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FX intervention and domestic credit in a partially dollarized economy: Evidence using microdata from Peru.

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FX intervention and domestic credit in a partially dollarized economy: Evidence using microdata from Peru.

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Abstract

In this work we study the impact of FX interventions on Credit growth in Peru. Using Panel data at the firm-bank level from the Peruvian Credit Registry we find that purchases of dollars by the Central Bank are associated with reductions on the stock of credit held by Medium, Big and Corporate Firms in the Peruvian economy. We also found that the impact is stronger for firms with a higher level of debt dollarization. These results suggest that FX interventions can be seen as an additional tool for Financial stability, especially in times of large inflows of capital.

Keywords: FX intervention; Credit registry; Emerging markets; Credit growth.

JEL: E58, F31, F33, G20

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1 Introduction

In the past few decades, financial integration around the world and changing global financial conditions have posed new challenges to policy makers across the world, particularly for emerging market economies. To address these challenges, policymakers in these countries have implemented a mix of policy tools, including macro-prudential measures, capital controls and foreign exchange (FX) interventions. The objective of these measures is to mitigate the impact of significant capital inflows and sudden stops. Unfortunately, the effectiveness of these tools are still under debate and more research is needed to have a better assessment on the use of these policy tools. The evidence has been particularly difficult to find in the case of FX interventions, due to serious endogeneity problems that hinder the identification of its effects, especially on the exchange rate.

Many central banks in emerging markets have relied on FX interventions to smooth the effects of rapidly shifting capital flows (Ghosh et al, 2018) and to reduce exchange rate volatility while providing businesses and households with insurance against exchange rate risks. Moreover, foreign currency debt in emerging markets economies have been increasing, making those countries more exposed to global financial flows, and therefore financial stability has become an important motive for FX interventions.

While individual country studies report mixed results on the effectiveness of FX intervention, cross-country studies generally find some effectiveness in curbing financial conditions and exchange rate dynamics (Ghosh et al (2018), Villamizar-Villegas and Perez-Reyna (2017), Fratzscher et al (2018)). Recent empirical findings have shed some light on how FX intervention reduces the impact of capital flows on domestic financial conditions. For instance, Blanchard et al. (2015) show that capital flow shocks have significantly smaller effects on exchange rates and capital accounts in countries that intervene in Forex markets on a regular basis.

We propose to contribute to this literature by estimating the effect of Forex intervention on credit growth for the Peruvian economy. The Peruvian case can be of interest since the financial system is characterized for being partially dollarized and the Central Bank intervenes very often in the FX markets. To achieve our goal we will follow Hoffman et al (2019) and Hofmann et al (2021) as they also estimate a similar relationship for Colombia. According to Hoffman et al (2019), sterilized Forex intervention has two mutually reinforcing effects on credit growth: on one hand, it counteracts the increase in bank lending after a dollar appreciation , know as the risk-taking channel of the exchange rate; and, on the other hand, there is a "crowding out" of bank lending whenever there is an increase in the supply of domestic bonds to be absorbed by banks after the

Central Bank sterilizes the FX intervention. The aggregate impact of FX intervention results from the mixture of these two effects.

The rest of the work proceeds as follows. Section 2 introduces a simplified model elucidating the principal channels through which sterilized FX interventions are anticipated to impact credit growth in the economy. In this section, we also present two key predictions of the model that will be tested empirically: **i.** The existence of a negative correlation between FX purchases by the Central Bank and Credit, and **ii.** The amplification of this effect in firms with higher levels of debt dollarization. Section 3 briefly outlines the Peruvian context and provides an overview of the data employed in the empirical analysis. Section 4 outlines the empirical strategy employed to assess our hypotheses, while Section 5 presents the results. Finally, we conclude in Section 6.

2 Model

In order to explain the main mechanisms through which FX interventions might affect credit growth we present and describe a simple model first developed in Hofmann et al (2021)[1]. This model aims to clarify how banks allocate credit to firms and the subsequent influence of FX interventions and exchange rate fluctuations on the volume of loans extended to these firms. The model consists of two key components: a basic theory of loan demand and a theory of bank credit supply, both grounded in the context of banks functioning under Value-at-Risk constraints. Once we presented the model, we describe its analytical predictions regarding the impact of FX interventions on credit. While the main section of the text focuses on the core aspects of the model, detailed proofs for the propositions can be found in Hofmann et al (2021).

2.1 Loan Demand

It is assumed that there is a continuum of risk-neutral borrowers that invest in a project. Each project uses one unit of labor and one unit of fixed capital that is funded with loans from the banks at period 0 denoted in the national currency (at an interest rate r that is assumed to be exogenous). The project realization and repayment is due at period 1. Borrowers are also assumed the have an existing debt of one dollar that is subject to valuation effects of exchange rate changes. The dollar value of the national currency at period 0 is denoted θ and the project value V_1 follows the Merton (1974) model of credit risk. More specifically, the value of the project

[1] In this section we closely adhere to the model's exposition as delineated in Hofmann et al. (2021). This model, in turn, was developed based on the banking model of Bruno and Shin (2015).

at period 1 is given by equation 1.

$$V_1 = exp\{1 - \frac{s^2}{2} + sZ_j\} \tag{1}$$

Where s is a constant and Z_j is a standard normal given by the linear combination of two mutually independent standard normals X_j and Y ($Z_j = \sqrt{\rho}Y + \sqrt{1-\rho}X_j$) that represent the common risk factor (Y) and the borrower j's idiosyncratic risk, respectively[2].

Therefore, the borrowers defaults when the realization of his project is not enough to cover the loan repayment $(1 + r)$ and the valuation effects of his legacy debt in dollars (θ).

2.2 Credit Supply and Bank Capital allocation

There is a continuum of competitive banks and each bank has two units : a loan unit vested in extending credit to domestic firms in the national currency, and a bond unit which holds risk-free sovereign bonds[3]. The bank allocates capital to the two units in order to maximize its total profits subject to Value-at-Risk constraints. For the loan unit, the bank lends to many firms and can diversify away idiosyncratic credit risk.

Proposition 1: the c.d.f. of the bank's loan portfolio is lower when the national currency is stronger.

Proof for proposition 1 is found in Appendix A on Hofmann et al (2019). As explained by these authors, the main message from proposition 1 is that banks can diversify away idiosyncratic risk for individual firms, but they are not able to fully diversify away the tail risk due to the existence of the common risk component Y. In that context, the appreciation of the national currency against the dollar would imply a reduction in individual firms default and has the effect of reducing tail risk given that the balance sheet of the debtor improves with the appreciation of the national currency. Therefore, a bank that is subject to Value-at-Risk constraints responds to the appreciation of the national currency by providing more credit to firms.

Now we turn to the bank's portfolio choice between loans and bonds. The total capital for each bank (E^i) is divided between the two divisions:

$$E_i^B + E_i^C = E_i \tag{2}$$

[2]The parameter ρ represents the weight given to the common factor and is bounded between zero and one

[3]For the Peruvian case this would include Central bank's papers: Deposit certificates-CDBCRP, among other instruments

Where C stands for credit and B for bonds. The loan unit is assumed to be subject to the Value-at-Risk constraint that states that the probability of loan losses should not be higher than the capital allocated to the unit loan by some positive and constant probability α. If we denote L_i the non-equity funding amount[4] and F(.) the c.d.f. of the banks loan portfolio, the Value-at-Risk constraint is given by the following expression: $F((1 + f)L_i) \leq \alpha$.

Proposition 2: Total credit (C_i) granted by bank i can be represented as $C_i = \lambda(\theta)E_i^C$, where $\lambda(.)$ is an decreasing function of the exchange rate θ and is identical for all banks.

Proof of Proposition is also found in Appendix B in Hofmann et al (2019). In other words, from proposition 2 we have that an appreciation of the national currency increases the total lending C_i for each unit of capital E_i^C. This result is explained by the fact that when the national currency appreciates, following proposition 1, the tail risk of the Loan portfolio shrinks, which, in turn, relaxes the Value-at-Risk constraint and allows the banks to lend more money to firms for each unit of capital.

2.3 Impact of FX interventions

As for the case of the loan unit, the model assumes that the bank's bond holdings is determined as a constant leverage factor μ of the capital allocated to the bond unit of the bank. Using equation 2 we have that the bond holding by bank i is given by the following equation:

$$B_i = \mu E_i^B = \mu(E_i - E_i^C) \tag{3}$$

Therefore, aggregate bond holding by the banking system is obtained by aggregating equation 3 across all banks. Similarly, the aggregate of loans by all banks in the economy can be obtained by summing up C_i following the result in preposition 2. Therefore we have the following expressions for the aggregate loan supply (C) and the aggregate bond holding by banking system (B).

$$\begin{aligned} C &= E^C\lambda(\theta) \\ B &= \mu(E - E^C) \end{aligned} \tag{4}$$

Therefore, combining the market clearing condition for bonds($B = \bar{B}$)[5] and Equations 4, we obtain an equation for the total lending of the banking sector to firms in the economy (Equation 5). Now, given that $\lambda(.)$ is an decreasing function of θ, this implies that appreciations of the

[4]That pays a fixed funding rate f.

[5]Assuming that the total stock of these bonds is held by the banks in the economy.

national currency increases the overall amount of credit provided to firms by the banking sector.

$$C = (E - \frac{\bar{B}}{\mu}).\lambda(\theta) \tag{5}$$

Now we turn to the analysis of FX interventions. In the context of large capital inflows to emerging market economies, many central banks have relied on FX interventions in order to smooth the exchange rate or to generate movements opposite to its trend in periods of extreme volatility in the foreign exchange market , as it was the case for the Peruvian economy for the period 2003-2015 (Duran, 2016). In the eyes of the model, FX interventions would affect the total credit to the economy through two main channels. First, FX purchases by the central Bank would depreciate the national currency, generating a reduction in the leverage ,λ, thus reducing domestic credit. This is the denoted Risk-taking channel. Second, the sterilization leg of the FX intervention would generate a crowding-out effect on domestic loans by increasing the stock of Sovereign bonds ($\bar{B}$), as follows from equation 5. Analytically, we have that the total impact of FX interventions is given by the following expression:

$$\frac{dC}{dFXI} = \frac{-\lambda(\theta)}{\mu}.\frac{d\bar{B}}{dFXI} + (E - \frac{\bar{B}}{\mu}).\lambda'(\theta)\frac{d\theta}{dFXI} < 0 \tag{6}$$

Where FXI denotes the amount of FX purchases by the Central Bank. Given that $\frac{d\bar{B}}{dFXI} < 0$ and $\frac{d\theta}{dFXI} > 0$, the model predicts a negative relationship between FX purchases by the central bank and the amount of credit given by the Banking sector. Besides, given that this relationship is explained, in part,by a balance sheet effect, this implies that the negative effect of FX purchases will be stronger for firms with a higher level of debt in dollars. These are the two predictions that we will test in the empirical part of this work.

3 Data

3.1 Loans

In the empirical analysis, we use monthly data for Peru for the period 2011-2019. The reason for excluding data before 2011 in our analysis is the unavailability of debtor-level information for that period information at the debtor level prior to that date. Likewise, we refrain from considering data from the post-2020 period due to the potential impact of the pandemic on the relationship between the variables of interest. We focus on loan information pertaining to Corporate firms, Big-size firms and Medium-size firms provided by the Peruvian Banking System. Specifically, we examine the stock of debt for each of those firms in local and foreign currency on a monthly basis. [6] This data is obtained from the *Reporte Crediticio Consolidado (RCC)*, the national credit bureau created by the *Superintendencia de Banca, Seguros y AFP* (SBS), the local bank supervisor.

Over the course of the past decade, credit dollarization has demonstrated a consistent downward trend. Specifically, by the end of 2019, the level of dollarization of the stock of debt for medium, big, and corporate firms stood at 48% of the total stock of debt. This indicates a substantial decline compared to the 70% level observed by the end of 2010. The decrease in credit dollarization suggests a shift towards a reduced reliance on foreign currency debt among these types of firms. Furthermore, the stock of loans in dollars only grew 3,8 % annually on average during that period (6,1 % when converted to local currency), while the total stock of wholesale loans grew 10,5 %.

Table 1: Loan distribution, per type and currency (in millions, local currency)

Type of firm	Currency	Mean	Median	Quartile 3	Std. Desv	Number of Firms
Corporate Firms	Dollars	59.9	6.4	55.1	145.2	3,471
Corporate Firms	Soles	54.5	4.8	49.0	146.0	3,408
Large Firms	Dollars	9.9	1.9	9.1	26.0	20,577
Large Firms	Soles	7.0	1.1	5.9	19.5	19,533
Medium Firms	Dollars	1.3	0.4	0.9	6.5	138,439
Medium Firms	Soles	0.7	0.4	0.6	3.3	221,028

Source: RCC

3.2 FX intervention

Similar to the case in Colombia, the BCRP uses FX intervention in order to diminish the volatility of the USD/PEN exchange rate, due to the managed float regime in the country. This intervention can take place by buying or selling dollars in the spot market or by buying or selling FX swaps. In addition, for the intervention, the BCRP uses the *Certificado de Depósitos Reajustables* (CDR), an instrument issued in local currency with adjustments in its value according to the variation of the USD/PEN exchange rate, and the *Certificado de Depósitos Liquidables en Dólares* (CDLD), an instrument issued by the BCRP in local currency (at a fixed or variable interest rate) but paid and redeemed in foreign currency. The information concerning these interventions is sourced from the BCRP website.

During the period spanning 2011 to 2019, FX interventions were conducted in approximately 87%

[6] Corporate loans refer to loans to firms with annual sales greater than S/ 200 millions (approximately USD 50 millions), according to their audited annual financial statements. Big-size firms refer to those with sales between S/ 20 millions to S/ 200 millions (USD 5 to 50 millions), or those which have emitted debt instruments in the capital markets. Medium-size firms include firms with loan stock greater than S/ 300 000 (USD 75 000) and not classified as large-size firm or corporate.

of the months, accounting for 94 out of 108 months. Furthermore, within this timeframe, around 63% of these months exhibited net sales, with an average value of USD 1,735 million. In contrast, the remaining months displayed net purchases, averaging USD 913 million. It is noteworthy that a significant majority of these interventions involved purchases conducted within the spot market, while sales were predominantly executed using other instruments. We also use monthly data from banks, especially related to their financial statements, such as ROA, ROE, liquidity ratios, capital adequacy ratio (CAR), Non Performing Loans (NPL), etc. Those variables are obtained from the SBS public database. In addition, we use other additional variables, such as the exchange rate and the Monetary Policy interest rate (TIR).

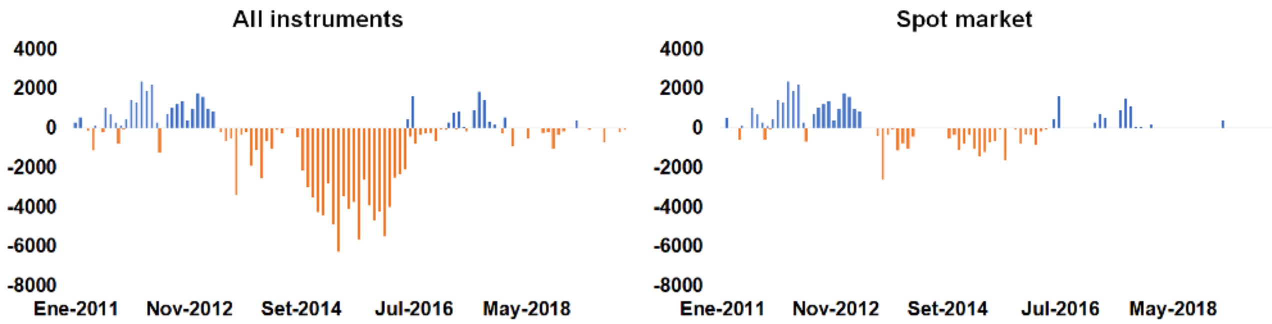

Figure 1: FX interventions. This figure shows the monthly sales and purchases of dollars by the Peruvian Central Bank in USD Millions. The right Figure shows the intervention in the spot market and the left figure shows the intervention considering all types of instruments.

Table 2: Indicators of banks' performance.

	Mean	Std. Desv	Quartile 1	Quartile 3	Median
CAR	14,5	0,7	14,0	15,1	14,5
NPL Total (%)	2,5	0,6	2,0	3,1	2,6
NPL Soles (%)	2,8	0,5	2,6	3,3	2,9
NPL Dollars (%)	2,0	0,7	1,2	2,6	2,3
ROE	20,9	2,0	18,9	22,1	20,6
ROA	2,1	0,1	2,0	2,2	2,1
Liq. Ratio Soles	33,9	8,6	27,0	38,5	29,8
Liq. Ratio Dollars	47,8	4,6	44,2	50,1	47,2
TIR	3,68	0,62	3,25	4,25	4,00
Exchange Rate	3,05	0,29	2,77	3,30	3,18

Source: RCC, BCRP

4 Empirical specification

The theoretical model outlined in section 2 yields two key predictions. First, it proposes a negative relationship between FX purchases carried out by the Central Bank and the growth of domestic credit. Second, it posits that the negative impact of FX interventions on credit growth is more pronounced for firms with higher levels of debt dollarization. In order to test whether these two predictions of the model are present in the Peruvian Economy we consider two different datasets and explore two different empirical specifications. To test the first hypothesis, we consider aggregate data at the economy level with a monthly frequency. To conduct this analysis, we employ the methodology of Local Linear projections (Jorda, 2005).

To test the second hypothesis we utilize microdata from the Peruvian Credit Registry. This particular dataset allows us to provide a more credible causal relationship between FX interventions and Credit growth. Given that the credit stock represents an equilibrium variable and our interest lies in evaluating the impact of FX interventions on the bank credit supply to firms, it becomes imperative to account for variations in credit demand across firms. By utilizing this dataset, we are able to control for certain sources of heterogeneity that were not feasible to address when analyzing data at the aggregate level. More specifically, we will narrow our focus to firms that have at least two bank relationships, following the methodology of Khwaja and Mian (2008) and Jimenez et al (2012).

4.1 Estimation approach with time series

To explore the relationship between FX interventions and Credit Growth at the macro level we run local linear projection regressions (Jorda (2005)) using data at the monthly level. The empirical specification is given by the following equation:

$$Y_{t+h} = \alpha_h + \lambda_h y_{t-1} + \beta_h FXI_{t-1} + \Psi_h X_{t-1} + \epsilon_{t+h} \tag{7}$$

Where the dependent variable Y_{t+h} represents the cumulative log change in the stock of credit (including both national and foreign currency) between the month "t" and "$t+h$". We consider 4 different credit measures : total credit, credit to corporate and big firms, credit to medium, big and corporate firms and mortgage credit. The equation 7 is estimated for various values of h (from 1 to 12) in order to evaluate the impact of FX interventions over the year following the intervention. To account for potential pre-trends in the evolution of credit, we include y_{t-1}, which represents the log change in credit in the month before the intervention, as a control variable. The main independent variable FXI_{t-1} represents the net purchases of dollars by the Central bank in the spot market. The error term is denoted as ϵ_t.

Equation 7 also incorporates an extensive set of control variables (denoted as the vector X_{t-1}) which aims to capture potential drivers influencing the FX interventions conducted by the Central Bank. In particular, we consider Macroeconomic controls such as the change in non-resident holdings of government bonds, which serves as a proxy for capital inflows; the change in the policy rate; the deviation in the inflation from the Central Bank's target level; and the change in the exchange rate (Soles per dollar). Additionally, we consider some other controls at the bank system level. It includes total assets, the share of liquid assets, the capital ratio and the fraction of non-performing loans.

4.2 Estimation approach with Loan level Panel data

Based on the theoretical model presented in section 2, it becomes clear that firm FX debt plays a central role in transmitting the effects of FX interventions on changes in credit provided to firms. This is because higher(lower) levels of exchange rate would generate that firms with debt in foreign currency are less (more) likely to repay their loans. This, in turn, will affect the willingness of banks to lend, with firms carrying higher levels of FX debt being particularly susceptible to this transmission channel. In this section, our objective is to assess this mechanism in more detail. Specifically, we aim to quantify how variations in firms' FX debt contribute to the transmission of FX interventions to firm loans. By examining this relationship, we can gain a better understanding of the specific impact and dynamics involved in the interaction between FX interventions and firms' borrowing activities.

To achieve this objective, we use data from the Peruvian Credit Registry (RCC), which provides monthly information for the stock of debt of every firm with each bank in the financial system. We construct a panel data at the bank-firm level for the stock of debt[7], including both national and foreign currency. Since the evidence in the previous section shows that the impact is higher for bigger firms, we exclude from the analysis small and micro firms, leaving in our sample only medium sized, big and corporate firms. The empirical specification is given by the Equation 8:

$$\begin{gathered} Y_{f,b,t+h} = \alpha_{b,y} + \alpha_{s,h} + \alpha_{f,h} + \lambda_h y_{f,b,t-1} + \\ \beta_h^R FXI_{t-1} D_{f,b,t-1} + \beta_h D_{f,b,t-1} + \Psi_h X_{b,t-1} + \epsilon_{f,b,t+h} \end{gathered} \tag{8}$$

[7]That is, we follow the evolution of the stock of debt for each bank-firm pair.

Where the dependent variable $Y_{f,b,t+h}$ represents the log change in the stock of credit provided to firm f by bank b between months $t-1$ and $t+h$. The key independent regressor is the interaction between the lagged level of firm foreign debt and the lagged level of FX net purchases in the spot market by the Central Bank. $y_{f,b,t}$ denotes the change in the stock of credit for each firm-bank pair f, b in the period previous to the intervention. We control for a set of variables at the bank level in order to control for variables that could affect the their lending behavior. In the vector $X_{b,t-1}$ we consider individual banks' total assets, equity ratio, liquidity ratio, Capital adequacy ratio, fraction of non-performing loans ratio, return to assets and return to equity. At the firm level we control for the level of FX debt with bank b in month $t-1$. In our preferred specification, we also include a set of fixed effects. $\alpha_{s,h}$ represents an industry-month fixed effect and it is included to capture some heterogeneity in the demand for credit across industries. $\alpha_{b,y}$ represents a bank-year fixed effect and it is intended to capture some differences in the lending behavior that were not captured by the other controls in the vector $X_{b,t-1}$.

To account for differences in credit demand among firms, we introduce the term $\alpha_{f,h}$ (a firm-month fixed effect) into the analysis, following the approach suggested by Khwaja and Mian (2008). The stock of credit is an equilibrium variable influenced not only by credit supply but also by credit demand. Since our focus is specifically on evaluating the impact of FX interventions on the credit supply provided by banks to firms, it is crucial to control for variations in credit demand. Khwaja and Mian (2008) suggest to use debtors with multiple bank relationships in order to control for credit demand and identify only the credit supply side effect. Therefore, by this empirical strategy, we estimate the cumulative impact of the FX interventions on the credit supply from bank b to firm f, "h" months after the intervention only for firms with at least two bank relationships in the period of study.

5 Evidence at the Macroeconomic Level (Time series)

Figure 2 displays the estimated dynamic effects of FX interventions conducted by the Central Bank during the period of 2011-2019 on credit growth.[8] To facilitate comparability, the main independent variable has been standardized, such that one unit corresponds to \$ 100 million dollars of net purchases made by the Central Bank. According to our estimates for the total credit (upper left figure), we find that for every 100 million dollars that the Central Bank purchases in the spot market, the total credit to the economy is reduced in 0.05 percent four, months after the intervention.

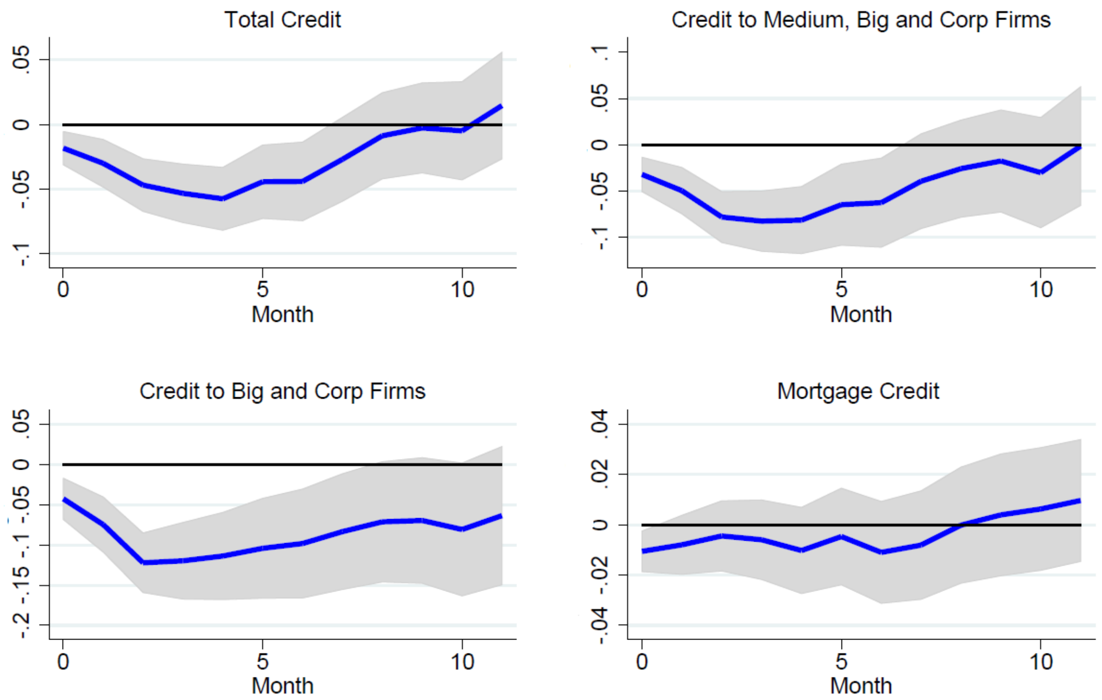

Figure 2: Impulse response on Credit Growth. This figure shows the estimated coefficient β_h from Equation 7, accompanied by a confidence interval of 10%. The Variable FXI_{t-1} was standardized so one unit is equivalent to \$ 100 million dollars of (monthly) net purchases by the Central Bank. Period: 2011-2019. The Y-axis represent the percentage change in credit corresponding to the estimated coefficient.

To provide a sense of the coefficient's magnitude, let's consider the period from 2010 to 2013 when there was a significant inflow of capitals into the Peruvian economy. During this period, the average monthly intervention by the Central Bank was approximately \$500 million of purchases. According to our estimations, this implies that at the peak of its impact (around 4 months post-intervention), an FX intervention of such size was accompanied by a reduction in total credit of roughly 0.30 percent. Moving on to the subsequent figure (top right), we observe that the impact surges by about 50% when we narrow our focus exclusively to credit extended to Medium, Big, and Corporate firms. The effect becomes even more pronounced (almost doubling)

[8] The coefficient β_h in Equation 7

when considering solely the domain of big and corporate firms (bottom left figure). Within this subset of firms, an FX purchase of $500 triggers a credit contraction of approximately 0.60 percent.

Finally, in the lower-right figure, we observe that FX interventions seem to have negligible impact on mortgage credits. This finding can be explained by the different maturity profiles of mortgage credits compared to the credit provided to firms. Typically, mortgage credits exhibit longer maturities, while the instruments employed by the Central Bank to neutralize FX interventions have relatively shorter maturities, generally ranging from 6 to 12 months. This maturity mismatch could explain the absence of a significant impact on mortgage credit.

In summary, the results from this first section of the study confirm that there exist a negative relationship between FX interventions and credit growth in the Peruvian economy, consistent with the theoretical model developed in section 2. These findings are consistent with those found by Hofmann et al (2019, 2021) for the case of Colombia. Specifically, the authors found that a weekly FX purchase of $ 90 million led to a peak reduction of around 0.25% in the stock of corporate loans, approximately three months after the intervention.

Moreover, our findings propose that this negative correlation exerts a stronger influence on larger firms. This latter outcome could potentially be linked to the secondary hypothesis stemming from the model, namely, that this negative association operates prominently through a balance sheet channel intertwined with the currency composition of firm debt. Larger firms often exhibit higher levels of foreign currency debt, in contrast to their smaller counterparts. If this hypothesis holds true within the Peruvian context, it would suggest that major firms, characterized by heightened levels of debt dollarization, are more vulnerable to the effects of FX interventions. In the next section, the study will further explore this evidence by examining the role of the currency composition of firm debt and its impact on the relationship between FX interventions and credit growth.

6 Evidence at the Loan level (panel data)

Figure 3 presents the baseline results obtained from estimating equation 8[9] . We plot the values for the coefficients β_h for the period of 12 months after the intervention episode. By construction, with the inclusion of the firm-month fixed effect, we consider in this regression only firms that have two bank lending relationships every month, strategy that allow us to control for differences

[9]In this baseline specification, we have incorporated Firm-month fixed effects, along with a set of additional fixed effects, to account for various factors. These additional fixed effects include Bank-year fixed effects, type of credit-month fixed effects, industry-month fixed effects, and controls at the bank level.

in credit demand across firms. In the baseline results we have weighted the observations by the total stock of debt of each firm in the previous month and clustered the standard errors under two-way clustering by firm and industry-month.

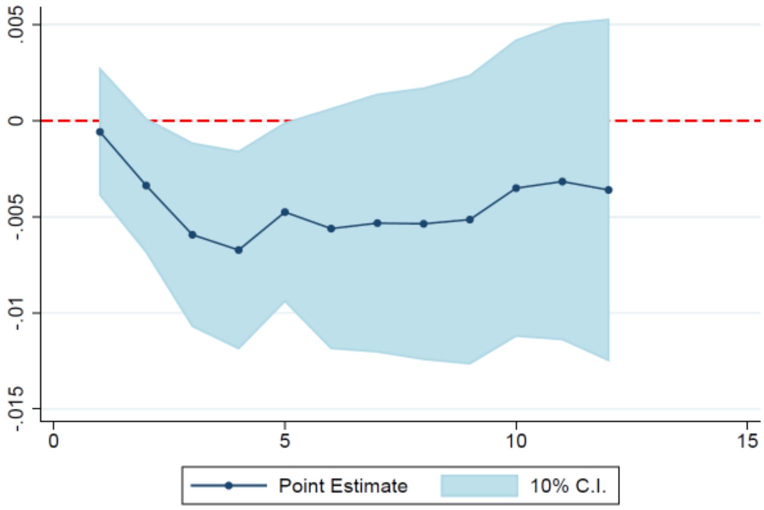

Figure 3: Impact on Credit Growth. Period: 2011-2019. This figure shows the estimated coefficient β_h^R from Equation 8. The Variable FXI_{t-1} was standardized so one unit is equivalent to $ 100 million dollars of (monthly) net purchases by the Central Bank.

We can observe that for all the months after the intervention the estimated coefficient for the interaction of Firm FX debt dollarization and FX interventions is negative, reaching its greatest magnitude in the fourth month after the intervention. However, it is important to note that the impact is statistically significant only for the months 2 to 5 after the intervention, indicating a relatively short-term effect. Beyond this period, the estimated coefficient is no longer significant, suggesting that the relationship between the currency composition of firm debt and the impact of FX interventions on credit growth becomes less pronounced over time.

To have an idea of the magnitudes associated with the estimated coefficients, we have that in its peak (for $h = 4$), for each $100 million dollars that the Central Bank buys in the FX spot market, a 10 percentage point increase in FX debt would be associated with a reduction in credit of around 0.07 percent. Or put differently, for a firm with a debt dollarization of 40% (the average for the year 2018), a purchase of dollars of $ 500 millions by the Central Bank[10] will be followed by a reduction in credit of around 1.3%, 4 months after the FX intervention. These results are consistent with the model predictions and with the results found by Hofmman et al (2021) for Colombia. In particular, as mentioned, by those authors, these results support the idea that the effect of Central Bank's FX intervention on credit works to an important extent through a balance sheet channel that is related to the currency composition of the firm debt.

[10]The monthly average observed in the period 2011-2013, a period of an important inflow of capitals to the Peruvian Economy.

Next, we present some robustness exercises in which we consider different sets of fixed effects. Specifically, we focus on the impact on credit four months after the intervention (denoted as h=4 in Equation 8), which represents the period when the impact reaches its maximum. It is important to note that the results obtained for this specific period are qualitatively consistent with the findings for other time periods. This exercise is shown in Table 3. In column 1 we have the baseline results (those with the same specification considered for Figure 3). In columns 2 to 4, we continue using the same identification strategy, by including a firm-month fixed effect that is expected to control for the heterogeneity in the demand for credit, but including different sets of controls/fixed effects. Compared to the baseline specification, in Column 2 we do not include Firm's debt dollarization, Column 3 does not include Bank controls (vector $X_{b,t-1}$) and Column 4 only consider a bank-year fixed effect. We can see that all the results in columns 2 to 4 are very similar in magnitude (and statistical significance) compared to the baseline results. However, the results in columns 5 to 7 show that the significance and magnitude of this coefficient depends on the inclusion of the firm-month fixed effect, the variable at the core of our identification strategy. When this variable is excluded (col 5) or when we consider only a firm fixed effect (col 6) or a firm-year fixed effect (col 7) the estimated coefficient turns to be very close to zero and not significant. Finally, we can observe that the coefficient associated with the firm debt dollarization turns out to be negative but not significant.

Table 3: Impact on Credit Growth

Impact on Δ Credit-4 months after FX intervention							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FX Int * Firm Debt Dollariz.	-0.0067**	-0.0069**	-0.0067**	-0.0066**	-0.0001	0.0001	-0.0026
	(0.031)	(0.028)	(0.031)	(0.036)	(0.967)	(0.971)	(0.115)
Firm Debt Dollariz.	-0.0208		-0.0186	-0.0199	-0.0039	-0.0165	-0.0335
	(0.577)		(0.620)	(0.601)	(0.812)	(0.600)	(0.372)
N Obs.	2.75 Mill	2.75 Mill	2.75 Mill	2.75 Mill	3.44 Mill	3.44 Mill	3.43 Mill
Adj-R2	0.329	0.329	0.327	0.329	0.073	0.097	0.174
Firm-Month FE	✓	✓	✓	✓	✗	✗	✗
Firm FE	✗	✗	✗	✗	✗	✓	✗
Firm-Year FE	✗	✗	✗	✗	✗	✗	✓
Bank-Year FE	✓	✓	✓	✓	✓	✓	✓
Type of Credit-Month FE	✓	✓	✓	✗	✓	✓	✓
Industry-Month FE	✓	✓	✓	✗	✓	✓	✓
Lima-Month FE	✓	✓	✓	✗	✓	✓	✓
Bank controls	✓	✓	✗	✗	✓	✓	✓

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. P-values in parenthesis. Period: 2011-2019. This table shows the estimated coefficient β_h from Equation 3 , for $h = 4$ under different specifications. The variable FXI_{t-1} was standardized so one unit is equivalent to $ 100 million dollars of (monthly) net purchases by the Central Bank. The standard errors where calculated under two-way clustering by firm and industry-month.

Some additional robustness exercises are provided in the Appendix, in particular, we have considered i) different clustering variables and ii) different time periods . In all the cases the estimated coefficients show similar magnitudes and continue to be significant in the same periods. In Figure A1, we present the results of regressing the same specification used for Figure 3, but considering different variables for the two-way clustering. In all the cases we can see that the significance does not change. In Figure A2 we can see that for different sub-samples the message stays the same: there exists a negative relationship between credit growth and FX interventions that works through the firm foreign debt; and this relationship shows its peak four months after the intervention, period after which it starts to fade out and lose significance. In the lower middle figure (Figure A2) we have repeated the exercise considering only the periods in which the central bank intervened in the spot market mostly with purchases of dollars[11].

We can observe that in this case the estimated coefficient is negative and actually its magnitude is more than 100% bigger compared to the 4 previous exercises. Again, the peak of the impact is observed 4 months after the intervention. In periods when there are important outflows of capitals and the Central Bank sells dollars to smooth FX volatility the only channel that we would expect to be working is the risk-taking channel, as there are no direct sterilizations associated with dollar sales. Therefore, the fact that the magnitude of the estimated coefficients is bigger for this sub-period could be taken as a suggestive evidence that the Portfolio channel is the most important one for the Peruvian economy.

Next, we consider the heterogeneous impact by firm size and by currency. In figure 4 we repeated the baseline exercise for medium sized firms and for big and corporate firms while in figure 5 we consider the impact by type of currency. Regarding size, the figures show that the negative impact observed for the whole sample was driven by Big and corporate firms. The estimated coefficient for the case of medium sized firms is very close to zero and not significant while the impact for big and corporate firms is significant and bigger than for the whole sample. The fact that the total impact seems to be driven by Big firms is consistent with the results found at the macro level (See Figure 2). In that section we found that the impact of the FX interventions on credit was higher when we considered bigger firms, giving more support to the idea that are the bigger firms the most affected by this mechanism.

Regarding currency, the estimated coefficient tell us that in the first months after the intervention, there is a negative impact on the credit growth in both currencies, being the impact much stronger for the case of national currency. After that, the cumulative impact begins to decrease,

[11]The period from June 2013 to June 2016 was characterized by an outflow of capitals from the Peruvian Economy, period in which the central bank intervened mainly with dollar sales.

Note: 90% confidence bands displayed. Weighted regressions.

Figure 4: Impact on Credit Growth by Firm Size. Period: 2011-2019. This figure shows the estimated coefficient β_h from Equation 3. The Variable FXI_{t-1} was standardized so one unit is equivalent to $ 100 million dollars of (monthly) net purchases by the Central Bank.

being that in the case of foreign currency it becomes positive around 10 months after the intervention, although not significant. The change in the sign for the results with foreign currency and the reversion in the magnitude of the impact for national currency could be explained by the maturity of the instruments used by the Central Bank to sterilize the FX intervention. In particular, the Central Bank uses mainly bonds with maturities up to 6 or 12 months, which means that after that time, the liquidity that the banks lost with the interventions will return to their balances at the expiration of said instruments.

However, we have to take these exercise with great caution because they were performed considering different samples. This is because our empirical strategy considers the inclusion of Firm-month fixed effects, which means that for each currency, we only consider the months in which the firm had debt in that specific currency. For instance, for the fourth period ($h = 4$) Figure 5 considered 2.75 million observations for the regressions with the total stock of debt, but only 1,73 millions and 1.23 millions for the regressions in National and foreign currency, respectively.

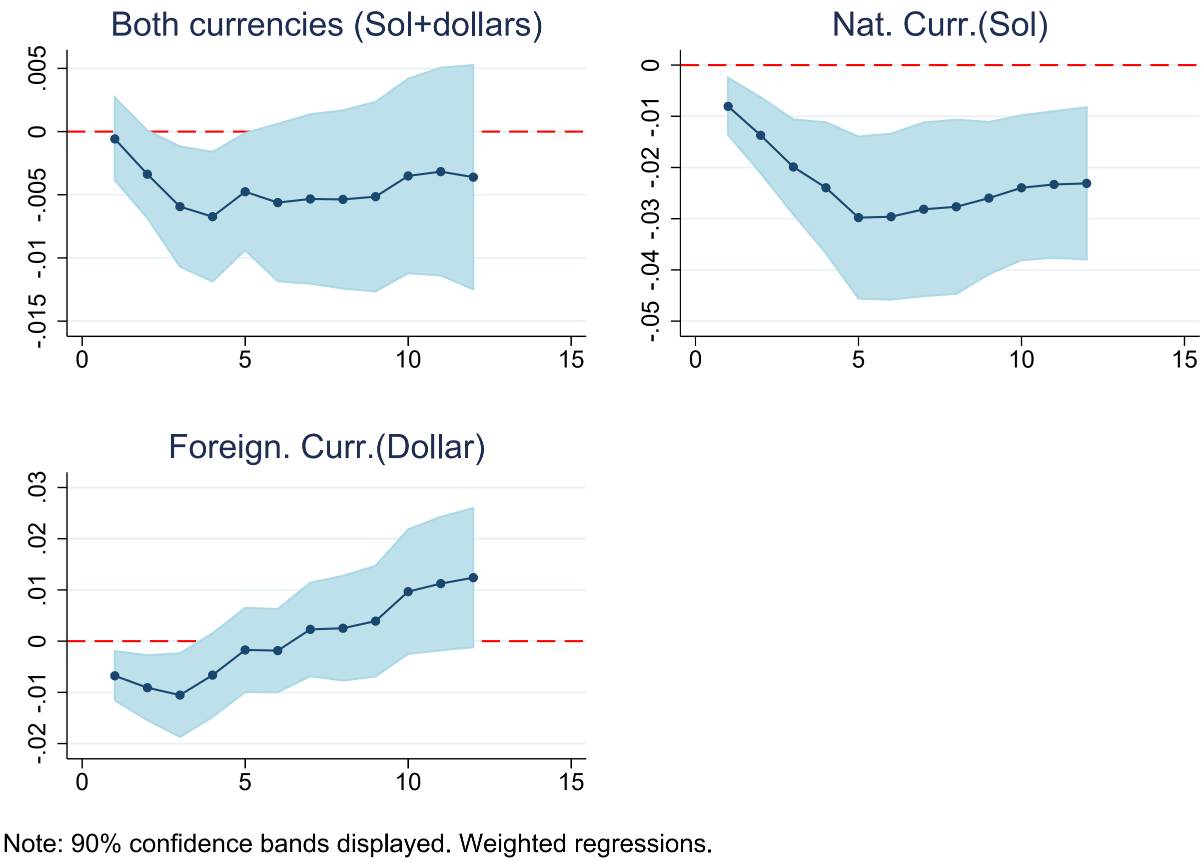

Figure 5: Impact on Credit Growth by Currency. Period: 2011-2019. This figure shows the estimated coefficient β_h from Equation 3. The Variable FXI_{t-1} was standardized so one unit is equivalent to $ 100 million dollars of (monthly) net purchases by the Central Bank.

7 Conclusions

FX interventions have been extensively employed by central banks in emerging markets as a means to mitigate the impact of volatile capital flows. These interventions serve the dual purpose of reducing exchange rate volatility and offering protection to businesses and households against exchange rate risks. However, the full extent of the impacts generated by these instruments on the economy and the financial stability remains incompletely understood. This research focuses on investigating a potential additional consequence of FX interventions, specifically examining how sterilized interventions can influence credit growth during periods of substantial capital inflows. By analyzing the effects of these interventions on credit expansion, the study aims to shed light on their role in promoting financial stability.

The research conducted in this paper, through both theoretical and empirical analysis, provides compelling evidence in support of the effectiveness of sterilized foreign exchange (FX) intervention in mitigating capital inflows within emerging market economies. Specifically, the study reveals that sterilized FX purchases have a notable impact on restraining credit growth, primarily affecting corporate and large firms within the Peruvian economy. Additionally, it was observed that the extent of this impact is largely influenced by the level of debt dollarization among firms.

These findings suggest that FX intervention serves as a valuable tool that can complement the existing measures employed by the Central Bank to promote macro-financial stability. It is important to note that although the impact identified in this study was relatively modest, it is comparable to the effects observed in other countries such as Colombia. This underscores the significance of FX intervention as a viable approach in managing capital inflows and their implications for credit markets.

Finally, it is important to mention that we have to take these results with caution, as further investigation is necessary to fully comprehend the underlying mechanisms at work. There are certain variables that were not accounted for in our regression analysis, which may potentially introduce biases into our estimates. One such limitation is the inability to observe how the total FX intervention is allocated among individual banks. Since we only have access to the aggregated total amount (without disaggregation by bank), we implicitly assume that each dollar bought or sold in the spot market affects all banks equally. Acquiring data elucidating how banks operate within the spot market would enhance our comprehension of the mechanisms involved.

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A Appendix.

A.1 Additional Tables

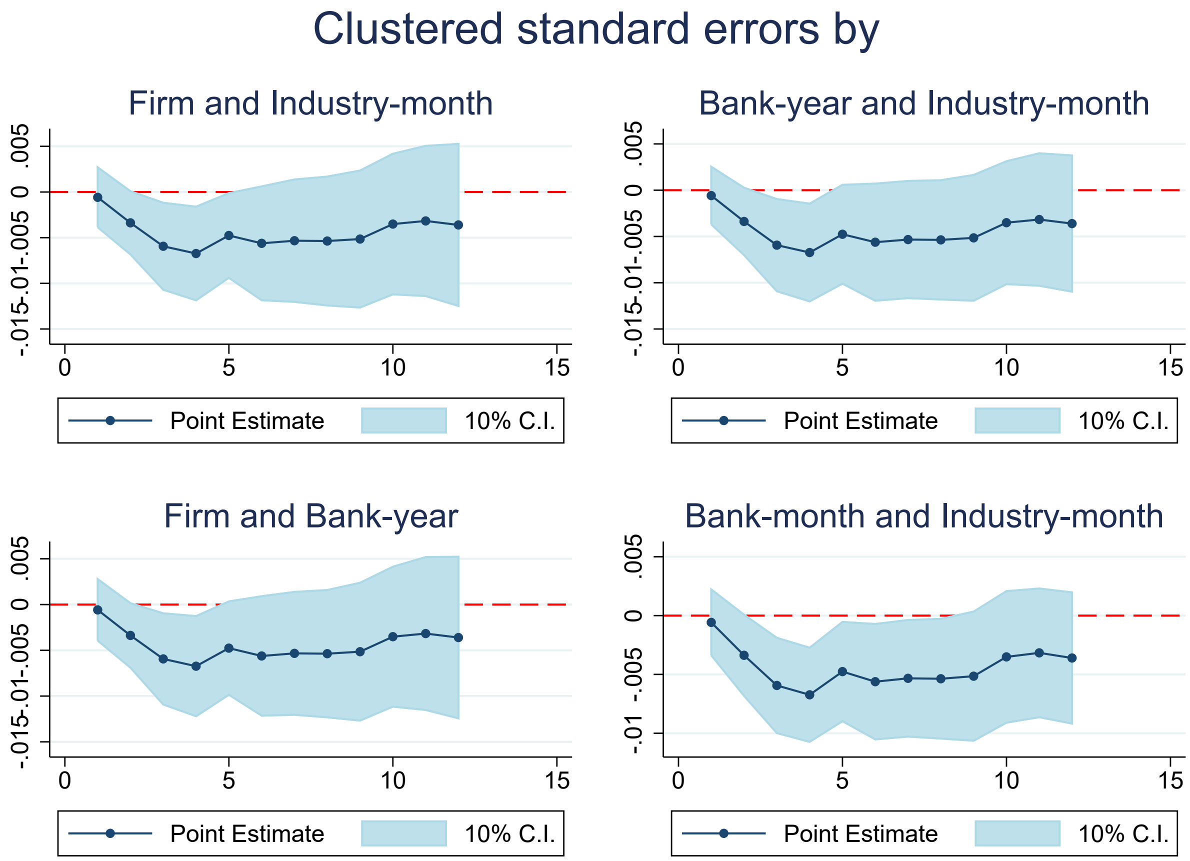

Figure A1: Impact on Credit -Multiple clustering variables. Period: 2011-2019. This figure shows the estimated coefficient β_h from Equation 3. The standard errors where calculated under two-way clustering by: (upper left) firm and industry-month, (upper right) bank-year and industry-month, (lower left) firm and bank-year, and (lower right) bank-month and industry-month

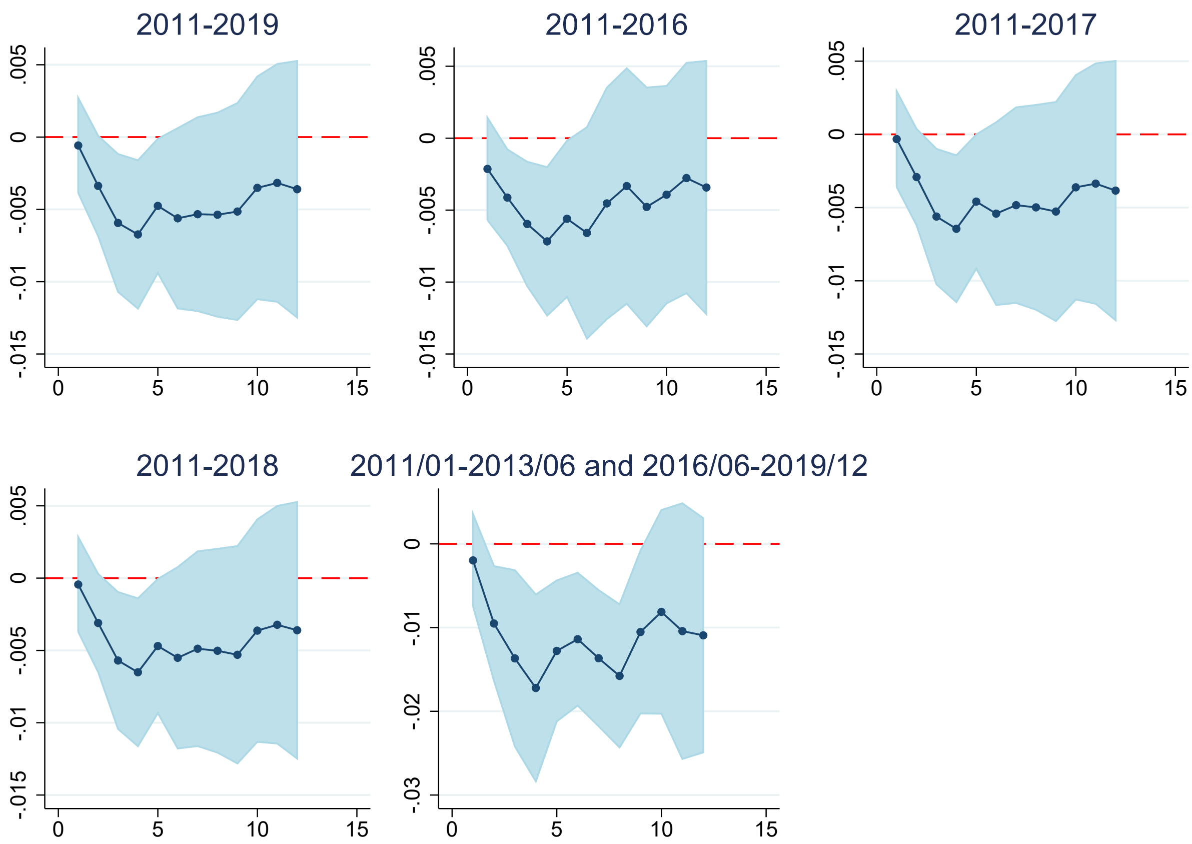

Figure A2: Impact on Credit Growth- Multiple time periods. This figure shows the estimated coefficient β_h from Equation 3. The standard errors where calculated under two-way clustering by firm and industry-month. The sample considered for each exercise was the following: (upper left) 2011-2019 , (upper middle) 2011-2016 ,(upper right) 2011-2017 , (lower left) 2011-2018 and (lower middle) 2011-2013:06 and 2016:06-2019.