Foreign-borne Interest Rate Risk

Rashad Ahmed*

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Abstract

This paper shows that interest rates on deposits issued in the foreign offices of US banks ("foreign deposits") are more sensitive to US monetary policy than rates on domestically issued deposits. Estimated *deposit betas* are roughly 20 percentage points larger for foreign deposits, a gap that persists across dollar-denominated accounts, under Fed rate hikes and cuts, and after controlling for other drivers of deposit betas. The uninsured status of foreign deposits explains only part of the difference. At the consolidated level, US banks with high foreign deposit shares will have more interest-sensitive liabilities, but they also hold more interest-sensitive assets. Despite this, these banks exhibit stronger stock price reactions to US monetary policy, suggesting that foreign deposits raise their net exposure to interest rate risk and investors price this risk.

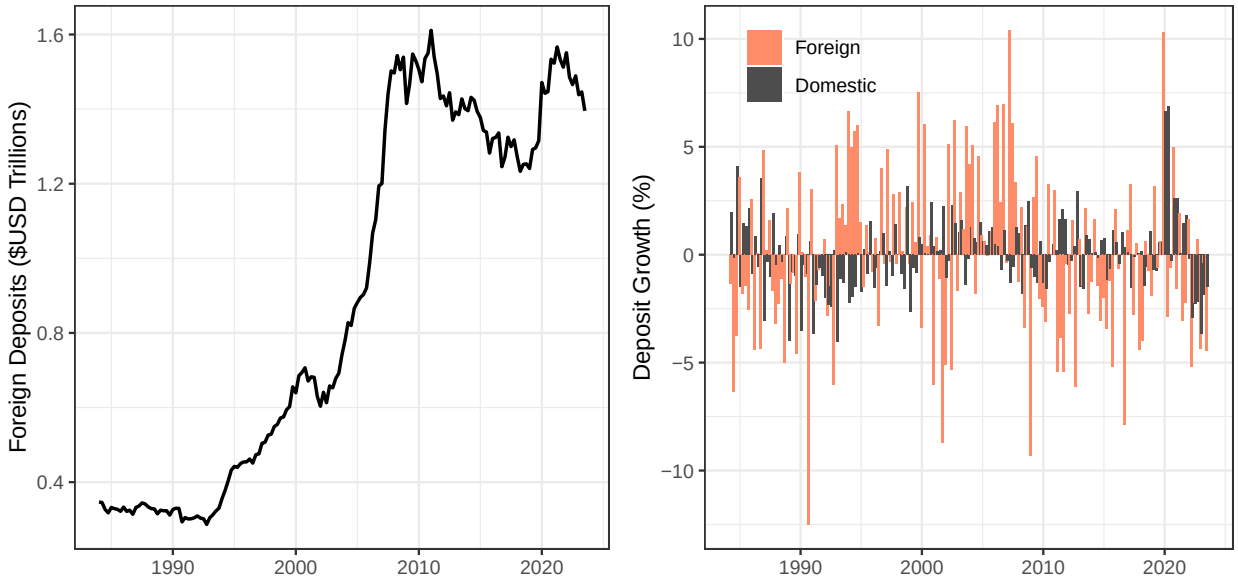
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*Andersen Institute for Finance and Economics. E-mail address: rashad.ahmed@andersen.com. The author gratefully acknowledges Iñaki Aldasoro, Luca Guerrieri, Arpit Gupta, Bryan Hardy, Francisco Ilabaca, Anil Jain, Gabriele La Spada, Todd Messer, Camelia Minoiu (Discussant), Win Monroe, Friederike Niepmann, Gabor Pinter (Discussant), Jonathan Pogach, Alexi Savov, Tim Schmidt-Eisenlohr, Andreas Schrimpf, Pinar Uysal, David Zeke, and seminar participants at the BCBS-BIS-CEPR Workshop on Banks' Liquidity in Volatile Macroeconomic and Market Environments, the Federal Reserve Board, the OCC Bank Research Symposium on Depositor Behavior, Bank Liquidity, and Run Risk, and the Reserve Bank of Australia for valuable comments and suggestions. The views expressed in this paper are those of the author and do not represent the views of the Andersen Institute or affiliated organizations.

1 Introduction

Deposit liabilities are the largest and cheapest funding source for US commercial banks. Funding cost advantages of deposits are often characterized by low *deposit betas*: low sensitivities of US bank deposit rates to changes in US monetary policy rates [Hannan and Berger, 1991; Neumark and Sharpe, 1992; Drechsler et al., 2021]. Deposit betas are consequential for financial stability because they affect bank funding stability, interest rate risk, and deposit franchise values [Greenwald et al., 2023; Li et al., 2023]. Deposit betas also shape the transmission of monetary policy to deposit costs and bank lending [Bernanke and Blinder, 1992; Drechsler et al., 2017].

Figure 1: Aggregate Foreign Deposits of US Commercial Banks



Note: Quarterly deposit growth rates calculated as de-meaned log-differences of deposit levels. The standard deviations of quarterly domestic and foreign deposit growth are 1.67% and 3.75%, respectively with a correlation coefficient of -0.116 (t=-1.47). Sample period is 1984Q1-2023Q3.

Most analyses of deposit betas exclusively consider domestic deposits, due to the size of the domestic deposit base in the United States. However, US banks that operate globally also issue foreign deposits, i.e., deposits issued in their foreign office branches [Aldasoro et al., 2022; Niepmann, 2023]. The left-panel of Figure 1 shows that aggregate foreign deposits

are sizable, with well over $1 trillion outstanding. In 2025 Q2, foreign deposits hit a new record high of $1.63 trillion. Since 1984, interest expense on foreign deposits accounted for an average of 10 percent of total interest expense.[1] Foreign deposits are also considerably more volatile than domestic deposits (Figure 1, right-panel). As such, foreign deposits can influence a bank's overall funding stability, and expose banks to cross-border financial spillovers [Hale et al., 2020]. These distinct qualities of foreign deposits could also result in meaningful differences between foreign and domestic deposit betas. However, quantitative estimates of foreign deposit betas remain limited.[2]

This paper estimates the foreign deposit betas of US banks and analyzes their macro-financial implications. Our key parameters of interest are the deposit betas of foreign and domestic deposit rates with respect to the Federal Funds Rate (FFR) [Drechsler et al., 2017]. We show that foreign deposit betas are significantly larger than domestic deposit betas in aggregate and within US banks issuing both foreign and domestic deposits. While foreign deposits are uninsured and therefore riskier than insured domestic deposits, this can only partially account for their large deposit betas. The difference in deposit betas persists under a number of robustness checks.

Large foreign deposit betas can affect financial stability and banks' interest rate risk. We use the fact that a consolidated bank's total deposit beta is the share-weighted average of its foreign and domestic deposit betas, and thereby increases with its foreign deposit share. As a result, large foreign deposit betas imply that bank funding costs are more (less) sensitive to interest rates when the foreign deposit share is high (low). At the bank level, we find that banks with high foreign deposit shares also hold more interest-sensitive assets, suggesting some balance sheet hedging of interest rate risk. However, we also show that the stock returns of banks with higher *ex ante* foreign deposit shares declined by considerably more during the 2021-2022 US interest rate hikes. This suggests that foreign deposits, with their

[1] See Appendix A1 and Figure A.6.

[2] Some US banks self-report foreign deposit betas in non-public regulatory filings, while Gerlach et al. [2018] presents estimates of foreign and domestic deposit betas, albeit only aggregate estimates.

larger deposit betas, increase the net interest rate risk carried by banks despite adjustments to the asset side of their balance sheets.

We begin our analysis by discussing the data and presenting some key empirical facts and institutional details of foreign deposits. We rely on regulatory data from Call Reports along with a range of public and non-public datasets. Foreign deposits are issued by a small number of US banks, yet they are subject to disproportionately large fluctuations. While less than 1.5% of US banks issue foreign deposits, There are over $1 trillion in foreign deposits, and the aggregate foreign deposit share reached as high as 18% in 2008 before declining to 7.5% in 2023. It is well known that foreign deposits are primarily composed of uninsured, multi-national corporate accounts. Such accounts tend to be more volatile and have larger deposit betas than insured or retail deposits [Brimmer and Dahl, 1975; Comizio and Chiachiere, 2014].[3] The regulatory treatment of foreign deposits is also consistent with their risk profile. Foreign deposits tend to be bucketed with other riskier and uninsured deposit categories.[4] US banks with foreign deposits tend to self-report large foreign deposit betas in their regulatory filings, although they do not provide an explanation as to why they are larger [Gerlach et al., 2018]. Foreign deposits of US banks are mostly dollar-denominated, and mostly domiciled in countries with strong economic ties to the US and those with lower reserve requirements [Brimmer and Dahl, 1975; Goldberg and Saunders, 1980; He and McCauley, 2012; Claessens and Van Horen, 2021].

Next, we estimate foreign and domestic deposit betas at the aggregate bank level. Deposit betas are estimated from regressions of deposit rate changes on FFR changes [Drechsler et al., 2017; Messer and Niepmann, 2023]. We show that estimates of contemporaneous and 4-quarter deposit betas are significantly larger for foreign deposit rates. For every 100 bps change in the FFR, about 54 bps pass through to foreign deposit rates within the same quarter, as opposed to 23 bps to domestic deposit rates. Over a 4-quarter period, foreign

[3] See *FDIC Risk Management Manual of Examination Policies* sections 6.1 and 11.1.

[4] For example, the Liquidity Coverage Ratio (LCR) rule designed to stress test a bank's ability to meet its short-term obligations assigns larger 'runoff rate' assumptions and smaller 'available stable funding' factors to foreign deposits compared to domestic insured deposits.

deposit betas are on average 63% while domestic deposit betas are 42%. These differences in deposit betas are robust to different sample periods and persist after allowing for asymmetric deposit betas.

Using bank-level data, we show that consolidated bank-level deposit betas (foreign plus domestic) are significantly increasing in a bank's foreign deposit share. The bank-level estimates suggest that foreign deposit betas are 20-35 percentage points larger than domestic deposit betas, thus aligning closely with the aggregate estimates. The estimates are robust to excluding foreign banking organizations (FBOs) from the sample, as foreign parent banks may have outsized influence the US affiliate's foreign operations. The estimates also hold after isolating dollar-denominated foreign deposits. The sizable difference between foreign and domestic deposit betas is also robust to controlling for other drivers of bank deposit betas, including proxies for bank market power and corporate deposit share.

The uninsured treatment of foreign deposits can only partially explain their larger deposit betas.[5] The bank-level data lets us decompose foreign deposit betas into an uninsured deposit beta and a residual. We identify the uninsured deposit beta by exploiting differences in bank issuance of uninsured versus insured domestic time deposits. Across specifications, we estimate an uninsured deposit beta 'premium' that is between 10.1 and 13.2 percentage points over insured deposit betas, while our range of estimates of the foreign deposit beta 'premium' lie between 9.4 and 34.9 percentage points over domestic deposit betas. Therefore it is more likely than not that the uninsured treatment of foreign deposits only partly explains why foreign deposit betas are much larger.

These large foreign deposit betas carry important macro-financial and risk management implications for US banks. Specifically, foreign deposits can raise the interest rate sensitivity of banks by increasing the average deposit beta within the consolidated bank and across the bank sector. On average, banks with higher foreign deposit shares seem aware of foreign deposit betas raising the overall interest-sensitivity of their liabilities. Specifically, we find

[5]Uninsured deposit betas are typically larger than insured deposit betas [Drechsler et al., 2023].

that banks with higher foreign deposit shares tend to also hold higher shares of liquid and interest-sensitive assets, suggesting some hedging across the balance sheet. However, we still find that these banks are increasingly sensitive to US monetary policy. At the bank level, we adopt an event study approach similar to Aharony et al. [1986] and English et al. [2018] to study how bank stock prices performed over the 2021-22 Federal Reserve monetary tightening cycle. Over the 12 months between September 2021-22 when the Federal Reserve raised the FFR by 500 bps, the stock returns of US banks fell by an additional 4-5% for every 10 percentage points of a bank's foreign deposit share. This effect is robust to controlling for uninsured domestic deposits and bank size. These estimates suggest that on net, foreign deposits raise the interest rate risk of US banks despite asset-side adjustments, and that investors price this risk.

Meaningful differences in foreign and domestic deposit betas introduce important trade offs between monetary policy and financial stability objectives [Stein, 2012; Akinci et al., 2020]. In principle, large foreign deposit betas strengthen the pass-through of US monetary policy via the deposits channel when foreign deposit shares are high [Drechsler et al., 2017]. However, high or variable foreign deposit shares coupled with large foreign deposit betas, could potentially raise funding and interest rate risks. Consequently, overlooking the role of foreign deposits in the banking system could result in an incomplete assessment of macro-financial risks.

Related Literature. This paper's contribution lies in the intersection of international finance and bank deposit markets. While the literature on global banks is both broad and deep, few studies focus specifically on foreign deposits and their pricing implications. Moreover, the literature on banking presents several estimates of deposit betas for domestic deposits of US banks, while this paper is largely dedicated to analyzing foreign deposit betas.

This paper contributes to the literature on international finance and global banking. US banks with foreign deposits are often considered 'global banks' – some of the largest banks

whose balance sheets figure prominently into the risk-taking capacity of the financial sector [Miranda-Agrippino and Rey, 2020; Bruno and Shin, 2015; Cesa-Bianchi et al., 2018]. Financial institutions might desire access to foreign funding markets for a variety of reasons. Early work of Brimmer and Dahl [1975] and Goldberg and Saunders [1980] and more recently Claessens and Van Horen [2021] suggest that banks may expand overseas due to regulatory appeal, growing trade and financial integration, and to cater to increasingly multinational corporations. Additional reasons banks may expand their foreign operations include benefits such as capital efficiency, lower systemic risk, and resilience to domestic shocks. Niepmann [2023] motivates cross-border banking with a theoretical model to show that banks operating across borders improve welfare by making international capital allocation more efficient. Karolyi et al. [2023] shows empirically that cross-border banking is associated with lower systemic risk. Liu and Pogach [2017] shows that foreign lending by US banks typically compliments domestic lending. While much of the literature focuses on asset-side implications of international banking, our work emphasizes the liability side. Similarly, Anderson et al. [2021] and Aldasoro et al. [2022] show that US wholesale funding is an important source of dollar funding for global banks. Foreign deposits are another important source of funding, though not without their unique risks. Foreign deposits of US banks are material and volatile, having driven systemic bank runs in the past, such as the 1984 run on Continental Illinois [Wall and Peterson, 1990; Hanc, 1998; Carlson and Rose, 2016].[6] We contribute to the literature by presenting new evidence on foreign deposit betas of US banks and their macro-financial implications.

This paper also contributes to the literature on international spillovers via banks by building on Cetorelli and Goldberg [2012c], Cetorelli and Goldberg [2012b], Popov and Udell [2012], Berrospide et al. [2017], Hale et al. [2020] among others. Cetorelli and Goldberg [2012a] shows that lending activities of domestic banks with foreign operations are insulated

[6]Continental Illinois was among the top 10 largest US banks at the time. More than half of the bank's deposits were foreign deposits. The bank also held a large foreign loan portfolio that was particularly exposed to Latin America. Credit risk concerns rose during the 1980s Latin American Debt Crisis, which played a role in the bank's eventual failure.

from domestic monetary policy. This is because these banks access foreign funding when domestic financial conditions tighten. Meanwhile, the evidence we present suggests a simultaneous consequence of foreign funding. That is, foreign deposit funding alters monetary policy sensitivity of the consolidated US bank because foreign deposit betas differ from domestic deposit betas within banks. Correa et al. [2022], Spiegel [2022] and Correa et al. [2023] argue that foreign monetary policy and trade shocks can spill over by altering bank lending patterns in the US. Our findings complement these studies by emphasizing international spillovers through bank funding [Aldasoro et al., 2022]. Specifically, we examine US bank deposit funding issued outside the US.

This paper also contributes to the literature on bank deposits and their role in shaping interest rate risk and monetary policy transmission. The deposits channel of monetary policy emphasizes the incomplete pass-through of interest rates to deposit rates [Neumark and Sharpe, 1992; Nagel, 2016; Yankov, 2018; Kurlat, 2019; Krishnamurthy and Li, 2023]. As described in Drechsler et al. [2017], the deposits channel suggests that bank market power explains the observation of low deposit betas. In turn, this affects the transmission of monetary policy through bank funding costs and bank lending [Bernanke and Blinder, 1988; Afanasyeva and Güntner, 2020; Li et al., 2023]. Wang et al. [2022] finds that both bank market power and regulatory constraints affect the transmission of monetary policy through banks. Li et al. [2019] finds that changes in the supply of US Treasury securities affects the deposits channel when US Treasuries and bank deposits are substitutes. d'Avernas et al. [2023] documents deposit beta differences between large and small US banks driven by differences in technology, financial services, and customer demographics. Greenwald et al. [2023] shows how deposit betas are inherently dynamic and become larger under higher interest rates, giving rise to deposit convexity. Our contribution also relates to Gerlach et al. [2018] which studies the macroeconomic dynamics of bank funding costs under rising rates. Thus far, the literature has largely focused on the pass-through of monetary policy to domestic deposit rates. We build on this literature by showing that foreign deposits meaningfully

impact bank-level deposit betas, and thus interact with the deposits channel.

Roadmap. The rest of the paper is structured as follows. Section 2 describes the data used the analysis. Section 3 reports estimates of aggregate foreign and domestic deposit betas. Section 4 studies deposit betas within banks using bank-level data, and tests whether the uninsured nature of foreign deposits can explain their large deposit betas. Section 5 studies the macro-financial implications of foreign deposit betas. Section 6 concludes. Appendices A1 and A2 present additional results, trends and statistics on foreign deposit dynamics, and discusses their key institutional and regulatory details.

2 Data

We combine data from a variety of sources. Aggregate bank data is taken from the FDIC Quarterly Banking Profile and is also derived from the bank-level regulatory Call Reports. In addition to aggregate bank sector data, we collect data on the Fed Funds Rate (FFR), GDP and inflation from FRED. The FFR is aggregated to quarterly frequencies by averaging monthly observations within each quarter. All other aggregate data is sampled quarterly, and we consider the 1984Q1-2023Q3 sample period. Aggregate foreign and domestic deposit rates are computed using data on quarterly interest expense on foreign and domestic deposits, respectively and total foreign and interest-bearing domestic deposits, respectively. Specifically, deposit rates are computed as:

$$\text{Deposit Rate } (\%) = \frac{\text{Interest Expense} \times 4}{\text{Deposit Balances}} \times 100. \tag{1}$$

This is done for both domestic office and foreign office deposits and follows a procedure similar to Kang-Landsberg et al. [2023]. To calculate domestic deposit rates, we divide interest paid on domestic deposits by total interest-bearing domestic deposits. To calculate

foreign deposit rates, we divide interest paid on foreign deposits by total foreign deposits.[7] Figure 2 plots these deposit rates along with the FFR. The share of foreign deposits is computed by dividing foreign deposits by total (foreign and domestic) deposits. Table 1 reports summary statistics for bank sector and macroeconomic aggregates.

Table 1: Aggregate Data Summary

Variable	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Federal Funds Rate	159	3.561	2.953	0.060	0.478	3.213	5.563	11.390
Foreign Deposit Rate	159	3.895	3.395	0.029	0.590	3.202	6.103	11.779
Domestic Deposit Rate	159	3.207	2.629	0.166	0.813	3.023	4.352	11.565
Foreign Deposit Share	159	11.641	2.665	7.520	9.213	11.750	13.154	18.005
Real GDP Growth	159	2.684	2.050	−7.827	1.812	2.782	3.910	11.288
CPI Inflation	159	2.794	1.535	−1.620	1.793	2.643	3.593	8.210

Note: Sample period is 1984Q1-2023Q3. Variables are reported in percentage points. Real GDP growth and CPI inflation are year-over-year. Foreign deposit share is a percent of total deposits.

Data on US commercial bank-level variables comes from the FFIEC quarterly Call Reports. The quarterly Call Reports data is prepared following Drechsler et al. [2017] and the 1984Q1-2020Q1 period is considered for the bank-level analysis. The main sub-sample is restricted to bank-quarter observations with both positive domestic deposit and foreign deposit balances. Although for robustness, we also consider a sub-sample that tracks the cohort of banks which held foreign deposits in 2020 over the same 1984Q1-2020Q1 period. Bank-level summary statistics are reported in Table 2. One outlier bank-quarter observation is removed from the sample due to a very high (total) deposit rate.[8] Deposit rates calculated at the bank level refer to the bank-level total deposit rates based on the sum of a bank's interest-bearing domestic deposits and a bank's foreign deposits. Foreign deposit shares at the bank level are calculated by dividing a bank's foreign deposits by its total deposits. Finally, asset market concentration is calculated as the percent of assets held by a bank divided by aggregate system-wide assets.

We also collect data on foreign office liabilities of US banks by source country from form

[7] Almost all foreign deposits are interest-bearing. From 1984-2020, interest-bearing foreign deposits made up least 90% of total foreign deposits in any given quarter.

[8] First Interstate Bancorp reported a 111% deposit rate in 1991Q4.

Table 2: Bank Level Data Summary

Variable	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Domestic Deposits	17,396	24.479	103.727	0.00001	0.761	3.675	11.113	1,577.444
Interest-bearing Domostic Deposits	17,396	17.324	70.528	0.00001	0.561	2.624	8.127	1,063.057
Foreign Deposits	17,396	6.909	38.372	0.00000	0.036	0.211	1.134	589.762
Assets	17,396	45.053	181.967	0.016	1.317	5.721	20.054	2,690.959
Deposit Rate	17,396	4.562	2.757	0.003	2.511	4.382	6.627	30.282
Foreign Deposit Share	17,396	16.279	21.387	0.00002	1.980	6.885	21.599	99.998
Asset Market Concentration	17,396	0.437	1.302	0.0004	0.021	0.102	0.299	13.626

Note: Sample period is 1984Q1-2020Q1 and consists of bank-quarters reporting positive foreign deposits. Deposit rate is the bank's total deposit rate calculated using the sum of interest paid on foreign deposits and domestic interest-bearing deposits over the sum of foreign deposits and domestic interest-bearing deposits, reported in annualized percentage points. Foreign deposit share is reported as the percent of foreign deposits to total deposits. Asset market concentration is reported as the percent of a bank's total assets to aggregate market-wide assets. Domestic deposits, domestic interest-bearing deposits, foreign deposits, and assets are reported in USD billions.

FFIEC 009a (Federal Reserve form E.16). Under some reasonable assumptions, we infer the geography of aggregate foreign deposits using this dataset. We also use this data to infer the proportion of dollar-denominated and foreign-denominated foreign deposits of US banks. While the aggregated 009a data is public, the bank-level foreign office liabilities via form 009 is non-public supervisory data. We use the bank-level 009 data to infer which banks have high shares of dollar-denominated foreign deposits. We also use the BIS Locational Banking Statistics (LBS) as an additional source of international exposures of US banks.

Lastly, we collect publicly available daily stock prices of foreign deposit-issuing US banks that are listed on US exchanges. This data are used to analyze the real-time response of banks to the 2021-2022 Fed interest rate hikes.

2.1 Institutional Details

In Appendix A1, additional empirical analysis is presented, and institutional details of foreign deposits are discussed. These include aggregate trends and drivers of foreign deposit variation over time, regulatory and legal treatmeatment of foreign deposits, and the distribution of foreign deposits across US banks and across countries.

3 Aggregate Foreign and Domestic Deposit Betas

Foreign deposits are more volatile than domestic deposits, are uninsured, and composed of sophisticated corporate depositors.[9] Therefore *a priori* one would expect more competitive pricing of foreign deposits that domestic deposits on average. In this section, we present aggregate level evidence of differential deposit betas on foreign and domestic deposit rates that verifies this view.

3.1 Foreign and Domestic Deposit Betas to US Monetary Policy

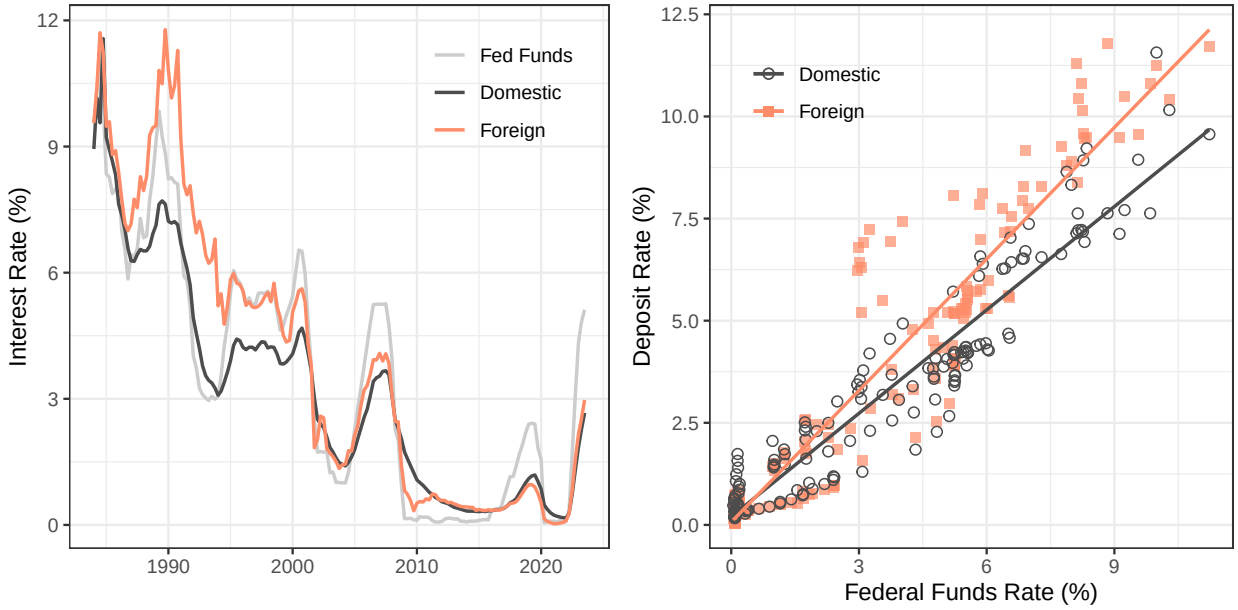
The left-panel of Figure 2 reports the time-series of aggregate domestic and foreign deposit rates along with the FFR.[10] Foreign deposit rates were, on average, substantially higher than domestic deposit rates prior to 2000. Visually inspecting Figure 2 also shows that foreign deposit rates tend to co-move tightly with domestic deposit rates especially after 2000. Both deposit rates appear to adjust to monetary policy slowly.

The right-panel charts the scatterplot of FFR levels against domestic and foreign deposit rate levels, respectively. Although limited inference can be reliably drawn from this scatterplot, the steeper slope of foreign deposit rates provides cursory evidence of larger deposit betas for foreign deposits. Note that Figure A.4 of the Appendix shows that these patterns hold when comparing aggregate foreign and domestic deposit rates from the sub-sample of US banks that hold both domestic and foreign deposits (i.e., excluding domestic-only banks from the calculations).

Visual inspection suggests that aggregate foreign deposit betas may be larger than domestic deposit betas. Formally, deposit betas for domestic and foreign deposit rates can be estimated using a dynamic regression specification that builds on Messer and Niepmann [2023]:

[9] See Appendix A1 for key institutional details about the foreign deposits of US banks.
[10] Aggregate deposit rates are calculated as described in Section 2.

Figure 2: Aggregate Foreign and Domestic Deposit Rates of US Commercial Banks



Note: Quarterly foreign (domestic) deposit rates calculated as annualized interest paid on foreign (domestic interest-bearing) deposits divided by total foreign (domestic interest-bearing) deposits. Sample period is 1984-2023.

$$\Delta DR_{kt} = \alpha_k + \sum_{l=0}^{L} \beta_{kl} \Delta FFR_{t-l} + \Phi_k [FFR_{t-1} - \overline{DR}_{t-1}] + \mathbf{\Gamma}_k \mathbf{X}_t + \epsilon_{kt}, \tag{2}$$

where ΔDR_{kt} is the quarterly change in the deposit rate of segment $k \in \{\text{domestic}, \text{foreign}\}$ and ΔFFR_{t-l} is the quarterly change in the FFR lagged l quarters. The specification is estimated with $L = 3$ lags allowing the deposit rate a total of four quarters to adjust to FFR changes. Deposit betas are defined as the pass-through coefficient of the FFR to deposit rates. Short-run deposit betas are given by β_{k0} while long-run, or 4-quarter deposit betas are given by the sum of coefficients $\sum_{l=0}^{3} \beta_{kl}$. The error-correction term $[FFR_{t-1} - \overline{DR}_{t-1}]$ measures the deposit rate gap, defined as the difference between the FFR and the total deposit rate $\overline{DR}_t$. The total deposit rate, $\overline{DR}_t$, is calculated as the sum of interest paid on domestic and foreign deposits divided by the sum of foreign and interest-bearing domestic deposits. Intuitively, the coefficient on the deposit rate gap captures the non-linearity of deposit rates increasingly moving to close the deposit rate gap as the distance between the

FFR and the deposit rate widens. In other words, the error-correction term characterizes convexity in deposit betas [Greenwald et al., 2023] or cointegration between FFR and deposit rates.[11] The vector $\mathbf{X}_t$ controls for year–over-year growth in real GDP and year-over-year CPI inflation to account for macroeconomic conditions impacting deposit demand.

Table 3: Federal Funds Rate Pass-through to Foreign and Domestic Deposit Rates

	Foreign	Domestic	F-D Difference
ΔFFR_t	0.539***	0.232***	0.307**
	(0.124)	(0.037)	(0.119)
$\sum_{l=0}^{3} \Delta FFR_{t-l}$	0.63***	0.418***	0.212*
	(0.121)	(0.046)	(0.116)
$[FFR_{t-1} - \overline{DR}_{t-1}]$	0.082*	0.119***	-0.037
	(0.044)	(0.036)	(0.041)
Adjusted R^2	0.413	0.773	0.069
Observations	155	155	155

Note: Standard errors are adjusted for autocorrelation and heteroscedasticity. Estimation period is 1984Q1-2023Q3. '*','**','***' correspond to 10%, 5%, 1% significance, respectively. Estimates correspond to Equation 2.

Table 3 reports estimates for aggregate US domestic and foreign deposit betas. Both short-run and long-run deposit betas are significantly larger for foreign deposit betas. Domestic deposits exhibit weaker contemporaneous adjustment to changes in the FFR within the same quarter (23 bps per 100 bps change in the FFR, or a contemporaneous beta of 23%) and over a course of 4 quarters (41.8 bps per each 100 bps change in the FFR).[12] Meanwhile, foreign deposits exhibit much stronger contemporaneous adjustment to changes in the FFR (53.9 bps change per 100 bps change in the FFR within the same quarter). Over a course of 4 quarters, 63 bps per each 100 bps change in the FFR passes through to foreign deposit rates. These estimates are similar to those in Gerlach et al. [2018] which estimates foreign

[11] In practice, both proprietary and vendor-based deposit rate models typically allow for error-correction in deposit rates. The goal of this term is to allow deposit rates to increase at a faster rate and decrease at a slower rate when the prevailing deposit rate gap is wide and positive.

[12] A 1 basis point (bps) change in an interest rate refers to a 0.01 percentage point change in the interest rate.

and domestic deposit betas of 67% and 42%, respectively, but over a shorter sample period and using a different methodology. The confidential Y-14 data shows that banks self-report nearly identical foreign time deposit betas and foreign non-time deposit betas [Gerlach et al., 2018], suggesting that large foreign deposit betas are unlikely to be driven by the presence of foreign time deposits. Column 3 of Table 3 shows that these differences in deposit betas are economically and statistically significant.

The coefficients on the error-correction terms are significant and positive for both foreign and domestic deposit rates, although larger for domestic deposits. These estimates are consistent with deposit rates adjusting faster to an increase in the FFR as the deposit rate gap grows larger and more positive, a behavior we directly observed during the most recent series of US monetary policy rate hikes beginning in 2021 [Kang-Landsberg et al., 2023].

3.2 Additional Results

Additional results are reported in Appendix A2. Table A.1 reports additional domestic deposit beta estimates after splitting domestic deposit rates into three segments: deposit rates on domestic transaction, savings, and time deposits. As expected, betas tend to be smaller for transaction deposits and larger for time deposits. 1-quarter betas range from 7.6% to 28.4% while 4-quarter betas on domestic transaction, savings, and time deposits are 10.2%, 32.1%, and 50.8%, respectively. Both 1-quarter and 4-quarter foreign deposit betas of 53.9% and 63% are notably larger than the deposit betas across the domestic segments, even domestic time deposits.[13]

Table A.2 modifies the regression specification in (2) to allow for asymmetric pass-through of the FFR to deposit rates. Deposit betas are roughly twice as large when the FFR decreases than when the FFR increases at 1-quarter and 4-quarter horizons. Foreign deposit betas, however, remain larger than domestic deposit betas under both an increasing or decreasing

[13]Interest expense on time deposits implied from Call Reports is a weighted average of expense on newly issued time deposits and existing time deposits. As a result, the estimated time deposit betas from Call Reports data may be smaller than betas estimated on time deposit rates quoted in the market.

FFR. The differences between foreign and domestic deposit betas remain in a similar range regardless of the directional move in the FFR. That is, downside betas are 25 percentage points larger for foreign deposit rates than domestic deposit rates while upside betas are 30.6 percentage points larger for foreign deposit rates.

Table A.3 reports estimates from the benchmark regression, but over the period 2000Q1-2023Q3. The estimates are very similar to the estimates over the full sample period, suggesting that the differences in deposit betas between foreign and domestic deposits do not rise exclusively from the earlier period of observably high foreign deposit rates.

4 Bank-level Deposit Betas

In the previous section we showed that deposit beta differences exist in the aggregate time-series of domestic and foreign deposit rates. In this section we show that these differences in deposit betas persist within US banks that issue both foreign and domestic deposits.

4.1 Foreign Deposit Shares and Bank-level Deposit Betas

While the aggregate data suggest that foreign deposit betas are significantly larger than domestic deposit betas, similar patterns at the bank-level would verify that the phenomenon holds in the cross-section of banks. To test this, we start by using quarterly data from Call Reports to estimate panel regressions for total (domestic plus foreign) deposit betas at the bank level. We consider the sub-sample of bank-quarter observations with positive foreign deposits.[14] The following fixed-effects panel regressions, similar to Drechsler et al. [2017], are estimated using levels and changes of deposit rates, respectively:

$$DR_{it} = \alpha_i + \beta_0 FFR_t + \beta_1[FFR_t \times FDS_{i,t-1}] + \beta_2[FFR_t \times AMC_{i,t-1}] + \epsilon_{it}, \qquad (3)$$

[14]Banks without foreign deposits are excluded from the main analysis to avoid selection bias.

$$\Delta DR_{i,[t-4,t]} = \alpha_i + \beta_0 \Delta FFR_{[t-4,t]} + \beta_1[\Delta FFR_{[t-4,t]} \times FDS_{i,t-4}] + \beta_2[\Delta FFR_{[t-4,t]} \times AMC_{i,t-4}] + \epsilon_{i,[t-4,t]}. \quad (4)$$

The first equation regresses the deposit rate level of bank i on the level of the FFR while the second equation regresses the 4-quarter change in the deposit rate of bank i on 4-quarter changes in the FFR. Bank-specific deposit rates are calculated by dividing the sum of interest paid on domestic and foreign deposits by the sum of interest-bearing domestic deposits and foreign deposits. The coefficient α_i captures bank-level fixed effects that absorb persistent within-bank unobservable factors. The FFR is interacted with the lagged foreign deposit share (FDS_{it}) of bank i and the FFR is also interacted with a measure of asset market concentration (AMC_{it}) of bank i. Foreign deposit share at the bank level is measured as the foreign deposits of bank i divided by its total deposits within each quarter. To measure asset market concentration of bank i, bank i assets are divided by aggregate system-wide assets within each quarter.

The coefficient on β_0 is expected to be positive but less than one, implying incomplete pass-through of monetary policy to bank deposit rates. The coefficient on β_1 is expected to be positive, since banks with larger foreign deposit shares would have larger (total) deposit betas if foreign deposit betas are larger than domestic deposit betas. Finally the coefficient on β_2 is expected to be negative, consistent with banks with more market share exerting their market power to enjoy smaller deposit betas [Drechsler et al., 2017].

Table 4 reports the results from the bank-level regressions. Banks on average have positive and significant (total) deposit betas but the betas are less than 1, implying incomplete pass-through of the FFR to deposit rates. Deposit betas, however, are significantly increasing in a banks share of foreign deposits, and decreasing in a banks asset concentration. For two hypothetical banks, one issuing entirely foreign deposits and the other issuing only domestic deposits, these estimates imply bank-level deposit betas to be 20-35 percentage points larger for the bank funded with foreign deposits. These bank-level estimates are in line with the

Table 4: Bank-level Regressions of Deposit Rates on the Federal Funds Rate

	Dependent variable:					
	Bank Deposit Rate (Level)			Bank Deposit Rate (4Q Change)		
	(1)	(2)	(3)	(4)	(5)	(6)
FFR_t	0.811***	0.779***	0.784***			
	(0.010)	(0.010)	(0.010)			
$FFR_t \times$ Foreign Deposit Share$_{i,t-1}$		0.164***	0.190***			
		(0.040)	(0.045)			
$FFR_t \times$ Asset Market Concentration$_{i,t-1}$			−4.305***			
			(1.089)			
$\Delta FFR_{t-4,t}$				0.574***	0.516***	0.522***
				(0.011)	(0.012)	(0.012)
$\Delta FFR_{t-4,t} \times$ Foreign Deposit Share$_{i,t-4}$					0.326***	0.349***
					(0.051)	(0.045)
$\Delta FFR_{t-4,t} \times$ Asset Market Concentration$_{i,t-4}$						−2.574***
						(0.682)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17,396	16,867	16,867	15,672	15,672	15,672
Adjusted R^2	0.754	0.763	0.766	0.360	0.366	0.366

Note: Standard errors are clustered at the bank level. Estimation period is 1984Q1-2020Q1. '*', '**', '***' correspond to 10%, 5%, 1% significance, respectively. Sample of all bank-quarter observations with positive foreign deposits. Foreign deposit share (bank's foreign deposits as a percent of the bank's total deposits) and asset market concentration (bank's total assets as a percent of market-wide assets) lie between 0 and 1 and their standard deviations are 0.213 and 0.013, respectively. Estimates correspond to Equations 3 and 4.

aggregate deposit beta estimates reported in Table 3 that find aggregate foreign deposit betas to be roughly 20-30 percentage points larger than aggregate domestic deposit betas.

The effects of foreign deposit share on deposit betas are similar yet somewhat stronger than that of asset concentration. The standard deviation of bank-level foreign deposit share of total deposits is 21.3 percentage points and the standard deviation of bank-level assets as a percent of aggregate assets is 1.3 percentage points. So based on columns 1 and 6, a 1-standard deviation increase in foreign deposit share raises a bank's deposit beta by 4-7.4 percentage points while a 1-standard deviation increase in asset market concentration lowers a bank's deposit beta by 3.3-5.5 percentage points.

4.2 Different subsets of US banks

For robustness, we re-estimate the regression on a panel of the cohort of banks which reported foreign deposit liabilities in 2021Q1. Some of these banks, for example, may have not issued foreign deposits earlier in the sample period. Table A.4 reports the results, which are closely in line with the baseline estimates.

4.3 Non-FBO Banks and Foreign Dollar Deposits

We re-estimate the bank-level panel regressions on a subsample keeping only US banks that are not foreign-banking organizations (FBOs).[15] This may be an important robustness check as FBOs have parent banks domiciled in foreign jurisdictions that disproportionately influence their foreign deposit franchise. Columns 1 and 2 of Table A.5 reports the results, which shows that the non-FBO subsample of US banks exhibit deposit betas that are significantly increasing with foreign deposit shares.

The currency denomination of foreign deposits may also drive the results. If foreign deposits are denominated in foreign currency, then deposit rates would be tied mechanically

[15]Some FBO banks that are filtered out of the sample include MUFG, Deutsche Bank, HSBC, TD Bank, Santander Bank, Bank of the West.

to foreign interest rates rather than the FFR. While the aggregate data in Appendix A1 suggest that the majority of foreign deposits are dollar-denominated, the share of dollar-denominated and foreign-denominated foreign deposits may vary from bank to bank. To infer which banks have high shares of dollar-denominated foreign deposits, we rely on non-public FFIEC 009 data wherein banks report the quantity of local currency and non-local currency foreign office liabilities.[16] We assume that non-local currency foreign office liabilities are dollar-denominated foreign deposits. We then isolate the sub-sample of banks that on average, reported dollar-denominated foreign deposits of at least 70%. This gives us a distinct sub-sample of banks with dollar-denominated foreign deposits.

Columns 3 and 4 of Table A.5 reports results for dollar-denominated foreign deposits. The main results hold for the subset of banks with dollar-denominated foreign deposits: bank deposit betas increase significantly in the foreign deposit shares.

4.4 Do Uninsured Deposit Premia explain Foreign Deposit Betas?

One leading explanation for larger deposit betas on foreign deposits could be that foreign deposits are uninsured. Like foreign depositors, uninsured domestic depositors tend to be more volatile and price-sensitive, giving rise to uninsured deposit betas that are larger than insured deposit betas [Drechsler et al., 2023]. Therefore, it may be that larger foreign deposit betas simply reflect the riskier nature of uninsured deposits over insured deposits. Conceptually, we can decompose the foreign deposit beta premium into two components: the pure uninsured deposit premium plus an unexplained residual:

$$\Delta\beta^{foreign}_{uninsured} = [\beta^{domestic}_{uninsured} - \beta^{domestic}_{insured}] + [\beta^{foreign}_{uninsured} - \beta^{domestic}_{uninsured}]. \tag{5}$$

It is possible that larger foreign deposit betas are entirely explained by their uninsured nature, i.e., that $[\beta^{foreign}_{uninsured} - \beta^{domestic}_{uninsured}] = 0$. Alternatively, it may be the case that the

[16] Banks began reporting this data in the mid 2000s.

uninsured premium does not entirely account for the gap in deposit betas between foreign and domestic deposits, i.e., $0 < [\beta^{foreign}_{uninsured} - \beta^{domestic}_{uninsured}] \leq \Delta\beta^{foreign}_{uninsured}$.

Because we do not observe deposit rates on uninsured and insured domestic deposits, we aim to recover the uninsured domestic deposit beta by using available bank level data on estimated uninsured and insured domestic time deposits. Following Drechsler et al. [2017] and Drechsler et al. [2021], uninsured domestic time deposits are measured as a banks domestic time deposits exceeding $100,000 until from 1984-2009 and exceeding than $250,000 after that. This approach assumes that any difference in bank deposit betas under entirely uninsured domestic time deposits and entirely insured domestic time deposits is a consistent estimate of the uninsured deposit beta premium, and the average premium is the same across banks. We augment (3) and (4) bank-level panel regressions with the share of uninsured domestic time deposits (as a percent of total domestic time deposits) interacted with the FFR, along with several other balance sheet variables that could potentially impact bank deposit betas:

$$DR_{it} = \alpha_i + \beta_0 FFR_t + \beta_1[FFR_t \times FDS_{i,t-1}] + \beta_2[FFR_t \times AMC_{i,t-1}] + \beta_3[FFR_t \times Uninsured_{i,t-1}] + \mathbf{B}[FFR_t \times \mathbf{X}_{i,t-1}] + \epsilon_{it}, \quad (6)$$

$$\Delta DR_{i,[t-4,t]} = \alpha_i + \beta_0 \Delta FFR_{[t-4,t]} + \beta_1[\Delta FFR_{[t-4,t]} \times FDS_{i,t-4}] + \beta_2[\Delta FFR_{[t-4,t]} \times AMC_{i,t-4}] + \beta_3[\Delta FFR_{[t-4,t]} \times Uninsured_{i,t-4}] + \mathbf{B}[\Delta FFR_{[t-4,t]} \times \mathbf{X}_{i,t-4}] + \epsilon_{i,[t-4,t]}. \quad (7)$$

From (6) and (7), estimates of β_3 will provide a range for the uninsured beta premium, $[\beta^{domestic}_{uninsured} - \beta^{domestic}_{insured}]$, that we can compare to β_1 which yields an estimate of the total foreign deposit beta premium inclusive of the uninsured beta premium: $\Delta\beta^{foreign}_{uninsured}$. Any difference between the two can be attributed to beta premium specific to foreign deposits that is unexplained by their uninsured treatment, $[\beta^{foreign}_{uninsured} - \beta^{domestic}_{uninsured}]$.

Table 5: Bank-level Regressions of Deposit Rates on the Federal Funds Rate and Accounting for the Uninsured Deposit Beta Premium: Controlling for Balance Sheet Composition

	Dependent variable:	
	Bank Deposit Rate (Level)	Bank Deposit Rate (4Q Change)
	(1)	(2)
FFR_t	0.537^{***}	
	(0.026)	
$FFR_t \times$ Foreign Deposit Share$_{i,t-1}$	0.094^{**}	
	(0.045)	
$FFR_t \times$ Asset Market Concentration$_{i,t-1}$	-4.643^{***}	
	(1.135)	
$FFR_t \times$ Uninsured Deposit Share$_{i,t-1}$	0.101^{***}	
	(0.029)	
$FFR_t \times$ Time Deposit Share$_{i,t-1}$	0.182^{***}	
	(0.041)	
$FFR_t \times$ Commercial Loan Share$_{i,t-1}$	0.233^{***}	
	(0.046)	
$\Delta FFR_{t-4,t}$		0.468^{***}
		(0.034)
$\Delta FFR_{t-4,t} \times$ Foreign Deposit Share$_{i,t-4}$		0.269^{***}
		(0.052)
$\Delta FFR_{t-4,t} \times$ Asset Market Concentration$_{i,t-4}$		-2.520^{***}
		(0.668)
$\Delta FFR_{t-4,t} \times$ Uninsured Deposit Share$_{i,t-4}$		0.132^{**}
		(0.054)
$\Delta FFR_{t-4,t} \times$ Time Deposit Share$_{i,t-4}$		-0.097
		(0.063)
$\Delta FFR_{t-4,t} \times$ Commercial Loan Share$_{i,t-4}$		0.100
		(0.072)
Bank FE	Yes	Yes
Observations	14,872	13,671
Adjusted R^2	0.737	0.377

Note: Standard errors are clustered at the bank level. Estimation period is 1984Q1-2020Q1. '*', '**', '***' correspond to 10%, 5%, 1% significance, respectively. Sample of all bank-quarter observations with positive foreign deposits. Foreign deposit share (bank's foreign deposits as a percent of the bank's total deposits), asset market concentration (bank's total assets as a percent of market-wide assets), uninsured domestic deposit share (bank's uninsured domestic time deposits as a percent of the bank's total domestic time deposits), time deposit share (bank's domestic time deposits as a percent of total domestic deposits), and commercial loan share (bank's commercial and industrial loans as a percent of total loans) lie between 0 and 1. Estimates correspond to Equations 6 and 7 augmented with time deposit share and commercial loan share variables.

The term $[FFR_t \times \mathbf{X}_{it}]$ interacts the FFR with additional factors that may drive important variation in bank-level deposit betas, such as the bank's share of time deposits and corporate deposits. A larger share of domestic time deposits (as a percent of domestic deposits) could surely result in larger bank-level deposit betas. The share of domestic corporate depositors may also affect bank deposit betas, as corporate deposits typically carry larger deposit betas than retail deposits. Moreover, many foreign depositors are corporations, raising the possibility of a bank's foreign deposit share being correlated with its domestic corporate deposit share. Domestic corporate deposits are partly captured by uninsured deposits, but Call Reports data does not disclose specific depositor types, so precisely measuring corporate deposit shares is not straightforward. To try and further capture the share of domestic corporate depositors within a bank, we control for the share of domestic commercial and industrial loans as a percent of total loans issued by a bank. The assumption we rely on is that banks specializing in domestic commercial customers are likely to have larger shares of both loans and deposits with corporations.

Table 5 reports the results. The uninsured beta premium is significant and positive across specifications, ranging between 10.1 in the 'levels' specification and 13.2 percentage points in the 'changes' specification. The coefficients on FFR_t interacted with the foreign deposit share range from 0.094 to 0.269 percentage points, slightly smaller than the benchmark regression estimates in Table 4 (0.19 to 0.349), but remain economically and statistically significant. Banks with more domestic time deposits do tend to have larger deposit betas (according to column 1). Banks with higher commercial loan shares also tend to have meaningfully larger deposit betas.

These results suggest that the uninsured nature of foreign deposits cannot fully account for the larger betas on foreign deposits. Moreover, across the several estimates presented in this paper, the total foreign deposit beta premium is estimated to lie in the range of 9.4 and 26.9 percentage points and possibly up to 34.9 percentage points (e.g., Table 4). Meanwhile, the uninsured premium is estimated to lie between 10.1 and 13.2 percentage points. Putting

slightly more weight on the estimates under the 'changes' specifications, it is more likely than not that the uninsured nature of foreign deposits only partially explains the larger foreign deposit betas. According to column 2 of Table 5, half of the estimated foreign deposit beta premium remains unaccounted for by the uninsured deposit premium.[17]

5 Implications for Interest Rate Risk Management

In previous sections, we showed that foreign deposit betas are larger than domestic deposit betas. In this section, we suggest that this bears important macro-financial implications. US banks become more sensitive to monetary policy when foreign deposit shares are larger, and *vice versa*. As a result, foreign deposit betas give rise to important financial risk management concerns.

First, we show that consolidated US bank asset compositions change with foreign deposits in ways that are consistent with banks managing their interest rate risk across the entire balance sheet. Then, we examines the stock prices of foreign deposit issuing US banks under rising interest rates.

5.1 Asset Portfolios of Banks with Foreign Deposits

If banks recognize that foreign deposits have a different risk profile from other liabilities, then US banks with a high share of foreign deposits may look and behave differently than other US banks. Compared to other deposit types, foreign deposits are volatile and foreign deposit rates have larger deposit betas. It then follows that issuing foreign deposits could alter the liquidity risk and interest rate risk of overall bank liabilities. We examine if bank asset portfolios adjust to a bank's foreign deposit share in ways that are consistent asset-liability

[17]For example, a bank with all deposits as domestic uninsured deposits would be predicted to have a 13.2 percentage point larger deposit beta (compared to a benchmark bank with all domestic insured deposits), but a bank with all deposits as foreign deposits would be predicted to have a 26.9 percentage point larger deposit beta.

management of these risks. We estimate the following fixed effects panel regression:

$$FDS_{it} = \alpha_i + d_t + \sum_{a \in A} \beta_a Assets^a_{it} + \epsilon_{it}, \tag{8}$$

where FDS_{it} is the foreign deposit share of bank i in quarter t measured as its foreign deposits divided by its total deposits, α_i and d_t are bank and time period fixed effects, and $Assets^a_{it}$ are specific asset positions of the bank each measured as a percent of the banks total assets. The asset categories (a) we consider are: reserves and balances due from other banks (i.e., 'cash'), securities, net fed funds and repo assets, foreign office loans, domestic real estate (RE) loans, domestic commercial and industrial (CI) loans, and domestic personal loans. Again, we consider the subset of foreign deposit issuing banks to control for selection into being a 'global bank' with both domestic and foreign operations.

Table 6: Bank Asset Portfolios and Foreign Deposit Shares

Asset	Coefficient (β_a)	Std. Error
Reserves and Balances Due	0.321***	(0.085)
Securities	0.001	(0.071)
Net Fed Funds and Repo	0.018	(0.071)
Foreign Loans	0.185*	(0.109)
RE Loans	-0.106	(0.067)
CI Loans	0.102	(0.075)
Personal Loans	-0.176**	(0.071)

Note: Standard errors are clustered at the bank level. Estimation period is 1984Q1-2020Q1. '*', '**', '***' correspond to 10%, 5%, 1% significance, respectively. Sample of all bank-quarter observations with positive domestic deposits with and without foreign deposits. Foreign deposit share is measured as the bank's foreign deposits as a percent of the bank's total deposits. All asset categories are measured as a percent of the bank's total assets. Estimates correspond to Equation 8 and includes both bank and time period fixed effects. Total sample size is 15,386 observations.

Table 6 reports the results. Banks with larger foreign deposit shares hold significantly more cash and reserve balances.[18] On average, a 10 percentage point increase in the foreign deposit share is associated with a 3.21 percentage point increase in cash assets held as a

[18]Before 2008, the Fed did not pay interest on reserve balances and most banks held cash balances with other depository institutions. After the Fed began paying interest on reserves, the majority of cash balances moved over to the Fed.

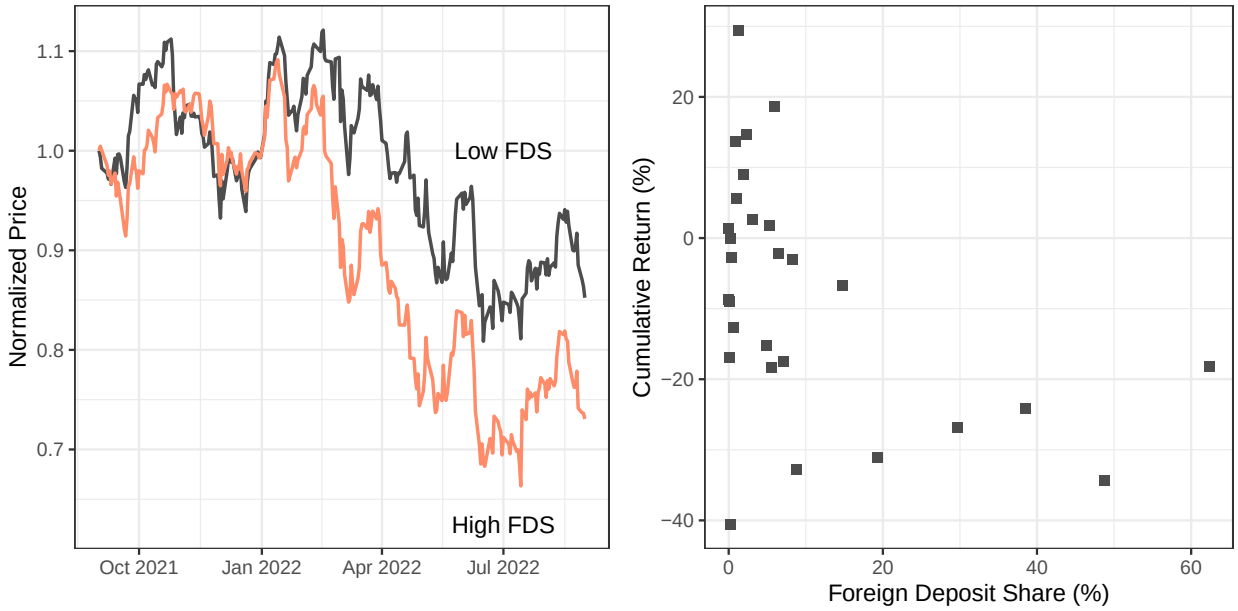
percent of total assets. This supports the view that banks recognize foreign deposits as a relatively volatile funding source. Perhaps unsurprisingly, banks with larger foreign deposit shares also hold larger positions of foreign loans. Banks with larger foreign deposit shares hold significantly fewer personal loans but more CI loans, although the coefficient on the latter is estimated imprecisely. Fewer personal loans and more CI loans could suggest that foreign depositors are composed of more corporate entities, assuming these banks cater toward multi-national corporates with operations in the US and abroad. Along with holding more cash assets, which are priced to overnight rates, banks with larger foreign deposit shares effectively swap out fixed rate loans (RE loans and personal loans) for variable rate loans (foreign and CI loans). This suggests that banks with larger foreign deposit shares tend to hold relatively interest-sensitive asset portfolios of relatively shorter duration.

Foreign deposits, with their larger deposit betas and more volatile flows, are relatively short duration liabilities. Therefore, issuing foreign deposits in lieu of domestic deposits make bank liabilities more interest-sensitive. It appears that banks with large foreign deposit shares hold more interest-sensitive asset portfolios, thus hedging their overall interest rate risk exposure across the balance sheet. However, in the following section, we show that banks with more foreign deposits are still more sensitive to monetary policy, suggesting that this asset portfolio adjustment does not fully offset the gain in interest rate sensitivity from issuing foreign deposits.

5.2 Bank Stock Returns During the 2021-2022 Rate Hikes

Large foreign deposit betas imply that foreign deposit issuing banks have more interest rate sensitive funding costs. However, *a priori*, it is unclear if more interest rate sensitive funding leads to risker banks. For instance, we find that banks with more (large beta) foreign deposits hedge their balance sheet by holding more (large beta) assets. Alternatively, banks could hedge their residual interest risk using derivatives. However, if left unhedged, foreign deposits can make banks more interest rate sensitive, with rising interest rates inducing

Figure 3: Stock Performance of Publicly Traded US Banks from September 2021-2022 and *Ex Ante* Foreign Deposit Shares as of 2020 Q1



Note: 28 US listed equities out of the US banks that held foreign deposits as of 2020 Q1 shown in Figure A.2. Left-panel plots the average 12-month performance of the 5 stocks with the lowest 2020 Q1 foreign deposit shares ('Low FDS') and the 5 stocks with the highest 2020 Q1 foreign deposit shares ('High FDS'). Right-panel plots individual stocks 2020 Q1 foreign deposit share against their September 2021-2022 stock return, with a correlation of -0.46.

Table 7: Cross-sectional Regression of September 2021-2022 Bank Stock Returns on 2020 Q1 Bank-level Foreign Deposit Shares

	Dependent variable: 12-month Stock Return		
	(1)	(2)	(3)
Constant	−3.027 (3.668)	0.193 (4.054)	41.361 (25.572)
Foreign Deposit Share	−0.501*** (0.165)	−0.514*** (0.148)	−0.401*** (0.131)
Uninsured Deposit Share		−0.308 (0.211)	−0.338* (0.187)
ln(Assets)			−2.285* (1.375)
Observations	28	28	28
Adjusted R^2	0.185	0.235	0.274

Note: Robust standard errors. '*', '**', '***' correspond to 10%, 5%, 1% significance, respectively. Cross-sectional regression of 28 US listed bank stocks that held foreign deposits as of 2020 Q1 from Figure A.2. September 2021 was chosen as the start date for calculating 12-month stock returns because it aligns with several measures of US monetary policy tightening, including the 2-year US Treasury yield, the shadow rate of Wu and Xia [2016], and the proxy rate of Choi et al. [2022].

greater funding pressures that potentially impact bank margins and capital adequacy.

To formally test whether foreign deposits make banks more interest rate sensitive, we consider the recent 2021-2022 Federal Reserve monetary policy tightening episode as a case study. Over this period, the Federal Reserve embarked on its sharpest series of interest rate hikes since at least 1983. The FFR was raised over 500 basis points and much of the increase was unexpected by most banks, market participants and economists.

We examine whether *ex ante* foreign deposit shares from 2020 can explain the cross-section of bank stock price changes during this unexpected and sharp rate hike cycle. Our analysis is therefore conceptually similar to Aharony et al. [1986] and English et al. [2018] which examine how bank equity values respond to US monetary policy using stock prices. We compute stock price changes as 12-month log returns of bank stocks starting September 2021. Our sample of banks is restricted to the 28 US-listed banks that held foreign deposits in 2020 (i.e., a subset of the banks reported in Figure A.2). We choose September 2021 as the start date because it marks a key inflection point across several measures of US monetary policy including 2-year US Treasury yields, the shadow FFR of Wu and Xia [2016] and the proxy rate of Choi et al. [2022].[19]

Figure 3 left-panel plots the average price changes of the 5 banks with the lowest foreign deposit shares ('low FDS') and the 5 banks with the highest foreign deposit shares ('high FDS') as of 2020 Q1. Over the 12 month period of September 2021-2022, 'high FDS' banks saw their stock prices fall 10 percentage points more on average. The right-panel of Figure 3 plots 2020 foreign deposit shares of each bank in the sample against its September 2021-2022 cumulative stock return. A statistically significant negative correlation can be observed, with all banks with foreign deposit shares of roughly 20% or more losing over -18% over the 12-month period, compared to the sample average of -8%. Table 7 reports coefficient estimates from regressing September 2021-2022 bank stock returns on 2020 foreign deposit shares. The estimates suggest that bank stock prices fell 4-5 percentage points more for every 10

[19]Examining the 12 months following September 2021 allows us to isolate the period of sharply rising interest rates that came prior to the regional banking crisis of March 2023.

percentage points of foreign deposit share. This effect is robust to controlling for the share of domestic time deposits that are uninsured, and bank size. These two control variables also explain the cross-section of bank returns during the Fed tightening cycle, but to a lesser extent. These results suggests that (i) the asset-side adjustments of these banks issuing foreign deposits do not fully mitigate additional interest rate risk from foreign deposits, and (ii) investors recognize the additional risk inherent to banks issuing foreign deposits.

6 Concluding Remarks

Foreign deposit betas are 20-30 percentage points larger than domestic deposit betas. These large foreign deposit betas are only partly explained by the uninsured treatment of foreign deposits. This difference persists in aggregate and within banks, and under several robustness checks: excluding FBOs, isolating dollar-denominated foreign deposits, allowing for asymmetric deposit betas, and controlling for other factors driving deposit betas.

Because foreign deposit betas differ meaningfully from domestic deposit betas, they have important macro-financial and risk management implications. Although banks with foreign deposits have more interest-sensitive liabilities, they also tend to hold more interest-sensitive assets. However, banks with high foreign deposit shares are still more sensitive to US monetary policy, suggesting that on net, banks carry more interest rate risk from issuing foreign deposits.

Consequently, foreign deposits could contribute to a trade off between monetary policy and financial stability. Larger foreign deposit shares improve the pass-through of monetary policy via the deposits channel by increasing the aggregate deposit beta of the bank sector. But at the same time, bank profitability becomes more volatile with respect to monetary policy, potentially raising funding stability risks. Because banks that issue foreign deposits are also some of the largest banks, these issues are unlikely to diminish at the aggregate level.

References

Afanasyeva, E. and J. Güntner (2020). Bank market power and the risk channel of monetary policy. *Journal of Monetary Economics 111*, 118–134.

Aharony, J., A. Saunders, and I. Swary (1986). The effects of a shift in monetary policy regime on the profitability and risk of commercial banks. *Journal of Monetary Economics 17*, 363–377.

Akinci, O., G. Benigno, M. Del Negro, and A. Queralto (2020). The financial (in) stability real interest rate, r. *FRB of New York Staff Report* (946).

Aldasoro, I., F. Balke, A. Barth, and E. Eren (2022). Spillovers of funding dry-ups. *Journal of International Economics 137*, 103622.

Aldasoro, I., T. Ehlers, and E. Eren (2022). Global banks, dollar funding, and regulation. *Journal of International Economics 137*, 103609.

Anderson, A. G., W. Du, and B. Schlusche (2021). Arbitrage capital of global banks. Technical report, National Bureau of Economic Research.

Bernanke, B. S. and A. S. Blinder (1988). Credit, money, and aggregate demand. *American Economic Review 78*, 435–439.

Bernanke, B. S. and A. S. Blinder (1992). The federal funds rate and the channels of monetary transmission. *The American Economic Review 82*, 901–921.

Berrospide, J. M., R. Correa, L. S. Goldberg, and F. Niepmann (2017). International banking and cross-border effects of regulation: Lessons from the United States. *International Journal of Central Banking 13*, 435–476.

Brimmer, A. F. and F. R. Dahl (1975). Growth of American international banking: Implications for public policy. *The Journal of Finance 30*, 341–363.

Bruno, V. and H. S. Shin (2015). Capital flows and the risk-taking channel of monetary policy. *Journal of Monetary Economics 71*, 119–132.

Carlson, M. A. and J. Rose (2016). Can a bank run be stopped? Government guarantees and the run on Continental Illinois. Technical report, Bank for International Settlements.

Cesa-Bianchi, A., A. Ferrero, and A. Rebucci (2018). International credit supply shocks. *Journal of International Economics 112*, 219–237.

Cetorelli, N. and L. S. Goldberg (2012a). Banking globalization and monetary transmission. *The Journal of Finance 67*, 1811–1843.

Cetorelli, N. and L. S. Goldberg (2012b). Follow the money: Quantifying domestic effects of foreign bank shocks in the great recession. *American Economic Review 102*, 213–218.

Cetorelli, N. and L. S. Goldberg (2012c). Liquidity management of US global banks: Internal capital markets in the great recession. *Journal of International Economics 88*, 299–311.

Choi, J., T. Doh, A. Foerster, Z. Martinez, et al. (2022). Monetary policy stance is tighter than federal funds rate. *FRBSF Economic Letter 30*, 1–5.

Claessens, S. and N. Van Horen (2021). Foreign banks and trade. *Journal of Financial Intermediation 45*, 100856.

Comizio, V. G. and R. Chiachiere (2014). Ringfencing US bank foreign branch deposits: Working toward a clearer understanding of where deposits are payable in the midst of chaos. *Am. U. Bus. L. Rev. 3*, 249.

Correa, R., J. di Giovanni, L. S. Goldberg, and C. Minoiu (2023). Trade uncertainty and US bank lending. Technical report, National Bureau of Economic Research.

Correa, R., T. Paligorova, H. Sapriza, and A. Zlate (2022). Cross-border bank flows and monetary policy. *The Review of Financial Studies 35*, 438–481.

d'Avernas, A., A. L. Eisfeldt, C. Huang, R. Stanton, and N. Wallace (2023). The deposit business at large vs. small banks. Technical report, National Bureau of Economic Research.

Drechsler, I., A. Savov, and P. Schnabl (2017). The deposits channel of monetary policy. *The Quarterly Journal of Economics 132*, 1819–1876.

Drechsler, I., A. Savov, and P. Schnabl (2021). Banking on deposits: Maturity transformation without interest rate risk. *The Journal of Finance 76*, 1091–1143.

Drechsler, I., A. Savov, P. Schnabl, and O. Wang (2023). Banking on uninsured deposits. *NBER Working Paper* (w31138).

English, W. B., S. J. Van den Heuvel, and E. Zakrajšek (2018). Interest rate risk and bank equity valuations. *Journal of Monetary Economics 98*, 80–97.

Gerlach, J. R., N. Mora, and P. Uysal (2018). Bank funding costs in a rising interest rate environment. *Journal of Banking and Finance 87*, 164–186.

Goldberg, L. G. and A. Saunders (1980). The causes of US bank expansion overseas: The case of Great Britain. *Journal of Money, Credit and Banking 12*, 630–643.

Greenwald, E., S. Schulhofer-Wohl, and J. Younger (2023). Deposit convexity, monetary policy, and financial stability. *FRB of Dallas Working Paper*.

Hale, G., T. Kapan, and C. Minoiu (2020). Shock transmission through cross-border bank lending: Credit and real effects. *The Review of Financial Studies 33*, 4839–4882.

Hanc, G. (1998). The banking crises of the 1980s and early 1990s: Summary and implications. *FDIC Banking Rev. 11*.

Hannan, T. H. and A. N. Berger (1991). The rigidity of prices: Evidence from the banking industry. *The American Economic Review 81*, 938.

He, D. and R. McCauley (2012). Eurodollar banking and currency internationalisation. *BIS Quarterly Review*, 33.

Kang-Landsberg, A., S. Luck, and M. Plosser (2023). Deposit betas: Up, up, and away? Technical report, Federal Reserve Bank of New York.

Karolyi, G. A., J. Sedunov, and A. G. Taboada (2023). Cross-border bank flows and systemic risk. *Review of Finance 27*, 1563–1614.

Krishnamurthy, A. and W. Li (2023). The demand for money, near-money, and treasury bonds. *The Review of Financial Studies 36*, 2091–2130.

Kurlat, P. (2019). Deposit spreads and the welfare cost of inflation. *Journal of Monetary Economics 106*, 78–93.

Li, L., E. Loutskina, and P. E. Strahan (2023). Deposit market power, funding stability and long-term credit. *Journal of Monetary Economics 138*, 14–30.

Li, W., Y. Ma, and Y. Zhao (2019). The passthrough of treasury supply to bank deposit funding. *Columbia Business School Research Paper, USC Marshall School of Business Research Paper*.

Liu, E. X. and J. Pogach (2017). The effect of foreign lending on domestic loans: An analysis of US global banks. *Economics Letters 156*, 151–154.

Marino, J. A. and R. L. Bennett (1999). The consequences of national depositor preference. *FDIC Banking Rev. 12*, 19.

Messer, T. and F. Niepmann (2023). What determines passthrough of policy rates to deposit rates in the Euro area? *FEDS Notes* (2023-07), 28–2.

Miller, R. M., D. Nguyen, and D. Thieme (2022). Construction and evaluation of an NSFR proxy using publicly available data. *FDIC Staff Studies*.

Miranda-Agrippino, S. and H. Rey (2020). Us monetary policy and the global financial cycle. *The Review of Economic Studies 87*, 2754–2776.

Nagel, S. (2016). The liquidity premium of near-money assets. *The Quarterly Journal of Economics 131*, 1927–1971.

Neumark, D. and S. A. Sharpe (1992). Market structure and the nature of price rigidity: Evidence from the market for consumer deposits. *The Quarterly Journal of Economics 107*, 657–680.

Niepmann, F. (2023). Banking across borders with heterogeneous banks. *Journal of International Economics 142*, 103748.

Popov, A. and G. F. Udell (2012). Cross-border banking, credit access, and the financial crisis. *Journal of International Economics 87*, 147–161.

Spiegel, M. M. (2022). Monetary policy spillovers under COVID-19: Evidence from lending by US foreign bank subsidiaries. *Journal of International Money and Finance 122*, 102550.

Stein, J. C. (2012). Monetary policy as financial stability regulation. *The Quarterly Journal of Economics 127*, 57–95.

Wall, L. D. and D. R. Peterson (1990). The effect of Continental Illinois' failure on the financial performance of other banks. *Journal of Monetary Economics 26*, 77–99.

Wang, Y., T. M. Whited, Y. Wu, and K. Xiao (2022). Bank market power and monetary policy transmission: Evidence from a structural estimation. *The Journal of Finance 77*, 2093–2141.

Wu, J. C. and F. D. Xia (2016). Measuring the macroeconomic impact of monetary policy at the zero lower bound. *Journal of Money, Credit and Banking 48*, 253–291.

Yankov, V. (2018). In search of a risk-free asset: Search costs and sticky deposit rates. *Journal of Money, Credit and Banking*.

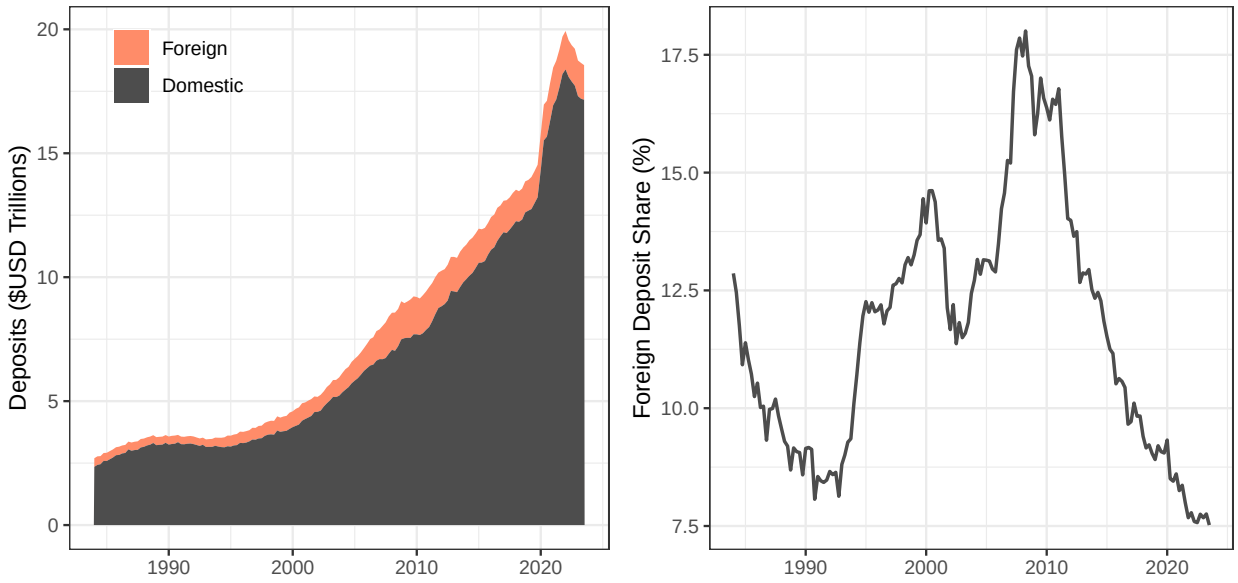
Appendix

A1 Foreign Deposit Funding of US Commercial Banks

The Appendix presents additional empirical analysis and discusses institutional details of foreign deposits. These include aggregate trends and potential drivers of foreign deposit variation over time, regulatory and legal treatment of foreign deposits, and the distribution of foreign deposits across banks and across countries.

A1.1 Aggregate Dynamics and the Distribution of Foreign Deposits

Figure A.1: Aggregate Foreign Deposit Level and Foreign Deposit Share of Total Deposits



Note: Quarterly foreign deposit shares calculated as foreign deposits divided by total deposits. Share of interest paid on foreign deposits calculated as interest paid on foreign deposits divided by interest paid on total deposits. Sample period is 1984-2023.

Foreign deposits make up a non-trivial portion of bank sector deposits (and therefore liabilities). In dollar value, foreign deposits rose from roughly $300 billion in the early 1990s and peaked at $1.6 trillion in 2011. Since 2011, foreign deposits fluctuated between $1.2-1.6 trillion. Both foreign deposit shares and their contribution to total deposit expense varied considerably over time. On average, interest paid on foreign deposits made up 10% of total bank sector interest expense from 1984-2023.[A1] Figure A.1 right panel plots the evolution of foreign deposits as a percent of total deposits since 1984. Foreign deposits made up nearly 18% of total deposits in 2008 before the Global Financial Crisis, and has since steadily declined to about 7.5%.

Foreign deposit dynamics differ from domestic deposits in that they are much more volatile than domestic deposits and largely uncorrelated with domestic deposit growth as shown in Figure 1. Because foreign depositors are typically large, sophisticated corporate entities, it is not surprising that foreign deposit volatility is high. Similarly, the volatility of domestic corporate deposits and uninsured domestic deposits are relatively high. However, at the same time, foreign deposit growth is uncorrelated with domestic corporate deposit and uninsured domestic deposit growth (Figure A.5 in the Appendix).[A2]

A1.2 Potential Sources of Aggregate Foreign Deposit Variation

The pre-2008 rise in foreign deposit share and the secular post-2008 decline are visually striking (Figure A.1). What factors drove these trends? Domestic deposits continued to steadily rise since 2008 while foreign deposits peaked in 2011 and have fluctuated between $1.2-1.6 trillion since. Domestic deposits grew even faster since 2019 increasing by roughly $6 trillion in three years. Mechanically, this drove the foreign deposit share lower in the post-pandemic period. Much of this domestic deposit growth resulted from the combination of domestic fiscal and unconventional monetary policy during the pandemic.

[A1] Foreign deposit interest expense contributed roughly 12% to total bank sector interest expense before 2008, reaching upward of 16% at times. See Figure A.6.

[A2] Corporate deposits are calculated from the Federal Reserve Flow of Funds data as the sum of nonfinancial corporate business checking and time and savings deposits.

A factor contributing to the earlier rise of foreign deposit shares may have been banks seeking to circumvent US regulatory costs and specifically the different reserve requirements on foreign deposits.[A3] Goldberg and Saunders [1980] and Claessens and Van Horen [2021] point to capital controls in the US as one determinant of US bank internationalization, along with growing US international trade. Moving forward but prior to 2008, reserve requirements were binding for US banks, but deposits issued in other jurisdictions were subject to local reserve requirements. This incentivized US banks to issue foreign deposits in jurisdictions with lower reserve requirements. In addition, holding reserves on the balance sheet was particularly costly because the Fed did not pay interest on reserves before 2008. As shown later in Figure A.3, it is likely that a large majority of these deposits are held in the UK, and some in other countries such as Hong Kong and the Cayman Islands, jurisdictions without explicit reserve requirements. The 2008 inflection point in the foreign deposit share aligns with the period after which reserve requirements were no longer binding in the US, the Fed began paying interest on reserve balances, and system-wide reserve levels were no longer scarce due to unconventional monetary policies.[A4] Trade integration seems to be a part of the story too. The pre-2008 rise and 2011 peak observed in foreign deposits align with the rapid growth and twin peaks of US global trade measured as a percent of GDP observed in 2008 and 2011.

In addition, the 2011 peak in foreign deposits of $1.6 trillion somewhat aligns with the resolution over the debate on the uninsured treatment of foreign deposits of US banks, which was finalized in 2013. The rule clarified that foreign depositors are excluded from 'depositor preference' and therefore subordinate to domestic insured and uninsured depositors. If foreign countries perceived this hierarchy as unfair, they may choose to seize the assets of foreign branches of failed US banks [Marino and Bennett, 1999]. These risks may have also contributed to the deceleration of foreign deposit growth.[A5]

[A3] Regulatory arbitrage is considered one important motivation behind the formation of the eurodollar market [He and McCauley, 2012].

[A4] See Figure A.7 in the Appendix.

[A5] In Europe, foreign branches of the home country bank are covered by the home country insurance,

Another possible set of factors behind early foreign deposit growth were high foreign interest rates – a common feature of eurodollar deposits [He and McCauley, 2012]. Foreign interest rates were notably high before the. 2000s. At that time, foreign deposit rates were also substantially higher than domestic deposit rates (and the FFR). These high foreign deposit rates in turn coincided with the growth surge in foreign deposit share from 1990-2000.

A1.3 Regulatory Treatment of Foreign Deposits

The regulatory and legal treatment of foreign deposits is consistent with their relatively high volatility and risk. Foreign deposits are often cited as being a more volatile deposit type. For example, see the discussion on foreign deposits within the *FDIC Risk Management Manual of Examination Policies* (sections 6.1 and 11.1). Foreign deposits are also explicitly treated as less stable from a regulatory standpoint. In addition, FFIEC includes foreign deposits in its category of *volatile liabilities*, which include foreign deposits, federal funds, uninsured domestic time deposits, and trading liabilities.

Under the Liquidity Coverage Ratio (LCR) rule requiring banks to hold high quality liquid assets (HQLA) sufficient to withstand a 30-day stress period, foreign deposits are treated as uninsured deposits and assigned an assumed runoff rate of 10% to 25% compared to a runoff assumption of 3% assigned to standard domestic retail deposits.[A6] In a similar vein, the Available Stable Funding (ASF) weights assigned to foreign deposits in calculating Net Stable Funding Ratio (NSFR) tend to be smaller, implying that they are less stable forms of deposit funding. Depending on the type of foreign deposit, ASF weights on foreign deposits range between 90% and 50% compared to 95% to 90% ASF weights assigned to most domestic deposit types.[A7]

Some large banks with assets exceeding $100 billion self-report expected deposit betas

contrary to the US.

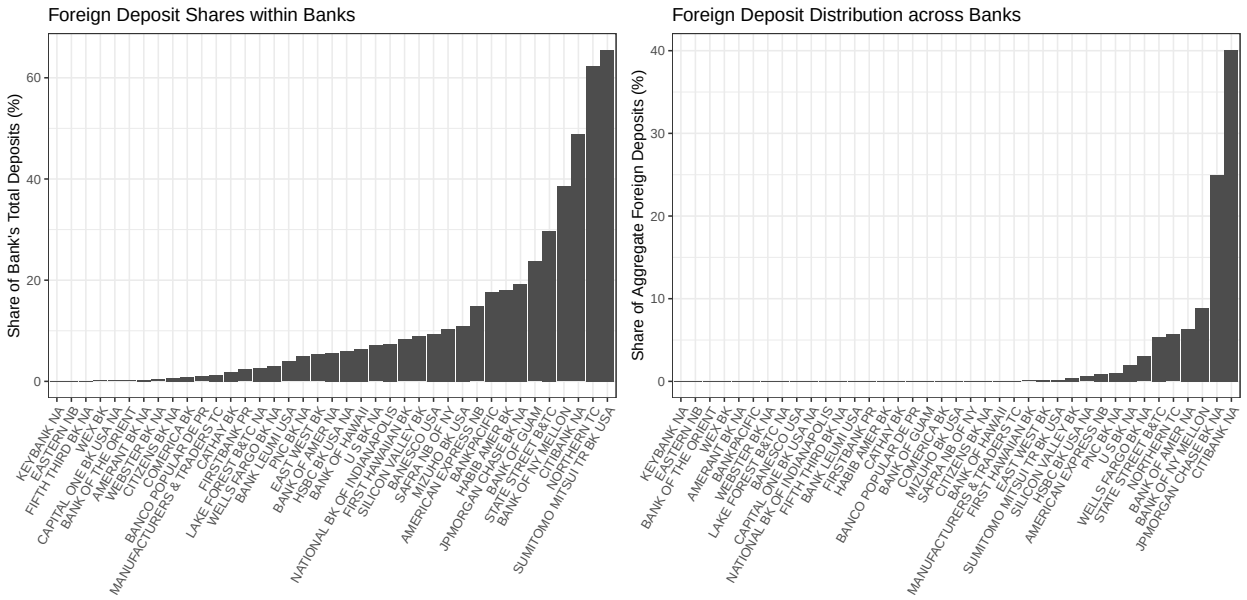
[A6] See '*Liquidity Coverage Ratio: Liquidity Risk Measurement Standards," 79 Fed. Reg. 61440 (October 10, 2014)*' section 3.

[A7] See Miller et al. [2022].

across different deposit segments in confidential FR Y-14 regulatory filings. Gerlach et al. [2018] presents summary statistics on these self-reported deposit betas. Again consistent with the volatility and risk of foreign deposits, Banks report foreign deposit betas that are larger than domestic deposit betas. For example, self-reported median deposit betas on foreign deposits ranged from 50% to 70%, while the median across domestic deposit types ranged from 23% to 52%.

Finally, foreign deposits are uninsured. The only exception lies in foreign deposits that are transferrable and able to be withdrawn at a domestic branch of the bank, but such cases are rare.[A8] In 2013, the FDIC issued the Final Rule establishing that foreign branch deposits do not fall under 'depositor preference'. Therefore, foreign depositors are not treated equally to domestic uninsured deposits amidst a bank failure.[A9] Domestic uninsured depositors are subject to 'depositor preference' and are therefore treated senior to general creditors. Foreign depositors are not subject to 'depositor preference' and are subordinate to domestic uninsured depositors. Thus, if a US bank were to fail, its foreign depositors would share in the distribution of the bank's liquidated assets as general creditors after the claims of insured and uninsured domestic depositors have been satisfied.[A10] The 2023 failure of Silicon Valley Bank exemplified this, as uninsured domestic deposits were *de facto* insured via a government guarantee, but foreign deposits were not.[A11] Such uninsured treatment of foreign deposits can contribute to their volatility.

Figure A.2: Foreign Deposits: Shares within Banks and Distribution across Banks, Q1 2020



Note: left-panel reports foreign deposit shares calculated as foreign deposits divided by total deposits at the bank level. Right-panel reports the percent of aggregate foreign deposits held by each bank in 2020.

A1.4 The Distribution of Foreign Deposits within the US Banking System

It's quite clear that foreign deposits account for a non-trival share of total deposits in the US banking system. However, foreign deposits are unevenly distributed and tend to be highly concentrated among just a few banks. In fact, since 1984, the proportion of banks holding foreign deposits ranged between 0.5% to 1.5% of all banks. As of 2020, a total of 39 banks held foreign and domestic deposits, out of 5,098 RSSD IDs, or about 0.76% of banks. Figure A.2 reports banks holding foreign deposits as of 2020. Two critical dimensions of concentration

[A8]These are referred to 'dual' deposits.

[A9]Legal debates over the treatment and insurance of US bank foreign office deposits grew out of a need to address inherent political risks. The history of state actors appropriating foreign deposits include cases from the Russian Revolution, the Vietnam War, and the Cuban Revolution [Comizio and Chiachiere, 2014]. In 2013, the FDIC approved a final rule clarifying that foreign deposits are not subject to 'depositor preference' and are not insured by the FDIC.

[A10]See '*Final Rule on Definition of Insured Deposit*', FDIC, September 5, 2013.

[A11]See June 19, 2023 Reuters article, "SVB's Asian customers who lost deposits remain on the hook for loans".

emerge. First, the left-panel reports within-bank foreign deposit shares (a bank's foreign deposits as a % of its total deposits). Even conditional on holding foreign deposits, some banks are more reliant on foreign deposit funding than others, such as Citibank, Northern Trust, and Sumitomo Mitsubishi, all of which had foreign deposit shares exceeding 40% as of 2020. Closer inspection reveals that several of the banks holding foreign deposits are connected to foreign or international financial institutions, which may explain their relatively high foreign deposit shares.[A12]

Similar to the observation of concentrated domestic deposit markets, the right-panel of Figure A.2 reveals that the foreign deposit market is also highly concentrated among a few, mega-sized banks and these banks also tend to issue the majority of aggregate *domestic* deposits (e.g., BNY Mellon, JP Morgan Chase, Citibank). As of 2020, half of all domestic deposits outstanding were issued by the small fraction of banks that also issue foreign deposits.

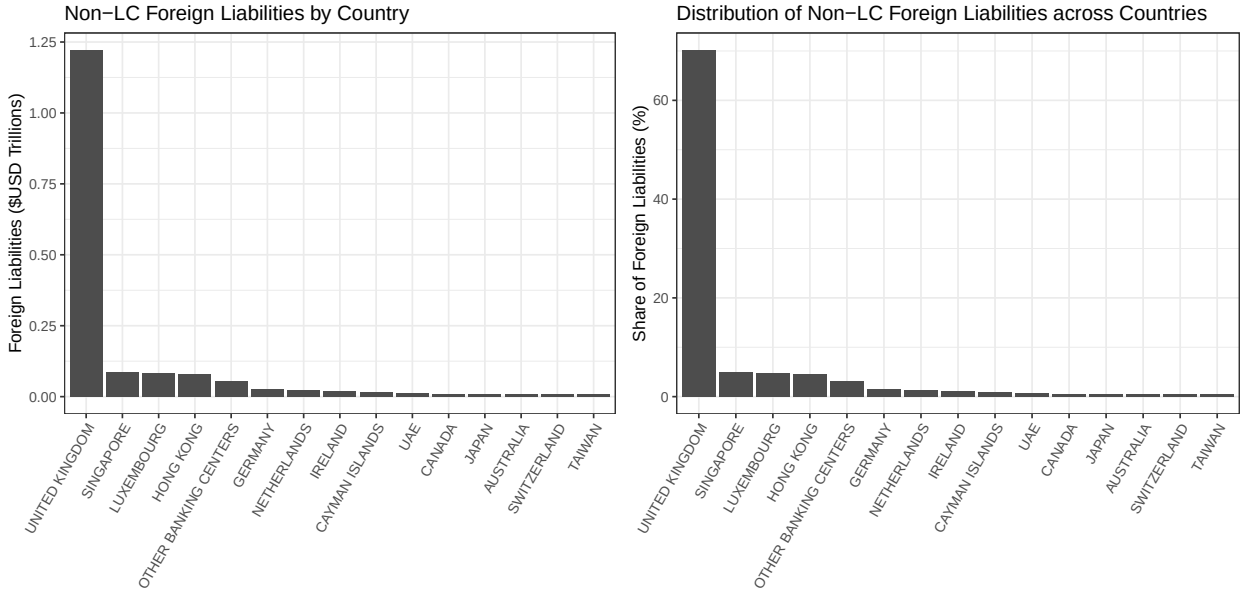
A1.5 The Geography of Foreign Deposits

Public data breaking down foreign deposits by source country is not available, but is reported in non-public form FFIEC 009. However, public form FFIEC 009a and Federal Reserve E.16 publish less granular local and non-local currency (LC) foreign office liabilities by source country. To get a rough idea for where these foreign deposits might be located geographically, we assume that non-local currency foreign office liabilities are in some reasonable capacity referring to USD-denominated foreign office deposits.[A13] Figure A.3 reports such non-LC foreign liabilities for several countries in 2023Q3. Total non-LC foreign liabilities of US commercial banks were about $1.74 trillion in 2023Q3 (compared to $1.4 trillion of foreign deposits). Non-LC foreign liabilities are highly concentrated across source countries with over 70% issued in the UK. Global financial centers outside the US show a distinct affinity

[A12] See, for example, Bank of the Orient, Banco Popular, Bank Leumi, HSBC, Banesco, Safra Bank, Mizuho, Habib America, Bank of Guam, Sumitomo Mitsubishi.

[A13] In aggregate, the majority of foreign deposits are denominated in non-local currency, but there is substantial variation in the currency denomination of foreign deposits at the bank level.

Figure A.3: Non-Local Currency Foreign Liabilities of US Banks by Source Country, Q3 2023



Note: left-panel reports non-LC foreign office liabilities of US commercial banks (in USD trillions). Right-panel reports each country's share of total non-LC foreign liabilities which were approximately $1.74 trillion in 2023Q3. Data is from form FFIEC 009a.

to house non-LC foreign liabilities, with more than 87% of non-LC foreign liabilities held in the UK, Singapore, Luxembourg, Hong Kong, and 'Other Banking Centers'. This high concentration toward financial centers offers support toward the view that foreign deposits are highly mobile and held by relatively sophisticated depositors. In turn, foreign depositors may be more 'flighty' and sensitive to deposit rates. Moreover, the high concentration of foreign office liabilities in the UK and Hong Kong is consistent with their attractiveness as foreign deposit centers, given that there is no reserve requirement.

As a secondary source of geographical data, one might refer to the BIS Locational Banking Statistics. Again, the data is limited since it does not identify deposits exclusively. However, it does provide a geographical distribution of the cross-border liabilities of the US. As of Q3 2023, US cross-border liabilities were most concentrated in the UK, Cayman Islands, Japan, Canada, France, and Germany (in descending order), which is qualitatively consistent with the FFIEC 009a data.

A2 Additional Figures and Tables

Table A.1: Federal Funds Rate Pass-through to Domestic Deposit Rates by Segment

	Transaction	Savings & MMDA	Time
ΔFFR_t	0.076***	0.284***	0.198**
	(0.02)	(0.042)	(0.098)
$\sum_{l=0}^{3} \Delta FFR_{t-l}$	0.102***	0.321***	0.508***
	(0.013)	(0.037)	(0.057)
$[FFR_{t-1} - \overline{DR}_{t-1}]$	0.006	0.047***	0.082***
	(0.007)	(0.017)	(0.019)
Adjusted R^2	0.367	0.641	0.608
Observations	146	146	146

Note: Standard errors are adjusted for autocorrelation and heteroscedasticity. Estimation period is 1987Q1-2023Q3. '*','**','***' correspond to 10%, 5%, 1% significance, respectively. Estimates correspond to Equation 2 with different domestic deposit rate segments as the dependent variable.

Table A.2: Asymmetric Federal Funds Rate Pass-through to Foreign and Domestic Deposit Rates

	Foreign		Domestic		F-D Difference	
	β_{down}	β_{up}	β_{down}	β_{up}	β_{down}	β_{up}
ΔFFR_t	0.737***	0.263	0.318***	0.120**	0.418**	0.144
	(0.166)	(0.219)	(0.043)	(0.054)	(0.166)	(0.209)
$\sum_{l=0}^{3} \Delta FFR_{t-l}$	0.830***	0.470**	0.580***	0.164	0.250	0.306
	(0.169)	(0.199)	(0.052)	(0.133)	(0.174)	(0.200)
$[FFR_{t-1} - \bar{DR}_{t-1}]$	0.084*		0.137***		-0.053	
	(0.046)		(0.039)		(0.043)	
Adjusted R^2	0.441		0.796		0.098	
Observations	155		155		155	

Note: Standard errors are adjusted for autocorrelation and heteroscedasticity. Estimation period is 1984Q1- 2023Q3. '*','**','***' correspond to 10%, 5%, 1% significance, respectively. Estimates correspond to Equation 2 augmented with the following interaction terms to test for asymmetric deposit betas: $\Delta FFR_{t-l} \times \mathbf{1}_{FFR_{t-l}>0}$ for $l = 0, 1, 2, 3$.

Table A.3: Federal Funds Rate Pass-through to Foreign and Domestic Deposit Rates Since 2000

	Foreign	Domestic	F-D Difference
ΔFFR_t	0.657^{***}	0.267^{***}	0.389^{***}
	(0.127)	(0.035)	(0.133)
$\sum_{l=0}^{3} \Delta FFR_{t-l}$	0.632^{***}	0.428^{***}	0.203
	(0.147)	(0.041)	(0.142)
$[FFR_{t-1} - \overline{DR}_{t-1}]$	0.048	0.061^{***}	-0.013
	(0.044)	(0.011)	(0.046)
Adjusted R^2	0.705	0.94	0.297
Observations	91	91	91

Note: Standard errors are adjusted for autocorrelation and heteroscedasticity. Estimation period is 2000Q1-2023Q3. '*','**','***' correspond to 10%, 5%, 1% significance, respectively. Estimates correspond to Equation 2.

Table A.4: Bank-level Regressions of Deposit Rates on the Federal Funds Rate using Banks that held Foreign Deposits in 2020Q1

	Dependent variable:					
	Bank Deposit Rate (Level)			Bank Deposit Rate (4Q Change)		
	(1)	(2)	(3)	(4)	(5)	(6)
FFR_t	0.829^{***}	0.806^{***}	0.810^{***}			
	(0.018)	(0.018)	(0.018)			
$FFR_t \times$ Foreign Deposit Share$_{i,t-1}$		0.150^{**}	0.199^{**}			
		(0.065)	(0.080)			
$FFR_t \times$ Asset Market Concentration$_{i,t-1}$			-3.723^{***}			
			(0.568)			
$\Delta FFR_{t-4,t}$				0.537^{***}	0.474^{***}	0.483^{***}
				(0.025)	(0.027)	(0.028)
$\Delta FFR_{t-4,t} \times$ Foreign Deposit Share$_{i,t-4}$					0.344^{***}	0.387^{***}
					(0.104)	(0.082)
$\Delta FFR_{t-4,t} \times$ Asset Market Concentration$_{i,t-4}$						-2.135^{***}
						(0.745)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,992	4,948	4,948	4,827	4,827	4,827
Adjusted R^2	0.837	0.837	0.840	0.355	0.363	0.365

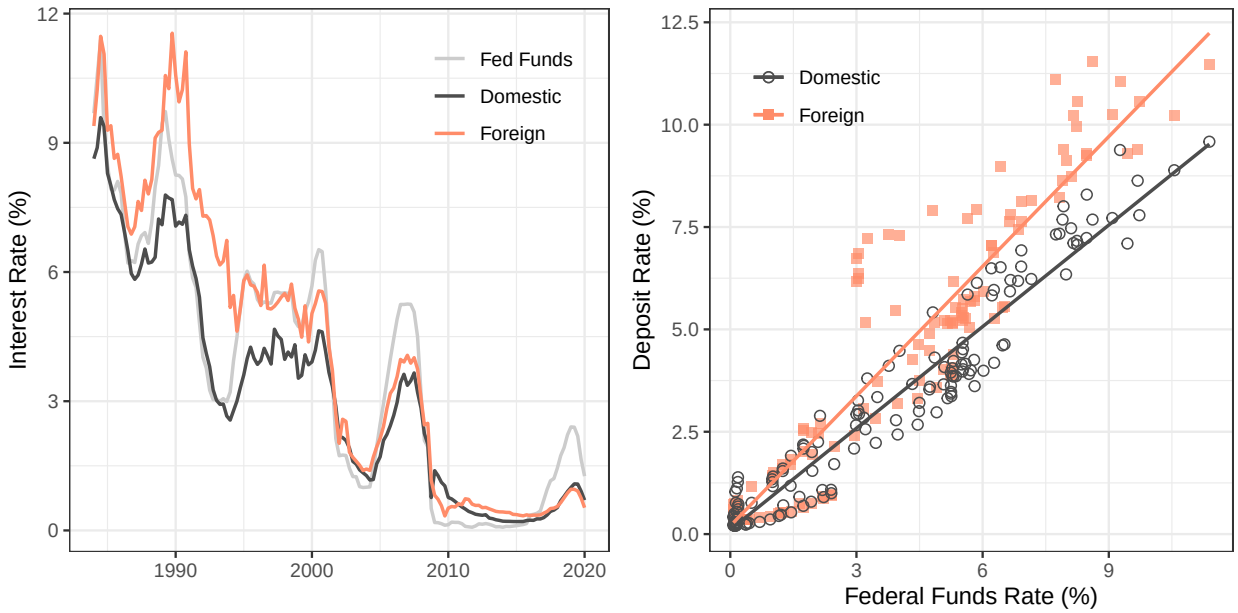
Note: Standard errors are clustered at the bank level. Estimation period is 1984Q1-2020Q1. '*', '**', '***' correspond to 10%, 5%, 1% significance, respectively. Sample consists of bank-quarter observations of the banks that held foreign deposits in 2020Q1. Foreign deposit share (bank's foreign deposits as a percent of the bank's total deposits) and asset market concentration (bank's total assets as a percent of market-wide assets) lie between 0 and 1 and their standard deviations are 0.227 and 0.023, respectively. Estimates correspond to Equations 3 and 4.

Table A.5: Bank-level Regressions of Deposit Rates on the Federal Funds Rate and Foreign Policy Rates: Subset of Non-FBO Banks and Dollar-denominated Foreign Deposits

	Sub-sample:			
	Non-FBO Banks		USD Foreign Deposits	
	(1)	(2)	(3)	(4)
FFR_t	0.826^{***}		0.829^{***}	
	(0.020)		(0.022)	
$FFR_t \times$ Foreign Deposit Share$_{i,t-1}$	0.280^{**}		0.239^{**}	
	(0.112)		(0.096)	
$FFR_t \times$ Asset Market Concentration$_{i,t-1}$	-5.388^{***}		-4.072^{***}	
	(1.117)		(0.485)	
$\Delta FFR_{t-4,t}$		0.541^{***}		0.465^{***}
		(0.025)		(0.030)
$\Delta FFR_{t-4,t} \times$ Foreign Deposit Share$_{i,t-4}$		0.245^{***}		0.628^{***}
		(0.070)		(0.107)
$\Delta FFR_{t-4,t} \times$ Asset Market Concentration$_{i,t-4}$		-2.322^{***}		-1.974^{***}
		(0.683)		(0.309)
Bank FE	Yes	Yes	Yes	Yes
Observations	4,240	4,098	1,220	1,189
Adjusted R^2	0.805	0.363	0.902	0.505

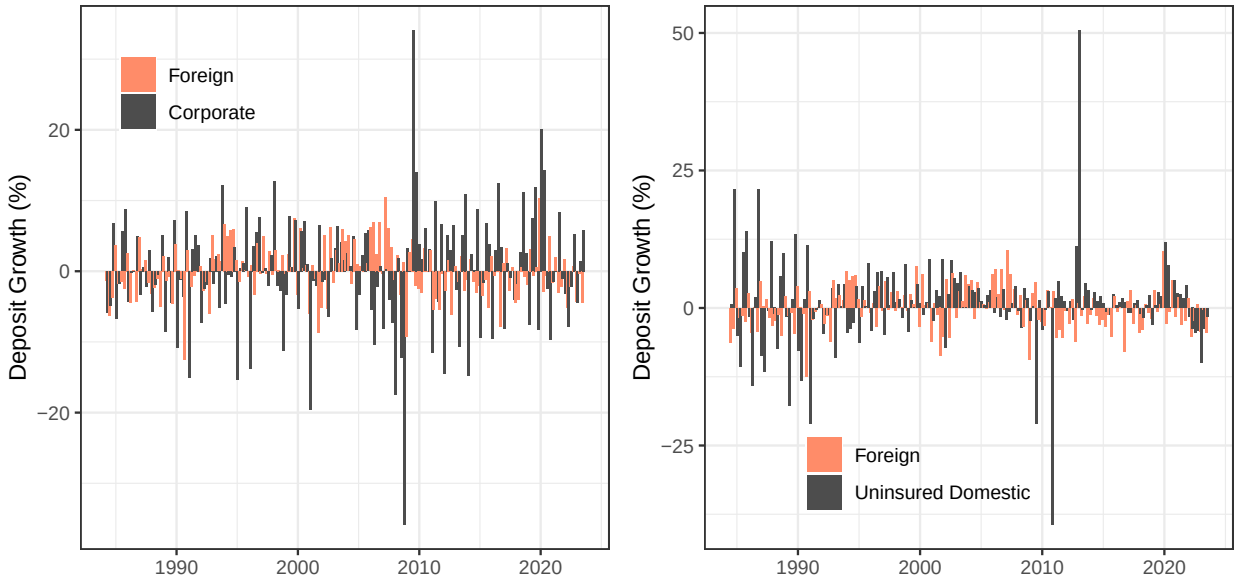
Note: Standard errors are clustered at the bank level. Estimation period is 1984Q1-2020Q1. '*', '**', '***' correspond to 10%, 5%, 1% significance, respectively. Columns 1 and 2 refer to the sample of all bank-quarter observations with positive foreign deposits, further filtered to include only non-FBO US banks. Columns 3 and 4 refer to the sample of all bank-quarter observations with positive foreign deposits, further filtered on banks that averaged non-local currency denominated foreign office liabilities of at least 70% of total foreign office liabilities. Non-local currency liabilities are a proxy for dollar-denominated foreign deposits. Data on currency denomination is from bank-level FFIEC 009 supervisory data. Estimates correspond to Equations 3 and 4.

Figure A.4: Aggregate Foreign and Domestic Deposit Rates from Subset of US Commercial Banks that Hold Foreign Deposits



Note: Quarterly foreign (domestic) deposit rates calculated as annualized interest paid on foreign (interest-bearing domestic) deposits divided by total foreign (interest-bearing domestic) deposits from the sub-sample of US banks that hold foreign deposits along with domestic deposits. Sample period is 1984-2020 and deposit rates are estimated using aggregated bank-level data from Call Reports.

Figure A.5: Foreign Deposit, Corporate Deposit, and Uninsured Deposit Growth



Note: Quarterly deposit growth rates calculated as de-meaned log-differences of deposit levels. Correlation between corporate deposit growth and foreign deposit growth is -0.05. Correlation between corporate deposit growth and uninsured deposit growth is -0.03. Neither correlation is statistically distinguishable from 0. Corporate deposits measured as. the sum. of Nonfinancial corporate business checking and time and savings deposits from the Federal Reserve Flow of Funds. Sample period is 1984-2023.

Figure A.6: Aggregate Interest Expense of Foreign Deposits as a Percent of Total Bank Sector Interest Expense



Note: Calculated by dividing quarterly aggregate interest expense paid on foreign deposits by aggregate total interest expense of US banks. Sample period is 1984-2023.

Figure A.7: Aggregate Reserves and Cash Assets of US Commercial Banks



Note: Quarterly reserve balances and cash assets of US commercial banks. Sample period is 1984-2023.