The Global Financial Cycle Meets Global Imbalances

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Abstract

This paper studies the role of global banks in cross-border gross and net capital flows. I propose a tractable multi-country model in which leverage-constrained global banks intermediate funds between local banks with heterogeneous projects. Following a relaxation of their constraint, global banks reallocate more funds, generating higher gross capital flows. I show that countries with higher net external liabilities to global banks experience a larger deterioration in their current account balance, driven by a larger increase in investment, after a leveraging up by global banks. Empirically, a unit standard deviation increase in the leverage of global banks leads to a lower current account of 0.9% GDP in Portugal, a debtor country, while it leads to a higher current account of 0.2% GDP in Israel, a creditor country on global banks. As such, fluctuations in global banks' leverage also play a key role in driving global imbalances.

Keywords: Global Banks' Leverage, Capital Flows, Current Account, Investment
JEL Codes: F32, F33, F34, E44, C23

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1 Introduction

Two voluminous and largely independent bodies of literature focus on "Global Imbalances" and the "Global Financial Cycle" (GFC). The former refers to the significant external international payment imbalances that emerged in the early 1980s and persisted to date. The later refers to the fact that, along this long-run tendency, international capital inflows and outflows co-move closely with credit flows, asset prices, and the leverage of global financial intermediaries, as initially pointed out in Rey (2013).

While it has been extensively documented that the GFC drives risky asset prices and gross capital flows, its potential impact on net capital flows —the current account balance— is little explored[1]. It is important to understand the potential effects of the GFC on the current account for at least two reasons. First, at the country-level, because they reflect the broader impact of global financial conditions on the real economy, e.g. on output growth or investment, and thus may guide the optimal domestic policy response to these global exogenous shocks. Second, at the global-level, because the build-up of external imbalances between creditor and debtor countries may be associated with greater systemic risks to the world economy[2].

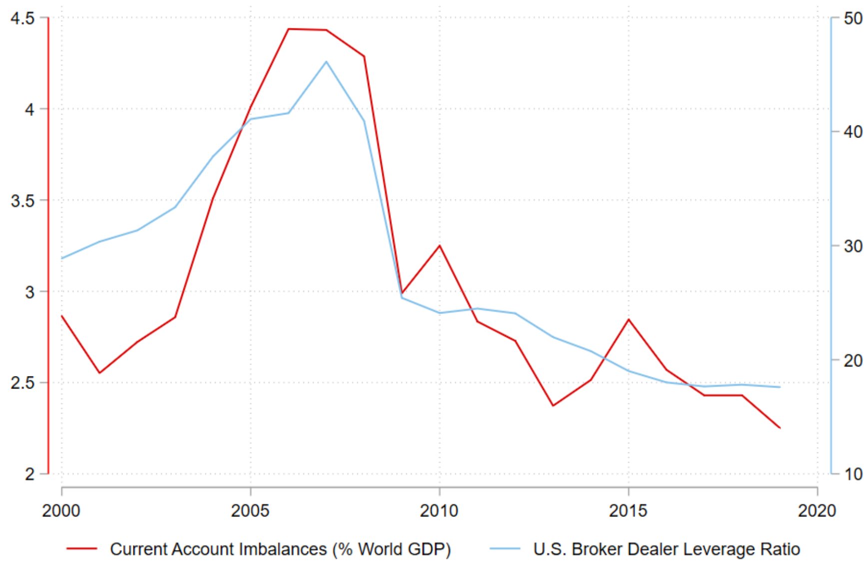
This paper proposes a framework for the joint explanation of the global financial cycle and global imbalances through the leverage of large internationally active banks, called global banks. These global banks play a central role in the international financial architecture (Gabaix and Maggiori 2015, Miranda-Agrippino and Rey 2020). As Figure 1 shows, the leverage of U.S. broker dealers, a proxy for global banks' leverage, is highly correlated with global current account imbalances—defined as the sum of the absolute value of current account balances across countries. This suggests that changes in the leverage of global financial intermediaries may have implications not only for gross flows, as emphasized by the GFC literature, but also for net flows.

In order to shed light on the role of global banks in cross-border gross and net capital flows, I propose a tractable model of the international banking system. The model features a multi-country economy comprised of leverage-constrained global banks located heterogeneously across countries and, in each country, a continuum of local banks that are ex-ante identical but have uncertain bank-specific project returns. The key ingredient of

[1] In balance of payments terminology, inflows and outflows are net items themselves, and can be positive and negative, since they involve both buying and selling transactions by foreigners (non-residents) in case of inflows and domestic agents (residents) in case of outflows, respectively. Net capital flows can be defined as the net of the two gross flows – that is, gross outflows minus gross inflows, and then satisfy the identity that the current account balance equals net capital flows.

[2] See e.g. IMF External Sector Report "Pandemic, War, and Global Imbalances", August 2022.

Figure 1 U.S. Broker-Dealer Leverage and Global Imbalances



Note. This chart shows the U.S. Broker-Dealer leverage (right axis) and global imbalances (left axis) over the period 2000-2019. The U.S. Broker-Dealer leverage is computed as assets over equity. Global imbalances are computed as the sum of the absolute value of current account balances across countries, normalized by world nominal GDP. Source: Flows of Funds, IMF BOP, author's calculations.

the model is that there is both cross-country and within-country heterogeneity regarding the returns on local projects. Additionally, local banks interact with global banks by borrowing and lending on the wholesale inter-bank market after the project returns are revealed, but a financial friction a la Gertler and Kiyotaki (2010) prevents local banks from interacting with each other.

These features of the model rationalize a few empirical facts. In particular, following a relaxation of their constraint (because of looser regulation or higher risk appetite), global banks reallocate more funds by borrowing from low-productivity local banks to lend to high-productivity local banks, generating both higher gross capital inflows and outflows at the country-specific and global levels. Thus, consistent with the GFC hypothesis, gross inflows and outflows are positively correlated and increasing in the leverage of global banks. The model also generates differences in the size of external positions across countries that are not only explained by fundamentals—namely a country's average productivity in the model— but also by the heterogeneous presence of global banks across countries. Moreover, the model produces sharp testable predictions about the direction, and the underlying drivers, of net capital flows.

The first prediction of the model is that a higher leverage of global banks leads to a larger deterioration of the current account balance in countries that have larger net external liabilities to global banks. Conversely, countries that have more net external assets on global banks will experience a larger improvement of their current account balance. As a consequence, an increase in the leverage of global banks opens up the valves on capital flows and magnifies existing global imbalances. The difference between net debtor and net creditor countries is not the same as the distinction between advanced and emerging market countries. For example, Switzerland and Israel are net creditors on global banks, while Portugal and Turkey are net debtor to global banks on average over the last 20 years. As the model does not feature heterogeneity on the household side, the second prediction of the model is that this differentiated effect on the current account across countries comes from a differentiated impact on investment rather than savings[3]. Thus, the model predicts that Portugal and Turkey will experience a larger increase in investment than Switzerland and Israel after an increase in the leverage of global banks.

Motivated by the model's predictions, I analyze the empirical relationship between global banks' leverage and current account balances in a panel study of 41 advanced and emerging market countries for the period 2000Q1-2019Q4. I find that the interaction of global banks' leverage with the country's cross-border position on global banks—defined as its external claims on global banks minus its external liabilities to global banks, and obtained from the BIS Locational Banking Statistics— is statistically and economically significant in explaining the behavior of the current account and investment across countries and across time in the way predicted by the model. The results are robust to controlling for numerous factors, including the world business and financial factors as well as country-specific GDP growth. The results are also robust to considering separately the periods before and after the global financial crisis, or excluding major advanced economies which host global banks' headquarters from the regressions.

In order to deal with potential endogeneity issues, I complement this empirical analysis by exploiting the large heterogeneity in leverage and in size across large intercnationally active banks in order to construct a granular instrumental variable a la Gabaix and Koijen (2020). This identification strategy allows me to establish a causal effect from global banks' leverage to current account balances and confirms my baseline results. Lastly, I show that the mechanism described in my model can partly rationalize at a low frequency the observed increase in global imbalances which preceded the global financial crisis, as well as their reversal after the crisis. Thus, fluctuations in global banks' leverage play a

[3]Fundamental national income accounting identities ensure that the current account is equal not only to net flows, but also to the difference between savings and investment.

key role in driving global external imbalances.

Literature. As mentioned above, this paper is related to the growing empirical literature on the global financial cycle (GFC). This literature argues that that there is a strong global co-movement in asset prices, gross capital flows, credit and risk premia. There is evidence that this GFC is closely tied to a global leverage cycle, and in particular to the leverage of U.S. broker dealers (Bruno and Shin 2015, Cerutti et al. 2017, Cesa-Bianchi et al. 2018a).

My paper also relates to a specific strand of this literature which focuses on the positive correlation between gross capital inflows and outflows (Forbes and Warnock 2012, Broner et al. 2013, Blanchard and Acalin 2016). Avdjiev et al. (2017) emphasizes that the positive co-movement of total capital inflows and outflows is driven by inflows and outflows vis-a-vis the domestic banking sector. They find that in response to an adverse change in global financial conditions, inflows to domestic banks decline, while domestic banks invest less abroad, decreasing their outflows. While this correlation is extensively documented from an empirical perspective, few models are able to explain this high correlation between gross banking capital inflows and outflows. Caballero and Simsek (2020) provides a model with fickle local banks and liquidity risk which can explain the positive correlation between banking inflows and outflows, but do not look at the impact of sudden stops on the current account. The model in my paper contributes to the literature by providing a rationale for positively correlated gross banking inflows and outflows.

Second, this paper also relates to the literature on the relevant role of global banks in the transmission of international shocks (Cetorelli and Goldberg 2012a and Cetorelli and Goldberg 2012b). Following the seminal work of Gertler and Kiyotaki (2010), there has been considerable progress in developing macroeconomic models which include a leveraged banking sector subject to financial frictions. In this class of models, aggregate shocks transmit internationally to periphery countries through global financial intermediaries' net worth. Cao et al. (2021) studies the impact of the openness to multinational banks on the depth and duration of recessions. Morelli et al. (2022) studies the role of global financial intermediaries in international lending. In contrast to those models, I do not focus on the dynamics of net worth, which is very sticky in the data, but on the dynamics of leverage. Similar to Bruno and Shin (2015), I develop a model where global wholesale banks interact with local retail banks. Compared to their paper, my analysis provides a rationale for two-way capital flows, and a differentiated response of the current account across countries to a change in global banks' leverage. The model also allows me to link the activity of global banks to global external imbalances.

Third, this paper also relates to the literature on the determinants of the current account and global imbalances (Milesi-Ferretti and Tille 2014, Mendoza et al. 2009, Jiang et al. 2022). Aguiar and Gopinath (2007) finds that emerging market business cycles exhibit counter-cyclical current accounts. While business cycles, fiscal and monetary policies, and other structural characteristics (e.g. demographics, productivity), are well documented determinants of the current account, I find that global financial conditions also matter. In the model, consistent with the empirical evidence in the literature, international net private capital flows are positively correlated with countries' productivity growth (Gourinchas and Jeanne 2013, Alfaro et al. 2014). A relaxation of the leverage constraint on global banks leads to higher gross flows, but also to higher global imbalances: countries that are net debtor vis-a-vis global banks experience a deterioration of their current account balance, while countries that are net creditors vis-a-vis global banks experience an improvement of their current account balance. One contribution of my paper is to show that an increase in the leverage of global banks magnifies global imbalances, while a decrease in the leverage of global banks reduces global imbalances. This result is reminiscent of Kraay and Ventura (2000) which studies the current account response to transitory income shocks and find that favorable shocks lead to deficits in external debtor countries and surpluses in external creditor countries.

Finally, this paper is closely related to the recent theoretical literature on the global financial cycle. Jeanne and Sandri (2020) shows that emerging market countries can hedge against fluctuations in the GFC by accumulating reserves when foreigners' appetite for domestic assets increase. Akinci et al. (2022) finds that an increase in U.S. uncertainty leads to global deleveraging pressures, a decrease in global asset prices, and an appreciation of the dollar. Their model has implications for net flows and asset prices, but not for gross flows. While their model focuses on two economies, advanced and emerging market economies, I build a multi-country framework which allows to distinguish different countries within each group of economies. Davis and van Wincoop (2021) develops a theory to account for changes in the prices of risky and safe assets and gross and net capital flows over the GFC. Their analysis is based on a portfolio model with heterogeneity in return and risk aversion, but without financial intermediaries such as global banks. Similar to their paper, and in order to keep my model analytically tractable with both within and cross-country heterogeneity, I simplify in the time dimension by using a two-period model. While they consider frictionless trade in equity and safe bonds by households across borders, I explicitly model financial institutions, in the form of local and global banks, and the constraints under which they operate. My paper relates to this recent literature by providing a theoretical framework to understand the propagation of global financial conditions through banks in an multi-country economy.

The rest of the paper is organized as follows. In section 2, I present stylized facts related to the leverage and the cross-border operations of global banks. In section 3, I develop a tractable multi-country model of the international banking system with both local and global banks, and I derive some key predictions to be tested against the data in section 4. Section 5 presents my empirical analysis and confirms that the main predictions of the model are borne out in the data. Section 6 tests the implications of the model for global imbalances, and section 7 concludes.

2 Stylized Facts

This section presents stylized facts that are used to guide the theoretical model. I provide stylized facts regarding the concentration of global banks, their leverage ratio, and the nature of their cross-border operations.

Balance sheet data are collected at the quarterly frequency from Compustat - Capital IQ and Bloomberg to compute leverage at the individual bank level. Leverage is computed as the ratio of assets over book equity, defined as common equity. My sample covers 298 banks located in 21 countries for the period from 2000Q1 until 2019Q4. I also use the Locational Banking Statistics database from the BIS which provides aggregate information about BIS reporting banks–essentially internationally active global banks–to document the nature of of global banks' cross-border operations. More details regarding the source and construction of the data are provided in Appendix A.1.

Stylized Fact 1. Large global banks have a higher and more volatile leverage than other banks.

Table 1 shows that the average level of leverage, and its volatility, are significantly increasing in average assets. This fact is robust to considering only the top 100 banks by asset size. Figure 2 provides a visual representation of this result and shows the distribution of leverage for each bank against its rank by size. Banks are ordered from the largest (left-most) to the smallest (right-most) bank by average asset size. Each dot represents the leverage of a bank for a given quarter. As can be seen from this figure, the leverage of the largest banks is both higher and more volatile than of the other banks. These findings are in line with Coimbra and Rey (2017). Figure A1 in Appendix shows the unweighted and asset weighted averages of leverage across all 298 banks in the sample.

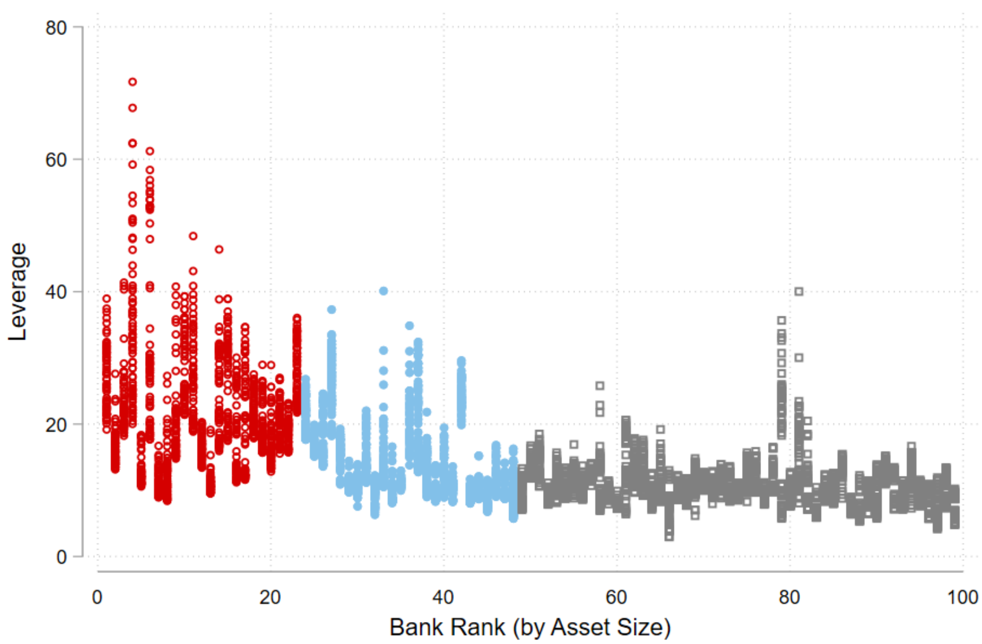
Table 1 Leverage Moments And Bank Average Assets

LEVERAGE	(1) Average	(2) Std Dev	(3) Coef. Var	(4) Average	(5) Std Dev	(6) Coef. Var
Average Assets	6.762***	2.049***	0.037**	6.508***	2.160***	0.042***
	[0.511]	[0.320]	[0.016]	[0.777]	[0.319]	[0.015]
Constant	11.006***	1.954***	0.169***	11.346***	1.806***	0.161***
	[0.209]	[0.131]	[0.007]	[0.550]	[0.226]	[0.011]
Observations	298	298	298	100	100	100
R-squared	0.372	0.122	0.017	0.417	0.318	0.075

Standard errors in brackets
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note. This table shows the results of a cross-sectional regression of the first and second moments of leverage on individual banks' average assets. Average assets are expressed in trillion US dollars. Average represents the average leverage of a bank over the sample period. Std Dev is the standard deviation of a bank leverage over the sample period. Coef. Var is the ratio of Std Dev to Average. The results are reported for all banks in the sample (columns 1-3), and for the largest 100 banks by average asset size (columns 4-6). Source: Capital IQ and Bloomberg.

Figure 2 Individual Banks' Leverage by Rank



Note. This chart shows a scatter plot of leverage by bank for the 100 largest banks. Banks are ordered by rank from the largest (left-most) to the smallest (right-most) bank by average asset size. Each dot represents the leverage of a bank for a given quarter. The largest 23 banks are denoted in red, banks ranked between the 24th and 50th position are denoted in blue, and banks ranked between the 51st and 100th position are denoted in grey. Source: Capital IQ and Bloomberg.

This fact motivates my focus on the leverage of the largest and internationally active banks, which I refer to as global banks for brevity. In order to compute an aggregate measure of the leverage of global banks, I only keep large institutions with assets worth more than 500 billion dollars on average over 2000-2019. This sub-sample contains 23 banks located in 10 countries. Those 23 global banks account for 80% of the assets of all 298 banks in my sample. The list of the largest global banks is provided in Table 2. As can be seen from this table, most global banks are headquartered in a handful of countries: the U.S., the U.K., Japan, Germany, and France[4].

Table 2 List of Global Banks

Ticker	Bank Name	Country	Weight	Average Leverage	Std Dev Leverage
BNPQY	BNP PARIBAS	FRA	5.8%	26.9	5.0
HSBC	HSBC HLDGS PLC	GBR	5.7%	16.3	2.6
MUFG	MITSUBISHI UFJ FINANCIAL GRP	JPN	5.4%	23.2	4.9
DB	DEUTSCHE BANK AG	DEU	5.2%	34.8	12.3
JPM	JPMORGAN CHASE & CO	USA	5.0%	12.8	2.1
BCS	BARCLAYS PLC	GBR	4.9%	32.1	13.3
CITI	CITIGROUPINC	USA	4.9%	12.7	4.1
BAC	BANK OF AMERICA CORP	USA	4.8%	11.0	1.7
NWG	NATWEST GROUP PLC	GBR	4.6%	20.3	6.3
SMFG	SUMITOMO MITSUI FINANCIAL GR	JPN	3.7%	26.9	6.8
SCGLY	SOCIETE GENERALE GROUP	FRA	3.6%	27.9	5.4
SAN	BANCO SANTANDER SA	ESP	3.4%	16.4	1.8
WFC	WELLS FARGO & CO	USA	2.9%	11.2	1.7
CSW	CREDITSUISSE	CHE	2.7%	27.2	6.7
LYG	LLOYDS BANKING GROUP PLC	GBR	2.7%	24.1	6.7
MS	MORGANSTANLEY	USA	2.3%	19.5	7.9
GS	GOLDMANSACHSGP	USA	2.2%	17.0	5.9
RY	ROYAL BANK OF CANADA	CAN	2.1%	21.7	2.8
TD	TORONTO DOMINION BANK	CAN	1.8%	19.4	3.2
BBVA	BBVA	ESP	1.8%	17.1	3.5

Note. This table shows the list of the largest 20 global banks, the location of their headquarters, and summary statistics for their leverage ratio. Weight represents their average share in all 298 banks' total assets over the sample period 2000-2019. Source: Capital IQ and Bloomberg.

Stylized Fact 2. Global banks interact mainly with banks for their cross-border operations, through loans and deposits.

[4]Using data from Aldasoro et al. (2022), I find that 42 out of 96 headquarters of global bank holdings of BIS reporting banks are located in these 5 countries. A similar pattern holds when looking at global systemically important banks instead of BIS reporting banks. A global systemically important bank is a bank whose systemic risk profile is deemed to be of such importance that the bank's failure would trigger a wider financial crisis and threaten the global economy. The Basel Committee has developed a formula for determining which banks are G-SIBs, deploying criteria including size, interconnected-ness and complexity.

Turning to the nature of global banks' cross-border operations, I find that global banks interact mainly with other banks for their cross-border operations, through loans and deposits. This evidence is reported in Table 3 and holds both for their assets (claims) and liabilities. On average during the period from 2000Q1 to 2019Q4, 64% of BIS reporting banks cross-border liabilities (in value) were towards other banks, and 88% of BIS reporting banks cross-border liabilities were in the form of loans and deposits. One limitation of the BIS LBS data is that it does not allow me to differentiate between global and local banks within the counter-party domestic banking sector. However, to the extent that global banks are only concentrated in a few countries, the numbers should reflect the positions of global banks against local banks in most countries. This fact motivates my focus on the interaction between global and local banks, through cross-border loans, in the model.

Table 3 BIS Reporting Banks Cross-border Positions (In Value)

Sectors	% Total	Instruments	% Total
Claims - All sectors	100%	Claims - All instruments	100%
Claims - Banks, total	60%	Claims - Loans and deposits	72%
Claims - Non-banks, total	39%	Claims - Debt securities	21%
Claims - Unallocated by sector	1%	Claims - Other instruments	7%
Liabilities - All sectors	100%	Liabilities - All instruments	100%
Liabilities - Banks, total	64%	Liabilities - Loans and deposits	88%
Liabilities - Non-banks, total	29%	Liabilities - Debt securities	8%
Liabilities - Unallocated by sector	7%	Liabilities - Other instruments	4%

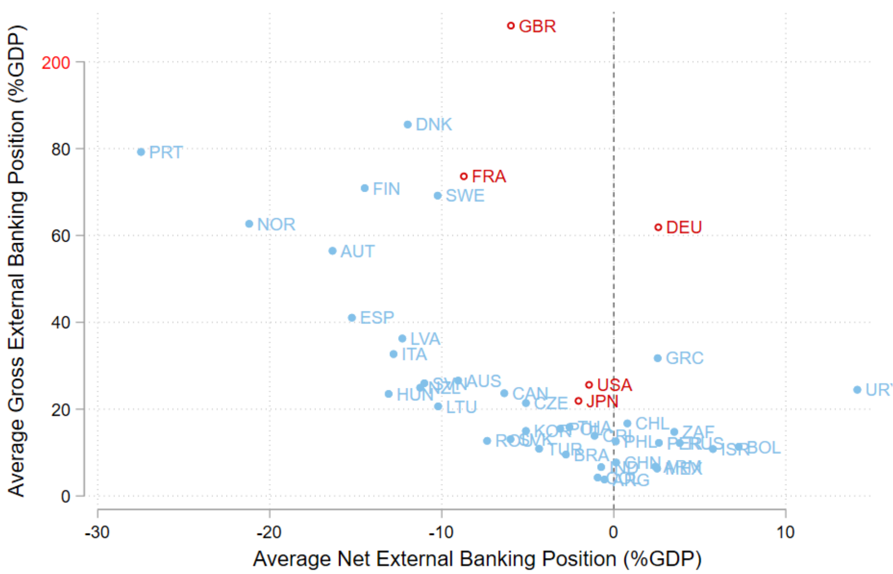
Note. The table provides the decomposition of total claims and liabilities of all BIS reporting banks by counter-party sector and by instrument. The numbers correspond to the average over the period from 2000 to 2020. Source: BIS LBS.

Stylized Fact 3. There is a large dispersion of net external positions vis-a-vis global banks. The distinction between creditor and debtor countries differs from the traditional distinction between advanced and emerging market countries.

Finally, I report the average gross and net external positions of global banks against different counter-party countries' domestic banking sector over the sample period. The gross external position corresponds to the sum of cross-border claims and liabilities of global banks vis-a-vis the domestic banking sector. The net external position corresponds to the difference between the cross-border liabilities and claims of global banks vis-a-vis the domestic banking sector. Both measures are normalized by the counter-party country GDP. The gross position denotes the size of the financial transactions of global banks with a country's banks. The net position denotes the relative size of stocks. A negative value means that global banks have more claims than liabilities on the country's banks or, put differently, that global banks are net lenders to the country's domestic banks.

As can be seen on Figure 3, there is a large distribution of net external positions vis-a-vis global banks in other countries. Some countries are on average net creditors on global banks, while other countries are on average net debtor towards global banks. This distinction between countries differs from the traditional distinction between advanced and emerging market countries. For example, Switzerland, Belgium, Bolivia, Peru and Israel are net creditors on global banks, while Spain, Austria, Portugal, Turkey and Brazil are net debtor towards global banks. Table A2 in Appendix reproduces this fact using the positions of global banks on all resident counter-party sectors, not just the domestic banking sector, for the countries included in the sample for my empirical analysis.

Figure 3 External Positions vis a vis Global Banks



Note. The charts shows the average gross and net external positions over 2000-2020 for the countries where most global banks are headquartered (red) and the remaining countries (blue). Source: BIS LBS, author's calculations.

The stylized facts will guide the assumptions made in my multi-country model of the international banking system presented in the next section.

3 A Multi-Country Model with Global and Local Banks

In this section, I build on the above stylized facts and develop a multi-country model of the international banking system in which leveraged-constrained global banks interact with local banks through cross-border loans. The model features global banks located heterogeneously across countries, and, in each country, a continuum of local banks that have uncertain bank-specific project returns. The key ingredient of the model is that there is both cross-country and within-country heterogeneity regarding the returns on local projects. Additionally, local banks interact with global banks on the wholesale interbank market, but a financial friction prevents them from interacting with each other.

Set-up. Consider a single-good, two-period ($t = 1, 2$) economy. The world economy consists of a large number N of countries indexed by superscript i. There are three type of agents: households, local banks, and global banks. In each country, there is a representative household who faces an inter-temporal consumption-savings decision, and a unit continuum of local banks indexed by superscript j. Each local bank raises deposits from domestic households on the local retail market, has access to a stochastic bank-specific project, and can participate in the global wholesale market. There is also a unit continuum of global banks indexed by superscript g, and located across countries, which perform wholesale banking operations allowing them to reallocate capital among local banks, subject to a leverage constraint. We denote by s^i the exogenous share of global banks which is headquartered in country i, with $\sum_{i=1}^{N} s^i = 1$. A simplified schematic of the model economy is sketched in Figure 4. The following sections provide more details regarding the timelime and each agent.

Timeline. In this two-period economy, the sequence of events is the following:

1. Period 1:

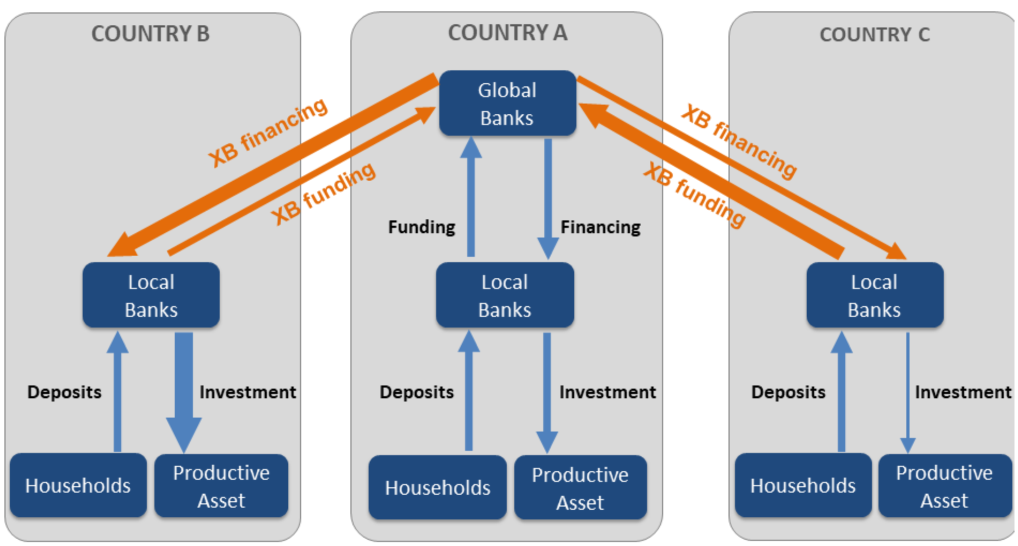
   (a) At the beginning of period 1, local banks compete to raise deposits from domestic households in the retail market.

   (b) At the end of period 1, after the retail market closes, the stochastic bank-specific returns are revealed and global banks reallocate capital across local banks worldwide, by borrowing and lending on the wholesale funding market, subject to a leverage constraint.

2. Period 2: The projects are financed and output is consumed by banks and households.

The economic interpretation of this sequence of events in period 1 is that deposits are considered as long-term, and more sticky, while investment opportunities are more volatile. This characterization of global and local banks follows Gertler et al. (2016) which distinguishes between the subset of financial intermediaries, global banks, that is highly leveraged, often with short-term debt and relies heavily on borrowing from other financial institutions in wholesale markets, and banks borrowing from households in retail markets. In my model, global banks are defined as highly leveraged internationally active banks that lend to foreign entities through cross-border loans. The local banks, in turn, include financial institutions that rely mainly on household saving for external funding and are either net lender or borrower of short-term funds vis-a-vis global wholesale banks[5].

Figure 4 Model - Simplified Overview



Note. This chart provides a simplified schematic representation of the model for the case where $N = 3$, $s^A = 1$, and $R^C < R^A < R^B$. The red arrows denote cross-border (XB) transactions and the blue arrows denote local transactions. Global banks intermediate funds across countries by receiving funding from low-return local banks and financing high-return local banks. In this simplified example, country B, which has a high average productivity, is a net recipient of funds and has more investment than savings (deposits). On the opposite, country C is a net exporter of funds and has more deposits than investment. Country A, which hosts all global banks, has a higher gross external banking position, but a balanced net external banking position.

[5]In my model, I assume that projects are bank-specific and financed by local banks. Thus, global banks lend to local banks in order to finance projects. Shen (2021) finds that local (resp. global) banks have a comparative advantage in extracting information on local (resp. global) risk, and this double information asymmetry creates a segmented credit market.

3.1 Households

In each country i, there is a representative household. Households are born with a wealth endowment W in period 1, optimally consume and save through local bank deposits d^i at the gross competitive deposit rate R^i_H. Households in country i maximize:

$$\max_{d^i} U^i = \ln(c^i_1) + \beta\,\mathbb{E}[c^i_2] \tag{1}$$

Their budget constraints in period 1 and 2 are given by:

$$c^i_1 + d^i = W \tag{2}$$

$$c^j_2 = R^i_H d^i \tag{3}$$

3.2 Local Banks

Within each country i, there is a unit continuum of local banks indexed by superscript j. Local banks are endowed with an initial equity endowment E_L, and have access to a bank-specific project with gross return $R^{i,j}$. At the beginning of period 1, local banks are active on the retail market, through which they can raise deposits $d^{i,j}$ at the competitive rate R^i_H from households. At the end of period 1, local banks are active on the interbank wholesale market, through which they can borrow $d^{i,j}_M$ at the competitive rate R^d_M or lend $l^{i,j}_M$ at the competitive rate R^l_M. Local banks borrow from or lend to global banks, but not directly to each other[6].

Productive assets. Local banks have access to a bank-specific project with gross return $R^{i,j}$, which can be decomposed between a stochastic country-specific component R^i and a stochastic bank-specific component $\epsilon^{i,j}$. Local banks can invest up to $\bar{k}$ units of capital in their project, which pays off in period 2. The project of local bank j located in country i

[6]This assumption can be micro-founded by introducing an agency problem between borrowers and lenders. More specifically, we can assume that local banks can respectively divert a fraction θ^G and θ^L of the borrowed funds from global and local banks, and default on their debt. The creditors may re-claim the remaining fraction of funds. Because local banks recognize other local banks' incentive to divert funds, they will restrict the amount they lend to each other. In this way a borrowing constraint may arise. I implicitly consider the corner case where $\theta^G = 0$ and $\theta^L = 1$, but the main results would hold as long as $\theta^G < \theta^L$, i.e. as long as local banks have a lower incentive to divert funds from global than from other local banks. For simplicity, I also assume that global banks cannot divert funds (e.g. due to higher reputation, or tighter regulatory constraints). See for example Gertler et al. (2016) or Maggiori (2017). This institutional feature of the international banking system is also consistent with Cetorelli and Goldberg (2012a) and Cetorelli and Goldberg (2012b) which conjecture that global banks manage liquidity on a global scale, actively using cross-border internal funding in response to local shocks.

produces output according to the following technology[7]:

$$y^{i,j} = \left(\underbrace{R^i + \epsilon^{i,j}}_{\equiv R^{i,j}} \right) k^{i,j} \tag{4}$$

where $R^i \sim \mathcal{U}_{[\underline{R};\overline{R}]}$ is a stochastic country-specific productivity parameter uniformly distributed on the interval $[\underline{R};\overline{R}]$, $\epsilon^{i,j} \sim \mathcal{U}_{[-\sigma;\sigma]}$ is a bank-specific stochastic productivity shock uniformly distributed on the interval $[-\sigma, \sigma]$, and $k^{i,j}$ is the amount of capital invested by bank j located in country i in its project. R^i and $\epsilon^{i,j}$ are independent random variables, and we denote $R \equiv \mathbb{E}[R^i]$. These assumptions regarding the distribution of country-specific and bank-specific shocks are made to simplify the exposition, but do not affect the essence of the results. We denote by $G(x)$ the global cumulative distribution function of projects' returns at the end of period 1, and by $F_i(x)$ the cumulative distribution function of projects' returns at the end of period 1 in country i.

Retail operations. At the beginning of period 1, before uncertainty is resolved, local banks compete to raise deposits from their home representative household. Local banks set their demand for deposits in order to maximize their expected profits in period 2:

$$\max_{d^{i,j}} \; \mathbb{E}[\pi^{i,j}] \tag{5}$$

Interbank operations. At the end of period 1, after the stochastic returns are revealed, local banks can borrow from and lend to global banks on the global wholesale market. Local banks maximize their period-2 profits:

$$\max_{d_M^{i,j} \geq 0, l_M^{i,j} \geq 0} \pi^{i,j} = \left(\underbrace{R^i + \epsilon^{i,j}}_{\equiv R^{i,j}} \right) k^{i,j} + R_M^l l_M^{i,j} - R_H^i d^{i,j} - R_M^d d_M^{i,j} \tag{6}$$

Local banks are subject to a balance sheet identity:

$$k^{i,j} + l_M^{i,j} = E_L + d^{i,j} + d_M^{i,j} \tag{7}$$

and to a technological constraint:

$$k^{i,j} \leq \bar{k} \tag{8}$$

[7] An alternative interpretation of the model is that local banks are located on a continuum of islands and, given their supply of available funds, can only make friction-less (equity-like) loans to non-financial firms located on the same island (Gertler and Kiyotaki 2010).

This technological constraint, which puts a limit on the availability of projects for local banks, is made to prevent a corner solution where, given the linear technology specification in (4), only the bank with the highest realization of the shocks receives market funding from all other banks. Figure 5 represents the balance sheet of a local bank.

Figure 5 BALANCE SHEET OF LOCAL BANK j LOCATED IN COUNTRY i

Assets	Liabilities
$k^{i,j}$	E_L
$l_M^{i,j}$	$d^{i,j}$
	$d_M^{i,j}$

3.3 Global Banks

Global banks are endowed with initial equity E_G and have the ability to lend an amount l_M^g to or borrow an amount d_M^g from local banks, located either at home or abroad, on the global wholesale market. At the end of period 1, after returns' uncertainty is resolved, global banks can reallocate capital across local banks, subject to a leverage constraint. Global banks maximize their period-2 profits:

$$\max_{l_M^g \geq 0, d_M^g \geq 0} \pi^g = R_M^d l_M^g - R_M^l d_M^g \tag{9}$$

Global banks are subject to a balance sheet identity:

$$l_M^g = E_G + d_M^g \tag{10}$$

and a to leverage constraint:

$$d_M^g \leq \lambda \tag{11}$$

The leverage constraint, which sets a limit on the size of global banks' balance sheet will play a key role in the model[8]. In particular, a tight leverage constraint (i.e. a low λ) limits the ability of global banks to borrow funds on the wholesale market, and thus limits its capital reallocation from local banks associated with a low return project to the ones associated with a high return project. In practice, this leverage constraint can either take the form of a value at risk constraint (Adrian and Shin 2013), or a regulatory constraint (Basel III). Figure 6 represents the balance sheet of a global bank.

[8]As shown in Figure A2 in Appendix, the equity of global banks is very sticky in the data. Thus, for simplicity, I specify the leverage constraint as a limit on their debt liabilities.

Figure 6 Balance sheet of global bank g

Assets	Liabilities
l_M^g	E_G
	d_M^g

3.4 Equilibrium

Definition. We turn to the definition of an equilibrium. In the competitive equilibrium:

i) Global banks set their levels of l_M^g and d_M^g so as to maximize their profits subject to their balance sheet and leverage constraints, taking the interbank rates as given;

ii) Local banks raise deposits $d^{i,j}$, and set their levels of $l_M^{i,j}$ and $d_M^{i,j}$ contingent on the realization of their productivity parameter, so as to maximize their expected profits subject to their balance sheet and technological constraints, taking the interbank rates and the bank deposit rate as given;

iii) Households set their level of d^i so as to maximize their utility, taking the bank deposit rate as given; and

iv) The lending and borrowing interbank rates, R_M^l and R_M^d, and the bank deposit interest rates, R_H^i, clear the global wholesale market and the local retail markets for household deposits in all countries.

We derive the equilibrium by starting with the equilibrium on the wholesale market at the end of period 1, and then the equilibrium on the retail markets at the beginning of period 1. We restrict the attention to symmetric equilibria in which local banks are ex ante identical.

Remark 1 *In a symmetric equilibrium, the deposits collected from households by local banks are equalized across all local banks, both across and within countries. We have* $d^{i,j} = d^i = d \; \forall i, j$.

Proof. In Appendix B.1. ■

The reason for focusing on symmetric equilibria is that it reduces the heterogeneity of local banks to their asset side, while their liabilities are identical just after the retail market closes. This assumption simplifies the model and does not affect the essence of the results.

3.4.1 Equilibrium in the inter-bank wholesale market

At the end of period 1, after uncertainty is resolved, local banks set $d_M^{i,j}$ and $l_M^{i,j}$ in order to maximize their profits in period 2. As shown in Appendix C.1, the optimization problem of local banks leads to corner solutions. We can distinguish 3 cases regarding the decisions of local banks, depending on the realization of $R^{i,j}$: banks with high returns borrow on the wholesale market and invest until their technological constraint binds, banks with intermediate returns are inactive on the wholesale market, i.e. invest their deposits in their own project, and banks with low returns lend all their funds on the wholesale market.

Equilibrium. At the end of period 1, the supply of funds on the inter-bank market comes both from the internal liabilities of global banks–their equity–and their external liabilities–the funds borrowed on the inter-bank wholesale market from local banks. In particular, local banks will supply funds on the inter-bank market if the inter-bank lending rate is higher than the return on their project. The supply of funds by local bank j in country i is given by:

$$l_M^{i,j} = \begin{cases} E_L + d & \text{if } R^{i,j} \leq R_M^l \\ 0 & \text{otherwise} \end{cases} \tag{12}$$

The demand for funds on the inter-bank market comes from the local banks which borrow funds from global banks to finance local projects. In particular, local banks will demand funds on the inter-bank wholesale market if the inter-bank borrowing rate is lower than the return on their project. The demand for funds by local bank j in country i is given by:

$$d_M^{i,j} = \begin{cases} \bar{k} - E_L - d & \text{if } R^{i,j} \geq R_M^d \\ 0 & \text{otherwise} \end{cases} \tag{13}$$

In equilibrium, the global supply of funds should be equal to the global demand for funds on the inter-bank market. The equilibrium condition is:

$$\underbrace{\underbrace{\int_g E^g}_{\text{Global banks' internal equity}} + \underbrace{\sum_{i=1}^{N} \int_j \left(l_M^{i,j}\right) \mathbb{I}(R^{i,j} \leq R_M^l)}_{\text{Local banks' lending}}}_{\text{Global banks' lending}} = \underbrace{\sum_{i=1}^{N} \int_j \left(d_M^{i,j}\right) \mathbb{I}(R^{i,j} \geq R_M^d)}_{\text{Local banks' borrowing}} \tag{14}$$

where $\mathbb{I}(R^{i,j} \leq R_M^l)$ is an indicator function equal to 1 if $R^{i,j} \leq R_M^l$ and 0 otherwise. Similarly, $\mathbb{I}(R^{i,j} \geq R_M^d)$ is an indicator function equal to 1 if $R^{i,j} \geq R_M^d$ and 0 otherwise.

The equilibrium condition given by equation (14) simplifies to:

$$E_G + N\left(E_L + d\right) G(R_M^l) = N\left(\bar{k} - E_L - d\right)\left(1 - G(R_M^d)\right) \tag{15}$$

The two terms on the left-hand side represent the liabilities of global banks. A change in their leverage constraint changes their ability to take on external liabilities. In equilibrium, the sum of those liabilities is equal to global banks' lending, which is itself equal to local banks' borrowing.

As the inter-bank market is segmented, there is a spread between the inter-bank borrowing and lending rates. The inter-bank lending rate R_M^l at which local banks can lend their funds on the wholesale market is increasing in the leverage of global banks λ, and is decreasing in the quantity of funds supplied. Intuitively, as global banks can increase their leverage, their demand for funds increases, which drives the lending rate up. Conversely, the interbank borrowing rate R_M^d at which local banks can borrow funds on the wholesale market is decreasing in the leverage of global banks λ, and is increasing in the quantity of funds demanded. Intuitively, as global banks can increase their leverage, their supply of funds increases, which drives the borrowing rate down. The two rates are equalized when the leverage constraint of global banks does not bind anymore, i.e. when λ is greater than a threshold λ^*. We establish the following lemma.

Lemma 3.1 *If $\lambda < \lambda^*$, then the inter-bank lending rate R_M^l is given by:*

$$R_M^l = G^{-1}\left(\frac{\lambda}{N\left(E_L + d\right)}\right) \tag{16}$$

and is increasing in λ. Moreover, the inter-bank borrowing rate R_M^d is given by:

$$R_M^d = G^{-1}\left(1 - \frac{\lambda + E_G}{N\left(\bar{k} - E_L - d\right)}\right) \tag{17}$$

and is decreasing in λ.

If $\lambda \geq \lambda^*$, then the inter-bank lending rate R_M^l and borrowing rate R_M^d are equalized:

$$R_M^l = R_M^d \tag{18}$$

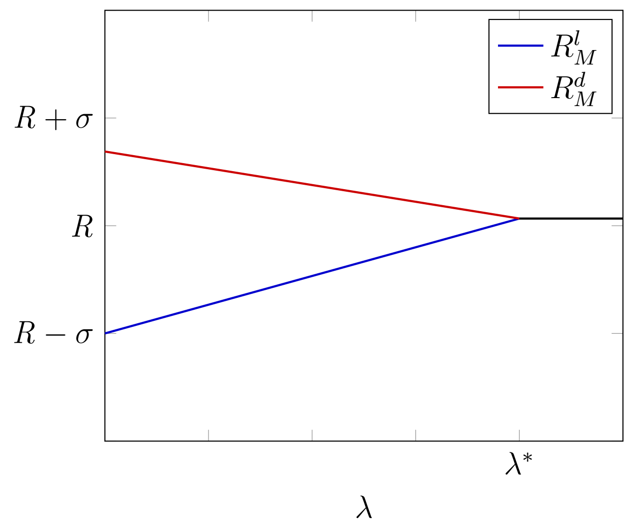
where $\lambda^* = \frac{1 + \frac{E_G}{N\left(\bar{k} - E_L - d\right)}}{\frac{1}{N\left(E_L + d\right)} + \frac{1}{N\left(\bar{k} - E_L - d\right)}}$.

Proof. In Appendix B.1. ■

In the remainder of this paper, we consider the case where the leverage of global banks is binding, i.e. $\lambda < \lambda^*$. An increase in the leverage of global banks λ, i.e. a relaxation of their constraint, leads to an increase in the lending rate, and to a decrease in the borrowing rate. This reduction in the spread on the wholesale market is associated with a reduction in the number of inactive local banks: some local banks which were initially inactive will lend on the wholesale market following the relaxation on global banks' constraint, and some other local banks will obtain funding from global banks.

Figure 7 represents the inter-bank interest rates as a function of global banks' leverage, in the special case where there is no country-specific productivity shock, i.e. $R^i = R\ \forall i$.

Figure 7 Inter-bank Borrowing and Lending Rates



Note This figure shows the inter-bank borrowing (red line) and lending (blue line) rates as a function of global banks' leverage, in partial equilibrium, in the special case where $R^i = R\ \forall i$. The value λ^* denotes the leverage level such that the constraint of global banks does not bind.

3.4.2 Equilibrium in the retail markets for local deposits

At the beginning of period 1, before uncertainty is resolved, local banks compete to raise deposits $d^{i,j}$ from their home representative household. The supply of deposits d^i is given by households' first-order condition:

$$d^i = W - \frac{1}{\beta R^i_H} \tag{19}$$

The supply of deposits is increasing in R^i_H.

Local banks set their demand for deposits $d^{i,j}$ in order to maximize their expected profits in period 2, taking the inter-bank rates as given. As shown in Appendix, local banks' demand for deposits is given by:

$$\mathbf{R^e} \equiv R^l_M G(R^l_M) + \mathbb{E}\left[R^{i,j} | R^l_M \leq R^{i,j} \leq R^d_M\right]\left[G(R^d_M) - G(R^l_M)\right] + R^d_M\left[1 - G(R^d_M)\right] = R^i_H \tag{20}$$

The left hand side represents the expected marginal value of the deposit for the local bank, where the 3 terms denote, respectively, the expected marginal return if the bank lends, is inactive, and borrows on the inter-bank market. The right hand side is the marginal cost of raising deposits from households.

As we are interested in the consequences of a change in the leverage of global banks, we will make the following assumptions to ensure that local banks will be active on the wholesale market at the end of period 1.

Assumption 1 *The following conditions on the exogenous parameters hold:*

$$0 \leq W - \frac{1}{\beta(\underline{R} - \sigma)} \tag{21}$$

$$W - \frac{1}{\beta(\overline{R} + \sigma)} + E_L \leq \bar{k} \tag{22}$$

As shown in Appendix C.2, these conditions ensures that in equilibrium local banks do not raise enough deposits such that their technological constraint binds. Intuitively, the first condition ensures that even if local banks were certain to obtain the lowest possible return on their project, they would still raise non-negative deposits from households. The second condition ensures that even if local banks were certain to obtain the highest return on their project, this would not be able to raise sufficient deposits from households so as to make their technological constraint to bind.

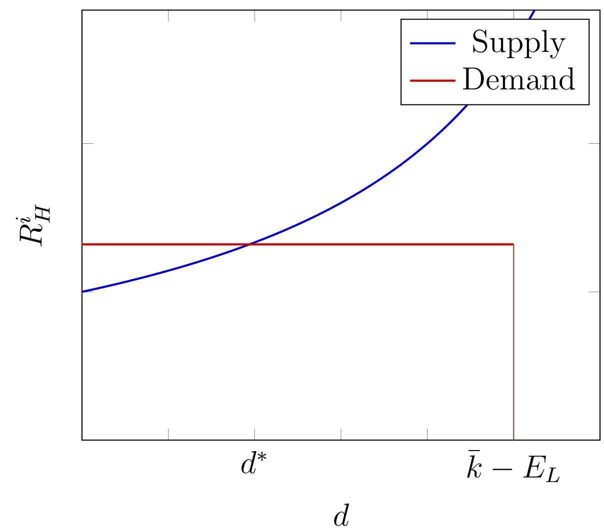
Equilibrium. Using Remark 1, the demand for deposits (20) and the supply of deposits (19), and the equilibrium inter-bank lending and borrowing rates, there is a unique equilibrium domestic bank deposits d^* that solves the fixed-point problem:

$$d^* = W - \frac{1}{\beta \mathbf{R^e}(d^*)} \tag{23}$$

Proof. As seen from equations (16) and (17), R^l_M and R^d_M are decreasing in d. Using equation (20), we observe that $\mathbf{R^e}(d)$ is decreasing in d. Thus, d^* exists and is unique. ■

Figure 8 represents the equilibrium on the retail market for local deposits.

Figure 8 Equilibrium on the Retail Market for Local Deposits



Note This figure shows the equilibrium on the retail market for local deposits. The supply of deposits is given by equation (19), and the demand for deposits is given by equation (20).

The expected marginal value of deposits for a local bank given by equation (20) is increasing in the inter-bank lending rate and in the inter-bank borrowing rate. However, as shown in Lemma 3.1, an increase in the leverage of global banks increases the inter-bank lending rate, and thus raises the expected marginal value of deposits. On the opposite, it decreases the inter-bank borrowing rate, and thus lowers the expected marginal value of deposits. Thus, the impact of a higher leverage of global banks on the equilibrium deposit rate is ambiguous. We establish the following lemma.

Lemma 3.2 *There exists $\underline{k}$ such that $\forall \bar{k} > \underline{k}$ we have $\frac{d\mathbf{R^e}}{d\lambda} > 0$.*

Proof. In Appendix B.1. ■

Intuitively, the inter-bank borrowing rate is less sensitive to the leverage of global banks as the limit on the technological constraint increases. This is because with a higher limit on the technological constraint, only a small fraction of local banks with a high-return project will be borrowing. In the limit as $\bar{k} \to \infty$ only the local bank with the highest project return will borrow on the inter-bank market. Lemma 3.2 states that there is a threshold $\underline{k}$ above which the impact of a higher leverage of global banks has more effect on the lending rate than on the borrowing rate, and unambiguously leads to an increase in $\mathbf{R^e}$ and in the equilibrium deposit rate and amount of deposits.

As seen from equation (20) the deposit rate for households R_H^i is higher than the lending rate on the inter-bank market R_M^l. Thus, local banks might default. For simplicity, I assume that local banks are well capitalized and do not raise sufficient deposits to be in the default region. The introduction of default in this model is left for future research.

4 Global Banks' Leverage and Capital Flows

Capital Flows. We turn to the analysis of capital flows. The main derivations are reported to Appendix B.2. In order to obtain a unique closed-form solution for countries' capital inflows and outflows we will make the following assumption.

Assumption 2 *The lending by any local bank to global banks is randomly distributed across all global banks, whether those global banks are headquartered in the same country as the local bank or not. Similarly, the borrowing by any local bank from global banks is randomly distributed across all global banks, whether those global banks are headquartered in the same country as the local bank or not.*

At the margin global banks are indifferent between borrowing from a local bank located in the same country or abroad. The former does not generate a cross-border capital flow while the latter does. Thus, this assumption is needed to pin-down cross-border flows.

Special case. In a first step, and in order to clarify the exposition, I present a special case where there is no country-specific heterogeneity in the productivity parameter, i.e. $R^i = R\ \forall i$. Note that in this specific case, the global and local cumulative distribution function of projects' returns at the end of period 1 in country i are the same. The capital outflows of country i are given by:

$$O^i = \left(1 - s^i\right)\frac{\lambda}{N} + s^i\left(\frac{N-1}{N}\right)(E_G + \lambda) \tag{24}$$

The first term corresponds to funds lent by local banks of country i to global banks headquartered outside of country i. Note that if all global banks are headquartered in country i, i.e. if $s^i = 1$, then this first term is equal to zero as local banks do not lend funds to banks located outside of the country. The second term corresponds to funds lent by global banks headquartered in country i to local banks located outside of country i.

Similarly, the capital inflows of country i are given by:

$$I^i = \left(1 - s^i\right) \frac{E_G + \lambda}{N} + s^i \left(\frac{N-1}{N}\right) \lambda \tag{25}$$

The first term corresponds to the money borrowed by local banks of country i from global banks located outside of country i. The second term corresponds to the money borrowed by global banks headquartered in country i from local banks not located in country i. As can be seen from equation (24) and (25), a country's capital inflows and outflows are both increasing in global banks' leverage λ. Moreover, global capital outflows and inflows are are both increasing in global banks' leverage. This feature of the model is in line with the global financial cycle hypothesis (Rey 2013). Additionally, gross capital flows are increasing in the share of global banks headquartered in the country s^i as long as the number of countries is large enough[9].

The net capital outflows of country i, are given by:

$$N^i \equiv O^i - I^i = E_G \left[s^i - \frac{1}{N}\right] \tag{26}$$

Note that countries which host more global banks tend to have higher capital outflows because they can use their own internal equity to lend to local banks located in other countries. In this special case without country-specific heterogeneity in the productivity parameter across countries, the net capital flows of all countries are equal to zero if either $E_G = 0$ or $s^i = \frac{1}{N}$ $\forall i$. Put differently, there are no global imbalances if either global banks have no internal capital or are equally distributed across countries. Moreover, in this special case, the leverage of global banks has no effect on net capital flows.

General case. Building on the above analysis, we turn to the general case, where there is country-specific heterogeneity in the productivity parameter R^i. As shown in Appendix B.2, the capital outflows of country i are given by:

$$O^i = \left(1 - s^i\right) \frac{\lambda}{N} \frac{F_i(R_M^l)}{G(R_M^l)} + s^i \left(E_G + \lambda\right) \left[\frac{N\left(1 - G(R_M^d)\right) - \left(1 - F_i(R_M^d)\right)}{N\left(1 - G(R_M^d)\right)}\right] \tag{27}$$

where $G(x)$ is the global cumulative distribution function of projects' returns at the end of period 1, and by $F_i(x)$ the cumulative distribution function of projects' returns at the

[9]More formally, $\frac{dI^i}{ds^i} >$ if and only if $N > 2 + \frac{E_G}{\lambda}$. Because global banks are highly leveraged, I assume that their debt liabilities are larger than their equity, $\lambda > E_G$. Thus, the condition simplifies to $N \geq 3$.

end of period 1 in country i.

As before, the first term corresponds to the money lent by local banks of country i to global banks headquartered outside of country i, and the second term corresponds to the money lent by global banks headquartered in country i to local banks located outside of country i. Note that if $F_i(R^d_M) = G(R^d_M)$ and $F_i(R^l_M) = G(R^l_M)$ then we are back to the special case. Moreover, both $F_i(R^d_M)$ and $F_i(R^l_M)$ are decreasing in R^i. Thus, capital outflows are decreasing with R^i, i.e. with the realization of the country-specific productivity shock. Intuitively, if a country has a higher country-specific productivity shock then it will invest less abroad. In particular, local banks will provide less funding to the global wholesale market, and domestic global banks will lend less to foreign local banks. Similarly, the capital inflows of country i are given by:

$$I^i = \left(1 - s^i\right) \frac{E_G + \lambda}{N} \frac{1 - F_i(R^d_M)}{1 - G(R^d_M)} + s^i \lambda \left[\frac{NG(R^l_M) - F_i(R^l_M)}{NG(R^l_M)}\right] \tag{28}$$

The first term corresponds to the money borrowed by local banks of country i from global banks headquartered outside of country i. The second term corresponds to the money borrowed by global banks headquartered in country i from local banks located abroad. Capital inflows are increasing with R^i, i.e. with the realization of the country-specific productivity shock. Intuitively, if a country has a higher country-specific productivity shock then it will attract more investment. In particular, local banks will borrow more funding from the wholesale market, and domestic global banks borrow more funds from foreign local banks.

As derived in the Appendix, a country's gross capital flows are both increasing in global banks' leverage λ and in the share of global banks headquartered in the country s^i. Turning from gross to net capital flows, I establish the main proposition.

Proposition 1 *The net capital outflows of country i, is given by:*

$$N^i \equiv O^i - I^i = \frac{\lambda}{N} \left[\underbrace{\frac{F_i(R^l_M)}{G(R^l_M)} - \frac{1 - F_i(R^d_M)}{1 - G(R^d_M)}}_{\equiv \xi^i} \right] + \frac{E_G}{N} \left[s^i N - \frac{1 - F_i(R^d_M)}{1 - G(R^d_M)} \right] \tag{29}$$

The net capital outflows from a country, i.e. its current account balance, depends on the interaction between global banks' leverage (λ) and its net external position against global banks (proxied by ξ^i).

The proposition states that the sign and the magnitude of net outflows N^i in response to fluctuations in global banks' leverage λ depends on ξ^i, which has the same sign as, and is increasing in, the country's net external position vis-a-vis global banks. The variable ξ^i depends on the relative distribution of projects' returns in a given country (both the lower and upper tail) compared to projects' returns worldwide. Net external assets on global banks are decreasing with R^i, i.e. with the realization of the country-specific productivity shock. Intuitively, if a country has a higher country-specific productivity shock then it will invest less abroad and it will attract more investment. In particular, local banks will provide less net funding to (or obtain more net borrowing from) the global wholesale market and domestic global banks provide less net funding to (or obtain more net borrowing from) foreign local banks. Countries with a positive value of ξ^i are thus net creditor vis-a-vis global banks, and can be thought as low-productivity, capital abundant countries, while countries with a negative value of ξ^i are net debtor vis-a-vis global banks, and can be thought as high-productivity, capital scarce countries[10].

Savings and Investment. A natural extension of this result is to decompose the current account between saving and investment. A fundamental national income accounting identity in international macroeconomics is that the current account of a country is equal to the difference between its savings and investment. Thus, any change in the current account should be reflected by a change in savings and/or investment. In the model, following an increase in global banks' leverage, investment is increasing in aggregate, and more in countries which are net debtor against global banks, while savings are increasing in aggregate without distinction across countries. As the model does not feature heterogeneity on the household side, the heterogeneous impact on the current account across countries is entirely driven by heterogeneous responses of investment across countries.

Proposition 2 *The differentiated effect on the current account across countries in response to fluctuations in global banks' leverage is driven by investment, not by savings.*

Proof. In Appendix B.1. ■

Intuitively, this proposition follows from two facts. First, the fact that all local banks have a similar structure on their liabilities side after raising deposits in the beginning of period 1, because they face the same constraints and the same expected return on their

[10] The focus of this paper is on private, as opposed to public, capital flows. In my model, consistent with the empirical evidence in Gourinchas and Jeanne (2013), countries with faster productivity growth attract more foreign private capital. Alfaro et al. (2014) also finds that international net private capital flows are positively correlated with countries' productivity growth.

project. Second, the fact that they have heterogeneous realized returns, and thus that they will have different optimal composition on the asset side of their balance sheet after the shocks are realized.

5 Empirical Analysis

The closed-form solutions given by the model provide some testable predictions. In particular, the two main predictions to be tested in the data are the following:

1. The current account of a country is a function of the interaction between global banks' leverage and its net external position against global banks.

2. The differentiated effect on the current account across countries in response to fluctuations in global banks' leverage is driven by investment, not by savings.

To test those predictions, I build on Rey (2013) and Bruno and Shin (2015) and run the following dynamic panel regressions:

$$Y_{i,t} = c_i + \beta_0 t + \beta_1 L_t + \beta_2 L_t \; P_{i,t-1} + \beta_3 P_{i,t-1} + \alpha_1 \mathbb{X}_t + \beta_4 Y_{i,t-1} + \epsilon_{i,t} \tag{30}$$

where $Y_{i,t}$ is either the current account to GDP, net outflows to GDP, the gross fixed capital formation to GDP, or savings to GDP, in country i and quarter t; L_t is an aggregate measure of the leverage of global banks; $P_{i,t-1}$ is the net external asset positions of country i on global banks at $t-1$; and $\mathbb{X}_t$ is a vector of control variables. I include one lag of the dependant variable as an explanatory variable to control for country-time specific conditions.

All regressions are estimated via OLS, include country fixed effects and country-specific linear time trends, and double-clustered standard errors by country and time. By doing so, I allow for correlated shocks across countries for a given quarter, as well as correlated shocks over time for a given country.

My main focus is on the coefficient β_2 which quantifies the impact of the interaction term. First, the model predicts that countries with higher net external liabilities to global banks tend to experience a larger improvement in their current account balance following a deleveraging by global banks. Thus, I expect the sign to be positive for the current account and net outflows regressions. Second, the model predicts that this differentiated response of the current account is driven by investment, not savings. Thus, I expect the sign to be negative for investment, and not significant for savings.

5.1 Sample and Variables

My sample consists of a panel of 41 advanced and emerging market economies, for the period from 2000Q1 to 2019Q4. Summary statistics are provided in the Appendix[11].

Global Banks' Leverage. Leverage is computed at the individual bank level and is defined as the ratio of assets over book equity. The data are obtained from Capital IQ and Bloomberg for the period 2000Q1-2019Q4. I use the median leverage of the 23 global banks identified in Section 2 as my aggregate measure of leverage in the baseline regressions. In robustness checks, I also use the average leverage of the 23 global banks weighted by asset size and the U.S. Broker-Dealers' leverage as alternative measures for aggregate global banks' leverage[12].

Net Positions Against Global Banks. I use BIS Locational Banking Statistics (LBS) to measure the net cross-border positions vis-a-vis global banks. The LBS collects data from internationally active banks which report both their claims on and liabilities towards different countries. As argued in Bruno and Shin (2015), large global banks account for most of these international exposures reported by internationally active banks. The key organisational criteria of the BIS locational statistics data are the country of residence of the reporting banks and their counter-parties. This makes the LBS appropriate for measuring the role of global banks in the intermediation of international capital flows and lending flows. In my empirical analysis, I define a country's net position vis-a-vis global banks as the difference between the liabilities of BIS reporting banks against all counter-party sectors in this country minus the assets of BIS reporting banks on all counter-party sectors in this country. All variables are normalized by the counter-party country's GDP. To be clear, a negative value means that a given country has net liabilities towards global banks, while a positive value means that a country has net assets on global banks. In robustness checks, I also use the position of the counter-party banking sector vis-a-vis global banks, and the net other investment positions from the External Wealth of Nations database by Lane and Milesi-Ferretti (2001).

[11]List of countries: United States, Austria, Denmark, France, Germany, Italy, Norway, Sweden, Canada, Japan, Finland, Portugal, Spain, Turkey, Australia, New Zealand, South Africa, Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, Uruguay, Israel, India, Korea, Rep. of, Philippines, Thailand, Armenia, Rep. of, Russian Federation, China, P.R.: Mainland, Czech Rep., Slovak Rep., Hungary, Lithuania, Slovenia, Rep. of, Poland, and Rep. of, Romania.

[12]For the reasons discussed in Adrian and Shin (2010), the U.S. broker dealer sector closely mirrors the wholesale funding operations of global banks.

Current Account, Savings, and Investment. I use data on the current account to GDP ratio from the International Monetary Fund (IMF). I also construct an alternative measure of net flows by taking the difference between total gross outflows and total gross inflows in a given quarter, normalized by GDP[13]. Investment, defined as gross fixed capital formation, is obtained from the IMF IFS database. Savings are computed as the sum of the current account and investment, using the fundamental national income accounting identity that the current account is equal to the difference between savings and investment.

Additional Control Variables. I include the VIX and the world real GDP growth rate, which are factors that also affect capital flows according to the global financial cycle literature, as control variables in my baseline regressions. In my robustness checks, I use the global financial factor and the international business cycle factor computed from Acalin and Rebucci (2020). Moreover, I also control for own country's real GDP growth as this is a driver of the current account according to the open-economy RBC literature.

5.2 Panel Regressions

The main results are presented in Table 4. Following the closed-form solutions given by the model, my focus is on the coefficient on the interaction between the leverage of global banks and the net external position vis a vis global banks, reported on the first line.

Results. The coefficient on column 1 is positive and significant for the current account regression, meaning that when the leverage of global banks is high, the current account balance improves in countries which are net creditor against global banks, while it deteriorates in countries which are net debtor against global banks. The main result is confirmed by the positive and significant coefficient in the regression in column 2 for net outflows, which is used as a proxy for the current account. Quantitatively, an increase by one-standard deviation of the leverage of global banks leads to an instantaneous quarterly drop in the current account balance by on average 0.9% GDP in Portugal, while it leads to an increase in the current account balance by 0.2% GDP in Israel, and has no effect on the current account in Germany which has a balanced position vis a vis global banks.

[13] I construct total gross inflows as the sum of FDI gross inflows, portfolio gross inflows, and other investment gross inflows. I construct total gross outflows as the sum of FDI gross outflows, portfolio gross outflows, other investment gross outflows, and reserves outflows. All variables are obtained from the IMF BOP database.

Countries which are more net debtor vis a vis global banks tend to receive more net inflows when the leverage of global banks goes up. As shown in columns 3 and 4, this differentiated effect on the current account is driven by the response of investment, and not by savings. As predicted by the model, when the leverage of global banks increases, investment increases more in countries which are net debtor against global banks, while there is no significant difference in the response of savings across countries related to different positions against global banks.

5.3 Robustness Checks

I conduct multiple robustness checks to confirm the results. The β_2 coefficients from those regressions are reported in Appendix.

Lagged Endogenous Variable. A difficulty arises with the fixed effects model in the context of a dynamic panel data model because the demeaning process creates a correlation between the regressor and the error. Yet, Nickell (1981) demonstrates that the inconsistency is of order $1/T$, which should be limited in my estimations given that in my panel $T = 80$. To confirm that the estimates are not driven by the inclusion of a lag of the dependent variable as a control variable, I replicate the analysis without the lagged dependent variable in control variables. I show that my results are robust to removing the lagged dependent variable from the regressors.

Position against Global Banks. I use the net external asset positions of the counter-party banking resident sectors, instead of all counter-party resident sectors, of country i on global banks at $t-1$ in my robustness checks. My results are robust to using this alternative measure of a country's exposure to global banks.

Excluding Main Countries. As the leverage of global banks may be endogenous to the business cycle in main advanced economies, I re-run my regression by excluding the main advanced economies where most global banks are located (the U.S., the U.K., France, Germany, and Japan) from the sample. My results are robust to excluding those countries from the sample.

Leverage. Results are robust to using the weighted average leverage of global banks and the leverage of U.S. broker dealers as alternative measures of the leverage of global banks.

Table 4 Impact on the Current Account, Investment, and Savings
Baseline Results

$$Y_{i,t} = c_i + \beta_0 t + \beta_1 L_t + \beta_2 L_t\ P_{i,t-1} + \beta_3 P_{i,t-1} + \alpha_1 \mathbb{X}_t + \beta_4 Y_{i,t-1} + \epsilon_{i,t}$$

	Dependent Variable			
	Current Account (1)	Net Outflows (2)	Investment (3)	Savings (4)
Global Banks Leverage	0.757***	1.463***	-0.820***	0.086
# Net Assets on Global Banks	[0.248]	[0.390]	[0.293]	[0.357]
Global Banks Leverage	0.010	0.040	0.026	0.087
	[0.055]	[0.071]	[0.069]	[0.056]
Net Assets on Global Banks	-12.894**	-26.355***	17.143**	2.584
	[5.603]	[9.256]	[6.415]	[8.178]
World Real GDP Growth	0.015	-0.108	-0.183	-0.173
	[0.212]	[0.277]	[0.486]	[0.307]
VIX	0.011	-0.014	-0.018	-0.008
	[0.012]	[0.018]	[0.022]	[0.017]
Real GDP Growth	-0.128*	-0.210*	0.357***	0.299***
	[0.067]	[0.111]	[0.079]	[0.089]
Lagged Dependent Variable	0.410***	0.156***	0.272***	0.145**
	[0.045]	[0.041]	[0.079]	[0.055]
Constant	-0.178	-0.134	16.596***	18.566***
	[1.040]	[1.472]	[2.345]	[1.805]
Country FE	Yes	Yes	Yes	Yes
Country-specific Time Trend	Yes	Yes	Yes	Yes
Observations	2,756	2,753	2,581	2,561
R-squared	0.776	0.526	0.650	0.786
R-squared (within)	0.233	0.082	0.128	0.056

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note. All regressions are estimated via OLS, include country fixed effects and country-specific linear time trends, and double-clustured standard errors by country and time.

Pre- and Post- Global Financial Crisis. I consider separately the periods before and after the global financial crisis to make sure the results are not driven by this major financial event. I estimate the regression for two sub-periods before (2000-2007) and after (2010-2019) the global financial crisis. The results are still robust, but the coefficients display some heterogeneity across the sample.

Control Variables. Finally, the results are also robust to including and an interaction term between the leverage of global banks and a dummy variable equal to 1 for emerging market countries and 0 for advanced economies, as control variable. To confirm that the effect is not driven by the business or financial cycles, I also include an interaction term between those factors and the net position vis a vis global banks. The results are presented in Table 5 when I use the VIX and world real GDP growth as financial and business cycle factors. I replicate this analysis using the factors from Acalin and Rebucci (2020). My main results remain robust across all specifications.

Thus, I find strong empirical support for the mechanism described in the model, which shows that the net external position of a country against global banks plays a key role in explaining its macroeconomic response to the leverage of global banks. Moreover, this result is not driven by the traditional distinction in the literature between advanced and emerging market economies.

5.4 Granular Instrumental Variable

In this section, I use a granular instrumental variable strategy to adress potential endogeneity issues and identify the causal effect of global bank's leverage on individual countries' current account balance. Gabaix and Koijen (2020) provides a methodology to extract idiosyncratic shocks from the data and create a "granular instrumental variable" (GIV), which is a size-weighted sum of idiosyncratic shocks. As discussed in Section 1, the bank size distribution is heavily skewed, with a few large global banks accounting for an important share of banking activity worldwide: The top 10 largest banks account for 50% of assets of all 298 banks in my sample. The idea behind granular instrumental variables is that as the idiosyncratic shocks from these large banks affect aggregate outcomes, they are valid instruments.

Table 5 IMPACT ON THE CURRENT ACCOUNT, INVESTMENT, AND SAVINGS
ROBUSTNESS WITH ADDITIONAL CONTROLS

$$Y_{i,t} = c_i + \beta_0 t + \beta_1 L_t + \beta_2 L_t \ P_{i,t-1} + \beta_3 P_{i,t-1} + \alpha_1 \mathbb{X}_t + \beta_4 Y_{i,t-1} + \epsilon_{i,t}$$

	Dependent Variable			
	Current Account	Net Outflows	Investment	Savings
	(1)	(2)	(3)	(4)
Global Banks Leverage	1.051***	1.924***	-1.330***	0.002
# Net Assets on Global Banks	[0.295]	[0.415]	[0.397]	[0.463]
Global Banks Leverage	-0.104	-0.173*	0.220*	0.059
# Emerging Market	[0.088]	[0.093]	[0.111]	[0.110]
VIX	-0.076	-0.029	0.047	-0.031
# Net Assets on Global Banks	[0.087]	[0.126]	[0.067]	[0.078]
World Real GDP Growth	0.643	2.033	-1.514***	-0.454
# Net Assets on Global Banks	[1.047]	[1.251]	[0.475]	[1.153]
Global Banks Leverage	0.102*	0.191***	-0.155**	0.044
	[0.059]	[0.062]	[0.076]	[0.105]
Net Assets on Global Banks	-17.969**	-37.013***	28.204***	5.419
	[6.769]	[9.312]	[7.714]	[10.750]
World Real GDP Growth	0.104	0.178	-0.392	-0.230
	[0.316]	[0.333]	[0.469]	[0.283]
VIX	0.001	-0.018	-0.011	-0.012
	[0.015]	[0.019]	[0.022]	[0.019]
Real GDP Growth	-0.119*	-0.197*	0.343***	0.296***
	[0.066]	[0.114]	[0.079]	[0.091]
Lagged Dependent Variable	0.402***	0.151***	0.259***	0.145**
	[0.043]	[0.040]	[0.079]	[0.055]
Constant	-0.694	-1.334	18.085***	18.913***
	[0.976]	[1.274]	[2.273]	[1.854]
Country FE	Yes	Yes	Yes	Yes
Country-specific Time Trend	Yes	Yes	Yes	Yes
Observations	2,756	2,753	2,581	2,561
R-squared	0.777	0.528	0.654	0.786
R-squared (within)	0.237	0.086	0.136	0.056

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

NOTE. All regressions are estimated via OLS, include country fixed effects and country-specific linear time trends, and double-clustured standard errors by country and time.

5.4.1 The Basic Intuition

The goal of this empirical exercise is to recover the causal effect of global banks' leverage on individual countries' current account balance. As in many macroeconomic settings, I face an identification problem as aggregate macroeconomic outcomes and global banks' leverage are both endogenous, for example to global risk aversion or global business cycle fluctuations. The objective of my estimation is to identify β_2, the sensitivity of a country's current account $Y_{i,t}$ to the interaction between its net exposure $P_{i,t-1}$ to global banks and global banks' leverage L_t. I present the estimation problem for the simplest case of a single economy under the strong assumption that all banks leverage can be decomposed between a single common shock and an idiosyncratic shock, and abstracting from other control variables:

$$Y_t = \alpha + \beta_2 P_{t-1} L_t + \varepsilon_t \tag{31}$$

We observe individual banks' leverage. We thus denote by $l_{j,t}$ leverage from bank j:

$$l_{j,t} = \eta_t + u_{j,t}$$

where η_t is a shock common to all banks, and $u_{j,t}$ is an idiosyncratic, bank-specific, shock. By assumption, let $u_{j,t}$ be orthogonal to η_t and ε_t. Global banks' leverage is given by the weighted average of banks' leverage from individual reporting bank, where weights are given by the asset share of bank j in aggregate assets (s_j) :

$$L_t = \sum_j l_{j,t} \times s_j$$

Importantly, we can not recover β_2 directly from estimating equation (31) with OLS, as ε_t and η_t are likely correlated, biasing the estimate of β_2. In my baseline analysis, I have included measures of the business and financial cycles (and their interactions with the net position vis a vis global banks) as control variables to limit this bias. Another option is to find an instrument for L_t. Such instrument, which I label z_t, can be constructed from observable data on the j banks. To that end, following Gabaix and Koijen (2020), I exploit the heterogeneity in shares s_j documented in my stylized facts and use the difference between the share-weighted leverage and the unweighted leverage, with the latter defined as $\bar{L}_t = \sum_j l_{j,t} \frac{1}{N}$. The granular instrumental variable is:

$$\begin{aligned} z_t = L_t - \bar{L}_t &= \sum_j \left(s_j l_{j,t} - \frac{1}{N} l_{j,t} \right) \\ &= \sum_j \left(\left(\eta_t + u_{j,t}\right) s_j - \left(\eta_t + u_{j,t}\right) \frac{1}{N} \right) \\ &= \sum_j \left(u_{j,t} \left(s_j - \frac{1}{N} \right) \right) \\ &= \tilde{u}_t - \bar{u}_t \end{aligned}$$

where, $\tilde{u}_t$ and $\bar{u}_t$ are the share-weighted and equally-weighted sums of idiosyncratic shocks, respectively. The difference between share-weighted and equally-weighted claims boils down to the difference between the sums of size-weighted and unweighted idiosyncratic shocks.

The intuition why z_t can be a good instrument is simple. First, the difference between L_t and $\bar{L}_t$ removes the common shock η_t and thus the possibility of endogeneity. This renders z_t exogenous as, by assumption, idiosyncratic shocks are uncorrelated with aggregate shocks (e.g. $E\left(u_{j,t}\varepsilon_t\right) = E\left(u_{j,t}\eta_t\right) = 0$). That is, idiosyncratic shocks "shift" leverage but are not correlated with shocks to the endogenous variable Y_t. Second, for z_t to be relevant, $L_{j,t}$ has to be "granular": idiosyncratic shocks to large players give a valid IV for global banks' leverage. That is, there has to be heterogeneity in the share/size distribution: if there were no difference between share-weighted and equally weighted errors, z_t would be close to zero and would be a poor instrument. The heterogeneity in the size distribution allows the difference in share-weighted and equally-weighted shocks to correlate with global banks' leverage (e.g. $E\left(z_t\tilde{y}_t\right) \neq 0$).

5.4.2 Procedure and Results

In my estimation procedure, I construct the granular instrumental variable by regressing the change in individual banks' leverage on a bank-fixed effect and the first two factors in leverage:

$$\Delta L_{jt} = \alpha_j + \Lambda F_t + \epsilon_{jt}$$

The two factors explain about 23% of the variance. The decision to use two factors is guided by economic theory (see, among others, Cesa-Bianchi et al. 2018b) and is confirmed by the Bai and Ng (2002) test statistics[14]. This specification allows for different loadings on the factors. The granular instrumental variable is constructed as the difference between the share-weighted and the equally-weighted idiosyncratic shocks to banks' leverage, which is by construction equal to zero:

$$z_t = \sum_j s_j \epsilon_{jt} - \underbrace{\frac{1}{N}\epsilon_{jt}}_{=0}$$

Finally, the leverage factor is recovered by taking the cumulative sum of the granular instrumental variable:

$$Z_T = \sum_{t=0}^{T} z_t$$

Table A3 shows that the obtained measure of the leverage factor is highly correlated with global banks' leverage. Yet, this measure from the GIV procedure is not correlated with world real GDP growth and the VIX, which are proxies for the business and financial cycles. I perform the same regressions as in the baseline analysis, using the variable Z_T as my measure of global banks' leverage (Table A3).

Results. This analysis confirms my previous results. The main results are reported in Table 6. The coefficient on column 1 is positive and significant for the current account, meaning that when the leverage of global banks is high, the current account balance improves in countries which are net creditor against global banks, while it deteriorates in countries which are net debtor against global banks. The main result is confirmed by the positive and significant coefficient in the regression in column 2 for net outflows, which is used as a proxy for the current account. Quantitatively, an increase by one-standard deviation of the leverage of global banks leads to an instantaneous quarterly drop in the current account balance by 0.7% GDP in Portugal, while it leads to an increase in the current account balance by 0.2% GDP in Israel, and has no effect on the current account in Germany which has a balanced position vis a vis global banks. The results are robust to including additional control variables (Table 7), removing the lagged dependent variable, using banks' positions against global banks, and removing the main advanced economies from the sample[15].

[14]Using a different setting, Davis et al. (2019) finds that two factors account for 40% of the variance in net capital flows.

[15]Results reported in Appendix.

Table 6 Impact on the Current Account, Investment, and Savings
Granular Instrumental Variable

$$Y_{i,t} = c_i + \beta_0 t + \beta_1 L_t + \beta_2 L_t * P_{i,t-1} + \beta_3 P_{i,t-1} + \alpha_1 \mathbb{X}_t + \beta_4 Y_{i,t-1} + \epsilon_{i,t}$$

	Dependent Variable			
	Current Account (1)	Net Outflows (2)	Investment (3)	Savings (4)
Global Banks Leverage	1.014**	1.939***	-1.185***	0.103
# Net Assets on Global Banks	[0.388]	[0.546]	[0.413]	[0.624]
Global Banks Leverage	-0.025	-0.041	0.174	0.232***
	[0.075]	[0.093]	[0.119]	[0.085]
Net Assets on Global Banks	0.635	0.477	2.543	4.180
	[1.958]	[3.482]	[2.156]	[2.740]
World Real GDP Growth	0.161	-0.013	-0.124	0.034
	[0.220]	[0.285]	[0.520]	[0.323]
VIX	0.012	-0.020	-0.009	0.001
	[0.012]	[0.017]	[0.025]	[0.020]
Real GDP Growth	-0.113*	-0.170	0.325***	0.271***
	[0.056]	[0.114]	[0.076]	[0.084]
Lagged Dependent Variable	0.381***	0.123**	0.233***	0.115*
	[0.049]	[0.046]	[0.081]	[0.057]
Constant	-0.138	0.684	17.709***	20.504***
	[0.410]	[0.719]	[1.818]	[1.402]
Country FE	Yes	Yes	Yes	Yes
Country-specific Time Trend	Yes	Yes	Yes	Yes
Observations	2,396	2,394	2,252	2,241
R-squared	0.778	0.527	0.659	0.791
R-squared (within)	0.198	0.063	0.126	0.050

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note. All regressions are estimated via OLS, include country fixed effects and country-specific linear time trends, and double-clustured standard errors by country and time.

Table 7 IMPACT ON THE CURRENT ACCOUNT, INVESTMENT, AND SAVINGS
ROBUSTNESS - GRANULAR INSTRUMENTAL VARIABLE

$$Y_{i,t} = c_i + \beta_0 t + \beta_1 L_t + \beta_2 L_t * P_{i,t-1} + \beta_3 P_{i,t-1} + \alpha_1 \mathbb{X}_t + \beta_4 Y_{i,t-1} + \epsilon_{i,t}$$

	Dependent Variable			
	Current Account (1)	Net Outflows (2)	Investment (3)	Savings (4)
Global Banks Leverage	1.435***	2.445***	-1.690***	0.202
# Net Assets on Global Banks	[0.380]	[0.523]	[0.475]	[0.719]
Global Banks Leverage	-0.271**	-0.311*	0.309*	-0.076
# Emerging Market	[0.113]	[0.154]	[0.158]	[0.181]
VIX	-0.007	0.059	0.002	0.000
# Net Assets on Global Banks	[0.073]	[0.110]	[0.047]	[0.077]
World Real GDP Growth	0.573	1.452	-0.928***	-0.010
# Net Assets on Global Banks	[1.134]	[1.477]	[0.241]	[1.106]
Global Banks Leverage	0.187**	0.206*	-0.067	0.289
	[0.084]	[0.119]	[0.104]	[0.179]
Net Assets on Global Banks	-0.359	-2.789	4.116*	3.963
	[2.755]	[3.599]	[2.346]	[4.227]
World Real GDP Growth	0.248	0.206	-0.271	0.026
	[0.373]	[0.387]	[0.542]	[0.298]
VIX	0.011	-0.011	-0.009	0.001
	[0.016]	[0.020]	[0.025]	[0.022]
Real GDP Growth	-0.104*	-0.161	0.314***	0.274***
	[0.059]	[0.116]	[0.078]	[0.085]
Lagged Dependent Variable	0.374***	0.120**	0.227***	0.115*
	[0.046]	[0.045]	[0.080]	[0.057]
Constant	-0.279	0.222	18.061***	20.490***
	[0.544]	[0.694]	[1.849]	[1.405]
Country FE	Yes	Yes	Yes	Yes
Country-specific Time Trend	Yes	Yes	Yes	Yes
Observations	2,396	2,394	2,252	2,241
R-squared	0.779	0.528	0.662	0.791
R-squared (within)	0.203	0.066	0.132	0.050

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

NOTE. All regressions are estimated via OLS, include country fixed effects and country-specific linear time trends, and double-clustured standard errors by country and time.

6 Global Banks' Leverage and Global Imbalances

In this section, I test the implications of my model for global imbalances. I first provide cross-sectional empirical evidence by examining separately the period before and after the global financial crisis. Then, I quantify the global imbalances predicted by my model.

6.1 Cross-sectional Evidence

As seen in Figure A3, the leverage of global banks increased sharply in the run up to the global financial crisis, and then decreased after the crisis. The model predicts that global banks' leverage magnifies imbalances. Thus, countries which were net debtor against global banks in the mid 2000s should have experienced a deterioration in net debtor position until the global financial crisis. On the opposite, countries which were net creditor against global banks in mid 2000s should have experienced an improvement in net creditor position until the global financial crisis. As the leverage of global banks decreased after the global financial crisis, the model predicts that countries which were net debtor against global banks in 2007 and 2008 should have experienced an improvement in net debtor position after the global financial crisis. The opposite applies for creditor countries.

To test those predictions, I run the following regressions:

$$P_{i,0708} - P_{i,0405} = \alpha_0 + \beta^B P_{i,0405} + \epsilon_i \tag{32}$$

$$P_{i,1415} - P_{i,0708} = \alpha_1 + \beta^A P_{i,0708} + \epsilon_i \tag{33}$$

where $P_{i,t}$ is the average net external asset positions of country i on global banks during years t. I run the regression for both total net external asset positions and banking net external asset positions on global banks.

Results. The results are reported in Table 8. As expected, the coefficient β^B is positive and significant. Countries which were net debtor against global banks in the mid 2000s have experienced a deterioration in net debtor position until the global financial crisis. The coefficient β^A is positive and significant. Countries which were net debtor against global banks in 2007 and 2008 have experienced an improvement in net debtor position after the global financial crisis. Figure 9 provides a visual representation of this results. The results are robust to using the net position of the banking counter-party sector vis a vis global banks (columns (3) and (4)).

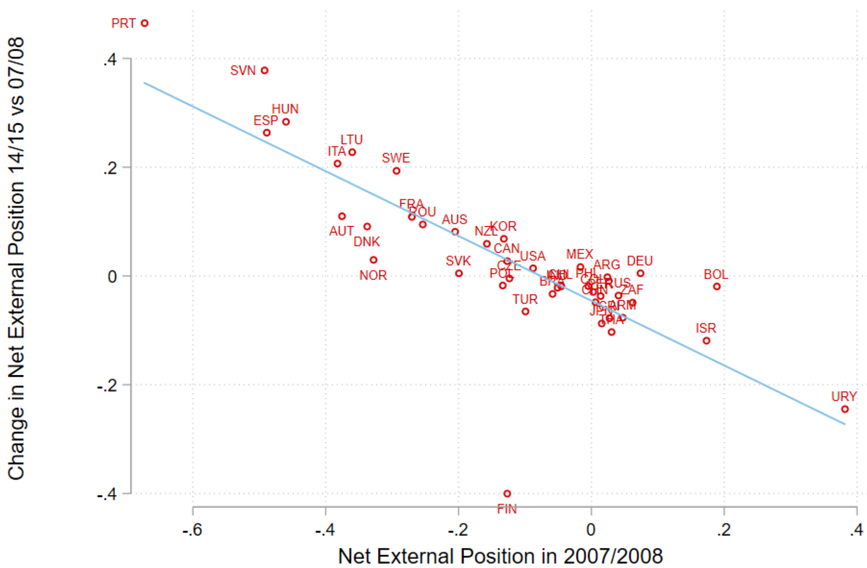
Table 8 Change in Net Position on Global Banks versus Initial Net Position on Global Banks: Pre-GFC and Post-GFC

	Dependent Variable: Change in Net Assets on Global Banks			
	Total pre-GFC	Total post-GFC	Banks pre-GFC	Banks post-GFC
Net Assets on Global Banks	(1)	(2)	(3)	(4)
Total 2004-2005	0.179**			
	[0.076]			
Total 2007-2008		-0.595***		
		[0.066]		
Banks 2004-2005			0.269***	
			[0.088]	
Banks 2007-2008				-0.667***
				[0.075]
Constant	-0.031**	-0.045***	-0.028***	-0.027**
	[0.014]	[0.016]	[0.009]	[0.011]
Observations	41	41	41	41
R-squared	0.124	0.673	0.194	0.669

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note. This table shows the output of a cross-country regression of the change in net total assets on global banks versus the initial net total assets on global banks. The table shows the results for all counter-party resident sectors in columns (1)-(2), and for the banking counter-party resident sector in columns (3)-(4).

Figure 9 Change in Net External Position vis a vis Global Banks



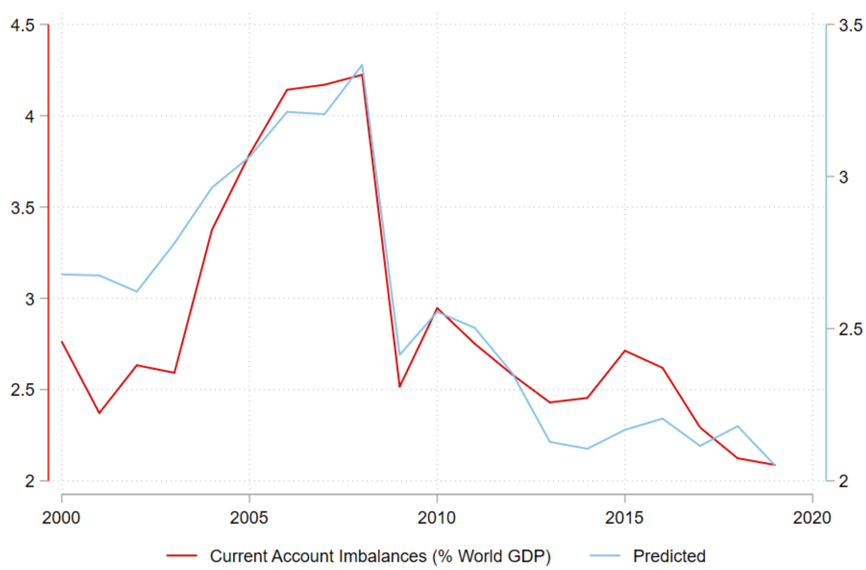
Note. This chart shows a scatter plot of the change in a country's net external asset position vis a vis global banks between 2014/2015 and 2007/2008 against its net external asset position vis a vis global banks in 2007/2008. Source: BIS LBS.

6.2 Global Current Account Imbalances

Lastly, I quantify the global imbalances predicted by the model. I obtain the predicted values for current account balances from the regression estimated in Table 4. Then, predicted global imbalances are computed as the quarterly sum of the absolute value of predicted current account balances across countries, normalized by world nominal GDP.

As shown in Figure 10, the mechanism described in my model can rationalize the increase in global imbalances which preceded the global financial crisis, as well as the reversal in global imbalances which followed the crisis. The model does not rationalize the magnitude of global imbalances as they are driven by other factors not taken into account in my analysis (e.g. commodity prices and reserve accumulation). Despite this gap, the model is able to reproduce the pattern of imbalances around the global financial crisis as well as their subsequent reduction in recent years.

Figure 10 Global Imbalances - Actual versus Predicted



Note. This chart shows the actual and predicted values of global imbalances. Actual global imbalances are computed as the quarterly sum of the absolute value of current account balances across countries, normalized by world nominal GDP. Predicted global imbalances are computed as the quarterly sum of the absolute value of predicted current account balances obtained from the regression estimated in Table 4 across countries, normalized by world nominal GDP. Source: IMF BOP, author's calculations.

This confirms that fluctuations in the leverage of global banks not only have implications for gross flows, as highlighted by the global financial cycle literature, but also for net flows and global imbalances.

7 Conclusion

This paper develops a tractable multi-country model of the international banking system in which leveraged-constrained global banks interact with heterogeneous local banks. In the model, consistent with the data, when the leverage of global banks goes up, countries experience higher gross capital inflows and outflows, and global imbalances increase. A key feature of the model is the presence of both within and across country heterogeneity. Within-country heterogeneity in local projects' returns lead to both gross banking inflows and outflows as global banks channel funds across countries from banks associated with the least productive projects to the ones associated with the most productive projects. Cross-country heterogeneity in the country-specific return lead to net external banking positions at the country level, where the high-return, capital-scarce, countries will have net external banking liabilities, and the low-return, capital-abundant, countries will have net external banking assets. Moreover, the distribution of global banks across countries helps explain why some advanced countries have higher external gross assets and liabilities than other countries.

The main prediction of the model is that a country's current account balance is a function of the interaction between its net external position against global banks and global banks' leverage. In particular, countries with higher net external liabilities to global banks tend to experience a larger drop in their current account balance following a deleveraging by global banks. These predictions are borne out in a large panel study of advanced and emerging market countries, and are robust to numerous checks. In order to deal with potential endogeneity issues, I also provide additional causal empirical evidence using a granular instrumental variable a la Gabaix and Koijen (2020), and by comparing the periods before and after the global financial crisis.

The model presented in this paper could be extended to include a tradable sector and a non-tradable sector in order to introduce the exchange rate. Another potential extension would be to render the leverage of global banks endogenous and analyze its underlying determinants such as monetary policy or risk-aversion shocks (Akinci et al. 2022, Coimbra and Rey 2017). Finally, it would be interesting to study the normative implications of the model, and in particular the need for macro-prudential policies.

Indeed, to the extent that imbalances reflect systemic distortions, the policy response should be to reduce these distortions at the systemic level. Yet, in the model, global imbalances arise due to investment behavior: A country with attractive investment opportunities may well want to finance part of its investment through foreign saving, and thus run a current account deficit. In this case, it may be unwise to want to reduce imbalances as they simply reflect the optimal allocation of capital across time and space. However, as pointed out in Blanchard and Milesi-Ferretti (2009), even if the factors behind current account balances are "good", they may interact with other distortions to create inefficient outcomes or increase risks. For example, large current account deficits and real exchange rate appreciations resulting from credit booms fueled by "over-optimism" can be difficult to unwind without a protracted real depreciation, which can be very painful when the exchange rate is fixed and partner-country inflation is low. I leave a more detailed policy analysis based on this framework for future research.

A Appendix - Data, Figures and Tables

A.1 Variables - Definitions and Sources

The data set includes the period 2000:Q1-2019:Q4 (subject to availability) for the following variables:

U.S. Broker-Dealers leverage. U.S. Broker-Dealers leverage computed as the ratio of assets to equity of the U.S. broker-dealer sector and obtained from the Federal Reserve's Flow of Funds.

VIX. CBOE Volatility Index (VIX Index).

World GDP growth rate. Source: OECD, IMF, IFS,Bloomberg.

Nominal and Real GDP. Source: IMF IFS, Global Financial Database.

Consumer prices. Consumer price index. Source: IMF IFS, Global Financial Database.

Net Assets on Global Banks. Computed as liabilities (all instruments, in all currencies) of all BIS reporting banks vis-a-vis all counter-party sectors located in the country minus claims (all instruments, in all currencies) of all BIS reporting banks vis-a-vis all counter-party sectors located in the country. The net external position vis-a-vis global banks is normalized by the counter-party country's GDP. Source: BIS.

Banks Net Assets on Global Banks. Computed as liabilities (all instruments, in all currencies) of all BIS reporting banks vis-a-vis the banking counter-party sector located in the country minus claims (all instruments, in all currencies) of all BIS reporting banks vis-a-vis the banking counter-party sector located in the country. The net external position vis-a-vis global banks is normalized by the counter-party country's GDP. Source: BIS.

Net flows. Computed as the difference between total gross outflows and total gross inflows as a share of GDP. Total gross inflows are computed as the sum of FDI gross inflows, portfolio gross inflows, and other investment gross inflows. Total gross outflows are computed as the sum of FDI gross outflows, portfolio gross outflows, other investment gross outflows, and reserves outflows. Source: IMF BOP database.

Current account to GDP ratio. Current account balance as a share of nominal GDP. Source: IMF IFS, IMF BOP.

Investment. Gross fixed capital formation as a share of GDP. Source: IMF IFS.

Savings. Computed as the difference between the sum of the current account to GDP ratio and investment to GDP ratio.

Total net external assets. Total external assets minus total external liabilities, normalized by GDP. I decompose total net assets by type: FDI, portfolio, and other investment (banking). Source: Lane and Milesi-Ferretti (2001) updated database.

Banks' Leverage. I use balance sheet data from Compustat - Capital IQ and Bloomberg to compute quarterly leverage at the individual bank level. Leverage is defined as the ratio of assets over book equity, defined as common equity[16]. I linearly interpolate the value for assets and equity if the value is missing for a given quarter. I drop banks with negative equity from the dataset, and banks with assets worth less than 1 million USD on average over 2000Q1-2019Q4 or with less than 60 quarterly observations. I also remove institutions that have leverage higher than 100 at least once across the sample. The final sample contains 298 financial intermediaries.

A.2 Figures and Tables

Table A1 Summary Statistics

Variable	Count	Mean	Std. Dev.
Global Banks' Median Leverage	3,680	20.19	2.94
Global Banks' Asset Weighted Leverage	3,680	21.55	4.61
Leverage Factor (GIV)	3,128	1.04	1.62
Leverage U.S. Broker Dealer	3,680	28.12	9.18
Net Assets on Global Banks (%GDP) - Total	3,680	-0.10	0.16
Net Assets on Global Banks (%GDP) - Banks	3,680	-0.04	0.11
Current Account (%GDP)	3,640	-0.85	5.98
Net Outflows (%GDP)	3,638	-0.84	6.43
Investment (%GDP)	3,059	23.10	5.16
Savings (%GDP)	3,039	22.36	6.60
World Real GDP Growth	3,634	0.67	0.50
VIX	3,680	19.49	7.81
Global Financial Factor	3,128	0.14	1.64
International Business Cycle factor	3,128	2.10	2.09
Real GDP Growth	3,128	0.68	1.19

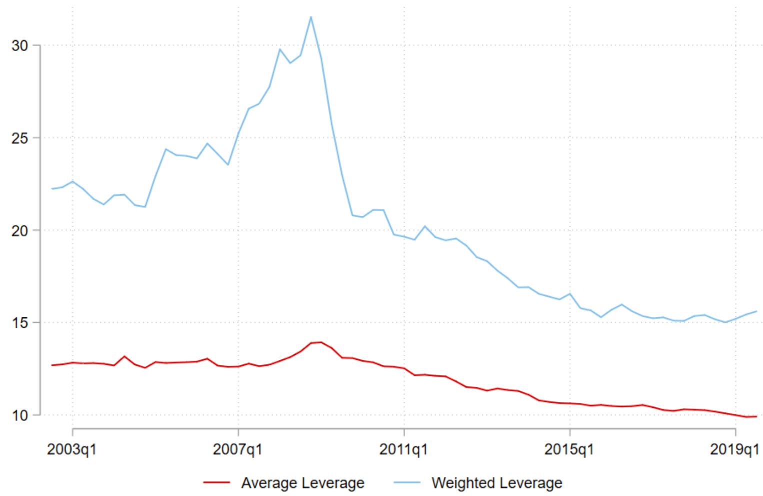
[16]The Compustat - Capital IQ Bank Fundamentals Quarterly database provides granular regulatory financial data for 16,000+ operating and 29,000+ global historical holding companies, banks, and credit unions. I complement this database with data collected from Bloomberg in order to include the main investment banks characterized as G-SIBs by the BIS but not included in the Compustat - Capital IQ Bank Fundamentals Quarterly database. This includes Citigroup, Goldman Sachs, Morgan Stanley, Credit Suisse, UBS, Unicredit, Nordea, Nomura, Intesa Sanpaolo, Commerzbank, and Mitsubishi FG.

Table A2 NET DEBTORS AND NET CREDITORS VIS A VIS GLOBAL BANKS

Country Name	ISO	WEO	Group	Average Net Position (%GDP)	Prob.
Portugal	PRT	182	AE	-43	0%
Austria	AUT	122	AE	-28	0%
Spain	ESP	184	AE	-28	0%
Norway	NOR	142	AE	-28	0%
Finland	FIN	172	AE	-27	13%
Hungary	HUN	944	EMDE	-27	6%
Italy	ITA	136	AE	-26	0%
Denmark	DNK	128	AE	-25	6%
Slovenia, Rep. of	SVN	961	EMDE	-24	40%
Sweden	SWE	144	AE	-21	4%
France	FRA	132	AE	-19	0%
Lithuania	LTU	946	EMDE	-17	31%
New Zealand	NZL	196	AE	-17	4%
Slovak Rep.	SVK	936	EMDE	-16	15%
Australia	AUS	193	AE	-15	0%
Romania	ROU	968	EMDE	-15	40%
Turkey	TUR	186	EMDE	-12	28%
Poland, Rep. of	POL	964	EMDE	-12	34%
Czech Rep.	CZE	935	EMDE	-12	26%
Canada	CAN	156	AE	-1	23%
Korea, Rep. of	KOR	542	EMDE	-8	66%
Brazil	BRA	223	EMDE	-7	70%
Chile	CHL	228	EMDE	-7	74%
United States	USA	111	AE	-6	93%
Japan	JPN	158	AE	-5	78%
Thailand	THA	578	EMDE	-4	93%
India	IND	534	EMDE	-4	88%
Philippines	PHL	566	EMDE	-4	95%
Costa Rica	CRI	238	EMDE	-3	100%
Colombia	COL	233	EMDE	-1	100%
Mexico	MEX	273	EMDE	-1	100%
Peru	PER	293	EMDE	-0	100%
China, P.R.: Mainland	CHN	924	EMDE	-0	100%
Germany	DEU	134	AE	0	85%
Argentina	ARG	213	EMDE	1	98%
Russian Federation	RUS	922	EMDE	1	99%
Georgia	GEO	915	EMDE	2	98%
Armenia, Rep. of	ARM	911	EMDE	2	89%
South Africa	ZAF	199	EMDE	8	100%
Israel	ISR	436	EMDE	10	100%
Bolivia	BOL	218	EMDE	11	100%
Uruguay	URY	298	EMDE	25	100%

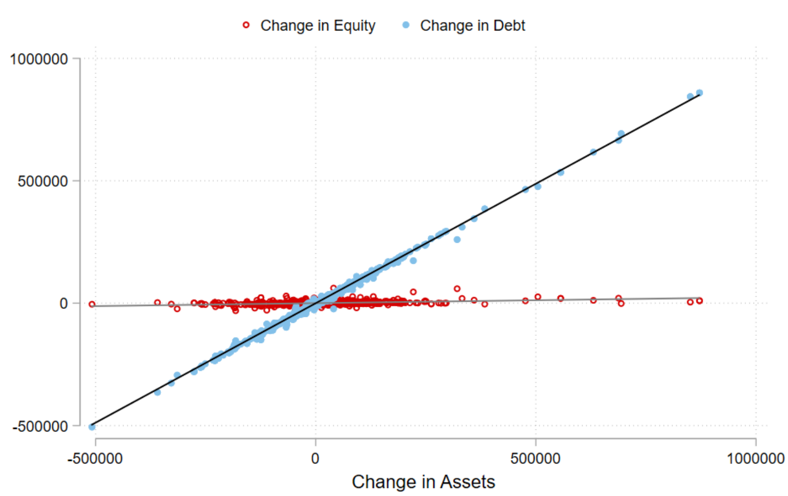
NOTE. Average Net Position measures the average net position vis a vis global banks over the period 2000Q1-2019Q4 as a share of GDP. The cross-country average of this measure is equal to -9% GDP. Prob measures the probability that the net position vis a vis global banks is above this unconditional average of -9% GDP over the sample period. The upper sample shows the net debtor countries, defined as countries with an average net position below the unconditional average and a Prob lower than 50%. The lower sample shows the net creditor countries, defined as countries with an average net position above the unconditional average and a Prob higher than 50%.

Figure A1 Banks' Leverage - Average



Note. This chart shows the time series of unweighted and weighted averages of leverage across all 298 banks in the sample. Leverage is computed as assets over common equity. Source: Capital IQ and Bloomberg.

Figure A2 Change in Assets - Decomposition



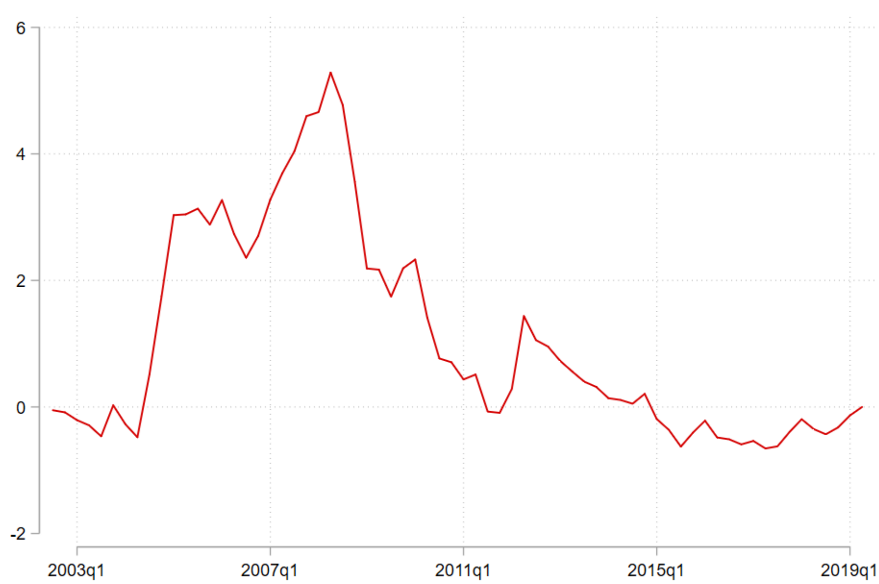
Note. This chart, which extends the analysis in Adrian and Shin (2013), shows a scatter plot of change in banks' equity and banks' debt against change in banks' assets for my large panel of banks. The chart shows that balance sheet expansions and contractions tend to be done through changes in debt and not through movements in equity.

Table A3 Pairwise Correlations

Variables	(1)	(2)	(3)	(4)
(1) Global Banks' Leverage	1.000			
(2) GIV	0.829	1.000		
	(0.000)			
(3) VIX	0.512	0.196	1.000	
	(0.000)	(0.109)		
(4) World RGDP Growth	-0.298	-0.133	-0.678	1.000
	(0.013)	(0.281)	(0.000)	

Note. This table shows the correlation between quarterly value of the asset weighted global banks' leverage, the Leverage factor Z_t obtained from the GIV procedure, the VIX, and the world real GDP growth for the entire sample period. Significance levels are in parentheses.

Figure A3 Global Banks' Leverage Factor



Note. This charts shows the leverage factor Z_t obtained from the GIV procedure described in the main text.

Table A4 Robustness Checks (I)

Counter-party: All				Dependent Variable			
Leverage	Lag	Sample	Add. Controls	Current Account	Net Outflows	Investment	Savings
Median	Yes	Entire	No	0.757***	1.463***	-0.820***	0.086
				[0.248]	[0.390]	[0.293]	[0.357]
Median	No	Entire	No	1.261***	1.707***	-1.139***	0.086
				[0.432]	[0.480]	[0.398]	[0.416]
Median	Yes	Pre	No	1.581***	2.074***	-1.510***	0.101
				[0.435]	[0.659]	[0.469]	[0.534]
Median	No	Pre	No	1.683***	2.084***	-1.563***	0.073
				[0.419]	[0.664]	[0.438]	[0.518]
Median	Yes	Post	No	3.281***	5.778***	-3.014**	1.470
				[1.104]	[1.338]	[1.137]	[1.016]
Median	No	Post	No	4.126***	5.688***	-2.877***	1.390
				[1.242]	[1.299]	[1.046]	[1.013]
Median	Yes	Entire	Yes	1.051***	1.924***	-1.330***	0.002
				[0.295]	[0.415]	[0.397]	[0.463]
Median	No	Entire	Yes	1.774***	2.241***	-1.794***	0.010
				[0.498]	[0.514]	[0.502]	[0.536]
GIV	Yes	Entire	No	1.014**	1.939***	-1.185***	0.103
				[0.388]	[0.546]	[0.413]	[0.624]
GIV	No	Entire	No	1.608**	2.200***	-1.533***	0.085
				[0.598]	[0.638]	[0.555]	[0.688]
GIV	Yes	Entire	Yes	1.435***	2.445***	-1.690***	0.202
				[0.380]	[0.523]	[0.475]	[0.719]
GIV	No	Entire	Yes	2.253***	2.757***	-2.133***	0.225
				[0.589]	[0.615]	[0.621]	[0.785]

Note. This table shows the β_2 coefficient from regressions using the total net position against global banks. Leverage is either the median or the GIV measure. Lag denotes the inclusion or not of the lagged endogenous variable as regressor. Sample is either the entire sample, or the sub-period before 2008 (Pre) or the sub-period after 2010 (Post). Add. Controls denotes the inclusion of additional controls as specified in the main text.

Table A5 Robustness Checks (II)

Counter-party: Banks				Dependent Variable			
Leverage	Lag	Sample	Add. Controls	Current Account	Net Outflows	Investment	Savings
Median	Yes	Entire	No	0.865**	1.738***	-1.085**	-0.026
				[0.392]	[0.599]	[0.412]	[0.545]
Median	No	Entire	No	1.489**	2.041***	-1.491**	-0.033
				[0.689]	[0.742]	[0.567]	[0.636]
Median	Yes	Pre	No	1.715**	2.601**	-2.088***	-0.300
				[0.706]	[1.137]	[0.589]	[0.675]
Median	No	Pre	No	1.831**	2.638**	-2.171***	-0.328
				[0.669]	[1.141]	[0.556]	[0.663]
Median	Yes	Post	No	3.903***	6.846***	-3.592**	1.811
				[1.413]	[1.897]	[1.485]	[1.247]
Median	No	Post	No	4.985***	6.767***	-3.431**	1.709
				[1.676]	[1.871]	[1.378]	[1.245]
Median	Yes	Entire	Yes	1.272**	2.385***	-1.839***	-0.169
				[0.482]	[0.673]	[0.602]	[0.682]
Median	No	Entire	Yes	2.227**	2.806***	-2.460***	-0.160
				[0.820]	[0.836]	[0.772]	[0.789]
GIV	Yes	Entire	No	1.266**	2.366***	-1.547**	0.113
				[0.616]	[0.852]	[0.575]	[0.983]
GIV	No	Entire	No	2.051**	2.721***	-1.994**	0.101
				[0.968]	[0.986]	[0.784]	[1.090]
GIV	Yes	Entire	Yes	1.848***	3.045***	-2.259***	0.271
				[0.595]	[0.827]	[0.686]	[1.095]
GIV	No	Entire	Yes	2.976***	3.484***	-2.843***	0.330
				[0.942]	[0.970]	[0.907]	[1.194]

Note. This table shows the β_2 coefficient from regressions using the banking net position against global banks. Leverage is either the median or the GIV measure. Lag denotes the inclusion or not of the lagged endogenous variable as regressor. Sample is either the entire sample, or the sub-period before 2008 (Pre) or the sub-period after 2010 (Post). Add. Controls denotes the inclusion of additional controls as specified in the main text.

B Appendix - Derivations

B.1 Proofs

Proof. (Remark 1) All representative households face the same optimization problem. Thus, their supply schedule of deposits is the same across countries. Moreover, all local banks face the same optimization problem, and the same expected rate of return R on their project, at the beginning of period 1, before uncertainty is revealed. Thus, their demand schedule for deposits is the same, both across and within countries. As a result, the deposit rate is equalized across countries. In a symmetric equilibrium, all local banks collect the same quantity of deposits. ■

Proof. (Lemma 3.1) We start from the equilibrium condition given by equation (15):

$$E_G + N\left(E_L + d\right)G(R_M^l) = N\left(\bar{k} - E_L - d\right)\left(1 - G(R_M^d)\right) \tag{B.1}$$

If the leverage constraint of global banks is binding, then we have:

$$N\left(E_L + d\right)G(R_M^l) = \lambda \tag{B.2}$$

Solving for R_M^l yields:

$$R_M^l = G^{-1}\left(\frac{\lambda}{N\left(E_L + d\right)}\right) \tag{B.3}$$

Using equations (B.1) and (B.2), we obtain:

$$E_G + \lambda = N\left(\bar{k} - E_L - d\right)\left(1 - G(R_M^d)\right) \tag{B.4}$$

Solving for R_M^d yields:

$$R_M^d = G^{-1}\left(1 - \frac{\lambda + E_G}{N\left(\bar{k} - E_L - d\right)}\right) \tag{B.5}$$

Using equations (B.3) and (B.5) we can solve for the leverage threshold λ^* above which the leverage constraint does not bind:

$$\lambda^* = \frac{1 + \frac{E_G}{N\left(\bar{k} - E_L - d\right)}}{\frac{1}{N(E_L + d)} + \frac{1}{N\left(\bar{k} - E_L - d\right)}} \tag{B.6}$$

■

Proof. (Lemma 3.2) We want to show that there exists $\underline{k}$ such that $\forall \bar{k} > \underline{k}$ we have $\frac{d\mathbf{R^e}}{d\lambda} > 0$. In order to do so, we compare $\mathbf{R^e}_1$ to $\mathbf{R^e}_2$, with $\lambda_1 < \lambda_2$. We have:

$$\mathbf{R^e}_1 \equiv R^l_{M,1}G(R^l_{M,1}) + \mathbb{E}\left[R^{i,j}|R^l_{M,1} \leq R^{i,j} \leq R^d_{M,1}\right]\left[G(R^d_{M,1}) - G(R^l_{M,1})\right] + R^d_{M,1}\left[1 - G(R^d_{M,1})\right]$$
$$\mathbf{R^e}_2 \equiv R^l_{M,2}G(R^l_{M,2}) + \mathbb{E}\left[R^{i,j}|R^l_{M,2} \leq R^{i,j} \leq R^d_{M,2}\right]\left[G(R^d_{M,2}) - G(R^l_{M,2})\right] + R^d_{M,2}\left[1 - G(R^d_{M,2})\right]$$

The difference is given by:

$$\Delta\mathbf{R^e} = \underbrace{\left(R^l_{M,2} - R^l_{M,1}\right)}_{>0} G(R^l_{M,1}) + \underbrace{\left(R^l_{M,2} - \mathbb{E}\left[R^{i,j}|R^l_{M,1} \leq R^{i,j} \leq R^l_{M,2}\right]\right)}_{>0}\left[G(R^l_{M,2}) - G(R^l_{M,1})\right]$$
$$+ \underbrace{\left(R^d_{M,2} - \mathbb{E}\left[R^{i,j}|R^d_{M,2} \leq R^{i,j} \leq R^d_{M,1}\right]\right)}_{<0}\left[G(R^d_{M,1}) - G(R^d_{M,2})\right] + \underbrace{\left(R^d_{M,2} - R^d_{M,1}\right)}_{<0}\left[1 - G(R^d_{M,1})\right]$$

where $R^l_{M,t} = G^{-1}\left(\frac{\bar{\lambda}_t}{N(E_L+d)}\right)$ and $R^d_{M,t} = G^{-1}\left(1 - \frac{\lambda_t + E_G}{N\left(\bar{k} - E_L - d\right)}\right)$.

The sign of the difference is ambiguous. Note that:

$$\frac{dG(R^l_M)}{d\lambda} = \frac{1}{N\left(E_L + d\right)} \text{ and } \frac{dG(R^d_M)}{d\lambda} = -\frac{1}{N\left(\bar{k} - E_L - d\right)}.$$

If $\bar{k} \to \infty$ then $G(R^d_M) \to 1$ and $\frac{dG(R^d_M)}{d\lambda} \to 0$. Thus, if $\bar{k} \to \infty$ then:

$$\Delta\mathbf{R^e} \to \underbrace{\left(R^l_{M,2} - R^l_{M,1}\right)}_{>0} G(R^l_{M,1}) + \underbrace{\left(R^l_{M,2} - \mathbb{E}\left[R^{i,j}|R^l_{M,1} \leq R^{i,j} \leq R^l_{M,2}\right]\right)}_{>0}\left[G(R^l_{M,2}) - G(R^l_{M,1})\right] > 0$$

The sign of the difference becomes unambiguously positive. Thus $\exists\ \underline{k}$ such that $\forall \bar{k} > \underline{k}$ we have $\frac{d\mathbf{R^e}}{d\lambda} > 0$. A sufficient condition for the lower bound on $\bar{k}$ is:

$$G(R^l_{M,1}) > 1 - G(R^d_{M,1}) \text{ and } |\frac{dG(R^l_M)}{d\lambda})| > |\frac{dG(R^d_M)}{d\lambda}|.$$

This is equivalent to:

$$\frac{\lambda}{N\left(E_L + d\right)} > \frac{\lambda + E_G}{N\left(\bar{k} - E_L - d\right)} \text{ and } \frac{1}{N\left(E_L + d\right)} > \frac{1}{N\left(\bar{k} - E_L - d\right)} \text{ or :}$$

$$\bar{k} > \frac{2\bar{\lambda} + E_G}{\lambda}\left(E_L + d\right) \text{ and } \bar{k} > 2\left(E_L + d\right).$$

The second condition is redundant given that $E_G \geq 0$. We can note that d is bounded above by $W - \frac{1}{\beta(\overline{R}+\sigma)}$. Thus we obtain:

$$\bar{k} > \frac{2\bar{\lambda} + E_G}{\lambda}\left(E_L + W - \frac{1}{\beta(\overline{R}+\sigma)}\right) \equiv \underline{k} \tag{B.7}$$

■

Proof. (Proposition 1) See section B.2.2. ■

Proof. (Proposition 2) As shown in Proposition 1 the impact on net flows is heterogeneous across countries. As shown in Lemma 3.2, if $\bar{k} > \underline{k}$ then an increase in global banks' leverage λ leads to an increase in the deposit rate to households R^i_H. This increase in the deposit rate leads to an increase in the equilibrium deposits for all local banks, and in all countries, using Remark 1. Thus, the impact on savings is the same across countries. As a result, the heterogeneity across countries comes from investment. ■

B.2 Country Aggregates

B.2.1 Special case

The outflows of country i are given by:

$$O^i = \left(1 - s^i\right)\int_j l^{i,j}_M + s^i\left[\sum_{i=1}^{N}\int_j \left(k - E_L - d^{i,j}\right)\mathbb{I}(R^{i,j} > R^d_M) - \int_j \left(k - E_L - d^{i,j}\right)\mathbb{I}(R^{i,j} > R^d_M)\right] \tag{B.8}$$

$$= \left(1 - s^i\right)(E_L + d)G(R^l_M) + s^i\left[(N-1)\left(k - E_L - d\right)\left(1 - G(R^d_M)\right)\right] \tag{B.9}$$

$$= \left(1 - s^i\right)\frac{\lambda}{N} + s^i\left(\frac{N-1}{N}\right)\left(E_G + \lambda\right) \tag{B.10}$$

Using equations (B.2) and (B.4) to move from the second to third line.

The inflows of country i are given by:

$$I^i = \left(1 - s^i\right)\int_j d^{i,j}_M + s^i\left[\sum_{i=1}^{N}\int_j \left(E_L + d^{i,j}\right)\mathbb{I}(R^{i,j} < R^l_M) - \int_j \left(E_L + d^{i,j}\right)\mathbb{I}(R^{i,j} < R^l_M)\right] \tag{B.11}$$

$$= \left(1 - s^i\right)(k - E_L - d)\left(1 - G(R^d_M)\right) + s^i\left[(N-1)\left(E_L + d\right)G(R^l_M)\right] \tag{B.12}$$

$$= \left(1 - s^i\right)\frac{E_G + \lambda}{N} + s^i\left(\frac{N-1}{N}\right)\lambda \tag{B.13}$$

The derivatives of gross flows with respect to the leverage of global banks and the share of global banks are:

$$\frac{dO^i}{d\lambda} = \frac{dI^i}{d\lambda} = \frac{1}{N} + \left(\frac{N-2}{N}\right) s^i > 0 \tag{B.14}$$

$$\frac{dO^i}{ds^i} = \left(\frac{N-1}{N}\right) E_G + \left(\frac{N-2}{N}\right) \lambda > 0 \tag{B.15}$$

$$\frac{dI^i}{ds^i} = \left(\frac{-1}{N}\right) E_G + \left(\frac{N-2}{N}\right) \lambda > 0 \tag{B.16}$$

B.2.2 General case

The outflows of country i are given by:

$$O^i = \left(1 - s^i\right) \int_j l_M^{i,j} + s^i \left[\sum_{i=1}^{N} \int_j \left(k - E_L - d^{i,j}\right) \mathbb{I}(R^{i,j} > R_M^d) - \int_j \left(k - E_L - d^{i,j}\right) \mathbb{I}(R^{i,j} > R_M^d)\right] \tag{B.17}$$

$$= \left(1 - s^i\right) (E_L + d) F_i(R_M^l) + s^i \left[N \left(k - E_L - d\right) \left(1 - G(R_M^d)\right) - \left(k - E_L - d\right) \left(1 - F_i(R_M^d)\right)\right] \tag{B.18}$$

$$= \left(1 - s^i\right) \frac{\lambda}{N} \frac{F_i(R_M^l)}{G(R_M^l)} + s^i \left[(E_G + \lambda) - \frac{(E_G + \lambda)\left(1 - F_i(R_M^d)\right)}{N\left(1 - G(R_M^d)\right)}\right] \tag{B.19}$$

$$= \left(1 - s^i\right) \frac{\lambda}{N} \frac{F_i(R_M^l)}{G(R_M^l)} + s^i \left(E_G + \lambda\right) \left[\frac{N\left(1 - G(R_M^d)\right) - \left(1 - F_i(R_M^d)\right)}{N\left(1 - G(R_M^d)\right)}\right] \tag{B.20}$$

Using equations (B.2) and (B.4) to move from the second to third line.

The inflows of country i are given by:

$$I^i = \left(1 - s^i\right) \int_j d_M^{i,j} + s^i \left[\sum_{i=1}^{N} \int_j \left(E_L + d^{i,j}\right) \mathbb{I}(R^{i,j} < R_M^l) - \int_j \left(E_L + d^{i,j}\right) \mathbb{I}(R^{i,j} < R_M^l)\right] \tag{B.21}$$

$$= \left(1 - s^i\right) (k - E_L - d) \left(1 - F_i(R_M^d)\right) + s^i \left[N \left(E_L + d\right) G(R_M^l) - \left(E_L + d\right) F_i(R_M^l)\right] \tag{B.22}$$

$$= \left(1 - s^i\right) \frac{E_G + \lambda}{N} \frac{1 - F_i(R_M^d)}{1 - G(R_M^d)} + s^i \lambda \left[\frac{NG(R_M^l) - F_i(R_M^l)}{NG(R_M^l)}\right] \tag{B.23}$$

The net outflows of country i, are given by:

$$N^i \equiv O^i - I^i = \frac{\lambda}{N}\left[\underbrace{\frac{F_i(R_M^l)}{G(R_M^l)} - \frac{1-F_i(R_M^d)}{1-G(R_M^d)}}_{\equiv \xi^i}\right] + \frac{E_G}{N}\left[s^i N - \frac{1-F_i(R_M^d)}{1-G(R_M^d)}\right]$$

The country-specific variable ξ^i has the same sign as, and is increasing in, the net banking asset position vis-a-vis global banks. Thus, by taking a linear approximation around a zero net banking asset position, we can rewrite net outflows as:

$$N^i \equiv O^i - I^i = \frac{\lambda}{N}\left[c\gamma^i\right] + \frac{E_G}{N}\left[s^i N - \frac{1-F_i(R_M^d)}{1-G(R_M^d)}\right]$$

where γ^i is the net banking asset position vis-a-vis global banks, and c is a constant. The derivatives of gross and net outflows with respect to the leverage of global banks are:

$$\frac{dO^i}{d\lambda} = \left(1-s^i\right)\frac{1}{N}\frac{F_i(R_M^l)}{G(R_M^l)} + s^i\frac{1}{N}\left[N - \frac{\left(1-F_i(R_M^d)\right)}{\left(1-G(R_M^d)\right)}\right] \tag{B.24}$$

$$\frac{dI^i}{d\lambda} = \left(1-s^i\right)\frac{1}{N}\frac{1-F_i(R_M^d)}{1-G(R_M^d)} + s^i\frac{1}{N}\left[N - \frac{F_i(R_M^l)}{G(R_M^l)}\right] \tag{B.25}$$

$$\frac{dN^i}{d\lambda} = \frac{1}{N}\left[\frac{F_i(R_M^l)}{G(R_M^l)} - \frac{1-F_i(R_M^d)}{1-G(R_M^d)}\right] \tag{B.26}$$

C Appendix - Additional Derivations

C.1 Equilibrium in the inter-bank wholesale market

We solve the model backwards. At the end of period 1, after uncertainty is resolved, local banks set $d_M^{i,j}$ and $l_M^{i,j}$ in order to maximize their profits in period 2:

$$\max_{d_M^{i,j}\geq 0, l_M^{i,j}\geq 0} \pi^{i,j} = \left(\underbrace{R^i + \epsilon^j}_{\equiv R^{i,j}}\right) k^{i,j} + R_M^l l_M^{i,j} - R_H^i d^{i,j} - R_M^d d_M^{i,j} \tag{C.1}$$

subject to a balance sheet identity:

$$k^{i,j} + l_M^{i,j} = E_L + d^{i,j} + d_M^{i,j} \tag{C.2}$$

and a technological constraint:

$$k^{i,j} \leq \bar{k} \tag{C.3}$$

The Lagrangian is given by:

$$\mathcal{L}^{i,j} = R^{i,j}\left(E_L + d^{i,j} + d_M^{i,j} - l_M^{i,j}\right) + R_M^l l_M^{i,j} - R_H^i d^{i,j} - R_M^d d_M^{i,j} - \mu_1\left(\bar{k} - (E_L + d^{i,j} + d_M^{i,j} - l_M^{i,j})\right) - \mu_2(d_M^{i,j}) - \mu_3(l_M^{i,j}) \tag{C.4}$$

The FOCs are:

$$\frac{d\mathcal{L}^{i,j}}{dd_M^{i,j}} = 0 \ : \ R^{i,j} - R_M^d = \mu_1 + \mu_2 \tag{C.5}$$

$$\frac{d\mathcal{L}^{i,j}}{dl_M^{i,j}} = 0 \ : R^{i,j} - R_M^l = \mu_1 - \mu_3 \tag{C.6}$$

As discussed below, we focus on the case where the technological constraint of local banks does not bind at the beginning of period 1, i.e. $\mu_1 = 0$, so that local banks have the possibility to borrow from global banks at the end of period 1. The optimization problem of local banks leads to corner solutions. We can distinguish 3 cases regarding the decisions of local banks, depending on the realization of $R^{i,j}$: banks with high returns borrow on the wholesale market and invest until $k^{i,j} = \bar{k}$, banks with intermediate returns are inactive on the wholesale market, and banks with low returns lend all their funds on the wholesale market. We have:

$$\begin{cases} d_M^{i,j} = \bar{k} - E_L - d^{i,j} \text{ and } l_M^{i,j} = 0 & \text{if } R^{i,j} > R_M^d \\ d_M^{i,j} = 0 \text{ and } l_M^{i,j} = 0 & \text{if } R_M^d \geq R^{i,j} \geq R_M^l \\ d_M^{i,j} = 0 \text{ and } l_M^{i,j} = E_L + d^{i,j} & \text{if } R^{i,j} < R_M^l \end{cases} \tag{C.7}$$

Global banks maximize their period 2 profits:

$$\max_{d_M^g} \pi^g = R_M^d l_M^g - R_M^l d_M^g \tag{C.8}$$

subject to a balance sheet identity:

$$l_M^g = E^g + d_M^g \tag{C.9}$$

and a leverage constraint:

$$d_M^g \leq \lambda \tag{C.10}$$

The Lagrangian is given by:

$$\mathcal{L}^g = R_M^d \left(E^g + d_M^g\right) - R_M^l d_M^g + \mu^g \left[\lambda - d_M^g\right] \tag{C.11}$$

The FOC is:

$$\frac{d\mathcal{L}^g}{dd_M^g} = 0 \ : \ R_M^d = R_M^l + \mu^g \tag{C.12}$$

There is a wedge between the lending and borrowing rates on the inter-bank market if and only if the leverage constraint is binding.

C.2 Equilibrium in the retail markets for local deposits

The profits of local bank j located in country i in period 2 are:

$$\pi^{i,j} = R^{i,j} k^{i,j} + R_M^l l_M^{i,j} - R_M^d d_M^{i,j} - R_H^i d^{i,j} \tag{C.13}$$

Local banks are subject to a balance sheet identity:

$$k^{i,j} + l_M^{i,j} = E_L + d^{i,j} + d_M^{i,j} \tag{C.14}$$

and to a limit on the availability of projects (a technological constraint):

$$k^{i,j} \leq \bar{k} \tag{C.15}$$

At the beginning of period 1, before uncertainty is resolved, local banks compete to raise deposits $d^{i,j}$ from their home representative household in order to maximize their expected profits in period 2. Using equations (C.13) and (C.7), expected profits are given by:

$$\begin{aligned}\mathbb{E}[\pi^{i,j}] = R_M^l \left(E_L + d^{i,j}\right) G(R_M^l) + \mathbb{E}\left[R^{i,j} | R_M^l \leq R^{i,j} \leq R_M^d\right] \left(E_L + d^{i,j}\right) \left[G(R_M^d) - G(R_M^l)\right] \\ + \left[\mathbb{E}\left[R^{i,j} | R_M^d \leq R^{i,j}\right] \bar{k} - R_M^d \left(\bar{k} - E_L - d^{i,j}\right)\right] \left[1 - G(R_M^d)\right] - R_H^i d^{i,j}\end{aligned} \tag{C.16}$$

In order to derive local banks' demand for deposits, it will be useful to introduce the following lemma.

Lemma C.1 *If $\bar{\lambda} < \lambda^*$ then the deposit rate for households in any country i is strictly higher than the lending rate on the inter-bank market: $R_H^i > R_M^l$.*

Corollary 1 *If $\bar{\lambda} < \lambda^*$ then no local bank will raise deposits $d^{i,j}$ such that $d^{i,j} > \bar{k} - E^{i,j}$.*

Proof. (Corollary 1) Assume one local bank raises $d^{i,j} > \bar{k} - E^{i,j}$. Then, using the balance sheet identity (7), we must have $l_M^{i,j} > 0$ independently of the realization of the stochastic return $R^{i,j}$. Yet, because $R_H^i > R_M^l$ if $\bar{\lambda} < \lambda^*$, the local bank incurs a loss with certainty, independently of the realization of its stochastic return, equal to a least $(R_H^i - R_M^l)(d^{i,j} - \bar{k} + E^{i,j})$. The local bank can unambiguously increase its profits by instead setting $d^{i,j} = \bar{k} - E^{i,j}$. Thus, this is not an equilibrium. ■

Thus, we have:

$$0 \leq d^{i,j} \leq \bar{k} - E_L \tag{C.17}$$

Local banks maximize their expected profits in (C.16) subject to (C.17).

The Lagrangian is:

$$\begin{aligned}\mathcal{L}^{i,j} = R_M^l \left(E_L + d^{i,j}\right) G(R_M^l) + \mathbb{E}\left[R^{i,j} | R_M^l \leq R^{i,j} \leq R_M^d\right] \left(E_L + d^{i,j}\right) \left[G(R_M^d) - G(R_M^l)\right] \\ + \left[\mathbb{E}\left[R^{i,j} | R_M^d \leq R^{i,j}\right] \bar{k} - R_M^d \left(\bar{k} - E_L - d^{i,j}\right)\right] \left[1 - G(R_M^d)\right] - R_H^i d^{i,j} \\ - \mu_0^{i,j} \left[d^{i,j} - s_0^{i,j}\right] - \mu_1^{i,j} \left[d^{i,j} - \bar{k} + E_L + s_1^{i,j}\right]\end{aligned} \tag{C.18}$$

For notation purposes, it will be convenient to denote:

$$\mathbf{R^e} \equiv R^l_M G(R^l_M) + \mathbb{E}\left[R^{i,j} | R^l_M \leq R^{i,j} \leq R^d_M\right]\left[G(R^d_M) - G(R^l_M)\right] + R^d_M\left[1 - G(R^d_M)\right] \tag{C.19}$$

Taking derivatives:

$$\frac{d\mathcal{L}^{i,j}}{dd^{i,j}} = \mathbf{R^e} - R^i_H - \mu^{i,j}_0 - \mu^{i,j}_1 \tag{C.20}$$

$$\frac{d\mathcal{L}^{i,j}}{d\mu^{i,j}_0} = d^{i,j} - s^{i,j}_0 \tag{C.21}$$

$$\frac{d\mathcal{L}^{i,j}}{d\mu^{i,j}_1} = d^{i,j} - \bar{k} + E_L + s^{i,j}_1 \tag{C.22}$$

From this point onward, the complementary slackness conditions have to be considered. We have two slack variables $s^{i,j}_0$ and $s^{i,j}_1$ and the corresponding Lagrange multipliers are $\mu^{i,j}_0$ and $\mu^{i,j}_1$. We now have to consider whether a slack variable is zero (the corresponding inequality constraint is active) or whether the Lagrange multiplier is zero (the corresponding inequality constraint is inactive). There are three possible cases:

1. $\mu^{i,j}_0 = \mu^{i,j}_1 = 0 \quad$ and $s^{i,j}_0 = d^{i,j} = \bar{k} - E_L - s^{i,j}_1$, $s^{i,j}_1 = \bar{k} - E_L - d^{i,j}$.

   For $R^i_H = \mathbf{R^e}$, local banks make no profits in expectation, so they are indifferent over all values of $0 \leq d^{i,j} \leq \bar{k} - E_L$.

2. $\mu^{i,j}_0 = 0$, $\mu^{i,j}_1 \neq 0$ and $s^{i,j}_0 = d^{i,j} = \bar{k} - E_L$, $s^{i,j}_1 = 0$.

   For $R^i_H < \mathbf{R^e}$, local banks want to raise as much deposits as possible, subject to their constraint, so $d^{i,j} = \bar{k} - E_L$.

3. $\mu^{i,j}_0 \neq 0$, $\mu^{i,j}_1 = 0$ and $s^{i,j}_0 = d^{i,j} = 0$, $s^{i,j}_1 = \bar{k} - E_L$.

   For $R^i_H > \mathbf{R^e}$, local banks do not want to raise deposits, so $d^{i,j} = 0$.

Thus, in the $(d^{i,j}, R^i_H)$ space, local banks' demand for deposits is horizontal at $R^i_H = \mathbf{R^e}$ for $0 \leq d^{i,j} \leq \bar{k} - E_L$ and is vertical at $d^{i,j} = \bar{k} - E_L$ for $R^i_H < \mathbf{R^e}$.

Households in country i maximize:

$$\max_{d^i} U^i = u(c^i_1) + \beta\,\mathbb{E}[c^i_2] \tag{C.23}$$

Their budget constraints in period 1 and 2 are given by:

$$c_1^i + d^i = W \tag{C.24}$$

$$c_2^j = R_H^i d^i \tag{C.25}$$

The supply of deposits d^i is given by households' first-order condition:

$$u'(W - d^i) = \beta R_H^i \tag{C.26}$$

Thus, households' supply of deposits is increasing in R_H^i.

To solve for the equilibrium in the retail markets for local deposits, we assume non-binding constraints (i.e. deposit supply curve crosses the horizontal line at $\mathbf{R^e}$). We obtain:

$$u'(W - d^i) = \beta \mathbf{R^e} \tag{C.27}$$

Assuming that $u(.) = \ln(.)$, we obtain:

$$d^i = W - \frac{1}{\beta \mathbf{R^e}} \tag{C.28}$$

For this to be a solution, we need the following condition to be satisfied:

$$0 \leq W - \frac{1}{\beta \mathbf{R^e}} \leq \bar{k} - E_L \tag{C.29}$$

We can note that $\mathbf{R^e}$ is bounded above by the highest realization possible of the project return $(\overline{R} + \sigma)$ and bounded below by the lowest realization possible of the project return $(\underline{R} - \sigma)$. We assume that the following conditions on the exogenous parameters holds so that condition (C.29) is satisfied:

$$0 \leq W - \frac{1}{\beta(\underline{R} - \sigma)} \tag{C.30}$$

$$W - \frac{1}{\beta(\overline{R} + \sigma)} \leq \bar{k} - E_L \tag{C.31}$$

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