

# Global Bank Lending and Exchange Rates\*

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## Abstract

We study how global banks' cross-currency lending flows affect exchange rates. When non-US banks expand USD-denominated lending relative to US banks' foreign-currency lending, the USD appreciates. This effect arises because cross-currency lending generates currency-specific funding demand: foreign banks must obtain USD liquidity, typically via FX swaps, while intermediaries require compensation for expanding the balance sheet. Using a granular instrumental variable approach, we document that the exchange rate response has intensified since the global financial crisis, particularly when USD funding conditions are tight. Consistent with this mechanism, cross-currency lending also affects FX swap pricing and deviations from covered interest parity.

**Keywords:** Cross-currency lending, exchange rates, granular instrumental variable, CIP deviation

**JEL Classification:** F31, E44, G21

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# 1 Introduction

A growing literature studies the nexus between capital flows and exchange rates and highlights the central role of intermediaries. Globally active banks sit at the core of this intermediation of portfolio flows through their broker-dealer arms, and they also extend cross-currency loans to financial and non-financial borrowers. At the heart of this intermediation are globally active banks, which facilitate portfolio flows through their broker-dealer arms and provide cross-currency loans to both financial and non-financial borrowers. This provides for a useful laboratory for investigating the impact of how exchange rates respond to such global bank lending flows. The interplay between these flows and exchange rate movements is particularly relevant in light of recent work suggesting that asset markets are “inelastic”, where flows have a direct impact on prices.<sup>1</sup> In this context, cross-currency lending by globally active banks and the corresponding demand for non-domestic currency funding emerge as critical mechanisms for the link of capital flows and exchange rates. Beyond its academic significance, this inquiry holds practical importance for policymakers and market participants, given its implications for USD short-term funding markets which have been at the centre of numerous liquidity crises in the past.

We contribute to the literature on financial flows and financial frictions by showing that global banks’ cross-currency lending decisions are a direct driver of exchange rate dynamics. Focusing on the origination of syndicated loans, we study (i) how shifts in the currency denomination of bank lending affect exchange rates, (ii) why the associated exchange rate elasticity varies over time as a result of intermediation frictions, and (iii) how these lending shifts transmit to key funding markets, in particular the FX swap market. Our main contribution is to identify a novel funding-based intermediation channel through which cross-currency loan flows matter for exchange rates: when non-US banks expand their USD lending, they generate additional demand for USD funding and intermediation capacity that must be absorbed by intermediaries. To compensate intermediaries for expanding their balance sheets, the dollar needs to appreciate in the spot market, while dollar funding costs are driven higher as indicated by covered interest

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<sup>1</sup>See the pioneering work of Gabaix and Koijen (2021) in this regard.

parity (CIP) deviations. By combining granular loan-level data with exchange rate and funding market outcomes, we provide systematic evidence that bank balance-sheet reallocations across currencies are a significant determinant of exchange rates.

In our empirical tests, we make use of a large sample of around 1.8 million syndicated lending relationships obtained from LPC DealScan. An important feature of these syndicated loans is that both US and non-US banks originate loans denominated in USD and extend them to firms located in various currency areas.<sup>2</sup> More specifically, we observe 307 globally operative banks in our sample, of which 285 are domiciled outside the US.

Our interest is centered on banking flows across key currency areas. We define cross-currency loan flows as net USD lending by non-US banks minus net non-USD lending by US banks. As an example, the cross-currency net lending flow in EUR/USD in a given period equals syndicated loan flows in USD by non-US (euro-area) banks minus syndicated loan flows in EUR by US banks. A key challenge in our analysis is to measure the elasticity of the exchange rate vis-à-vis cross-currency lending flows. Because flows and prices are jointly determined, we exploit cross-sectional heterogeneity in our syndicated-loan micro data to build a Granular Instrumental Variable (GIV) as in [Gabaix and Koijen \(2024\)](#) and use it to instrument cross-currency lending flows. The identification strategy in our context addresses two main challenges: the potential for global shocks (e.g., risk appetite or monetary policy changes) and currency-specific credit demand shocks to create spurious correlations between banks' cross-currency lending and exchange rates. To overcome these, the strategy leverages granular variation in lending across global banks, isolating idiosyncratic fluctuations in their portfolios that are unlikely to correlate with exchange rate changes. By aggregating these idiosyncratic components, the approach generates variation in net cross-currency lending that is plausibly independent of common shocks. The resulting GIV instrument is correlated with lending flows, ensuring its relevance, but has no direct effect on the exchange rate, satisfying the exclusion restriction. We also control for global factors and currency area-level macroeconomic conditions, and include a rich set of

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<sup>2</sup>In our sample period from 1997 to 2022, US banks originate around 48% of the global USD syndicated lending market volume whereas around 43% of all USD syndicated loans flow to borrowers headquartered outside the US. See Table IA.3 in the internet appendix.

fixed effects.<sup>3</sup>

Based on our instrumental variable setup, we find a statistically and economically meaningful effect of net cross-currency lending on exchange rates. Specifically, a rise in USD lending by foreign banks relative to US banks' foreign-currency lending by one standard deviation implies a USD appreciation of about 37 basis points at the monthly frequency. Consistent with the underlying funding mechanism, we show that this initial impact reverses over time to compensate dealer and that dollar scarcity, proxied by the cross-currency basis, increases when net cross-currency lending flows into USD rise. The effect is economically sizable and statistically significant only after the global financial crisis (GFC) in 2008/2009, when funding markets changed and banks and their broker-dealers became more tightly regulated.<sup>4</sup> Moreover, the effect is stronger when the US Federal Reserve is in a hiking cycle and when intermediaries' balance sheet usage via leverage is more constrained. Together, these results suggest that the exchange-rate elasticity vis-à-vis flows increases when dollar liquidity is tighter and when it is more costly for global dealers to supply liquidity to non-US banks.

Digging deeper into the economic mechanisms that generate these empirical results, we study how global banks typically fund the provision of cross-currency syndicated loans. Access to dollar funding liquidity is highly segmented, with only few non-US banks being in a position to acquire US dollars cheaply via direct sources such as US dollar deposits or wholesale funding markets (e.g. Rime, Schrimpf, and Syrstad, 2022; Khetan, 2024). As such, when non-US banks originate dollar-denominated loans, they often obtain the necessary liquidity to pay out the loan through a foreign exchange swap with another bank. They do so by exchanging some of their home currency deposits for immediate liquidity in the foreign currency. This is commonly done in the form of FX swaps, such that the originating bank acquires a term deposit and subsequently exchanges it for cash in the foreign currency.

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<sup>3</sup>Specifically, in our empirical analysis, we control for measures of global risk appetite and U.S. monetary policy shocks (see, e.g., Kremens and Martin (2019), Lilley, Maggiori, Neiman, and Schreger (2022), and Bruno and Shin (2015) among others) that might drive the relation of cross-currency lending and spot exchange rates.

<sup>4</sup>In a similar vein, e.g. Du, Tepper, and Verdelhan (2018) and Avdjiev, Du, Koch, and Shin (2019) document sharp increases in CIP deviations and violations of other no arbitrage conditions after the GFC that could be related to the same underlying factor, such as higher balance sheet costs for financial institutions.

Because many banks turn to the global FX swap market to raise liquidity when extending loans in foreign currency, cross-currency loan flows should affect conditions in that market (and related short-term funding markets). We test this prediction using the same GIV setup. We focus on covered interest parity (CIP) deviations (e.g. Du, Tepper, and Verdelhan, 2018; Correa, Du, and Liao, 2020; Rime, Schrimpf, and Syrstad, 2022, among others). We find that dollar scarcity, proxied by the cross-currency basis, increases when net cross-currency lending flows into USD rise. A one standard deviation increase in USD lending by foreign banks relative to US bank lending in foreign currency widens CIP deviations by about 4.7 basis points. The effect is strongest at the three-month maturity, the most common tenor in banks' internal refinancing.

Finally, we show that our main results hold using an augmented GIV approach and in a setting with an alternative, economically motivated, instrument capturing the tightening of bank lending as a result of the capital exercise by the European Banking Authority (EBA).

*Related Literature.* Our paper connects to various strands of literature on the exchange rate determination, capital flows, and the role of intermediary frictions and financial flows in asset pricing.

A growing literature emphasizes the role of flows in driving exchange rates. Gabaix and Maggiori (2015) develop a model in which constrained international financiers intermediate capital flows and influence currency demand and exchange rates. Engel and Wu (2023) show that changes in liquidity yields account for movements in G10 exchange rates, while Liao and Zhang (2025) identify a "currency hedging channel" linking external imbalances to exchange rates.<sup>5</sup> We contribute to this literature by focusing on the funding process and frictions underlying global bank lending and their implications for exchange rates. Unlike Liao and Zhang (2025), we identify an aggregated micro-level channel arising from banks' lending activity rather than a macro-level hedging demand driven by external imbalances.

Closely related work studies deviations from covered interest parity (CIP) to identify frictions in international funding markets. Du, Tepper, and Verdelhan (2018); Avdjiev, Du, Koch, and

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<sup>5</sup>Relatedly, Fang and Liu (2021) propose a model with Value-at-Risk-constrained FX intermediaries, and Malamud, Schrimpf, and Zhang (2025) show that intermediation markups shape FX risk.

Shin (2019); Rime, Schrimpf, and Syrstad (2022) document persistent CIP deviations after the global financial crisis. We show that cross-currency lending flows have stronger effects on exchange rates when US dollar liquidity is tight and that the cross-currency basis widens following increases in foreign-currency cross-currency lending. We complement the results in Du, Hébert, and Li (2023) on the co-movement of dealer positions, exchange rates, and CIP deviations by providing a mechanism and empirical results showing that the funding of USD-denominated loans leads to a dollar appreciation and wider CIP deviations.

We also contribute to the literature on cross-border bank flows and their interaction with monetary policy.<sup>6</sup> Bruno and Shin (2015) show that monetary policy spills over to cross-border bank flows and the dollar exchange rate via the banking sector, while Adrian and Xie (2020) find that a higher USD asset share in non-US banks' portfolios predicts dollar appreciation. Shen and Zhang (2022) document reduced elasticity of cross-border loan supply since the financial crisis, consistent with our finding that the exchange-rate impact of global lending has strengthened post-GFC. Correa, Paligorova, Sapriza, and Zlate (2022) show that domestic monetary policy is central for bilateral bank flows, and Meisenzahl, Niepmann, and Schmidt-Eisenlohr (2020) find that dollar movements affect syndicated loan terms even absent trade exposure. Bräuning and Ivashina (2020) show that international banks benchmark foreign lending to domestic lending. We add to this literature by showing that US monetary policy shapes the strength of the exchange-rate response to global lending flows. In contrast to Bräuning and Ivashina (2020), we focus on the first-order effect of cross-currency lending on exchange rates rather than on funding cost differentials driving lending reallocation.<sup>7</sup>

In concurrent work, Bippus, Lloyd, and Ostry (2023) use a GIV framework to show that larger net external USD debt positions are associated with a stronger dollar for global banks operating in the UK. They emphasize supply and demand elasticities and the role of intermediaries' risk-bearing capacity. Our analysis differs by covering a broader set of globally active banks and by

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<sup>6</sup>See Buch and Goldberg (2020) for an excellent overview. Related work includes Niepmann (2023), Avdjiev, Gambacorta, Goldberg, and Schiaffi (2020), and studies on USD funding sources of non-US banks such as Aldasoro and Ehlers (2018), Aldasoro, Ehlers, McGuire, and von Peter (2020), and Aldasoro, Ehlers, and Eren (2022).

<sup>7</sup>See Ivashina, Scharfstein, and Stein (2015) and Anderson, Du, and Schlusche (2021) on funding frictions and arbitrage responses.

delivering a more general result across currencies: when non-US banks expand USD lending relative to non-USD lending by US banks, the dollar tends to appreciate.

Methodologically, our approach relates to the Granular Instrumental Variables framework of Gabaix and Koijen (2024). Closest to our work, Camanho, Hau, and Rey (2022) study global portfolio rebalancing and exchange rates, while Aldasoro, Beltrán, Grinberg, and Mancini-Griffoli (2023) use GIVs to analyze the macro-financial effects of cross-border bank lending to EMEs and highlight biases in conventional instruments. Kubitza, Sigaux, and Vandeweyer (2024) apply GIVs to show that capital flows respond to changes in FX hedging costs. We show that this framework is also well suited to studying how global bank lending affects exchange rates and funding markets.

## 2 Institutional Background and Framework

To understand how global bank lending affects exchange rates, we first outline the funding mechanics when banks issue loans in a non-domestic currency such as the dollar. We then connect these institutional features to recent theories of exchange rate determination with financial intermediaries to derive testable implications that guide our empirical analysis.

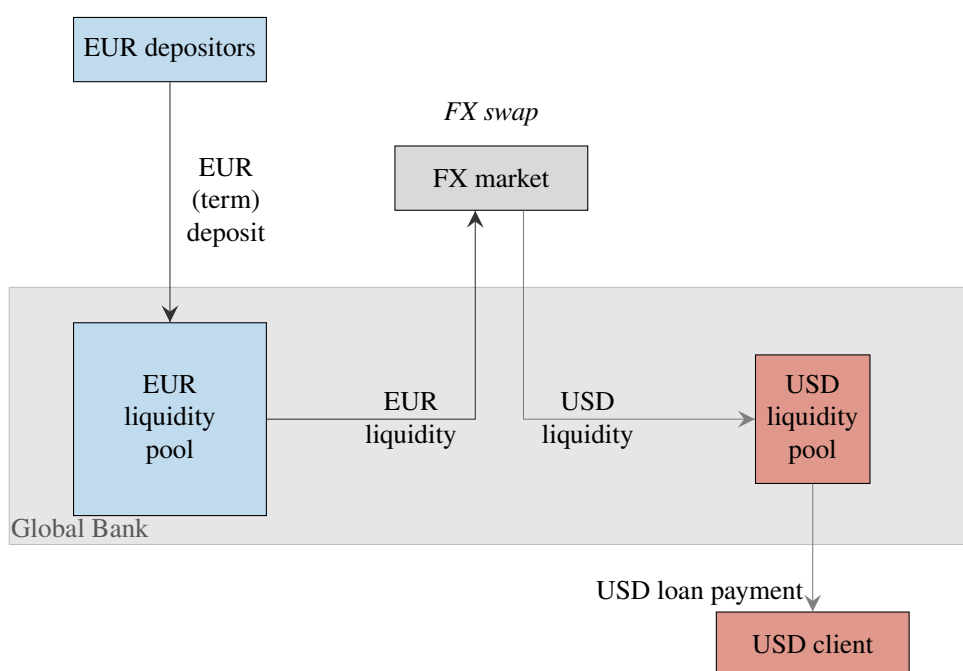
**Funding mechanism in the cross-border provision of loans.** Global USD lending is distinctive in that neither borrowers nor lenders need to be located in the United States, in line with the global reach of the dollar. A non-US bank can originate a USD loan to a non-US borrower without having access to direct sources of dollar funding. Unlike US banks, which typically fund dollar lending through deposits or wholesale USD markets, non-US banks often need to actively obtain USD liquidity when disbursing dollar-denominated loans.

Consider a European bank granting a USD loan. The bank manages liquidity pools in multiple currencies, with its home-currency pool typically largest due to its deposit base and access to central bank liquidity. When the borrower draws down the USD loan, the bank faces an immediate USD liquidity need. This need can be met either by raising USD deposits through

US branches, issuing USD-denominated commercial paper, or by obtaining synthetic USD liquidity via FX swaps.

FX swaps are the dominant short-term funding instrument in practice. As illustrated in Figure 1, the bank exchanges EUR liquidity for USD liquidity at the spot leg of an FX swap, typically with a maturity of three months. If the loan remains outstanding, the bank must roll over the swap until repayment. These FX swap positions are intermediated by dealers, which are typically affiliated with large global banks. By supplying USD liquidity, dealers accumulate foreign currency exposure on their balance sheets. Absorbing these imbalances requires compensation for the associated balance sheet costs and risks, which is achieved through adjustments in exchange rates.

**Figure 1:** Exchange of EUR Liquidity for USD Liquidity



*Notes:* This figure provides a stylized example of a EUR bank obtaining USD liquidity to pay out a USD loan. EUR cash raised from depositors (or other forms of local debt securities) is used to swap for USD liquidity via an FX swap. In a final step, the USD loan is paid to the borrower from the USD liquidity pool. Figure IA.1 in the Internet Appendix depicts a stylized example featuring bank balance sheets.

**Link to theories of exchange rate determination with financial intermediaries.** The mechanism related to funding and intermediation frictions outlined above aligns closely with recent theoretical work emphasizing the role of financial intermediaries in exchange rate determination. [Gabaix and Maggiori \(2015\)](#) model exchange rates as the outcome of risk absorption by intermediaries with limited balance-sheet capacity. When a shock increases demand for one currency relative to another, intermediaries must absorb the resulting imbalance and require compensation in the form of expected returns.

In equilibrium, this compensation is generated through spot exchange rate adjustment: a currency experiencing increased demand appreciates on impact, creating the expectation of future depreciation. [Bacchetta, Davis, and van Wincoop \(2024\)](#) and [Liao and Zhang \(2025\)](#) extend this framework by showing that intermediary constraints also affect forward (and swap) rates and generate predictable return patterns, particularly when intermediaries' capacity to expand their balance sheet for arbitrage is limited or funding conditions are tight.

**Implications.** These considerations yield the following four testable implications.

When foreign banks expand USD lending, they increase their demand for liquid USD funding. A key marginal source of these dollars is the synthetic creation via FX swaps, especially when the loan-issuing bank cannot easily access wholesale USD funding directly. This extra demand for dollars in the FX swap market must be absorbed by intermediaries (dealers) who effectively lend USD and take the corresponding foreign-currency exposure. Given their limited risk-bearing capacity, intermediaries require compensation in the form of expected returns, which materialize through exchange rate adjustment: the USD appreciates on impact, thereby generating expected subsequent USD depreciation that compensates intermediaries for holding the position, as summarized in Implication 1.

*IMPLICATION 1: When foreign banks increase their USD lending, the USD appreciates on impact against the foreign currency, followed by a subsequent depreciation and vice versa.*

Given the special role of the USD in international funding markets ([Ivashina, Scharfstein, and Stein, 2015](#)), funding pressures are more likely to arise when non-US banks expand USD

lending than when US banks expand foreign-currency lending. This asymmetry motivates the following second implication.

*IMPLICATION 2: USD lending by non-US banks should have a larger effect on the exchange rate than foreign currency lending by US banks.*

Intermediary constraints further amplify these effects. As intermediaries' positions expand or their risk-bearing capacity diminishes, the marginal impact of lending flows on exchange rates increases (Gabaix and Maggiori, 2015). Bacchetta, Davis, and van Wincoop (2024) emphasize that these constraints become particularly binding during periods of financial stress or tight USD funding conditions, as summarized in Implication 3.

*IMPLICATION 3: Higher intermediation costs for dealers and/or tighter USD funding conditions amplify the effect of cross-currency lending flows on the exchange rate.*

Finally, funding pressure combined with intermediary frictions also manifests in covered interest parity deviations. When foreign institutions obtain synthetic USD funding through FX swaps, limited arbitrage capacity prevents full alignment between synthetic and direct funding costs, leading CIP deviations to widen (Bacchetta, Davis, and van Wincoop, 2024), as summarized in Implication 4.

*IMPLICATION 4: Higher net lending flows contribute to a widening of CIP deviations.*

We test these implications empirically in the following sections using granular syndicated loan data.

### **3 Data and Empirical Approach**

This section describes the data and empirical approach used in our analysis. Section 3.1 presents the syndicated loan data and descriptive statistics, while Section 3.2 focuses on global syndicated loan flows, in particular cross-currency lending. Section 3.3 describes additional data sources, and Section 3.4 outlines our approach to measuring lending flows. Section 3.5 details the empirical framework and the construction of a generalized instrumental variable

based on micro-level syndicated loan data.

### 3.1 Syndicated loans: Data

Cross-currency bank lending of an economically significant magnitude typically occurs in the form of syndicated lending. Within a syndicate, banks split the overall loan amount depending on their willingness to participate in the provision of the loan. The lead banks organize the syndication process, while the participating banks help to provide the necessary capital. The composition of the syndicate varies by the sector and country of the borrower and the currency demanded by the borrower.

We obtain data on all issued term loans and credit lines from Refinitiv LPC DealScan for the time period 1997-01 to 2022-12.<sup>8</sup> We obtain full information on the loan allocation between syndicate members for about 34% of all loans. For the remaining 68%, we follow [De Haas and Van Horen \(2013\)](#) and divide the loan facility equally among all participants where exact proportions are not available.

Apart from geographical information, DealScan contains information on the issuance and maturity date, currency, total amount and allocation of a loan facility. We construct a measure of monthly outstanding loans of a bank parent company in a given currency and study changes in this measure over time. In other words, we look at the syndicated lending flows between currency areas. We do not differentiate between the country of the borrower of the loan, but rather focus entirely on the *currency* ([Avdjiev, Du, Koch, and Shin, 2019](#)). To ensure a clean estimation in our empirical analysis, we exclude public banks that primarily provide development loans, and focus on loans to non-financial customers and exclude loans granted to banks and non-bank financial corporations.

Section [IA.2.1](#) in the Internet Appendix describes the data cleaning process step by step, in which [Table IA.1](#) lists the top 30 currencies of non-USD loans issued by US banks and the top 30 currency areas where foreign banks, domiciled outside of US, issued USD loans, and [Table](#)

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<sup>8</sup>Ending the sample in 2019-12, prior to the COVID-19 outbreak, does not affect our main findings. See [Table IA.6](#) in the Internet Appendix.

IA.2 summarizes the sectoral decomposition of borrowers in our sample. Our final sample consists of banks headquartered in Australia, Canada, China, Denmark, the Euro Area<sup>9</sup>, India, Japan, Malaysia, Mexico, Norway, Philippines, Poland, Singapore, South Africa, South Korea, Sweden, Switzerland, Taiwan, Thailand, the United Kingdom, and the US.<sup>10</sup> We are left with 307 internationally operative banks, of which 285 are domiciled outside the US.

Table 1 contains summary statistics. Our sample comprises around 181,000 loans which entail around 1.8mn borrower-lender-loan connections. Overall, USD loans to non-US borrowers are similar in size to those to US borrowers, but have longer maturities. There are 271 banks granting loans to US borrowers, which underlines the large source of credit provided by non-US banks to borrowers domiciled in the US.

### 3.2 Syndicated loans: Global loan flows

Figure 2 maps syndicated loan transaction flows denominated in USD where each line connects the country of the parent bank with the borrower's country of origin. The size of lines reflects the total value of loan flows, that is, a thicker line indicates greater loan flows. Red depicts loan flows from non-US banks to US borrowers, green the flow from US banks to non-US borrowers, and blue lines capture the "off-shore" credit flows where neither the borrower nor the bank's headquarter are located in the US.

Two key patterns emerge from this graph. First, a significant portion of these loan flows involves the US, highlighting the pivotal role of the USD and the US financial system in both supplying and demanding USD financing. Second, the graph also reveals that a substantial share of USD-denominated loans occurs between borrowers and lenders located outside the US.

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<sup>9</sup>We consider Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Slovenia, Slovakia and Spain for the Euro Zone. We exclude Hong Kong and Saudi Arabia given their currency regimes that are closely pegged to the USD.

<sup>10</sup>To focus on a meaningful and active set of banks, we further exclude banks with less than USD 10mn of outstanding loans in a given month and retain only banks that have at least 40 changes in their outstanding loan volume over the sample period. This also excludes locally-oriented banks that do not contribute much to *cross-currency* lending flows. We also report results in Section IA.2.11 in the Internet Appendix using alternative filters of at least 10 or 20, instead of 40, changes, to show that our main findings do not rely on the specific choice of this threshold.

**Table 1:** Global syndicated lending differentiated by borrower and lender origin

Category	Obs.			
<b>Loans</b>				
Individual Loans	181,215			
Individual Tranches	273,197			
Borrower-Lender-Loan Connections	1,801,092			
<b>Banks</b>				
	Number of Banks	Median Tranche (in mn USD)	Std.Dev. (in mn USD)	
United States	22	201.30	935.03	
Euro Area	83	229.98	1,218.10	
United Kingdom	14	300.00	1,250.90	
Japan	28	118.35	960.01	
Rest of World	160	185.00	955.54	
<b>USD Loans</b>				
		to US borrowers	to non-US borrowers	
	Obs.	Countries	Obs.	Countries
Lending Parent Banks	271	24	302	26
Borrowers	33,260	1	12,952	159
	Mean	St. Dev.	Mean	St. Dev.
Tranche Term (yr)	4.22	2.20	4.72	3.17
Ind. USD Loan Size (mn)	49.00	96.82	48.51	99.35

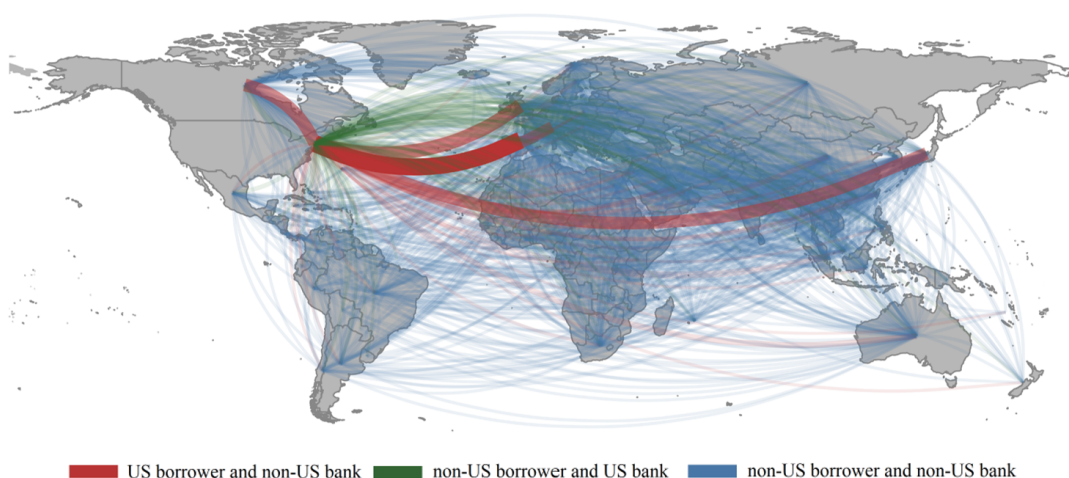
*Notes:* This table summarizes the characteristics of syndicated loans in our sample. We distinguish between US and non-US borrower. Our sample ranges from 1997/01-2022/12 and includes banks from Australia, Canada, China, Denmark, the Euro Area, India, Japan, Malaysia, Mexico, Norway, Philippines, Poland, Singapore, South Africa, South Korea, Sweden, Switzerland, Taiwan, Thailand, the United Kingdom, and the US.

This latter observation underscores the unique role and extensive global reach of the USD. For further discussion, see, e.g., Bruno and Shin (2017), Maggiori, Neiman, and Schreger (2019), Avdjiev, Du, Koch, and Shin (2019), and Gopinath and Stein (2021). Our empirical setup to identify the impact of global loan flows on exchange rates exploits the rich heterogeneity in lending relationships which are depicted in Figure 2.<sup>11</sup>

To benchmark the size of cross-currency lending flows, we also compare the total outstanding syndicated loan volumes for a currency area from DealScan to the total banking systems cross-border claims in all currencies from the BIS Locational Banking Statistics (LBS). Figure IA.2 in the Internet Appendix presents the results for Australia, Canada, Switzerland, the EU, the United Kingdom and Japan. In all displayed currency areas, the total outstanding loan volume resulting

<sup>11</sup>In our empirical analysis we contrast USD loans extended by non-US banks (red and blue lines) with foreign currency loans extended by US banks. The latter are not shown in Figure 2 to preserve readability of the figure. We provide descriptive statistics on those loans in Table IA.3.

**Figure 2:** Global USD syndicated lending flows between 1997/01 and 2022/12



*Notes:* This figure depicts lending relations between banks and firms in the syndicated loan market. The size of the red lines indicates the value of syndicated USD loans that flow to non-financial borrowers headquartered in the United States from non-US banks. Green lines depict the loan volume originated by US banks with a non-US borrower. Blue lines represent 'off-shore' syndicated lending flows in USD to borrowers located outside the US by non-US banks. Syndicated loan data are from LPC DealScan and the sample period is 1997/01-2022/12.

from syndicated loans increased over time. There is some heterogeneity among the countries relating to the importance of syndicated loans for total cross-currency claims, reflecting the diverse importance of debt contracts other than syndicated loans.

Overall, syndicated cross-currency loans that are denominated in USD make up a sizable part of cross-currency bank claims. The increasing trend in outstanding loans underlines that cross-currency syndicated loans are a significant source of capital flows between countries.

### 3.3 Other data used in the empirical analysis

In our regressions below, we employ spot exchange rates for a number of currencies (all against USD), which are available from the BIS website. More specifically, we compute log changes for monthly exchange rates (measured in basis points) based on the last trading day in each month. We complement these spot exchange rate data with forward exchange rates and overnight index swap (OIS) rates for maturities from one month to three years to compute deviations from covered interest parity. We also make use of a number of (macro-finance) control variables in

our regressions, which we retrieve from various sources. Details on all these variables can be found in Appendix A.1.

### 3.4 Measuring cross-currency lending flows

Our interest is in the estimation of the effect of changes in cross-currency bank lending flows on exchange rates. A crucial starting point for the measurement of this elasticity is the measurement of net cross-currency lending flows.

*Measuring Net Cross-Currency Lending.* We define (the logarithm of) *Net Cross-Currency Lending*, denoted NCCL, of foreign country  $c$  at time  $t$  as follows

$$\text{NCCL}_{c,t} = \log(\text{loans}_{c,t}^{\text{USD}}) - \log(\text{loans}_{US,t}^c),$$

where  $\text{loans}_{c,t}^{\text{USD}}$  denotes outstanding USD loans originated by non-US banks, and  $\text{loans}_{US,t}^c$  denotes outstanding foreign currency  $c$  loans granted by US banks.

This measure captures shifts in global bank credit supply across currencies, rather than changes in aggregate lending activity. A positive realization of  $\Delta\text{NCCL}_{c,t}$  reflects an outward shift in the supply of USD-denominated credit by non-U.S. banks relative to the supply of foreign-currency credit by U.S. banks.

Economically, such a shift increases the net demand for USD balance-sheet capacity in the global banking market, i.e.,  $\Delta\text{NCCL}_{c,t}$  translates into changes in the demand for USD funding liquidity and intermediation services. In frictionless markets, this additional demand would be absorbed without any impact on prices. In the presence of intermediary balance-sheet constraints, however, the marginal price of USD funding will adjust. In our setting, this adjustment occurs through movements in spot exchange rates and, as we show below, through deviations from covered interest parity.

In our empirical analysis, we look at the time series difference ( $\Delta$ ) between the value of the net cross-currency lending at the end of month  $t$  and the value at the end of month  $t - 1$ . An increase in  $\text{NCCL}_{c,t}$  implies a *rise in* USD lending of banks from currency area  $c$  *relative to* US

bank lending denominated in currency  $c$ .

### 3.5 Estimation via Granular Instrumental Variables

A key challenge in our estimation is the potential endogeneity of flows and exchange rates. For example, exchange rates can affect the funding cost of loan origination, the profitability of lending in the foreign currency, or the loan demand by non-financial firms (see, e.g. [Niepmann and Schmidt-Eisenlohr, 2023](#), on the negative relation between a broad USD index and U.S. banks' corporate loan origination). This in turn would affect the flows that we observe and lead to a potential bias of our estimate of the effect of loan flows on the exchange rates.

Our empirical strategy is thus designed to address two central identification challenges. First, global shocks, such as changes in risk appetite or monetary policy, may simultaneously affect banks' cross-currency lending decisions and exchange rates, generating spurious correlations. Second, currency-specific credit demand shocks may induce both higher USD borrowing and contemporaneous exchange rate movements, even in the absence of supply-side effects.

We address these challenges by exploiting the granular variation in cross-currency lending across large global banks. Although individual banks are exposed to aggregate financial conditions, idiosyncratic fluctuations in their lending portfolios are unlikely to be systematically related to contemporaneous exchange rate innovations. Aggregating these idiosyncratic components therefore provides a source of variation in net cross-currency lending that is plausibly orthogonal to common shocks.

Exploiting the high degree of heterogeneity between market shares in USD lending across currency areas (as well as with foreign currency lending by US banks), our setting is suitable for implementing a granular instrumental variables (GIV) approach as suggested by [Gabaix and Koijen \(2024\)](#).

*The GIV Approach.* In our setting, changes in flows can result from *common shocks* affecting all banks (and, plausibly, exchange rates directly), as well as *idiosyncratic shocks* affecting individual banks (but not exchange rates). A GIV allows us to construct an instrument that

isolates idiosyncratic shocks to lending that is not driven by common shocks. Specifically, aggregate lending flows move more strongly when large banks are hit by idiosyncratic shocks compared to idiosyncratic shocks that only affect small banks. This differential effect on lending flows can be used to estimate the exchange rate elasticity.

Specifically, we model flows as being driven by both common shocks and idiosyncratic (bank-level) shocks. Suppose we have:

$$\Delta l_{jct} = -\alpha \Delta s_{ct} + f_{jct}, \quad (1)$$

$$\text{where } f_{jct} = \eta'_{ct} \delta_c + u_{jct}, \quad (2)$$

where  $j$  denotes the bank,  $c$  the currency area, and  $t$  the month.  $\Delta l_{jct}$  represents the change in lending flows of bank  $j$  in currency  $c$  at time  $t$ . We use  $\Delta l_{jct}$  to capture either the inflows from foreign banks in USD ( $\Delta l_{j,USD,t}^c$ ) or the outflows from U.S. banks in foreign currencies ( $\Delta l_{jct}^{US}$ ). As described above, and elaborated in more detail later, inflows and outflows are always calculated separately, and their difference is used to construct net cross-currency flows.  $\Delta s_{ct}$  denotes the change in the spot exchange rate of currency  $c$  at time  $t$ .  $\eta'_{ct}$  is a vector of characteristics of currency area  $c$ , and  $u_{jct}$  is the residual of bank  $j$ 's flows, defined to be orthogonal to  $\eta'_{ct}$ , i.e.,  $\mathbb{E}[u_{jct} \eta'_{ct}] = 0$ . In other words, changes in lending flows are driven by movements in the exchange rate, exposure to common shocks ( $\delta_c$ ), and an idiosyncratic shock ( $u_{jct}$ ).

The aggregate change in bank lending flows for currency  $c$  at time  $t$  is given by:

$$\Delta l_{ct} = \sum_j \Delta l_{jct} = -\alpha' \Delta s_{ct} + \varepsilon_{ct}, \quad (3)$$

$$\text{where } \varepsilon_{ct} = \sum_j f_{jct}. \quad (4)$$

Our estimation equation of interest is:

$$\Delta s_{ct} = \kappa \Delta l_{ct} + \varepsilon'_{ct}, \quad (5)$$

and our main object of interest is  $\kappa$ , that is, the elasticity of the exchange rate with respect to changes in bank loan flows. Whenever  $\Delta l_{ct}$  is correlated with  $\eta'_{ct}$ , we have  $Corr(\Delta l_{ct}, \varepsilon'_{ct}) \neq 0$ , implying that the OLS estimates are biased. To address this, we require an instrument  $z_{ct}$  such that

$$\mathbb{E}[z_{ct}\varepsilon'_{ct}] = 0, \quad (6)$$

that is, the instrument needs to be exogenous, and, in addition, it needs to satisfy the relevance condition

$$\mathbb{E}[z_{ct}\Delta l_{ct}] \neq 0. \quad (7)$$

For the baseline analysis, we follow [Gabaix and Koijen \(2024\)](#) and construct  $z_{ct}$  as the difference between the loan-share weighted average and the unweighted average of bank loan flows in currency area  $c$  at time  $t$ . Specifically, the GIV instrument is defined as:

$$z_{ct} = \Delta l_{ct}^{\Omega} - \Delta l_{ct}^{\iota} = \sum_{j \in C_c} (\omega_{jct} - \frac{1}{N_{ct}}) \Delta l_{jct}, \quad (8)$$

where  $\omega_{jct}$  denotes the loan share of bank  $j$  in total lending in currency  $c$  at time  $t$ , with  $\sum_j \omega_{jct} = 1$ .  $\Delta l_{ct}^{\Omega}$  and  $\Delta l_{ct}^{\iota}$  denote, respectively, the loan-share weighted and the equally weighted averages of flows in currency  $c$  at time  $t$ .

Under the assumption of homogeneous exposure to the common shock across banks, as specified in Equation (2), we obtain:

$$\Delta l_{ct}^{\Omega} = -\alpha \Delta s_{ct} + \eta'_{ct} \delta_c + \sum_j \omega_{jct} u_{jct}, \quad (9)$$

$$\Delta l_{ct}^{\iota} = -\alpha \Delta s_{ct} + \eta'_{ct} \delta_c + \frac{1}{N_{ct}} \sum_j u_{jct}, \quad (10)$$

$$z_{ct} = \sum_j (\omega_{jct} - \frac{1}{N_{ct}}) u_{jct}. \quad (11)$$

The relevance condition of the instrument is satisfied, as it is correlated with our endogenous measure of cross-currency lending:  $\mathbb{E}[(\Delta l_{ct}^{\Omega} - \Delta l_{ct}^{\iota}) \Delta l_{ct}] \neq 0$ . As for the exclusion restriction, the instrument is exogenous because it cancels out the impact of common shocks and isolates the idiosyncratic bank-level shocks  $u_{jct}$ , which are *by definition orthogonal to common shocks*.

Moreover, the exclusion restriction would also hold if the weights  $\omega_{jct}$  are as good as randomly assigned.

For now, we assume that exposure to common shocks is homogeneous across banks ( $\delta_c$ ). Later, we relax this assumption and allow for heterogeneous exposure ( $\delta_{jc}$ ) to further mitigate concerns that large banks may differentially load on unobserved global factors. Specifically, we augment this approach by residualizing bank-level lending changes with respect to observable bank characteristics and common components prior to aggregation. As shown in Section 5, this refinement leaves the estimated exchange rate elasticities largely unchanged, while strengthening the interpretation of the instrument as capturing shifts in credit supply rather than demand.

### 3.6 Empirical implementation

Taking the methodology to our data, for the inflow (from the US perspective) of loans, defined as non-US bank lending in USD, we take the difference between value-weighted and equally-weighted average of loans originated by banks from currency area  $c$  denominated in USD as follows

$$\Delta_{c,t}^{\text{Inflow}} = \underbrace{\sum_{j \in C_c} \Delta l_{j,USD,t}^c \times w_{j,USD,t-1}^c}_{\text{Value-weighted average}} - \underbrace{\frac{1}{N_{C_c}} \sum_{j \in C_c} \Delta l_{j,USD,t}^c}_{\text{Equally-weighted average}}, \quad (12)$$

where  $w_{j,USD,t-1}^c$  is the share of outstanding USD loans in the previous month of bank  $j$  from a given currency area  $c$  in USD lending of total outstanding USD loans in that month.  $\Delta l_{j,USD,t}^c$  is the change in the outstanding loans of bank  $j$  that occurred until the end of month  $t$  compared to month  $t - 1$ . From this value-weighted average, we subtract the equally-weighted average of changes in outstanding loans, where  $N_{C_c}$  denotes the number of non-US banks in the set  $C_c$  of foreign banks that grant USD loans.

In an analogous manner, we perform this calculation for outflows, i.e. loans originated by US banks denominated in foreign currency  $c$  at time  $t$ :

$$\Delta_{c,t}^{\text{Outflow}} = \underbrace{\sum_{j \in C_{US}} \Delta l_{j,c,t}^{US} \times w_{j,c,t-1}^{US}}_{\text{Value-weighted average}} - \underbrace{\frac{1}{N_{C_{US}}} \sum_{j \in C_{US}} \Delta l_{j,US,t}^c}_{\text{Equally-weighted average}} \quad (13)$$

Having constructed the value- and equally-weighted differentials for inflows (USD lending of banks from currency area  $c$ ) and outflows (foreign currency lending of US banks) according to Equations (12) and (13), we use their net, defined as

$$z_{c,t} = \Delta_{c,t}^{\text{Inflow}} - \Delta_{c,t}^{\text{Outflow}}, \quad (14)$$

as our instrument for net currency lending flows in our micro-level panel regression section.

*Two-stage Panel IV Least Squares.* We estimate the following two-stage IV panel procedure

$$\begin{aligned} \text{First stage: } \Delta \text{NCCL}_{c,t} &= z_{c,t} + \text{Controls}_{c,t} + \varepsilon_{c,t}, \\ \text{Second stage: } \Delta s_{c,t} &= \phi \widehat{\Delta \text{NCCL}_{c,t}} + \text{Controls}_{c,t} + \vartheta_{c,t}, \end{aligned} \quad (15)$$

where  $\Delta \text{NCCL}_{c,t}$  is the previously defined net cross-currency bank lending measure. An increase in this variable indicates a positive net flow *into* the USD, i.e. the volume of loans originated in USD by non-US banks from currency area  $c$  increases compared to the foreign currency lending by US banks. The variable  $z_{c,t}$  denotes the GIV instrument as defined above. As control variables, we include the first difference of the VIX, the U.S. monetary policy shock measure from Jarociński and Karadi (2020), the first four principal components of CPI inflation, 5 and 10 year sovereign yield and the 3 month interbank rate, as well as enrich our setting with currency and year fixed effects.<sup>12</sup>  $\vartheta_{c,t}$  and  $\varepsilon_{c,t}$  are idiosyncratic error terms.

In the first stage, we obtain the changes in the net cross-currency lending measure attributable to idiosyncratic shocks to large banks' net cross-border lending as opposed to that by smaller ones. In the second stage, we then use this variation to consistently estimate the effect of changes in net lending flows on spot exchange rate changes.

*Diagnostic checks.* We now provide diagnostic checks of the instrument to judge its validity. In our data, the resulting instrument exhibits a high correlation with net cross-currency loan

<sup>12</sup>By using year instead of year-month fixed effects, we retain the variation across months for a given currency, allowing us to assess the influence of global factors on currency values, such as the global financial cycle proxied by the VIX (which is on a monthly frequency and would be absorbed by year-month fixed effects). Also, including year-quarter or year-month fixed effects instead of year fixed effects does not materially alter our main findings. See Section IA.2.8 and Tables IA.7-IA.8 in the Internet Appendix.

flows and minimal correlation with exchange rate changes. Specifically, the correlation with net cross-currency lending flows,  $\Delta NCCL$ , is 0.41. The correlation between the GIV instrument and spot exchange rate changes, by contrast, is a mere 0.06. In addition, the correlation between the bank-level weights and foreign banks' USD loan flows is 0.027, and that between the weights and U.S. banks' foreign loan flows is 0.003. Both are very small, providing additional support for the validity of the exclusion restriction.

We then provide a narrative-based explanation showing that the GIV is non-systematic and arises from granular shocks at the bank level. Specifically, we examine significant fluctuations and relate them to key events involving major contributors to the corresponding values of the instrument. Figure A.1 shows the evolution of the GIV instrument for four currency areas: the Euro Area (EUR), the United Kingdom (GBP), Canada (CAD), and Australia (AUD). We relate the observed spikes to bank-level events identified through news searches. Many of the large fluctuations can be traced to events such as bank mergers, unexpected profit gains or losses, and major shifts in banks' strategies – often undertaken in collaboration with government authorities. For example, the largest fluctuation in the Euro Area occurred in February 2018, when Deutsche Bank announced a major restructuring and a sharp increase in restructuring costs, developments that were likely to reduce its USD lending. Similarly, the largest fluctuation in the United Kingdom occurred in October 2009, when Lloyds Banking Group and the Royal Bank of Scotland (RBS) received additional government aid, signaling weaker conditions than the market had anticipated and negatively affecting their USD lending. An evaluation based on the excess Herfindahl index is also provided in section A.2.

We further conduct a check by excluding months in which GIV spikes coincide with major macroeconomic shocks, in order to mitigate their confounding impact on both the instrument and the exchange rate. Specifically, we exclude the large GIV fluctuations observed during the Global Financial Crisis and the COVID-19 crisis. The results, reported in Table IA.6 in the Internet Appendix, confirm that our main findings remain robust.

We will provide further robustness on these methodological choices in Section 5.1, where we use (i) a residualization approach to address the concern that bank heterogeneity might not be

fully eliminated by simple differencing, and (ii) allow for heterogeneous loadings on common shocks across banks.

## 4 Global Bank Lending and Exchange Rates

In this section, we document our main result: when non-US banks grant more cross-currency loans denominated in US dollar compared to the foreign currency-denominated lending of US banks, the US dollar appreciates significantly (Section 4.1). This initial appreciation of USD is followed by a subsequent depreciation over two to three months, there is a strong asymmetry between USD and non-USD lending and we show that the importance of lending flows for exchange rates only emerged after the great financial crisis (GFC). Section 4.2 then dissects the exchange elasticity and shows that intermediary balance sheet constraints and conditions in dollar funding markets have a significant effect on the exchange rate elasticity with respect to flows.

### 4.1 Cross-currency lending flows and exchange rate elasticity

We start by reporting full-sample estimates for our main specification in Eq. (15) and report results in Table 2 for different combinations of fixed effects as well as macroeconomic controls. The first-stage results show a strong correlation between the GIV and the key explanatory variable, with F-statistics well above the critical values in Stock and Yogo (2005) and Olea and Pflueger (2013), indicating that weak instrument concerns are not an issue. Throughout all these specifications, we find a significant appreciation of the USD whenever we observe a rise in net lending flows into the USD. Notably, controlling for year fixed effects, currency fixed effects and economic fundamentals leaves the point estimate of the elasticity of exchange rates with respect to lending flows largely unchanged.<sup>13</sup>

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<sup>13</sup>The Global Financial Cycle as proposed in Rey (2015) is unlikely to explain the observed effect, as we control for it in all our regressions by including the first difference of the VIX. Moreover, as a robustness check, replacing the first difference of the VIX with the global financial cycle factor extracted by Miranda-Agrippino and Rey (2020) does not affect our main findings. See Table IA.9 in the Internet Appendix.

**Table 2:** The exchange rate elasticity of net cross-currency lending flows

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	<i>Second Stage</i>							
$\widehat{\Delta NCCL}$	58.480** (28.876)	55.633** (24.092)	58.507** (29.027)	55.633** (24.237)	69.723* (36.327)	68.869** (27.009)	71.730** (35.044)	68.869** (27.180)
Observations	1615	1615	1615	1615	1551	1551	1551	1551
Macro Controls	No	No	No	No	YES	YES	YES	YES
Currency FE	No	No	YES	YES	No	No	YES	YES
Year FE	No	Yes	NO	YES	No	YES	No	YES
Currency Areas	20	20	20	20	20	20	20	20
Pseudo- $R^2$	0.060	0.110	0.070	0.120	0.080	0.130	0.090	0.140
	<i>First Stage</i>							
GIV Instrument	0.444*** (0.040)	0.430*** (0.038)	0.444*** (0.041)	0.429*** (0.039)	0.428*** (0.037)	0.417*** (0.035)	0.427*** (0.038)	0.411*** (0.036)
F-Statistics	61.618	63.814	58.203	61.524	23.254	22.519	22.041	20.920

*Notes:* The table reports the results of the two-step panel IV estimation with a granular instrument. The dependent variable is the first difference of the logarithm of the spot exchange rate vis-à-vis the USD in the dimension FC/USD.  $\widehat{\Delta NCCL}_{c,t}$  is the contemporaneous GIV-instrumented difference between the lending of foreign banks into the USD and US bank lending flow out of the USD (obtained from the first-stage regression). An increase in this measure implies that foreign banks lend more in USD than US banks in foreign currency. The first difference of the end-of-month VIX index and the U.S. monetary policy shock measure from Jarociński and Karadi (2020) are included in all regressions, but not reported. Macro-controls refer to the first four principal components extracted from CPI inflation, 5y and 10y government bond yields and 3-month interbank rates in the respective currency areas. The sample runs from 1997/01 to 2022/12 and includes the currencies AUD, CAD, CHF, CNY, DKK, EUR, GBP, INR, JPY, KRW, MXN, MYR, NOK, PHP, PLN, SEK, SGD, THB, TWD, ZAR. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses. Pseudo- $R^2$  refers to the squared correlation between the second stage variables and the dependent variable here and in the henceforth. In the first-stage results, the effect of the GIV instrument is scaled by 1,000 for ease of readability.

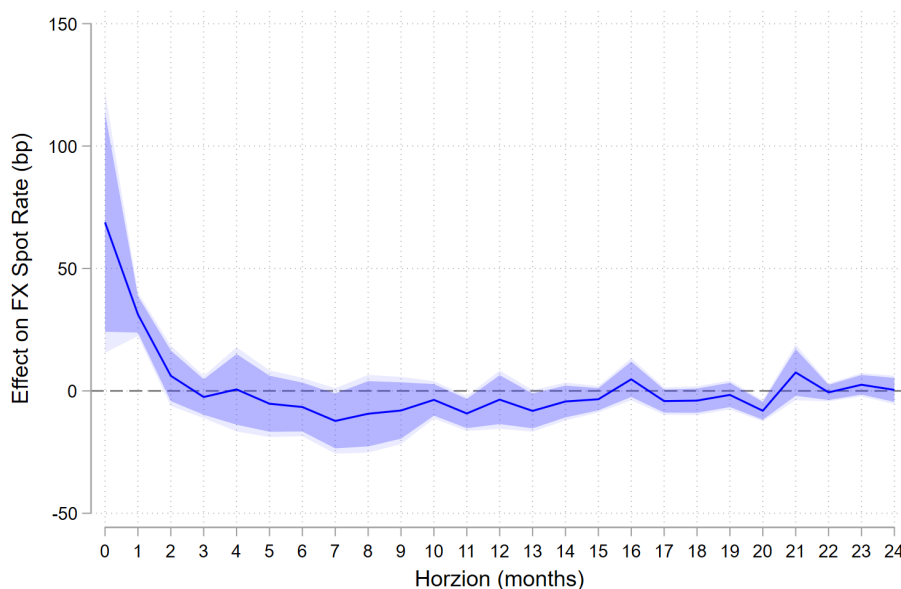
The results in column (8) with year and currency fixed effects as well as macroeconomic controls, show a statistically and economically significant effect of net foreign currency lending on exchange rates. A 100 basis point (bp) increase in foreign banks' outstanding USD loans, relative to the foreign currency lending by US banks, leads to an annualized appreciation of the USD by 69 bp—an economically significant magnitude. On the same note, a one standard deviation increase in the net cross currency lending of a magnitude of 718 bp, which corresponds to a 62bn USD additional net lending flow into the USD from its average level, leads to an appreciation of the USD by 37 basis points (unannualized).<sup>14</sup>

<sup>14</sup>In the sample,  $\Delta NCCL$  has a mean of -0.51 and a standard deviation of around 7. The average outstanding USD loans issued by non-US banks amount to 863.28 billion dollars. Assuming that US banks' non-USD loans remain unchanged, a 7% increase in non-US banks' USD lending from the average outstanding value corresponds to an inflow increase of 62 billion dollars. This change impacts the unannualized monthly exchange rate growth by an

While these magnitudes seem large, the mechanism outlined in Section 2, suggests that the effect of lending flows on exchange rates should *not* be permanent, which we turn to next.

#### 4.1.1 Persistence and asymmetry

Our conceptual framework predicts an exchange rate reversal following the initial impact of a lending shock, generating intermediary profits as compensation for absorbing the shock (second part of Implication 1). To test this, we run local projections (Jordà, 2005) of cumulative changes in the spot exchange rates over a 24-month horizon on cross-currency lending flows. Results shown in Figure 3 support Implication 1 and show that the initial impact is reversed after about three months. In other words, net lending flows do not alter the level of exchange rates permanently but contribute to the observed “excess volatility” in foreign exchange markets.



**Figure 3:** Local Projection on FX Spot Rate

*Notes:* The figure reports the Jordà (2005) local projection estimates at horizons up to 24 months. We adopt the specification in the last column of Table 2, replacing the dependent variable with the cumulative change in the logarithm of the spot exchange rate (in basis points). The solid line shows the estimated coefficient on contemporaneous GIV-instrumented  $\Delta$ NCCL. The dark and light blue shaded areas denote the 90% and 95% confidence intervals, respectively. The sample spans 1997/01–2022/12 at the initial horizon and ends in 2020/12 at the longest horizon.

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estimated  $7.18 \times 61.98/12 = 37.1$ .

Another key implication of our conceptual framework (Implication 2) concerns the asymmetry of the exchange rate elasticity depending on whether the funding need is in USD or the foreign currency. To test this, we run regressions of exchange rates on USD lending in- and outflows separately instead of the ratio of flows as in Eq. (15). Table 3 shows that an inflow of loans, measured as a flow out of the foreign currency and into USD, leads to a significant appreciation of the USD vis-à-vis the foreign currency. A one standard deviation increase of loan outflows leads to an appreciation of the USD of around 205 basis points (annualized). Conversely, column (3) of Table 3 reports results for the respective outflow measure, which intuitively leads to a depreciation of the USD vis-à-vis the foreign currency, but by a smaller magnitude than the appreciation upon inflows.

**Table 3: Separate Analysis of Inflow and Outflow**

	(1)	(2)	(3)	(4)
$\widehat{\Delta NCCL}$	68.869** (27.180)			
$\Delta \log(\text{Outstanding Loans in USD Issued by non-US Banks})$		106.620*** (38.007)		114.881*** (31.158)
$\Delta \log(\text{Outstanding Loans in Foreign Currency Issued by US Banks})$			-62.994** (32.007)	-62.512* (32.389)
Observations	1551	1551	1551	1551
Macro Controls	YES	YES	YES	YES
Currency FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Currency Areas	20	20	20	20
Pseudo- $R^2$	0.140	0.160	0.150	0.140

*Notes:* The table reports the results of two-stage panel IV estimation with a granular instrument.  $\widehat{\Delta NCCL}_{c,t}$  is the contemporaneous GIV instrumented difference between the USD syndicated lending of foreign banks and the logarithm of foreign currency syndicated lending of US banks. An increase in this measure implies that foreign banks lend more in USD than US banks in foreign currency.  $\Delta \log(\text{Outstanding Loans in USD Issued by non-US Banks})$  and  $\Delta \log(\text{Outstanding Loans in Foreign Currency Issued by US Banks})$  denote first difference of the log of the outstanding loans in USD issued by non-US banks (inflow) and outstanding loans in foreign currency issued by US banks (outflow). The first difference of the end-of-month VIX index and the U.S. monetary policy shock measure from Jarociński and Karadi (2020) are included in all regressions, but not reported. Macro-controls refers to the first four principal components extracted from CPI inflation, 5y and 10y government bond yields and 3-month interbank rates in the respective currency areas. The sample runs from 1997/01 to 2022/12 and includes the currencies AUD, CAD, CHF, CNY, DKK, EUR, GBP, INR, JPY, KRW, MXN, MYR, NOK, PHP, PLN, SEK, SGD, THB, TWD, ZAR. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses. Column (1) shows the baseline result. Columns (2) and (3) use the GIV instrument for the inflows and outflows instead of the net measure of in- and outflows. Column (4) uses both GIV instruments for the two endogenous variables.

In sum, the results above strongly support Implications 1 and 2 of our conceptual motivation in Section 2. Increases in USD lending by foreign banks are associated with an immediate appreciation of the USD and a subsequent reversal (Table 2 and Figure 3). Table 3 further provides evidence in favor of Implication 2, indicating that this exchange rate response is substantially stronger for USD lending by non-US banks than for foreign-currency lending by US banks.<sup>15</sup>

#### *4.1.2 Exchange rate elasticity before and after the Global Financial Crisis*

Economic intuition and the implications of our framework in Section 2 suggest that the elasticity of exchange rates with respect to global lending flows should have changed after the Great Financial Crisis (GFC). First, the aftermath of the GFC saw the implementation of tighter banking regulation, which raised constraints on banks and their affiliated broker-dealers to intermediate capital flows and derivatives transactions such as FX swaps. Second, the structure of dollar funding markets has changed notably, with a pronounced decline in unsecured interbank activity and a greater reliance on FX swaps and non-bank funding sources. Both of these developments suggest tighter conditions in USD funding markets, which should result in a larger elasticity of exchange rates with respect to bank lending flows as summarized by Implication 3 in Section 2.

To test whether such a structural shift has indeed affected the elasticity of exchange rates, we partition our sample into pre- and post-GFC, with the cut-off set at January 2009. The results, reported in Table 4, indicate that the effect is statistically and economically significant only after, but not before, the GFC. A further test on the difference between the two coefficients confirms a statistically significant higher coefficient in the post-GFC sample. In addition, we examine the change in the coefficients over time by restricting the sample period month by month in Section IA.2.10 of the Internet Appendix, and again, we document a jump in elasticity when the sample

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<sup>15</sup>We provide additional evidence on the impact of cross-currency bank lending flows in Table IA.4 in the Internet Appendix, which reports estimated elasticities for (log changes in) forward rates as well as swap rates. We find that spot exchange rates move more strongly than forward rates. Table IA.5 presents the estimated elasticity of spot exchange rates for selected currencies across major country groups. We find that the estimates elasticities are fairly stable across these groups of countries.

is limited to periods after 2007.

**Table 4:** Exchange rate elasticity before and after the GFC

	Pre-GFC			Post-GFC		
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{\Delta NCCL}$	4.322 (26.561)	9.756 (18.503)	13.720 (22.344)	182.220*** (44.161)	168.526*** (41.820)	174.503*** (35.235)
Observations	678	678	616	937	937	935
Macro Controls	No	No	YES	No	No	YES
Currency FE	No	YES	YES	No	YES	YES
Year FE	No	YES	YES	No	YES	YES
Currency Areas	17	17	17	16	16	16
Pseudo- $R^2$	0.090	0.060	0.040	0.020	0.040	0.070

*Notes:* The Table reports second-stage regression results of the two-step panel IV estimation with a granular instrument. Pre-GFC refers to the time period before 2009/01, and post-GFC refers to the subsequent time period. The dependent variable is the first difference of the logarithm of the spot exchange rate vis-à-vis the USD in the dimension FC/USD.  $\widehat{\Delta NCCL}_{c,t}$  is the GIV-instrumented difference between the USD syndicated lending of foreign banks and the logarithm of foreign currency syndicated lending of US banks (obtained from the first-stage regression). An increase in this measure implies that foreign banks lend more in USD than US banks in foreign currency. The first difference of the end-of-month VIX index and the U.S. monetary policy shock measure from Jarociński and Karadi (2020) are included in all regressions, but not reported. Macro-controls refer to the first four principal components extracted from CPI inflation, 5y and 10y government bond yields and 3-month interbank rates in the respective currency areas. The sample runs from 1997/01 to 2022/12 and includes the currencies AUD, CAD, CHF, CNY, DKK, EUR, GBP, INR, JPY, KRW, MXN, MYR, NOK, PHP, PLN, SEK, SGD, THB, TWD, ZAR. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses.

Overall, these findings suggest that structural developments in the financial system since the GFC have greatly increased the importance of cross-border banking flows for exchange rates. In line with Implication 3, this increased impact of flows can be traced to a tightening of intermediation capacity in the global financial system—an issue we turn to next.

## 4.2 The role of constrained intermediation capacity and tighter USD funding conditions

We now dig deeper into the economic mechanism that generates our main finding. In line with Implication 3 of the framework in Section 2, the key premise is that cross-currency lending affects exchange rates because it requires intermediaries to expand their balance sheet and supply dollar liquidity. When this capacity is scarce, the marginal price of USD intermediation increases, which manifests in a stronger exchange rate response.

Guided by this mechanism, we study factors that proxy for the tightness of intermediary balance sheets and USD funding conditions. Specifically, we examine broker-dealer constraints and measures of USD funding market tightness, including variation across the monetary policy cycle. We complement these state-dependence tests with direct evidence from CIP deviations in Subsection 4.3, which provides a price-based measure of dollar scarcity in FX swap markets.

#### 4.2.1 *The role of broker-dealer leverage*

In the aftermath of the great financial crisis, several regulatory reforms have tightened capital constraints for broker-dealers significantly. It is thus natural that intermediary balance sheet constraints may be an important factor driving the change in the elasticity of exchange rates to lending flows.<sup>16</sup>

To investigate this question, we analyze broker-dealers' capital and leverage and their interaction with the exchange rate elasticity. To that end, we draw on the measures of broker-dealer capital and leverage as proposed by He, Kelly, and Manela (2017).<sup>17</sup> We compare time periods in which banks exhibit low leverage or capital ratios (below average) to times when they are high (above average). Table 5 presents the results. It shows that exchange rates react more strongly to flows when they are constrained by high leverage or low capital, that is, in periods when broker-dealers have less ability to flexibly expand their balance sheet via leverage. Table 5 shows that such times go hand in hand with a higher exchange rate elasticity, which is conceptually in line with Gabaix and Maggiori (2015).

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<sup>16</sup>In this context, for instance Gabaix and Maggiori (2015) suggest that tighter balance sheet constraints of intermediaries (as introduced after the GFC) can have a bearing on the exchange rate, which is generally in line with our findings in Table 4. In a similar vein, Du, Tepper, and Verdelhan (2018) trace violations of the CIP (arbitrage) condition to balance sheet constraints while Cenedese, Della Corte, and Wang (2021) show that the Basel III leverage ratio constrained dealers charge customers a higher premium for synthetic dollar funding.

<sup>17</sup>The capital ratio is constructed as the end of period ratio of total market capitalization to (total market capitalization + book assets - book equity) of NY Fed primary dealers' publicly-traded holding companies, and leverage square is defined as  $(1/\text{capital ratio})^2$ , see He, Kelly, and Manela (2017). We use the average of leverage squares to divide the sample into high and low leverage subsamples, thus the division differs from that based on the capital ratio. We present the time series of the capital and leverage square measurements in Figure IA.7 in the Internet Appendix.

**Table 5:** Exchange rate elasticity and broker-dealer constraints

	(1)	(2)	(3)	(4)
	Low Leverage	High Leverage	High Capital	Low Capital
$\overline{\Delta NCCL}$	48.319*	127.686**	35.227	178.255***
	(29.357)	(52.628)	(30.119)	(48.587)
Observations	950	601	744	807
Macro Controls	YES	YES	YES	YES
Currency FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Currency Areas	20	15	17	17
Pseudo- $R^2$	0.070	0.060	0.050	0.050

*Notes:* The Table reports second-stage regression results of the two-step panel IV estimation with a granular instrument. Dependent variable is the first difference of the logarithm of the spot exchange rate vis-à-vis the USD in the dimension FC/USD.  $\overline{\Delta NCCL}_{c,t}$  is the contemporaneous GIV instrumented difference between the USD syndicated lending of foreign banks and the logarithm of foreign currency syndicated lending of US banks (obtained from the first-stage regression). An increase in this measure implies that foreign banks lend more in USD than US banks lend in foreign currency. We obtain data on the leverage and capital ratio from He, Kelly, and Manela (2017). A high (low) leverage ratio period corresponds to times with above (below) average in the leverage measure. The remainder of the empirical setup resembles the one of our main analysis presented in Table 2. The sample runs from 1997/01 to 2022/12 and includes the currencies AUD, CAD, CHF, CNY, DKK, EUR, GBP, INR, JPY, KRW, MXN, MYR, NOK, PHP, PLN, SEK, SGD, THB, TWD, ZAR. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses.

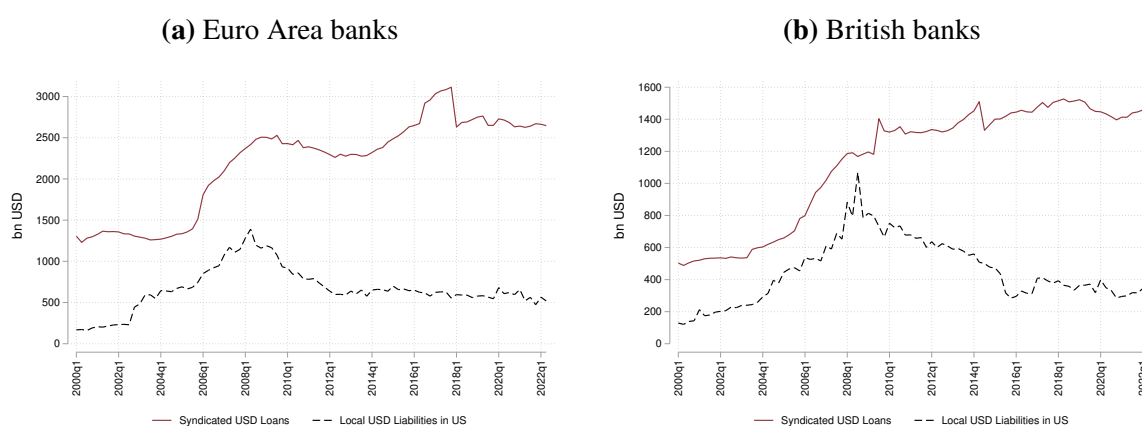
#### 4.2.2 The role of US dollar funding market tightness

The arguments laid out in Section 2 suggest that the tightness of conditions in USD markets and their accessibility for foreign banks is crucial in affecting the exchange rate response to cross-border lending flows. In the following, we investigate this channel from various angles.

To further motivate the analysis, we start out with a brief discussion of the structural shifts in USD funding markets that occurred after the GFC. Figure 4 plots outstanding volumes in cross-currency USD syndicated loans (solid line) and local USD liabilities by non-US banks (dashed line) for euro area and British banks. The latter can be seen as summarizing “conventional”, on-balance sheet USD funding by foreign banks, such as USD deposits, commercial paper and certificates of deposit.

As can be seen from Figure 4, conventional USD funding and syndicated lending steadily grew together from 2000 until 2008. Since the GFC, however, cross-currency syndicated lending

**Figure 4:** USD syndicated loans in relation to local USD liabilities of non-US banks



*Notes:* This figure relates the volume of syndicated USD loans to local USD liabilities of banks from a given currency area. The data for the syndicated loans is obtained from LPC Refinitiv DealScan and the data on the local USD liabilities in the US is obtained from the BIS Consolidated Banking Statistics database. Euro Area banks refer to the banks domiciled in eleven Euro Area member countries. British banks refer to banks domiciled in the United Kingdom.

in USD has continued to increase whereas local USD funding by non-US banks has dwindled. Taken together, these observations indicate that banks that operate in the global syndicated loan market may need to increasingly rely on funding sources other than local USD liabilities in the US to finance their dollar-denominated banking assets.<sup>18</sup>

We now proceed by exploring the impact of USD funding conditions in shaping the elasticity of exchange rates to banking flows more formally, in line with Implication 3. We do so in various ways, first examining the role of direct borrowing in USD as a source of funding for non-US banks. As previously discussed, if US banks have ample dollar liquidity and are able to easily supply funding to non-US banks, we would expect the exchange rate elasticity to be more subdued relative to circumstances where they are more constrained in supplying dollars.

To test this hypothesis, we use balance sheet information of US banks obtained from the Federal Financial Institutions Examination Council (FFIEC) through call reports. As [Correa, Du, and Liao \(2020\)](#) show, the largest US banks operate as marginal distributors of dollar liquidity to other (especially foreign) banks. Hence, we focus on the largest 30 banking

<sup>18</sup>After origination, banks may also securitize part of the syndicated loans and sell them to (non-bank) investors. In situations where non-US banks are unable to secure direct USD funding (e.g., in the US interbank market), they may turn to FX swaps to obtain USD liquidity.

institutions in the US and relate their reserve holdings at the Fed to their total (risk-weighted) assets to obtain a measure of “reserve abundance” for the time period after January 2009, dividing our sample into above and below average across the sample period.<sup>19</sup> Table 6 shows that when the share of reserves to total risk-weighted assets is low, the exchange rate elasticity is higher. In other words, when US banks have limited liquidity to distribute, the marginal cost of providing USD funding rises, which induces a stronger appreciation of the USD.

**Table 6:** Exchange rate elasticity and US bank funding scarcity measures

	Share of Reserves		Share of Loans to Foreign Banks	
	(1) High	(2) Low	(3) High	(4) Low
$\overline{\Delta NCCL}$	69.515* (35.645)	231.029*** (48.900)	89.703 (60.028)	211.997*** (35.249)
Observations	452	483	429	506
Macro Controls	YES	YES	YES	YES
Currency FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Currency Areas	15	16	16	15
Pseudo- $R^2$	0.110	0.070	0.110	0.080

*Notes:* The Table reports second-stage regression results of the two-step panel IV estimation with a granular instrument. Dependent variable is the first difference of the logarithm of the spot exchange rate vis-à-vis the USD in the dimension FC/USD.  $\overline{\Delta NCCL}_{c,t}$  is the contemporaneous GIV-instrumented difference between the USD syndicated lending of foreign banks and the logarithm of foreign currency syndicated lending of US banks (obtained from the first-stage regression). An increase in this measure implies that foreign banks lend more in USD than US banks lend in foreign currency. All high-low separations of the sample are based on the average across the sample, see Internet Appendix IA.2.5 for a concrete definition. The first difference of the end-of-month VIX index and the U.S. monetary policy shock measure from Jarociński and Karadi (2020) are included as control variable, but not reported. Macro-controls refer to the first four principal components extracted from CPI inflation, 5y and 10y government bond yields and 3-month interbank rates in the respective currency areas. The sample runs from 1997/01 to 2022/12 and includes the currencies AUD, CAD, CHF, CNY, DKK, EUR, GBP, INR, JPY, KRW, MXN, MYR, NOK, PHP, PLN, SEK, SGD, THB, TWD, ZAR. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses.

As a second way of analyzing the role of USD funding market tightness, we examine whether the ease of access to USD liquidity for foreign banks shapes the exchange rate elasticity with respect to lending flows. To measure ‘ease of access’, we focus on the share of interbank loans that US banks grant to foreign banks, either in the US through a branch or abroad. When it is low, non-US banks will need to source USD liquidity synthetically from the FX swap market

<sup>19</sup>Figure IA.3 in Section IA.2.5 of the Internet Appendix defines periods of high and low shares of reserves relative to total risk-weighted assets.

as opposed to direct interbank borrowing. We divide the sample into time periods when the shares of loans granted to foreign banks are below and above average. The results in Table 6 indeed confirm that, when the share of loans granted to foreign banks is low, the exchange rate elasticity is higher.

#### *4.2.3 Phases of the monetary policy cycle and USD funding conditions*

It is also well-known that funding conditions for banks change markedly over the monetary policy cycle. In periods when the Federal Open Market Committee (FOMC) tightens monetary conditions, competition for funds in dollar markets tends to intensify. Drechsler, Savov, and Schnabl (2017) demonstrate that US banks hold a market power advantage over deposits which allows them to keep deposit rates subdued even if policy rates set by the central bank are rising. However, foreign banks face greater pressure to compete for alternative source of wholesale funding, such as the commercial paper/certificate of deposit market, leading to higher costs and a disadvantage relative to US banks. According to Implication 3 in Section 2, tighter conditions in USD wholesale funding markets will result in a larger exchange rate elasticity in response to a rise in net cross-currency lending flows.

To test this hypothesis, we divide our sample into monetary policy cycles characterized as “hiking”, “easing”, or “no change” as depicted in Figure IA.5 in the Internet Appendix, or simply into sub-samples when the Federal Funds rate is increasing or decreasing. Table 7 shows that the impact of flows on exchange rate tends to be particularly pronounced during Fed hiking cycles. In these periods funding conditions in USD markets tend to tighten, especially for foreign banks, which in turn leads to an increase in the exchange rate elasticity with respect to cross-currency lending flows.

### **4.3 Lending flows and CIP deviations**

As discussed in Section 2, when global banks pay out a loan in a currency in which they do not have direct access to deposits, they often obtain the necessary liquidity by swapping liquidity denominated in their home currency for the denomination currency of the loan. This implies

**Table 7:** Exchange rate elasticity and the US monetary policy cycle

	(1)	(2)	(3)	(4)	(5)
	Hike	No Change	Ease	$\Delta\text{FFR}>0$	$\Delta\text{FFR}\leq 0$
$\widehat{\Delta\text{NCCL}}$	138.462*** (11.691)	95.117*** (20.861)	-86.839* (48.805)	215.317*** (47.519)	26.336 (25.877)
Observations	458	777	316	705	846
Macro Controls	YES	YES	YES	YES	YES
Currency FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Currency Areas	16	17	15	18	18
Pseudo- $R^2$	0.040	0.090	0.000	0.050	0.110

*Notes:* The Table reports second-stage regression results of the two-step panel IV estimation with a granular instrument. Dependent variable is the first difference of the logarithm of the spot exchange rate vis-à-vis the USD in the dimension FC/USD.  $\widehat{\Delta\text{NCCL}}_{c,t}$  is the contemporaneous GIV-instrumented difference between the USD syndicated lending of foreign banks and the logarithm of foreign currency syndicated lending of US banks (obtained from the first-stage regression). An increase in this measure implies that foreign banks lend more in USD compared to what US banks lend in foreign currency. ‘Hike’ refers to time periods with an increasing Federal Funds rate, ‘No Change’ refers to periods with moderate or no change in the Federal Funds rate and ‘Ease’ refers to a declining Federal Funds rate. ‘ $\Delta\text{FFR} > 0$ ’ refers to a higher Federal Funds rate compared to last month, and ‘ $\Delta\text{FFR} \leq 0$ ’ refers to a smaller or same Federal Funds rate compared to last month. The first difference of the end-of-month VIX index and the U.S. monetary policy shock measure from Jarociński and Karadi (2020) are included as control variable, but not reported. Macro-controls refer to the first four principal components extracted from CPI inflation, 5y and 10y government bond yields and 3-month interbank rates in the respective currency areas. The sample runs from 1997/01 to 2022/12 and includes the currencies AUD, CAD, CHF, CNY, DKK, EUR, GBP, INR, JPY, KRW, MXN, MYR, NOK, PHP, PLN, SEK, SGD, THB, TWD, ZAR. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses.

that shifts in net cross-currency lending should not only affect spot exchange rates, but also show up in the pricing of synthetic USD funding in FX swap markets. In line with Implication 4 of our framework, we therefore expect higher net lending flows into USD to be associated with larger CIP deviations, and we show this prediction is borne out in the data in this subsection.

We follow Du, Tepper, and Verdelhan (2018) and define the (log) cross-currency basis  $x_{t,t+n}$  as

$$x_{t,t+n} = y_{t,t+n}^{\$} - (y_{t,t+n} - \rho_{t,t+n}), \quad (16)$$

where the basis  $x_{t,t+n}$  is the difference between the *direct* USD borrowing cost,  $y_{t,t+n}^{\$}$ , and the *synthetic* USD borrowing cost,  $(y_{t,t+n} - \rho_{t,t+n})$ . The forward premium  $\rho_{t,t+n}$ , is defined as  $\rho_{t,t+n} \equiv \frac{1}{n} (f_{t,t+n} - s_t) = y_{t,t+n} - y_{t,t+n}^{\$}$ .

Deviations of the cross-currency basis from zero are commonly interpreted as deviations from Covered Interest Parity (Du, Tepper, and Verdelhan, 2018). A negative currency basis implies tightness of funding conditions in US dollar markets in that the synthetic USD borrowing cost – implied by borrowing in the foreign currency and exchanging spot while agreeing on a forward purchase of the foreign currency – exceeds the direct USD borrowing cost. As a measure for risk-free interest rates ( $y_{t,t+n}$ ), we use overnight index swap (OIS) rates. We obtain data from Refinitiv Eikon on the OIS rates, spot and forward rates on a monthly basis (end of month). Our sample spans the currencies AUD, CAD, CHF, DKK, EUR, GBP, INR, JPY, MYR, PLN, SEK, and SGD for the time period after GFC (01/2009 to 12/2022).

To test Implication 3, we analyze how changes in net cross-currency lending by global banks affect the CIP deviation across maturities from 1 month to 3 years. As in our analysis before, there is a potential endogeneity issue in the sense that a larger CIP deviation itself might increase the cost of USD lending for and thus lower USD loan originations by foreign banks. To address this issue, we again rely on our GIV framework when estimating the effect of flows on CIP deviations. Specifically, the regression equations are

$$\begin{aligned}\Delta NCCL_{c,t} &= z_{c,t} + \text{Controls}_{c,t} + \varepsilon_{c,t}, \\ \text{CIP deviation}_{n,c,t} &= \phi \widehat{\Delta NCCL}_{c,t} + \text{Controls}_{c,t} + \vartheta_{c,t},\end{aligned}\tag{17}$$

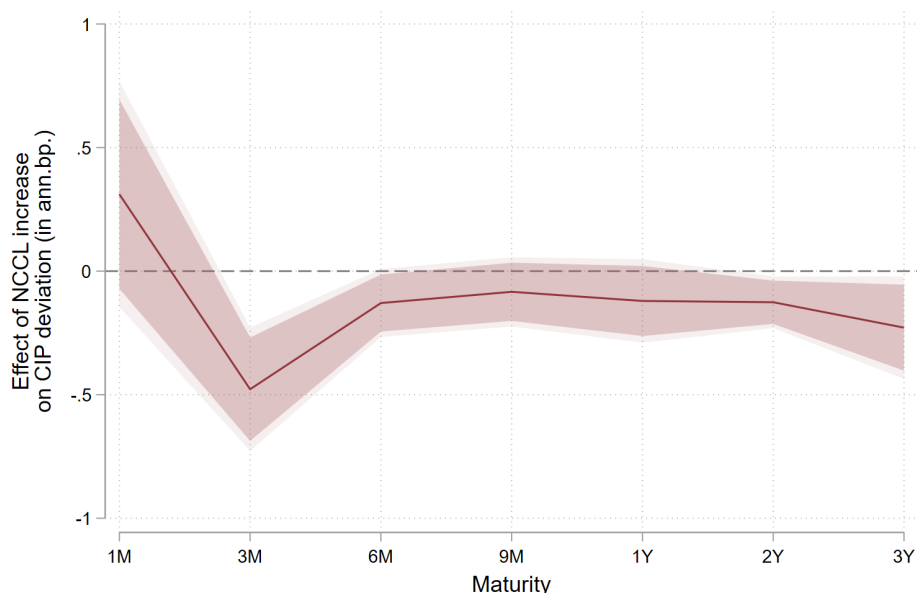
where the dependent variable,  $\text{CIP deviation}_{n,c,t}$ , is the cross currency basis for a contract with  $n$  months to maturity.  $\Delta NCCL_{c,t}$  is the previously defined net cross-border lending flow.  $z_{c,t}$  is the GIV instrument defined in Equation (14). We otherwise proceed analogously to our estimation approach in Section 3.5 when we looked at effects on the spot exchange rate.

Figure 5 shows the effect of cross-border bank lending flows on the CIP deviation across different maturities. Most of the estimated coefficients are negative which implies that an increase in net USD cross-currency lending implies a larger (i.e. more negative) CIP deviation. In terms of economic significance, a one standard deviation increase in net USD lending flows implies a 4.7 basis points more negative CIP deviation (at the three-month tenor).<sup>20</sup> Turning to

<sup>20</sup>The estimated coefficient for the three-month CIP deviation is -0.48, and  $\Delta NCCL$  in the post-GFC sample has a

the results across maturities in Figure 5, we find that the effect is strongest at the three-month tenor. This finding seems interesting, because banks that secure short-term USD liquidity via FX swaps commonly do so with contracts at a three-month maturity.<sup>21</sup> If non-US banks expand their USD lending more than their US counterparts in the respective foreign currency, the imbalance in demand for FX swaps should thus be most pronounced at this tenor and Figure 5 confirms this hypothesis. Overall, this finding lends credence to the view that cross-currency lending drives demand for USD liquidity via FX swaps, supporting Implication 4 of the motivating framework in Section 2.

**Figure 5:** Effect of net cross-currency lending on CIP deviation



*Notes:* This figure illustrates the effect of differential global bank lending on the CIP deviation. For a term of 3M the effect implies that when foreign banks grant more USD loans than US banks grant FC loans, the CIP deviation decreases, i.e. synthetic borrowing costs increase compared to direct USD borrowing costs. The (light) red area indicates the (95) 90% confidence intervals.

standard deviation of 9.75. Therefore, a one-standard-deviation increase in net USD lending flows corresponds to a larger (more negative) CIP deviation of  $0.48 \times 9.75 = 4.7$  basis points.

<sup>21</sup>Based on our discussions with market participants in treasury and syndicated loan divisions at banks, the three-month tenor was mentioned as the most common swap maturity by far. This is also consistent with the maturity structure in the USD-EUR FX derivatives market, as documented by Kubitza, Sigaux, and Vandeweyer (2024), with an average time to maturity of 2.3 months.

## 5 Additional results and robustness

This section contains the results of additional results and robustness exercises. It shows that the main insights from the paper also hold with alternative constructions for the GIV instrument as well as with a narrower, yet fully economically motivated, instrument.

### 5.1 Augmented GIV Approach

Bank heterogeneity in generating net cross-currency lending flows may not be fully addressed by simple differencing based on granularity. For instance, larger banks are often more exposed to global shocks, such as U.S. monetary policy, domestic politics, or geopolitical tensions, which also affect the USD exchange rate. To account for this, we follow [Gabaix and Koijen \(2024\)](#) and [Camanho, Hau, and Rey \(2022\)](#) and apply an augmented residualization approach. This method filters out the predictable component of bank loans using bank characteristics and fixed effects.

Specifically, we regress bank-level loan flows  $\Delta l_{jct}$  on global components and bank characteristics with bank fixed effects, as shown in Equation (18).  $\eta_{ct}$  denotes a vector of common shocks, including U.S. monetary policy shocks measured by [Jarociński and Karadi \(2020\)](#) and changes in the VIX.  $Bank_{jct}$  is a vector of bank characteristics, including bank size, equity-to-asset ratio, loan-to-asset ratio, and profitability.<sup>22</sup>  $\alpha_j$  denotes bank fixed effects, which absorb lender characteristics that do not vary over time. We then use the residual bank loan flows  $\hat{v}_{jct}$ , instead of the raw flows, to construct the GIV while keeping all other components unchanged. The resulting instrument,  $z_{ct}^{res}$ , is then used to re-estimate the baseline specification.

$$\Delta l_{jct} = \gamma \eta_{ct} + \beta Bank_{jct} + \alpha_j + v_{jct} \quad (18)$$

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<sup>22</sup>These bank-level variables are measured at the bank-year level and are constructed from Bankscope and BankFocus balance sheet data. We create a concordance between the lender parent identifier in DealScan and the bank identifier in Bankscope and BankFocus, making use of the link table from [Schwert \(2018\)](#) and manually completing the remaining links.

Panel A of Table 8 reports the results using the residualized GIV. As indicated in the lower panel, we employ different sets of bank control variables, ranging from no controls to specifications including bank size, equity-to-asset ratio, loan-to-asset ratio, and net income-to-asset ratio. Across these variations, the estimated coefficients are very close to, and in some cases even stronger than, the baseline results.

In an additional exercise, we extend Equation (2) to allow for heterogeneous loadings on common shocks across banks:  $f_{jct} = \eta'_{ct} \delta_{jc} + u_{jct}$ . Consequently,  $z_{ct} = \sum_i (\omega_{jct} - \frac{1}{N_{ct}}) (\eta'_{ct} \delta_{jc} + u_{jct})$ . In this case, the simple differencing approach may no longer be sufficient to ensure the exogeneity of the instrument, since  $z_{ct}$  still contains  $\eta'_{ct}$ . To address this issue, we follow [Galaasen, Jamilov, Juelsrud, and Rey \(2020\)](#) and perform non-parametric factor extraction and include the ensuing  $k$  factors,  $\eta^k_{ct}$ , as explicit controls in the IV regression. This procedure removes the influence of  $\eta'_{ct}$  from  $z_{ct}$ . Specifically, we apply principal component analysis (PCA) to the residualized bank flows, conducting the analysis separately for each currency area  $c$ :  $\hat{v}^*_{jct} = \eta'_{ct} \delta_{jc} + u_{jct}$  where  $\hat{v}^*_{jct}$  denotes the de-meaned residualized bank loan flows:  $\hat{v}^*_{jct} = \hat{v}_{jct} - \frac{1}{N_{ct}} \sum_j \hat{v}_{jct}$ .

As our panel is unbalanced, we first restrict the sample for principal component extraction to banks with loan flows observed for at least 200 months. We then implement an Expectation Maximization Principal Component Analysis (EMPCA) algorithm using an Alternating Least Squares (ALS) routine, which recursively estimates the principal components. This approach is particularly well suited for datasets with missing observations, where standard PCA would be biased or infeasible.

Specifically, we extract two components, starting with random initial values  $\eta^1_{ct}$  and  $\eta^2_{ct}$ . We then estimate  $\delta^1_{jc}$  and  $\delta^2_{jc}$  via least squares regressions of  $\hat{v}^*_{jct}$  on the current factor values for each bank. Next, holding  $\delta^1_{jc}$  and  $\delta^2_{jc}$  fixed, we re-estimate  $\eta^1_{ct}$  and  $\eta^2_{ct}$  by regressing  $\hat{v}^*_{jct}$  on the current loadings for each month. This procedure is repeated until convergence. In all cases, we conduct EMPCA separately for inflows and outflows, obtaining  $\eta^k_{ct}$  ( $k = 1, 2$ ) for each. We then take the difference between the principal components from inflows and outflows to construct net values and use these in turn as controls in the IV regressions.

**Table 8:** Results using residualized GIV and controlling for principal components

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Residualized GIV</i>						
$\overline{\Delta NCCL}$	72.287*** (27.260)	69.364*** (26.794)	68.942*** (24.994)	69.397*** (26.895)	68.919*** (25.078)	69.640*** (25.320)
Observations	1551	1551	1551	1551	1551	1551
Macro Controls	YES	YES	YES	YES	YES	YES
Currency FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Currency Areas	20	20	20	20	20	20
Pseudo- $R^2$	0.140	0.140	0.140	0.140	0.140	0.140
F-Statistics	24.326	22.312	14.448	22.441	14.544	14.539
<i>Panel B: Principal Components in Control</i>						
$\overline{\Delta NCCL}$	75.694*** (20.168)	67.610** (27.413)	67.976*** (24.143)	65.714** (27.151)	73.890*** (15.978)	76.458*** (15.279)
Observations	1515	1515	1515	1515	1515	1515
Macro Controls	YES	YES	YES	YES	YES	YES
Currency FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Currency Areas	13	13	13	13	13	13
Pseudo- $R^2$	0.140	0.140	0.140	0.150	0.140	0.140
<i>Controls in Residualization:</i>						
Only Bank FE	YES					
Bank Size		YES	YES	YES	YES	YES
Loan-to-Asset Ratio			YES		YES	YES
Equity-to-Asset Ratio				YES	YES	YES
Net Income-to-Asset Ratio						YES

*Notes:* The table reports second-stage results of the two-step panel IV estimation with a granular instrument. We use the residualized instrument in all regressions. Specifically, we regress bank-level loan flows on the bank-level control variables listed in the lower panel, take the residuals, and use these residuals to construct the residualized granular instrument. The dependent variable is the first difference of the logarithm of the spot exchange rate vis-à-vis the USD in the dimension FC/USD.  $\overline{\Delta NCCL}_{c,t}$  is the contemporaneous GIV-instrumented difference between the lending of foreign banks into the USD and US bank lending flow out of the USD (obtained from the first-stage regression). An increase in this measure implies that foreign banks lend more in USD than US banks in foreign currency. The first difference of the end-of-month VIX index and the U.S. monetary policy shock measure from Jarociński and Karadi (2020) are included in all regressions, but not reported. Macro-controls refer to the first four principal components extracted from CPI inflation, 5y and 10y government bond yields and 3-month interbank rates in the respective currency areas. The sample runs from 1997/01 to 2022/12 and includes the currencies AUD, CAD, CHF, CNY, DKK, EUR, GBP, INR, JPY, KRW, MXN, MYR, NOK, PHP, PLN, SEK, SGD, THB, TWD, ZAR. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses. Pseudo- $R^2$  refers to the squared correlation between the second stage variables and the dependent variable here and in the henceforth.

As a consequence of the way of implementing the algorithm, specifications that include the principal components  $\eta_{ct}^1$  and  $\eta_{ct}^2$  as controls have fewer observations. Panel B of Table 8 reports the results with these additional controls, showing that our main findings become even stronger once bank-level principal components of loan flows are accounted for.

## 5.2 Capital constrainedness as an alternative instrument

Next, we provide robustness of our main finding by utilizing an alternative instrument instead of the Granular IV we deployed in our main analysis in Section 5.2. We provide further robustness results in the Internet Appendix.

Finding an instrument that impacts cross-currency loan flows but not exchange rates is challenging because most candidate variables would affect not only lending flows but also overall economic conditions and thus exchange rates. Our GIV instrument in our baseline results addresses this main issue, allowing for a clean identification of the impact of cross-currency loan flows on exchange rates. That said, to strengthen the robustness of our main finding, we also construct an alternative instrument that is based on a shift in credit lending conditions but plausibly uncorrelated with exchange rate changes. This alternative instrument, makes use of a change in regulations in the Eurozone, allowing for a clear economic interpretation. A drawback though is that it has limitations in terms of the sample of countries and the time period that can be covered in our estimation (06/2011 until 12/2013). We hence prefer the GIV approach for our baseline.

Specifically, we utilize the European Banking Authority (EBA) capital exercise as a quasi-natural experiment. The EBA capital exercise, conducted in 2011/2012, mandated the largest European banks to raise their Core Tier 1 capital ratios to 9% by the end of June 2012. As this only affected European banks, we employ our global lending data to analyze the differential impact of lending on the exchange rate of European banks in comparison to banks in the United Kingdom and Canada.<sup>23</sup>

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<sup>23</sup>We restrict our attention to banks from these countries as they are most similar and comparable lending condition surveys are available for our period of interest. We include banks from the UK in the control group despite the largest banks having been part of the EBA capital exercise, as the four banking groups already considerably

The instrument we use considers the interaction of the (log of the) Tier 1 capital and an indicator variable indicating the post-EBA period.

$$\text{Instrument}_{c,t} = \text{Tier 1 capital}_{c,t} \times \mathbb{1}_{c,t}^{EBA}.$$

High levels of Tier 1 capital allow banks to be less affected by the EBA capital exercise in their lending business. This is in line with [Gropp, Mosk, Ongena, and Wix \(2019\)](#), who find that banks that needed to raise capital during the capital exercise reduced their lending. The last factor takes on the value 1 if the currency area is subject to the EBA capital exercise. Thus, we expect this measure to correlate positively with inflows into the country, as tighter regulatory scrutiny in the home country makes lending by foreign banks relatively more attractive compared to local banks.

Notably, the EBA capital exercise is unlikely to have affected exchange rates directly, which makes the lending tightness measure a suitable instrument for net cross-currency lending. This is supported by a negligible correlation between our lending tightness measures and spot exchange rate changes.

Table 9 reports estimation results using this alternative lending tightness instrument. The instrument exhibits a positive correlation with the cross-border loan measure in the first-stage regression. This is intuitive as higher capitalized banking systems are less affected by the EBA capital exercise. In the second stage, we find a positive and significant effect of cross-currency lending flows on exchange rates. The effect turns out to be somewhat larger in magnitude than our baseline estimate (see Table 2 for comparison). These results support the notion that differences between countries in the ease of originating new syndicated loans have a bearing on the exchange rate via a decline in cross-currency loan flows.<sup>24</sup>

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exceeded the regulatory threshold prior to the EBA capital exercise following prior scrutiny by local regulators.  
<sup>24</sup>To account for differences in this small time frame in the lending condition expectations, we control for the current value of lending expectations in the respective home countries throughout all our specifications.

**Table 9:** Baseline regression with alternative instrument

<i>Instrument:</i>	Tier 1 Capital $_{c,t} \times \mathbb{1}_{c,t}^{EBA}$	
	(1)	(2)
	First Stage	Second Stage
<i>Dependent variable:</i>	$\Delta NCCL$	$\Delta s$
Instrument	0.819*** (0.277)	
$\widehat{\Delta NCCL}$		181.566*** (52.368)
Observations	93	93
Macro Controls	Yes	YES
Currency FE		YES
Year FE	Yes	YES
Currency Areas	3	3
Pseudo- $R^2$		0.010

*Notes:* The Table reports the results of two-stage panel IV estimation with an alternative instrument. Dependent variable is the first difference of the logarithm of the spot exchange rate vis-à-vis the USD in the dimension FC/USD.  $\widehat{\Delta NCCL}_{c,t}$  is the contemporaneous instrumented difference between the USD syndicated lending of foreign banks and the logarithm of foreign currency syndicated lending of US banks. An increase in this measure implies that foreign banks lend more in USD than US banks lend in foreign currency. As instrument, we use the (log of) Tier 1 capital holdings, and a binary variable indicating European banks under effect of the EBA capital exercise (07/2012-03/2013). The first difference of the end-of-month VIX index, the U.S. monetary policy shock measure from Jarociński and Karadi (2020), as well as the current lending condition expectation are included as control variables, but not reported. Macro-controls refers to the first four principal components extracted from CPI inflation, five-year and ten-year government bond yields and three-month interbank rates in the respective currency areas. The sample runs from 2011/06 to 2013/12 and includes the currencies CAD, EUR, GBP. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses.

## 6 Conclusion

We examine the impact of flows on exchange rates leveraging granular information on cross-currency lending in the syndicated loan market. We demonstrate that when foreign banks increase USD-denominated lending relative to US banks' foreign-currency lending, the USD appreciates. Guided by our conceptual motivating framework, we show that this effect arises from the interplay between heightened demand for USD liquidity by foreign banks and inelastic supply of dollars by intermediaries. These effects have intensified since the Global Financial Crisis (GFC), reflecting structural shifts in funding markets and tighter regulatory constraints on intermediaries.

Our findings further reveal that the exchange rate elasticity to lending flows is state-dependent and shaped by intermediation constraints and USD funding market tightness. Furthermore, we show that cross-currency lending flows influence FX swap pricing, with significant deviations from covered interest parity (CIP), particularly at the three-month tenor. All in all, these findings point to an important role for intermediation and funding frictions in affecting exchange rate dynamics.

Overall, our paper has a number of implications both for the literature on frictions in FX markets and the importance of intermediaries for asset prices as well as for policy makers. First, we add to the literature on inelastic markets (Gabaix and Koijen, 2021) and provide evidence that cross-currency lending flows significantly move exchange rates. While the earlier literature recognizes the importance of cross-currency capital flow “bonanzas” in emerging markets, our results suggest sizeable effects generated by international bank lending flows even in developed markets. Importantly, banks are not simply intermediaries here that accommodate other investors’ flows, for instance through their dealer subsidiaries that intermediate trade in instruments such as bonds or derivatives, but they are also at the heart of this effect by making lending decisions themselves. Second, our results emphasize the importance for policymakers to consider the international spillover effects of monetary policy that may be magnified by the cross-currency lending activities of global banks.

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## Appendix

This Appendix provides additional information on data sources and tickers, as well as additional information on the granular instrumental variable approach underlying our empirical results.

### A.1 Additional Information on Data

**Table A.1: Data Sources**

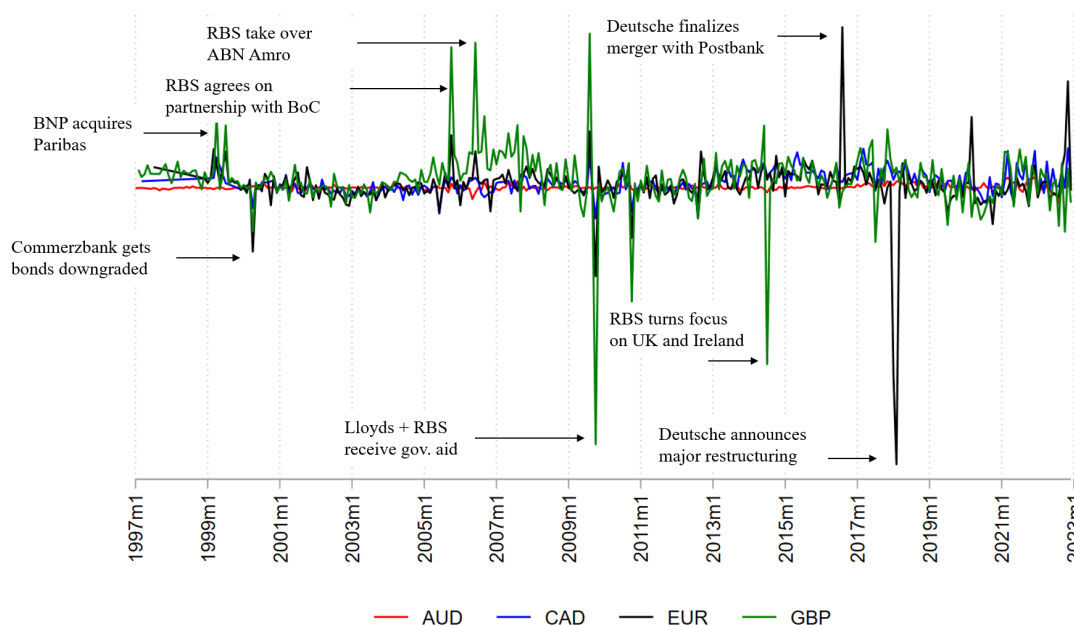
Variable Name	Description	Data Source	Mnemonic/Link
Spot exchange rate	FC/USD (ann. bp.)	BIS	<a href="#">Link</a>
Forward rates	FC/USD (ann. bp.)	Refinitiv Eikon	USD+X+1M=R, X=3 digit currency code
Loan volume	Volume of outstanding loans	Refinitiv DealScan	<a href="#">Link</a>
VIX index	CBOE Volatility Index	Federal Reserve Bank of St. Louis	VIXCLS (Monthly, Average)
3 month interbank	90-day interbank rates and yields	Federal Reserve Bank of St. Louis	IR3TIB01+X+M156N, X=2 digit country code
CPI inflation	Core CPI, Standardized, SA, Chg P/P	Refinitiv Eikon	a+X+CCORPE/A, X=2 digit country code
5y and 10y gov. bond yields		Refinitiv Eikon	X+5YT=RR/X+10YT=RR, X=2 digit country code
OIS rates	1 Month Overnight Index Swap	Refinitiv Eikon	X+1MOIS= with X=['JPY', 'CHF', 'USD', 'GBP', 'AUD', 'CAD', 'NZD'], 'EUREON1M=', 'KRW1MOIS=KMBC', 'CNYAMOS1M=CFIC', 'INRAMONMI1M=', 'NOK1MOIS=TDS'
CP/CD Issuance	USD CP/CD Issuance volume	Refinitiv Eikon	Manual download of issued CP/CDs
CP/CD Rating	CP/CD Issuer Rating	Refinitiv Eikon	TR.IssuerRating of ISINs
Net USD positions within country	USD claims - liab. positions	BIS LBS	
Lending conditions	Exp. lending cond. 3 months ahead	ECB Canada UK	BLS.Q.U2.ALL.LE.E.Z.F3.ST.S.WFNET SLOS Credit Conditions Survey
Tier 1 capital holdings of banks	Tier 1 capital holdings of banks	BankFocus	

*Notes:* This table summarizes the data sources used to obtain the information we deploy in our empirical analysis.

## A.2 Validity of the Granular Instrument Variable

To provide a more comprehensive understanding of the GIV instrument’s dynamics, we examine significant fluctuations and relate them to key corporate events involving major contributors to respective value of the instrument. In Figure A.1, we depict the temporal evolution of the GIV instrument. Notably, many of the substantial fluctuations can be attributed to events such as bank mergers, unanticipated profit spikes or drops, and significant shifts in a bank’s strategy - often developed in collaboration with government authorities.

**Figure A.1:** GIV instrument over Time



*Notes:* This figure illustrates time-series variation in the GIV instrument. Large spikes in the instrument can be linked to corporate events. Notably, most of the substantial fluctuations can be linked to idiosyncratic events such as bank mergers, unanticipated spikes or decreases in profits, or announcements of significant shifts in a bank’s corporate strategy.

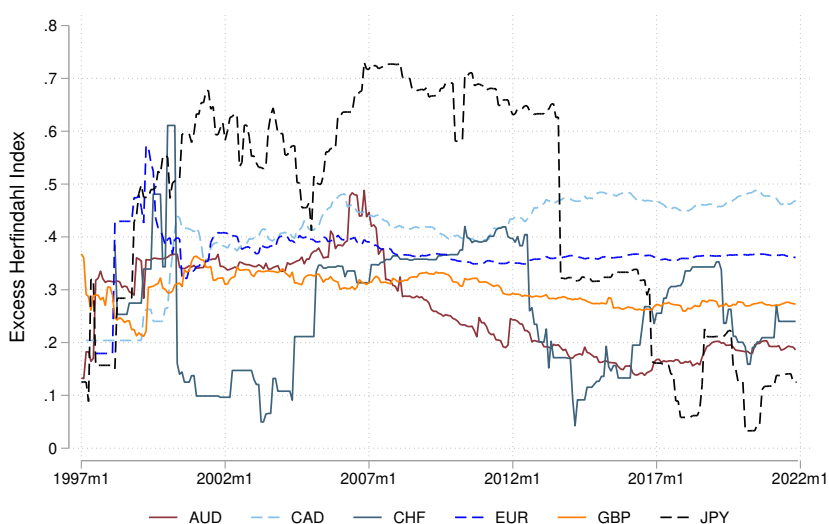
If the concentration within a country’s banking sector is high, deploying the GIV estimation approach might lead to a bias given that the estimate loses precision when estimated with few very large banks. Conversely, if banks are similar in size, the proposed instrument, which makes use of the differential effect between large and small entities, might lead to an imprecise estimate.

Therefore, we calculate the excess Herfindahl Index over time. Figure A.2 shows the evolution

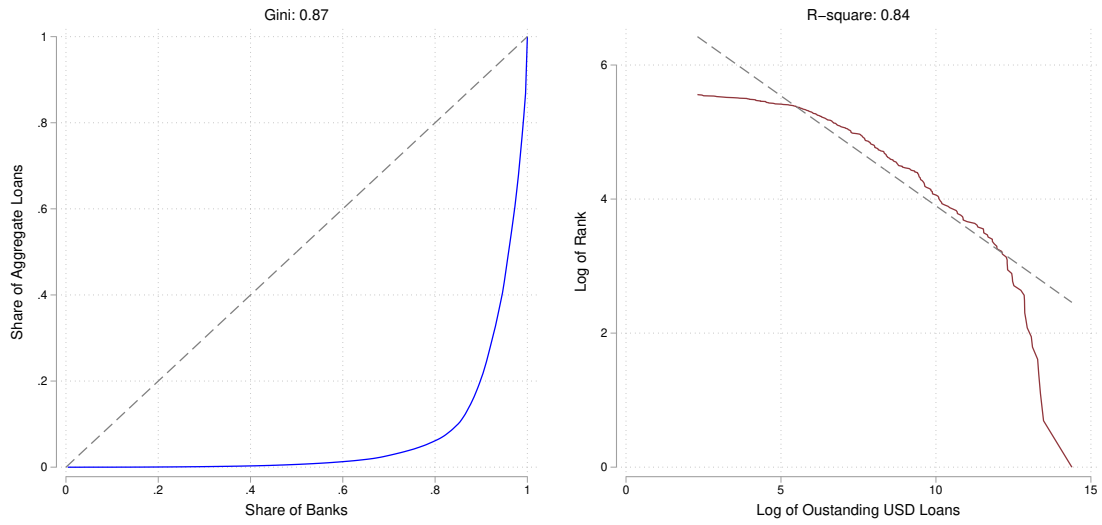
of the excess Herfindahl Index over time. The excess Herfindahl index is defined as  $h := \sqrt{-\frac{1}{N} + \sum_{i=1}^N \Psi_i^2}$ , where  $\Psi_i$  is the share of a bank among the total syndicated loan market within a currency area. Across all countries, the values of the Herfindahl index indicate a level of concentration that is suitable for a precise estimation of the endogenous flow variable by the GIV instrument as discussed in [Gabaix and Koijen \(2024\)](#).

In addition, we show the Lorenz curves and associated Gini coefficients based on banks' aggregate loans, as well as the relationship between log-rank and log size of outstanding loans, both in the last period of our sample, in [Figures A.3 and A.4](#) for US banks' non-USD loans and foreign banks' USD loans separately. They also show evidence of appropriate heterogeneity and granularity of our bank-level data.

**Figure A.2: Excess Herfindahl Index Over Time**

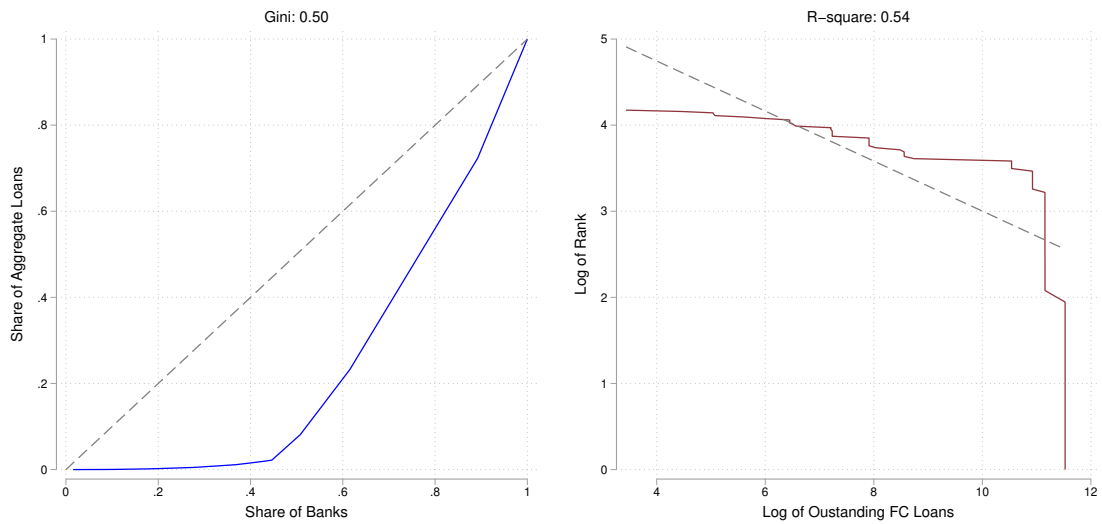


*Notes:* This figure depicts the excess Herfindahl index defined as  $h := \sqrt{-\frac{1}{N} + \sum_{i=1}^N \Psi_i^2}$ , where  $\Psi_i$  is the share of bank  $i$  as a percentage of all syndicated loans within a given currency area. For each currency area, the index is mostly between 0.1 and 0.7 over time. This implies that the GIV instrument should have sufficient precision as discussed in [Gabaix and Koijen \(2024\)](#).



**Figure A.3:** Distribution and granularity of non-US banks' USD lending

*Notes:* The figure on the left shows the distribution of the share of aggregate loans and the share of banks, from which the Gini coefficient is derived. The figure on the right shows the distribution of log rank and log loans, yielding the R-squared from the fitted regression. The data are the non-US banks' USD lending in the last period in our sample.



**Figure A.4:** Distribution and granularity of US banks' non-USD lending

*Notes:* The figure on the left shows the distribution of the share of aggregate loans and the share of banks, from which the Gini coefficient is derived. The figure on the right shows the distribution of log rank and log loans, yielding the R-squared from the fitted regression. The data are the US banks' non-USD lending in the last period in our sample.

## Internet Appendix

### Global Bank Lending and Exchange Rates

(Not for publication)

#### IA.1 Additional details on the funding mechanism

To illustrate how non-US banks fund their USD lending, Figure IA.1 shows an example of the necessary balance sheet operations for the case in which a euro area (with home currency EUR) bank grants a USD loan without having direct access to USD deposits in the US onshore financial system. When the euro bank agrees with its customer on the terms of the loan, the loan is booked on the balance sheet of the bank. This occurs in the form of a balance sheet expansion equal to the size of the USD loan, which is accompanied by granting the customer an equivalent deposit, see Step 1.

In anticipation of the drawdown of USD liquidity of the customer, say, to transfer it to a foreign supplier with a USD account (in the context of this example at a USD bank), the bank first has to acquire USD reserves for the subsequent transfer. These reserves are typically obtained via FX swaps offered by FX dealers. In essence, EUR reserves are swapped for USD reserves.<sup>25</sup>

In the last step, the bank transfers the loan notional to the other bank, for instance because the borrower has to pay a foreign supplier. The foreign bank would receive USD reserves and credit its customer's account with USD deposits. The EUR bank remains with a new position of USD denominated loans and fewer EUR liquidity on the asset side of its balance sheet. As the dealer took the opposite side of this transaction, she now holds more EUR reserves than USD reserves.

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<sup>25</sup>For the sake of illustration, the FX swap in this example takes place as a simple exchange of EUR versus USD *reserves* (base money) on the balance sheet of the dealer and the lender bank. In practice, FX swaps are off-balance sheet instruments, need not settle in reserves directly, and the euro bank does not necessarily have a reserve account at the US Federal Reserve. In the latter case, the euro bank would hold a \$ claim against a bank with Fed access. We abstract from such technicalities to keep the exposition focused.

**Figure IA.1: Loan Origination in Foreign Currency for Global Banks**

**Step 1: Expansion of the Balance Sheet when Loan is Booked**

EUR bank		Dealer		USD bank	
€ Reserves	Equity	\$ Reserves	Equity		
€ Loans	€ Deposits	€ Reserves	LT funding		
+ \$ Loans	+\$ Deposits				

**Step 2: Exchange of € Reserves and \$ Reserves in Preparation for Step 3**

EUR bank		Dealer		USD bank	
\$ Reserves	Equity	\$ Reserves	Equity		
€ Reserves	€ Deposits	€ Reserves	LT funding		
€ Loans	€ Deposits				
+ \$ Loans	+\$ Deposits				

**Step 3: Outflow of Deposits to USD Bank when Loan is Used by Customer**

EUR bank		Dealer		USD bank	
€ Reserves	Equity	\$ Reserves	Equity	\$ Reserves	+\$ Deposits
€ Loans	€ Deposits	€ Reserves	LT funding		
+ \$ Loans					

*Notes:* This figure provides a stylized example of an origination of a syndicated USD denominated loan of a bank without access to USD deposits (EUR bank). Step 1 shows the balance sheet expansion following the agreement on the loan terms and booking of the agreed upon amounts in the banks own accounts. Step 2 depicts the exchange of EUR reserves for USD reserves to be able to pay out the drawdown of the loan to the customer's beneficiary which happens in Step 3., i.e. transfer of USD reserves to the USD bank.

## IA.2 Additional data, descriptive statistics, and results

### IA.2.1 DealScan data clean process

We download all Refinitiv LoanConnector DealScan data from WRDS for period June 1981 to June 2024. The raw data has 2,907,345 obs. We clean the DealScan data based on the following procedures:

1. Deal with the problem of missing values of lender share (68.65% of the deals lack lender share information):
  - Divide the loan facility equally among all participants where exact lender shares are not available, and replace the lender share with missing if the value is negative and with 100 if the value is higher than 100
  - Use the filled loan shares to obtain the loan amount for each lender by multiplying the tranche loan amount
2. Keep closed or in process deals, drop the observations that are in the phases of canceled, rumor, on-hold, pre-mandate, or no further info (20,933 obs dropped)
3. Keep the following tranche types and drop the rest: 364-Day Facility, Delay Draw Term Loan, Limited Line, Revolver/Line < 1 Yr., Revolver/Line >= 1 Yr., Revolver/Term Loan, Term Loan, Term Loan A-K (227,546 obs dropped)
4. Drop the 62 parent lenders that are public development banks and export-import banks such as World Bank, European Investment Bank, Asian Development Bank, Export–Import Bank of China etc (32,207 obs dropped)
5. Drop the borrowers in the financial sector (300,347 dropped)
6. Drop if parent lender identifier is missing and some potential miscoding for borrowers in Indonesia (16,709 obs dropped)
7. Drop if tranche active date is later than January 2023 (125,446 obs dropped)
8. Drop lending in Deutsche Mark, France Franc, Italy Lira, Spanish Peseta, Netherlands Guilder (currencies before euro) (5,308 obs dropped)  
2,178,849 obs remain after the clean procedure
9. Table [IA.1](#) summarizes the top 30 non-USD currencies of loans made by US banks, and

the top 30 foreign currency areas in terms of issuing USD loans

**Table IA.1: Main Currencies of non-USD Loans and Currency Areas of USD Loan Issuers**

Rank	Non-USD Lending by US Banks			Foreign Banks Lending in USD		
	Currency	Freq (# of Obs)	Share (%)	Foreign Country	Freq (# of Obs)	Share (%)
1	EUR	17232	42.48 %	Euro Area	234090	35.07 %
2	CAD	10899	26.87 %	Japan	105977	15.88 %
3	GBP	5500	13.56 %	Canada	94539	14.16 %
4	AUD	2911	7.18 %	United Kingdom	90398	13.54 %
5	HKD	867	2.14 %	Switzerland	39901	5.98 %
6	JPY	602	1.48 %	Taiwan	23139	3.47 %
7	CHF	263	0.65 %	China	13846	2.07 %
8	INR	230	0.57 %	Australia	11475	1.72 %
9	NZD	225	0.55 %	Norway	6815	1.02 %
10	TWD	223	0.55 %	South Korea	3917	0.59 %
11	SEK	196	0.48 %	Israel	3911	0.59 %
12	PLN	191	0.47 %	Singapore	3770	0.56 %
13	KRW	179	0.44 %	Hong Kong	3678	0.55 %
14	SGD	157	0.39 %	United Arab Emirates	3596	0.54 %
15	MXN	152	0.37 %	India	3571	0.54 %
16	ZAR	105	0.26 %	Sweden	2881	0.43 %
17	NOK	87	0.21 %	Bahrain	2322	0.35 %
18	CNY	78	0.19 %	South Africa	2077	0.31 %
19	MYR	60	0.15 %	Denmark	2072	0.31 %
20	DKK	58	0.14 %	Malaysia	1679	0.25 %
21	CZK	49	0.12 %	Brazil	1385	0.21 %
22	PHP	48	0.12 %	Saudi Arabia	1281	0.19 %
23	THB	43	0.11 %	Jordan	930	0.14 %
24	RON	37	0.09 %	Thailand	864	0.13 %
25	COP	31	0.08 %	Kuwait	771	0.12 %
26	BDT	24	0.06 %	Qatar	624	0.09 %
27	PKR	24	0.06 %	Mexico	606	0.09 %
28	CLP	13	0.03 %	Russia	604	0.09 %
29	HUF	10	0.02 %	Turkey	584	0.09 %
30	BRL	9	0.02 %	Philippines	539	0.08 %
	Remaining Currencies	64	0.16 %	Remaining Currencies	5604	0.84 %

*Notes:* This table lists the top 30 currencies of the non-USD loans issued by US banks, and the top 30 currency areas where foreign banks domicile and issue USD loans, based on the cleaned DealScan data.

10. Keep the loans denominated in USD or one of the top 30 currencies (over 98% of the data), and calculate the outstanding loans for each bank-currency-month
11. Keep the banks headquartered in US and have at least 10 mn outstanding loans denominated in the non-USD currency; and banks headquartered in a foreign country and have at least 10 mn outstanding loans denominated in USD

12. Require each bank to have at least 40 changes in the outstanding loans across the sample period

The remaining observations are used to provide summary statistics shown in Table 1.

Table IA.2 depicts the sectoral distribution of the borrowers included in our starting sample. Most borrowers are from the manufacturing and service sector, but no sector seems to dominate over-proportionately compared to their size of the world economy.

**Table IA.2: Borrower Sector Distribution**

Industry	Percentage (%)
Manufacturing	18.71
Service	15.80
Other	11.42
Natural Resources	9.30
Wholesale & Retail	9.02
Utilities	7.62
Automotive & Transportation	6.15
Healthcare	5.56
Technology	4.95
Beverage	3.89
Telecommunications	3.79
Construction	3.79

*Notes:* This table depicts the distribution of the borrower sector within our initial sample of syndicated loans. We have reorganized the sectors in DealScan to create a more concise classification. ‘Manufacturing’ includes general manufacturing, chemicals, plastics, & rubber, textiles and apparel, and paper & packaging. ‘Service’ includes business services, services, restaurants, hotel & gaming, broadcasting, government, leisure and entertainment, and shipping. ‘Wholesale & Retail’ includes retail & supermarkets and wholesale. ‘Automotive & Transportation’ includes automotive and transportation. ‘Beverage’ includes beverage, food, and tobacco processing. Most of the borrowers are from the manufacturing sector, followed by the service sector.

### IA.2.2 Where global banks originate USD loans

Global USD syndicated lending is not confined to the US, or countries that use the USD as payment currency. Table IA.3 shows a large fraction of USD lending occurring from non-US lenders to borrowers outside the US. US banks grant around 91% of their USD denominated loans in the US, the highest fraction among all other countries. Around 48% of all USD denominated syndicated loans originate from banks domiciled in the US, again the largest country in providing USD credit globally. In comparison, banks from the Euro Area and the

United Kingdom originate 17 and 9% of all syndicated USD loans. There is a stark heterogeneity in the syndication country of the USD loan across the origin countries of banks, albeit most of the banks have a high preference to lend in the US, or their home country.

**Table IA.3: Where Global Banks Originate USD Loans**

		Borrower Origin Country										Share of Total	
		AU	CA	CH	CN	EU	GB	JP	OTH	SE	SG		US
Bank Origin Country	AU	11.59	3.49	4.22	1.56	3.12	9.35	0.78	9.88	0.31	3.89	51.81	1.05
	CA	0.19	16.14	0.75	0.01	2.00	1.83	0.04	2.13	0.06	0.25	76.60	7.60
	CH	0.97	2.17	2.10	0.26	3.70	2.58	0.05	3.20	0.10	0.55	84.33	4.84
	CN	3.38	1.85	1.96	18.25	4.38	2.82	0.20	32.83	0.09	4.35	29.89	1.32
	EU	0.60	1.92	2.66	0.49	9.47	4.65	0.58	12.03	0.40	1.00	66.20	17.58
	GB	0.67	3.19	1.85	0.58	5.17	7.82	0.46	9.02	0.22	0.81	70.21	9.58
	JP	1.08	2.33	1.25	0.52	3.42	2.87	2.96	10.86	0.14	1.14	73.42	7.62
	OTH	0.75	1.73	2.25	3.90	5.36	2.96	0.22	44.72	2.14	4.03	31.95	2.31
	SE	0.47	1.60	4.53	0.33	8.31	5.31	0.20	29.96	20.81	3.27	25.20	0.23
	SG	4.51	3.35	3.95	3.15	4.62	0.75	0.11	30.47	0.08	18.73	30.28	0.23
	US	0.21	2.26	0.56	0.09	1.98	1.58	0.24	1.87	0.06	0.16	90.99	47.63
Share of Total		2.22	3.64	2.37	2.65	4.69	3.86	0.53	17.00	2.22	3.47	57.35	

*Notes:* Country codes in the rows refer to the lending bank's parent country. Country codes in columns denote the country of the borrower (for USD loans). For example, the entry 3.49 in cell AU–CA indicates that out of all loans that Australian banks extend in USD (of which Australian banks originate 1.05% of the global market, see entry in the last column), 3.49% flow to Canadian borrowers. Conversely, Canadian banks extend 0.19% of their USD loans to Australian borrowers. Each row adds up to 100%, with each entry denoting the likelihood of a given country's banking system to lend to a borrower of a specific country. The last line denotes the share of borrowers from that country among all USD borrowers globally. The last column denotes the share of the bank origin country among the global USD lending market. All shares are calculated based on the volume of the extended loan.

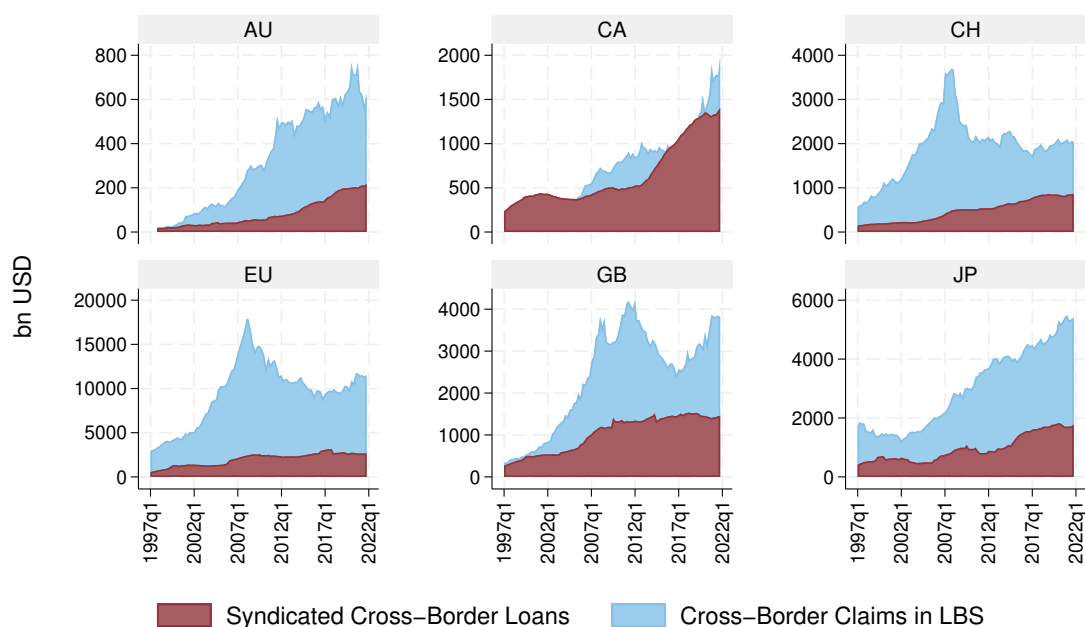
### IA.2.3 Benchmarking syndicated loans to total claims from the Locational Banking Statistics

Figure IA.2 relates the cross-currency syndicated loan volumes obtained from DealScan to the total claims banks headquartered in a currency area towards the rest of the world obtained from the BIS Locational Banking Statistics. Across countries, there is a large difference in the importance of syndicated loans among all total claims. Canada for instance has a high share of syndicated loans among total claims, whereas Australia or Japan have lower shares of syndicated lending in relation to total claims.

### IA.2.4 Spot and forward exchange rates

In our main analysis in Section 4 we show that cross-currency lending flows affect *spot* exchange rates. However, as banks hedge the exchange rate risks from cross-currency loans, a natural question is whether both spot and forward markets are affected in the same way or not.

**Figure IA.2: Cross-Currency Syndicated Loan Claims Compared to Total Claims against RoW**



*Notes:* This Figure compares total outstanding cross-currency syndicated loan volumes (red areas) to *total claims* of banks headquartered, the latter being more broadly defined and including syndicated loans as one component. Each subfigure compares syndicated cross-currency loans and total claims for banks headquartered in a particular currency area (as indicated by currency codes at the top of each sunfigure). Total claims are based on data from the BIS Locational Banking Statistics.

Against this backdrop, we compare our baseline regression involving spot exchange rates and the net cross-currency lending flows to the same regressions with the growth rates of forward rates (of various tenors) and the difference of the growth rates between forward and spot rates as dependent variables. As endogeneity can equally arise in the context of forward rates, we deploy the same GIV approach as for our baseline results.

The effect on the growth rates of forward rates is also strongly statistically significant as shown in panel (a), but slightly smaller in economic terms, as panel (b) shows. Take the 3-month forward exchange rate as an example, a 1% increase in net USD lending of foreign banks leads to an appreciation of the USD by around 64.3 annualized basis points vis-à-vis the home currency of the foreign bank. This compares to the 68.6 annualized basis points appreciation when the spot exchange rate is used as the dependent variable.<sup>26</sup> Furthermore, we test whether the difference in the impact on forward and spot rates is significant and the results show that a 1% increase in net USD lending by foreign banks moves the 3-month forward rate less than the spot rate by a smaller magnitude of 4.3 basis points.

#### *IA.2.5 Definition of sample splits*

We define in Figure IA.3 periods of reserve scarcity and abundance based on the share of reserve holdings to total assets among the top 30 US banks. If a value is above the sample average, we consider this a period of ‘reserve abundance’ and conversely below the average as ‘reserve scarce’.

Figure IA.4 defines the level of high and low shares of loans to foreign banks. As US banks could provide USD liquidity in the inter-bank market, we study the effect in periods when there is ‘high credit provision’ (above average share of loans to foreign banks in relation to risk-weighted assets) or ‘low credit provision’ (below average).

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<sup>26</sup>Note in panel (a) that the data availability of the forward rates of various tenors is different, thus the data in calculating the difference between the forward and spot rate growth is also different as shown in panel (b). More specifically, if we use the same data used for the 1-month forward rate to estimate the impact on the spot rate, the spot rate elasticity is 87.98, higher than 83.83 as shown for the 1-month forward rate.

**Table IA.4: Elasticity of Spot and Forward Exchange Rates**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Dependent variable: <math>\Delta f</math> with various tenor</i>	1M	3M	6M	9M	1Y	2Y	3Y
$\Delta NCCL$	83.574*** (8.533)	64.539** (27.336)	64.510** (27.119)	85.428*** (6.766)	62.599** (26.685)	78.908*** (4.595)	72.371*** (4.906)
Observations	1548	1551	1551	1538	1551	1460	1425
Macro Controls	YES	YES	YES	YES	YES	YES	YES
Currency FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Currency Areas	20	20	20	19	20	14	13
Pseudo- $R^2$	0.130	0.140	0.140	0.120	0.140	0.120	0.110

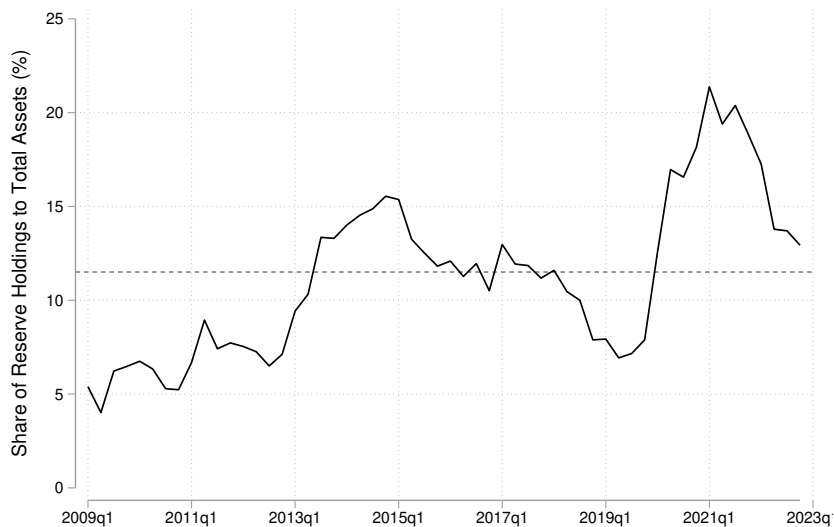
**(a) Growth Rates of Forward Rate**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Dependent variable: <math>\Delta f - \Delta s, f</math> with various tenor</i>	1M	3M	6M	9M	1Y	2Y	3Y
$\Delta NCCL$	-4.208*** (1.126)	-4.330*** (1.253)	-4.359*** (1.403)	-4.797** (2.120)	-6.271*** (1.951)	-11.206** (4.853)	-19.080*** (5.334)
Observations	1548	1551	1551	1538	1551	1460	1425
Macro Controls	YES	YES	YES	YES	YES	YES	YES
Currency FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Currency Areas	20	20	20	19	20	14	13
Pseudo- $R^2$	0.030	0.040	0.050	0.040	0.050	0.010	0.000

**(b) Difference in Growth Rates Between Forward Rates and Spot Rate**

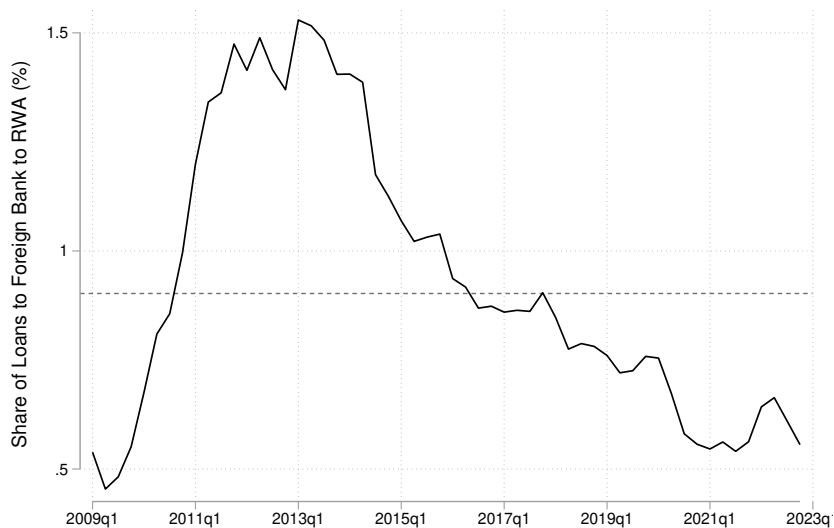
*Notes:* We compare the baseline regression of the first difference of the logarithm of the spot exchange rate vis-à-vis the USD on net cross-currency loan flows ( $\Delta NCCL$ ) with analogous regressions for forward exchange rate (log) changes (upper panel) and changes in the spread between forward and spot rates (lower panel) as dependent variables.  $\Delta NCCL_{c,t}$  is the contemporaneous GIV instrumented difference between the USD syndicated lending of foreign banks and the logarithm of foreign currency syndicated lending of US banks. An increase in this measure implies that foreign banks lend more in USD than US banks lend in foreign currency. The first difference of the end-of-month VIX index and the U.S. monetary policy shock measure from Jarociński and Karadi (2020) are included as control variable (not reported for brevity). Macro-controls refers to the first four principal components extracted from CPI inflation, five-year and ten-year government bond yields and 3 month interbank rates in the respective currency areas. The sample runs from 1997/01 to 2022/12 and includes the currencies AUD, CAD, CHF, CNY, DKK, EUR, GBP, INR, JPY, KRW, MXN, MYR, NOK, PHP, PLN, SEK, SGD, THB, TWD, ZAR. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses.

**Figure IA.3: Definition of Reserve Scarcity and Abundance**



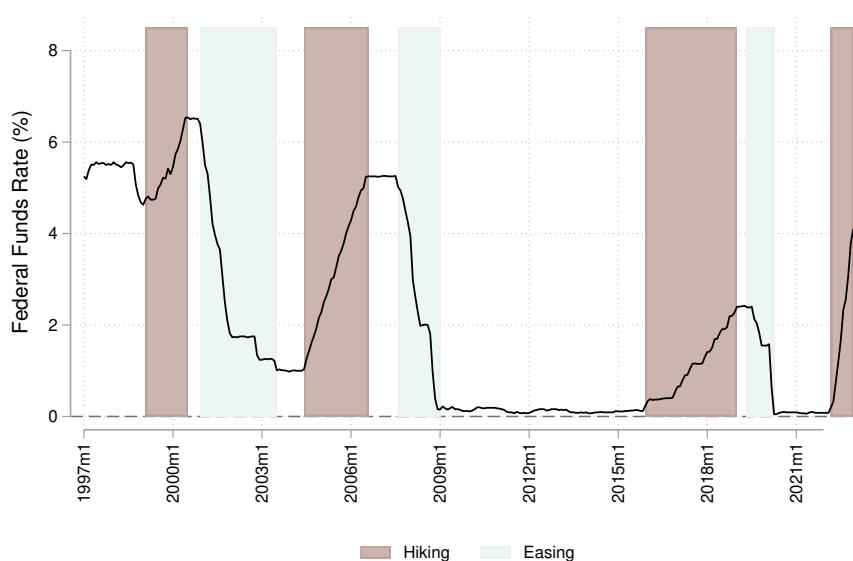
*Notes:* This figure defines the periods of high and low reserve scarcity measured as the share of reserves in relation to total risk-weighted assets. High and low refers to values above and below the average share of reserves indicated in the dashed line.

**Figure IA.4: Definition of High and Low Share of Loans to Foreign Banks**



*Notes:* This figure defines periods of high and low credit provision measured as the share of loans to US subsidiaries of foreign banks. High and low refer to above and below the average value of credit provision indicated in the dashed line.

**Figure IA.5: Definition of Monetary Policy Cycles**



*Notes:* This figure defines US monetary policy hiking (red) and easing (blue) cycles, where each cycle comprise a series of subsequent rate cuts/hikes from top to bottom and vice versa. Periods with no rate changes are not highlighted in this figure and correspond to the “No Change” category in Table 7.

### IA.2.6 Currency areas of major country groups

Table IA.5 shows the baseline regression results for selected currencies of major country groups (excluding US). ‘G3’ refers to a sample including EUR and JPY; ‘G6’ refers to EUR, JPY, and GBP; ‘G7’ refers to EUR, JPY, GBP, and CAD; ‘G7+CHF’ refers to EUR, JPY, GBP, CAD, and CHF; ‘G10’ refers to EUR, JPY, GBP, CAD, CHF, and SEK.

### IA.2.7 Excluding the Crisis Periods of GFC and COVID-19

Table IA.6 presents the baseline regression results excluding the crisis periods of the GFC (2007–2008) and/or COVID-19 (2020–2022).

### IA.2.8 Different time fixed effects

The key variables, NCCL and spot rates, are measured at the currency-area-month level. By using year fixed effects (FE) instead of month FE, we retain the variation across months for a given currency, allowing us to analyze how month-to-month changes in exchange rates

**Table IA.5: Elasticity of Spot Exchange Rates of Major Country Groups**

	G3		G6		G7		G7+CHF		G10	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\Delta NCCL$	105.766*** (6.975)	93.662*** (21.206)	104.262*** (5.665)	88.538*** (10.699)	109.024*** (6.467)	91.624*** (7.417)	108.373*** (6.359)	92.123*** (6.842)	107.317*** (6.243)	93.637*** (7.138)
Observations	414	414	719	719	990	990	1043	1043	1092	1092
Macro Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Currency FE	No	YES	No	YES	No	YES	No	YES	No	YES
Year FE	No	YES	No	YES	No	YES	No	YES	No	YES
Currency Areas	2	2	3	3	4	4	5	5	6	6
Pseudo- $R^2$	0.000	0.040	0.010	0.050	0.020	0.070	0.020	0.070	0.020	0.070

*Notes:* This table shows the baseline regression results for selected currencies of major country groups (excluding US). ‘G3’ refers to a sample including EUR and JPY; ‘G6’ refers to EUR, JPY, and GBP; ‘G7’ refers to EUR, JPY, GBP, and CAD; ‘G7+CHF’ refers to EUR, JPY, GBP, CAD, and CHF; ‘G10’ refers to EUR, JPY, GBP, CAD, CHF, and SEK. Dependent variable is the first difference of the logarithm of the spot exchange rate vis-à-vis the USD in the dimension FC/USD.  $\Delta NCCL_{c,t}$  is the contemporaneous GIV-instrumented difference between the USD syndicated lending of foreign banks and the logarithm of foreign currency syndicated lending of US banks (obtained from the first-stage regression). An increase in this measure implies that foreign banks lend more in USD than US banks lend in foreign currency. The first difference of the end-of-month VIX index and the U.S. monetary policy shock measure from Jarociński and Karadi (2020) are included as control variable, but not reported. Macro-controls refer to the first four principal components extracted from CPI inflation, 5y and 10y government bond yields and 3-month interbank rates in the respective currency areas. The sample runs from 1997/01 to 2022/12. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses.

correspond to changes in NCCL. This approach also enables us to assess the influence of global factors on currency values, such as the global financial cycle, which can be proxied by the VIX. On the other hand, using month FE emphasizes cross-sectional differences in NCCL and the varying elasticities across currencies, but we will lose the within currency variation across time.

Tables IA.7 and IA.8 provide results based on different specifications, including year-month FE and year-quarter FE, for both the pre- and post-GFC samples. Our main findings remain consistent across these specifications.

### IA.2.9 Controlling for the Global Financial Cycle Factor

Table IA.9 reports the results when we replace the first difference of the VIX with the global financial cycle factor extracted by Miranda-Agrippino and Rey (2020) among the control variables in the baseline specification. The main findings remain robust.

**Table IA.6: Excluding Crises Periods**

	Exclude GFC (2007-2008)		Exclude COVID (2020-2022)		Exclude Both	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta NCCL$	76.383*	73.165**	66.529**	65.406**	70.917*	69.757**
	(39.004)	(32.186)	(33.262)	(26.126)	(37.937)	(31.768)
Observations	1420	1420	1374	1374	1243	1243
Macro Controls	YES	YES	YES	YES	YES	YES
Currency FE	YES	YES	YES	YES	YES	YES
Year FE	No	YES	No	YES	No	YES
Currency Areas	19	19	20	20	19	19
Pseudo- $R^2$	0.090	0.130	0.090	0.120	0.090	0.110

*Notes:* This table reports second-stage regression results of the two-step panel IV estimation with a granular instrument, excluding the GFC and/or the COVID-19 crisis from the full sample period running from 1997/01 to 2022/12. The dependent variable is the first difference of the logarithm of the spot exchange rate vis-à-vis the USD in the dimension FC/USD.  $\Delta NCCL_{c,t}$  is the GIV-instrumented difference between the USD syndicated lending of foreign banks and the logarithm of foreign currency syndicated lending of US banks (obtained from the first-stage regression). An increase in this measure implies that foreign banks lend more in USD than US banks in foreign currency. The first difference of the end-of-month VIX index and the U.S. monetary policy shock measure from Jarociński and Karadi (2020) will be absorbed when the year-month FE is specified. Macro-controls refer to the first four principal components extracted from CPI inflation, 5y and 10y government bond yields and 3-month interbank rates in the respective currency areas. The sample includes the currencies AUD, CAD, CHF, CNY, DKK, EUR, GBP, INR, JPY, KRW, MXN, MYR, NOK, PHP, PLN, SEK, SGD, THB, TWD, ZAR. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses.

**Table IA.7: Using Year-Month Fixed Effects**

	Pre-GFC			Post-GFC		
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{\Delta NCCL}$	4.322 (26.561)	-24.141 (35.655)	-38.434 (36.718)	182.220*** (44.161)	159.315*** (45.407)	151.393*** (37.872)
Observations	678	678	616	937	937	935
Macro Controls	No	No	YES	No	No	YES
Currency FE	No	YES	YES	No	YES	YES
Month FE	No	YES	YES	No	YES	YES
Currency Areas	17	17	17	16	16	16
Pseudo- $R^2$	0.090	0.100	0.010	0.020	0.020	0.000

*Notes:* The Table reports second-stage regression results of the two-step panel IV estimation with a granular instrument. Pre-GFC refers to the time period before 2009/01, and post-GFC refers to the subsequent time period. The dependent variable is the first difference of the logarithm of the spot exchange rate vis-à-vis the USD in the dimension FC/USD.  $\widehat{\Delta NCCL}_{c,t}$  is the GIV-instrumented difference between the USD syndicated lending of foreign banks and the logarithm of foreign currency syndicated lending of US banks (obtained from the first-stage regression). An increase in this measure implies that foreign banks lend more in USD than US banks in foreign currency. The first difference of the end-of-month VIX index and the U.S. monetary policy shock measure from Jarociński and Karadi (2020) will be absorbed when the year-month FE is specified. Macro-controls refer to the first four principal components extracted from CPI inflation, 5y and 10y government bond yields and 3-month interbank rates in the respective currency areas. The sample runs from 1997/01 to 2022/12 and includes the currencies AUD, CAD, CHF, CNY, DKK, EUR, GBP, INR, JPY, KRW, MXN, MYR, NOK, PHP, PLN, SEK, SGD, THB, TWD, ZAR. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses.

**Table IA.8: Using Year-Quarter Fixed Effects**

	Pre-GFC			Post-GFC		
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{\Delta NCCL}$	4.322 (26.561)	8.436 (28.651)	10.502 (34.842)	182.220*** (44.161)	163.486*** (29.833)	164.702*** (26.299)
Observations	678	678	616	937	937	935
Macro Controls	No	No	YES	No	No	YES
Currency FE	No	YES	YES	No	YES	YES
Quarter FE	No	YES	YES	No	YES	YES
Currency Areas	17	17	17	16	16	16
Pseudo- $R^2$	0.090	0.120	0.090	0.020	0.060	0.090

*Notes:* The Table reports second-stage regression results of the two-step panel IV estimation with a granular instrument. Pre-GFC refers to the time period before 2009/01, and post-GFC refers to the subsequent time period. The dependent variable is the first difference of the logarithm of the spot exchange rate vis-à-vis the USD in the dimension FC/USD.  $\widehat{\Delta NCCL}_{c,t}$  is the GIV-instrumented difference between the USD syndicated lending of foreign banks and the logarithm of foreign currency syndicated lending of US banks (obtained from the first-stage regression). An increase in this measure implies that foreign banks lend more in USD than US banks in foreign currency. The first difference of the end-of-month VIX index and the U.S. monetary policy shock measure from Jarociński and Karadi (2020) are included in all regressions, but not reported. Macro-controls refer to the first four principal components extracted from CPI inflation, 5y and 10y government bond yields and 3-month interbank rates in the respective currency areas. The sample runs from 1997/01 to 2022/12 and includes the currencies AUD, CAD, CHF, CNY, DKK, EUR, GBP, INR, JPY, KRW, MXN, MYR, NOK, PHP, PLN, SEK, SGD, THB, TWD, ZAR. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses.

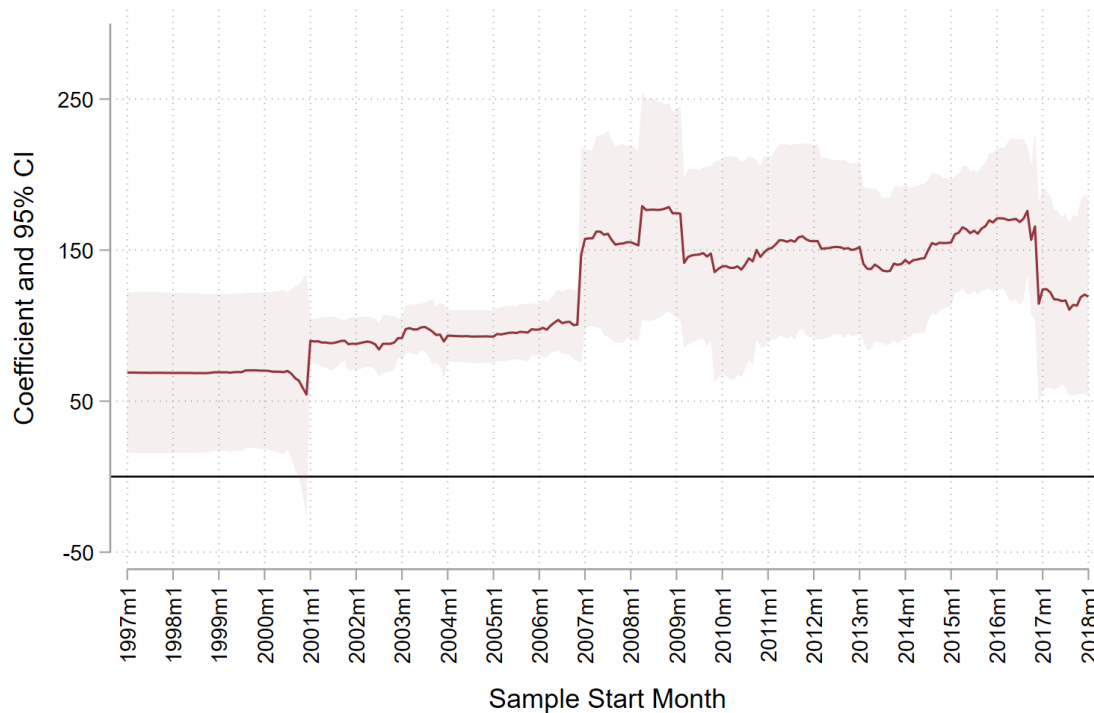
**Table IA.9: Controlling for the Global Financial Cycle Factor**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta NCCL$	55.532*	55.392**	60.304**	55.392**	68.896*	68.651**	74.454**	68.651**
	(32.142)	(25.188)	(27.833)	(25.340)	(36.981)	(28.302)	(32.482)	(28.481)
Observations	1615	1615	1615	1615	1551	1551	1551	1551
Macro Controls	No	No	No	No	YES	YES	YES	YES
Currency FE	No	No	YES	YES	No	No	YES	YES
Year FE	No	Yes	NO	YES	No	YES	No	YES
Currency Areas	20	20	20	20	20	20	20	20
Pseudo- $R^2$	0.000	0.060	0.000	0.060	0.010	0.070	0.020	0.080

*Notes:* The table reports second-stage results of the two-step panel IV estimation with a granular instrument. The dependent variable is the first difference of the logarithm of the spot exchange rate vis-à-vis the USD in the dimension FC/USD.  $\Delta NCCL_{c,t}$  is the contemporaneous GIV-instrumented difference between the lending of foreign banks into the USD and US bank lending flow out of the USD (obtained from the first-stage regression). An increase in this measure implies that foreign banks lend more in USD than US banks in foreign currency. The global financial cycle factor constructed by [Miranda-Agrippino and Rey \(2020\)](#) is included in all regressions, but not reported. Macro-controls refer to the first four principal components extracted from CPI inflation, 5y and 10y government bond yields and 3-month interbank rates in the respective currency areas. The sample runs from 1997/01 to 2022/12 and includes the currencies AUD, CAD, CHF, CNY, DKK, EUR, GBP, INR, JPY, KRW, MXN, MYR, NOK, PHP, PLN, SEK, SGD, THB, TWD, ZAR. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses. Pseudo- $R^2$  refers to the squared correlation between the second stage variables and the dependent variable here and in the henceforth.

### IA.2.10 Dynamics and persistence of the elasticity

We explore the dynamics of the exchange rate elasticity and re-run the baseline regression (with year and currency FE) by starting the sample with each of the months between 1997M1 and 2018M1 (the full sample is from 1997M1 to 2022M12). Then we plot the estimates obtained from each sample with a 95% confidence interval. Figure [IA.6](#) shows that there is a jump in the elasticity when limiting the sample to periods after 2007 and a decline in the elasticity when limiting the sample to periods after mid-2016. These findings strengthen our findings that the elasticity of exchange rates to changes in net dollar lending is stronger after the GFC.



**Figure IA.6:** Dynamics of the Elasticity by Changing Sample Periods

*Notes:* The figure reports second-stage regression results of the two-step panel IV estimation with a granular instrument. The horizontal axis indicates the month that we start the sample with (between 1997M1 and 2018M1, the full sample is from 1997M1 to 2022M12), while the end of the sample is always 2022M12. The shaded area indicates the 95% confidence interval.

#### IA.2.11 Alternative filters of active banks

In our main analysis, we filter out small and inactive global banks by limiting the banks in the DealScan database to having at least 40 changes in outstanding loans. Here we demonstrate that our findings do not rely on the arbitrary filter of 40 changes. Tables IA.10 and IA.11 show that restricting the sample to banks with at least 20 or 10 changes yields consistent findings as the baseline.

#### IA.2.12 Broker-dealer leverage and capital ratio

We use the broker-dealer capital ratio and leverage square ratio constructed by He, Kelly, and Manela (2017). Capital ratio is defined as the end of period ratio of total market capitalization

**Table IA.10: Using a filter of at least 20 changes in outstanding loans**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\overline{\Delta NCCL}$	56.098* (33.435)	58.032** (25.931)	60.046** (30.113)	58.032** (26.085)	69.736* (37.355)	70.221*** (26.467)	73.524** (34.286)	70.221*** (26.633)
Observations	1637	1637	1637	1637	1567	1567	1567	1567
Macro Controls	No	No	No	No	YES	YES	YES	YES
Currency FE	No	No	YES	YES	No	No	YES	YES
Year FE	No	Yes	NO	YES	No	YES	No	YES
Currency Areas	20	20	20	20	20	20	20	20
Pseudo- $R^2$	0.050	0.100	0.060	0.110	0.080	0.130	0.090	0.140

*Notes:* The table reports second-stage results of the two-step panel IV estimation with a granular instrument. Here we re-construct the sample by requiring banks in the DealScan database to have at least 20 changes in outstanding loans. The dependent variable is the first difference of the logarithm of the spot exchange rate vis-à-vis the USD in the dimension FC/USD.  $\overline{\Delta NCCL}_{c,t}$  is the contemporaneous GIV-instrumented difference between the lending of foreign banks into the USD and US bank lending flow out of the USD (obtained from the first-stage regression). An increase in this measure implies that foreign banks lend more in USD than US banks in foreign currency. The first difference of the end-of-month VIX index and the U.S. monetary policy shock measure from [Jarociński and Karadi \(2020\)](#) are included in all regressions, but not reported. Macro-controls refer to the first four principal components extracted from CPI inflation, 5y and 10y government bond yields and 3-month interbank rates in the respective currency areas. The sample runs from 1997/01 to 2022/12 and includes the currencies AUD, CAD, CHF, CNY, DKK, EUR, GBP, INR, JPY, KRW, MXN, MYR, NOK, PHP, PLN, SEK, SGD, THB, TWD, ZAR. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses. Pseudo- $R^2$  refers to the squared correlation between the second stage variables and the dependent variable here and in the henceforth.

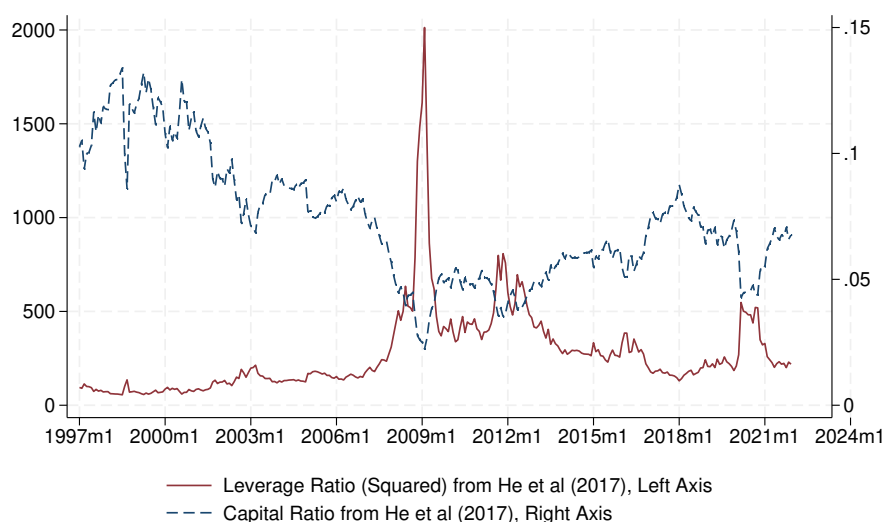
**Table IA.11: Using a filter of at least 10 changes in outstanding loans**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\widehat{\Delta NCCL}$	56.197*	55.218**	57.404**	55.218**	65.308*	57.210*	69.723**	66.415***
	(29.154)	(24.097)	(28.309)	(24.246)	(35.689)	(32.236)	(32.153)	(24.663)
Observations	1661	1661	1661	1661	1584	1584	1584	1584
Macro Controls	No	No	No	No	YES	YES	YES	YES
Currency FE	No	No	YES	YES	No	No	YES	YES
Year FE	No	Yes	NO	YES	No	YES	No	YES
Currency Areas	21	21	21	21	21	21	21	21
Pseudo- $R^2$	0.050	0.100	0.060	0.110	0.080	0.130	0.090	0.140

*Notes:* The table reports second-stage results of the two-step panel IV estimation with a granular instrument. Here we re-construct the sample by requiring banks in the DealScan database to have at least 10 changes in outstanding loans. The dependent variable is the first difference of the logarithm of the spot exchange rate vis-à-vis the USD in the dimension FC/USD.  $\widehat{\Delta NCCL}_{c,t}$  is the contemporaneous GIV-instrumented difference between the lending of foreign banks into the USD and US bank lending flow out of the USD (obtained from the first-stage regression). An increase in this measure implies that foreign banks lend more in USD than US banks in foreign currency. The first difference of the end-of-month VIX index and the U.S. monetary policy shock measure from [Jarociński and Karadi \(2020\)](#) are included in all regressions, but not reported. Macro-controls refer to the first four principal components extracted from CPI inflation, 5y and 10y government bond yields and 3-month interbank rates in the respective currency areas. The sample runs from 1997/01 to 2022/12 and includes the currencies AUD, CAD, CHF, CNY, DKK, EUR, GBP, INR, JPY, KRW, MXN, MYR, NOK, PHP, PLN, SEK, SGD, THB, TWD, ZAR. The coefficient describes the effect of a 100 bp increase in the lending measure on the spot exchange rate in basis points (p.a.). HAC-robust standard errors in parentheses. Pseudo- $R^2$  refers to the squared correlation between the second stage variables and the dependent variable here and in the henceforth.

to (total market capitalization + book assets - book equity) of NY Fed primary dealers' publicly-traded holding companies, and leverage ratio squared is defined as  $(1/capital\ ratio)^2$ . Figure IA.7 shows that the broker-dealer capital ratio is lower and leverage ratio is higher after GFC.

**Figure IA.7: Broker-dealer leverage**



*Notes:* This figure presents the broker-dealer capital ratio and leverage square ratio constructed by He, Kelly, and Manela (2017). Capital ratio is defined as the end of period ratio of total market capitalization to (total market capitalization + book assets - book equity) of NY Fed primary dealers' publicly-traded holding companies, and leverage ratio squared is defined as  $(1/capital\ ratio)^2$ .

### IA.3 Additional information on CIP deviations and global bank lending

#### IA.3.1 CIP deviations as a measure of USD funding tightness

A substantial body of literature has demonstrated that the tightness of funding markets is closely related to CIP deviations (Rime, Schrimpf, and Syrstad, 2022) and that post-financial crisis bank regulation has exacerbated funding stress in the FX swap market (e.g. Du, Tepper, and Verdelhan, 2018; Correa, Du, and Liao, 2020).

The CIP deviation is a measure of the synthetic cost of obtaining USD funding, i.e. borrowing foreign currency, swapping it for USD and then selling it forward, compared to direct USD funding costs. The more negative the CIP deviation, the more costly it is to access USD via FX swaps in comparison to direct USD borrowing. We also dig deeper into the relation between funding costs, net cross-currency loan growth, and CIP deviations in the subsection below.

We define the CIP condition as

$$\left(1 + y_{t,t+n}^{\$}\right)^n = \left(1 + y_{t,t+n} + x_{t,t+n}\right)^n \frac{S_t}{F_{t,t+n}},$$

where  $y_{t,t+n}^{\$}$  denotes the risk-free interest rate in USD for the term (in years)  $n$ . Equivalently,  $y_{t,t+n}$  denotes the risk-free interest rate in the foreign currency.  $S_t$  and  $F_{t,t+n}$  denote the spot rate at time  $t$  and forward rate at time  $t$  for time  $t+n$  respectively.  $x_{t,t+n}$  denotes the cross-currency basis, which we can also express in log form as

$$x_{t,t+n} = y_{t,t+n}^{\$} - (y_{t,t+n} - \rho_{t,t+n}),$$

where the basis  $x_{t,t+n}$  is the difference between the *direct* USD borrowing cost,  $y_{t,t+n}^{\$}$ , and the *synthetic* USD borrowing cost,  $(y_{t,t+n} - \rho_{t,t+n})$ . The forward premium  $\rho_{t,t+n}$ , is defined as

$$\rho_{t,t+n} \equiv \frac{1}{n} (f_{t,t+n} - s_t) = y_{t,t+n} - y_{t,t+n}^{\$}.$$

A negative currency basis implies that the synthetic USD borrowing cost implied by borrowing in the foreign currency and exchanging spot while agreeing on a forward purchase of the foreign currency after term  $n$  is higher than the direct USD borrowing cost.

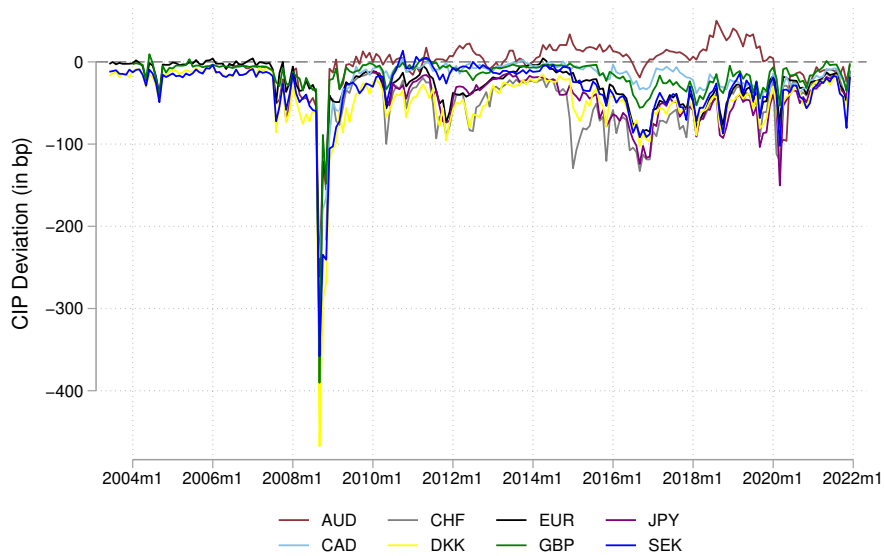
Figure IA.8 shows the evolution of CIP deviations over time. Akin to Du, Tepper, and Verdelhan (2018) we find that whereas before 2009 CIP deviations were essentially 0, large (mostly negative) CIP deviations persist thereafter. This implies that USD borrowing costs for banks without access to direct USD borrowing exceed those of their US counterparts.

### IA.3.2 Global loan flows and CIP deviations

Table IA.12 reports the impact of net cross-currency lending on the CIP deviations as well as its components of interest rate differences ( $y_{t,t+n}^{\$} - y_{t,t+n}$ ) and forward premium ( $\rho_{t,t+n}$ ). The coefficients of the elasticity on CIP (first column of every tenor) correspond to the values shown in Figure 5.

Figure IA.9 illustrates the median 3-month CIP deviation of a currency area after the financial crisis and the median value of the net lending flow measure  $\Delta\text{NCCL}_{c,t}$ . There is a clear negative

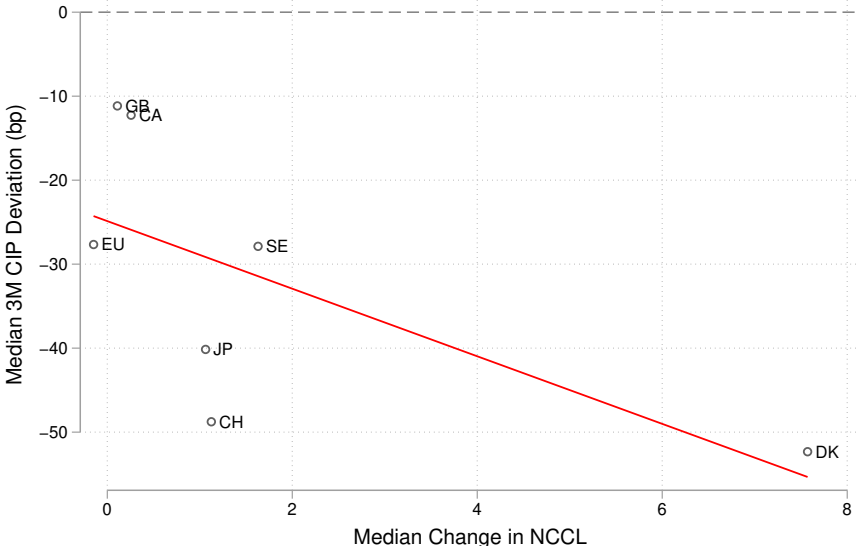
**Figure IA.8: CIP Deviations at Three Month Term**



*Notes:* This figure depicts the deviations from the CIP condition as defined in equation (16) at 3 month term. The data is obtained from Refinitiv Eikon. Large negative CIP deviations persist since the 2009.

relation between the lending flows and CIP deviations, indicating that greater inflows correspond to more substantial negative CIP deviations across different currency areas in a cross-sectional context.

**Figure IA.9:** Global Loan Flows and CIP deviations in the cross section



*Notes:* This figure shows medians of CIP deviations (at the three-month maturity) and medians of changes in net cross-currency lending  $\Delta NCCL_{c,t}$  over the sample period after 2009. The data on CIP deviations are obtained from Refinitiv Eikon.

**Table IA.12: Impact on CIP and Decomposition**

	1M			3M			6M			9M			1Y			2Y			3Y		
	(1) CIP	(2) Int Diff	(3) Rho	(4) CIP	(5) Int Diff	(6) Rho	(7) CIP	(8) Int Diff	(9) Rho	(10) CIP	(11) Int Diff	(12) Rho	(13) CIP	(14) Int Diff	(15) Rho	(16) CIP	(17) Int Diff	(18) Rho	(19) CIP	(20) Int Diff	(21) Rho
$\Delta$ NCCL	0.311 (0.233)	-0.275 (0.851)	0.586 (1.038)	-0.478*** (0.127)	-0.276 (0.730)	-0.202 (0.686)	-0.129* (0.070)	-0.096 (0.582)	-0.033 (0.600)	-0.084 (0.072)	0.066 (0.572)	-0.150 (0.600)	-0.121 (0.086)	0.151 (0.522)	-0.272 (0.557)	-0.126** (0.053)	0.720 (0.546)	-0.846 (0.528)	-0.229** (0.106)	0.815 (0.677)	-1.044* (0.594)
Observations	1046	1046	1046	1047	1047	1047	1050	1050	1050	1045	1045	1045	1050	1050	1050	618	618	618	507	507	507
Macro Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Currency FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Currency Areas	12	12	12	12	12	12	12	12	12	12	12	12	12.000	12	12	8	8	8	7	7	7
Pseudo- $R^2$	0.330	0.630	0.540	0.400	0.610	0.580	0.430	0.650	0.610	0.450	0.660	0.620	0.480	0.660	0.630	0.510	0.580	0.680	0.760	0.860	0.710

*Notes:* The table reports second-stage results of the two-step panel IV estimation with a granular instrument. The dependent variable is the CIP deviations as well as its components of interest rate differences ( $y_{t,t+n}^{\$} - y_{t,t+n}$ ) and forward premium ( $\rho_{t,t+n}$ ) for each tenor of 1-month, 3-month, 6-month, 9-month, 1-year, 2-year, and 3-year.  $\widehat{\Delta NCCL}_{c,t}$  is the contemporaneous GIV-instrumented difference between the lending of foreign banks into the USD and US bank lending flow out of the USD (obtained from the first-stage regression). An increase in this measure implies that foreign banks lend more in USD than US banks in foreign currency. The first difference of the end-of-month VIX index and the U.S. monetary policy shock measure from Jarociński and Karadi (2020) are included in all regressions, but not reported. Macro-controls refer to the first four principal components extracted from CPI inflation, 5y and 10y government bond yields and 3-month interbank rates in the respective currency areas. The sample runs from 2009/01 to 2022/12 and includes the currencies AUD, CAD, CHF, DKK, EUR, GBP, INR, JPY, MYR, PLN, SEK, and SGD. The coefficient describes the effect of a 100 bp increase in the lending measure on the dependent variable in basis points (p.a.). HAC-robust standard errors in parentheses. Pseudo- $R^2$  refers to the squared correlation between the second stage variables and the dependent variable here and in the henceforth.