Foreign Currency Exposure and Bank Credit: Evidence from Emerging Europe*

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Abstract: This paper constructs a novel bank level dataset on foreign currency denominated assets and liabilities in emerging market economies in Europe to study how banks' foreign currency exposure affects the transmission of exchange rate shocks to the real economy. Using bank balance sheet data, we show that following home currency depreciation banks with net foreign liabilities lend less relative to banks without net foreign liabilities. This reduction in lending growth is economically significant with an average home currency depreciation during the sample period associated with 5 percentage point lower loan growth for banks with net foreign currency liabilities. Our results are robust to alternate econometric specifications and measures of foreign currency exposure, the choice of foreign currency, and banks' ownership type. The inclusion of off-balance sheet positions that could be utilised to hedge foreign currency exposure too does not affect our results.

JEL Classification Numbers: G15; G21; F30; F65.
Keywords: Bank lending; Exchange Rates; Emerging Europe; Currency Mismatch

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1 Introduction

Low dollar funding costs in the run up and aftermath of the 2008-09 financial crisis led to an increase in foreign currency borrowing by banks and firms in emerging markets (McGuire and von Peter, 2012; Barajas et al., 2020). If foreign currency borrowing is not perfectly hedged either by foreign currency lending or by offsetting positions in currency derivatives, banks' net open positions in foreign currency can have an impact on the transmission of exchange rate shocks to the real economy by affecting credit supply. Recent work has highlighted banks' inability to perfectly hedge their foreign currency exposure (Rampini et al., 2019), as well as documented the role of banks' net foreign currency exposure in the transmission of exchange rate shocks to the real economy in the context of advanced economies (Agarwal, 2019). However, the importance of this channel for emerging markets remains unexplored. This paper fills this gap in the literature by studying the role of banks' foreign currency exposures in the transmission of exchange rate shocks for a sample of emerging market economies in Europe.

It is important to study the role of this channel in emerging markets for the following reasons. First, episodes of currency depreciation are more common in emerging markets than in advanced economies. Second, bank credit is an important source of capital for firms in emerging markets, implying larger real economic effects of credit supply shocks in emerging markets relative to advanced economies (Beck and Demirguc-Kunt, 2006; Bruhn and Love, 2014). Third, prior literature has shown that banks may not be not able to perfectly hedge their currency exposures, especially during periods of stress (Ivashina et al., 2015). This would be especially true for banks in emerging markets, thereby making the bank currency exposure channel of exchange rates particularly important for emerging markets.

In the aftermath of the 2008 global financial crisis, emerging markets in Europe saw their currencies sharply depreciate relative to the US dollar. In particular, for the five countries in our sample, the average depreciation of home currency was 7 percent following the crisis. These economies also have an international banking sector, with total foreign claims and liabilities equal to 7 percent and 32 percent of banking sector assets and liabilities respectively.[1] The relatively large currency depreciation shock faced by these economies in the post-crisis period, along with a large foreign exposure of the banking sector, and a high reliance on exports make these countries particularly useful to study the importance of the bank lending channel of exchange rates.

Home currency depreciation would have a negative impact on the net worth of banks if banks have more foreign currency liabilities than foreign currency assets on their balance sheet. In the presence of financial frictions, Modigilani-Miller would not

[1]Foreign claims and liabilities are defined as claims on non-residents and liabilities to non-residents, respectively. The measures are calculated using data from IMF International Financial Statistics.

hold, and the negative impact on banks' net worth would be translated into a negative impact on bank credit supply. This reduction in credit supply could, in turn, have a negative impact on investment of non-financial firms. Hence, the positive impact of home currency depreciation on exports could be offset by the negative impact of home currency depreciation on credit supply and investment (Kashyap and Stein, 2000, 1995). The overall impact of currency depreciation on economic activity would depend on the relative strength of the bank lending channel and the exports channel. If the two channels are equally strong, a deterioration in the value of home currency will not have a significant impact on the real economy.

Over the period 2006-2018, countries in our sample experienced an average depreciation of 7 percent. We use micro data on banks' foreign currency exposure to study the impact of a sizable home currency depreciation on bank credit supply. The empirical strategy relies on the differential exposure of banks to foreign currency borrowing and lending. We construct a novel dataset on foreign currency exposure of 96 banks using information on foreign assets and liabilities from their annual reports. Using micro data on banks' currency exposure allows us to circumvent the typical endogeneity issues (reverse causality and simultaneity bias) associated with macroeconomic analyses of this issue. Currency exposure of one bank is unlikely to affect the value of local currency. Similarly, any other macroeconomic factor that simultaneously affects aggregate bank credit and exchange rates will not affect our results since our analysis relies on cross-sectional differences in banks' exposure to foreign currency. The average foreign currency exposure of banks in our sample is 0.3 percent, with a standard deviation of 11 percent. 44 percent of banks in our sample holds net foreign currency denominated liabilities. Our results suggest that at home currency depreciation of 7 percent, banks with net foreign currency denominated liabilities are associated with 4.8 percentage point lower loan growth on average. This is economically significant given the average loan growth in the sample is 7 percent.

We conduct a battery of robustness tests to make sure our results are not driven by our choice of the exposure measure, econometric specification, bilateral exchange rates, type of banks, inclusion of off-balance sheet positions, and exchange rate shock measures. Our main results are unaffected by any of these additional checks and remain qualitatively comparable to those in the baseline specification.

Standard macroeconomic models suggest that countries with flexible exchange rates should allow its free adjustment in response to shocks. However, market frictions and imperfections, ranging from currency mismatches on balance sheets and invoicing of trade in dollars, provide rationale for deploying alternative policy tools such as foreign exchange intervention, capital flow management measures, and macroprudential policies (IMF, 2020). Our findings contribute to this important policy consideration

by documenting a clear trade-off facing policymakers in responding to external shocks. They provide evidence for why exchange rates may become shock amplifiers through tighter financial conditions.

The paper is organized as follows. The next section describes the data including hand-collected foreign currency denominated assets and liabilities. Section 3 provides the details of our methodological approach. Section 4 documents that in response to a home currency depreciation banks with net foreign currency denominated liabilities reduce credit supply. Section 5 offers concluding remarks.

2 Data and descriptive statistics

For our analysis, we construct a novel bank-level dataset on foreign currency exposures of banks in five emerging European economies. The sample covers the period from 2006 to 2018 and includes annual bank-level observations from Hungary, Poland, Romania, Serbia, and Turkey. To best of our knowledge, the bank-level data on currency composition of banks' balance sheet is not available in existing databases. Hence, for the banks in our sample, we hand-collect foreign currency denominated assets and liabilities data from individual banks' annual reports published at the end of the year.

To ensure that our results are not driven by non-bank financial subsidiaries, we only include non-consolidated annual reports in our sample. For majority of the banks in our sample, the annual reports contain the breakdown of major currencies including the share of euro and dollar denominated assets and liabilities. This information allows us to construct a more direct measure of foreign currency exposure compared to indirect measures based on the residence or nationality of the entities involved.

All other bank-level variables we use are obtained from Fitch Connect, which sources bank financial data from financial reports. Specifically, we take bank balance sheet variables from non-consolidated financial statements available. This broader set of variables are matched to the hand-collected foreign currency denominated assets and liabilities data to construct our sample.

To avoid any potential impact of entry and exit of firms in our sample, we drop banks which entered or exited our sample during the period under consideration. Finally, all bank-level variables are winsorized at 5 and 95 percent to remove potential outliers. This leaves us with 751 unique bank-year observations from 96 banks.

Table 1 presents the total assets held by the banks in our sample as a share of the total assets held by all banks in each country. On average, as shown in Figure 1, the sample covers around 45 percent of total assets held by non-central depository institutions. Total assets held by Turkish banks in the sample covers around 85 percent of total assets held by all Turkish non-central bank depository institutions, which is the

highest coverage rate among countries in our sample. The difference in coverage among countries is mostly driven by the availability of foreign currency related information reported in bank annual reports. Figure 2 shows the share of each country in the entire sample.

Table 2 reports summary statistics of key bank-level variables. The sample banks displayed average annual loan growth of 7 percent during the sample period, with Hungary being the only country with negative average loan growth rate. This is consistent with the aggregate-level observation that the annual credit growth of sample countries except Hungary remained mostly positive during the sample period despite the decline in growth rate.

Countries in our sample exhibit significant exposure to foreign currencies during the period under consideration. On average, foreign currency denominated assets and liabilities make up about 40 percent of total assets and liabilities held by banks in our sample. While aggregate-level data on foreign currency denominated assets and liabilities is unavailable, cross-border assets and liabilities data is available from the Locational Banking Statistics database of the Bank for International Settlements. It suggests that all countries in our sample had significant exposure to foreign currencies prior to the global financial crisis. However, this declined marginally post-crisis, except in Turkey which experienced an increase in foreign liabilities as a share of total liabilities. Figure 3 depicts the foreign liabilities held by banks across countries in our sample countries and how it has evolved post-global financial crisis.

Our main dependent variable is the annual gross loan growth, defined as log difference between the amount of annual gross loans and its lagged value. To control for bank-level characteristics, we include lagged values of total assets, equity-to-assets ratio, liquidity ratio, loans-to-deposits ratio, and the amount of government securities held in our baseline regression. The use of first four bank-level controls is in line with the literature on the bank-lending channel of monetary policy (Kashyap and Stein, 2000, 1995). The amount of government securities held is added to capture the possible effect of sovereign debt exposure to bank credit supply. We also include real GDP growth, annual policy rate, and inflation rate as macro-level control variables. The GDP growth captures macro level economic circumstances of the country. Policy rates are included to control for policy interventions. Inflation rate is added to control potential impact of prices and foreign factors on bank credit supply decisions.

The measure of annual exchange rate change, another key variable in our empirical strategy, is constructed using monthly average data on bilateral exchange rate between local currencies against major foreign currencies in which banks in our sample hold foreign liabilities. As in Figure 4, the major foreign currencies primarily include the US dollar, Euro, and Swiss Franc. Bilateral exchange rates are obtained from the IMF's

International Financial Statistics and Bloomberg database. Specifically, we use annual change in exchange rate lagged by a quarter, defined as the year-on-year change in September monthly average exchange rate, as our main measure of exchange rate change. Since banks' annual reports reflect year-end positions of balance sheet items, lagging the exchange rate measure by a quarter ensures that banks' responses to exchange rate changes are timely and reflected in annual reports. We also undertake robustness checks with alternate definitions of exchange rate measures.

See Table A1 for more detailed sources and definitions of key variables used in our empirical analysis.

3 Methodology

3.1 Measures of foreign currency exposure

We start our analysis by constructing measures of foreign currency exposure at the bank level. These measures allow us to examine differential responses in bank's lending in the aftermath of local currency depreciation. Specifically, we use the difference between foreign currency denominated liabilities and foreign currency denominated assets to construct two measures. The first is a bank and time varying dummy variable which equals one if the size of foreign currency denominated liabilities is greater than foreign currency denominated assets. It captures how the mere presence of net foreign currency denominated liabilities on a bank's balance sheet is associated with it loan growth in the aftermath of exchange rate changes.

$$\text{fc exposure} = \begin{cases} 1, & \text{if FC Liabilities} > \text{FC Assets} \\ 0, & \text{otherwise} \end{cases} \tag{1}$$

However, such a measure is agnostic of the magnitude of the mismatch. The second measure, a scaled measure of net foreign currency liabilities, tried to address this concern. It is defined as the difference between foreign currency denominated liabilities and assets as a share of bank total liabilities and total assets, respectively. This measure captures the size of currency mismatch in bank balance sheet.

$$\text{fc exposure} = \frac{\text{FC Liabilities}}{\text{Total Liabilities}} - \frac{\text{FC Assets}}{\text{Total Assets}} \tag{2}$$

Figure 5 shows the distribution of foreign currency denominated liabilities and assets share in our sample. There is a notable difference in the sign and magnitude of foreign currency exposures among countries in our sample. Observations from Hungary, Poland, and Romania display higher foreign currency assets share compared to foreign currency

liabilities share on average. However, on the contrary, observations from Turkey and Serbia are more likely to hold net foreign currency denominated liabilities.

Figure 6 shows the share of bank-year observations with net foreign currency denominated liabilities in each of the countries. Consistent with the distribution of foreign currency denominated assets and liabilities share, Romania and Poland display notably lower share of banks with positive exposure (i.e. lower net foreign currency denominated liabilities compared to other countries). The share of sample banks with net foreign currency denominated liabilities remained largely stable over the sample period, except for the case of Romania where it declined and Turkey where it increased.[2]

3.2 Empirical strategy

Next, we estimate the following model to examine how foreign currency exposure is associated with exchange rate changes:

$$\begin{aligned} \text{Loan Growth}_{b,c,t} = \alpha &+ \beta \Delta\text{Exchange Rate}_{c,t} + \gamma \text{fc exposure}_{b,c,t-1} \\ &+ \delta(\Delta\text{Exchange Rate}_{c,t} \times \text{fc exposure}_{b,c,t-1}) + \eta \text{BC}_{b,c,t-1} \\ &+ \zeta \text{MC}_{c,t} + u_b + v_t + w_c + \eta_{b,c,t} \end{aligned} \tag{3}$$

where $\text{Loan Growth}_{b,c,t}$ is the annual gross loan growth of bank b in country c at time t. $\text{fc exposure}_{b,c,t-1}$ denotes the two foreign currency exposure measures of bank b lagged by a period. $\Delta\text{Exchange Rate}_{c,t}$ is the change in annual bilateral exchange rate between local currency against the foreign currency of interest. Exchange rate is defined such that depreciation has a negative sign in the change. $\text{BC}_{b,c,t-1}$ is a set of lagged bank-level controls including bank total assets, equity to assets ratio, liquidity ratio, loans to deposits ratio, and the amount of government securities held. $\text{MC}_{c,t}$ is the set of macro-level controls including GDP growth, annual policy rate, inflation rate, and capital inflows. u_b, v_t, and w_c are bank, year, and country fixed-effects, respectively. Standard errors are clustered at the bank-level to allow for auto-correlation of residuals across time.

In our baseline specification, we use the first measure of foreign currency exposure — the bank and time varying dummy that captures the presence of foreign liabilities on balance sheets. Therefore, in Equation (3), the parameter β measures the correlation between loan growth and exchange rate change when foreign currency denominated liabilities are lesser than foreign currency denominated assets. $\beta + \delta$ measures the same correlation when foreign currency denominated liabilities are greater than foreign currency denominated assets.

[2]Going forward, we refer to banks with more foreign currency denominated liabilities than assets as banks with positive exposure, and vice versa.

δ, the coefficient of the interaction term between foreign currency exposure measure and exchange rate change, is the main coefficient of interest. It reflects the differential association between change in exchange rate and loan growth of banks with heterogeneous foreign currency exposure. A positive sign would indicate that banks with net foreign currency liabilities curtailed lending growth in the aftermath of local currency depreciation relative to banks with net foreign currency assets. Thus, a positive δ would provide evidence for our claim that home currency depreciation through negative impact on the net worth of banks would cause them to reduce supply of credit.

4 Results

4.1 Baseline findings

Table 4 reports the results from our baseline regressions. Since the euro accounts for the largest share of foreign currency on the balance sheets of banks in our sample, we utilise the exchange rate of euro against the local currency (i.e. local currency per euro) in our baseline regressions. Column (1) of Table 4 reports how exchange rate and baseline bank controls are associated with banks' loan growth. Bank, year, and country fixed effects are included to account for unobserved bank heterogeneity. The coefficient on exchange rate change is positive and significant, implying that currency depreciation is associated with a decline in loan growth in these emerging economies, and vice versa. Specifically, the average currency depreciation of 7 percent during the sample period is associated with around 3 percent lower loan growth on average. This result is consistent with previous studies such as Agarwal (2019) that focuses on advanced economies. Bank size and liquidity ratios too are correlated with loan growth. Bank size is negatively associated with loan growth while liquidity ratio is positively associated with loan growth. Both these results are in line with the banking lending channel literature.

Columns (2) presents our main results. We augment the specification in column 1 by introducing the dummy foreign currency exposure measure and its interaction with exchange rate change as set out in Equation (3). In addition, we introduce interaction terms between exchange rate changes and all the other-bank level variables in our specification.[3]These additional interaction terms rule out any omitted variable biases by absorbing any variation in loan growth that could be driven by bank characteristics associated with exchange rate changes. As we hypothesized, the interaction term between foreign currency exposure and exchange rate change is positive and statistically significant. Our results indicate that in the aftermath of home currency depreciation

[3]Coefficients are not reported in the table but available on request.

banks with net foreign currency denominated liabilities reduce their loan supply more than their counterparts without net foreign currency liabilities.[4] The magnitude of coefficients suggest our results are economically meaningful. At the average currency depreciation (7 percent) during the sample period, banks with positive foreign currency exposure (i.e. banks with net foreign currency liabilities) reduced their loan supply by 5 percentage points more than banks with negative exposure. Given that the average loan growth during in our sample is 7 percent, the estimated difference between the two types of banks is economically significant.

It is possible that our results could be biased as we do not control for macroeconomic variables that affect loan growth. To address this concern, we include country-level variables — real GDP growth, annual policy rate, and inflation rate. Our results remain essentially unchanged by their inclusion.

In Column (4), we report results of an estimation that replaces country-level controls with country-year pair fixed effects. This specification allows us to focus on within-bank variation of loan growth and foreign currency exposure and within-country-year variation of exchange rate changes. It controls for all country-year specific shocks and rules out any reverse causality. The coefficient on the interaction term remains positive and significant, and none of our other results are affected.

4.1.1 Robustness checks

We undertake two specific robustness robustness checks of our baseline results which we document in the Appendix.

First, a potential concern could be our decision to lag the the exchange rate changes by a quarter. Is this a reasonable choice? We choose to lag exchange rate changes by a quarter for two reasons. First, the change in exchange rate need to remain relevant to the year-end positions reflected in banks' annual reports. Second, at the same time, the choice should accommodate some time for banks to respond to exchange rate changes as it is unlikely that banks can respond instantaneously. If the exchange rate shock hits the economy in December, for example, annual reports prepared using year-end positions will not be able to fully capture the responses from banks. To further allay this concern, we document the baseline regressions with alternate lag choices for exchange rate changes. Table A3 reports the results of this exercise.[5] Specifically, we run regression using annual exchange rate changes lagged by 9 months (March), 7 months (May), 5 months (July), 3 months (September / baseline), and 1 month (November) (Columns 1-5). Our baseline results hold for all regressions except for exchange rate changes lagged by 9 months (March). The magnitude and significance of the coefficient

[4] Please note for ease of interpretation we describe our results in terms of home currency depreciation.

[5] All results documented in Table A3 are comparable to Column 2 of Table 4.

of the interaction term increases as the change is measured closer to the end of the year, and more important for our purposes peaks when lagged by 3 months.

Second, we examine if our results hold when we use an alternate measure of foreign currency exposure. To this end, we replace our dummy measure of foreign currency exposure with the second continuous measure of foreign currency exposure. Table A2 documents results of these regressions.[6] Both the coefficient on exchange rate change and its interaction term with foreign currency exposure measure are positive and significant.

4.2 The choice of foreign currency

Could our results be driven by the choice of foreign currency? We exploit the breakdown of assets and liabilities by foreign currencies available from annual reports to investigate this issue. Given that our sample countries neighbor the euro area, the euro enjoys a special status and remains the most important foreign currency on the balance sheets of banks in our sample. Nevertheless, the US dollar and Swiss franc denominated assets and liabilities too constitute a significant share of banks' foreign currency denominated assets and liabilities in our sample. In Turkey, for instance, the US dollar denominated assets and liabilities constitute the highest share in foreign currency denominated assets and liabilities, an exception in our sample. The Swiss franc is also a major currency among some countries in our sample, especially prior to the global financial crisis, which had mortgage loans denominated in the currency.

Thus, given the importance of the US dollar and Swiss franc denominated assets and liabilities in our banks' balance sheets, we hypothesize that changes in the exchange rate of home currencies against these two foreign currencies to affect bank lending outcomes as with the case of the euro. To examine this hypothesis, we use the annual change in bilateral exchange rate of local currency against US dollar and Swiss Franc as our exchange rate measure.

Table 5 reports the results of this exercise. Columns (1) through (3) uses the exchange rate against US dollar and follows the specifications of columns (2) through (4) of our baseline results documented in Table 4. The estimates confirm our hypothesize. The coefficient on exchange rate changes and its interaction term with foreign currency exposure measure remain positive and significant across all three specification. Columns (4) through (6) uses the exchange rate against Swiss franc. Once again both the coefficients of interest remain positive and significant. These set of regressions confirm that our results hold for the US dollar and the Swiss franc and are not limited to exchange rate against any one major foreign currency.

[6]Except for the measure of foreign currency exposure, Columns 1-4 correspond to the specifications reported in columns 1-4 of Table 4.

4.3 Domestic and foreign-owned banks

Do domestic and foreign-owned bank respond to an exchange rate shock in a similar fashion? Foreign-owned banks often have access to funds, including denominated in foreign currencies. This could result in a different currency composition on their balance sheets when compared to domestic-owned banks. More importantly, they may respond to exchange rate changes differently to their domestic counterparts. In this section, we examine this issue.

We define a bank to be a domestic bank if the five largest shareholders of the bank are all domestic, and a foreign otherwise. About forty percent of our sample banks fall into the category of domestic banks. While the share of bank-year observations with net foreign currency denominated liabilities remains similar for both types of banks, domestic and foreign-owned banks differ in the extent to which they are exposed to exchange rate risk associated with US dollar. In particular, the share of US dollar denominated asset in total foreign currency denominated assets is on average 10 percentage point higher for domestic banks in our sample. On the other hand, foreign-owned banks on average holds 5 percentage point higher share of Euro denominated assets in total foreign currency denominated assets. Similar patterns can be found in the share of US dollar and Euro denominated liabilities in total foreign currency denominated liabilities.

We divide our sample into domestic and foreign-owned banks to run subsample regressions. Our baseline results imply that the positive association between loan growth of banks with net foreign currency liabilities and currency appreciation should be stronger for exchange rate against foreign currency which banks have larger exposure. We hypothesize that loan growth of foreign-owned banks should be more strongly correlated with exchange rate changes against Euro. Table 7 reports the results from subsample regressions using domestic and foreign-owned banks. Columns (1) through (3) use domestic banks while columns (4) through (6) use foreign-owned banks in the sample. Specification of each column follows that of Table 4. The coefficient of the interaction term is positive and significant for all specifications using the foreign-owned subsample.

The magnitude of association with each foreign currency displays a difference between domestic and foreign-owned banks as we hypothesized. Loan growth of foreign-owned banks with net foreign currency denominated liabilities shows a stronger positive association between the exchange rate in Euro compared to their domestic counterparts. Loan growth of domestic banks, on the other hand, displays a stronger positive association when the US dollar exchange rates are used.

4.4 Off-balance sheet items and hedging

What if net foreign currency liabilities are perfectly hedged either by offsetting positions in currency derivatives? This question raises a genuine concern about our identification as the measure of foreign currency exposure used in our baseline specification fails to account for hedging. While we acknowledge this issue, addressing it requires comprehensive data on derivatives financial institutions use for hedging purposes, difficult data to access, especially in the context of emerging market economies. Nevertheless, in section, we provide arguments why hedging alone does not not fully account for the exchange rate channel of the bank credit.

First, there is growing evidence that banks are often unable to perfectly hedge their foreign currency exposures because of costs associated with hedging, including opportunity costs and indirect costs. Recent research has documented why this could be the case. Rampini et al. (2019) uses derivatives positions of US financial institutions to show that more financially constrained institutions, that is, institutions with lower net worth, hedge less. They further argue that the cost of foregoing lending or cutting credit lines is higher at the margin for such institutions. Regulatory responses in the aftermath of the global financial crisis too have introduced additional indirect costs to hedging, such as the rising cost of hedging due to higher capital requirements for derivatives transactions. Jobst (2018) discusses this issue in the context of risks to infrastructure investments.

Second, despite data limitations, we examine this issue in our sample. This is possible because annual reports of the Turkish banks in our sample provide off-balance sheet positions which can be used to hedge foreign currency related risk. However, comparable data are not available for other countries in our sample. Thus, unlike in our baseline specification, we are able to construct a new measure of foreign currency exposure that account for hedging behaviour of the banks.

As before, off-balance sheet positions of sample banks are hand-collected. This leaves us 301 total year-bank observations of off-balance sheet positions. The off-balance sheet position is then normalized as a share of total assets and is subtracted from the net balance sheet position to create a measure *Hedged Foreign Currency Exposure*.

$$\textbf{Hedged fc exposure} = \text{Net fc liabilities} - \frac{\text{Off balance sheet position}}{\text{Total assets}} \tag{4}$$

Figure 7 shows the distribution of foreign currency exposure measures before and after the inclusion of off-balance sheet positions. The variance of mismatch in foreign currency denominated assets and liabilities decreases after the inclusion, supporting the idea that hedging activities using off-balance sheet items. The remaining question is if

the hedged measure still has a similar relationship with exchange rate shocks. If the hedging is effective, we should see a significant decline in the size of our coefficient of interest.

For the empirical analysis, we use the dummy variable which equals 1 where *Hedged fc exposure* > 0. Table 8 reports the results for equation (4) using the interaction term between the dummy measure and the change in exchange rate as the variable of interest. The coefficient of the interaction term remains positive and significant. We see the magnitude of coefficient declines with the hedged measure, but it remains economically significant. In the aftermath of home currency depreciation, banks with net foreign currency denominated liabilities are associated with lower loan growth compared to their counterparts without net foreign currency denominated liabilities, even after taking into account hedging activities associated with banks' off-balance sheet position.

5 Conclusion

This paper highlights the importance of the bank balance sheet channel in the transmission of exchange rate shocks in emerging European countries. We construct a novel dataset on foreign currency exposures of banks in emerging European economies and show that banks with a net liability foreign exposure reduce lending in the aftermath of domestic currency depreciation. This result is robust to using alternate measures of currency exposure and exchange rate changes. An important implication of our result is that, contrary to the predictions of standard macroeconomic models, currency depreciation may not always be expansionary.

This result has important policy implications for emerging markets where the exchange rate is often used as a central tool of monetary policy and the share of foreign banks in the banking sector is significant. In the presence of unhedged currency exposure of banks' balance sheets, the negative effect of a reduction in credit supply may outweigh the positive effects of currency depreciation on exports. If the bank lending channel is strong enough, currency depreciations may even prove to be contractionary. Given that the ongoing pandemic has negatively affected economic activity in many emerging markets, governments will have to judiciously weigh the tradeoff associated with using currency depreciation as their monetary policy instrument.

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Table 1: Sample Share in Total Assets Held by Banks

	2005	06	07	08	09	10	11	12	13	14	15	2016	Avg.
Hungary	0.23	0.34	0.29	0.35	0.27	0.36	0.39	0.36	0.41	0.33	0.36	0.24	0.32
Poland	0.39	0.20	0.27	0.27	0.34	0.40	0.44	0.50	0.54	0.53	0.52	0.31	0.37
Romania	0.13	0.09	0.03	0.25	0.27	0.45	0.52	0.18	0.41	0.31	0.35	0.26	0.26
Serbia	0.05	0.08	0.27	0.47	0.53	0.59	0.62	0.51	0.52	0.57	0.62	0.60	0.44
Turkey	0.78	0.78	0.79	0.76	0.83	0.92	0.92	0.93	0.96	0.95	0.95	0.77	0.85

This table reports the amount of total assets held by sample banks as a share of country-level total assets held by banks. The country-level total assets held by banks is defined as the amount of total assets held by depository institutions excluding the central bank from IMF International Financial Statistics. The sum of total assets held by sample banks in each country is divided by the country-level total assets to calculate the sample coverage.

Table 2: Descriptive Statistics

	Hungary	Poland	Romania	Serbia	Turkey
loan growth	-0.0209	0.116	0.0990	0.0617	0.0875
	(0.199)	(0.245)	(0.262)	(0.421)	(0.333)
total assets (USDm)	8330.7	17336.8	5299.7	1346.9	19790.1
	(10005.5)	(17975.5)	(5213.9)	(1283.3)	(24933.6)
equity-to-assets	11.02	10.58	12.17	20.76	16.07
	(4.633)	(4.263)	(4.346)	(6.556)	(9.673)
liquidity	77.85	28.80	35.95	41.58	56.57
	(48.66)	(13.03)	(22.66)	(20.15)	(50.16)
gov. securities (USDm)	1430.1	2888.1	935.2	167.6	3024.8
	(2456.4)	(3023.6)	(1168.2)	(251.4)	(4342.2)
fc exposure	0.0281	-0.0621	-0.0841	0.0306	0.0236
	(0.248)	(0.0812)	(0.117)	(0.125)	(0.0731)
fc asset share	0.341	0.214	0.443	0.542	0.407
	(0.201)	(0.129)	(0.180)	(0.141)	(0.182)
fc liabilities share	0.362	0.155	0.366	0.561	0.432
	(0.235)	(0.122)	(0.162)	(0.123)	(0.179)
Observations	76	121	72	145	337

This table reports summary statistics for the main variables used in the empirical analyses by country. Δ ER is defined as the percentage change in exchange rate of local currency against each foreign currency. *fc exposure* is defined as the difference between foreign currency denominated liabilities and assets as a share of bank total liabilities and total assets, respectively. Table A1 reports variable definitions and data sources.

Table 3: Distribution of Foreign Currency Exposure Measure

	Hungary	Poland	Romania	Serbia	Turkey
D1, 2006-08	0.429	0.286	0.200	0.333	0.654
	(0.535)	(0.488)	(0.447)	(0.577)	(0.485)
D1, 2009-12	0.400	0.217	0	0.643	0.527
	(0.503)	(0.422)	(0)	(0.485)	(0.502)
D1, 2013-18	0.410	0.0933	0.385	0.416	0.649
	(0.498)	(0.293)	(0.493)	(0.496)	(0.478)
D1, entire sample	0.409	0.133	0.281	0.485	0.614
	(0.495)	(0.342)	(0.453)	(0.502)	(0.488)
avg. std(D1)	0.272	0.219	0.231	0.417	0.385
	(0.266)	(0.220)	(0.239)	(0.194)	(0.195)
avg. std(continuous fc measure)	0.0822	0.0418	0.0666	0.0536	0.0451
	(0.0372)	(0.0333)	(0.0594)	(0.0629)	(0.0448)
Observations	76	120	72	145	337

This table reports the distribution of foreign currency exposure measures constructed for empirical analyses by country. Standard deviations are reported in parentheses. $D1$ is a bank and time varying dummy variable which equals one if the net foreign currency denominated liabilities is positive. A continuous measure of foreign currency exposure is defined as the difference between foreign currency denominated liabilities and assets as a share of bank total liabilities and total assets,respectively. Standard deviations of foreign currency exposure measures is calculated for each bank over the sample period and the average standard deviation of foreign currency exposure measures are reported in the table.

Table 4: Net Foreign Liabilities and Loan Growth

	loan growth			
	(1)	(2)	(3)	(4)
Δ ER	0.416***	1.520*	1.472*	
	(0.091)	(0.811)	(0.784)	
NFL=1		-0.023	-0.024	-0.025
		(0.035)	(0.035)	(0.038)
NFL=1 × Δ ER		0.691***	0.631***	0.678***
		(0.172)	(0.160)	(0.181)
size	-0.198***	-0.196**	-0.192***	-0.224***
	(0.056)	(0.075)	(0.070)	(0.066)
liquidity	0.003***	0.002**	0.002	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
equity-to-assets	-0.006	-0.008	-0.007	-0.007
	(0.005)	(0.007)	(0.006)	(0.007)
loans-to-deposits	-0.003***	-0.001*	-0.001	-0.001*
	(0.001)	(0.001)	(0.001)	(0.001)
gov. securities	-0.012	-0.001	0.009	0.002
	(0.011)	(0.016)	(0.017)	(0.018)
Constant	1.894***	1.869***	1.788***	1.978***
	(0.466)	(0.656)	(0.617)	(0.532)
Observations	1176	679	679	677
R-squared	0.370	0.441	0.459	0.495
Country FE	Yes	Yes	Yes	No
Year FE	Yes	Yes	Yes	No
Bank FE	Yes	Yes	Yes	Yes
Year-Country FE	No	No	No	Yes
Δ ER × Bank Controls	No	Yes	Yes	Yes
Macro Controls	No	No	Yes	No
Foreign Currency	EUR	EUR	EUR	EUR

This table reports regression results from equation (3) where the *Net Foreign Liabilities* dummy was used as the measure of foreign currency exposure. The dependent variable is annual growth rate of gross loans. $NFL = 1$ when the bank holds net foreign liabilities. ΔER is the percentage change in exchange rate of local currency against Euro. Bank-level controls include one-year lag of total assets, liquidity ratio, equity-to-assets ratio, loans-to-deposits, and total government securities holdings. Macro controls include real GDP growth, annual policy rate, and inflation rate. Column (2) adds interactions between lagged bank-level controls and exchange rate. Column (3) adds macro variables. Column (4) replaces macro variables with Year-Country Fixed Effects. Standard errors are reported in parentheses and clustered at the bank level. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Alternate Exchange Rate Measures: Other Major Foreign Currencies

	loan growth					
	(1)	(2)	(3)	(4)	(5)	(6)
Δ ER	2.483***	2.416***		1.834**	1.801**	
	(0.719)	(0.680)		(0.786)	(0.779)	
NFL=1	-0.019	-0.019	-0.009	-0.014	-0.014	-0.007
	(0.034)	(0.033)	(0.035)	(0.036)	(0.035)	(0.036)
NFL=1 × Δ ER	0.667***	0.632***	0.810***	0.616***	0.574***	0.704***
	(0.143)	(0.138)	(0.178)	(0.165)	(0.165)	(0.197)
size	-0.196**	-0.194***	-0.223***	-0.187**	-0.189**	-0.218***
	(0.079)	(0.073)	(0.067)	(0.078)	(0.073)	(0.069)
liquidity	0.002**	0.001	0.002*	0.002*	0.001	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
equity-to-assets	-0.008	-0.007	-0.007	-0.008	-0.007	-0.008
	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)
loans-to-deposits	-0.001*	-0.001*	-0.002*	-0.001*	-0.001	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
gov. securities	-0.001	0.011	0.002	-0.004	0.010	-0.001
	(0.015)	(0.016)	(0.016)	(0.016)	(0.017)	(0.018)
Constant	1.895***	1.817***	1.914***	1.841***	1.777***	1.934***
	(0.687)	(0.648)	(0.554)	(0.680)	(0.640)	(0.556)
Observations	679	679	677	679	679	677
R-squared	0.455	0.473	0.512	0.442	0.463	0.501
Country FE	Yes	Yes	No	Yes	Yes	No
Year FE	Yes	Yes	No	Yes	Yes	No
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Country FE	No	No	Yes	No	No	Yes
Δ ER × Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	No	Yes	No	No	Yes	No
Foreign Currency	USD	USD	USD	CHF	CHF	CHF

This table reports regression results from equation (3) where the *Net Foreign Liabilities* dummy was used as the measure of foreign currency exposure. The dependent variable is annual growth rate of gross loans. $NFL = 1$ when the bank holds net foreign liabilities. Bank-level controls include one-year lag of total assets, liquidity ratio, equity-to-assets ratio, loans-to-deposits, and total government securities holdings. Macro controls include real GDP growth, annual policy rate, and inflation rate. Interactions between lagged bank-level controls and exchange rate are included as controls in all columns. In Columns (1) through (3), ΔER is the percentage change in exchange rate of local currency against the US dollar. In Columns (4) through (6), ΔER is the percentage change in exchange rate of local currency against Swiss Franc. Column (2) and (4) add macro variables to Column (1) and (3), respectively. Column (3) and (5) replace macro variables with Year-Country Fixed Effects. Standard errors are reported in parentheses and clustered at the bank levels. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Descriptive Statistics, by Ownership Structure

	domestic	foreign
Share of bank-year obs with positive fc exposure	0.484	0.449
	(0.501)	(0.498)
Continuous fc exposure measure	0.00380	-0.00218
	(0.120)	(0.115)
Observations	322	429

	domestic	foreign
Share of EUR denominated asset in total fc asset	0.517	0.577
	(0.272)	(0.303)
Share of EUR denominated liabilities in total fc liabilities	0.548	0.578
	(0.278)	(0.311)
Share of USD denominated asset in total fc asset	0.404	0.280
	(0.285)	(0.290)
Share of USD denominated liabilities in total fc liabilities	0.416	0.315
	(0.282)	(0.303)
Observations	277	396

This table reports the distribution of foreign currency exposure measures and the currency composition of bank assets and liabilities by ownership structure. Standard deviations are reported in parenthesis. Domestic banks are defined as banks such that the five largest shareholders of the banks are all domestic. The lower panel only includes banks with both USD and EURO assets and liabilities information available in their annual reports.

Table 7: Local and Foreign Bank Subsamples

	loan growth					
	(1)	(2)	(3)	(4)	(5)	(6)
Δ ER	2.971*	3.347**		0.357	0.458	
	(1.500)	(1.328)		(1.249)	(1.283)	
NFL=1	-0.096	-0.110*	-0.157**	0.016	0.027	0.050
	(0.061)	(0.061)	(0.059)	(0.033)	(0.030)	(0.033)
NFL=1 × Δ ER	0.448	0.373	0.477*	0.743**	0.689**	0.696**
	(0.270)	(0.287)	(0.271)	(0.284)	(0.264)	(0.304)
Constant	1.972**	1.920**	2.027**	1.010	1.005	1.297**
	(0.857)	(0.806)	(0.854)	(0.805)	(0.848)	(0.621)
Observations	291	291	287	388	388	382
R-squared	0.323	0.340	0.450	0.588	0.604	0.640
Country FE	Yes	Yes	No	Yes	Yes	No
Year FE	Yes	Yes	No	Yes	Yes	No
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Country FE	No	No	Yes	No	No	Yes
Δ ER × Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	No	Yes	No	No	Yes	No
Local	Yes	Yes	Yes	No	No	No
Foreign Currency	EUR	EUR	EUR	EUR	EUR	EUR

This table reports sub-sample regression results from equation (3) where the *Net Foreign Liabilities* dummy was used as the measure of foreign currency exposure. The dependent variable is annual growth rate of gross loans. $NFL = 1$ when the bank holds net foreign liabilities. ΔER is the percentage change in exchange rate of local currency against Euro. Bank-level controls include one-year lag of total assets, liquidity ratio, equity-to-assets ratio, loans-to-deposits, and total government securities holdings. Macro controls include real GDP growth, annual policy rate, and inflation rate. Interactions between lagged bank-level controls and exchange rate are included as controls in all columns. Columns (1) through (3) use domestic banks, defined as banks with which largest five shareholders are all domestic. In Columns (4) through (6), the sample only includes foreign-owned banks. Column (2) and (4) add macro variables and Column (3) and (5) replace macro variables with Year-Country Fixed Effects. Standard errors are reported in parentheses and clustered at the bank levels. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Off-Balance Sheet Measure, Turkish Banks

	loan growth		
	(1)	(2)	(3)
Pos. fc exposure	0.006	0.022	0.023
	(0.031)	(0.032)	(0.029)
Pos. fc exposure × Δ ER	0.451***	0.514***	0.518**
	(0.141)	(0.164)	(0.221)
Constant	1.987**	1.676**	1.918**
	(0.913)	(0.772)	(0.864)
Observations	301	301	301
R-squared	0.441	0.455	0.442
Year FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Δ ER × Bank Controls	Yes	Yes	Yes
Foreign Currency	No	No	No
ER	EUR	USD	CHF

This table reports Turkish sub-sample regression results from equation (3) where the *Hedged Net Foreign Liabilities* dummy was used as the measure of foreign currency exposure. The dependent variable is annual growth rate of gross loans. $HNFL = 1$ when the bank holds net hedged foreign liabilities. Bank-level controls include one-year lag of total assets, liquidity ratio, equity-to-assets ratio, loans-to-deposits, and total government securities holdings. Macro controls include real GDP growth, annual policy rate, and inflation rate. Interactions between lagged bank-level controls and exchange rate are included as controls in all columns. In Column (1), ΔER is the percentage change in exchange rate of local currency against Euro. In Column (2), ΔER is the percentage change in exchange rate of local currency against the US dollar. In Column (3), ΔER is the percentage change in exchange rate of local currency against Swiss Franc. Standard errors are reported in parentheses and clustered at the bank levels. *** p<0.01, ** p<0.05, * p<0.1.

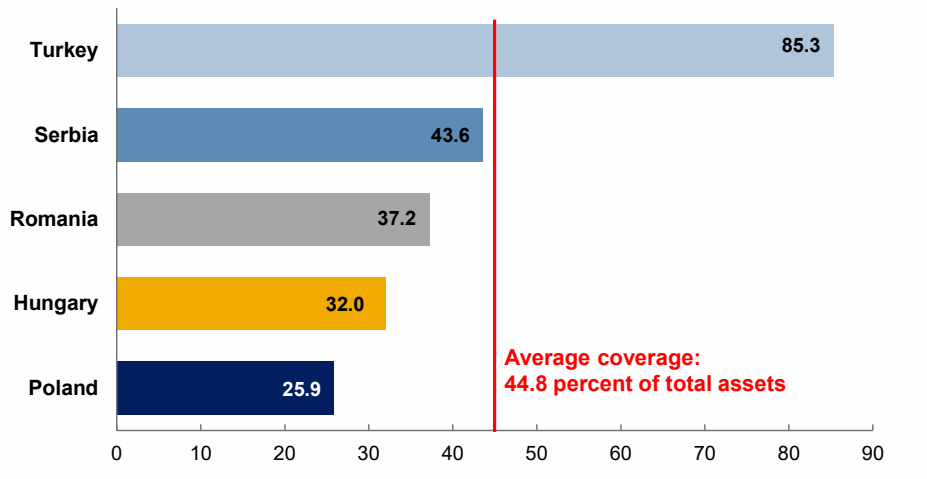

Figure 1: Sample Coverage, 2006-2018

This figure shows the share of banks in our sample in percent of total assets held by non central bank depository institutions in each country, averaged over the sample period.

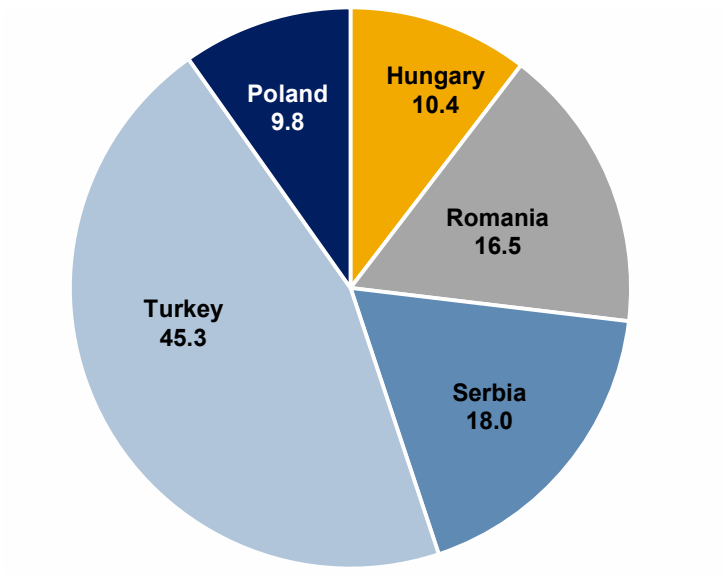

Figure 2: Share of Each Country in the Sample

This figure shows the sample share of each country in percent of total number of bank-year observations.

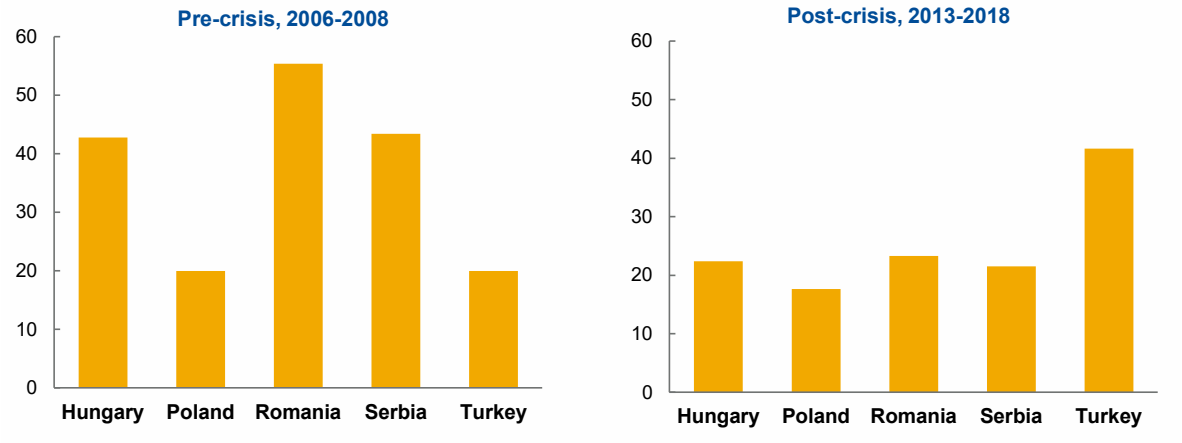

Figure 3: Foreign Liabilities (Non-resident Liabilities), 2006-08 vs 2012-18

This figure shows the change in liabilities to non-residents in 2006-08 and 2013-18 in percent of total liabilities of non central bank depository institutions.

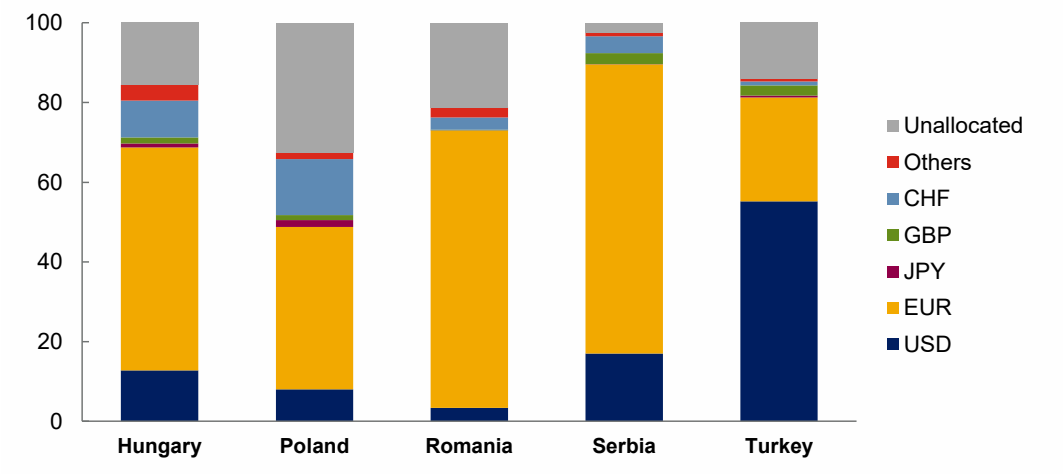

Figure 4: Currency Composition of Foreign Claims, 2006-2018

This figure shows the currency composition of foreign claims in percent of total BIS reported cross border (non resident) claims. The share was averaged over 2006-2018 and includes both bank and non bank counterparties.

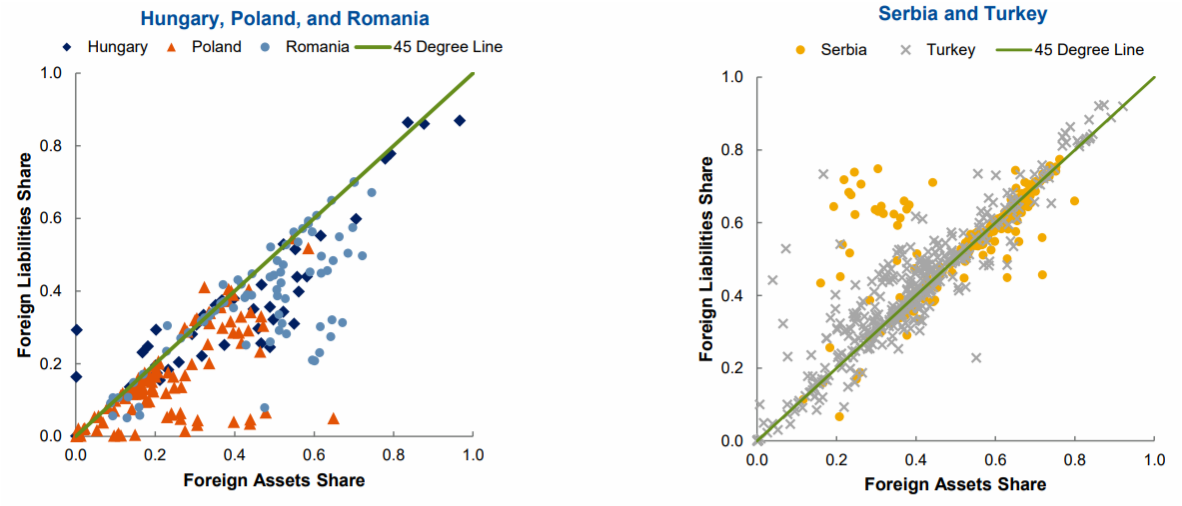

Figure 5: Distribution of Foreign Currency Denominated Assets and Liabilities

This figure shows the distribution of foreign currency denominated liabilities and assets of observations in our sample.

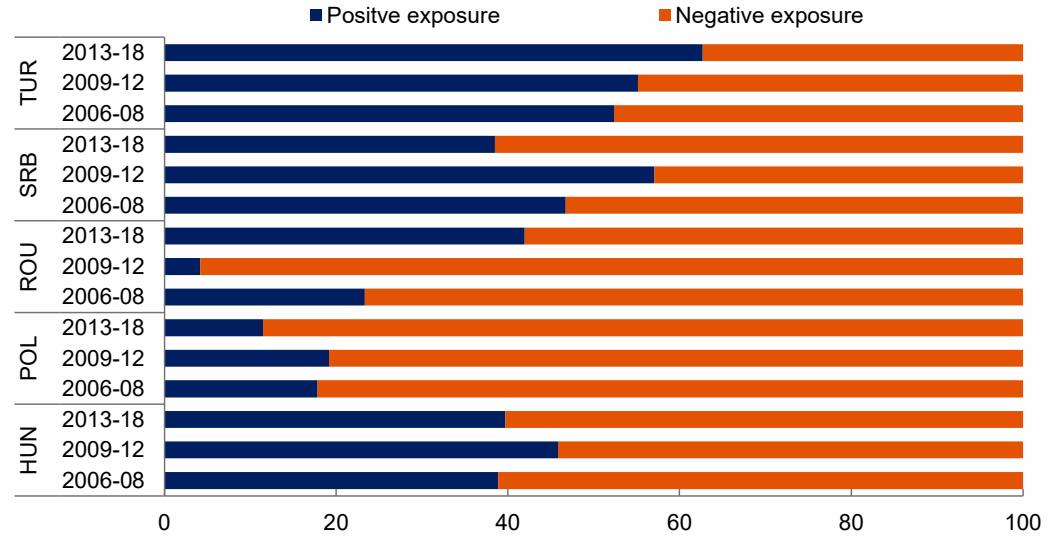

Figure 6: Banks with Net Foreign Currency Liabilities, 2006-2018

This figure shows the share of banks with net foreign currency liabilities in percent share of total number of bank-year observations in the sample.

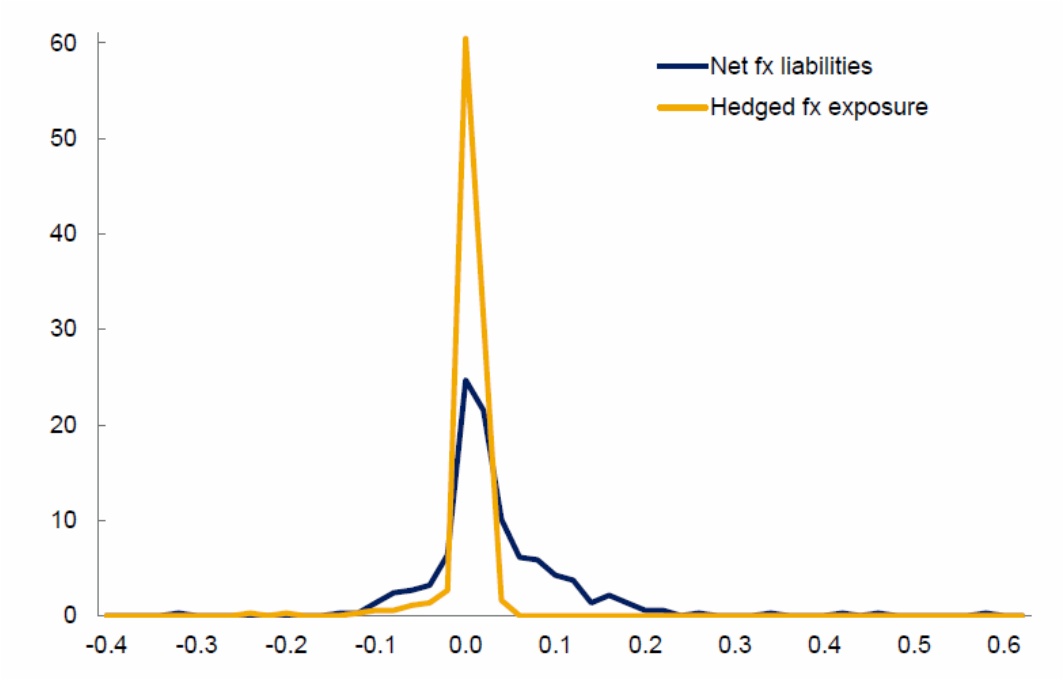

Figure 7: Distribution of Net Foreign Currency Liabilities, Turkish Banks Subsample

This figure shows the distribution of *hedged* and un-hedged measure of net foreign currency denominated liabilities in percent share of total Turkish Banks subsample.

A Appendix

Table A1: Variable Definitions

Variable	Definition	*Source*
Loan Growth	Annual difference in log of gross loans	*Fitch Connect*
Size	Log of total assets	*Fitch Connect*
Equity-to-Assets	Total equity over total assets	*Fitch Connect*
Liquidity	Liquid assets and marketable debt securities over deposits and money market	*Fitch Connect*
Loans-to-Deposits	Loans over deposits and short-term funding	*Fitch Connect*
Government Securities	Log of government securities	*Fitch Connect*
GDP Growth	Real GDP growth, percentage change	*IMF IFS*
Policy Rate: Hungary	1-12 Month Business Deposit Rate	*IMF IFS*
Policy Rate: Poland	Comml Bank 12-Month Zloty Deposit Rate	*IMF IFS*
Policy Rate: Romania	Deposit Rate (% per annum)	*IMF IFS*
Policy Rate: Serbia	Deposit Rate (EOP, %)	*IMF IFS*
Policy Rate: Turkey	3-mo Time Deposit Rate, Turkish Lire Denominated	*IMF IFS*
Inflation Rate	Consumer Prices (% Change Over Prev. Year)	*IMF IFS*
$\Delta \text{ER}_{t,c}$	Log difference in September (unless otherwise noted) exchange rate of country c in year t and $t-1$.	*IMF IFS; Bloomberg*

This table describes the variables used in empirical analyses and lists the data sources.

Table A2: Alternate Exposure Measure: Continuous Measure

	loan growth			
	(1)	(2)	(3)	(4)
Δ ER	0.416***	1.550*	1.503*	
	(0.091)	(0.919)	(0.877)	
fc exposure		0.221	0.205	0.299
		(0.226)	(0.218)	(0.233)
Δ ER × fc exposure		2.482**	2.163**	2.682**
		(0.995)	(1.009)	(1.132)
size	-0.198***	-0.200***	-0.196***	-0.232***
	(0.056)	(0.075)	(0.070)	(0.065)
liquidity	0.003***	0.002*	0.001	0.002
	(0.001)	(0.001)	(0.001)	(0.001)
equity-to-assets	-0.006	-0.007	-0.006	-0.007
	(0.005)	(0.007)	(0.006)	(0.007)
loans-to-deposits	-0.003***	-0.001*	-0.001	-0.001*
	(0.001)	(0.001)	(0.001)	(0.001)
gov. securities	-0.012	-0.001	0.010	0.001
	(0.011)	(0.017)	(0.018)	(0.019)
Constant	1.894***	1.891***	1.804***	2.033***
	(0.466)	(0.658)	(0.615)	(0.511)
Observations	1176	679	679	677
R-squared	0.370	0.426	0.447	0.483
Country FE	Yes	Yes	Yes	No
Year FE	Yes	Yes	Yes	No
Bank FE	Yes	Yes	Yes	Yes
Year-Country FE	No	No	No	Yes
Δ ER × Bank Controls	No	Yes	Yes	Yes
Macro Controls	No	No	Yes	No
Foreign Currency	EUR	EUR	EUR	EUR

This table reports regression results from equation (3) where the continuous measure of net foreign currency exposure calculated as in (2) was used as the measure foreign currency exposure. The dependent variable is annual growth rate of gross loans. ΔER is the percentage change in exchange rate of local currency against Euro. Bank-level controls include one-year lag of total assets, liquidity ratio, equity-to-assets ratio, loans-to-deposits, and total government securities holdings. Macro controls include real GDP growth, annual policy rate, and inflation rate. Column (2) adds interactions between lagged bank-level controls and exchange rate. Column (3) adds macro variables. Column (4) replaces macro variables with Year-Country Fixed Effects. Standard errors are reported in parentheses and clustered at the bank level. *** p<0.01, ** p<0.05, * p<0.1.

Table A3: Alternate Exchange Rate Measures: Different Months

	loan growth				
	(1)	(2)	(3)	(4)	(5)
Δ ER	-0.140	1.660	1.742	1.472*	1.726
	(1.219)	(1.371)	(1.197)	(0.784)	(1.274)
NFL=1	-0.061	-0.043	-0.039	-0.024	-0.032
	(0.048)	(0.040)	(0.040)	(0.035)	(0.038)
NFL=1 × Δ ER	-0.073	0.520**	0.527***	0.631***	0.575***
	(0.321)	(0.211)	(0.187)	(0.160)	(0.199)
Constant	1.790***	1.904***	1.807***	1.788***	1.747***
	(0.607)	(0.587)	(0.608)	(0.617)	(0.644)
Observations	679	679	679	679	679
R-squared	0.468	0.458	0.453	0.459	0.451
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Year-Country FE	No	No	No	No	No
Δ ER × Bank Controls	No	No	No	No	No
Macro Controls	No	No	No	No	No
Foreign Currency	EUR	EUR	EUR	EUR	EUR
Month	MAR	MAY	JUL	SEP	NOV

This table reports regression results from equation (3) where the *Net Foreign Liabilities* dummy was used as the measure of foreign currency exposure. The dependent variable is annual growth rate of gross loans. $NFL = 1$ when the bank holds net foreign liabilities. Bank-level controls include one-year lag of total assets, liquidity ratio, equity-to-assets ratio, loans-to-deposits, and total government securities holdings. In Column (1), ΔER is the annual percentage change in March exchange rate of local currency against Euro. Through Columns (2) to (5), ΔER is the annual percentage change in exchange rate of local currency against Euro using May, July, September, and November exchange rates respectively. Standard errors are reported in parentheses and clustered at the bank level. *** p<0.01, ** p<0.05, * p<0.1.