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DT. N°. 2019-005
Serie de Documentos de Trabajo
Working Paper series
Abril 2019

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April 30, 2019

Abstract

This paper assesses the impact of de-dollarization measures implemented by the Central Reserve Bank of Peru between the years 2013 and 2016. Our results show that, despite an already slight downward trend in credit dollarization indicators before their implementation, the pace of de-dollarization increased after the adoption of the mentioned policy measures, especially after the announcement in the beginning of 2015. We find evidence that since the announcement of the first policy measure, 6 out of the 10 percentage point reduction in credit dollarization is related to the implementation of the De-dollarization Program. In contrast to a generalized impact of measures in 2015 onwards on all market segments, de-dollarization measures in 2013 affected mainly certain segments by firm size such as corporate and small firms. In addition, an heterogeneous impact is identified by loan size, where banks preferred to substitute larger loans from foreign to domestic currency.

Resumen

Este trabajo evalúa el impacto de las medidas que el BCRP implementó entre 2013 y 2016. Nuestros resultados muestran que, a pesar de la existencia de una ligera tendencia a la baja en los indicadores de dolarización del crédito antes de su implementación, el ritmo de desdolarización se aceleró luego de la adopción de las medidas de política anteriormente mencionadas, especialmente luego del anuncio a inicios de 2015. Se encuentra evidencia que señala que desde el anuncio del primer paquete de medidas, 6 de los 10 puntos porcentuales de reducción en el grado de dolarización del crédito está asociado a la implementación del Programa de Desdolarización. A diferencia del impacto homogéneo de las medidas de 2015 en adelante en todos los segmentos de crédito, las medidas de 2013 afectaron principalmente ciertos segmentos tales como corporativos y empresas pequeñas. Asimismo, se identifica un efecto heterogéneo por tamaño del crédito, donde los bancos prefirieron sustituir los préstamos de mayor tamaño de moneda extranjera a moneda doméstica.

JEL classification: E58, G21, G28
Key words: credit dollarization, macroprudential policies, credit register data

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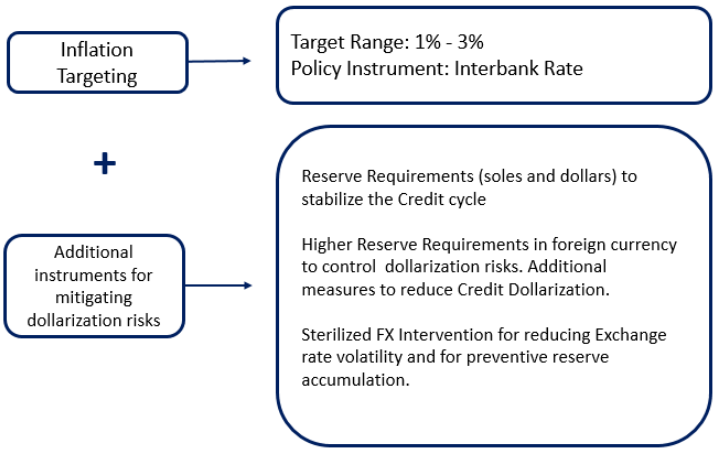
1 Introduction

One of the main risk exposures of the Peruvian financial system is the significant degree of financial dollarization. Specifically, currency mismatches in the balance sheet of firms between dollar-denominated credit and income flows in domestic currency creates an amplification mechanism on the financial cost when an abrupt sharp depreciation hits the economy. Despite its high degree of dollarization, Peru adopted the Inflation Targeting (IT) regime in 2002 after a decade of falling inflation rates starting in 1990 (Armas *et al.*, 2001; Armas and Grippa, 2005).

Since then, the exposure to this risk has decreased, with the ratio of credit dollarization falling from 78 percent in 2001 to 43 percent in 2012. However, this level of financial dollarization was still high compared to other economies in the region, and hence the Peruvian economy exhibited a considerable degree of vulnerability with respect to external shocks. Moreover, there exists some evidence showing that a depreciation of the domestic currency (sol) can produce a negative effect in output because of the balance sheet effect (see e.g. Bigio and Salas (2006), Castillo *et al.* (2011), Ramírez-Rondán (2018)). Thus, the Central Reserve Bank of Peru (BCRP hereafter) also intervenes in the Foreign Exchange Market in order to reduce excessive exchange rate volatility (see e.g. Armas (2005), Humala and Rodríguez (2010), Rossini *et al.* (2013)).

In addition, the BCRP started using additional macroprudential instruments such as reserve requirements in order to mitigate the risks associated with financial dollarization, especially during the Global Financial Crisis (Armas *et al.* (2014), Pérez-Forero and Vega (2014), Rossini *et al.* (2014)). All the mentioned measures are in line with the current state-of-the-art Inflation Targeting scheme, where central banks use additional policy tools besides the interest rate for financial stability purposes (Hammond, 2012).

Figure 1: Monetary Policy Framework of the BCRP (Armas *et al.*, 2014)



Due to the vulnerability of the financial system related with financial dollarization, the BCRP implemented a set of policy measures called *The BCRP de-dollarization program* in order to reduce the exposure of the aggregate economy to dollarization risks and to strengthen the transmission mechanism of monetary policy. Thus, since 2013 BCRP set additional reserve

requirements for the stock of credit to the private sector in foreign currency in order to promote currency substitution towards financial intermediation in domestic currency. This was complemented with additional policy measures where BCRP provided funding in domestic currency to banks through the currency-repo operations, where private banks receive cash in domestic currency (soles) and against cash in dollars as collateral[1].

This paper assesses and quantifies the impact of the mentioned policy measures on the currency composition of credit by the banking sector to private firms, and identifies the existence of heterogeneous impacts by credit segment, economic sector and loan size.[2] In order to do that, we use a large data set from the credit register central (RCC) at the bank-firm level with monthly data covering the period between December 2010 and December 2017. Using this granular data, we evaluate the impact of the de-dollarization policies implemented by BCRP since 2013. The empirical methodology follows a panel estimation with fixed effects. Also we consider estimations with a difference in difference approach to control whether the results are associated to other events that occurred simultaneously to the implementation of the de-dollarization program. In order to isolate the effect of de-dollarization measures, we include a set of control variables on different dimensions, given the benefit of having a very high degree of granularity in the credit register data. We consider macroeconomic variables, bank level variables and firm level characteristics.

The analysis of macroprudential measures using credit register data has been already used by other countries with this type of granular data. For instance, most of the existing literature focuses on the effect of macroprudential policy measures on credit growth rates (see e.g. Van Roy *et al.* (2017) and Collazo-Brananova and Watfe (2017).). Among the macroprudential policy tools, there are studies on the use of capital requirements (Aguirre and Repetto, 2017), reserve requirements (Barata Barroso *et al.* (2017), Cabello *et al.* (2017), Gomez *et al.* (2017)) and dynamic provisions (Cabello *et al.* (2017), Gomez *et al.* (2017), Jiménez *et al.* (2017)). Furthermore, this type of databases are also used to analyze the transmission mechanism of monetary policy and credit risk exposures in the banking sector (Jiménez *et al.*, 2012, 2014).

In particular, for countries with credit denominated in foreign currency, existing literature considers the differentiated impact by currency of macroprudential policies (Epure *et al.*, 2018) and monetary policy (Ongena *et al.*, 2014). Our work contributes to this strand of the literature by assessing the use of macroprudential measures that are specifically tailored to affect the currency denomination of credit and reduce the degree of credit dollarization.

Thus, some questions posed by this paper are:

- What proportion of firms that used to have dollar denominated credit have substituted it for domestic currency credit after the implementation of the de-dollarization program? What was the impact of the program modifications in 2015 and 2016?
- Does this effect change across time depending on either the domestic monetary policy

[1] For more details on the set of policies adopted, see Castillo *et al.* (2015), Castillo and Humala (2017), Oré *et al.* (2018).

[2] Although there exist some other sources of systemic risk, in this paper we focus our attention in the dollarization risks since this is one of the main vulnerabilities of the aggregate economy. A strengthening of the transmission mechanism of monetary policy is crucial for controlling inflation in Peru. As a result, the policy measures evaluated in this document point towards the de-dollarization of the financial system.

stance, the policy stance in advanced economies or the current business cycle phase?

- Are there differentiated effects by sector, firm size, loan size or by type of financial institution?

In this paper we use standard panel data regression models and also a difference-in-difference approach (Cameron and Trivedi, 2005) in order to assess the impact of the described policy measures. Our results show that the policy measures have contributed to reduce the degree of dollarization of credit from the banking system to the private sector. Thus, they have been successful in reducing the exposure of firms to currency risk and the exposure of banks to credit risk in the event of a sharp and abrupt exchange rate depreciation. Despite a slight downward trend in credit dollarization indicators before 2013, the pace of de-dollarization increased especially after the adoption of the policy measures announced in 2015. In particular, our difference in difference estimations show the contribution of the de-dollarization policy measures are significant since 9 months after the announcement of the policy measure in early 2015. We find evidence that 6 out of the 10 percentage point average reduction in the credit dollarization ratio are associated to the De-dollarization Program. That is, firms that took loans from banks that were constrained by the thresholds on the stock of credit in foreign currency show a 6 percentage larger reduction in dollarization than those firms that took credit from unconstrained banks.

In the case of the de-dollarization measures of 2013, their impact was mainly concentrated on certain segments such as corporate and small enterprises. With respect to credit size, the preferred strategy by banks was to substitute larger loans from foreign to domestic currency. Smaller loans are mostly in domestic currency and imply a smaller exposure of firms to currency risk as a proportion of their net worth.

This paper contributes to the strand of literature that uses granular credit register data to analyze the impact of monetary and macro-financial policies. There are several studies on the use of different types of macro-prudential policies and their effect on credit growth in a wide set of countries, such as: (i) capital requirements (Aguirre and Repetto, 2017), reserve requirements (Barata Barroso *et al.* (2017), Cabello *et al.* (2017), Gomez *et al.* (2017)), and dynamic provisions (Cabello *et al.* (2017), Gomez *et al.* (2017), Jiménez *et al.* (2017)). Even though our work also analyzes the use of a macroprudential tool (additional reserve requirements on the stock of foreign currency credit), we are interested in quantifying the impact on the currency composition of credit, not on the level of aggregate credit. On the other hand, there is a set of studies that analyze credit channel of monetary policy and its transmission mechanism using loan-level data (see e.g. BIS CCA CGDFS Working Group 2018).

Credit register data has also been used to study the impact of macroprudential policies on financial risk exposures, such as the impact on credit risk taking by the banking sector (Jiménez *et al.* (2012), Jiménez *et al.* (2014)). Closer to our work, some studies analyze the heterogeneous effects on credit growth by currency of both macroprudential policies (Epure *et al.* (2018), Camors and Peydró (2014)) and monetary policy (Ongena *et al.*, 2014). Thus, our work contributes by evaluating the use of a different type of macroprudential policy (additional reserve requirements on credit) on the currency composition of banking sector credit in Peru.

In particular, other assessments of the impact of macroprudential policies in Peru have focused on aggregate implications, such as a counterfactual analysis of the use reserve requirements

in dollars and the de-dollarization program (Castillo *et al.*, 2016) and the effect of traditional (deposit) reserve requirement shocks at the bank level (Vega and Chavez, 2017). In addition, other studies for the case of Peru have also exploited the use of credit register data, but have focused on credit to households rather than credit to firms. Some examples are the stylized facts of household credit dollarization in Peru (Céspedes, 2017) and the impact of credit rating revisions on non-performing loans and access to credit (Garmaise and Natividad, 2017).

This document is organized as follows. Section 2 presents the credit register data and some stylized facts of banking sector credit in Peru. Section 3 presents the empirical strategy. Section 4 shows the results of the econometric analysis and section 5 concludes.

2 Some stylized facts of banking sector credit in Peru

2.1 The de-dollarization program of the BCRP

At the end of 2014, the BCRP established the Credit De-dollarization Program, which sought to reduce the risks associated with a high dollarization of the credits of economic agents. The program established additional reserves in foreign currency, in order to make financing more expensive in this currency. In particular, banks were asked to reduce the balance of dollar credits. Given the relevance of the risks coming from currency mismatches in economies with a high degree of financial dollarization, BCRP implemented a set of policy measures to boost currency substitution of credit towards domestic currency and reduce the exposition of the banking sector to credit risk coming from fluctuations in the exchange rate. Figure 2 present a summary of the de-dollarization measures from 2013 onwards. A description of the program and a detailed chronology of the measures implemented can be found in Castillo *et al.* (2016).

In the case of total credit in foreign currency, banks had to reduce their stock of credit to avoid the additional reserve requirement. As of December 2015, the stock of credit for each bank had to be at most 90 percent of its own stock of credit in foreign currency as of September 2013. Subsequently, for the end of 2016 and 2017, the threshold was adjusted to 80 and 70 percent of the stock of September 2013, respectively (see Figure 3). In the case of car and mortgage loans, the limit required as of December 2015 was 85 percent of the stock of credit of February 2013, while for the end of 2016 and 2017 this was adjusted to 70 and 60 percent, respectively. In particular, Figure 4 shows that in the case of car and mortgage loans to families, banks were able to significantly reduce their credit in foreign currency to this segment.

Figure 2: Additional Reserve Requirements in Foreign Currency
(Banco Central de Reserva del Perú, 2015)

ADDITIONAL RESERVE REQUIRENMENT ACCORDING TO CREDIT IN FOREIGN CURRENCY

In force	As of June 2015	
	Limits*	**Additional RR**
Total excluding foreign trade 1/ (Base=Sep.13)	0.95 times from Sep.13 or 0.92 times from Dec.14 or 100% PE or US$ 100 MM	$0.3 \times \left(\frac{C_t}{C_{s13}} - 0.95\right) \times PT$
Car and mortgage (Base=Feb.13)	0.90 times from Feb. 13 ó 0.86 times from Dec. 14 ó 20% PE	$0.15 \times \left(\frac{CHV_t}{CHV_{f13}} - 0.90\right) \times PT$
In force	**As of December 2015**	
	Limits*	**Additional RR**
Total excluding foreign trade 1/ (Base=Sep.13)	0.90 times from Sep.13 or 0.85 times from Dic.14 or 100% PE or US$ 100 MM	$0.3 \times \left(\frac{C_t}{C_{s13}} - 0.90\right) \times PT$
Car and mortgage (Base=Feb.13)	0.85 times from Feb.13 or 0.75 times from Dic.14 or 20% PE	$0.15 \times \left(\frac{CHV_t}{CHV_{f13}} - 0.85\right) \times PT$
Approved	**As of December 2016**	
	Limits*	**Additional RR**
Total excluding foreign trade 1/ (Base=Sep.13)	0.80 times from Sep.13 or 100% PE or US$ 100 MM	$0.3 \times \left(\frac{C_t}{C_{s13}} - 0.80\right) \times PT$
Car and mortgage (Base=Feb.13)	0.7 times from Feb.13 or 15% PE	$0.15 \times \left(\frac{CHV_t}{CHV_{f13}} - 0.7\right) \times PT$

1/ Excludes new loans from January 2015 (terms more than 3 years and higher than US$ 10 million).
* These limits don't apply if the total balance of loans in foreign currency excluding foreign trade is less than the effective equity and the balance of car and mortgage loans if less than 20 percent of effective equity.

Figure 3: Bank Credit in Foreign Currency Excluding Trade Loans
(September 2013=100; in millions of U.S. dollars)
(Banco Central de Reserva del Perú, 2015)

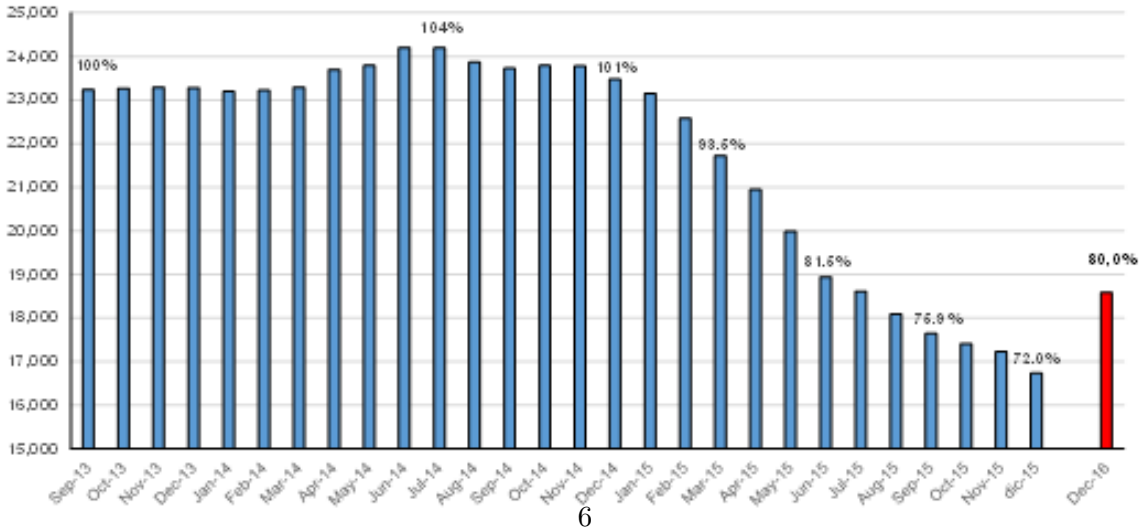
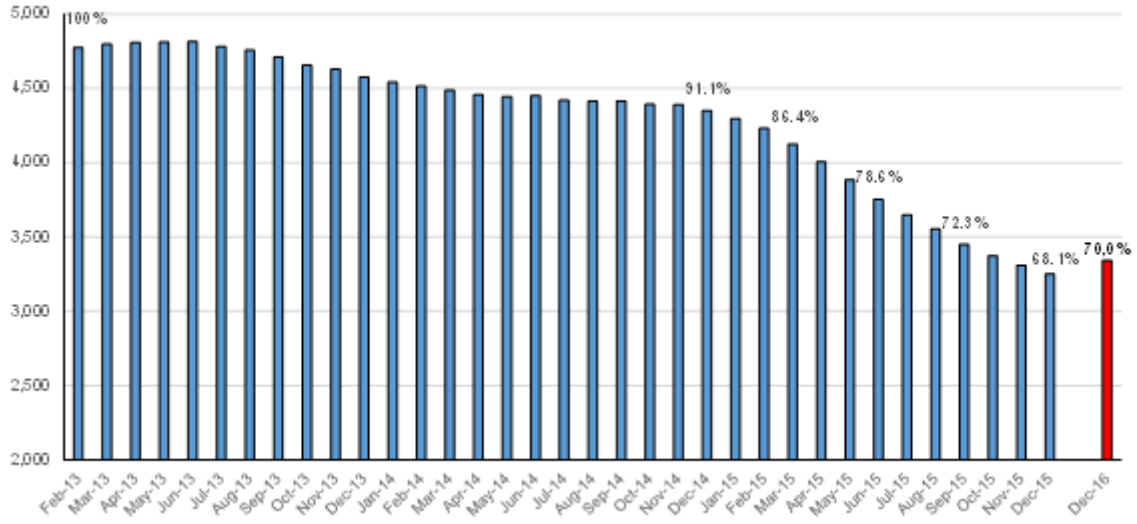


Figure 4: Banks Car and Mortgage Loans in Foreign Currency
(February 2013=100; in millions of U.S. dollars)
(Banco Central de Reserva del Perú, 2015)



A first glance at the data shows some evidence pointing towards the effectiveness of the policy measures. The upper section of Figure 5 shows a faster pace in the aggregate de-dollarization process after the announcement of the first policy measure and until the end date of the second policy measure. Also, if we separate the stock of new credit and the amortization of outstanding credit (lower section) there is evidence of (i) currency substitution for new loans (reduction in new dollar loans and higher growth rates for new loans in soles) and (ii) currency substitution in outstanding loans, with pre-payment of some dollar loans together with new loans in soles.

However, it should be noted that the success of this program was conditional on banks having funding in soles, so that credit in soles could be expanded as planned. Given that the dollarization ratio of bank deposits is also high, the BCRP injected liquidity in soles through currency repo operations, which use bank's dollar surplus as collateral (see Figure 6). It is important to notice that the maturity of these injection operations was approximately three years.

Figure 5: De-dollarization policy measures

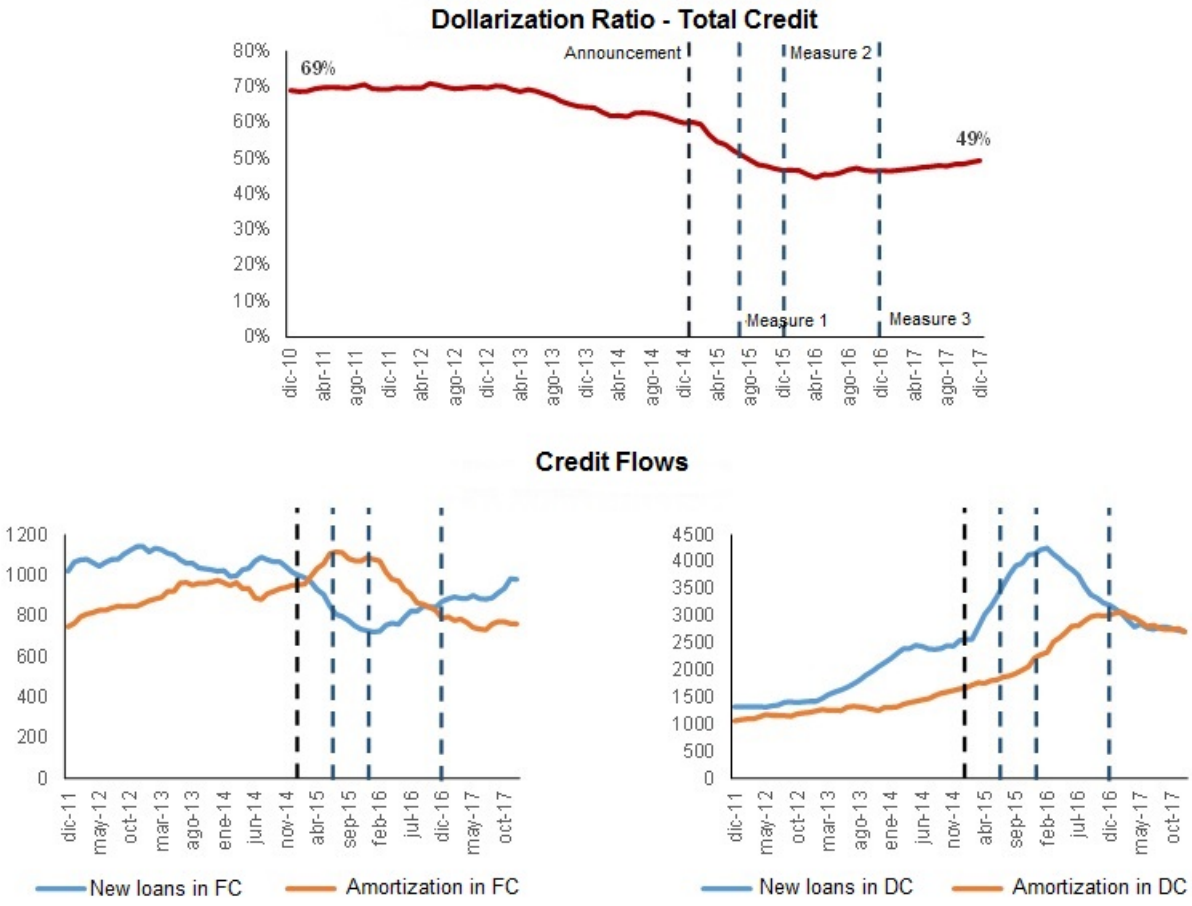
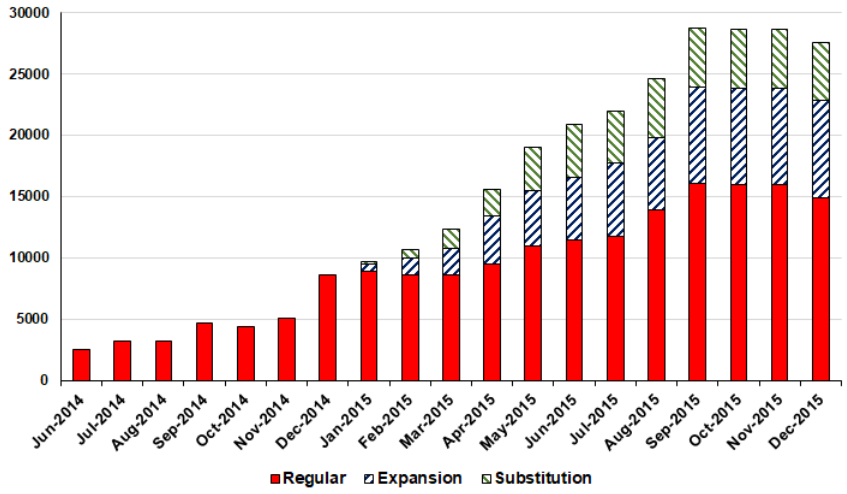


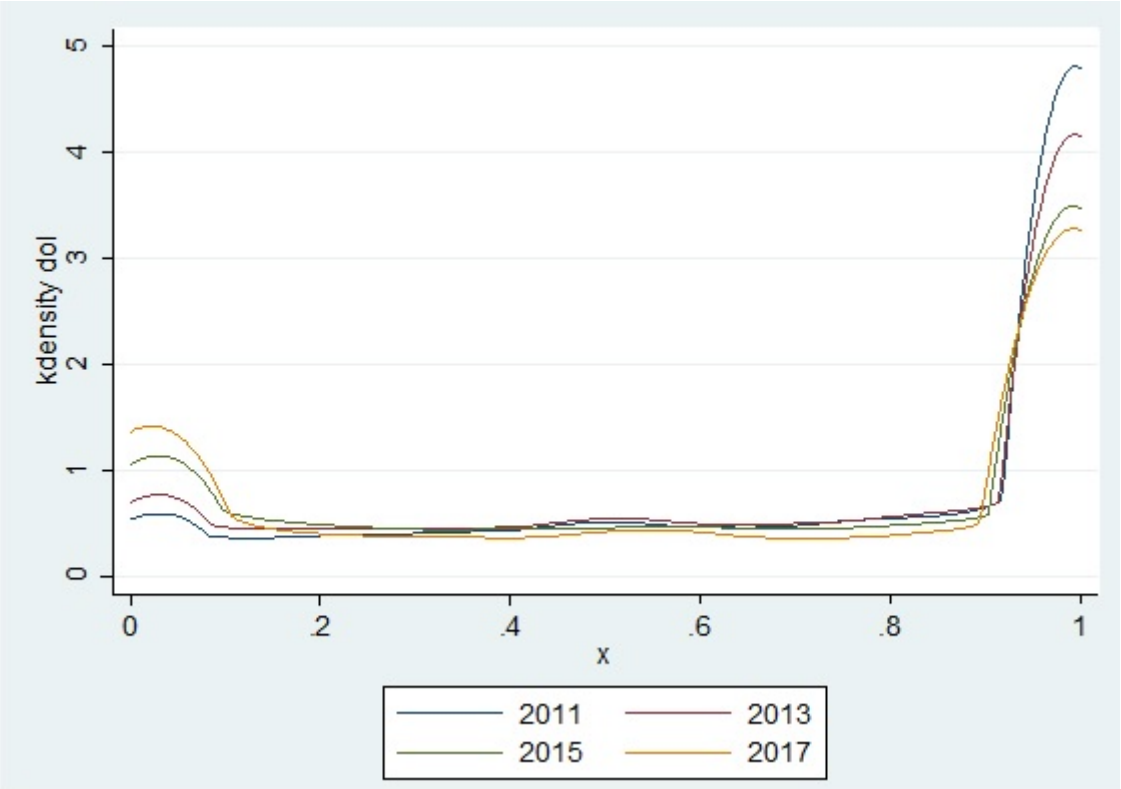
Figure 6: Total Stock of Currency Repo Operations
(in millions of soles)



2.2 Credit dollarization: a review of stylized facts

Using data from the credit register central (see data description in Appendix A), we observe some stylized patterns in the distribution of credit dollarization across firms and through time. Figure 7 shows that for a particular date, the cross-sectional distribution of the credit dollarization ratio is bimodal, as most firms either take all of their loans in soles or all in dollars. However, if we observe the evolution of this distribution over time, we find that the proportion of firms with loans only in dollars has decreased sharply.

Figure 7: Cross-sectional distribution of the credit dollarization ratio at the end of each year



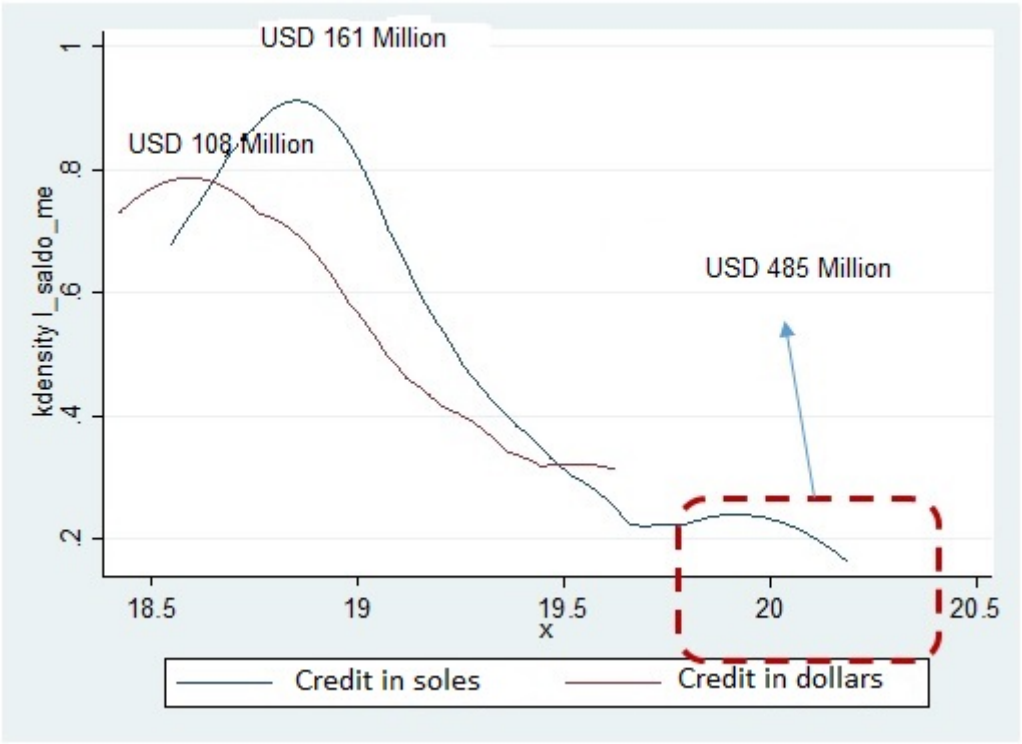
The proportion of firms that changed their loans from dollars to soles increased after the implementation of the de-dollarization program, especially for firms in the non-exporting sectors (trade and services). This effect is larger for firms of smaller size. Table 1 shows that firms in the trade and service sectors reduced their credit dollarization coefficient by 9 and 11 percentage points, respectively. Notice that firms in these sectors are more exposed to currency mismatches if they take a loan in foreign currency, as their income is mainly denominated in domestic currency and they have less access to financial hedging against exchange rate risk. In contrast, this result differs from credit to the corporate sector, where the largest impact of the de-dollarization program is observed on the industrial sector, with a reduction in the credit dollarization ratio by 16 percentage points.

Table 1: Contribution to credit de-dollarization by economic sector and segment
(in percentage points)

	Aggregate		Corporate		Big firms	
	Dollariz 2017	Contrib 2017-2011	Dollariz 2017	Contrib 2017-2011	Dollariz 2017	Contrib 2017-2011
Industry	47	-9	45	-16	55	-9
Trade	44	-2	47	1	54	-2
Services	39	-5	34	0	46	-3
	Medium size firms		Small firms(Pymes)			
	Dollariz 2017	Contrib 2017-2011	Dollariz 2017	Contrib 2017-2011		
Industry	44	-5	10	-4		
Trade	40	-6	8	-9		
Services	39	-10	12	-11		

A particular feature of the difference in the distribution of outstanding credit stocks in domestic and foreign currency is the size of the loan. Figure 8 shows that, even though most loans are denominated in soles, dollar-denominated loans are larger in size.

Figure 8: Outstanding credit stock distribution at the firm level:
credit in soles and dollars (in logs)
December 2017

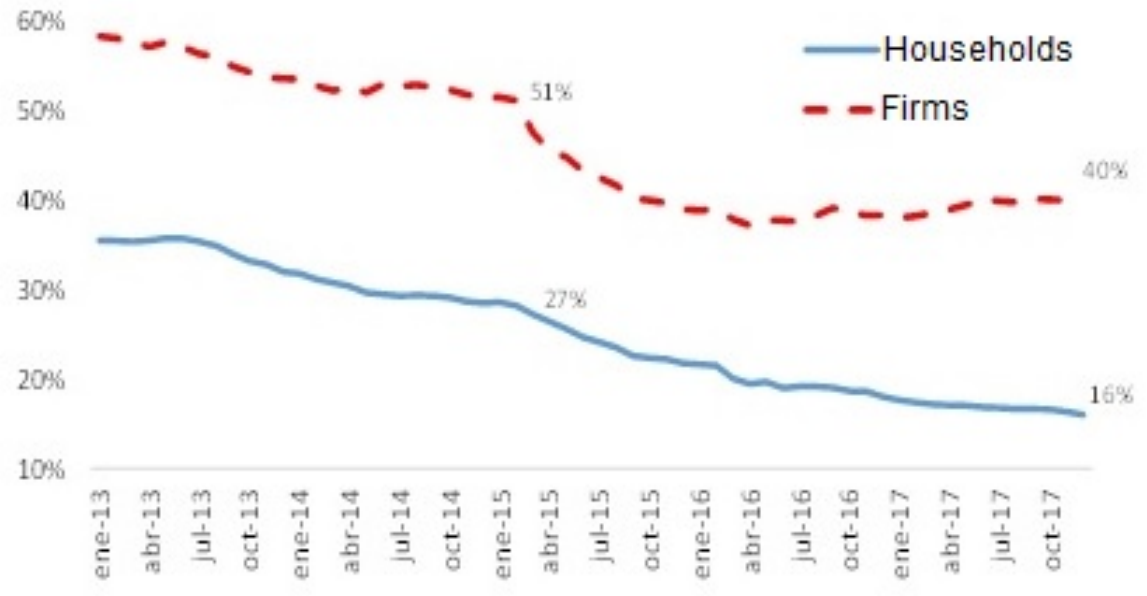


Thus, if we consider the aggregate indicator for credit dollarization, the ratio fell from 69,3 to

49,3 percent between 2011 and 2017. However, the proportion of firms with dollar loans fell from 33,8 to 16,8 percent in the same period.

A first look at the data on credit dollarization before and after the implementation of de-dollarization policies shows a reduction in the dollarization ratio and heterogeneous effects across segments. Figure 9 shows that dollarization fell sharply on credit to households (especially mortgages and car loans), whereas the reduction in credit dollarization for firms is more moderate (mostly due to loans to medium size firms and to the corporate sector). However, since 2016, the de-dollarization process became slower and might have even reverted slightly for the corporate sector.

Figure 9: Credit dollarization by segments



3 Empirical strategy

We evaluate the impact of the de-dollarization policy measures on the currency substitution of credit to soles using data described in Appendix A by using two methodologies: (i) a panel estimation with fixed effects and (ii) a difference in difference estimation.

It is important to mention that the Peruvian financial system simultaneously obtains funding and allocates its credit portfolio in two currencies (soles and dollars), so they act as imperfect substitutes. Thus, our estimation considers fixed effects in time and firm dimensions to control for changes in the type, volume and currency composition of credit demand by firms. Some of these controls are observable while others are not, such as the firms net worth, their investment opportunities, informational frictions and agency costs between banks and firms, heterogeneous risk taking profiles and firm access to collateral. Those unobservable features are partially controlled using fixed effects at the bank and firm levels.

3.1 Panel with fixed effects

The econometric model that we estimate is given by equation (1):

$$\Delta Dollarization_{bft} = \alpha_{bf} + \sum_{j=0}^{T} \beta_j \Delta DedollarizationMeasure_t + Controls_{bft} + \gamma period_t + \varepsilon_{bft} \quad (1)$$

The dependent variable is the monthly variation of the credit dollarization ratio of firm f from bank b in period t. First, we concentrate on analyzing the impact of the policy measures on average dollarization indicators, that is, on how much the degree of credit dollarization of a particular firm falls after the implementation of policy measures, conditional on firm f having some of its credit in dollars in period $t-1$.

The main explanatory variables are the de-dollarization policy measures. In order to do that, we consider a set of dummy variables that turn on from the month when the policy measure is announced to the date when each measure must be implemented completely (see Figure 2), and we also include fixed effects by firm and time[3].

In order to calculate the impact of the policy measures we control on a number of dimensions such as (i) macroeconomic variables, (ii) variables related to characteristics of the bank that is granting the loan, and (iii) variables related to characteristics of the firms that take the loans. The first group includes variables such as GDP growth, inflation rate, exchange rate depreciation, spread between lending rates in soles and in dollars, exchange rate volatility and expected exchange rate fluctuations.

The second group includes variables related to bank profitability (return on assets), solvency (capital to asset ratio), credit risk (non-performing loans) and liquidity (ratio of liquid assets to total assets).

To control for quantity and quality of the demand for credit from firms, we include variables that capture firm specific characteristics. One way is to include fixed effects at the firm level. Also, we have some information on the amount of outstanding credit by each firm and its credit rating. Also, we are able to identify those firms that do foreign trade transactions and those that have access to financial hedge against exchange rate fluctuations.

We also estimate the effect of the policy measures on the growth rate of new loans and amortization of existing loans in both currencies to assess the effect on the aggregate credit dollarization ratio. In order to do that, we estimate an equation for the flow of new credit for firm f in month t in currency k and the impact of the de-dollarization measures on this variable. Also, we estimate the impact of the policy measures on the amortization of existing credit of firm f in month t and currency k, conditional on firm f having positive outstanding stock of credit in dollars in month $t-1$.

[3]See Mora and Reggio (2017) for a more detailed discussion about different identification strategies using panel data and difference-in-difference approaches.

$$\Delta NewLoansUSD_{bft} = \alpha_{bf} + \beta \Delta DedollarizationMeasures_t + Controls_{bft} + \gamma period_t + \varepsilon_{bft} \quad (2)$$

$$\Delta AmortizationUSD_{bft} = \alpha_{bf} + \beta \Delta DedollarizationMeasures_t + Controls_{bft} + \gamma periodo_t + \varepsilon_{bft} \quad (3)$$

3.2 The Difference in difference estimator

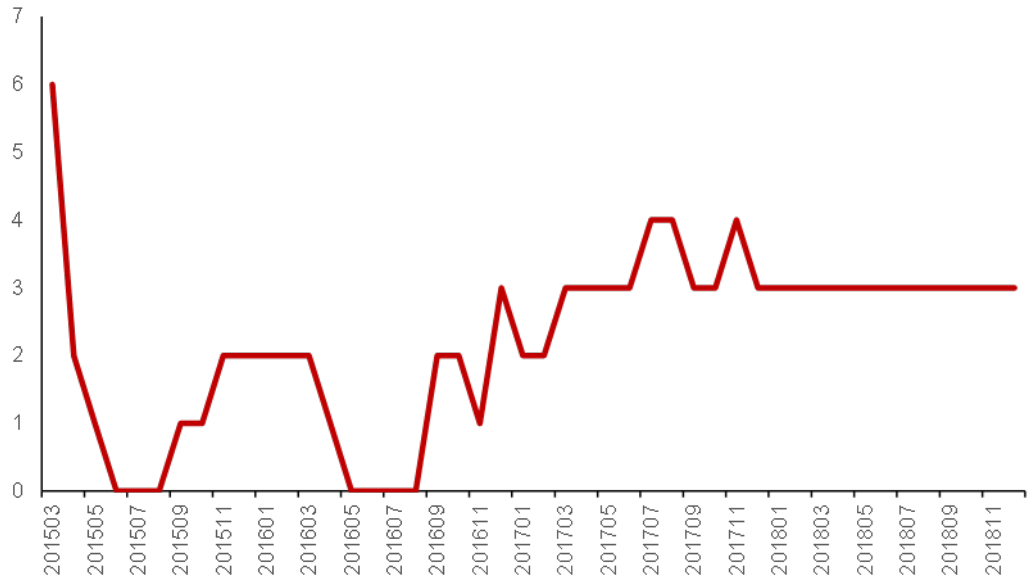
We also implement the difference in difference estimation (DiD hereafter) in order to isolate the causal effect of the de-dollarization policy measures on the ratio of credit dollarization. Even though, as previously shown, the ratio of credit dollarization decreased after the implementation of these policy measures, the effect could be partially related to other factors, such as the evolution of foreign and domestic interest rates, the level and volatility of the exchange rate and their expectations, among others.

Causal effect estimation has been more widespread used to evaluate interventions and provide reliable evidence on its effectiveness (Heckman and Vytlacil, 2007). The DiD estimator has been more heavily used to evaluate the impact of microeconomic policies, such as the effect of changes in the minimum wage (Card and Krueger, 1993), the impact of changes in school start dates on performance (Pischke, 2007). In terms of macroeconomic policy evaluation, it has been used to analyze topics such as the effect of trade liberalization on income (Slaughter, 2001) and the effect of exchange rate regimes on inflation (Miles, 2008).

However, the evaluation of the effect of macroeconomic policies require some additional caveats before using quasi experimental methods to obtain an estimation of a causal effect. These policies usually affect all economic agents in the population so they are not specifically directed to a particular group that can be identified as the treated group. Fortunately, the granularity of our credit register data allows us to identify a source of variation of the policy effect to evaluate the proposed methodology.

We use the thresholds for the stock of credit in foreign currency and bank-level data for credit stocks in order to identify those banks that were above the threshold by the time of the announcement of each policy measure. These policies were unexpected by the financial system so they can be considered exogenous at the macro level. Once the policy is announced, those financial institutions who are above the threshold will need to take actions to reduce the stock of credit in foreign currency in order to comply with the measure. In contrast, those banks that have already met the threshold have less incentives to reduce their stock of credit in foreign currency. We exploit this heterogeneity to obtain a causal effect estimation of the policy. Figure 10 shows the evolution of the number of banks that were above the threshold during the period of implementation of the policy measures. As we move closer to the end date of each policy measure, the number of banks that are above the threshold decreases, thus showing some evidence that those banks are taking actions to comply with the measure.

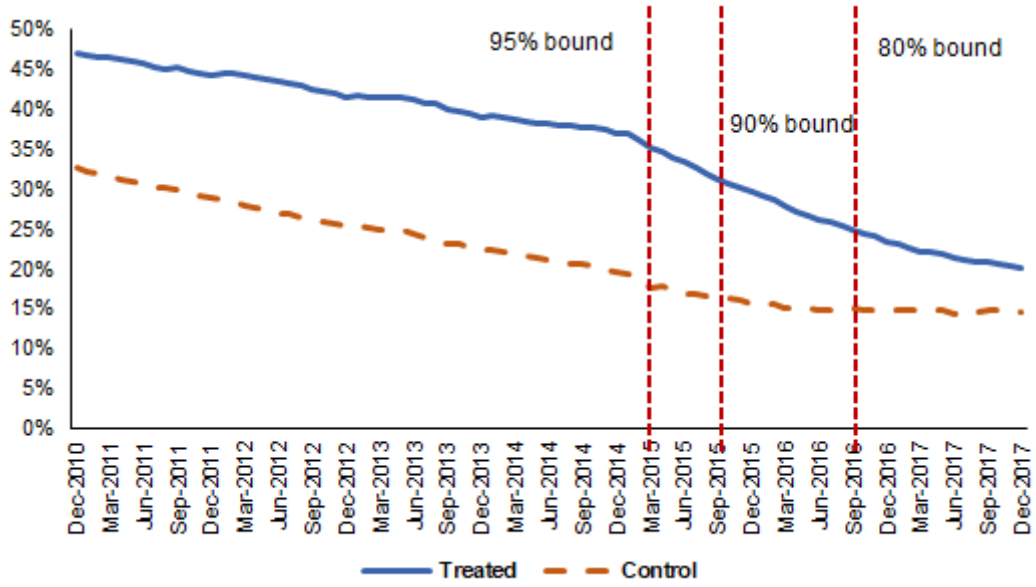
Figure 10: Number of constrained banks



We use the information on banks that are above and below the thresholds implied by the policy measures, and match it with the credit register data on credit flows at the bank-firm level. In this way, our identification of the 'treatment' group contains those firms that took more than 50 percent of their total credit from constrained banks (above the threshold for the stock of foreign currency credit) during the implementation period of the de-dollarization policies. We would expect that firms that take loans from this group of banks are the most affected, as those banks would have the incentives to switch credit in foreign currency to domestic currency.

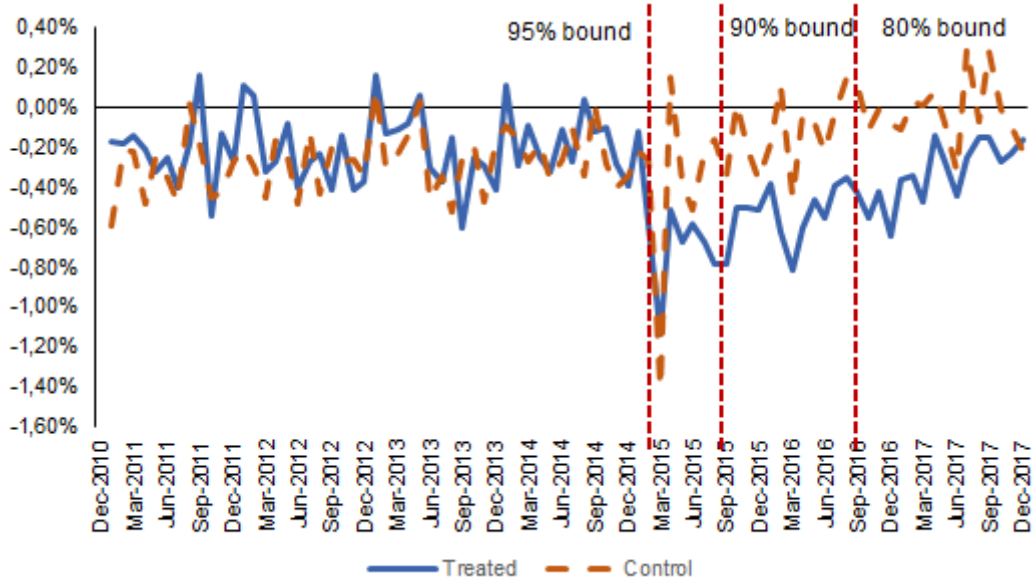
We propose a quasi experimental method, a difference-in-difference estimator, to obtain the causal effect. The data is structured as a panel, so we can use the pre and post treatment variation to obtain an estimation of the policy effect. This method robustness holds on the assumption of common trends, which in our case would be equal to argue that trends in dollarization should be equal in treated and not treated groups if the policy measures did not take place. We control for both demand and supply factors that affect credit in both currencies, local and foreign. Demand factors are related to the need of firms to finance their investment projects and do liquidity management. The decision of the currency denomination of the loan is related to the relative funding costs in each currency, the expected evolution of the exchange rate and the currency risk. On the supply side, loans in each currency are conditioned on the structure of the banks balance sheet, reserve requirements, the cost of funding of banks and the currency exposure targeted by the bank. It is important to note that the de-dollarization policy measures create an additional cost for financial institutions and affect the supply side of foreign currency credit. Our estimation controls for demand factors and in the case of supply side factors, we include dummies to identify different types of banks.

Figure 11: Dollarization ratio, treated and control groups



To assess this assumption, we can observe the pre-treatment evolution of the dollarization in treated and control groups. Figures 11 and 12 show that in the period prior to the implementation of the de-dollarization policies, credit dollarization in both groups followed a similar trend.

Figure 12: Variation in dollarization ratio, treated and control groups



Following the notation in Cameron and Trivedi (2005), we include the comparison before and

after the policy intervention (adoption of de-dollarization measures), where D_t^j considers period t equal to 1 after intervention and 0 before intervention; and for each j group, equal to 1 if treated and to 0 if untreated. The regression for our measure of outcome, the change in the credit dollarization coefficient, y_{it}, takes the form:

$$y_{it}^j = \alpha + \alpha_1 D_t + \alpha^1 D^j + \beta D_t^j + \gamma Controls_{it}^j + \varepsilon_{it}^j \tag{4}$$

where $i = 1 \dots N$, $j = 0, 1$ and $t = 0, 1$. Considering the values for the dummies, we can calculate the impact for treated and untreated groups by subtracting the difference between pre-intervention and post-intervention values. For the treated group, the value of credit dollarization before the adoption of the policy measures is:

$$y_{i0}^1 = \alpha + \alpha^1 + \gamma Controls_{i0}^1 + \varepsilon_{i0}^1 \tag{5}$$

After the adoption of the policy measures, the value of credit dollarization for the treated group of firms is:

$$y_{i1}^1 = \alpha + \alpha_1 + \alpha^1 + \beta + \gamma Controls_{i1}^1 + \varepsilon_{i1}^1 \tag{6}$$

For the treated group, the impact of the de-dollarization policy measures is given by subtracting equations (6) and (5):

$$y_{i1}^1 - y_{i0}^1 = \alpha_1 + \beta + \gamma(Controls_{i1}^1 - Controls_{i0}^1) + (\varepsilon_{i1}^1 - \varepsilon_{i0}^1) \tag{7}$$

Similarly, the impact of the de-dollarization measures for untreated firms is given by:

$$y_{i1}^0 - y_{i0}^0 = \alpha_1 + \gamma(Controls_{i1}^0 - Controls_{i0}^0) + (\varepsilon_{i1}^0 - \varepsilon_{i0}^0) \tag{8}$$

Thus, the coefficient β captures the marginal effect of the de-dollarization measures on the treated group. We can obtain a consistent estimator of β by using the sample average of $(y_{i1}^1 - y_{i0}^1) - (y_{i1}^0 - y_{i0}^0)$ that comes out by subtracting equations (7) and (8):

$$\begin{aligned}(y_{i1}^1 - y_{i0}^1) - (y_{i1}^0 - y_{i0}^0) = \beta + \gamma((Controls_{i1}^1 - Controls_{i0}^1) \\ -(Controls_{i1}^0 - Controls_{i0}^0)) + (\varepsilon_{i1}^1 - \varepsilon_{i1}^1) - (\varepsilon_{i1}^0 - \varepsilon_{i1}^0)\end{aligned} \tag{9}$$

4 Results

In this section we present the results of the empirical estimations. First we present results using the panel estimations with fixed effects as described in subsection 3.1. Table 2 shows the results for the total sample of firms in our database and analyze if there are any heterogeneous impacts by the type of banks that provide the loans.

Table 2: Determinants of the credit dollarization ratio
Segmented by type of bank

Dependent variable: Monthly variation of the credit dollarization ratio
Firms: Whole sample

Variable	(1)	(2)	(3)
Interest rate spread (PEN - USD) (-3)	0.001^{***}	0.001^{***}	0.001^{***}
GDP % var (-3)	0.002^{***}	0.002^{***}	0.002^{***}
XR volatility (-1)	-0.0093^{***}	-0.0078^{***}	-0.0078^{***}
XR expected % var	$-4e-5^{***}$	$-3e-5^{***}$	$-3e-5^{***}$
NPL (-1)	0.0001	0.0001	0.0001
Dedoll 2013	0.0006	0.0006	0.0011^{**}
Dedoll jun2015	-0.0018^{***}	-0.0017^{***}	-0.0015^{***}
Dedoll dec2015	-0.0014^{***}	-0.0013^{***}	-0.0012^{***}
Banks for corporate firms		-0.0026	-0.0012
Banks for big and medium firms		-0.0003	0.0000
Banks for small firms		-0.0011^{***}	-0.0011^{***}
Banks for consumption loans		-0.0229	-0.0280
Dedoll 2013 (corp)			-0.0218^{*}
Dedoll 2013 (big)			-0.0011
Dedoll 2013 (small)			-0.0025^{*}
Dedoll 2013 (consumption)			0.0142
Dedoll jun2015 (corp)			-0.0026
Dedoll jun2015 (big)			-0.0007
Dedoll jun2015 (small)			-0.0010
Dedoll dic2015 (corp)			-0.0056^{***}
Dedoll dic2015 (big)			-0.0016
Dedoll dic2015 (small)			0.0006
Dedoll dic2015 (consumption)			0.0608
Constant	-0.0018^{***}	-0.0018^{***}	-0.0018^{***}
Estimator	FE	FE	FE
Obs	7231333	7231333	6953027
Firms	264787	264787	263631
F stat	106.58^{***}	71.32^{***}	38.47^{***}

*, **, *** represent significance at 10, 5 and 1% respectively.

Results in Column (1) consider the average impact of de-dollarization policy measures on the ratio of credit dollarization for all banks in our sample. We find that, even in the period before the implementation of the policy measures, there already was a slight downward trend for credit dollarization, with a 0,2 percentage point reduction on average for the whole sample. However, policy measures contributed to accelerate the pace of de-dollarization, especially after the announcement of the 2015 set of policies at the end of February. This set of measures had an average monthly reduction in the credit dollarization ratio of 0,18 and 0,14 percentage points for the policy measures that needed to be implemented by June and December 2015, respectively.

Column (2) shows that before the adoption of these policy measures, different types of banks had differentiated strategies. For instance, banks that target mainly small firms, on average, had a faster credit de-dollarization process. This results could be reflecting that banks are improving their risk management profile in terms of exposure to clients with currency mismatches, where smaller firms have mostly income in domestic currency and are less able to obtain financial

hedge against exchange rate fluctuations.

Column (3) additionally calculates heterogeneous impacts for the de-dollarization measures depending on the type of bank. Even though on average, de-dollarization policy measures adopted in 2013 do not show significant currency substitution in the credit portfolio, this effect is significant for a subs-ample of banks. Those banks with credit mainly allocated to the corporate sector and to small firms do show a significant acceleration in the pace of credit de-dollarization.

The result for banks targeting the corporate sector might reflect that a higher proportion of their credit portfolio is denominated in foreign currency, whereas the threshold to which they must converge to is uniform for all banks. Therefore, these banks need to have a more aggressive strategy of currency substitution in order to comply with the new policy measure and avoid the cost of an additional reserve requirement.

In the case of banks targeting small firms, their credit portfolio is more likely exposed to credit risk stemming from those firms currency mismatches, so both from the banks and the firms side currency substitution of credit towards domestic currency is more desirable.

On the other hand, the de-dollarization policy measures announced at the beginning of 2015 show a more uniform result, where all banks had proper incentives to substitute dollar-denominated credit to domestic currency. The results are similar both for measure needed to be implemented by June and December 2015.

Stylized facts previously shown in Figure 8 point towards larger credits being mostly denominated in foreign currency. Thus, we also analyze whether there are heterogeneous effects by the size of the loans. This could reflect two possible strategies by banks to comply with the policy measure: either by (i) substituting the currency of a smaller number of loans of large size towards domestic currency or (ii) by substituting a large number of loans of smaller size, which might entail larger transaction costs.

Table 3: Determinants of the credit dollarization ratio
Segmented by loan size

Dependent variable: Monthly variation of the credit dollarization ratio
Firms: All firms

Variable	(4)	(5)
Interest rate spread (PEN - USD) (-3)	0.001^{***}	0.001^{***}
GDP % var (-3)	0.002^{***}	0.002^{***}
XR Volatility (-1)	-0.0093^{***}	-0.0096^{***}
Expected XR % var	$-4e-5^{***}$	$-3e-5^{***}$
NPL (-1)	0.0001	0.0001
Dedoll 2013	0.0006	0.0043^{***}
Dedoll jun2015	-0.0017^{***}	-0.0006
Dedoll dec2015	-0.0013^{***}	0.0025^{***}
Loan size p25-p50	0.0011^{***}	0.0014^{***}
Loan size p50-p75	0.0023^{***}	0.0029^{***}
Loan size p75-p100	0.0049^{***}	0.0062^{***}
Dedoll 2013 (p25-p50)		-0.0037^{**}
Dedoll 2013 (p50-p75)		-0.0056^{***}
Dedoll 2013 (p75-p100)		-0.0048^{***}
Dedoll jun2015 (p25-p50)		-0.0007
Dedoll jun2015 (p50-p75)		-0.0004
Dedoll jun2015 (p75-p100)		-0.0028^{***}
Dedoll dec2015 (p25-p50)		-0.0019^{***}
Dedoll dec2015 (p50-p75)		-0.0042^{***}
Dedoll dec2015 (p75-p100)		-0.0078^{***}
Constant	-0.0038^{***}	-0.0044^{***}
Estimator	FE	FE
Obs	6953027	6953027
Firms	263631	263631
F stat	76.55^{***}	67.79^{***}

*, **, *** represents significance to 10, 5 and 1% respectively.

Table 3 shows these results. By outstanding loan size, larger loans were more dollarized before the implementation of the policy measures. Thus, the change in the credit dollarization ratio is larger for higher percentiles of the loan size distribution (last quantile $p75 - p100$). Results are consistent with a strategy to de-dollarize larger loans to meet the policy measure threshold, as the coefficients that capture the reduction in the credit dollarization ratio after the policies are higher for the highest percentiles (quantiles 3 and 4) and this result is consistent for all de-dollarization policy announcements.

We also calculate the effect on the aggregate credit dollarization ratio, as this is the indicator monitored by the Central Bank. For that purpose, we analyze the determinants of the flow of new loans and the amortization of outstanding loans by currency. De-dollarization policy measures are expected to increae the pace of new loans in domestic currency and to an early amortization of dollar denominated loans, which would point towards a prepayment of dollar loans with new loans in soles. In this way, banks would be able to comply with the thresholds on credit in foreign currency without paying the additional reserve requirement.

Table 4: Determinants of the aggregate credit dollarization ratio

Variable	(1) newloan fc	(2) newloan fc	(3) amort fc	(4) amort fc	(5) inc credit growth fc
Dedoll measures	-0.323^{***}	-0.261^{***}	0.0257^{***}	0.0232^{***}	-0.105^{***}
	(0.0135)	(0.0160)	(0.0053)	(0.0062)	(0.00538)
XR yoy var		-0.0446^{***}		-0.0300^{***}	-0.0079^{***}
		(0.0088)		(0.0033)	(0.0030)
XR dep yoy var		0.00770^{***}		0.0361^{***}	-0.0156^{***}
		(0.0125)		(0.0048)	(0.0042)
NPL	-4.862^{***}	-4.861^{***}	-3.800^{***}	-3.800^{***}	0.134^{***}
	(0.0233)	(0.0233)	(0.0113)	(0.0113)	(0.0075)
Export dummyF2.expor	0.0105^{***}	0.0105^{***}	-0.0025	-0.0025	0.0077^{***}
	(0.0039)	(0.0039)	(0.0024)	(0.0024)	(0.0017)
FX derivative dummy	0.452^{***}	0.456^{***}	0.118	0.118	0.0254^{***}
	(0.0368)	(0.0368)	(0.0187)	(0.0187)	(0.0138)
USD loan stock			0.719^{***}	0.719^{***}	
			(0.0015)	(0.0015)	
Constant	5.171^{***}	5.089^{***}	-0.527^{***}	-0.559^{***}	
	(0.0468)	(0.0478)	(0.0222)	(0.0225)	
Additional constrols					
Type of bank	Yes	Yes	Yes	Yes	Yes
Credit segment	Yes	Yes	Yes	Yes	Yes
Obsv	603283	603283	1713593	1713593	3202294
R squared	0.149	0.149	0.216	0.216	
Firms	72834	72834	78672	78672	70219

Standard errors in parenthesis. *, **, *** represent significance of 10, 5 y 1% respectively.

Results in Table 4 show that the adoption of the de-dollarization policy measures reduced the pace of new loans in foreign currency (columns (1) and (2)), whereas amortization of foreign currency credit increased its pace (columns (3) and (4)). Also, column (5) shows and acceleration in the downward trend of foreign currency credit flows. Notice also that there is a positive correlation between firms that have access to financial hedging using FX derivatives (FX derivative) and the origination of new loans in foreign currency, which provides some evidence that some proportion of dollar loans do not pose currency risk as they would be equivalent to a synthetic of a domestic currency loan when we include the FX derivative as hedge.

Next, we present results related to the difference in difference estimation as described in subsection 3.2. We present the results for the DiD estimation of the impact of the de-dollarization policy measures. In this first estimation, we consider the set of different policy measures as one whole package. To guarantee that we are obtaining a clean estimation of the effect of the implemented policy, we first need to prove that conditions faced by the 'treated' and 'control' groups were similar in the previous period. As shown in Figure 11, there is evidence that the evolution of the dollarization ratio of credit was similar between those firms who took loans from constrained banks and from unconstrained banks.

Table 5 presents these results. We consider four different specifications, where we choose to include some controls on supply and/or demand factors. Our variables of interest is the variation in the coefficient of dollarization of credit at the firm level. We are mainly interested in the coefficient for the treated group after the implementation of the policy measures, the estimator

of β from the equation in the empirical strategy section. This is given by the coefficients of the variables named treatment. Each of these $'treatment_i'$ variables measures the effect of the policy measure i months after the announcement of the de-dollarization measure in January 2015[4].

Table 5: Estimated effect through a Difference-in-difference approach

Variables	(DID estimator) dol	(Control by demand factors) dol	(Control by supply factors) dol	(All controls) dol
treatment_9	-0.0124***	-0.0123***	-0.0122***	-0.0122***
	(0.00199)	(0.00199)	(0.00199)	(0.00198)
treatment_15	-0.0319***	-0.0321***	-0.0322***	-0.0324***
	(0.00217)	(0.00217)	(0.00216)	(0.00216)
treatment_21	-0.0468***	-0.0472***	-0.0469***	-0.0474***
	(0.00229)	(0.00228)	(0.00228)	(0.00228)
treatment_27	-0.0553***	-0.0560***	-0.0562***	-0.0568***
	(0.00237)	(0.00237)	(0.00236)	(0.00236)
treatment_33	-0.0627***	-0.0635***	-0.0633***	-0.0641***
	(0.00245)	(0.00244)	(0.00243)	(0.00243)
expor		6.90e-05		6.51e-05
		(0.000187)		(0.000192)
impor		0.00138***		0.00138***
		(0.000261)		(0.000262)
usa_der_me		-0.172***		-0.169***
		(0.00592)		(0.00590)
cartera_morosa			0.0431***	0.0420***
			(0.00112)	(0.00112)
Constant	0.329***	0.329***	0.329***	0.330***
	(0.00125)	(0.00125)	(0.00125)	(0.00125)
Observations	7,766,995	7,766,995	7,766,995	7,766,995
R-squared	0.041	0.044	0.043	0.046
Number of firms	333,799	333,799	333,799	333,799

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Among the demand control variables, we include firm characteristics such as identifiers of whether firms are involved in foreign trade activities, either by being exporters (*export*) or importers (*impor*). We expect this group of firms to have a higher proportion of credit in dollars, given their access to a natural hedge against currency risk. The results are consistent with this argument and significant for firms that are importers. In this regard, we do not believe that is appropriate to exclude these type of credits, since the main purpose of the measures was to de-dollarize the financial system and not only to mitigate the risks of financial dollarization. Thus, although a credit denominated in foreign currency might be hedged, ultimately the idea is to reach the scenario where that credit is denominated in domestic currency. Also, we include a control for those firms that have access to financial hedge against currency risk (*usa_der_me*). We would expect this group of firms to be more indifferent to taking credit in dollars. For supply control variables, we consider bank characteristics such as delinquency rates at the bank level.

Even though the policy is the same for all banks in the financial system, our identification strategy of the causal effect exploits the heterogeneity of the banks in reaching the thresholds for the stock of credit in foreign currency imposed by the policy. Our results show that a significant reduction in the ratio of dollarization of credit, starting from 9 months after the announcement of the first policy measure in early 2015. Consecutive measures also contributed in accelerating the de-dollarization process, where 33 months after the beginning of these package of policies

[4]See Appendix B for alternative specifications with different standard errors.

(December 2017) firms who borrowed from banks constrained by the threshold on the stock of credit in dollars reduced their ratio of credit dollarization in 6 percentage points more than those firms that borrowed from unconstrained banks. Our results are consistent if we observe all columns with different specifications where we control for demand and supply factors.

We observe in Figure 13 an increase in the policy effect since the announcement of the first policy measure in 2015. Evidence shows that the policy measures started to reduce dollarization of credit from constrained banks starting in August 2015. The effect increases as time goes by, as banks have enough time to adjust their credit portfolio structure progressively.

Figure 13: Average effect of a Policy measure implemented in January 2015

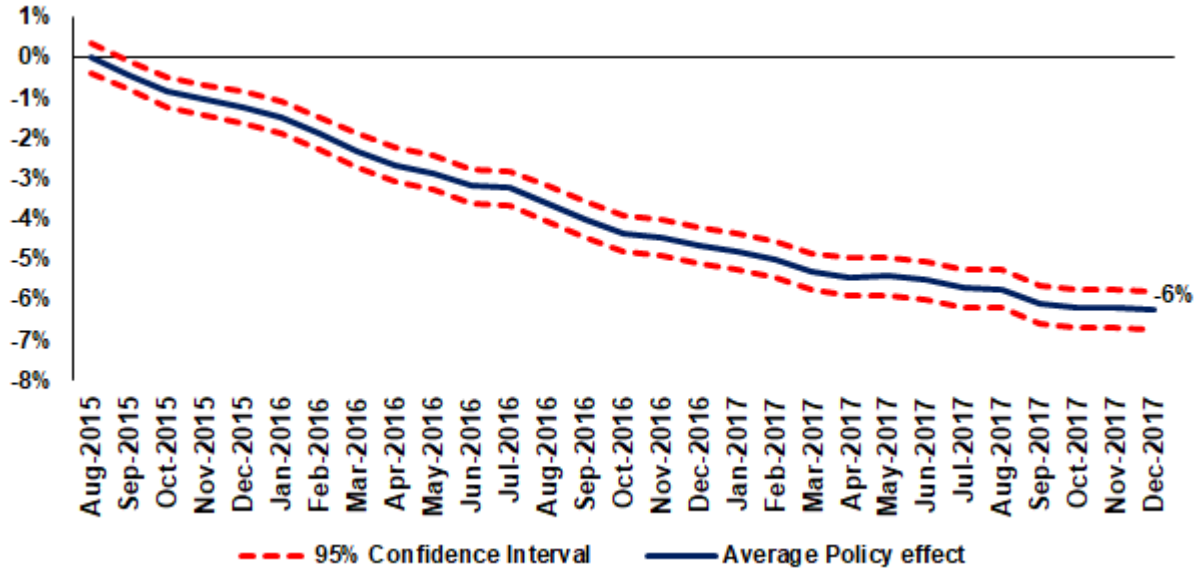


Table 6 shows the estimated contribution of the policy measures on the de-dollarization of credit. The reduction in the average credit dollarization ratio of all the firms in the sample is 20 percent from 2010 to 2017. From this, a reduction of 10 percentage points corresponds to the period after the announcement of the first policy measure in early 2015. Our estimation shows that 6 percentage points out of the 10 percentage point reduction could be associated to the de-dollarization policy measures, which correspond to about 60% of the total reduction.

Table 6: De-dollarization policy effect importance

	2010-2014	2014-2015	2014-2016	2014-2017
Observed	-9.7 %	-5.7 %	-9.0 %	-10.6 %
Due to Policy	0 %	-1,2 %	-4,7 %	-6,3 %
Importance	0 %	21,6 %	51,9 %	59,3 %

5 Conclusions and Further Extensions

The aim of this paper is to assess and quantify the impact of *The BCRP De-dollarization Program*, in order to reduce the exposure of bank credit to a sudden and sharp exchange rate depreciation. In order to do that, we use granular credit register data and calculate the impact on the average credit dollarization ratio and on the aggregate credit dollarization indicator.

Our results support the effectiveness of these policy measures to speed up the pace of credit de-dollarization, especially after the announcement of the policy measures of 2015. The effect of policy measures in 2013 were more limited to banks that target particular market segments, such as corporates and small firms. By loan size, banks de-dollarization strategy for their credit portfolio was linked to currency substitution of large loans.

Aggregate credit dollarization indicators also verify that de-dollarization policies helped to substitute the currency composition of loans towards soles, by increasing the pace of amortization of outstanding dollar loans and reducing the allocation of new loans in dollars and increasing new loans in soles.

Difference in difference estimations show the contribution of the de-dollarization policy measures are significant since 9 months after the announcement of the first policy measure in early 2015. We find evidence that 6 out of the 10 percentage point average reduction in the credit dollarization ratio are associated to the De-dollarization Program. That is, firms that took loans from banks that were constrained by the thresholds on the stock of credit in foreign currency show a 6 percentage larger reduction in dollarization than those firms that took credit from unconstrained banks.

Future lines of research might include the complementarity of credit dollarization and the currency composition of funding available for banks. In this line, since 2015, de-dollarization measures were accompanied by BCRP supplying currency repos to banks with large maturity, so that they could substitute funding using dollar deposits for domestic currency funding (for more details see Castillo and Humala (2017)). Thus, an analysis of the policy measures together with the funding structure of banks would be complementary.

References

Aguirre, H. and Repetto, G. (2017). Capital and currency-based macroprudential policies: an evaluation using credit registry data. *BIS Working Paper Series*, **672**.

Armas, A. (2005). Forex interventions in peru: 2002-2004, bIS Research Papers N24 - May 2005.

—, Castillo, P. and Vega, M. (2014). Inflation targeting and quantitative tightening:effects of reserve requirements in peru, banco Central de Reserva del Peru - Working Paper 2014-003.

— and Grippa, F. (2005). Targeting inflation in a dollarized economy: The peruvian experience, rES Working Papers 4423, Inter-American Development Bank, Research Department.

—, —, Quispe, Z. and Valdivia, L. (2001). De metas monetarias a metas de inflación en una economa con dolarización parcial: el caso peruano. *Revista de Estudios Económicos*, **7**.

Athey, S. and Imbens, G. W. (2006). Identification and inference in nonlinear difference-in-differences models. *Econometrica*, **74** (2), 431–497.

Banco Central de Reserva del Perú (2015). Annual report, banco Central de Reserva del Peru.

Barata Barroso, J., Barbone Gonzalez, R. and Van Doornik, B. (2017). Credit supply responses to reserve requirement: loan-level evidence from macroprudential policy, bIS Working Papers 674.

Bigio, S. and Salas, J. (2006). Efectos no lineales de choques de política monetaria y de tipo de cambio real en economías parcialmente dolarizadas: un análisis empírico para el perú, banco Central de Reserva del Peru - Working Paper 2006-008.

Cabello, M., Lupu, J. and Minaya, E. (2017). Empirical analysis of macroprudential policies in peru: The effects of dynamic provisioning and conditional reserve requirements. *BIS Working Paper Series*, **675**.

Cameron, A. and Trivedi, P. (2005). *Microeconometrics*. Cambridge University Press.

Camors, C. and Peydró, J. L. (2014). Macroprudential and monetary policy: loan-level evidence from reserve requirements. *mimeo*.

Cantú, C., Lobato, R., López, C. and López-Gallo, F. (2018). A loan-level analysis of bank lending in mexico. *mimeo*.

Card, D. and Krueger, A. B. (1993). *Minimum wages and employment: A case study of the fast food industry in New Jersey and Pennsylvania*. Tech. rep., National Bureau of Economic Research.

Castillo, P. and Humala, A. (2017). Dolarización, volatilidad cambiaria y retos para la operatividad de la poltica monetaria. *Revista Moneda*, **166**, 8–12.

—, Pérez Forero, F. and Tuesta, V. (2011). Los mecanismos de transmisión de la política monetaria en el perú. *Revista de Estudios Económicos*, **21**, 41–63.

—, Vega, H., Cabello, M. and Serrano, E. (2015). La conquista del sol: Resultados de las medidas del bcrp para acelerar la desdolarizacin de la economa. *Revista Moneda*, **164**, 4–10.

—, —, Serrano, E. and Burga, C. (2016). De-dollarization of credit in peru: the role of unconventional monetary policy tools. *BCRP Working Paper Series*, **2016-2**.

Céspedes, N. (2017). La heterogeneidad de la dolarización de cr'editos a nivel de personas. *BCRP Working Paper Series*, **2017-008**.

Collazo-Brananova, O. and Watfe, G. (2017). Use of anacredit granular data for macroprudential analysis, iFC-BIS-National Bank of Belgium Workshop on "Data needs and Statistics compilation for macroprudential analysis" Brussels, Belgium, 18-19 May 2017.

Epure, M., Mihai, I., Minoui, C. and Peydró, J.-L. (2018). Household credit, global financial cycle, and macroprudential policies: Credit register evidence from an emerging country. *IMF Working Paper Series*, **634**.

Garmaise, M. and Natividad, G. (2017). Consumer default, credit reporting, and borrowing constraints. *The Review of Finance*, **72** (5), 2331–2368.

Gomez, E., Lizarazo, A., Mendoza, J. and Murcia, A. (2017). Evaluating the impact of macroprudential policies in colombia. *BIS Working Paper Series*, **634**.

Gonzalez, R. B. (2018). Monetary policy and its real effects: loan-level evidence from brazil on the bank lending-channel. *mimeo*.

Hammond, G. (2012). *State of the art inflation targeting*. Tech. rep., Bank of England.

Heckman, J. J. and Vytlacil, E. J. (2007). Econometric evaluation of social programs, part i: Causal models, structural models and econometric policy evaluation. *Handbook of econometrics*, **6**, 4779–4874.

Humala, A. and Rodríguez, G. (2010). Foreign exchange intervention and exchange rate volatility in peru. *Applied Economics Letters*, **17** (15), 1485–1491.

Jiménez, G., Ongena, S., Peydró, J. L. and Saurina, J. (2012). Credit supply and monetary policy: Identifying the bank balance-sheet channel with loan applications. *American Economic Review*, **102(5)**, 2301–2326.

—, —, Peydró, J. L. and Saurina, J. (2014). Hazardous times for monetary policy: What do twentythree million bank loans say about the effects of monetary policy on credit risktaking? *Econometrica*, **82(2)**, 463–505.

—, —, — and Saurina, J. (2017). Macroprudential policy, countercyclical bank capital buffers, and credit supply: Evidence from the spanish dynamic provisioning experiments. *Journal of Political Economy*, **125(6)**, 2126–2177.

Miles, W. (2008). Exchange rates, inflation and growth in small, open economies: a difference-in-differences approach. *Applied Economics*, **40** (3), 341–348.

Mora, R. and Reggio, I. (2017). Alternative diff-in-diffs estimators with several pretreatment periods. *Econometric Reviews*, **0** (0), 1–22.

Morales, P., Osorio, D. and Lemus, J. S. (2018). The internalisation of domestic banks and the bank-lending channel: an empirical assessment. *mimeo*.

Ongena, S., Schindele, I. and Vonnák, D. (2014). In lands of foreign currency credit, bank lending channels run through? the effects of monetary policy at home and abroad on the currency denomination of the supply of credit. *CFS Working Paper Series*, **474**.

Oré, E., Pardo-Figueroa, R., Contreras, A., Ortiz, M. and Castillo, P. (2018). Taxonomía de la desdolarización del crédito. *Revista Moneda*, **167**, 4–8.

Pérez, F. and Vilchez, D. (2018). Ciclos financieros en el perú. *Revista Moneda*, **173**, 4–9.

Pérez-Forero, F. and Vega, M. (2014). The dynamic effects of interest rates and reserve requirements, banco Central de Reserva del Peru - Working Paper 2014-018.

Pischke, J.-S. (2007). The impact of length of the school year on student performance and earnings: Evidence from the german short school years. *The Economic Journal*, **117** (523), 1216–1242.

Ramírez-Rondán, N. (2018). Balance sheet and currency mismatch: evidence for peruvian firms. *Empirical Economics*.

Rossini, R., Armas, A. and Quispe, Z. (2014). Global policy spillovers and Perus monetary policy: inflation targeting, foreign exchange intervention and reserve requirements. In B. for International Settlements (ed.), *The transmission of unconventional monetary policy to the emerging markets*, *BIS Papers chapters*, vol. 78, Bank for International Settlements, pp. 241–264.

—, Quispe, Z. and Serrano, E. (2013). Foreign exchange intervention in Peru. In B. for International Settlements (ed.), *Sovereign risk: a world without risk-free assets?*, *BIS Papers chapters*, vol. 73, Bank for International Settlements, pp. 243–262.

Slaughter, M. J. (2001). Trade liberalization and per capita income convergence: a difference-in-differences analysis. *Journal of International Economics*, **55** (1), 203–228.

Van Roy, P., Barbic, G., Koban, A. and Kouratzoglou, C. (2017). Use of credit registers to monitor financial stability risks: A cross-country application to sectoral risk, iFC-BIS-National Bank of Belgium Workshop on "Data needs and Statistics compilation for macroprudential analysis" Brussels, Belgium, 18-19 May 2017.

Vega, M. and Chavez, J. (2017). Propagación de choques de encaje en el sistema bancario peruano, banco Central de Reserva del Peru - Working Paper 2017-004.

A Data Description

Our main data source for credit information at the bank-firm level comes from the credit register central. We complement this using different data sources to obtain control variables. In particular, we consider variables that capture bank characteristics, firm characteristics and macroeconomic variables.

The final database considers monthly data from December 2010 to December 2017. The total number of firm-date observations for credit in each currency is 7 472 052 observations. Table 7 presents a summary of some descriptive statistics from the database. It considers a total of 16 banks and 279,628 firms in our sample. Average characteristics across banks and firms are presented in the Table.

Table 7: Descriptive Statistics

Variable	Definition	Mean	Std Dev	Min	Median	Max
Dependent variables						
Δ Credit dollarization	yoy % var of credit dollarization ratio	-0,001835	0,1417	-1	0	1
De-dollarization Dummy	= 1 if Δ Credit dollarization¡0	0,2774	0,4477	0	0	1
Independent variables						
De-dollarization measure 2013	= 1 if Oct2013	0,0121	0,1095	0	0	1
De-dollarization measure jun2015	= 1 if between Feb2015 and Jun2015	0,0629	0,2428	0	0	1
De-dollarization measure dec2015	= 1 if between Feb2015 and Dec2015	0,1388	0,3458	0	0	1
NPL	non-performing loans as % of total loans	0,1290	0,3274	0	0	1
Macroeconomic variables						
Interest rate differential	i PEN - i USD - Δ exchange rate	0,41376	5,73	-11,21	1,92	10,81
Δ GDP	yoy % var in GDP	4,50	2,30	0,169	4,23	10,31
XR volatility	Std Dev of nominal exchange rate	0,0610	0,0331	0,0124	0,0562	0,1264
ΔXR^e	Expected XR (from survey) vs realized XR	-0,8377	6,12	-11,65	0,5617	12,11
Banking sector variables						
CAR	Capital asset ratio	14,31	0,968	12,03	14,24	32,37
NPL	Non performing loans	2,53	1,13	1,16	2,43	7,26
ROA	Return on assets	2.06	0,62	-1,26	2,15	5,71
LiqMN	Liquid assets in soles as % assets in soles	2,53	5,89	0,01	0,50	44,75
LiqME	Liquide assets in dollars as % of assets in dollars	6,83	20,11	0,46	1,52	9952,23

In this paper we use individual credit data at the firm level and compare the dollarization ratio before and after the adoption of these policy measures. Following the methodologies used in the event studies literature, we evaluate if there is a significant change in the trend of credit dollarization, and particularly, if there has been an acceleration towards faster currency substitution towards credit in soles.

However, there are some caveats on the limitations of our database that we must take into account:

- **Foreign trade operations:** Our sample of firms includes those who make foreign trade operations and therefore have direct access to natural hedge to currency risk. Additional reserve requirements to dollar denominated credit consider some exceptions for credit transactions classified as foreign trade, which differs from all credit transactions by firms engaged in exports and imports. In our estimations, we control only for those firms that have exported or imported during the year using information from the National Superintendency of Tax Administration (SUNAT). In this way, we control for those firms with access to natural hedge.
- **Financial hedge against currency risk:** The database includes firms that had financial

contracts to hedge against currency risk. 29 percent of firms with dollar loans had access to hedge contracts using exchange rate derivatives. These loans would not be exposed to a currency mismatch, as it would constitute a synthetic operation similar to a credit in domestic currency. In order to control for that, we include an indicator of whether the firm has a FX derivative contract.

- **Exceptions to the additional reserve requirement:** Even though there is no specific detail on those loans that are excluded from the policy measures (outstanding amount higher than USD 10 million and maturity longer than 3 years) due to the lack of information on the maturity of each credit, we control for those loans larger than USD 10 million.

B Alternative specifications with different standard errors

Table 8: Estimated effect through a Difference-in-difference approach (classic)

	(1)	(2)	(3)	(4)
VARIABLES	dol	dol	dol	dol
treatment_9	-0.0124***	-0.0123***	-0.0122***	-0.0122***
	(0.00136)	(0.00136)	(0.00136)	(0.00136)
treatment_15	-0.0319***	-0.0321***	-0.0322***	-0.0324***
	(0.00136)	(0.00136)	(0.00136)	(0.00136)
treatment_21	-0.0468***	-0.0472***	-0.0469***	-0.0474***
	(0.00137)	(0.00137)	(0.00137)	(0.00136)
treatment_27	-0.0553***	-0.0560***	-0.0562***	-0.0568***
	(0.00135)	(0.00135)	(0.00135)	(0.00135)
treatment_33	-0.0627***	-0.0635***	-0.0633***	-0.0641***
	(0.00137)	(0.00137)	(0.00137)	(0.00137)
expor		6.90e-05		6.51e-05
		(0.000112)		(0.000111)
impor		0.00138***		0.00138***
		(0.000191)		(0.000191)
usa_der_me		-0.172***		-0.169***
		(0.00114)		(0.00114)
cartera_morosa			0.0431***	0.0420***
			(0.000322)	(0.000322)
Constant	0.329***	0.329***	0.329***	0.330***
	(0.000807)	(0.000806)	(0.000806)	(0.000805)
Observations	7,766,995	7,766,995	7,766,995	7,766,995
R-squared	0.041	0.044	0.043	0.046
Number of ruc	333,799	333,799	333,799	333,799

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: Estimated effect through a Difference-in-difference approach (Bootstrapp)

VARIABLES	(1) dol	(2) dol	(3) dol	(4) dol
treatment_9	-0.0124***	-0.0123***	-0.0122***	-0.0122***
	(0.00196)	(0.00195)	(0.00203)	(0.00196)
treatment_15	-0.0319***	-0.0321***	-0.0322***	-0.0324***
	(0.00219)	(0.00222)	(0.00224)	(0.00216)
treatment_21	-0.0468***	-0.0472***	-0.0469***	-0.0474***
	(0.00238)	(0.00227)	(0.00235)	(0.00219)
treatment_27	-0.0553***	-0.0560***	-0.0562***	-0.0568***
	(0.00245)	(0.00230)	(0.00248)	(0.00233)
treatment_33	-0.0627***	-0.0635***	-0.0633***	-0.0641***
	(0.00245)	(0.00233)	(0.00248)	(0.00242)
expor		6.90e-05		6.51e-05
		(0.000223)		(0.000225)
impor		0.00138***		0.00138***
		(0.000390)		(0.000424)
usa_der_me		-0.172***		-0.169***
		(0.00592)		(0.00599)
cartera_morosa			0.0431***	0.0420***
			(0.00117)	(0.00108)
Constant	0.329***	0.329***	0.329***	0.330***
	(0.00150)	(0.00161)	(0.00157)	(0.00145)
Observations	7,766,995	7,766,995	7,766,995	7,766,995
R-squared	0.041	0.044	0.043	0.046
Number of ruc	333,799	333,799	333,799	333,799

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10: Estimated effect through a Difference-in-difference approach (Clusters)

VARIABLES	(1) dol	(2) dol	(3) dol	(4) dol
treatment_9	-0.0124***	-0.0123***	-0.0122***	-0.0122***
	(0.00199)	(0.00199)	(0.00199)	(0.00198)
treatment_15	-0.0319***	-0.0321***	-0.0322***	-0.0324***
	(0.00217)	(0.00217)	(0.00216)	(0.00216)
treatment_21	-0.0468***	-0.0472***	-0.0469***	-0.0474***
	(0.00229)	(0.00228)	(0.00228)	(0.00228)
treatment_27	-0.0553***	-0.0560***	-0.0562***	-0.0568***
	(0.00237)	(0.00237)	(0.00236)	(0.00236)
treatment_33	-0.0627***	-0.0635***	-0.0633***	-0.0641***
	(0.00245)	(0.00244)	(0.00243)	(0.00243)
expor		6.90e-05		6.51e-05
		(0.000187)		(0.000192)
impor		0.00138***		0.00138***
		(0.000261)		(0.000262)
usa_der_me		-0.172***		-0.169***
		(0.00592)		(0.00590)
cartera_morosa			0.0431***	0.0420***
			(0.00112)	(0.00112)
Constant	0.329***	0.329***	0.329***	0.330***
	(0.00125)	(0.00125)	(0.00125)	(0.00125)
Observations	7,766,995	7,766,995	7,766,995	7,766,995
R-squared	0.041	0.044	0.043	0.046
Number of ruc	333,799	333,799	333,799	333,799

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1