The Exchange Rate Disconnect and the Bank Lending Channel: Evidence from Switzerland

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Abstract: This paper investigates why exchange rate shocks do not always affect the economy as much as theory predicts. Using the January 2015 episode of the Swiss franc appreciation as an exogenous exchange rate shock, I show that the bank lending channel of exchange rates can explain this disconnect. I construct a novel dataset on foreign currency exposure of Swiss banks and show that it is an important determinant in the transmission of exchange rate shocks to bank lending and real activity. Banks with more foreign currency liabilities than assets increase lending in response to the shock as a stronger domestic currency positively affects their net-worth. This increase in lending allows some firms to invest more, partially offsetting the negative effect of currency appreciation on exporters. The bank lending channel of currency shocks can explain why domestic currency appreciation may not always be contractionary.

JEL Codes: G01; G21; J23; J63.

Keywords: Bank lending; Exchange Rates; Open Economy; Currency Mismatch

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1 Introduction

Competitive currency devaluation can be an important policy tool for central bankers in emerging markets to stimulate economic activity by affecting the relative price of exports. Even in advanced economies, the low interest rate environment after the financial crisis has accorded exchange rates a central role in monetary policy. However, recent empirical evidence seems to suggest that currency depreciations don't affect the real economy as much as standard open economy models would predict. The Japanese yen depreciated by a staggering 50 percent during the 'Abenomics' episode but the impact on the real economy was modest (Rodnyansky (2018)). Similarly, the British pound has fallen by more than 10 percent against the euro since the Brexit referendum but the depreciation has not given a boost to the economy. These observations have led to a resurgence of the debate on whether there is a disconnect between exchange rates and the real economy (Leigh *et al.* (2015)). In this paper, I use the Swiss currency appreciation episode of January 2015 to understand the role of bank-lending channel of exchange rates in explaining this disconnect.

Banks differ in their exposure to currency fluctuations. A bank that borrows heavily in foreign currency, and is not entirely hedged against currency movements (either naturally or through currency derivatives), is likely to face a negative shock to its net-worth and may contract lending in the event of home currency depreciation. This, in turn, can have a negative impact on the investment of firms that have banking relationship with such banks. Hence, the increased competitiveness of exporters due to home currency depreciation (trade channel) may be offset by a fall in investment of non-financial firms due to the negative credit supply shock induced by currency depreciation (bank-lending channel). Similarly, the negative effect of home currency appreciation on exporters can be mitigated if some banks gain and increase lending. Thus, the bank-lending channel can act as a "financial mitigator" in the transmission of exchange rate shocks and can potentially explain the weak response of economic activity to currency depreciation.

In this paper, I exploit a natural experiment to study the bank-lending channel of exchange rates. On January 15, 2015, the Swiss National Bank (SNB) surprised the market by abandoning the peg between the Swiss franc and the euro that had been in place since September 2011.[1] The announcement led to approximately a 20 percent appreciation in the value of the Swiss franc,

[1]The following statement from the annual report of Bank Linth shows the SNB's decision was not expected by the market: "*Like all market participants, we were surprised by the decision of the Swiss National Bank on 15 January, 2015.*" I will argue more about the exogeneity of the event in section 5.1.

which is considered huge in currency markets with daily average fluctuations of not greater than 1 percent.[2] Moreover, the value of the Swiss franc remained elevated for approximately a year after the announcement. The persistence of this shock can potentially have economically significant effects on the banking sector in Switzerland, that borrows heavily in foreign currency — as of December 2014, foreign currency liabilities accounted for 48 percent of the total liabilities of the banking sector. Besides, the Swiss economy has high reliance on exports, with a share of exports to GDP greater than 50 percent. Given the country's high reliance on exports and the significant exposure of the banking sector to foreign currency borrowing, this episode provides a useful laboratory to test the importance of both the trade channel as well as the bank-lending channel of exchange rates.

The empirical strategy relies on the differential exposure of banks to foreign currencies in the pre-shock period. I construct a novel dataset on Swiss banks' foreign currency exposure by scraping data from their annual reports. To the best of my knowledge, this is the first paper to document measures of currency exposure at the bank-level. This measure is constructed for the biggest 100 banks in Switzerland as the difference between their foreign assets and liabilities, normalized by total assets in 2014. The primary hypothesis is that the appreciation of the Swiss franc should have a positive impact on the net-worth of banks with more foreign currency liabilities than foreign assets as a stronger domestic currency reduces the value of banks' foreign liabilities. This increase in net-worth should allow banks to lend more assuming the Modigliani-Miller proposition holds for banks.

Using a difference-in-differences research design, I show that banks with more foreign currency liability than foreign assets experience a higher loan growth in the post-shock period as compared to banks with a higher foreign asset exposure. In particular, a one standard deviation increase in the foreign currency exposure measure leads to approximately a 3.3 percentage point increase in loan growth after the shock. This is economically significant given the average loan growth in the sample is 7 percent. This finding is qualitatively robust to using hedged measures of currency exposure, controlling for other events that could have coincided with the currency shock, and also satisfies the parallel pre-trends assumption in the difference-in-differences literature.

A potential concern is that distribution of exposure across banks is not random. In other words, certain bank characteristics, such as liquidity or size, are correlated with foreign currency

[2]The average quarterly appreciation in nominal effective exchange rate for advanced economies in the sample was 0.14 percent and the 95th percentile was 3.8 percent for the time period 1994 to 2016.

exposure. For instance, more liquid banks could also be the ones with greater shares of foreign currency liabilities than assets. If this is the case, relatively higher loan growth of such banks in the post-shock period could be attributed to their relatively liquid balance sheets and not to their foreign currency exposure. To account for this possibility, I interact bank characteristics with the dummy for the appreciation event so that it soaks up any variation in the outcome variable due to bank characteristics that could be correlated with currency exposure. Even after controlling for these interactions, the foreign currency exposure of banks remains statistically significant.

Another concern with the identification strategy could be that the differences in lending behavior of banks is driven by endogenous matching between banks and firms — banks which higher loan growth could be lending to firms that were relatively unaffected by the appreciation shock and hence, their relatively higher loan growth is an artifact of higher demand. To alleviate this concern, and also to shed light on the real effects of the appreciation shock, I match non-financial firms with banks using loan-level data from Dealscan. I compute average exposure of each non-financial firm to banks and show that there is no statistically significant difference between the banking exposures of exporters and non-exporters, and hence no evidence of sorting between banks and firms.

Further, I find that exporters are negatively affected in terms of investment, employment, and sales growth after the shock, however, firms that had banking relationships with positively affected banks are able to invest more after the shock. This implies that the bank-lending channel partially offsets the negative effect of currency appreciation on exporters.

For external validation, I collect data on foreign currency exposure of banking sectors in a sample of 44 emerging and advanced economies and explore the importance of the bank-lending channel in the transmission of exchange rate shocks. Using quarterly data on macroeconomic aggregates and nominal effective exchange rates for the period 1994-2016, I find that on an average, the elasticity of GDP growth to nominal currency appreciation is negative, but its magnitude is dampened by the presence of net foreign currency liability exposure on banks' balance sheets. Further, the bank-lending channel is more potent for emerging markets as compared to advanced economies. This could perhaps be explained by the fact that financial markets in advanced economies are more liquid and deep, hence, the banking sector can actively hedge its foreign currency exposure by buying foreign exchange swaps or forward contracts. Banks in emerging markets may not be able to insulate their balance sheets from foreign currency movements as

effectively as banks in advanced economies.

These findings suggest that currency devaluation may not stimulate growth if the banking sector has large foreign currency exposure that is not perfectly hedged and has implications for monetary policy setting in small open economies.

This paper makes two main contributions to the literature. First, it uses microdata to document a novel (bank-lending) channel through which exchange rate shocks can affect the real economy. Existing studies have mostly focused on the trade channel to study the effectiveness of monetary policy in small open economies. The literature has documented various features, such as, the emergence of global value chains and presence of imported intermediate inputs (Rodnyansky (2018), Amiti *et al.* (2014)), the dominant currency paradigm (Gopinath *et al.* (2010), Casas *et al.* (2016)), local currency pricing (Devereux and Engel (2003)), and pricing-to-market (Fitzgerald and Haller (2013)), among others, to explain the muted response of economic activity to exchange rate shocks. However, no studies have documented the bank-lending channel of exchange rates using micro data.

In a related paper which builds upon Bruno and Shin (2014), Bruno *et al.* (2018) show that the working capital channel of a weaker home currency can offset higher competitiveness of exporters as a stronger dollar tightens credit conditions. Their work, however, is based on a model in which a stronger dollar tightens bank credit supply due to increased credit risk of banks' borrowers who are exposed to currency mismatch on their balance sheets. Their model assumes no direct exposure to foreign currency on banks' balance sheets. I build upon their work by showing that the currency mismatch on banks' balance sheets can manifest as a positive credit supply shock in the event of home currency appreciation even if there is no currency mismatch on the balance sheet of non-financial firms.

The second contribution of this paper is that it expands the literature on the bank-lending channel of monetary policy by focussing on the currency exposure of banks. Exisitng studies have traditionally focused on banks' interest rate exposure to study the transmission of monetary policy through the bank-lending channel. Complementing earlier studies in this literature which have shown bank-size, liquidity, and bank capital to be important determinants of the bank-lending channel of monetary policy (Kashyap and Stein (2000), Kashyap and Stein (1995), Gambacorta and Mistrulli (2004)), this paper finds that bank equity and non-interest income is particularly sensitive to exchange rate shocks and can affect lending response of banks to such shocks.

Rest of the paper is organized as follows. Section 2 provides background on the Swiss currency appreciation episode and the Swiss banking sector. Section 3 presents data and summary statistics. Section 4 discusses the empirical strategy and results and section 5 concludes.

2 Background

2.1 The Currency Appreciation Episode - January 2015

Switzerland is a small open economy with high reliance on exports – the share of exports in GDP has been greater than 50 percent since 2000. Europe is the most important destination of Swiss exports. In 2016, exports to Europe accounted for 54 percent of the total exports of Switzerland. Hence, the chf/eur exchange rate is an important policy variable for the Swiss National Bank (SNB) as changes in this exchange rate can potentially have a big impact on the real economy by affecting exports. In the early 2000s, the exchange rate between the Swiss franc and the euro fluctuated between CHF 1.45 and 1.7 to the euro. However, since 2008, as the global economic turmoil gathered pace, demand for the Swiss franc as a safe haven currency increased and by August 2011, the Swiss franc had appreciated by around 30 percent as compared to its value in 2000. To prevent further appreciation of the Swiss franc, the SNB introduced a floor of CHF 1.20 per euro in September 2011. According to a press statement released in September 2011, the SNB announced that it was willing to purchase foreign exchange in unlimited quantities to defend the floor of CHF 1.20 to the euro.

On January 15, 2015, the SNB surprised the markets by discontinuing the minimum exchange rate of CHF 1.20 per euro. The announcement was even more surprising especially after the Vice Chairman of the SNB said in an interview on January 12, 2015 that "the cap on the swiss-euro exchange rate must remain a cornerstone of our monetary policy". The announcement on January 15 led to approximately 20 percent increase in the value of the Swiss franc immediately after the announcement (figure 2). This was a huge shock by historical standards and led to an immediate collapse in the broad stock market index. Even after one year from the announcement, the Swiss Franc maintained its high value at 1.09 CHF per euro.

There is some narrative evidence to support that the decision of the SNB to discontinue the minimum exchange rate was completely unanticipated. For instance, the following statement from the annual report of Bank Linth shows that the decision of the SNB took the market by surprise: "*Like all market participants, we were surprised by the decision of the Swiss National Bank on 15*

January, 2015". Moreover, the one-month forward exchange rate between the Swiss franc and the euro did not change in December 2014, which should have been the case if the announcement was anticipated (figure 3).

2.2 The Swiss Banking Sector

The banking sector in Switzerland is divided into six broad categories of banks – big banks, foreign banks, cantonal banks, regional and savings banks, Raiffeisen banks, and stock-exchange banks. UBS and Credit Suisse are the two banks in the 'big banks' category, with a market share of 48 percent in 2014.[3] Cantonal banks are government-owned banks, one in each canton of Switzerland.[4] Cantonal banks had a share of 17 percent in 2014. Foreign banks in Switzerland exist mostly as legal entities (controlled by their parent bank), with a share of 10 percent. Branches of foreign banks, which are not separate legal entities, had a market share of 2 percent in 2014. Most of the foreign banks in Switzerland are European banks. Regional and savings banks are small banks and focus on retail lending. They are geographically concentrated, with limited foreign exposure. The regional and savings banks had an asset share of 3.5 percent in 2014. Raiffeisen banks are structured as co-operatives, and have a regional presence, with an asset share of 6 percent. Stock exchange banks are primarily involved in providing asset management services to domestic and foreign clients, and have an asset share of 7 percent. 'Other' banks have an asset share of 6 percent in 2014.

The banking sector in Switzerland has a large exposure to international currencies. As of December 2014 (one month before the central bank announced its decision to abandon Swiss Euro peg), foreign currency assets accounted for 47 percent of the total assets of the banking system while foreign currency liabilities accounted for 48 percent of the total liabilities. Overall, the foreign currency exposure on the liability side exceeded the asset side by one percentage point. This is not trivial given that the size of the banking sector (measured as total assets) in Switzerland was approximately 5 times the GDP in 2014 . A breakdown by bank groups reveals that there is heterogeneity in the net foreign currency exposure, defined as the difference between the liability and asset share of foreign currency denominated liabilities and assets respectively. Big banks (UBS and Credit Suisse) had a net negative foreign currency exposure as of December 2014

[3]The share of assets in total assets of the banking system in 2014 is calculated using the list of reporting banks and their balance sheet size, downloaded from the SNB's website.

[4]There are 26 cantons in Switzerland and 24 cantonal banks. The cantonal bank in the canton of Appenzel Ausserrhoden was sold to UBS, and the one in the canton of Solothurn was privatized in 1995.

– their asset exposure exceeded their liability exposure by 4 percentage points.[5] While cantonal banks, regional banks, and Raiffeisen banks had a net positive foreign exposure – their liability exposure exceeded their asset exposure.

3 Data and Summary Statistics

A principal contribution of this paper is to construct a new dataset on foreign currency exposure (including off-balance sheet exposures) of banks and to link major bank- and firm-level datasets for Switzerland to observe the real effects of currency appreciation via changes in credit supply.

For the bank-level analysis, I use annual data on balance sheet, income statement, and cash flow variables for banks in Switzerland from the Bankscope Database, accessed through the Wharton Research Data Services. This database is compiled by Bureau van Dijik (BvD) and provides information on bank balance sheet variables for banks in many countries around the world. It sources micro-data on banks in different countries from their financial statements and presents the final data in a consistent and harmonized format across countries.[6] This database, however, does not have information on foreign currency exposure of banks. Hence, I hand-collect data on foreign currency denominated assets and liabilities from the annual reports of the biggest 100 banks, which account for approximately 80 percent of the banking system by assets in 2014.[7]

I use two sets of dependent variables for the bank-level analysis. I hypothesize changes in exchange rates to influence bank credit by affecting banks' profitability and equity. The first set of dependent variables includes lending outcomes such as annual loan growth, and loan growth broken down by types of customers – mortgage loans, inter-bank loans, and consumer loans.[8] The second set of dependent variables include profitability and net-worth variables such as pre-tax profits, net income, net interest income, and net non-interest income, trading income, and bank equity.[9] In line with the literature on the bank-lending channel of monetary policy (Kashyap and Stein (1995), Kashyap and Stein (2000)), bank-level controls include size (log of total assets), liquidity, bank equity (normalized by assets), and loans to deposits ratio. I use annual data on

[5]The gross asset exposure of the big banks to foreign currencies is huge – it was 71 percent in 2014. The high gross exposure makes these banks particularly vulnerable to foreign exchange shocks.

[6]BvD no longer publishes the Bankscope Database. It has replaced Bankscope database with ORBIS Bankfocus database. For my analysis, I have combined Bankscope database with ORBIS Bankfocus database.

[7]According to the Swiss National Bank's website, there are 268 reporting banks in Switzerland in 2014, including branches of foreign banks and excluding private bankers who do not actively seek deposits from the public.

[8]Bankscope does not have a good coverage of lending broken down by types (mortgage vs industrial). Hence, I hand-collect data on mortgage loans, inter-bank loans, customer loans.

[9]Data on trading income is hand-collected.

these variables for the time period 2011-2016.[10]

Sample selection is based on availability of data on foreign currency exposure. All variables are winsorized at 5 and 95 percent to remove outliers. Panel A of table 1 reports summary statistics for the main variables used in the bank-level analysis. The average values of control variables in my sample are similar in magnitude to those reported in the literature. Average equity-to-assets ratio is 8.9 percent in my sample, compared to 8.7 percent in Gomez *et al.* (2016) and 9.5 percent in Campello (2002). Liquidity ratio is 31.5 percent in my sample, compared to 27 percent in Gomez *et al.* (2016)'s sample and 32 percent in Campello (2002)'s sample.

Data on accounting variables and operating performance of firms in Switzerland is from the Worldscope database. This database provides information on financial and income statements of publicly listed firms in Switzerland. To study the trade channel of currency appreciation, I define firms as exporters and non-exporters. To do that, I merge Worlsdcope database with Amadeus database, which contains information on export turnovers of publicly listed as well as private firms in Switzerland. I characterize a firm as an exporter if it has positive values of export turnover to total turnover ratio in the pre-shock period (before 2015). Using this measure, 76 percent of the firms in my sample are exporters. This seems reasonable since I am using data on publicly listed firms which tend to be very large and there is a positive correlation between propensity to export and firm size.

To study the bank-lending channel of currency appreciation, I compute a measure of bank dependence of non-financial firms. I merge Capital IQ data with Worlsdsope data using 'ticker' symbol as the identifier. Capital IQ database has detailed information on capital structure of publicly listed firms. For each firm, I compute the average ratio of bank debt to total capital between 2011 and 2014. A firm is classified as bank dependent if its ratio of bank debt to total capital is in the top quartile of the bank debt to capital distribution. I also gather evidence on bank-firm relationships using Dealscan database. This database contains deal/loan level information on financial transactions between non-financial firms and financial intermediaries. I match firms in Worldscope database with those in Dealscan database and create a measure of their banking relationship with banks with different values of foreign currency exposure to study the impact of their banking relationships on credit supply/financial constraints in the post-shock period. I supplement this dataset with hand-collected data on bank-firm linkages from the financial statements

[10]See Data Appendix for definitions of variables used in the analysis.

of non-financial firms.[11]

For the firm-level analysis, I use annual data on assets, market capitalization, employment, pre-tax income, leverage, investment, Tobin's Q, cash-to-assets, sales, and profitability measures like return on assets and equity for the period 2011-2016.[12] The sample contains only non-financial firms – firms with SIC codes in the range 6000 - 6999 are dropped. Following Almeida and Campello (2007), I exclude firms for which annual asset growth is higher than 100 percent. This practice is standard in the empirical corporate finance literature. Annual asset growth rates higher than 100 percent can be indicative of mergers or reorganizations. Hence, this rule ensures such firms are excluded from the sample. I also drop firms with negative values for sales. I use a balanced sample of firms for my analysis to make sure that my results are not driven by the entry and exit margin. All variables are winsorized at 5 and 95 percent to exclude outliers.

This selection procedure implies I have 138 unique firm IDs and more than 600 firm-year observations. Around 65 percent of the firms are in manufacturing sector and 15 percent belong to the services sector. Panel B of Table 1 presents summary statistics for key firm-level variables for the pre-shock period (2011-2014).

Daily data on bilateral exchange rate between the Swiss franc and the euro and central bank policy rates is from the Global Financial Database (GFD).[13] Data on one-month forward exchange rate between the Swiss franc and the euro is from Datastream. Data on Nominal Effective Exchange Rate and Real Effective Exchange Rate Index are from the Bank for International Settlements (BIS). Aggregate data on foreign currency assets and liabilities of banking sector in different countries are from the International Financial Statistics database (IFS) of the IMF and the Locational Banking Statistics database of the BIS. Quarterly data on real GDP for advanced and emerging markets is from the IFS database. Panel C of table 1 shows summary statistics for the main macroeconomic variables used it the cross-country analysis.

4 Empirical Analysis

This section discusses the identification strategy and presents results.

[11] This is still work in progress.
[12] See table 11 for detailed definitions of all variabels used in the analysis and also their sources.
[13] See table 12 for definitions of policy rates for each country in the sample.

4.1 Identification Strategy

It is difficult to estimate the causal impact of exchange rates on real economy using macroeconomic data. Changes in exchange rates are often cyclically motivated. This leads to a problem of reverse causality and can produce biased estimates. Using lagged values of exchange rates may partially address the issue but can not completely eliminate it as the policy changes may be driven by anticipation of future economic activity. Another issue with using macroeconomic data is the simultaneity bias. A positive productivity shock may simultaneously lead to an appreciation in real exchange rate and an increase in current and future output. Hence, a time series analysis using macroeconomic data may lead us to falsely conclude that real exchange rate appreciations lead to higher economic growth.

To circumvent these endogeneity issues, I use micro-data on bank balance sheets and estimate the causal impact of currency appreciation using a difference-in-differences estimation strategy. In particular, I exploit the differential exposure of banks' balance sheets to foreign currency denominated assets and liabilities. A bank which has a higher share of foreign currency assets (in total assets) relative to foreign currency liabilities should be negatively affected by the appreciation of the Swiss franc as the value of its assets goes down and the value of its liabilities goes up. Similarly, a bank which borrows heavily in foreign currency but does not have a proportional foreign currency exposure on the asset side of the balance sheet should be positively affected by home currency appreciation since the appreciation reduces the debt burden of the bank.

Using micro-data ensures that reverse causality is not an issue — credit supply of one bank can not affect the SNB's decision to abandon the peg. Since the identification strategy relies on the cross-sectional variation in *currency exposure* of banks, it also mitigates the concerns that other macroeconomic events that coincide with the appreciation event would confound the casual mechanism.

A potential concern with the identification strategy is that distribution of exposure across banks is not random. In other words, certain bank characteristics, such as liquidity or size, are correlated with foreign currency exposure. Hence, the differential lending response of banks after the shock could be driven by differences in bank characteristics, and not in their currency exposure. To account for this possibility, I interact bank characteristics with the dummy for the appreciation event so that it soaks up any variation in the outcome variable due to bank characteristics that could be correlated with currency exposure.

Another concern with the identification strategy could be that the differences in lending behavior of banks is driven by endogenous matching of banks and firms — banks which higher loan growth could be lending to firms that were relatively unaffected by the appreciation shock and hence, their relatively higher loan growth is an artifact of higher demand. To alleviate this concern, and also to shed light on the real effects of the appreciation shock, I match non-financial firms with banks using loan-level data from Dealscan and provide evidence on this kind of sorting in section 4.5.

4.2 Currency Exposure and Lending Outcomes

I construct the foreign currency exposure for each bank in the sample as the difference between foreign currency denominated liabilities and assets (as a share of total liabilities and assets respectively) in December 2014:[14]

$$exposure \equiv \left[\frac{liabilities_{foriegn}}{liabilities_{tot}} - \frac{assets_{foreign}}{assets_{tot}}\right]_{2014}$$

This measure will be positive if the share of foreign currency liabilities exceeds the share of foreign currency assets. A bank with a positive value of this measure should be positively affected by the appreciation of the Swiss franc as the fall in the value of foreign assets is less than the fall in the value of foreign liabilities, leading to a positive impact on the banks' net-worth. The average foreign exposure of the banking sector using this measure is 2.7 with a standard deviation of 12.6. This implies that on an average, the share of foreign currency liabilities exceeds that of foreign currency assets by 2.7 percentage points. For comparison, I use aggregate data on foreign assets and liabilities of bank groups from SNB's website and compute an average measure of currency exposure across bank groups. The average foreign exposure of the banking sector using SNB data is 2.8 percentage points, which roughly matches the average foreign exposure in the sample constructed using hand-collected data from banks' annual reports.

To estimate the impact of foreign currency exposure on bank lending, I estimate the following

[14]This measure is constructed using information on foreign liabilities and assets based on domicile. Few banks report assets and liabilities broken down by currency and positions in the derivatives market. For the sample of banks which do report information on hedging, I compute net positions in foreign currencies after incorporating off-balance sheet exposure arising from positions in forex derivative markets. I show that my results robust to using the hedged measures of exposure and exposure on the basis of foreign currency in section 4.4.2. I use the measure based on domicile in the baseline analysis to ensure a large sample size.

model commonly used in the literature on bank-lending channel of monetary policy:

$$\begin{aligned} loan\ growth_{b,t} &= \alpha + \beta post_t + \gamma exposure_b + \delta(post_t \times exposure_b) \\ &+ \sum_{x \in controls} \eta_x (post_t \times x_{b,t-1}) + \sum_{x \in controls} \mu_x x_{b,t-1} + \epsilon_{b,t} \end{aligned} \tag{1}$$

where, $loan\ growth_{b,t}$ is the annual growth rate of gross loans of bank b in time t, $post_t$ is a dummy variable that takes a value 1 for years 2015 and 2016, $exposure_b$ is the foreign currency exposure of bank b as defined above, $exposure_b \times post_t$ is an interaction term between the post-shock period (i.e., for years 2015 and 2016) and the exposure variable. This variable estimates the differential impact of the currency shock on banks with different levels of foreign currency exposure and is our main variable of interest. The set of control variables include lagged value of total assets (size), ratio of equity to assets, bank liquidity, and loans to deposits ratio, in line with the literature on the bank-lending channel. To allow for the possibility that the exposure variable can be correlated with certain bank characteristics, the model contains interactions between bank characteristic and the event dummy. This would ensure that any variation in the outcome variable in the post-shock period that is driven by the bank characteristics is absorbed by these interaction terms. Since the treatment variable varies at the bank level, standard errors are clustered at the bank level to allow for intra-bank auto-correlation of residuals within banks. This equation is estimated for the time period 2011 to 2016.

The main variable of interest is δ as it reflects the differential lending response of banks with different levels of currency exposure. Table 2 reports the results for equation 1. From column (1), we see that the coefficient on the interaction between *exposure* and *post* is positive and significant. This implies that banks with a more positive net foreign currency exposure experience a higher loan growth in the post-shock period as compared to banks with smaller values of net exposure. Column (2) and (3) add bank- and country-level controls that are known to have an effect on bank lending. We see that the coefficient on the interaction term remains positive and significant. As is established in the banking literature, bank size (assets) is negatively correlated with loan growth while liquidity is positively related to loan growth. GDP growth has a positive and significant impact on loan growth. While the sign on the coefficient for interest rates is in the right direction (negatively related to loan growth), it is not statistically significant.

In column (4), I add the interaction terms between bank characteristics and the dummy for the currency shock. We see that while the magnitude on the interaction term between currency

exposure and the event dummy goes down, it remains positive and statistically significant. In particular, size plays an important role. The coefficient on the interaction between *size* and *post* is negative and significant. This implies that big banks were negatively affected by the currency shock and reduced lending more than smaller bank in the post-shock period.

Finally, in column (6), I test whether gross exposures also matter for bank lending. I decompose net currency exposure into exposure from only the liability side and that from the asset side. We see that the interaction term between foreign currency liabilities and post is positive and statistically significant while the interaction term between foreign currency assets and post is negative and statistically significant. This confirms the mechanism driving the results. As home currency appreciates, the value of foreign liabilities goes down and this should have a positive impact on the bank's net-worth and consequently its ability to lend. Hence, we should expect banks with high foreign liability exposure to gain from domestic currency appreciation. Similarly, banks with a high share of foreign currency assets should lose as home currency appreciates as their value in domestic currency falls. It is also encouraging to note that the cumulative magnitudes on the interaction terms for gross exposures roughly correspond to the magnitude on the interaction term between net exposure and post in column (4). A one standard deviation increase in the net exposure measure leads to approximately a 3.3 percentage point increase in loan growth after the shock. This is economically significant given the average loan growth in the sample is 7 percent.

A possible concern with the identification strategy could be that there are pre-existing trends that are driving the difference in lending growth of positively versus negatively exposed banks after the shock. To address this concern, I check for parallel trends. The parallel trends assumption requires that in the absence of treatment, the difference between treated and control group should be constant over time. I test this assumption formally using the following specification:

$$\begin{aligned} \log(loans)_{bt} \quad &= \alpha_b + \textstyle\sum_t \beta_t T_t + \sum_t \gamma_t (Treated_b \times T_t) + \\ &\textstyle\sum_t \sum_{x \in controls} \mu_{xt} (x_{b,t-1} \times T_t) + \sum_{x \in controls} \eta_x x_{b,t-1} + \epsilon_{b,t} \\ &\forall t \in \{2011, 2012, 2013, 2015, 2016\} \end{aligned} \tag{2}$$

where, α_b captures bank fixed effects, T_t is a dummy variable for each time period (year) in the sample (2014 is the omitted year), $Treated$ is a dummy variable that takes a value 0 if the bank is net long in foreign currency and 1 otherwise, $(Treated_b \times T_t)$ is an interaction term between time dummies and the dummy variable for exposure to foreign currency, $x_{b,t-1}$ is a set of lagged

bank-level controls and $x_{b,t-1} \times T_t$ are the interaction terms between bank-level controls and time dummies. Standard errors are clustered at the bank-level to allow for auto-correlation of residuals across time.

The main coefficients of interest are γ_t, which show the difference in loan growth of treated and control groups in each period in the sample. Figure 4 shows the 95 percent confidence interval plots for the estimated coefficients γ_t from equation 2. It is evident from the figure that there are no statistically significant differences in loan growth of banks with positive and negative foreign currency exposure in the years prior to the currency appreciation episode in 2015, which is consistent with the parallel trends assumption for the difference-in-differences methodology. In 2015, however, the banks with a positive foreign currency exposure (foreign currency liability share higher than foreign currency asset share) experience a higher loan growth as compared to banks with a negative foreign currency exposure and the difference is statistically significant.

4.2.1 Types of Lending

It may be important to understand how the currency shock affected lending in different markets. For instance, adjusting inter-bank lending vs industrial lending can have different macroeconomic implications. While it is not possible to distinguish between consumer loans and industrial loans, banks do report their loans broken down as inter-bank loans, mortgage loans, and costumer loans. Customer loans can be short-term consumer loans as well as industrial loans. Mortgage lending has the biggest share in bank lending, with an average share of roughly 72 percent. Customer lending and inter-bank lending have average shares of 22 percent and 18 percent in total lending. Bankscope does not have good coverage of different types of lending, hence I hand-collect data on inter-bank, customer, and mortgage loans for 2014 and 2015. To explore the effect on different types of lending, I estimate the following equation:

$$\Delta Y_b = \alpha + \beta exposure + \theta \mathbf{BANK}_b + \epsilon_b \tag{3}$$

where, the dependent variable can be loan growth of mortgage loans, inter-bank loans, and customer loans of bank b in 2015. $\mathbf{BANK}_b$ is a vector of lagged bank-level controls as discussed in the baseline specification. This equation is estimated for a cross-section of banks in 2015. Results are reported in table 3.

Columns (1), (2), and (3) show results for mortgage lending, inter-bank lending and customer lending, respectively. We see that *exposure* is significant and positive for mortgage loans and

customer loans. In terms of economic magnitude, a one standard deviation increase in exposure variable leads to 5.6 percentage point increase in growth rate of mortgage loans and 3.3 percentage point increase in the growth rate of customer loans. The coefficient on exposure is insignificant for inter-bank loans.

Another interesting dimension is to examine the effect on secured vs unsecured loans. When banks suffer losses, do they respond by changing the risk profile of their portfolio? To answer this question, I hand-collect data on loans secured by collateral and those without any collateral and investigate how the loan growth of secured vs unsecured loans reacts to the currency shock. Results are reported in table 3. The dependent variable is annual loan growth of unsecured loans in column (4) and of secured loans in column (5). We see that the foreign currency exposure does not matter for unsecured loans but it is positive and significant for secured loans. One way to interpret this result is that banks which have net long exposure in foreign currency reduce their collateralized lending when they are hit by the currency shock while they keep their unsecured lending unchanged. This implies that the share of unsecured loans increases in the lending portfolio of banks with a net long foreign currency exposure and has implications for risk shifting as an unintended consequence of currency appreciation.

4.3 Channels

In this section, I investigate what are the channels through which the Swiss franc appreciation episode affects bank lending. Financial intermediaries try to hedge foreign exchange risk on their balance sheets by buying foreign exchange forward contracts, swaps or other forex derivatives. However, a financial intermediary that actively hedges its portfolio may be unable to fully insulate its balance sheet from sudden movements in exchange rates as their Value-at-Risk models typically calculate expected losses based on historical events. The following statement from the annual report of UBS reflects the inability of banks to fully protect their balance sheets from unfavorable movements in market prices: " *As seen during the financial crisis of 2007-09, we are not always able to prevent serious losses arising from extreme or sudden market events that are not anticipated by our risk measures and systems. Value-at-risk, a statistical measure for market risk, is derived from historical market data, and thus by definition could not have anticipated the losses suffered in the stressed conditions of the financial crisis.*

Given that the January 2015 appreciation shock was largely unprecedented, it is likely that it affected banks' profits. Banks report losses arising from derivatives and foreign currency trans-

lation as net trading income. If banks were not perfectly hedged against the appreciation shock, we should expect the trading income of banks with a net liability foreign currency exposure to go up relative to banks with a net asset foreign currency exposure.

To test this formally, I investigate the response of profits and net income of banks around the shock. More importantly, I want to explore the response of the non-interest component of net income, which includes trading income. To do this, I estimate equation 1, with $\Delta Profit$, $\Delta NetIncome$, and $\Delta Non-interest\ Income$ and $\Delta Interest\ Income$ and $\Delta TradingIncome$ as dependent variables.[15] Results are reported in table 4. In column (1), the dependent variable is one-year difference in net income, in column (2) , the dependent variable is one-year difference in net interest income, in column (3), the dependent variable is one-year difference in net non-interest income and in column (4), the dependent variable is one-year difference in trading income. All outcome variables are scaled by bank assets in 2014. All columns include bank-level controls.

From table 4, we find that banks with more foreign currency liabilities see a higher increase in net income in 2015 (column 1). It is useful to examine whether this increase in net income is driven by an increase in interest income or non-interest income. In contrast to the conventional monetary policy transmission channel that works by affecting net interest income of banks, we see that the bank lending channel of currency appreciation works by affecting non-interest income. From column (2) and (3), we see that the exposure variable is insignificant for interest income but is positive and statistically significant for non interest income. Further, trading income is positively affected for banks with a net foreign currency liability exposure (column 4). Since trading income is part of non-interest income, it explains why the coefficient on exposure is statistically significant and positive for non-interest income.

4.4 Robustness and Additional Evidence

In this section, I conduct a battery of robustness checks to address a number of concerns with the identification strategy and also supplement the main analysis with a narrative measure of exposure.

[15] I am using a cross-section analysis for this section because I use hand-collected data on trading income (for which I collect data for 2014 and 2015).

4.4.1 Narrative Evidence

To provide additional support to the importance of foreign currency mismatch as a mechanism for transmission of currency shocks, I conduct an in-depth study of the annual reports of Swiss banks to gather narrative evidence on their foreign currency exposure and on the likely impact of the exchange rate shock on their balance sheet. I create a qualitative measure of exposure which takes a value 0 if the bank was negatively affected by the currency shock *and mentions so in its annual report.* For instance, the following statement from the annual report of Banque Privee BCP (Suisse) reflects a negative impact of the shock:

"*... the decision of the Swiss National Bank to discontinue the minimum exchange rate of CHF 1.20 per euro impacted negatively the results of the bank, given that costs are expressed in CHF while the asset and revenue base are split between EUR and USD.*"

The qualitative measure takes a value 0 for this bank. While Aargauische Cantonalbank has the following statement on the impact of the currency shock in its 2015 annual report:

"*A massive increase is reflected in the result from trading activities. The previous year's figure of CHF 32.2 million was increased by 52.4% to CHF 49.1 million. The additional income was accrued primarily in foreign exchange and foreign currency trading due to the decisions of the SNB in January 2015.*"

The qualitative measure of exposure takes a value 1 for this bank.

Using this measure, I investigate the response of bank lending to the change in exchange rate for a cross-section of banks by estimating the following model:

$$\Delta Y_b = \alpha + \beta QualitativeMeasure + \theta \mathbf{BANK}_b + \epsilon_b \tag{4}$$

where, ΔY_b could be loan growth, change in profit or change in income of bank b between 2014 and 2015, $QualitativeMeasure$ is an indicator variable which takes a value 0 if the bank mentioned in its 2015 annual report that it was negatively affected by the shock and 1 otherwise, and $\mathbf{BANK}_b$ is a vector of bank-level control variables including total assets (size), capital, liquidity, and loans to deposits in 2014. The main variable of interest is β, which provides an estimate of the differential impact of the currency shock on positively affected vs negatively affected banks. Equation 4 is estimated for a cross section of 53 banks in 2015.[16]

[16] I studied more than 100 annual reports to create this measure. Not all banks attribute changes in their balance sheets in 2015 to the currency shock. Sample selection (53 banks) for this analysis is based entirely on the existence of statements in banks' annual reports on the effect of the shock.

Table 5 reports the estimates from equation 4. Column (1) shows the estimate of β without including bank-level controls. We see that banks which reported as being positively affected by the shock experienced a 4.4 percentage point higher growth rate of loans as compared to banks which reported as being negatively affected by the shock. After controlling for bank-level variables like size, capital to assets ratio, liquidity, loans to deposits ratio (in 2014), we see that the coefficient on β is slightly lower in magnitude but remains statistically significant and positive (column (4)).

Next, I investigate what explains the relatively higher loan growth of banks which reported being positively affected by the currency shock. In particular, I test whether the banks which had a relatively higher loan growth rate in 2015 also experienced relatively higher growth in profit or income, which allowed them to expand credit. Table 5 presents the results. In column (2) and (3), the dependent variable is one-year difference in profit and income, respectively, normalized by total assets in 2014. Column (2) and (3) do not control for bank-level characteristics while column (5) and (6) include bank-level controls. From column (2) and (3), we see that banks which were positively affected by the currency shock did see an increase in their profits and net income. The coefficient for the Qualitative measure is positive and significant. Even after controlling for bank-level characteristics, the coefficient on qualitative measure remains positive and significant for profits and net income (column 5 and 6). These results suggest that the appreciation of the Swiss franc affected the loan growth of banks with differential exposure to foreign currency by affecting their profits.

4.4.2 Alternate Measures of Exposure

In this section, I construct different measures of exposure to test whether my results are dependent on the definition of exposure variable. The first measure of foreign currency mismatch is constructed using only on-balance sheet exposures and is based on currency of denomination rather than domicile. The second measure is constructed by incorporating positions in the derivatives market, i.e., by incorporating off-balance sheet exposure.

The measure of foreign currency mismatch on the basis of currency is constructed as follows:

$$\left[\frac{\sum_c liabilities_{foriegn^c}}{liabilities_{tot}} - \frac{\sum_c assets_{foreign^c}}{assets_{tot}}\right]_{2014}$$

where, foreign liabilities and foreign assets are liabilities and assets denominated in foreign currency. The average exposure was 3.4 percentage points in 2014 with a high standard deviation of 14.8 percentage points. Figure 5 shows the distribution of this measure for 69 banks for which

data is available. We can see that there is enough variation in this measure, with values ranging from -36.1 to 58.6.

Using this measure, I estimate equation 1 in a one-year window around the appreciation event. Results are reported in column (1) of table 6. The coefficient on the interaction term in column (1) is positive and significant. One standard deviation increase in the exposure measure leads to 4.4 percentage point increase in loan growth in the post-shock period.

The second measure of exposure is based on difference between liabilities and assets in different currencies as opposed to domicile. Even though the appreciation of the Swiss franc against all its trading partners was broad based (figure 2 panel (b)), the appreciation was strongest against the Euro. To capture the relative importance of Euro for certain banks, I construct a weighted measure of exposure as follows:

$$exposure \equiv \sum_{c} \frac{liabilities_c}{foreign\ liabilities} \left[liabilities_c - assets_c\right]_{2014}$$

where, c refers to currency c. This measure first computes the total difference between liabilities and assets of currency c (including off-balance sheet positions because of participation in derivatives markets). Then, it computes an average mismatch over all currencies using the share of each currency in total foreign liabilities as weights. The advantage of using this measure is that it captures the true extent of foreign currency exposure because it takes into account hedging activity by banks. Also, using pre-determined weights ensures that the measure captures the relative importance of different currencies for different banks.

I construct this measure for 54 banks which report information on off-balance sheet exposures. The average (hedged) exposure was CHF 8 million in 2014 with a standard deviation of CHF 37 million. The bottom panel of figure 5 plots this measure. We see that most banks have a net asset foreign currency exposure.

Column (2) of table 6 shows estimates from equation 1 using this measure of exposure. We see that the coefficient on the interaction term is positive and significant. One standard deviation increase in this measure leads to 4.1 percentage point increase in loan growth of banks in the post-shock period.

The above two measures are based on direct exposure of banks to currency fluctuations. However, there are indirect channels through which currency appreciation can affect the banks. For instance, banks which specialize in trade finance could be negatively affected because of

negative impact on exporters. One way to capture such indirect effects is to look at the effect of bank stock returns in response to the shock.

I compute one-month difference in bank stock returns around the currency appreciation event. Using it as an indirect measure of exposure, I estimate equation 1. Results are reported in column (3) of table 6. One standard deviation increase in this measure leads to 16 basis points increase in loan growth in the post-shock period. This suggests that the indirect effects of currency appreciation on banks are limited in terms of economic significance.

4.4.3 Robustness: Other

A standard robustness check in the difference-in-difference methodology is to change the window around the event and make sure that the effect of treatment dissipates as the window around the event expands. To test this, I estimate equation 1 for the sample period 2014-2016. If the identification strategy is really picking up the effect of currency exposure, we should expect a higher coefficient on the interaction term for this time period as compared to the baseline specification.

Table 7 reports the results. Column (1) reproduces estimates from equation 1 for comparison. In column (2), the sample period is 2014-2016. The coefficient on the interaction terms is higher as compared to the baseline specification. This implies that the treatment effect is stronger around the main event.

It can be argued that loan growth is generally persistent and the persistence should be controlled for by including lagged value of loan growth in controls. In column (3), I control for lagged value of loan growth and find that the coefficient on the interaction term becomes slightly smaller in magnitude but remains statistically significant and positive. Another robustness test is to exclude lagged value of loans to deposits variable from the set of controls. We see that the coefficient on the interaction terms barely changes because of this change (column 4).

A potential concern with the identification strategy is that there could be other macroeconomic events which coincided with the currency shock and could have negatively affected the loan growth of banks with a net asset exposure to foreign currency. If this is the case, it would confound the identification strategy. One major macroeconomic event that did coincide with the removal of the floor between the Swiss franc and euro, and merits discussion, is the reduction in interest rates on sight deposits that commercial banks hold with the SNB. In a press release on January 15, 2015, the SNB announced that in order to make investments in Swiss franc less attractive and to mitigate the effects of the discontinuation of the minimum exchange rate between the Swiss franc

and the euro, the interest rates for balances held on slight deposit accounts would be lowered to -0.75% from January 22.[17] This interest rate applies to sight deposits above a certain threshold, where the threshold is 20 times the minimum reserve requirement.

Such a high threshold implies that few banks were affected by the change in interest rates. For banks which have deposits above the exemption level, the reduction in interest rate should affect their balance sheet by affecting their net interest revenue. This will confound the identification of the currency shock only if banks which have a net asset foreign currency exposure are also the ones which have deposits above the exemption limit and are negatively affected by the interest rate decline.

To test this formally, I test whether the net interest revenue of banks with differential foreign currency exposure responds differently to the currency shock. If the decline in interest rates is driving the result, we should expect a significant difference in net interest revenue for banks with differential currency exposure around the event.

Column (4) in table 6 reports the results. The dependent variable is one-year difference in net interest revenue. We see that the interaction term is not significant. This suggest that the decline in interest rates is not driving the main results from the baseline specification.

4.5 Real Effects

This section investigates the real effects of the currency shock using micro-data on non-financial firms and tries to disentangle the trade channel from the bank-lending channel. Since Switzerland is an export oriented economy, a 20 percent appreciation of domestic currency should have a large negative impact on exporting firms. In particular, we should expect to see a negative impact on sales and profitability ratios of exporting firms. To test whether this was the case, I look at the response of sales growth, employment growth, and profitability ratios for exporters and non-exporters to the nominal exchange rate appreciation. I estimate the following model to tease out

[17] Sight deposits are balances that commercial banks hold with the SNB. These balances are used to satisfy statutory minimum reserve requirements. Commercial banks typically maintain sight balances higher than the minimum reserve requirement since these are the most liquid assets for banks, and are readily available for payment transactions. Current minimum reserve requirement stipulates that banks hold a minimum of 2.5 percent of their short-term liabilities (upto 90 days) plus 20 percent of liabilities towards customers in the form of savings and investments.

the causal effect of nominal exchange rate appreciation on various outcome variables for exporters:

$$Y_{it} = \alpha_i + \beta \mathbf{T}_t + \sum_{\mathbf{t}} \gamma_t (\mathbf{T}_t \times Exporter_i) + \sum_{\mathbf{t}} \delta_t (\mathbf{T}_t \times \mathbf{FIRM}_{it-1}) + \theta \mathbf{FIRM}_{it-1} + \epsilon_{it} \quad \forall t \in \{2011, 2012, 2013, 2015, 2016\} \backslash 2014 \tag{5}$$

where, Y_{it} could be sales growth, employment growth, or one-year change in return on equity for firm i at time t. α_i are firm fixed effects, $\mathbf{T}_t$ are time dummies for each year in the sample, excluding 2014, which is used as the reference year. $Exporter_i$ is a dummy variable which takes a value 1 for exporting firms and 0 otherwise. $(\mathbf{T}_t \times Exporter_i)$ is the interaction between year dummies and the *Exporter* variable. **FIRM** is a vector of firm-level control variables, including firm size, market capitalization and cash-to-assets ratio. Standard errors are clustered at the firm-level to allow for intra-firm serial correlation over time.

The above specification tests for the parallel trends assumption as well. In the absence of the event, the outcome variables for exporting and non-exporting firms should not deviate from their pre-existing trends. If this is not true, the results would be biased and we will not be able to get clean estimates of the causal impact. For further robustness, I have also included interactions of all control variables with time dummies to allow for differential correlation between the outcome variable and control variables across years.

The main variables of interest are γ_t which capture the difference in outcome variables of exporters and non-exporters over time. If exporters were negatively affected in 2015, we should expect to see a negative value for γ_t in 2015 (and not before 2015). Figure 6 shows the estimated γ_t for sales growth, employment growth, and one-year change in return on equity for the sample of listed firms in Worldscope. The red dashed line indicates the beginning of the exchange rate shock. The black dots represent point estimates from equation 5 and the blue bars show 90 percent confidence intervals around the point estimates.

Consistent with the parallel trends assumption, we find that there is no significant difference in the outcome variables of exporters and non-exporters in the pre-shock period, but the difference becomes negative and significant in 2015, i.e., after the currency shock. We see that in 2015 sales growth rate of exporters is 8 percentage points lower than that of exporters. Similarly, their employment growth is approximately 7 percentage points lower than that of non-exporters in 2015. Exporters also experience lower profits – the one-year change in return on equity is lower for exporters as compared to non-exporters.

These results suggest that the trade channel did, in fact, play an important role in the transmission of the exchange rate shock to the real economy. This is not surprising, given the high reliance of Swiss economy on exports. The next question to ask is: do lower profits and sales imply that exporters also invest less as compared to non-exporters in the aftermath of the currency shock? Figure 7 suggests that they do. The top panel of this figure shows the evolution of investment for exporters and non-exporters. Exporters and non-exporters have similar trends in the pre-shock period, but in 2015, exporters see a slowdown in investment while non-exporters continue to increase their capital expenditure.

The bottom panel of figure 7 plots coefficients γ_t from equation 5 with investment as the outcome variable. Firm control variables for investment include Tobin's Q, lagged value of cash to assets ratio, and the ratio of short-term debt to assets, as is standard in the corporate finance literature. From the figure, we see that there is no significant difference between investment of exporters and non-exporters in the pre-shock period, but it becomes negative and significant in 2015. This suggests that appreciation of Swiss franc in 2015 not only had a negative impact on firms' profits and sales growth but also had a detrimental impact on investment of exporting firms.

However, non-exporting firms continued to increase their investment. Since financial constraints also play an important role in shaping firms' investment decisions, I investigate the bank-lending channel played any role in firms' investment decisions. I match non-financial firms in Worldscope with those in the Dealscan database and compute the average exposure of each firm to multiple banks, depending upon their lending share in the syndicate. The bank lending channel would imply that firms that had banking relationship with positively affected banks should see an increase in investment as those banks increase credit supply.

To test the hypothesis that the positive credit supply shock due to positive foreign currency exposure of banks leads to higher investment of non-financial firms, I estimate the following equation:

$$\begin{aligned} Y_{it} = \quad & \alpha_i + \beta \mathbf{T}_t + \textstyle\sum_{\mathbf{t}} \gamma_t (\mathbf{T}_t \times BankExposure_i) + \sum_{\mathbf{t}} \delta_t (\mathbf{T}_t \times \mathbf{FIRM}_{it-1}) + \\ & \theta \mathbf{FIRM}_{it-1} + \epsilon_{it} \\ & \forall t \in \{2011, 2012, 2013, 2015, 2016\} \backslash 2014 \end{aligned}$$

where, Y_{ict} is either investment of firm i at time t, α_i are firm fixed effects, $\mathbf{T}_t$ are time dummies for each year in the sample, excluding 2014, which is used as the reference year. $BankExposure$

is a dummy variable which takes a value 1 for firms that had banking relationships with banks which were positively affected by the appreciation shock, ($\mathbf{T}_t \times BankExposure_i$) is the interaction between year dummies and the $BankExposure$ variable. **FIRM** is a vector of firm-level control variables, including firm size, investment opportunities, and cash-to-assets ratio. Standard errors are clustered at the firm-level to allow for intra-firm serial correlation over time.

Equation 6 is estimated for the time period 2011-2016 for the sample of listed firms from the Worldscope database. A potential concern with the identification strategy is that there is endogenous sorting between banks and firms – exporters were borrowing from banks which were negatively affected by the appreciation shock and hence the results we see could driven by demand changes. To alleviate this concern I provide direct evidence on sorting. The average bank exposure of exporting firms was -1.78 while that of non-exporters was -19.6. This difference is not statistically significant, which provides evidence against sorting.

Figure 8 plots the γ_t coefficient from the above equation. The blue dots are point estimates and the vertical lines represent 95 percent confidence intervals. We can see that after the appreciation shock, firms that had banking relationships with positively affected banks do see an increase in their investment. This suggest that the bank lending channel did partially offset the negative impact of currency appreciation on non-financial firms.

4.6 Macroeconomic Analysis

While the results from the previous section suggest that the bank-lending channel explains the muted response of real outcomes to the large currency appreciation shock in Switzerland, it is not clear whether the bank-lending channel can explain the exchange rate disconnect puzzle in general. Hence, in this section, I use macroeconomic data for a sample of emerging and advanced economies to test whether the bank-lending channel can mitigate the trade channel. In particular, I estimate the following model:

$$\Delta Y_{i,t} = \alpha_i + \beta \Delta NEER_{i,t-1} + \gamma Exposure_{i,t-1} + \delta \Delta NEER_{i,t-1} \times Exposure_{i,t-1} + \Theta \mathbf{X}_{i,t-1} + \epsilon_{i,t-1} \quad (6)$$

where, $\Delta Y_{i,t}$ is the year-over-year difference in quarterly real GDP of country i, α_i are country fixed effects, $\Delta NEER_{i,t-1}$ is the log change in quarterly nominal effective exchange rate for country i in quarter $t-1$, $Exposure_{i,t-1}$ is a dummy variable that takes a value 1 if the banking

sector of country i had more foreign currency liabilities relative to foreign currency assets in period $t-1$. The main variable of interest is the interaction between currency change and banking sector exposure: $\Delta NEER_{i,t-1} \times Exposure_{i,t-1}$. The interaction term captures the effect of the bank lending channel. $\mathbf{X}_{i,t-1}$ are country-level control variables, lagged one-quarter. Equation 6 is estimated for a sample of 44 emerging and advanced countries using quarterly data over the period 1994-2016.[18]

A positive β implies that nominal currency appreciation increases output growth in the following quarter, while a negative value for β indicates that nominal currency appreciation hurts growth. β captures the trade channel of currency fluctuations while δ captures the bank-lending channel. If the bank-lending channel is important and offsets the trade channel, we should expect δ to be positive and significant. A positive δ implies that the negative effect of trade channel is mitigated for countries that have a banking sector with more foreign currency liabilities relative to foreign currency assets.

Results from equation 6 are reported in table 9. Column (1) presents results for the entire sample, column (2) presents results for advanced economies, and column (3) for emerging markets. All columns include country-level control variables and country fixed effects. From column (1), we see that the coefficient on $\Delta NEER$ is negative and significant. This implies that for countries in the sample, nominal currency appreciation hurts growth next quarter. The coefficient on the interaction term is significant and positive, confirming the hypothesis that the bank lending channel mitigates the negative effect of currency appreciation on growth. The coefficient on the interaction term is positive and significant for the sub-samples of advanced and emerging economies as well, however, the coefficient for emerging markets is larger than that for advanced economies. This can perhaps be explained by the fact that banks in advanced economies are better equipped to hedge their foreign currency exposure as compared to banks in emerging markets as financial markets in advanced economies are relatively more developed.

5 Conclusion

This paper uses the Swiss franc appreciation episode of January 15, 2015 as an exogenous exchange rate shock to study the bank lending channel of exchange rates. Using a novel hand-collected dataset on foreign currency mismatch of Swiss banks, this paper finds that banks which had

[18] See Data Appendix for the list of countries and country group classification in the sample.

more foreign currency liabilities relative to foreign currency assets before the appreciation shock gain from appreciation of domestic currency and increase lending in the post-shock period. This positive credit supply shock leads to higher investment for bank-dependent firms, while exporters see a decline in their investment as a result of weak demand for exported goods. Hence, the financial channel of exchange rates mitigates the traditional trade channel of exchange rates and can explain the exchange rate disconnect puzzle. To test the importance of the bank-lending channel more generally, I use cross-country data on foreign exposure of banking sector for a sample of advanced and emerging markets and find that exchange rate appreciation negatively affects economic growth but the effect is negative effect is mitigated by the positive effect from short foreign currency exposure of the banking sector.

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Table 1: **Summary Statistics**

This table reports summary statistics for the main variables used in the analysis. Panel A is for bank-level variables for the time period 2011-2016. Panel B is for firm-level analysis from the Worldscope database over the time period 2014-2015. Panel C reports summary statistics for macroeconomic variables for the time period 1994-2016 using quarterly data. Panel C1 is for the sample of advanced economies and panel C2 is for emerging markets.

A. Bank-level variables	mean	sd	p25	p50	p75	count
$exposure$	2.712	12.107	-1.900	0.000	1.300	590
loan growth	6.750	13.142	1.790	4.446	7.849	564
$\Delta Profit$	-0.017	0.304	-0.035	0.000	0.043	570
$\Delta NetIncome$	-0.010	0.292	-0.023	0.000	0.035	570
$\Delta IntIncome$	0.017	0.117	-0.033	0.000	0.059	573
ΔNII	0.024	0.300	-0.042	0.000	0.044	573
size	14.910	1.584	13.493	14.618	16.537	581
equity to assets	8.927	3.527	6.774	8.005	9.520	580
liquidity	32.658	26.526	12.614	19.087	52.743	580
loans to deposits	89.024	39.195	52.738	107.415	118.861	579
B. Firm-level variables						
exporter	0.768	0.422	1.000	1.000	1.000	690
Employment growth	0.061	0.577	-0.017	0.023	0.078	495
Sales growth	0.017	0.119	-0.034	0.019	0.074	475
Return on assets	5.112	7.650	2.463	5.374	9.352	681
Return on equity	8.995	14.741	3.837	10.268	17.515	678
Pre-tax Income (CHF Million)	213.565	471.335	4.501	35.097	151.555	688
Firm Size	20.376	1.894	19.193	20.283	21.647	689
Market capitalization (log)	20.353	1.846	19.044	20.251	21.561	674
Investment	0.002	0.035	-0.013	0.003	0.019	532
Leverage	24.628	20.155	4.987	22.034	40.483	689
Tobin's Q	1.201	0.847	0.579	0.934	1.553	674
Cash-to-assets	0.147	0.115	0.060	0.114	0.203	665
C. Macro variables						
$\Delta NEER$	-0.361	5.155	-1.519	0.096	1.522	4004
$\Delta RGDP$	3.217	3.932	1.312	3.098	5.136	3791
Policy Rate	12.720	210.783	2.500	4.500	7.750	3234

Table 2: **Baseline Results: Effect on Lending**

This table reports estimates from equation 1, estimated for the time period 2011-2016. The dependent variable is annual growth rate of gross loans. *post* is a dummy variable that takes a value 1 for years 2015 and 2016. *exposure* measures foreign currency exposure of each bank, defined as the difference between the share of foreign currency liabilities and assets in total liabilities and assets respectively. Column (1) does not contain bank- and country-level controls, column (2) adds bank-level controls, column (3) adds country-level controls, and column (4) add interactions of bank characteristics with the *post* dummy, column (5) reports results after excluding big international banks, and column (6) reports results for foreign currency liability and foreign currency asset exposure separately. Standard errors are clustered at the bank level and are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Dep. Var: loan growth	(1)	(2)	(3)	(4)	(5)	(6)
post	-2.568**	-0.716	-4.048	23.746	32.064	-3.639
	(1.263)	(1.624)	(19.196)	(26.010)	(26.943)	(32.128)
post × *exposure*	0.380**	0.399**	0.409**	0.263*	0.279*	
	(0.172)	(0.172)	(0.166)	(0.148)	(0.148)	
size		-18.932***	-24.395***	-23.678***	-22.633***	-27.973***
		(5.918)	(6.658)	(6.986)	(7.155)	(8.311)
capital to assets		-1.167	-1.252	-1.041	-0.989	-0.987
		(0.829)	(0.847)	(0.812)	(0.810)	(1.691)
liquidity		0.431***	0.372**	0.477***	0.494***	0.422***
		(0.163)	(0.163)	(0.145)	(0.149)	(0.128)
loans to deposits		-0.143*	-0.194**	-0.176*	-0.178*	-0.286**
		(0.080)	(0.092)	(0.099)	(0.100)	(0.143)
post × *size*				-2.827***	-2.893***	-3.527***
				(0.646)	(0.650)	(1.133)
post × *capital*				0.602	0.667	-0.188
				(0.447)	(0.490)	(0.661)
post × *liquidity*				0.214	0.176	0.263*
				(0.160)	(0.193)	(0.150)
post × *loans to deposits*				0.053	0.035	0.364***
				(0.121)	(0.131)	(0.116)
gdp growth			10.511**	10.530**	10.647**	0.464
			(4.950)	(4.959)	(5.034)	(5.881)
policy rate			-9.769	-7.110	0.117	-18.780
			(25.721)	(24.972)	(25.198)	(39.066)
post × *foreign liab*						0.665***
						(0.250)
post × *foreign assets*						-0.429**
						(0.203)
Observations	564	564	564	564	552	564
R-squared	0.472	0.546	0.555	0.585	0.538	0.750
No. of banks	100	100	100	100	98	100
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	No	Yes	Yes	Yes	Yes	Yes
Macro Controls	No	No	Yes	Yes	Yes	Yes
Bank Controls X Post	No	No	No	Yes	Yes	Yes
Sample	All	All	All	All	Exclude Big Banks	All

Table 3: **Types of Lending**

This table reports estimates from equation 3, estimated for 2015. The dependent variable is annual growth of mortgage loans, inter-bank loans, customer loans, unsecured loans, and secured loans in column (1), (2), (3), (4), and (5) respectively. The main variable of interest is exposure computed as the difference in share of foreign liabilities and assets. All columns include bank-level controls: size, equity to assets, liquidity, and loans to deposits (in 2014). Robust standard errors are are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1) Mortgage Loans	(2) Inter-bank Loans	(3) Customer Loans	(4) Unsecured Loans	(5) Secured Loans
Net Exposure	0.0654*	-0.0470	0.1738**	0.0456	0.0442*
	(0.033)	(0.179)	(0.074)	(0.089)	(0.023)
size	1.3069	4.5682	-1.4545	0.6776	-1.6890
	(1.048)	(5.522)	(3.561)	(4.177)	(1.242)
capital to assets	-0.7733	-1.9753	2.5784	4.1187*	-0.0544
	(0.609)	(2.244)	(2.084)	(2.295)	(0.741)
liquidity	-0.2334	0.2119	0.1669	-0.8893	-0.2307
	(0.236)	(0.679)	(0.452)	(0.535)	(0.198)
loans to deposits	-0.2782**	-0.3305	-0.1514	-0.5566*	-0.2329*
	(0.132)	(0.418)	(0.292)	(0.296)	(0.121)
Observations	75	91	91	91	91
R-squared	0.404	0.178	0.239	0.146	0.206

Table 4: **Channels of Transmission**

This table reports the estimates from equation 1. In column (1), the dependent variable is one-year change in net income, in column (2), the dependent variable is one-year difference in net interest income, in column (3), the dependent variable is one-year difference in non interest income, In column (4), the dependent variable is one-year difference in trading income. Column (4) reports results only for the cross-section of banks in 2015 since data on trading income is hand-collected. Outcome variables in all columns are scaled by lagged size. All columns include bank-level control variables. Robust standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1) $\Delta NetIncome$	(2) $\Delta IntInc$	(3) $\Delta NonintInc$	(4) $\Delta TradingIncome$
Post	-0.0658	0.0040	-0.1390*	
	(0.066)	(0.029)	(0.075)	
Exposure				0.0056***
				(0.001)
Post × *Exposure*	0.1141*	0.0249	0.1299*	
	(0.058)	(0.028)	(0.067)	
size	-0.3044	-0.0448	-0.3865	-0.0147
	(0.246)	(0.047)	(0.245)	(0.013)
capital to assets	-0.0129	-0.0078	-0.0081	-0.0043
	(0.020)	(0.007)	(0.018)	(0.006)
liquidity	-0.0024	-0.0005	0.0047	-0.0003
	(0.005)	(0.001)	(0.003)	(0.002)
loans to deposits	-0.0045	-0.0012	-0.0040	-0.0005
	(0.004)	(0.001)	(0.003)	(0.001)
Observations	564	564	564	55
R-squared	0.026	0.026	0.088	0.111
Bank Fixed Effects	Yes	Yes	Yes	No

Table 5: **Robustness: Narrative Analysis**

This table reports the estimates from equation 4, estimated for the cross-section of 53 banks in 2015. In column (1) and (4), the dependent variable is loan growth, defined as yearly change in outstanding loans. Qualitative Measure is a dummy variable that takes a value 1 for banks which reported as being positively affected by the currency shock and 0 for banks which were negatively affected by the shock. In column (2) and (5), the dependent variable is one-year change in profits (normalized by assets in 2014), in column (3) and (6), the dependent variable is one-year difference in net income (normalized by assets in 2014). Columns (1), (2), and (3) do not control for bank-level variables while column (4), (5), and (6) include bank-level controls. Size is defined as the log of bank assets in 2014, capital to assets is the ratio of total capital to assets in 2014, and liquidity is the ratio of liquid assets to total assets in 2014, and loans to deposits is the ratio of loans to deposits in 2014. Standard errors clustered at the bank level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1) loan growth	(2) $\Delta Profit$	(3) $\Delta Income$	(4) loan growth	(5) $\Delta Profit$	(6) $\Delta Income$
Qualitative Measure	4.4046*	0.2103**	0.1641**	3.7200*	0.1826**	0.1438**
	(2.505)	(0.090)	(0.077)	(2.142)	(0.081)	(0.068)
size				-1.5316**		
				(0.609)		
capital to assets				-0.0954	-0.0030	-0.0017
				(0.501)	(0.015)	(0.014)
liquidity				0.2077**	-0.0026	-0.0022
				(0.082)	(0.004)	(0.003)
loans to deposits				0.1584***	-0.0006	-0.0006
				(0.056)	(0.002)	(0.002)
Observations	53	53	53	53	53	53
R-squared	0.081	0.160	0.135	0.323	0.191	0.161
Bank Controls	No	No	No	Yes	Yes	Yes

Table 6: **Robustness: Alternate Measures of Exposure**

This table reports the estimates from equation 1, estimated for the time period 2014-2016, for different measures of exposure. The dependent variable is annual loan growth in all columns. In column (1), the measure of foreign currency exposure is calculated as the difference between foreign currency liabilities and assets, where foreign assets and liabilities are characterized on the basis of foreign currency rather than domicile. In column (2), the measure of exposure is computed after taking off-balance sheet exposures for each foreign currency into account. In column (3), the measure of exposure is constructed by regressing daily bank returns on changes in exchange rate and broad stock market index. All columns include bank-level control variables and bank-fixed effects. Standard errors are clustered at the bank level and are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1) loan growth	(2) loan growth	(3) loan growth
Post	-5.2309**	-3.3656	-7.7388**
	(2.409)	(3.611)	(3.389)
Post × *Exposure*	0.2980*		
	(0.157)		
Post × *Exposure*		0.1114**	
		(0.048)	
Post × *Exposure*			0.0112*
			(0.006)
size	-6.5666	-12.6720	-17.7960
	(16.598)	(17.982)	(23.013)
capital to assets	3.7465	0.8484	-0.7130
	(2.402)	(1.219)	(2.973)
liquidity	0.5260**	0.5008*	0.9625*
	(0.202)	(0.270)	(0.528)
loans to deposits	-0.4406*	-0.2793	0.0653
	(0.255)	(0.243)	(0.169)
Observations	196	152	62
R-squared	0.176	0.130	0.164
Bank FE	Yes	Yes	Yes
Exposure Measure	Currency	Hedged	Stock Returns

Table 7: **Robustness: Other**

This table reports the results for robustness tests discussed in section 5.4.3 Column (1) reproduces the results from baseline specification (column (4) from table 2) for comparison. Column (2) estimates equation 1 for a smaller window around the currency shock – 2014 - 2016. Column (3) adds lagged loan growth as a control variable, column (4) drops loans to deposits from the set of controls, column (5) has one-year change in net interest revenue as the dependent variable. All columns include bank-level controls and bank fixed effects. Standard errors clustered at the bank level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1) loan growth	(2) loan growth	(3) loan growth	(4) loan growth	(5) Δ Net Interest Revenue
post	23.746	56.952**	-133.715	32.727*	73.577*
	(26.010)	(26.374)	(91.816)	(18.804)	(38.608)
post × *exposure*	0.263*	0.367**	0.263*	0.264*	0.025
	(0.148)	(0.166)	(0.156)	(0.157)	(0.262)
size	-23.678***	-57.394***	-23.858***	-22.307***	61.839**
	(6.986)	(12.197)	(8.202)	(6.721)	(30.189)
capital to assets	-1.041	1.543	-0.601	-1.178	0.665
	(0.812)	(1.017)	(0.720)	(0.828)	(1.537)
liquidity	0.477***	0.493***	0.494***	0.566***	0.129
	(0.145)	(0.181)	(0.149)	(0.133)	(0.311)
loans to deposits	-0.176*	-0.456**	-0.307**		-0.282
	(0.099)	(0.185)	(0.122)		(0.309)
post × *size*	-2.827***	-2.568***	-2.601***	-2.831***	-4.912*
	(0.646)	(0.772)	(0.638)	(0.651)	(2.527)
post × *capital*l	0.602	0.099	0.303	0.707	-0.173
	(0.447)	(0.592)	(0.443)	(0.470)	(0.972)
post × *liquidity*	0.214	0.262*	0.127	0.148***	-0.010
	(0.160)	(0.158)	(0.119)	(0.054)	(0.325)
post × *loans to deposits*	0.053	0.144	0.011		0.192
	(0.121)	(0.109)	(0.089)		(0.298)
lagged dep. var.,			0.160**		
			(0.074)		
Observations	564	291	564	564	564
R-squared	0.585	0.754	0.613	0.579	0.970
No. of banks	100	100	97	100	100
Bank FE	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes	Yes
Specification	Original	Smaller Window	Lagged Dep. Var	Controls	Interest Rate Exposure

Table 8: **Bank Dependence and Investment**

This table reports the estimates for equation 6. In column (1) and (2), the dependent variable is Investment. In column (3), the dependent variable is leverage. All columns include firm-level controls. Standard errors are clustered at firm-level in column (1) at at canton-level in column (2) and (3) since the main variable of interest - canton level measure of foreign currency exposure varies at the canton level. *** p<0.01, ** p<0.05, * p<0.1.

	(1)	(2)	(3)
	Inv	Inv	Inv
Post	-0.5305*	-1.3206***	-0.6309
	(0.319)	(0.484)	(0.401)
$Post \times Exporter$	-1.8400**		
	(0.000)		
$Post \times BankExposure$		1.0226*	
		(0.567)	
$Post \times ForeignDebt$			-0.5343
			(0.829)
Q	1.1787***	1.0595***	1.1594***
	(0.352)	(0.340)	(0.348)
Cash to assets	8.2713**	8.3083**	8.9946**
	(3.646)	(3.625)	(4.512)
size	1.9401	1.9711*	3.0972***
	(1.175)	(1.169)	(1.107)
Lagged dep. var	0.0165***	0.0146***	0.0151***
	(0.004)	(0.003)	(0.003)
Observations	702	702	702
R-squared	0.296	0.302	0.061
Firm FE	Yes	Yes	Yes

Table 9: **Macroeconomic Analysis**

This table reports the estimates for equation 6. The dependent variable is year-over-year difference in quarterly real GDP. $\Delta NEER$ is the quarterly growth in nominal effective exchange rate (lagged one quarter), *Exposure* is a dummy variable that takes a value 1 if the banking sector has more foreign currency liabilities than foreign currency assets. All columns include country-level control variables, country fixed effects and time fixed effects. Column (1) reports results for the entire sample, column (2) presents results for the sub-sample of advanced economies, column (3) shows results for the sub-sample of emerging markets. Standard errors clustered at the country level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1) $\Delta RGDP$	(2) $\Delta RGDP$	(3) $\Delta RGDP$
$\Delta NEER$	-0.0387*	-0.0712*	-0.0181
	(0.023)	(0.035)	(0.022)
Exposure	-0.5504*	-0.1036	0.0845
	(0.291)	(0.326)	(0.373)
$\Delta NEER \times Exposure$	0.1576***	0.1084*	0.1408***
	(0.032)	(0.053)	(0.031)
Observations	2,883	1,873	1,010
R-squared	0.436	0.475	0.538
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Sample	All	Advanced Economies	Emerging Markets

Figures

Figure 1: **Channels of Transmission**

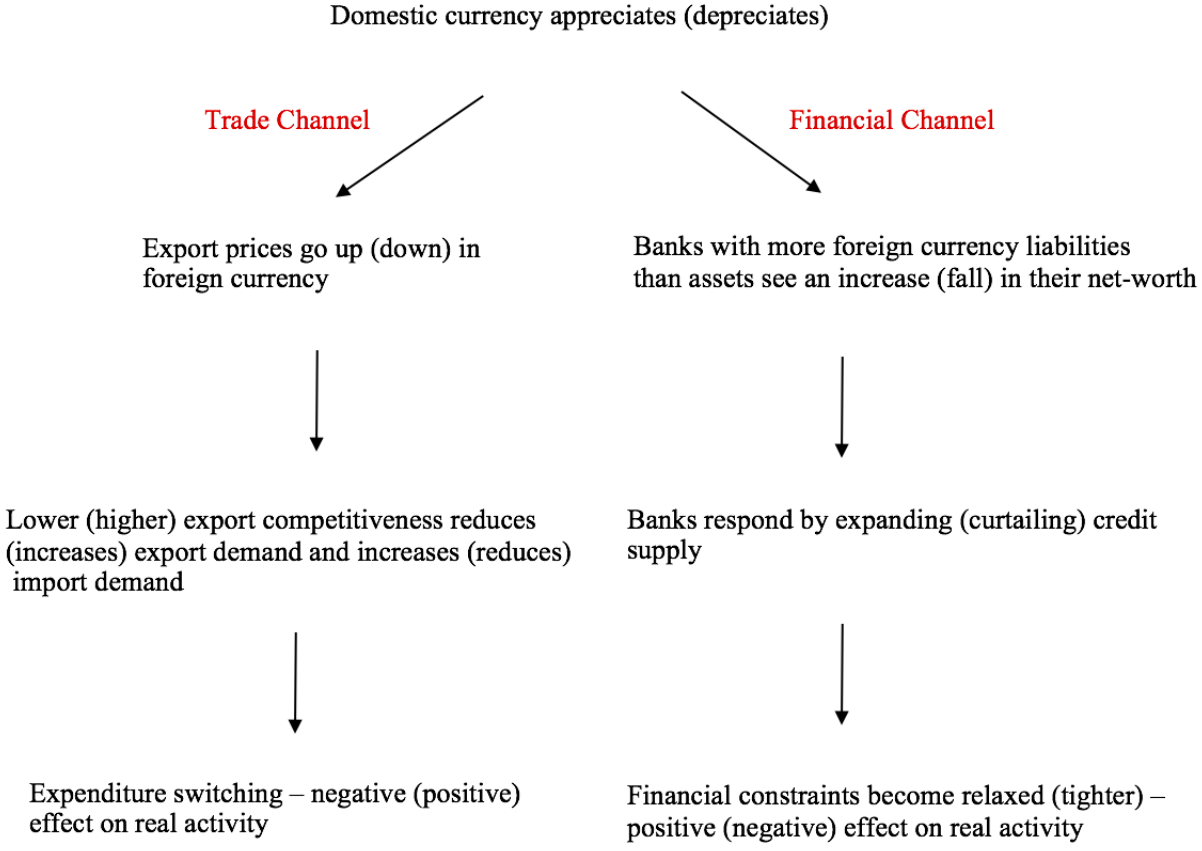
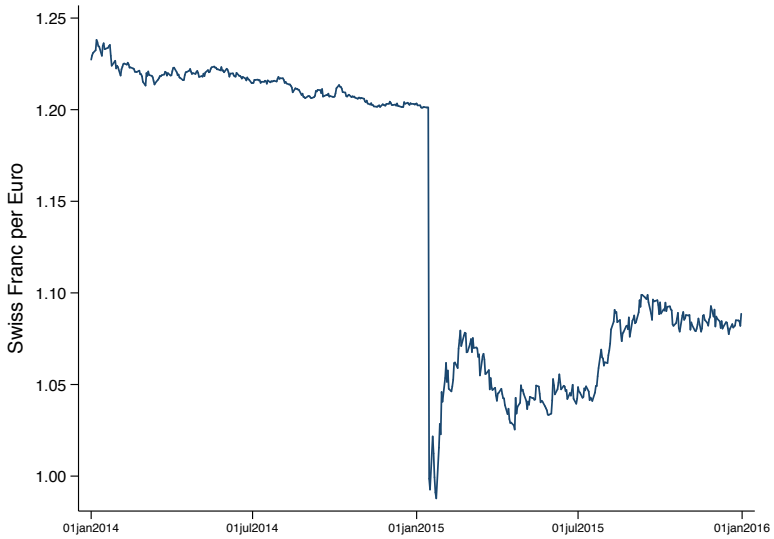
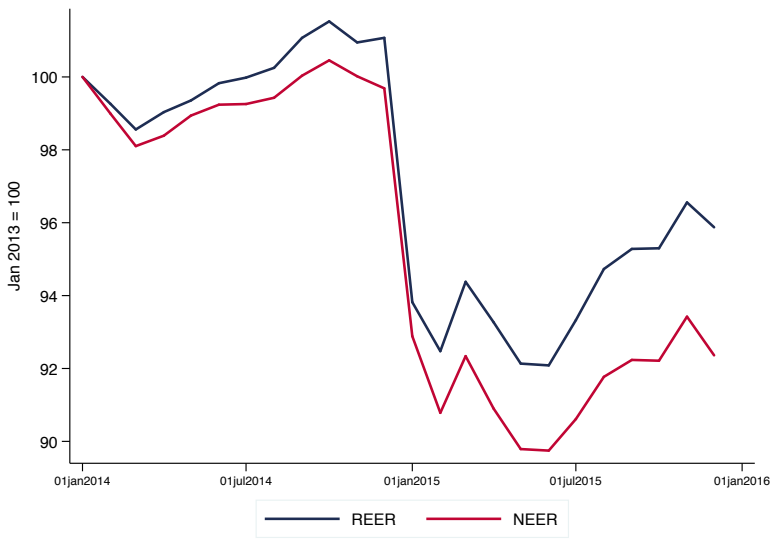


Figure 2: **The Jan 2015 Siwss Franc Appreciation Episode**

Panel (a) of this figure shows the daily exchange rate between the Swiss Franc and the Euro for the 2014-2015 period. The floor of 1.20 Swiss Franc per Euro was removed on January 15, 2015. Panel (b) of this figure shows the monthly trade weighted real and nominal exchange rate of Swiss franc for the period 2014-2015. Note: a fall in effective exchange rate is appreciation of home currency.



(a) Bilateral Exchange Rate



(b) Effective Exchange Rate

Figure 3: Sport and Forward Exchange Rate: CHF/EUR

This figure shows the daily spot and on-month forward exchange rates between the Swiss franc and the euro. Note: a fall in exchange rate is appreciation.

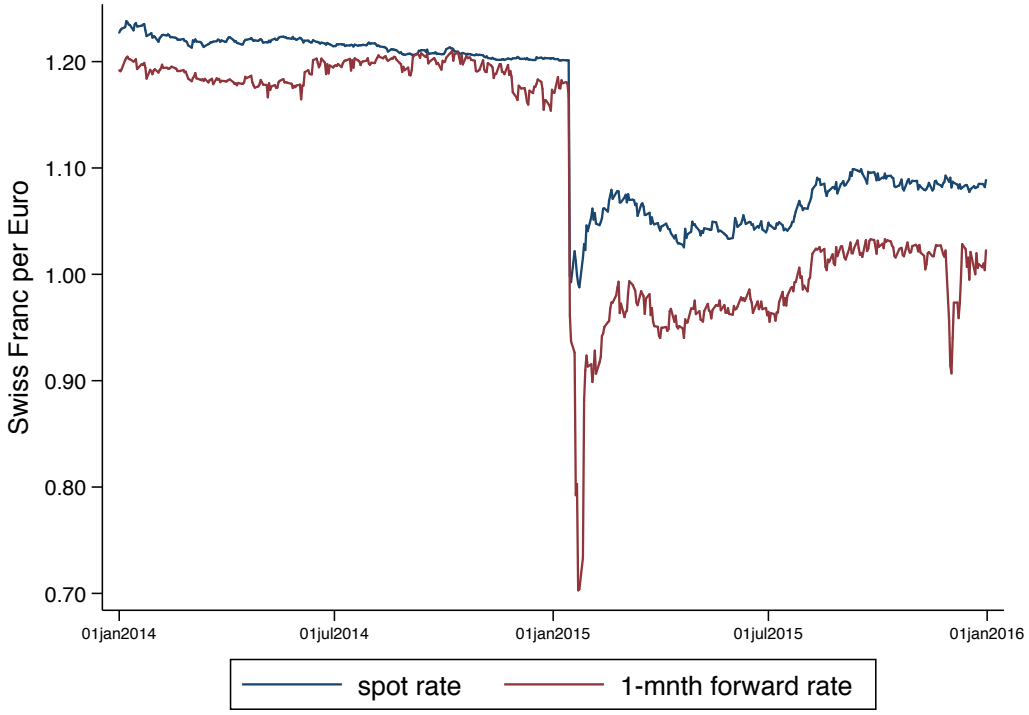


Figure 4: **Parallel Trends**

This figure plots the γ_t coefficients from equation 2. The blue diamonds represent the point estimates and the vertical lines around them reflect 95 percent confidence bands. The dashed green line marks the beginning of the Swiss franc appreciation episode.

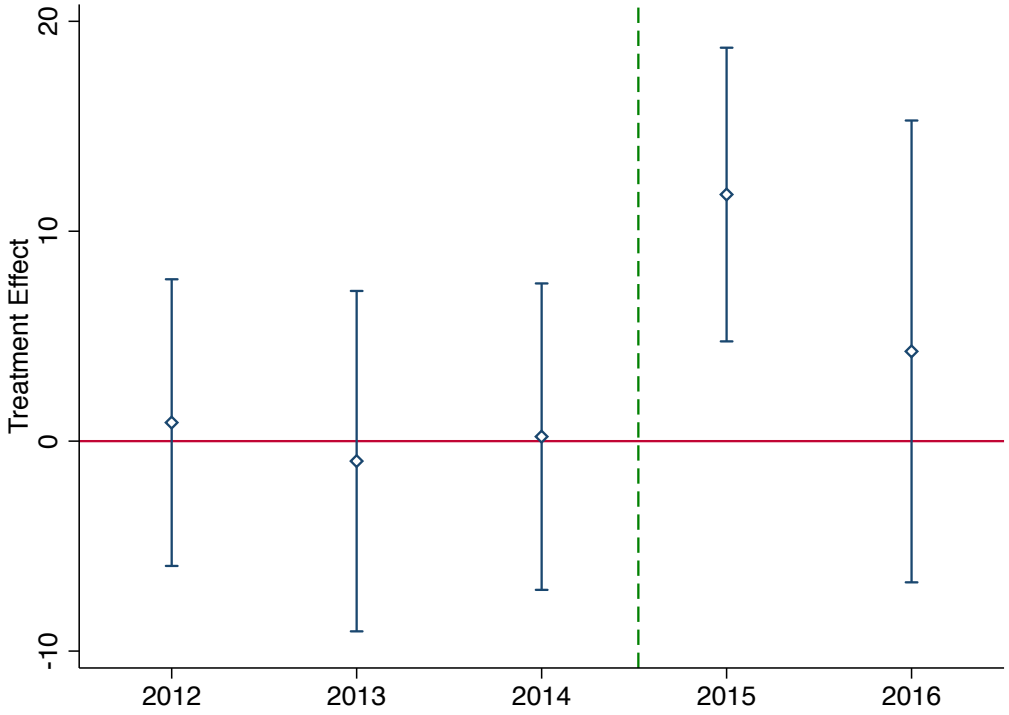


Figure 5: **Alternate measures of exposure**

This figure plots the distribution of alternative foreign currency measures. The top panel plots the exposure measure based on foreign vs domestic currency while the bottom panel plots the exposure measure after taking into account off-balance sheet positions.

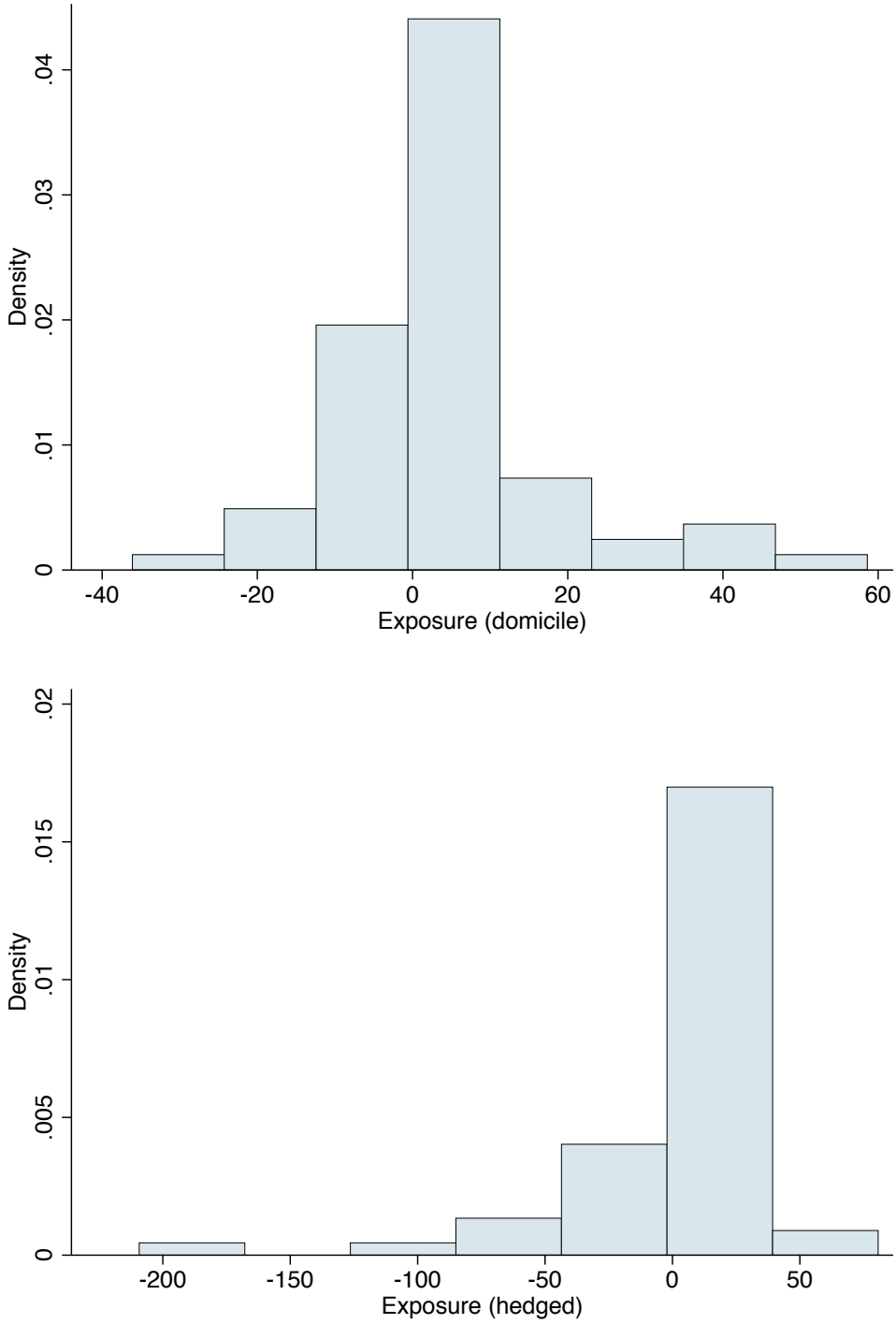


Figure 6: **Real Effects: Sales Growth, Employment Growth, and Return on Equity**

This figure plots the coefficients γ_t from equation 5 for sales growth, employment growth, and difference in return on equity. The red dashed lines indicate the beginning of the currency appreciation event. The blue vertical bars around point estimates represent 90 percent confidence intervals.

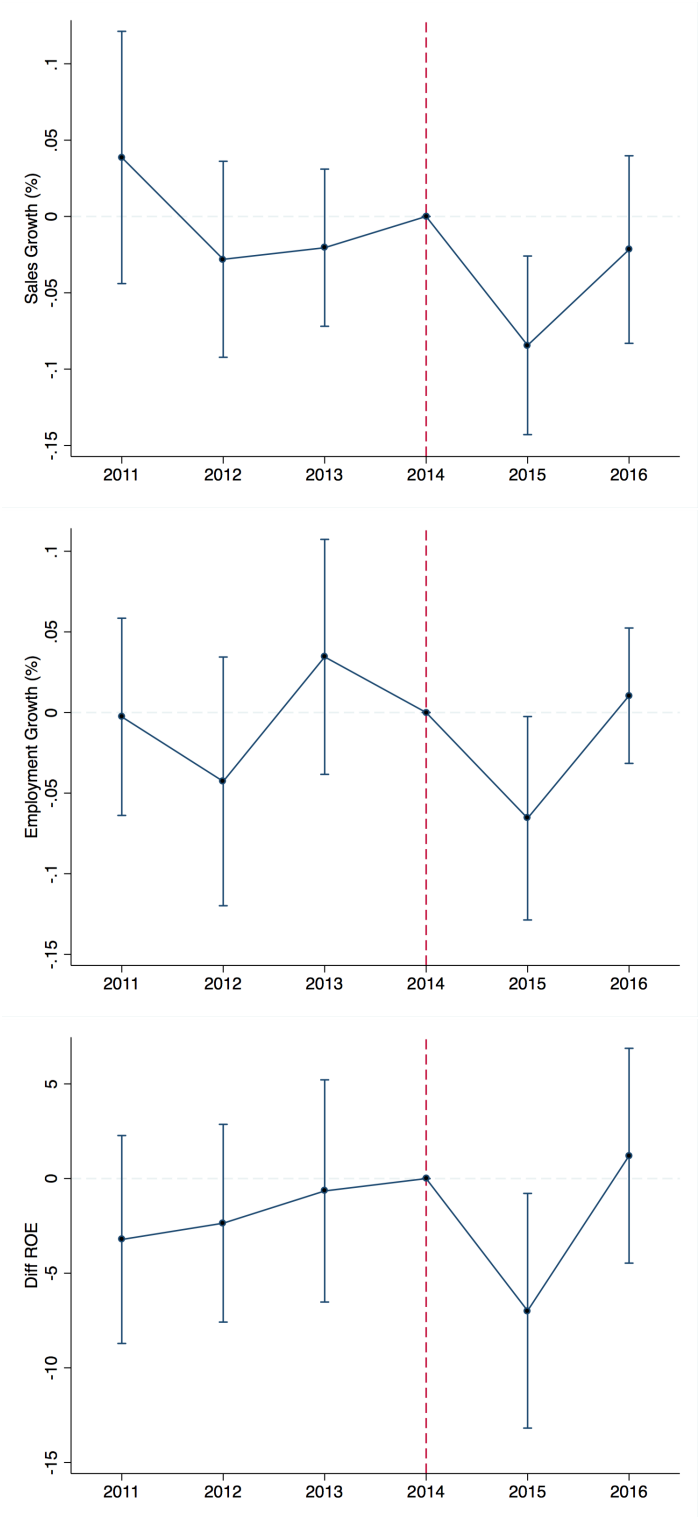


Figure 7: **Real Effects: Investment**

The top panel of this figure shows evolution of investment rates for exporters and non-exporters. The bottom panel shows the coefficients γ_t from equation 5 for investment. The red dashed lines indicate the beginning of the currency appreciation event. The blue vertical bars around point estimates represent 90 percent confidence intervals.

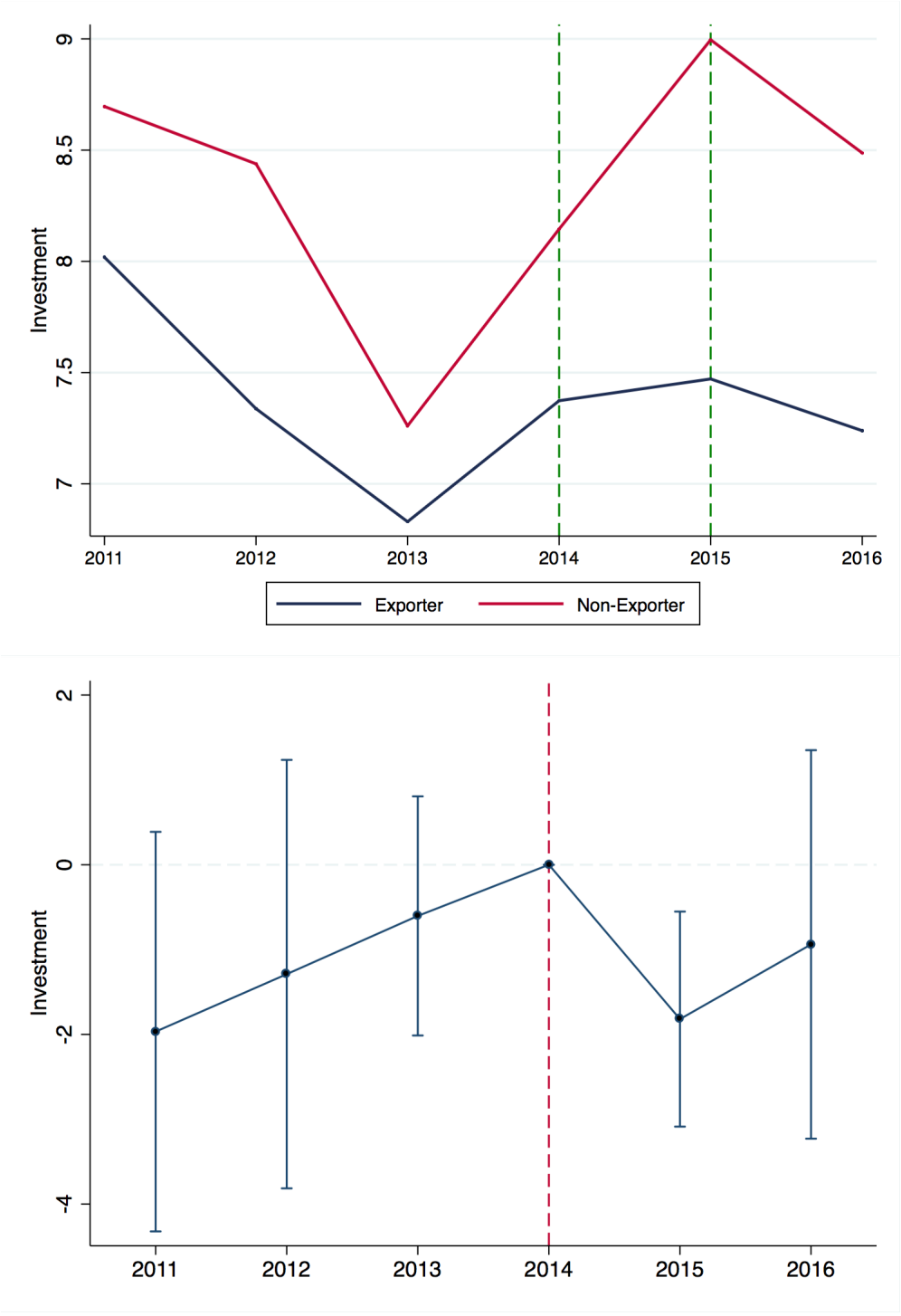
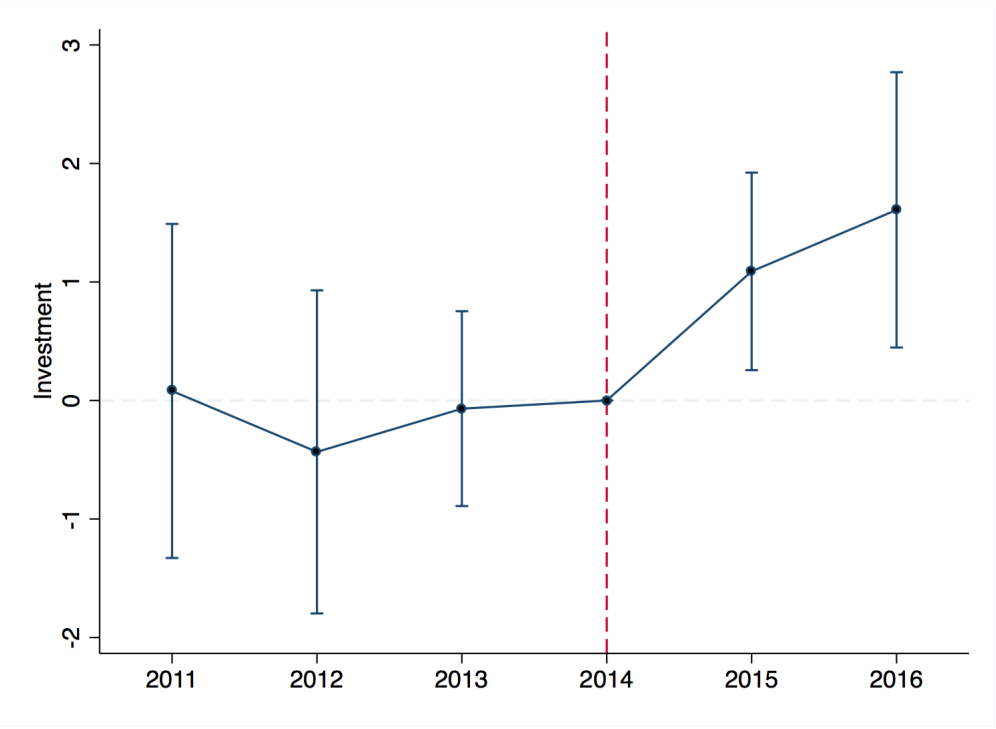


Figure 8: **Credit Supply and Investment**



Data Appendix

Table 10: **Country List**

This table list the countries used in the analysis in section 5.7. IMF's classification of advanced and emerging markets is used to define country groups in the sample.

Country	Emerging/Advanced	Country	Emerging/Advanced
Argentina	Emerging	Japan	Advanced
Australia	Advanced	Korea	Emerging
Austria	Advanced	Luxembourg	Advanced
Belgium	Advanced	Malaysia	Emerging
Brazil	Emerging	Netherlands	Advanced
Canada	Advanced	New Zealand	Advanced
Chile	Emerging	Norway	Advanced
China	Emerging	Peru	Emerging
Colombia	Emerging	Philippines	Emerging
Czech Republic	Emerging	Poland	Emerging
Denmark	Advanced	Portugal	Advanced
Finland	Advanced	Russia	Emerging
France	Advanced	Saudi Arabia	Emerging
Germany	Advanced	Singapore	Emerging
Greece	Advanced	South Africa	Emerging
Hong Kong SAR	Emerging	Spain	Advanced
Hungary	Emerging	Sweden	Advanced
India	Emerging	Switzerland	Advanced
Indonesia	Emerging	Thailand	Emerging
Ireland	Advanced	Turkey	Emerging
Israel	Emerging	United Kingdom	Advanced
Italy	Advanced	United States	Advanced

Table 11: **Variable Definitions**

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

Variable	Definition	Source
Loan Growth	Yearly growth rate of outstanding gross loans	Bankscope
$\Delta Profit$	One year difference in profits before tax, normalized by lagged assets	Bankscope
$\Delta NetIncome$	One year difference in net income, normalized by lagged assets	Bankscope
Size	Log of total assets	Bankscope
Capital to assets	Ratio of total capital to total assets	Bankscope
Liquidity	Ratio of liquid assets to deposits and short-term funding	Bankscope
Loans to Deposits	Ratio of gross loans to total deposits	Bankscope
Assets	Total assets of the firm	Worldscope
Sales	Total Sales of the firm	Worldscope
Employment	Includes both full time and part-time workers of the firm	Worldscope
Market Capitalization	Annual close price $\times$ number of shares outstanding	Worldscope
Investment	Change in capital expenditure (scaled by lagged property, plant, and equipment)	Worldscope
Return on Equity	Profitability Ratio - Net Income divided by lagged common equity	Worldscope
Leverage	Total Debt as a percentage of total capital	
Tobin's Q	Price to book ratio	Worldscope
Cash-to-assets	Cash and equivalents divided by total assets	Worldscope
Bank Debt to Capital	Ratio of total bank debt to total capital	Capital IQ
$\Delta RGDP$	Year-over-year percent growth in quarterly real GDP (%)	IMF IFS Database
$\Delta NEER$	Quarterly growth of Nominal Effective Exchange Rate (%)	Bank for International Settlements
Policy Rate	Central Bank Policy Interest Rate (%)	Global Financial Database

Table 12: **Policy Rates**

This table provides information on different policy rates used for each country in the sample.

Country	Policy Rate
Argentina	Argentina Reserve Bank Discount Rate
Australia	Australia Reserve Bank Overnight Cash Rate
Austria	Austria Central Bank Discount Rate
Belgium	Belgium Central Bank Discount Rate
Brazil	Brazil Central Bank Discount Rate
Canada	Bank of Canada Discount Rate
Chile	Chile Central Bank Minimum Interest Rate
China	China Central Bank Discount Rate
Colombia	Colombia Bank of the Republic Intervention Rate
Czech Republic	Czech Republic Central Bank Deposit Facility
Denmark	Denmark National Bank Discount Rate
Finland	Finland Central Bank Discount Rate
France	Bank of France Discount Rate
Germany	Germany Berlin Bundesbank Discount Rate
Greece	Bank of Greece Discount Rate
Hong Kong	Bank of Hong Kong Best Lending Rate
Hungary	Hungary National Bank Deposit Rate
India	India Reserve Bank Discount Rate
Indonesia	Indonesia 1-month SBI Certificates Discount Rate
Ireland	Bank of Ireland Repo Rate
Israel	Bank of Israel Discount Rate
Italy	Bank of Italy Discount Rate
Japan	Bank of Japan Discount Rate
Korea, Republic Of	Bank of Korea Discount Rate
Luxembourg	Luxembourg Interbank Offer Rate
Malaysia	Malaysia Bank Negara Discount Rate
Netherlands	Netherlands Bank Repo Rate
New Zealand	New Zealand Reserve Bank Official Cash Rate
Norway	Bank of Norway Overnight Lending Rate
Peru	Central Bank of Peru Discount Rate
Philippines	Philippines Central Bank Discount Rate
Poland	Poland Central Bank Refinancing Rate
Portugal	Bank of Portugal Discount Rate
Russian Federation	Russia Central Bank Refinancing Rate
Saudi Arabia	Saudi Arabia Repo Rate
Singapore	Singapore 3-month SIBOR
South Africa	South Africa 3-month JABIR
Spain	Bank of Spain Discount Rate
Sweden	Sweden Riksbank Repo Rate
Switzerland	Switzerland National Bank Discount Rate
Thailand	Bank of Thailand Lending Facility Rate
Turkey	Turkey Central Bank Discount Rate
United Kingdom	Bank of England Base Lending Rate
United States	USA Federal Funds Rate Market Rate