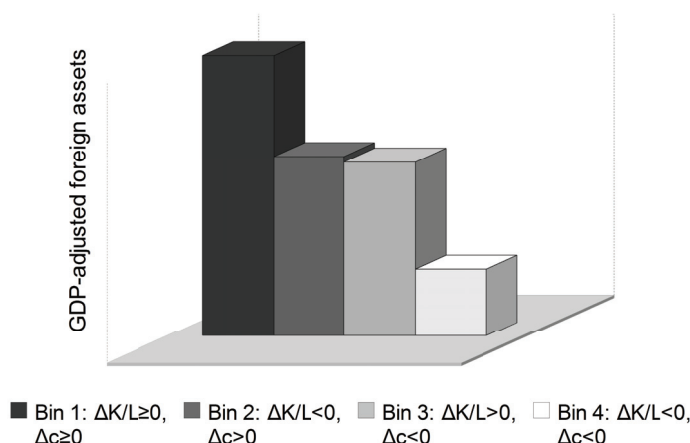
⁵²Zeros constitute approximately 5% of all observations in the sample on assets, a share that is much lower than found in most trade data.

⁵³For more information on the sample, see the Data Appendix.

⁵⁴Assets are normalized by dividing them through the product of the GDPs of the source and the recipient country.

hosts the less efficient banking sector, i.e. $\Delta(K/L_{ij}) < 0$ and $\Delta c_{ij} < 0$. Therefore, Bin 1 is expected to show the highest level of foreign bank assets, with Bins 2 and 3 taking intermediate values. In Bin 4, average foreign bank assets should be lowest. Table 1 summarizes bins and expected levels. The observed levels as displayed in Figure 5 are fully in line with these predictions.

Figure 5: Average foreign assets by bin



The graph shows average foreign bank assets in 2005 for four different groups of country pairs with the following characteristics (from left to right): Bin 1: $\Delta(K/L_{ij}) \geq 0$, $\Delta c_{ij} \geq 0$; Bin 2: $\Delta(K/L_{ij}) < 0$, $\Delta c_{ij} > 0$; Bin 3: $\Delta(K/L_{ij}) > 0$, $\Delta c_{ij} < 0$; Bin 4: $\Delta(K/L_{ij}) < 0$, $\Delta c_{ij} < 0$. Bank assets have been normalized with respect to size by dividing them through the product of the GDPs of the source and the recipient country.

6.1.3 Baseline regression results

To start with, Equation 29 is run on the cross-section. This is a litmus test for the two driving forces of foreign bank asset holdings. Column (1) of Table 2 shows the results. The efficiency and the endowment coefficient are both positive and highly significant taking a value of 0.41 and 0.35 respectively. The signs of all other coefficients are also in line with expectations. In particular, asset holdings increase in financial freedom of the recipient country and in capital account openness of the source country. The effect of capital account openness of the recipient country is smaller and the standard error related to the respective coefficient large, but this is likely due to a multi-collinearity problem as financial freedom and openness of the recipient country are highly correlated. When the Schindler Index, which provides separate measures for inflow and outflow restrictions, is used instead of the Chinn & Ito Index, financial freedom and openness of the recipient country are both highly

significant.⁵⁵ The dummy that indicates a systemic banking crisis in the recipient country is positive, which confirms earlier findings in the literature that foreign banks have stabilizing effects during crises in the host market (see de Haas and van Lelyveld (2006), Cetorelli and Goldberg (2010) and de Haas and van Lelyveld (2010)).⁵⁶ The magnitude of the other dummies and the estimated effect of distance are similar to estimates reported in related studies.

Columns (2) and (3) include source country and recipient country fixed effects, respectively. When source country fixed effects are included in the regression, only variation across recipient countries is used to estimate coefficients. The regression therefore tests whether recipient countries with lower banking sector efficiency and lower capital labor ratios are a bigger target for foreign banks. With recipient country fixed effects, only the variation across source countries is employed. The regression thus estimates whether source countries with higher capital-labor ratios and higher banking sector efficiency hold more assets abroad. In Column (2), where source country fixed effects are included, the estimates of δ_1 and δ_2 are lower in magnitude and their standard errors are larger. Note that the endowment coefficient is significant at a 1% significance level when it is estimated in absolute rather than log differences.⁵⁷ When recipient country fixed effects are controlled for, coefficients increase in magnitude and in significance. This suggests that variation across source countries helps identifying the effects and that unobserved recipient country heterogeneity biases estimates downward.

When the data is pooled across years, source and recipient country fixed effects can be controlled for simultaneously. Column (4) of Table 2 includes year fixed effects and Column (5) year, source and recipient country fixed effects. The efficiency coefficient is robust to these alternative specifications. It remains positive and significant at a 1% significance level taking a value of 0.174, which is similar to the estimate reported in Column (2). The point estimate of the endowment coefficient remains stable, but turns insignificant when all three types of fixed effects are included. This may be due to the fact that capital-labor ratios are persistent over time so that only little variation is added by pooling the data. While precise estimation of the effects is difficult, the results clearly suggest that foreign bank assets increase with the capital abundance of the source country and its advantage in terms of banking sector efficiency relative to the recipient country.

⁵⁵See the Online Appendix for more details.

⁵⁶The dummy for systemic banking crisis in the source country is excluded in Columns (1) to (3) as there was no banking crisis in the set of source countries in 2005.

⁵⁷The results for absolute differences are reported in the Online Appendix.

6.1.4 Comparative statics

How large are the effects of endowments and efficiency differences on bank assets? The following quantifications are based on the estimates presented in Column (1) of Table 2 implying an efficiency coefficient of 0.41 and an endowment coefficient of 0.35.

If the German banking sector (35% quantile in 1995) was as efficient as the Dutch (1% quantile in 1995), then bank asset holdings of German banks would increase by around 112%. If, in contrast, the Netherlands were as capital abundant as Germany, foreign assets of Dutch banks would increase by 8.25%. A similar comparison can be made for Spain and Brazil. If Spanish banks had the efficiency of Brazilian banks, asset holdings by Spanish banks (92% quantile versus 29% quantile in 1995), would decline by around 28%. If Brazil had the same endowments as Spain (54% quantile versus 85% quantile in 1995), foreign assets of Brazilian banks would show a 58% increase.

Next, consider the effect of banking sector liberalization in the recipient country. The financial freedom index of Mexico increased from 30 in 1995 to 70 in 2005. With a financial freedom coefficient of 0.01, the change in the index explains an increase in foreign asset holdings of around 40%. These quantifications suggest that differences in banking sector efficiency and differences in endowments across countries together with the degree of banking sector liberalization in the recipient country are major determinants of banks's foreign asset holdings.

6.1.5 Robustness

In the following, the robustness of the results is explored. First, it is shown that results do not change when differences in banking sector efficiency and differences in endowments are proxied by alternative measures. Second, the action in the data is shown to be where it is expected. Third, competing theories are excluded as an explanation for the empirical findings.

In Column (1) of Table 3, information on marginal products of capital from Caselli and Feyrer (2007) is used to proxy differences in rates of return to capital. Caselli and Feyrer (2007) take the income share of reproducible capital and relative prices of capital and consumption goods into account when calculating marginal products of capital. Despite the considerable reduction in sample size, the endowment coefficient hardly changes in terms of magnitude and remains significant at a 10% significance level when this alternative measure is used.

As an additional robustness check, differences in banking sector efficiency between countries are proxied by 10-year lagged differences in net interest rate margins. In contrast to overhead costs over total assets, the net interest rate margin is a blurred measure of efficiency because it is affected by

funding costs and the degree of competition in the banking market. In order to correct for this, information on the concentration of the banking sector in the source and the recipient country as well as the log difference in lending interest rates (also 10-year lagged values) are included in the regression. Estimates reported in Column (2) of Table 3 are very similar to previous results.⁵⁸

Next, country pairs are grouped into bins as in Section 6.1.2 and the constant, the endowment and the efficiency coefficient are estimated separately for each bin. This allows to check whether differences in the level of foreign assets across groups as detected in Figure 5 are statistically significant and whether marginal effects across bins are consistent with the model (see Table 1 for the description of the four bins and the expected marginal effects). Table 4 displays the results. The dummies for Bins 2, 3 and 4 are negative and statistically significant which confirms what was apparent from Figure 5. More interestingly, the efficiency coefficient is not significant for Bins 3 and 4, i.e. if $\Delta c_{ij} < 0$. As long as the source country's banking sector is less efficient than the one of the recipient country, there seems to be no effect of changes in $\Delta \log(c_{ij})$ on foreign assets, similar to what the theoretical model suggests. The marginal effects of differences in endowments merely differ across bins and have the correct signs. Foreign assets are the lower, the capital scarcer a source country relative to the recipient country. Overall, the action in the data is where the mechanisms discussed in the theoretical part of this paper suggest it should be.

In order to see how the regression performs across income groups, the sample is divided into low, lower middle, upper middle and high income recipient countries. Results of the regressions on the four sub-samples are shown in Columns (3) to (6) of Table 3. Both the efficiency and the endowment coefficient are positive and significant for high income recipients whereas effects are hard to identify for low income recipients where the number of observations is considerably smaller.⁵⁹ While differences in endowments seem to play a large role for foreign assets invested in upper middle income countries, differences in efficiency appear to be more important for the expansion of banks into lower middle income countries. This explains why coefficients change in the following when the sample of recipient income countries is truncated. Overall, the picture is largely similar across recipient income groups.

The literature has argued that banks follow their customers abroad.⁶⁰ Firms, which are active abroad are likely to operate in locations with cheap labor, i.e. low capital labor ratios.⁶¹ At the same time, they mostly come from developed countries where banking sector efficiency is high. The

⁵⁸The lending interest rate is the rate charged by banks on loans to prime customers (Source: WDI).

⁵⁹The negative effect of financial freedom on assets in upper middle income countries goes away when information on inflow and outflow restrictions from Schindler (2009) is used instead of the Chinn & Ito Index.

⁶⁰Evidence in line with the follow-your-customer hypothesis is presented in e.g. Goldberg and Saunders (1981), Grosse and Goldberg (1991).

⁶¹Differences in labor costs are the factor driving vertical FDI. See e.g. Brainard (1993), Hanson, Mataloni, and Slaughter (2005).

estimation results could therefore simply reflect the fact that banks serve domestic clients in foreign countries. To check the validity of this hypothesis, the log of the flow of foreign direct investment from country j to country i is included in the baseline regression. It 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 flows may be affected by how much money firms are able to borrow from their home banks. To address this issue, lagged values (3-year lags) of FDI flows instead of current ones are used.⁶² Column (7) shows the results. The coefficient on FDI flows indicates a positive relationship between foreign direct investment and bank asset holdings. At the same time, the efficiency and endowment coefficient are both significant. Thus the follow your customer motive may be relevant, but is probably only a part of the story.⁶³

According to portfolio theory, banks should invest in countries that exhibit assets returns that are negatively correlated with domestic returns (see e.g. Martin and Rey (2004)). In order to account for this, the baseline regression is estimated controlling for the correlation in stock market returns between country i and j .⁶⁴ Column (8) of Table 3 reports the results. As information on stock market correlations is only available for a smaller set of countries, the number of observations is more than halved. This, together with the fact that the reduced sample excludes many lower middle income countries, might be the reason why the efficiency coefficient turns insignificant. Regressions that sequentially include the variable $correlation_{ij}$ and information on differences in endowments and on differences in efficiency show that the interaction between these variables is negligible.

Several other robustness checks are performed, e.g. the dependent variables is replaced by total foreign assets including all sectors as counter parties and overhead costs and capital-labor ratios are lagged by an alternative number of years. See the Online Appendix for more details and more results. None of these checks alter the conclusion that both differences in rates of return to capital and differences in banking sector efficiency across countries are important determinants of foreign bank assets.

⁶²The quality of the FDI data is not very good, which limits the econometric techniques that can be applied. There are a lot of missing observations in the data. The three-year lag is the one that preserves the largest number of observations.

⁶³The presence of firms from the home country in a foreign market may give banks an advantage in going international. However, once established in a foreign market, banks start to also serve customers from countries other than their home country. See e.g. Seth, Nolle, and Mohanty (1998).

⁶⁴A description of the variable $correlation_{ijt}$ can be found in Coeurdacier and Guibaud (2011).

6.2 Evidence on testable implications B and C

Testable implications B and C make predictions about the liability structure of internationally active banks. The extent to which these can be tested is limited by the available information on liabilities. The Consolidated Banking Statistics only contain data on the liabilities of foreign affiliates, whose headquarters are in country j and which are located in country i , towards residents of the host country in local currency (so called local liabilities in local currency). These only partially represent the aggregate foreign liabilities of a banking sector. Local liabilities in local currency are likely to reflect those funds that are invested locally and may therefore capture global banking activities. Whether differences in endowments do also drive local liabilities depends on the extent to which banks use foreign affiliates to access foreign funding markets and in how far those liabilities are denoted in local currency.

There are two more drawbacks. The sample is not split by sector. Borrowing from banks and the public sector, which is likely to be driven by additional factors and which is an important component of banking across borders, is also included in foreign liabilities.⁶⁵ In this respect, the data may be blurred. Third, the number of observations is small as fewer countries report on liabilities. The empirical analysis is based on the cross-section of the year 2005, which yields 493 positive observations.⁶⁶ Summary statistics for the liability sample and information on included source and recipient countries are given in the Data Appendix.⁶⁷

6.2.1 Foreign liabilities and efficiency advantages

Testable implication B states that foreign liabilities are the larger, the more efficient the source country relative to the recipient country. To test this prediction, the following equation is estimated:

$$\log(\text{liabilities}_{ij}) = \delta_2 \Delta \log(c_{ij}) + X' \beta + [\alpha_i + \alpha_j] + \epsilon_{ij}. \quad (30)$$

The dependent variable comprises the liabilities of banks from country j in country i . The key interest lies in the effect of differences in banking sector efficiency on foreign liabilities. The model predicts $\delta_2 > 0$, i.e. the larger the source country's efficiency advantage, the more its banks expand abroad by raising capital in the foreign market. X includes the same set of controls as before plus a dummy for

⁶⁵For the set of countries contained in the liability sample, interbank lending amounts on average to 34% of total international assets in 2005. Assets vis-a-vis the non-bank private sector represent approximately 45% leaving around 20% for the public sector.

⁶⁶Due to data limitations, the analysis is not conducted on the panel.

⁶⁷Around 22% of observations are lost because zeros are excluded from the sample. When a selection model is estimated, the second-stage estimate of the efficiency coefficient is essentially the same as without the adjustment. See the Online Appendix for details.

a common border.⁶⁸

Column (1) of Table 5 reports the baseline results. Consistent with the theoretical model, the efficiency coefficient δ_2 is positive and highly significant. It takes a value of 0.526, which implies that a 10% decrease in overhead costs to total assets in the source country increases its liabilities towards residents in country i by 5.26%. The endowment coefficient is insignificant suggesting that endowment differences do not play a major role and that local liabilities mainly reflect the magnitude of local intermediation in the foreign market. The effect of capital account openness of the source country approximately triples compared to previous estimations. It increases from a point estimate of 0.361 (see Table 4 Column (1)) up to 1.215.

Column (2) includes source country fixed effects, Column (3) recipient country fixed effects. The number of observations is not enough to compute the F-statistics when recipient country fixed effects are included. Therefore, reported standard errors have to be treated with care. Still, as before, source country fixed effects tend to lower the effect and the significance of the coefficients, while recipient country fixed effects have the opposite effect.

In Column (4) and (5), results of regressions performed on two different subsamples are reported. Column (4) includes only high income recipient countries, Column (5) excludes them. The efficiency coefficient takes a similar positive value and is significant for both groups. Interestingly, the endowment coefficient becomes large and highly significant for high income recipients. This indicates that among this group of countries, the more capital abundant the source country relative to the recipient country, the more foreign liabilities in local currency it has. This may be explained by the fact that foreign liabilities comprise liabilities towards all sectors and that high income countries are more financially integrated reflected in increased borrowing also from foreign banks and the public sector.

6.2.2 International versus global banking

Testable implication C states that the share of foreign liabilities to foreign assets decreases with the relative capital abundance of the source country. The more capital abundant it is, the more it is involved in international banking relative to global banking, which raises its foreign assets relative to its foreign liabilities. This hypothesis is tested based on the following regression:

$$\log\left(\frac{\text{liabilities}}{\text{assets}}_{ij}\right) = \delta_1 \Delta \log(K/L_{ij}) + X'\beta + [\alpha_i + \alpha_j] + \epsilon_{ij}. \quad (31)$$

⁶⁸This dummy was excluded from previous regressions as it turned out insignificant in all regressions with assets as dependent variable.

The dependent variable is the ratio of foreign liabilities to foreign assets. The regressors consist of a set of controls X as well as $\Delta \log(K/L_{ij})$, the variable of interest here. The model predicts $\delta_1 < 0$. By taking the ratio, the dependent variable should be normalized with respect to size and transaction costs that affect cross-border lending and local borrowing symmetrically. Therefore, distance as well as variables related to economic size (population, GDP) are excluded as controls. GDP per capita is included instead in order to account for the fact that the share of local liabilities in local currency to foreign assets varies systematically with income as Figure 2 indicates.

Column (1) of Table 6 shows the baseline results. The endowment coefficient is negative and significant at a 5% significance level which indicates that the ratio of foreign liabilities to foreign assets declines with the relative capital abundance of the source country, just as predicted. More specifically, a 10% increase in the capital-labor ratio of the source country lowers its foreign liabilities relative to its foreign assets by around 5%. The effect of efficiency differences is insignificant, which is also in line with the theoretical model. Column (2) includes source and Column (3) recipient country fixed effects. As before, standard errors in Column (3) are problematic because of the small sample size and the large number of estimated coefficients. Again effects become weaker when source country fixed effects are included and stronger with recipient country fixed effects. The negative efficiency coefficient in Column (3) indicates that differences in banking sector efficiency impact foreign assets and liabilities asymmetrically.

In Columns (4) and (5) results are presented for lower income and high income recipient countries separately. The regression performs much worse between high income countries with an R^2 of only 0.067 in contrast to 0.279 for lower income recipients. Furthermore, the coefficient δ_1 is only significant when the regression is based on the sample of lower income countries. While this cannot be interpreted as direct evidence, it is fully in line with the theoretical predictions. Differences in capital-labor ratios are especially stark between countries of different income groups. Therefore, international banking in addition to global banking should play a major role between them. It should play less of a role between countries with similar capital-labor ratios so that the ratio of foreign liabilities to foreign assets should not be driven by $\Delta(K/L_{ij})$ for them.

In Column (6), the dependent variable is modified. International assets vis-a-vis the non-bank private sector are replaced by total foreign assets, which comprise assets invested in all sectors, i.e. also loans to banks and the public sector. The sample, as in Column (4), only includes lower income recipients. The endowment coefficient remains negative and highly significant. The effect of financial freedom on the ratio of foreign liabilities to foreign assets is positive and highly significant in Columns (4) and (6), which suggests that barriers to bank entry harm the access to foreign funds more than the

possibility to invest abroad. This vindicates the assumption made in the model that barriers to bank entry prohibit local deposit taking, but do not harm lending to foreign firms. As a robustness check, the above equation is also estimated with alternative sets of controls. Including GDP per capita as regressor is not crucial. If GDP per capita is exchanged for controls of institutional quality or for the whole set of gravity controls, results do not change qualitatively.

Fixed effects estimation on the liability sample is difficult due to the small number of observations and results are less robust to the inclusion of alternative controls in that standard errors become large. Despite these limitations, the presented regression results strongly support the validity of testable implications B and C.

7 Bank-to-bank lending

The paper has so far only considered lending by banks to foreign firms. However, bank-to-bank lending is also an important component of banking across borders. In this section, it is shown that bank-to-bank lending can be understood within the framework of the model. It is a substitute for direct lending by banks to firms. The presented empirical evidence supports this: banks engage the less in bank-to-bank and the more in direct lending, the more efficient they are relative to the banking sector of the recipient country and the more financially open the recipient country.

7.1 Theoretical considerations

Suppose that the only way for capital to flow between countries is through lending between banks. This could correspond to a situation where governments want to control capital accounts, but do not wish to prevent capital flows altogether. Assume further that bank-to-bank lending is free and that countries, as before, differ in their endowments and in banking sector efficiency. Then banks located in the country with the lower autarky interest rate lend to banks in the country with the higher autarky interest rate. In equilibrium, interest rates are equalized:⁶⁹

$$1 + r_i = 1 + r_j \tag{32}$$

$$\lambda R_i - c_i = \lambda R_j - c_j. \tag{33}$$

The country with the more efficient banking sector employs more capital in production.

Consider next what happens when capital accounts are liberalized and banks are allowed to lend

⁶⁹The formal analysis is presented in Appendix D.

directly to foreign firms, but bank-to-bank lending is still an option. Then the more efficient banking sector lends exclusively to foreign firms, while the less efficient banking sector channels all domestic depositor capital to foreign banks. This way the less efficient banking sector is circumvented.⁷⁰ In equilibrium, marginal products of capital are equalized across countries. More capital flows into the financially underdeveloped country than before.⁷¹ For the balance sheet of banks, capital account liberalization has the following implications. The more efficient banking sector substitutes away from bank-to-bank towards bank-to-firm lending, while the less efficient banking sector still engages in bank-to-bank lending. Foreign asset holdings expand for both. As before, foreign assets of the more efficient banking sector are the larger, the more capital abundant its home country. Also the ratio of foreign liabilities to foreign assets decreases with $\Delta(K^a/L)$. With additional banking sector liberalization, any reason for bank-to-bank lending disappears. Instead of sourcing capital from foreign banks, the more efficient banking sector raises capital directly from foreign depositors.⁷²

Altogether, this shows that key predictions of the model remain valid when bank-to-bank lending is taken into account. Moreover, some new predictions result for the cross-section. The lower barriers to capital transactions in the recipient country, the more direct as opposed to bank-to-bank lending occurs. Moreover, interbank lending relative to direct lending from country j to country i decreases with the efficiency advantage of country j 's banking sector. The following two testable implications summarize this:

Testable implication D *With capital account liberalization in the recipient country, source countries engage more in direct as opposed to interbank lending.*

Testable implication E *The extent to which a banking sector lends to foreign banks as opposed to foreign firms decreases with Δc .*

7.2 Empirical results

In order to test implications D and E, the following equation is estimated:

$$\log\left(\frac{\text{assets invested in banking sector}}{\text{assets invested in private sector}}\right)_{ij} = \delta_2 \Delta \log(c_{ij}) + \delta_3 \text{ financial openness}_i + X' \beta + [\alpha_i + \alpha_j] + \epsilon_{ij}. \quad (34)$$

⁷⁰This is a reinterpretation of the by-pass effect of globalization as discussed in Ju and Wei (2010).

⁷¹The model reduces to the case with banking sector liberalization with one important difference: instead of sourcing capital from foreign depositors directly, the more efficient banking sector borrows from foreign banks.

⁷²These theoretical considerations abstract from many relevant aspects such as synergies from lending and taking deposits. Also there may be additional costs to interbank lending stemming from the fact that an additional party is involved in the intermediation process etc..

The dependent variable is the log difference between assets invested in the banking sector in country i and assets invested in the non-bank private sector in country i by banks from country j . Vector X comprises a set of control variables. The key interest lies in the effect of barriers to capital account transactions in the recipient country and of differences in banking sector efficiency on the relative magnitude of bank-to-bank lending. From implications D and E, these effects should be negative, i.e. $\delta_2 < 0$ and $\delta_3 < 0$.

As the left hand side variable, which is a ratio, should be corrected for differences in GDPs as well as for transaction costs that affect bank-to-bank and bank-to-firm lending symmetrically, variables related to economic size and distance are excluded from the main specification.

The data indicates that the volume of bank-to-bank lending is much higher between high income countries than for any other recipient income group.⁷³ This is likely due to greater interbank market integration between open and financially developed countries, which is outside the theoretical considerations of this paper. In order to control for this, $\Delta \log K/L_{ij}$ is included as a regressor. As an alternative, GDP per capita of the source and the recipient country are used as controls.

Column (1) of Table 7 presents the results of the baseline estimation. The coefficients of interest δ_2 and δ_3 are both negative as expected and significant. This suggest that banking sectors in fact substitute away from bank-to-bank towards direct lending as the recipient country becomes more open to financial flows. Moreover, banking sectors with superior efficiency engage more in direct as opposed to bank-to-bank lending abroad. In Columns (2) and (3), source country and recipient country fixed effects, respectively are added. Columns (4) and (5) present estimations on two sub-samples. The former includes lower income countries, the latter high income countries only. In Column (6), the regressor $\Delta \log(K/L)$ is replaced by GDP per capita of the source and the recipient country. The results with regard to the key coefficients remain qualitatively the same throughout.

These findings relate more broadly to the topic of trade in intermediate inputs and in services. If banks want to invest capital in foreign firms, they can either lend and monitor themselves or they can lend capital to foreign banks, which do the monitoring on their behalf (arms-length trade). The empirical analysis indicates that this decision is systematically affected by barriers to bank entry and barriers to capital account transactions of the recipient country as well as by efficiency characteristics of banks in the target market. Understanding how the mode of delivery is chosen and ultimately affected by regulation is important for designing effective policies. While treatment of these issues in more depth is beyond the scope of this paper, the results suggest avenues for further research.

⁷³In 2005, interbank lending of BIS reporting countries constituted on average roughly 45% of total lending to high income countries. With lower income countries as recipients, about 25% of the lending was to foreign banks.

8 Conclusions

The model developed in this paper explains banking across borders based on differences in endowments and differences in banking sector efficiency across countries. It shows how these two driving forces jointly determine the foreign assets and liabilities of a banking sector. The analysis reveals that international banking is driven by differences in rates of return to capital while global banking arises from differences in country-level bank efficiency. Key predictions of the model are strongly supported by the empirical evidence presented.

This paper presents a coherent theoretical framework that matches key stylized facts of banking across borders. It can explain cross-country heterogeneity in global and international banking and provides a rationale for the rise in global banking relative to international banking over the past twenty years. First principles of international trade theory go far in explaining the cross-country pattern of foreign bank asset and liability holdings.

This suggests that, as a complement to the traditional portfolio view, an international trade and investment perspective can be fruitful for the study of international and global banking. The approach taken in this paper could be useful for analyzing several related aspects in more detail. The paper indicates a strong relationship between the two identified driving forces of banking across borders and the extent of FDI in the banking sector. Similarly, the organizational choice (branch versus subsidiary) of banks and their business models may be systematically linked to the different underlying driving forces.

In the framework developed, international and global bank activities arise endogenously when capital accounts and banking sectors are liberalized. Capital is allocated more efficiently and differences in banking sector efficiency across countries are exploited. In this, the paper shows that there is a natural role for internationally active banks in the global economy.

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Appendix A: Proofs

Solution to entrepreneur's maximization problem in the closed economy

$$\max_{x,y,z,R^E} I = z\lambda R^E + (1+r)(1-y) \quad (35)$$

$$s.t. \quad y \leq 1 \quad (BC^E) \quad (36)$$

$$z \leq x + y \quad (RC) \quad (37)$$

$$(\lambda(R - R^E) - c)z \geq (1+r)x \quad (PC^D) \quad (38)$$

$$R^E \geq \frac{b}{\lambda} \quad (IC^E) \quad (39)$$

In the following, it is shown that all constraints bind in equilibrium.

(i) The budget constraint binds. As the entrepreneur has to cover the fixed cost of entry from its entrepreneurial income, we have that in equilibrium $\lambda R^E > 1 + r$. Then it is optimal for the entrepreneur to invest all his capital in the firm: $y = 1$.

(ii) The resource constraint binds. In an optimum, no resources are wasted: $z = x + y$.

(iii) The participation constraint of a depositor binds. As the entrepreneur maximizes his own income, he reduces the return to depositors to the minimum.

(iv) The incentive-compatibility constraint of the entrepreneur binds. To show that this is true, one has to prove that it is optimal for the entrepreneur to minimize the per unit return R^E and to thereby raise the capital input z to the maximum. Given that all other constraints bind, we have:

$$x = \frac{\lambda R - \lambda R^E - c}{1 + r - \lambda R + \lambda R^E + c}. \quad (40)$$

The entrepreneurial income is therefore:

$$I = \lambda R^E \left(1 + \frac{\lambda R - \lambda R^E - c}{1 + r - \lambda R + \lambda R^E + c}\right). \quad (41)$$

Taking the derivative with respect to R^E yields:

$$\frac{dI}{dR^E} = \lambda(1+r)R^E \frac{1+r-\lambda R+c}{(1+r-\lambda R+\lambda R^E+c)^2}. \quad (42)$$

As $1+r > 0$ and $\lambda > 0$, the derivative is negative if $1+r-\lambda R+c < 0$. Then it is optimal for the entrepreneur to set $R^E = b/\lambda$. Assume that this is true, then the equilibrium interest rate is given by Equation 10. $1+r = \lambda R - c - b + \frac{b}{1+f} > 0 \Rightarrow 1+r-\lambda R+c = -\frac{bf}{1+f} < 0$. Therefore $\frac{dI}{dR^E} < 0$. All

constraints bind in equilibrium.

Proof of Propositions 1 and 2

The different steps of the proof are as follows:

- (1) It is shown that the only relevant solution to I_{ij} is where the incentive compatibility constraint of the entrepreneur binds and equivalently for I_{ji} .
- (2) If $c_j < c_i$, then $I_{ij} > I_{ii}$ and $I_{ji} < I_{jj}$ at $R_j = R_i$. This implies that in equilibrium $\bar{R}_j > \bar{R}_i$.
- (3) It is shown that $I_{ij}(K_{ij})$ and $I_{ii}(K_{ij})$ as well as $I_{ji}(K_{ij})$ and $I_{jj}(K_{ij})$ intersect once in the relevant interval, i.e. the indifference points of entrepreneurs in country j and in country i are unique.
- (4) Under the assumption that $\tau_{ji} > \underline{\tau}$ and $\tau_{ij} = 0$ and $\Delta c > 0$, the indifference point of an entrepreneur in the country with the more efficient banking sector implies a higher capital flow from j to i than the indifference point of an entrepreneur in the country with less efficient banking sector.
- (5) Three equilibrium cases are distinguished: (i) export case, (ii) no-trade case, (iii) import case.

Proof. (1) The entrepreneur's maximization problem in country i when drawing on the services of banks from country j is:

$$\max_{x_{ij}, y_{ij}, z_{ij}, R^E} I_{ij} = z_{ij} \lambda R^E + (1 + r_i)(1 - y_{ij}) \quad (43)$$

$$s.t. \quad y_i \leq 1 \quad (44)$$

$$z_{ij} \leq x_{ij} + y_{ij} \quad (45)$$

$$(\lambda(R_i - R^E) - c_j - \tau_{ij})z_{ij} \geq (1 + r_j)x_{ij} \quad (46)$$

$$R^E \geq \frac{b}{\lambda}. \quad (47)$$

The solution is:

$$I_{ij} = \begin{cases} \frac{(1+r_j)b}{1+r_j+b+c_j+\tau_{ij}-\lambda R_i} & \text{if } 1 + r_j - \lambda R_i + c_j \leq 0 \\ \lambda R & \text{if } 1 + r_j - \lambda R_i + c_j > 0. \end{cases} \quad (48)$$

If $1 + r_j - \lambda R_i + c_j > 0$, it is optimal for the entrepreneur to raise as little outside capital as possible. With $x = 0$, his income is equal to λR . From the solution to the closed economy, we know that $I_{ii} > \lambda R$. Therefore, as long as $I_{ij} \geq I_{ii}$, the solution to the maximization problem is $\frac{(1+r_j)b}{1+r_j+b+c_j+\tau_{ij}-\lambda R_i}$. Note that this includes the indifference point where $I_{ii} = I_{ij}$. Using the same arguments, $I_{ji} = \frac{(1+r_i)b}{1+r_i+b+c_i+\tau_{ji}-\lambda R_j}$ is the solution to the maximization problem of entrepreneurs in country j at least as long as $I_{jj} \leq I_{ji}$.

(2) Setting $\tau_{ij} = 0$, the indifference point of the entrepreneur in country i is determined by:

$$I_{ij} = \frac{(1+r_j)b}{1+r_j+b+c_j-\lambda R_i} = \frac{(1+r_i)b}{1+r_i+b+c_i-\lambda R_i} = I_{ii}. \quad (49)$$

In equilibrium, each capitalist must be indifferent between becoming an entrepreneur or an investor. Therefore the equilibrium interest rates in country i and country j are given by $1+r_i = \lambda R_i - c_i - b + \frac{b}{1+f}$ and $1+r_j = \lambda R_j - c_j - b + \frac{b}{1+f}$, respectively. Plugging the equilibrium interest rates in the above expression yields:

$$\frac{(\lambda R_j - c_j - b + \frac{b}{1+f})b}{\lambda R_j - \lambda R_i + \frac{b}{1+f}} = (\lambda R_i - c_i - \frac{bf}{1+f})(1+f). \quad (50)$$

Similarly, we have for entrepreneurs in country j :

$$I_{ji} = \frac{(\lambda R_i - c_i - b + \frac{b}{1+f})b}{\lambda R_i - \lambda R_j + \tau_{ji} + \frac{b}{1+f}} = (\lambda R_j - c_j - \frac{bf}{1+f})(1+f) = I_{jj}. \quad (51)$$

It is easy to see that if $\Delta c > 0$, then $I_{ij} > I_{ii}$ and $I_{jj} > I_{ji}$ at $R_j = R_i$. So for entrepreneurs in both countries to be indifferent, banks in country j must become less attractive, which implies that r_j must increase and r_i decrease, which in turn implies that in equilibrium $R_i < R_j$.

(3) Rearranging Expression 49 yields:

$$(\lambda R_i - c_i - b) = (c_i - c_j) \frac{b}{1+f} \frac{1}{\lambda} \frac{1}{R_j - R_i}. \quad (52)$$

Similarly we have for entrepreneurs in country j :

$$(\lambda R_j - c_j - b) = (c_i - c_j) \frac{b}{1+f} \frac{1}{\lambda} \frac{1}{R_j - R_i} + \tau_{ji} \frac{1}{\lambda} \frac{(\lambda R_j - c_j - \frac{bf}{1+f})}{R_j - R_i}. \quad (53)$$

Let K_{ij}^A denote the solution to 52 and let K_{ij}^B be the solution to 53. Remember that:

$$R_i = (1 + F'_{K_{ij}}(1, \frac{K_i^a + K_{ij}^B}{L_i})), \quad (54)$$

and

$$R_j = (1 + F'_{K_{ij}}(1, \frac{K_j^a - K_{ij}^B}{L_j})). \quad (55)$$

The production function is assumed to be continuous, increasing and convex in the capital input. As shown before, the solutions K_{ij}^A and K_{ij}^B must be such that $R_i < R_j$. Let K_{ij}^C denote the solution to $R_i = R_j$. Then $K_{ij}^A \in]K_{ij}^C, K_j^a[$ and $K_{ij}^B \in]K_{ij}^C, K_j^a[$.

To start with, it is shown that 53 has a unique solution. For $R_j = R_i$, the left hand side of Expression 53 is positive, while the right hand side goes to infinity. For $K_{ij} \rightarrow K_j^a$, the LHS goes to infinity and the RHS goes to zero. Both functions on the LHS and the RHS are continuous in K_{ij} . It is easy to see that the LHS is strictly increasing in K_{ij} in the relevant interval. The RHS is strictly decreasing in K_{ij} . To see this, note that

$$\frac{d\left(\tau_{ji} \frac{(\lambda R_j - c_j - \frac{b}{1+f})}{R_j - R_i}\right)}{dK_{ij}} = \left(\lambda \frac{\partial R_j}{\partial K_{ij}} (R_j - R_i) - (\lambda R_j - c_j - \frac{bf}{1+f}) \left(\frac{\partial R_j}{\partial K_{ij}} - \frac{\partial R_i}{\partial K_{ij}} \right) \right) / (\cdot)^2 \quad (56)$$

Clearly, $\frac{\partial R_j}{\partial K_{ij}} < \frac{\partial R_j}{\partial K_{ij}} - \frac{\partial R_i}{\partial K_{ij}}$ and also:

$$\lambda R_j - \lambda R_i = (1 + r_j) - (1 + r_i) - c_i + c_j < \lambda R_j - c_j - \frac{bf}{1+f} = (1 + r_j). \quad (57)$$

Therefore, both summands on the RHS of Expression 53 are strictly decreasing in K_{ij} . With the RHS being continuous and strictly increasing and the LHS being continuous and strictly decreasing in the relevant interval $K_{ij} \in]K_{ij}^C, K_j^a[$, the two curves must intersect exactly once. The solution K_{ij}^B to 53 is unique.

Next, it is shown that the solution K_{ij}^A to 52 is unique under a weak assumption. For $R_j = R_i$, the LHS of 52 is positive, the RHS of 52 goes to infinity. For $K_{ij} \rightarrow K_j^a$, the RHS goes to zero, while the LHS takes some value above 0. The LHS decreases in K_{ij} . So does the RHS. The RHS and the LHS are continuous in K_{ij} . Therefore the curves must intersect at least once and a solution exists. For the solution to be unique, the RHS and the LHS must intersect only once for $K_{ij} \in]K_{ij}^C, K_j^a[$. A sufficient condition for this is that $(\lambda R_i - c_i - b) - (c_i - c_j) \frac{b}{1+f} \frac{1}{\lambda} \frac{1}{R_j - R_i}$ is strictly increasing in K_{ij} on the interval $]K_{ij}^C, K_j^a[$, i.e. :

$$\begin{aligned} & \frac{d\left((\lambda R_i - c_i - b) - (c_i - c_j) \frac{b}{1+f} \frac{1}{\lambda} \frac{1}{R_j - R_i}\right)}{dK_{ij}} > 0 \quad (58) \\ \Rightarrow & \left(\lambda - (c_i - c_j) \frac{b}{1+f} \frac{1}{\lambda} \frac{1}{(R_j - R_i)^2} \right) \frac{\partial R_i}{\partial K_{ij}} + \left((c_i - c_j) \frac{b}{1+f} \frac{1}{\lambda} \frac{1}{(R_j - R_i)^2} \right) \frac{\partial R_j}{\partial K_{ij}} > 0. \end{aligned}$$

(4) Let R_i^A and R_j^A as well as r_i^A and r_j^A denote those values where $I_{ii} = I_{ij}$. Then, from Expression 49, we know that:

$$1 + r_i^A = \frac{(1 + r_j^A) \frac{b}{1+f}}{1 + r_j^A + b + c_j - \lambda R_i^A}. \quad (59)$$

For $I_{jj} > I_{ji}$, we must have that:

$$(1+f) > \frac{\frac{b}{1+f}}{1+r_j^A+b+c_j-\lambda R_j^A} \frac{b}{1+r_i^A+b+c_i-\lambda R_j^A+b+\tau_{ji}}, \quad (60)$$

where the expression for $1+r_i^A$ was substituted in. Substituting in the expressions for the equilibrium interest rates yields:

$$\frac{(1+f)^2}{b^2} > \frac{1}{\lambda R_j^A - \lambda R_i^A + \frac{b}{1+f}} \frac{1}{-\lambda R_j^A + \lambda R_i^A + \frac{b}{1+f} + \tau_{ji}}. \quad (61)$$

Solving this inequality with respect to τ_{ji} , $\underline{\tau}$ is obtained:

$$\tau_{ji} > \underline{\tau} = \frac{\lambda^2(R_j^A - R_i^A)^2}{\lambda(R_j^A - R_i^A) + \frac{b}{1+f}}. \quad (62)$$

If $\tau_{ji} > \underline{\tau}$, $I_{ii} = I_{ij}$ implies $I_{jj} > I_{ji}$. To make entrepreneurs in country j prefer banks from i , the interest rate in i must further fall, i.e. $K_{ij}^B > K_{ij}^A$. Therefore, if $I_{ii} = I_{ij}$ implies $I_{jj} > I_{ji}$, then $I_{ji} = I_{jj}$ must imply $I_{ii} > I_{ji}$.

(5) The previous steps have established that the indifference points of an entrepreneur in country i and in country j are unique. Furthermore, under the assumption that $\tau_{ij} = 0$ and $\tau_{ji} > \underline{\tau}$, $K_{ij}^B > K_{ij}^A$. So in the segment $]K_{ij}^C, K_{ij}^A[$, entrepreneurs in both countries prefer banks from country j . For $]K_{ij}^A, K_{ij}^B[$, they each prefer domestic banks. Finally for $]K_{ij}^B, K_j^A[$, entrepreneurs in both countries prefer banks from country i .

Autarky corresponds to $K_{ij} = 0$. According to the equilibrium definition, we must have that $I_{ii} \geq I_{ij}$ and $I_{jj} \geq I_{ji}$ in equilibrium. This implies that the equilibrium must lie in the segment $[K_{ij}^A, K_{ij}^B]$. There are three cases.

(i) Export case: Assume $K_{ij}^A > 0$. Then $K_{ij}^B > 0$. Entrepreneurs in both countries prefer banks from country j at autarky interest rates. Therefore $I_{ij}(K_{ij} = 0) > I_{ii}(K_{ij} = 0)$. This cannot be an equilibrium according to the equilibrium definition. Which point in the segment $[K_{ij}^A, K_{ij}^B]$ is the equilibrium? Capital flows must be consistent with the demand for banking services. As $K_{ij}^A > 0$ and $K_{ij}^B > 0$, in equilibrium country i must import capital and therefore banking service from country j . Where in the segment $[K_{ij}^A, K_{ij}^B]$ is the demand for banking services by entrepreneurs in country i positive? The only point that qualifies is K_{ij}^A . Therefore, $\bar{K}_{ij} = K_{ij}^A$.

(ii) No-trade case: Assume $K_{ij}^A \leq 0$ and $K_{ij}^B \geq 0$. Then there is no trade in banking services. At $K_{ij} = 0$, entrepreneurs in both countries prefer their domestic banks. In the segment $[K_{ij}^A, K_{ij}^B]$, there

is no positive demand for foreign banking services. Therefore $\bar{K}_{ij} = 0$. The equilibrium corresponds to the one under autarky.

(iii) Import case: Assume $K_{ij}^B < 0$, hence $K_{ij}^A < 0$. This implies that entrepreneurs in both countries prefer banks from country i at autarky interest rates. In equilibrium capital flows from i to j and country j imports banking services from country i . Where in the segment $[K_{ij}^A, K_{ij}^B]$ is the demand for banking services of banks from country i by entrepreneurs in country j positive? Only if $K_{ij} = K_{ij}^B$. Therefore $\bar{K}_{ij} = K_{ij}^B$. ■

The proof for the case where $\Delta c < 0$ follows correspondingly.

Proof of Proposition 3

Proof. (i) To show: $\bar{\Omega}_{ij}$ increases weakly in $\Delta(K^a/L)$ for $\Delta c \neq 0$.

The indifference points K_{ij}^A and K_{ij}^B are determined by:

$$I_{ij} = \frac{(1+r_j)b}{1+r_j+b+c_j-\lambda R_i} = \frac{(1+r_i)b}{1+r_i+b+c_i-\lambda R_i} = I_{ii}. \quad (63)$$

and

$$I_{ji} = \frac{(\lambda R_i - c_i - b + \frac{b}{1+f})b}{\lambda R_i - \lambda R_j + \tau_{ji} + \frac{b}{1+f}} = (\lambda R_j - c_j - \frac{bf}{1+f})(1+f) = I_{jj}. \quad (64)$$

Consider an increase in $\Delta(K^a/L)$ keeping K_i^a/L_i and hence R_i fixed. An increase in K_j^a/L_j lowers R_j . I_{ij} goes up. Thus K_{ij}^A increases. Similarly, the LHS of Equation 51 goes up, while the RHS goes down. As a result K_{ij}^B increases. Any equilibrium is either at K_{ij}^A , at K_{ij}^B or at $K_{ij} = 0$. Therefore \bar{K}_{ij} and hence $\bar{\Omega}_{ij}$ increase weakly in $\Delta(K^a/L)$. The same logic applies for a change in $\Delta(K^a/L)$ where K_j^a/L_j remains fixed, but K_i^a/L_i decreases.

(ii) To show: $\bar{\Omega}_{ij}$ increases weakly in $\Delta c = c_i - c_j \forall \Delta c \neq 0$.

With an increase in $\Delta c = c_i - c_j$ keeping c_j fixed, the RHS of 49 goes down. Thus K_{ij}^A increases. Similarly, the LHS of 51 goes down. Thus K_{ij}^B increases. Any equilibrium is either at K_{ij}^A , at K_{ij}^B or at $K_{ij} = 0$. Therefore \bar{K}_{ij} and hence $\bar{\Omega}_{ij}$ increase weakly in Δc . The same logic applies for a change in Δc where c_i remains fixed, but c_j decreases. ■

Proof of Proposition 5

Proof. (i) To show: $\frac{d\tilde{\Omega}_{ij}}{d\Delta K^a/L} \geq 0$ for $\Delta c \neq 0$. Assume $\Delta c > 0$. Then $\tilde{\Omega}_{ij} = \frac{K_i^a + \tilde{K}_{ij}}{\tilde{z}} \tilde{x} > 0$. $\frac{d\tilde{\Omega}_{ij}}{d\Delta K^a/L} = \frac{d\frac{K_i^a + \tilde{K}_{ij}}{\tilde{z}} \tilde{x}}{d\Delta K^a/L} = \frac{d\tilde{K}_{ij} \frac{\tilde{x}}{\tilde{z}}}{d\Delta K^a/L}$. From Equation 24, we know that $\tilde{K}_{ij} = \left(\frac{K_j^a}{L_j} - \frac{K_i^a}{L_i}\right) \frac{L_j L_i}{L_j + L_i} = \Delta \frac{K^a}{L} \frac{L_j L_i}{L_j + L_i}$. Therefore, $\frac{\partial \tilde{K}_{ij}}{\partial \Delta K^a/L} > 0$ and hence $\frac{d\tilde{\Omega}_{ij}}{d\Delta K^a/L} > 0$. Assume $\Delta c < 0$. Then $\tilde{\Omega}_{ij} = 0$ and $\frac{d\tilde{\Omega}_{ij}}{d\Delta K^a/L} = 0$.

- (ii) To show: $\tilde{\Omega}_{ij}$ weakly increases in $\Delta c \forall \Delta c \neq 0$. Note that $\tilde{\Omega}_{ij} > 0$ if $\Delta c > 0$ and $\tilde{\Omega}_{ij} = 0$ if $\Delta c < 0$.
- (iii) To show: $\tilde{\Psi}_{ij}$ weakly increases in $\Delta c \forall \Delta c \neq 0$. The proof is analogous to (ii). ■

Proof of Proposition 6

Proof. If $\Delta c > 0$, $\frac{d\left(\frac{\tilde{\Psi}_{ij}}{\tilde{\Omega}_{ij}}\right)}{d\Delta K^a/L} = \frac{\partial\left(\frac{K_i^a \tilde{x} - \tilde{K}_{ij}}{K_i^a \tilde{x} + \tilde{K}_{ij}}\right)}{\partial \tilde{K}_{ij}} \frac{\partial \tilde{K}_{ij}}{\partial \Delta K^a/L}$. It is easy to see that $\partial\left(\frac{K_i^a \tilde{x} - \tilde{K}_{ij}}{K_i^a \tilde{x} + \tilde{K}_{ij}}\right)/\partial \tilde{K}_{ij} < 0$. From Equation 24, we know that $\tilde{K}_{ij} = \left(\frac{K_j^a}{L_j} - \frac{K_i^a}{L_i}\right) \frac{L_j L_i}{L_j + L_i} = \Delta \frac{K^a}{L} \frac{L_j L_i}{L_j + L_i}$. Therefore, $\frac{\partial \tilde{K}_{ij}}{\partial \Delta K^a/L} > 0$. So $\frac{\partial\left(\frac{K_i^a \tilde{x} - \tilde{K}_{ij}}{K_i^a \tilde{x} + \tilde{K}_{ij}}\right)}{\partial \tilde{K}_{ij}} \frac{\partial \tilde{K}_{ij}}{\partial \Delta K^a/L} < 0$. ■

Appendix B: Data Appendix

$\Delta \log(\mathbf{K}/\mathbf{L}_{ijt})$: The preferred proxy for differences in rates of return to capital is the log difference in capital-labor ratios between source country j and recipient country i adjusted for differences in human capital. Capital stocks and data on the labor force are from Penn World Tables 6.2.⁷⁴ Average years of schooling for the population aged over 25 used for the adjustment are from Barro and Lee (2010). The adjustment for human capital follows Hall and Jones (1999):

$$H_i = e^{\phi(E_i)} L_i, \quad (65)$$

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 Hall and Jones (1999), it is assumed that $\phi(E)$ is piecewise linear, with a slope of 0.134 up to 4 years of schooling, a slope of 0.101 for the years of schooling between 4 and 8, and 0.068 for any year beyond that. Data on average years of schooling comes in 5-year frequencies. Linear interpolation is used to generate missing data. Denoting the capital stock of country i by K_i , the proxy for differences in rates of return to capital is precisely calculated as:

$$\Delta \log(K/L)_{ijt} = \log(K_{j \ t-10}/H_{j \ t-10}) - \log(K_{i \ t-10}/H_{i \ t-10}). \quad (66)$$

Consolidated Banking Statistics: The Consolidated Banking Statistics does not provide a sectoral breakdown for total foreign assets, which comprise all claims of banks whose headquarters are in country i vis-a-vis residents of country j in all currencies. As the model is set up to explain lending to

⁷⁴Capital stocks for the base year 2000, which are not publicly available yet, were kindly provided by Penn World Tables.

foreign firms, foreign assets are proxied by those assets that are broken down by sector, the so-called international claims vis-a-vis the non-bank private sector. As a robustness check, total foreign assets are used as the dependent variable. Foreign liabilities are proxied by the so-called local liabilities in local currency, the only information on liabilities that is available.

Financial Freedom: The index of Financial Freedom provided by the Heritage Foundation (see <http://www.heritage.org/index/financial-freedom>) is used to measure barriers to foreign bank entry as previously done by Beck, Demirguc-Kunt, and Levine (2006) and Buch and Lipponer (2007). The index is based on five criteria: the extent of government regulation of financial services, the degree of state intervention in banks and other financial firms through direct and indirect ownership, the extent of financial and capital market development, government influence on the allocation of credit, and openness to foreign competition. It takes values between 0 and 100, where 100 represents the highest degree of financial freedom. There have been attempts to construct more direct measures from information contained in the Bank Regulation and Supervision database of the World Bank (see Beck, Demirguc-Kunt, and Levine (2006)). Barth, Marchetti, Nolle, and Sawangngoenyuan (2009) for example provide a measure of discrimination against foreign bank entry for a large set of countries and one point in time. This measure, however, does not perform well in a cross-sectional analysis, which could be due to the coarse information upon which it is based.

Chinn & Ito Index: Capital account openness is proxied by the Chinn & Ito Index (see Chinn (2008), http://web.pdx.edu/~ito/Chinn-Ito_website.htm). In contrast to de facto measures of financial openness, which infer the degree of openness from observed capital flows and are therefore endogenous to bank flows, this measure is based on de jure restrictions on cross-border financial transactions documented by the IMF. It increases in capital account openness.

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

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

$\Delta \log(\text{MPK}_{ij})$: An alternative measure for differences in rates of return to capital comes from Caselli and Feyrer (2007). The authors compute MPKs for the year 1996 for 62 countries taking differences in relative prices of investment and consumption goods between countries into account. In the regression, the log differences of these calculated marginal products of capital are used (values of “PMPKL”).

GDP in current \$US, GDP per capita in current \$US, population and information on lending interest rates are from the World Development Indicators. Data on the net interest rate margin and banking sector concentration are from the Financial Structure Data Base provided by the World Bank.

FDI data comes from the OECD International Direct Investment Statistics: Organisation for Economic Cooperation and Development, International Development Statistics, ESDS, University of Manchester.

Table B.1: Summary statistics, sample of foreign assets

Variable	Mean	Std. Dev.	Min	Max
$\log(\text{assets}_{ij})$	4.69	2.85	-1.39	12.75
$\Delta \log(K/L_{ij})$	.842	1.27	-2.70	5.00
$\Delta \log(c_{ij})$	.195	.762	-2.29	2.54
financial freedom _i	55.00	21.71	10	90
openness _j	2.08	.941	-1.13	2.53
openness _i	1.18	1.45	-1.81	2.53
property rights _j	79.11	15.71	30	90
property rights _i	58.23	23.66	10	90
banking crisis _i	.015	.123	0	1
$\log(\text{distance}_{ij})$	8.44	.943	5.15	9.86
common currency _{ij}	.080	.272	0	1
common legal system _{ij}	.328	.470	0	1
common language _{ij}	.147	.354	0	1
colony _{ij}	.059	.236	0	1
$\log(\text{GDP}_j)$	27.42	1.26	23.46	30.16
$\log(\text{GDP}_i)$	25.70	1.92	20.94	30.16
$\log(\text{population}_j)$	17.29	1.47	14.99	20.81
$\log(\text{population}_i)$	16.85	1.53	12.91	20.99
Number of observations= 1249				

Sample selection: The set of recipient countries reported in the CBS was enlarged in 1998, which is why years before 1999 are discarded. Also data on overhead costs before 1989 is only available for a very limited set of countries. The years of the recent financial crisis are excluded.

Source Countries j :⁷⁵ Australia, (Austria), Belgium, Brazil, Canada, (Chile), Denmark, (Finland), France, Germany, Great Britain, Greece, India, Ireland, Italy, Japan, (Mexico), (Panama), Portugal, Spain, Sweden, Switzerland, The Netherlands, Turkey, United States of America

Recipient Countries i :⁷⁶ Algeria, Argentina, Australia, Austria, Bangladesh, Belgium, (Benin), Bolivia, Botswana, Brazil, (Burundi), Cameroon, Canada, Chile, China, Columbia, Costa Rica, Ivory Coast, Cyprus, Denmark, (Ecuador), Egypt, El Salvador, Finland, France, (Gabon), Germany, Ghana, Great Britain, Greece, Guatemala, Haiti, Honduras, Hungary, India, Indonesia, (Iran), Ireland, Is-

⁷⁵Source countries that are not included in the liability sample are in parentheses.

⁷⁶Recipient countries that are not included in the liability sample are in parentheses.

Table B.2: Summary statistics, sample of foreign liabilities

Variable	Mean	Std. Dev.	Min	Max
$\log(\text{liabilities}_{ij})$	5.87	3.21	-1.39	13.37
$\Delta \log(K/L_{ij})$	.668	1.10	-2.70	4.56
$\Delta \log(c_{ij})$	.093	.746	-2.29	2.29
financial freedom _i	57.99	21.91	10	90
openness _j	2.21	.796	-1.13	2.53
openness _i	1.38	1.37	-1.81	2.53
property rights _j	81.48	12.96	50	90
property rights _i	64.28	22.86	10	90
banking crisis _i	.008	.090	0	1
$\log(\text{distance}_{ij})$	8.21	1.10	5.15	9.83
common currency _{ij}	.128	.334	0	1
common legal system _{ij}	.351	.478	0	1
common language _{ij}	.181	.385	0	1
colony _{ij}	.120	.325	0	1
$\log(\text{GDP}_j)$	27.90	1.23	25.98	30.16
$\log(\text{GDP}_i)$	26.52	1.78	20.94	30.16
$\log(\text{population}_j)$	17.58	1.38	15.24	20.81
$\log(\text{population}_i)$	17.26	1.48	12.91	20.99
Number of observations = 493				

rael, Italy, Japan, Jordan, Kenya, Kuwait, (Mali), (Malawi), Malta, Malaysia, Mauritania, Mexico, Morocco, (Mozambique), Nepal, (New Zealand), (Nicaragua), (Niger), Norway, Pakistan, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, (Republic of Congo), (Romania), (Rwanda), Saudi Arabia, Senegal, Sierra Leone, South Africa, South Korea, Spain, (Sri Lanka), (Swaziland), Switzerland, Sweden, Thailand, The Netherlands, (Togo), Trinidad & Tobago, Tunisia, Turkey, Uganda, United Arab Emirates, United States of America, Uruguay, Venezuela, Zambia, Zimbabwe

Summary statistics for the asset sample and the liability sample are given in Tables B.1 and B.2, respectively.

More results of **robustness checks** are available in an online appendix under the following link: <http://www.eui.eu/Personal/Researchers/Niepmann/OnlineAppendix> .

Appendix D: Bank-to-bank lending

Assume that capital accounts are closed and that the only possibility for capital to flow between countries is through lending between banks. An entrepreneur can then raise external capital only through domestic banks, but the external capital may come from domestic or foreign depositors. The

maximization problem of an entrepreneur in country i then becomes:

$$\max_{x_i, y_i, z_i, R^E, \alpha} I_i = z_i \lambda R^E + (1 + r_i)(1 - y_i) \quad (67)$$

$$s.t. \quad y_i \leq 1 \quad (68)$$

$$z_i \leq x_i + y_i \quad (69)$$

$$R^D(1 - \alpha)x_i \geq (1 + r_i)(1 - \alpha)x_i \quad (70)$$

$$(\lambda(R_i - R^E) - c_i)z_i - R_i^D(1 - \alpha)x_i \geq (1 + r_j)\alpha x_i \quad (71)$$

$$R^E \geq \frac{b}{\lambda}. \quad (72)$$

where α is the fraction of external capital that is sourced from depositors in country j . R_i^D denotes the return to depositors located in country i . So

$$I_i = \begin{cases} \frac{(1+r_j)b}{1+r_j+b+c_i-\lambda R_i} & \text{if } r_j < r_i \\ \frac{(1+r_i)b}{1+r_i+b+c_i-\lambda R_i} & \text{if } r_i \leq r_j. \end{cases} \quad (73)$$

The equilibrium with capital account controls and bank-to-bank lending is characterized by the capital flow K_{ij} for which the following conditions are satisfied:

Definition 3 *An equilibrium under capital account controls with bank-to-bank lending is characterized by the capital flow K_{ij} which satisfies the following conditions:*

1. *Entrepreneurs source capital from those banks that demand the lower interest rate.*
2. *Depositors invest their capital in those banks that pay the highest interest rate.*
3. *Capital markets clear.*
4. *Labor markets clear.*
5. *Capitalists in each country are indifferent between becoming entrepreneurs or depositors.*

Equilibrium requires that $r_i = r_j$, which implies:

$$\lambda R_i - c_i = \lambda R_j - c_j. \quad (74)$$

The capital flow \hat{K}_{ij} that equates interest rates fully characterizes the equilibrium.⁷⁷ Assets held by banks from country j (country i) vis-a-vis banks from country i (country j) are denoted by Ω_{ij}^B (Ω_{ji}^B).

⁷⁷Only the net capital flow is determined. Foreign asset holdings are assumed to be the minimum required to implement the net capital flow.

Proposition 7 *In an equilibrium with capital account controls and bank-to-bank lending, interest rates equalize between countries. Assume $\Delta c > 0$ without loss of generality. Then three cases exists:*

(i) *Assume $r_i^a > r_j^a$. This implies $K_i^a/L_i < K_j^a/L_j$. Then $\hat{K}_{ij} = \hat{\Omega}_{ij}^B > 0$, $\hat{\Omega}_{ji}^B = 0$.*

(ii) *Assume $r_i^a = r_j^a$. Then $\hat{K}_{ij} = \hat{\Omega}_{ij}^B = \hat{\Omega}_{ji}^B = 0$.*

(iii) *Assume $r_i^a < r_j^a$. Then $\hat{K}_{ij} < 0$, $\hat{\Omega}_{ji}^B = -\hat{K}_{ij}$, $\hat{\Omega}_{ij}^B = 0$.*

In all three cases $\hat{r}_i = \hat{r}_j$ and as $\Delta c > 0$, $\hat{R}_i > \hat{R}_j$.

\hat{K}_{ij} weakly increases in $\Delta K^a/L$ and weakly decreases in Δc .

Proof. Omitted. ■

Figure 6: Illustration of the export case: $\bar{K}_{ij} > 0$

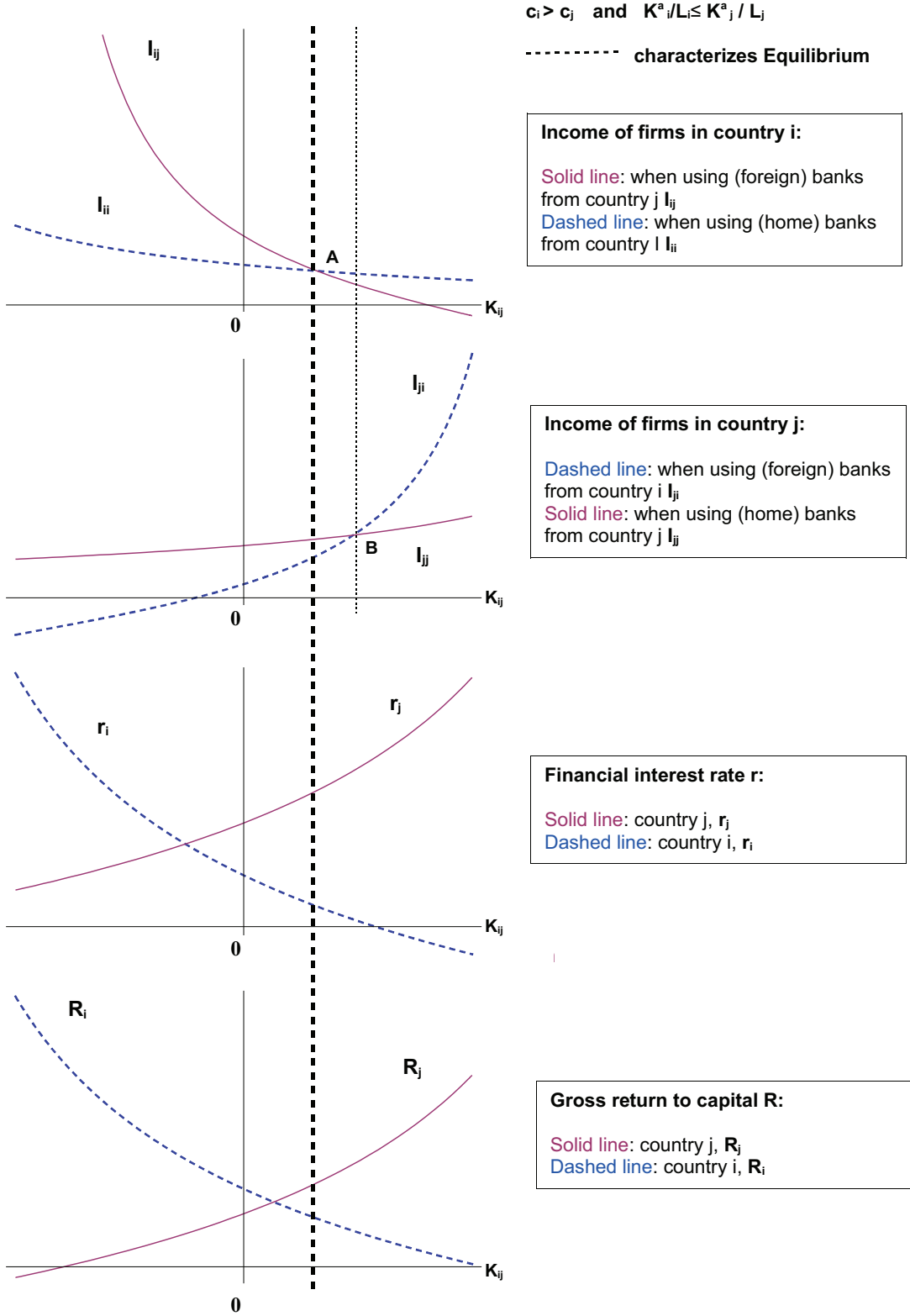


Table 2: The effect of differences in endowments and differences in banking sector efficiency on foreign assets

	Cross-section			Panel	
	(1)	(2)	(3)	(4)	(5)
$\Delta \log(K/L_{ijt})$	0.354*** (0.121)	0.136 (0.123)	1.283*** (0.232)	0.175* (0.0988)	0.153 (0.258)
$\Delta \log(c_{ijt})$	0.409*** (0.0766)	0.145* (0.0835)	0.980*** (0.104)	0.383*** (0.0541)	0.174*** (0.0489)
financial freedom _{it}	0.00970*** (0.00342)	0.0123*** (0.00297)		0.0100*** (0.00258)	0.00103 (0.00189)
openness _{jt}	0.361** (0.161)		0.215 (0.140)	0.206* (0.109)	0.0236 (0.0826)
openness _{it}	0.0484 (0.0539)	0.0398 (0.0460)		0.0114 (0.0378)	-0.0151 (0.0388)
property rights _{jt}	0.0331*** (0.00689)		0.0341*** (0.00666)	0.0220*** (0.00500)	0.0208*** (0.00633)
property rights _{it}	0.00481 (0.00419)	0.00651* (0.00369)		0.00939*** (0.00323)	0.00669* (0.00358)
banking crisis _{jt}				-0.405*** (0.129)	-0.000494 (0.0870)
banking crisis _{it}	0.754** (0.347)	0.832*** (0.283)		0.824*** (0.126)	0.412*** (0.0692)
$\log(\text{distance}_{ij})$	-0.867*** (0.0630)	-0.742*** (0.0584)	-1.259*** (0.0810)	-0.793*** (0.0517)	-0.961*** (0.0637)
common currency _{ij}	0.312* (0.174)	0.247 (0.160)	-0.101 (0.204)	0.160 (0.148)	0.0794 (0.137)
common legal system _{ij}	0.160 (0.124)	0.519*** (0.119)	-0.0733 (0.119)	0.325*** (0.100)	0.418*** (0.0857)
common language _{ij}	0.379** (0.178)	0.197 (0.166)	0.579*** (0.183)	0.428*** (0.148)	0.249* (0.135)
colony _{ij}	1.261*** (0.230)	1.228*** (0.236)	1.294*** (0.223)	1.082*** (0.193)	1.206*** (0.184)
$\log \text{GDP}_{jt}$	0.501** (0.199)		0.0319 (0.231)	1.008*** (0.137)	0.304 (0.263)
$\log \text{GDP}_{it}$	1.118*** (0.104)	1.030*** (0.0965)		0.974*** (0.0871)	0.623*** (0.146)
$\log \text{population}_{jt}$	0.302 (0.198)		0.842*** (0.229)	-0.118 (0.140)	1.097 (2.033)
$\log \text{population}_{it}$	-0.349*** (0.105)	-0.215** (0.0946)		-0.189** (0.0887)	-0.0643 (0.768)
R^2	0.627	0.727	0.704	0.636	0.790
N	1249	1249	1249	8163	8163
Year FE	-	-	-	yes	yes
Source country FE	-	yes	-	no	yes
Recipient country FE	-	-	yes	no	yes

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Robust standard errors in parentheses in Columns (1) to (3).
Columns (4) and (5) clustered standard errors (country pairs).
Dependent variable: $\log(\text{assets}_{ijt})$. Constant not reported.

Table 3: Robustness

	Alt. Proxies (1)	Low (3)	Low. Middle (4)	Up. Middle (5)	High (6)	FDI (7)	Diversification (8)
$\Delta \log(K/L)_{ij}$	0.339** (0.145)	0.324 (0.240)	0.290 (0.246)	0.844** (0.329)	0.957*** (0.217)	0.611*** (0.177)	0.976*** (0.219)
$\Delta \log(\text{MPK}_{ij})$	0.406* (0.219)						
$\Delta \log(c_{ij})$	0.380*** (0.109)	-0.038 (0.298)	0.621** (0.268)	0.113 (0.196)	0.503*** (0.112)	0.150* (0.084)	0.118 (0.108)
$\Delta \log(\text{net interest margin}_{ij})$	0.453*** (0.136)						
financial freedom _i	0.019*** (0.004)	-0.014 (0.015)	-0.001 (0.009)	-0.030*** (0.011)	0.017*** (0.005)	0.010*** (0.004)	0.015*** (0.004)
openness _{jt}	0.859*** (0.269)	-0.043 (0.791)	0.560 (0.375)	0.646** (0.309)	0.227 (0.203)	-0.073 (0.074)	0.583*** (0.296)
openness _{it}	0.053 (0.076)	-0.064 (0.131)	0.242** (0.094)	0.786*** (0.163)	0.001 (0.141)	-0.030 (0.074)	0.189** (0.0864)
banking crisis _i	0.763 (0.436)*	-0.081 (0.407)		0.396 (0.486)		0.990** (0.394)	
$\Delta \log(\text{lending interest rate}_{ij})$	0.454*** (0.129)						
concentration _j	-0.736 (0.503)						
concentration _i	-0.849** (0.353)						
correlation _{ij}							0.502 (0.388)
$\log(\text{FDI flow}_{ij})$						0.032** (0.014)	
R^2	0.67	0.67	0.38	0.45	0.66	0.63	0.68
N	655	940	111	285	597	702	562

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.
Dependent variable: $\log(\text{assets}_{ij})$. Constant and gravity variables not reported.

Table 4: Estimation of asset levels and marginal effects by bin

# Bin	Parameters	Dummy	$\Delta \log(c_{ij})$	$\Delta \log(K/L_{ij})$
Bin 1	$\Delta(K/L_{ij}) \geq 0, \Delta c_{ij} \geq 0$	-	0.392*** (0.149)	0.132 (0.130)
Bin 2	$\Delta(K/L_{ij}) < 0, \Delta c_{ij} > 0$	-0.832*** (0.272)	0.781** (0.330)	0.539** (0.214)
Bin 3	$\Delta(K/L_{ij}) > 0, \Delta c_{ij} < 0$	-0.480* (0.263)	0.347 (0.320)	0.364*** (0.135)
Bin 4	$\Delta(K/L_{ij}) < 0, \Delta c_{ij} < 0$	-0.964*** (0.284)	-0.058 (0.355)	0.651** (0.267)

* $p < 0.1$, ** $p < 0.05$; *** $p < 0.01$. Robust standard errors in parentheses.
 Dependent variable: $\log(\text{assets}_{ij})$. Controls not reported. $N = 1249$, $R^2 = 0.64$

Table 5: The effect of differences in efficiency on foreign liabilities

	Baseline (1)	Source FE (2)	Recipient FE (3)	Lower Inc. (4)	High Inc. (5)
$\Delta \log(K/L_{ij})$	0.324 (0.273)	0.383 (0.290)	-0.481 (0.572)	-0.435 (0.320)	1.862*** (0.460)
$\Delta \log(c_{ij})$	0.526*** (0.156)	0.292 (0.212)	0.797*** (0.226)	0.471** (0.239)	0.533** (0.220)
financial freedom _i	0.016** (0.008)	0.018** (0.008)		0.015 (0.011)	0.002 (0.011)
openness _j	1.215*** (0.260)		1.169*** (0.283)	2.409** (1.214)	0.784*** (0.290)
openness _i	0.040 (0.120)	0.089 (0.111)		-0.096 (0.133)	0.063 (0.325)
property rights _j	0.040*** (0.012)		0.020 (0.015)	0.012 (0.022)	0.063*** (0.018)
property rights _i	0.007 (0.010)	0.003 (0.010)		0.015 (0.014)	0.010 (0.017)
banking crisis _i	1.045 (0.661)	1.071 (0.722)		0.472 (0.911)	
log distance _{ij}	-0.493*** (0.157)	-0.431*** (0.155)	-1.072*** (0.185)	0.423 (0.317)	-0.642*** (0.196)
common currency _{ij}	0.229 (0.409)	0.185 (0.419)	0.080 (0.451)		0.087 (0.455)
common legal system _{ij}	0.658** (0.307)	0.740*** (0.281)	0.748** (0.323)	0.007 (0.434)	0.989** (0.427)
common language _{ij}	0.109 (0.383)	0.132 (0.335)	0.289 (0.469)	0.214 (0.442)	-0.031 (0.618)
colony _{ij}	2.415*** (0.346)	2.121*** (0.405)	1.985*** (0.371)	2.994*** (0.416)	1.992*** (0.565)
common border _{ij}	0.905** (0.451)	0.948** (0.457)	0.443 (0.470)	2.755*** (0.674)	0.334 (0.552)
log GDP _{jt}	-0.065 (0.341)		0.850** (0.429)	-0.896 (1.262)	-0.669 (0.414)
log GDP _{it}	0.935*** (0.231)	0.941*** (0.240)		0.352 (0.306)	1.734*** (0.567)
log(population _{jt})	1.029*** (0.322)		0.263 (0.414)	1.997 (1.236)	1.575*** (0.391)
log(population _{it})	0.096 (0.237)	0.053 (0.237)		0.503 (0.330)	-0.494 (0.578)
R^2	0.48	0.55	0.60	0.52	0.51
N	493	493	493	201	292

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.
Dependent variable: $\log(\text{liabilities}_{ij})$. Constant not reported.

Table 6: Global banking versus international banking

	Baseline (1)	Source FE (2)	Recipient FE (3)	Lower Inc. (4)	High Inc. (5)	Alt. Dep. Var (6)
$\Delta \log(K/L_{ij})$	-0.472** (0.240)	0.281 (0.244)	-2.599*** (0.415)	-0.979*** (0.311)	0.179 (0.397)	-0.789*** (0.229)
$\Delta \log(c_{ij})$	0.0653 (0.137)	0.280 (0.187)	-0.466** (0.196)	-0.0719 (0.195)	0.267 (0.197)	0.0725 (0.153)
financial freedom _i	0.005 (0.007)	-0.002 (0.006)		0.029*** (0.010)	-0.008 (0.009)	0.027*** (0.009)
openness _{jt}	0.708* (0.373)		1.268*** (0.357)	3.234** (1.431)	0.207 (0.379)	2.510** (1.037)
openness _{it}	0.0273 (0.111)	-0.0195 (0.0935)		-0.155 (0.132)	-0.0447 (0.262)	-0.0791 (0.0985)
common currency _{ij}	-0.248 (0.336)	0.213 (0.330)	0.431 (0.394)		-0.443 (0.362)	
common legal system _{ij}	0.107 (0.274)	0.147 (0.234)	0.556** (0.266)	-0.367 (0.456)	0.491 (0.345)	-0.449 (0.342)
common language _{ij}	0.488 (0.350)	0.458 (0.278)	0.0498 (0.405)	1.503*** (0.450)	-0.101 (0.501)	0.923*** (0.308)
colony _{ij}	1.052*** (0.297)	0.943*** (0.333)	0.704** (0.305)	0.466 (0.451)	1.038** (0.437)	0.515* (0.306)
common border _{ij}	0.725** (0.346)	0.916*** (0.299)	0.885** (0.363)	2.038*** (0.548)	0.774** (0.389)	1.130** (0.444)
$\log(\text{GDP per capita}_j)$	-0.398 (0.354)		0.550 (0.358)	-2.142* (1.272)	-0.342 (0.361)	-1.782* (0.923)
$\log(\text{GDP per capita}_i)$	-0.576*** (0.183)	0.0292 (0.198)		-1.166*** (0.273)	-0.286 (0.448)	-0.990*** (0.209)
R^2	0.111	0.308	0.366	0.279	0.067	0.268
N	490	490	490	200	290	201

*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.
Dependent variable: $\log(\text{liabilities/assets}_{ij})$. Constant not reported.

Table 7: Bank-to-bank versus bank-to-firm lending

	Baseline (1)	Source FE (2)	Recipient FE (3)	Lower Inc. (4)	High Inc. (5)	Altern. Controls (6)
$\Delta \log(K/L_{ij})$	-0.229*** (0.076)	-0.159* (0.086)	-0.237 (0.155)	-0.043 (0.095)	-0.600*** (0.151)	
$\Delta \log(c_{ij})$	-0.267*** (0.075)	-0.165* (0.096)	-0.391*** (0.104)	-0.179 (0.125)	-0.335*** (0.094)	-0.239*** (0.077)
financial freedom _i	-0.006 (0.003)	-0.007** (0.003)		0.004 (0.006)	-0.015*** (0.005)	-0.007* (0.003)
openness _j	0.289*** (0.105)		0.346*** (0.125)	0.433*** (0.143)	0.437*** (0.147)	0.102 (0.163)
openness _i	-0.115** (0.056)	-0.108** (0.054)		-0.181** (0.079)	-0.238** (0.114)	-0.115** (0.056)
property rights _j	-0.025*** (0.004)		-0.024*** (0.004)	-0.018*** (0.006)	-0.029*** (0.005)	-0.030*** (0.006)
property rights _i	0.022*** (0.004)	0.022*** (0.004)		0.017*** (0.006)	0.031*** (0.007)	0.020*** (0.005)
banking crisis _i	-1.240*** (0.456)	-1.380*** (0.446)		-0.835 (0.542)		-1.158** (0.464)
common currency _{ij}	0.707*** (0.145)	0.736*** (0.156)	0.319* (0.180)		0.600*** (0.149)	0.697*** (0.146)
common legal system _{ij}	-0.171 (0.130)	-0.305** (0.127)	-0.012 (0.123)	-0.336* (0.188)	0.073 (0.177)	-0.161 (0.130)
common language _{ij}	-0.143 (0.147)	-0.123 (0.159)	-0.218 (0.151)	0.034 (0.219)	-0.293 (0.212)	-0.071 (0.148)
colony _{ij}	-0.387** (0.197)	-0.176 (0.208)	-0.334* (0.173)	-0.586** (0.292)	-0.247 (0.269)	-0.420** (0.202)
log(GDP per capita _j)						0.130 (0.173)
log(GDP per capita _i)						0.196*** (0.068)
R^2	0.21	0.33	0.39	0.08	0.21	0.21
N	1071	1071	1071	490	581	1071

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.
 Dependent variable: $\log(\frac{\text{assets invested in banks}}{\text{assets invested in private sector}_{ij}})$. Constant not reported.

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