Macroprudential FX Regulations: Sacrificing Small Firms for Stability?*

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This version: January, 2021

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Abstract

Macroprudential FX regulation may reduce systemic risk; however, little is known about its unintended consequences. I show that policies taxing bank dollar lending may increase financing disparities between small and large firms. I propose a theoretical mechanism in which currency mismatch acts as a means for relaxing small firms' borrowing constraints. Under this framework, a tax on dollar lending negatively affects the total borrowing of constrained (small) firms, while it only has compositional effects on the total credit to unconstrained (large) firms. To verify this empirically, I study the implementation of a macroprudential FX tax by the Central Bank of Peru. I construct a novel firm-level dataset that combines confidential data on the universe of loans given by Peruvian banks to nontradable firms. Exploiting the heterogeneity in the strictness of the tax across banks, I provide causal evidence of the heterogeneous effects of this tax on firms of different sizes. I confirm the predictions of my mechanism: 10% increase in bank exposure to the tax significantly increases disparities in the growth of total loans between small and large firms by 1.5 percentage points. When accounting for firms switching to soles financing from different banks, the effect on large firms financing is only compositional. My findings have implications for the understanding of the link between macroeconomic policy and inequality.

Keywords: macroprudential FX regulations, currency mismatch, small firms, emerging markets, borrowing constraints, bank lending channel

JEL-Codes: E43, E58, F31, F38, F41

*I am especially grateful to Aaron Tornell, Saki Bigio and Ariel Burstein. I also benefited from discussions and comments from François Geerolf, Oleg Itskhoki, Lorena Keller, Marco Ortiz, Liliana Varela, participants at macro proseminars at UCLA's Department of Economics, the 95th Western Economic Association Annual Conference, the 90th Southern Economic Association Annual Conference, and the Central Bank of Peru seminar on macroeconomics (2019). I am particularly grateful to members of the Central Bank of Peru, Adrian Armas, Paul Castillo, Mirko Daga, Erick Lahura, Fernando Perez, and Marco Vega for insightful comments and their invaluable help in accessing the data. All errors are my own.

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I Introduction

Nontradable firms in emerging economies issue large amounts of dollar debt, exposing their balance sheets to exchange rate movements[2] and credit default risk. This is worrisome since by exposing their own balance sheets they are indirectly exposing the asset portfolio of banks that lend them. Regulatory authorities have responded implementing macroprudential policies on banks' use of dollar funding as a source of bank lending, particularly to nontradable firms.[3]

However, the unintended distributional effects of these regulations on firms' financing are not well understood and have remained unexplored in the literature. Macroprudential FX policies may impose disproportionate costs on small, financially constrained firms, for which currency mismatch is arguably a means for relaxing their borrowing constraints and for financing investment.[4] In this paper, I show theoretically and empirically that macroprudential FX policies increase financing disparities between small and large nontradable firms.

I propose a mechanism in which currency mismatch can be a source of cheaper financing that relaxes firms' borrowing constraints. I derive two credit-market equilibria, one in which firms face a severe contract-enforceability problem that gives raise to borrowing constraints (i.e., firms are small in equilibrium),[5] and one in which the enforceability problem is not severe enough, and firms are not highly constrained (i.e., they are large in equilibrium). I show that in equilibrium, denominating debt repayments in dollars (currency mismatch) is cheaper than in local currency (soles), but simultaneously exposes firms to insolvency risk. This dollar premium allows small firms to relax their borrowing constraints and increase their leverage and investment possibilities. By contrast, currency mismatch may entail profit gains for large firms, but it does not affect their leverage and optimal investment. I show that under some parametric conditions, small firms find optimal to take insolvency risk and exploit the leverage gains that the currency mismatch entails. I also show that depending on the size of their internal wealth, large firms may or may not find optimal to issue dollar debt.

Under this framework, imposing a macroprudential tax on lender's dollar funding, ultimately increases

[2] Bruno and Shin (2015); McCauley, McGuire, and Sushko (2015).

[3] Peru, Bulgaria, Croatia, and Romania are four of many examples. (See the IMF 2017 MaP survey).

[4] See Ranciere, Tornell, and Vamvakidis (2010) for evidence on the relationship between currency mismatch and growth for small firms in emerging countries in Europe.

[5] A large body of theoretical and empirical literature explains why the cost of external finance is larger for smaller firms—it's due to asymmetric information problems. See Schiantarelli (1995) for a review of relevant studies and Beck (2007) for a survey on empirical evidence in developing countries.

firm's cost of borrowing in dollars. If dollar debt becomes more expensive, the firm could find it optimal to switch away from dollar debt to more expensive but risk-free soles debt. Alternatively, if the gains of taking on mismatch risk are still high enough after the tax, the firm could find it optimal to keep on issuing dollar debt, and pay the tax. In either case, firm's cost of borrowing increases after the tax is implemented. In an equilibrium where firms are small, borrowing constraints become tighter after tax. Then, not only does the tax might affect the currency composition of firms' debt, but also generates reallocation effects in the economy. By contrast, in an equilibrium of large firms, issuing dollar debt is not a means for relaxing borrowing constraints; the tax only generates a change in the currency composition of firm's debt but does not affect total borrowing.

To verify this empirically, I take advantage of an unprecedented and arguably unexpected macroprudential FX policy intervention by the Central Bank of Peru (BCRP). In December 2014, it announced it was implementing a policy that would increase the reserve requirements *(tax)* on banks' dollar liabilities. This increase was heterogeneous across banks, depending on the following rule: the BCRP required that by December 2015 (*deadline*), banks in the financial system had to reduce their stock of dollar loans[6] to, at most, 90% of its own stock in September 2013 (*benchmark*). Otherwise, banks had to pay a tax on their FX liabilities proportional to the difference between their stock of dollar loans at the *deadline* and at the *benchmark*.

Based on this rule, two sources of variation determine banks' exposure to the policy: First, for a given increase in the tax rate, banks that at the announcement more strongly rely on dollar funding are more exposed to the tax. Second, for a given degree of reliance on dollar funding, banks that at the announcement are further from the regulatory benchmark are also more exposed to the tax. These two sources of bank exposure are strongly correlated: banks that at the announcement rely more heavily on dollar funding are also further from the regulatory benchmark.[7] Therefore, this regulation can be understood more simply as a progressive tax on banks' dollar liabilities: the tax rate increases as the base increases.

I exploit the cross-sectional variation in banks' exposure to the tax to identify the bank lending channel of the macroprudential tax to nontradable firms. Simultaneously, I test whether firms borrowing from

[6] Excluding loans granted to exporters or importers.

[7] The explanation is on the well documented evidence on banks hedging incentives and the presence of regulatory limits on banks' FX risk exposure. See Keller (2018) for evidence on Peruvian banks, and Canta, Collazos, and Shiva (2006) and Tobal (2018) for evidence in emerging economies.

differently exposed banks respond heterogeneously to this supply shock. As my proposed mechanism implies, an unexpected tax should generate a larger disparity between small and large firms' growth of total loans, within the loan portfolio of more exposed banks. Also, after accounting for firms switching from dollar to soles debt, the effect of the tax should be negligible on large firms.

To execute my empirical strategy, I assemble a unique dataset combining the following sources: first, a confidential credit register on the universe of all loans in the financial system, collected by the regulator of the financial system (SBS). Second, publicly available data on banks' monthly balance sheets, collected by the regulator of the financial system (SBS). Third, a confidential annual dataset on the universe of all formally registered firms, collected by the tax-collection agency (SUNAT).

I use difference-in-differences with continuous treatment to compare the credit supply of banks with different degrees of exposure to the tax, before and after the policy was implemented. I use the ratio of foreign funding over total assets, calculated at the moment of the policy announcement, as an indicator of bank exposure. And I determine the heterogeneity of the tax effect by analyzing the triple interaction of bank exposure with a firm-size indicator and a dummy that captures the timing of the policy.

The validity of this identification strategy relies on five assumptions:

(1) Firms of different sizes are randomly allocated across differently exposed banks. I find no sufficient evidence to support that a potential heterogeneous effect of the tax is driven by an endogenous sorting of firm size across exposed banks.

(2) It is implied that differently exposed banks act as valid counterfactuals; that is, the evolution of loans in soles and dollars, from differently exposed banks to firms of different sizes, would have been the same had the tax not been implemented. I verify the validity of this assumption by checking pretrends and testing balance on relevant observables.

(3) Banks did not anticipate the tax. I argue that this is not the case, as the effect of the tax on dollar loans starts being statistically significant right after the policy announcement, and not before. Also, the BCRP's policy has a particular feature that makes it suitable as an experiment: it was novel. It was the first time the Central Bank conditioned the increase in the reserve requirement rate on the *reduction* of dollar loans. Thus, even if banks knew that some type of measure was about to be

implemented, it was arguably hard for the banking system to anticipate the shape of the policy rule, and to behave strategically.

(4) The imposition of the tax is exogenous to domestic or external economic conditions. The policy was implemented in a context of a depreciatory trend of the sol that started before the policy was announced.[8] The policy was conveniently implemented in this context to facilitate firms' transition from dollar to soles debt. Nevertheless, by ruling out pre-trends, I am limiting the possibility that these external macroeconomic conditions are driving my results.

(5) Shifts to firms' demand for loans are uncorrelated with bank exposure. The depreciatory trend might be associated with firms' incentives to get rid of dollar loans, which can also be driving my results. However, by ruling out pre-trends, I show that there is no correlation between demand shifts in dollar loans and bank exposure, before the policy announcement. To invalidate this identification assumption one would need to argue why firms started to react to the depreciation of the sol right on December 2014 and not before.

My results are consistent with the predictions of my model. For the three smaller categories, a 10% increase in bank exposure to the shock (roughly equivalent to moving from the median to the 75th percentile of exposure) results in a statistically significant reduction of the growth rate of new *dollar* loans of around 4.2 percentage points the year after the announcement. This effect is –2 percentage points for *large* firms and also statistically significant.

The magnitude of these effects captures not only the effect of firms assuming a higher cost on dollar debt but also firms switching away from dollar debt to soles debt to avoid the tax burden. To account for the latter effect, I estimate the effect of the tax on the growth rate of new *total* (dollar plus soles) loans, for the same sample of firms. The results remain statistically significant for the three smaller categories, although smaller in magnitude: a 10% increase in bank exposure to the shock results in a reduction of the growth rate of new *total* loans of around 3.2 percentage points. However, for *large* firms, the estimated coefficients are imprecise and not statistically different from zero in most specifications. In addition, the differential effect of the shock between the three smaller categories and *large* firms is statistically significant, consistent with my proposed mechanism.

[8] This period started after the US Taper Tantrum announcement in May 2013 and ended in December 2015 with the policy "liftoff"

These results remain qualitatively robust to several additional checks: (1) alternative size-related indicators such as number of workers, sales-range, and age; (2) an alternative indicator of bank exposure to the policy; and (3) adding bank and date clusters.

Finally, to account for firms switching to soles debt from other banks, I aggregate loans at the firm level and estimate the effect that firm's overall exposure to the policy has on the growth rate of new loans. I construct a firm's exposure indicator as the weighted sum of the exposure of all banks from which the firm borrows. I find that the ability of firms to substitute their dollar loans to soles loans from other banks is increasing in size. In the end, the smallest size category (i.e., *micro* firms), remains significantly negatively affected by the tax in all specifications. *Large* firms in contrast, are better able to remain unaffected by the tax, and, as implied by my mechanism, changes in their overall financing are only compositional.

The main takeaway of this paper is that it provides evidence of a potential trade-off between small firms' growth and financial stability that has not been studied in the literature. It is worth noting that I am not taking a stance on the optimality of these policies, for which I would need to account for the likelihood and the size of the counterfactual growth losses of small firms during crisis.

The findings in this paper have important implications for policy design. For example, to facilitate the transition of highly financially constrained firms to soles borrowing, the monetary authority can provide additional liquidity facilities to banks conditional on lending to the smallest size segments. This should not be substantially expensive given the low share of small firms in banks' portfolio of loans.

Finally, by disproportionally hurting small firms' financing possibilities, these policies may have indirect implications on income inequality.

I.A Contribution to the Literature

This paper contributes to two main strands of the literature on macroeconomics and international finance: first, the literature on financial liberalization and capital allocation across firms, and second, the recent literature on the unintended consequences of macroprudential FX regulations. It is also related to the literature on the determinants of currency mismatch; the recent literature that studies the connection between UIP violations and corporate credit and the literature on the bank lending channel of monetary and macroprudential policies.

Financial liberalization and capital allocation across firms. Varela (2017), Alfaro, Chari, and Kanczuk (2017), Andreasen, Bauducco, and Dardati (2017), DeGregorio, Edwards, and Valdes (2000), Forbes (2007), Larrain and Stumpner (2017). Putting aside the semantic differences between capital controls and macroprudential FX policies,[9] my paper is in essence related to the literature on the imposition of capital controls (or financial liberalization episodes) and their heterogeneous effects on firms' investment through higher (or lower) aggregate interest rates. The source of heterogeneity is given by small firms' inability to access financial markets and avoid the higher borrowing costs generated by the capital control, as opposed to large, unconstrained firms. However, this literature remains silent on the trade-offs that exist between dollar and local currency financing, and how small firms optimally decide to assume mismatch risk as a way to relax borrowing constraints. I contribute to this literature by incorporating this trade-off in my theoretical framework. I also contribute to the empirical literature by providing direct evidence on firms' financial outcomes (dollar and local currency loans) instead of indirect evidence on real outcomes. Due to limited data availability, empirical literature typically relies on a sample of listed firms or survey data, where the definition of *small* is relative. An advantage of my approach is that it considers listed and nonlisted firms alike, capturing the impact of the policy across the entire economy and firms that are arguably the most credit-constrained.

Unintended consequences of macroprudential FX regulations. Keller (2018), Ahnert, Forbes, Friedrich, and Reinhardt (2018), Aiyar, Calomiris, and Wieladek (2014), Cerutti, Claessens, and Laeven (2017), Reinhardt and Sowerbutts (2015). The literature on the unintended consequences of macroprudential FX regulations is mostly related to regulatory arbitrage or a partial shift of FX risk from the banking sector to other sectors of the economy (e.g., investors, borrowers). This paper is to my knowledge, the first to address the unintended consequences of macroprudential FX regulations from a distributional perspective.

Determinants of currency mismatch. My paper is related to the literature that explains the determinants of firms' debt currency denomination. I use a framework in which currency denomination

[9]Capital controls are measures that discriminate operations with nonresidents, while macroprudential FX policies are bank regulations that discriminate based on the currency denomination of an operation. See DeCrescenzio, Golin, and Molteni (2017) for a detailed definition.

of firm's debt responds to a trade-off between a relaxation of borrowing constraints and insolvency risk, as in Ranciere and Tornell (2016). This mechanism is also complementary to that in Salomao and Varela (2018). Several empirical studies on the determinants of dollar borrowing analyze the macroeconomic and firm-level variables that determine a firm's willingness to take on currency mismatch, for example Basso, Calvo-Gonzales, and Jurgilas (2007) and Brown, Ongena, and Yesin (2009), who focus on small firms, and Allayannis, Brown, and Klapper (2007) and Bruno and Shin (2015), who highlight the carry-trade motive behind dollar debt issuance in emerging markets. My paper speaks to this literature by showing preliminary evidence on the greater willingness of small firms to take advantage of the interest-rate differential between soles and dollar loans.

UIP violations and corporate credit. This paper is also related to the empirical literature that studies the pass-through of UIP deviations to the cost of debt. For example, Richers (2019) uses evidence on the universe of corporate bonds issued by nonfinancial firms, while Ranciere et al. (2010) provide evidence in emerging economies using survey data on total debt. Similarly, DiGiovanni, Kalemli-Ozcan, Ulu, and Baskaya (2020) use granular data on loan-level lending rates from Turkey, to verify the presence of a UIP premium at the firm level. Ivashina, Salomao, and Gutierrez (2020), uses granular data on loan interest rates for large firms in Peru. They show that, in addition to deviations from the UIP using government rates, a dollar deposit discount explains the relative cheapness of dollar loans. To my knowledge, despite my lack of adequate granular data on interest rates, this is the first paper that provides suggestive evidence of a size-based bank pass-trough of the risk-free rate differentials to business loan rates.

Estimates of the bank lending channel. Khwaja and Mian (2008), Chodorow-Reich (2014) Dassatti, Peydro, Rodriguez-Tous, and Vicente (2017), Jimenez, Ongena, Peydro, and Saurina (2017), Keller (2018), Paravisini, Rappoport, Schnabl, and Wolfenzon (2014). My empirical methodology is related to the vast literature that uses natural experiments to study the bank lending channel of bank regulatory shocks, monetary policy shocks, or liquidity shocks that induce variation in the cross-section of credit availability.[10]

The rest of the paper is organized as follows. Section II introduces the theoretical framework. Section III provides background information on the Peruvian financial system as well as some descriptive empirical evidence. Section IV describes the main institutional aspects of the tax on dollar lending

[10]Notice, however, that the focus of my paper is to analyze heterogeneous effects of the policy coming from demand factors i.e. the tightness of borrowing constraints captured by firm size.

implemented by the BCRP. In section V, I describe the data. Section VI presents the identification strategy, the results, and robustness checks. Section VII analyses the external validity of my results. Section VIII concludes.

II A Channel Shaping Firms Heterogeneous Responses

In this section, I introduce a simple framework that captures the key mechanism shaping firms' heterogeneous responses to a tax on dollar lending, which are borrowing constraints. I analyze the equilibrium of a credit-market game for two types of nontradable firms that face different degrees of an agency problem: financially constrained firms (i.e., small) and unconstrained firms (i.e., large). I show that in equilibrium, denominating debt repayments in dollars (currency mismatch) is cheaper than in local currency (soles). This dollar premium allows small firms to relax their borrowing constraints and increase their leverage and investment possibilities, but simultaneously exposes them to insolvency risk. In contrast, while currency mismatch may entail profit gains for large firms, it does not affect their leverage and optimal investment. Then, the trade-off between insolvency risk and leverage gains is only relevant for small firms. Under this framework, imposing a tax on dollar lending decreases small firms' total borrowing in equilibrium. Large firms can reallocate to soles borrowing while keeping their overall equilibrium financing unaffected.

II.A Model Setup

I borrow elements of a credit market game from Schneider and Tornell (2004) and Ranciere and Tornell (2016), then I expand this framework in two ways. First, I analyze the implications of borrowing constraints on firms' optimal debt-denomination decisions. Second, I derive the implications of a tax imposed on dollar lending.

Consider the case of an economy populated by a continuum measure of nontradable firms run by identical entrepreneurs that live two periods, t and $t+1$. The representative entrepreneur decides to invest in the production of nontradable goods at period t. The firm's revenues are denominated in domestic currency (soles) and are obtained one period after the firm begins operations, at $t+1$. If the entrepreneur decides to invest, he uses his own wealth and can also issue debt. He can choose whether to denominate his debt in dollars or soles. If the debt is denominated in dollars, currency mismatch exposes the firm to exchange rate risk. If, in contrast, the debt is denominated in soles, the firm is hedged against exchange rate risk.

Evolution of the exchange rate. The entrepreneur takes the exchange rate, e_t (soles to dollars), as given when making his investment decisions at time t. Future fluctuations in the exchange rate, e_{t+1}, represent the only source of uncertainty in this model and evolve according to:

$$e_{t+1} = \begin{cases} \overline{e_{t+1}} & \textit{with probability} \ \ u \\ \underline{e_{t+1}} & \textit{with probability} \ \ 1-u \end{cases}$$

The *good state* happens when the exchange rate appreciates, $\overline{e_{t+1}} \geq e_t$, with probability u. The *bad state* happens when there is a severe depreciation of the exchange rate, $\underline{e_{t+1}} < e_t$, with probability $1-u$.

Expected interest rate differential (soles to dollar loans). If the entrepreneur decides to denominate a sufficiently large share, Δ, of the firm's debt in dollars, a severe exchange rate depreciation could cause the firm go bankrupt and be unable to pay its debt to the lender. In the context of this simple economy with identical entrepreneurs, high levels of debt dollarization might generate a massive default if the bad state materializes in $t+1$. In this scenario, it is assumed by lenders that the best response of the government is to provide bailout guarantees that pay lenders a fraction ϕ of the outstanding liabilities of each firm that defaults.[11] [12]

Then, bailout expectations incentivize lenders to shift the exchange rate risk to the government and do not completely charge the insolvency risk premium that currency mismatch entails. Meanwhile, borrowers that take on mismatch risk, will pay their debt only in the good state with probability u. Then, as long as the default probability given by $(1-u)$ is larger than the insolvency premium charged by the lender $(1-\phi)$, dollar borrowing is cheaper than soles borrowing in expectation.[13]

[11] Bailouts may take different forms in practice, such as capital injections, as well as liquidity provisions, guarantees of bank liabilities, etc. The main condition is that the government or any bailout agency provides this assistance during episodes of financial distress beyond the support given in normal circumstances. The motivation behind their implementation is typically related to systemic importance or interconnections of the lender as well as political reasons (see Berger and Roman (2020), Schich and Lindh (2012)).

[12] A justification for implicit guarantees for lenders' debt being a best response of the government when a critical mass of borrowers default is studied in Farhi and Tirole (2012).

[13] If, on the other hand, entrepreneurs denominate a sufficiently high share of their debt in soles, the absence of bankruptcy risk does not validate bailout expectations, and they cannot exploit the implicit subsidy.

Contract enforceability problem. Entrepreneurs can make arrangements to divert the investment returns of the firm, which requires a nonpecuniary diversion cost of h per unit of firm's assets. Once the diversion scheme is in place, the entrepreneur can divert the gross returns at date $t+1$, provided the firm is solvent. Firms have incentives to divert funds when h is smaller than the interest rate of its debt. That is, diversion incentives arise only when diverting one unit of assets is cheaper than the marginal cost of debt repayment. To eliminate diversion incentives, lenders impose an incentive compatibility constraint (i.e., borrowing constraints) that limits the amount firms can borrow.[14]

The parameter h can be understood as a measure of the severity of the enforceability problem or the tightness of borrowing constraints: a low h implies lax contract enforcement and therefore, tighter borrowing constraints. Again, the goal in this section is to analyze the equilibrium of the credit market game for two types of firms: firms with low contract enforcement (value of h below a threshold), and firms with high contract enforcement (value of h above a threshold).

Firm financing. An entrepreneur starts operating at time t with an initial endowment of internal funds given by w_t, denominated in dollars. He can finance his investment and/or savings using debt, B_t, plus internal funds, w_t. Entrepreneurs invest in nontradable goods (N-goods), $e_t I_t$, for next period's production[15] and can save in risk-free bonds, s_t, obtaining the international interest rate equal to r_t. Thus, his budget constraint is given by

$$e_t I_t + s_t \leq w_t + B_t \tag{1}$$

The entrepreneur can choose between two types of one-period debt: soles debt, b_t^s, with repayments denominated in soles, and dollar debt, b_t, with repayments denominated in dollars. Thus, the expected repayment if the two types of debt are issued becomes

$$L_{t+1} = e_{t+1}(1+\rho_t^s)b_t^s + (1+\rho_t)b_t \tag{2}$$

[14] The present value of expected debt repayment should be lower than the total cost of diverting funds.

[15] To produce N-goods, the firm uses capital that consists of N-goods invested during time t, I_t, and that fully depreciates after one period. The production function is linear and capacity constraints are imposed as a short cut to achieve a decreasing returns production function:

$$q_t = \theta k_t; \quad k_t = I_{t-1}; \quad I_t < \overline{I}$$

Imposing capacity constraints allows for investment to be bounded, when returns to investment are sufficiently high and firms do not face borrowing constraints that limit their investment. This assumption helps solve the equilibrium of the model in closed form.

where ρ_t and ρ_t^s are the respective interest rates on dollar and soles loans. Firm's profits, expressed in dollars, becomes

$$\pi(e_{t+1}) = e_{t+1}q_{t+1} + (1 + r_t)s_t - L_{t+1} \tag{3}$$

Note that if the entrepreneur chooses soles debt, future fluctuations in the exchange rate, e_{t+1}, will not generate insolvency risk, that is, risk of obtaining $\pi(e_{t+1}) < 0$. Thus, firms are hedged against exchange rate fluctuations by issuing soles debt, whereas issuing dollar debt can generate insolvency risk, since there is a mismatch between the denomination of debt repayments and the currency denomination of future revenues. By taking on currency mismatch risk, the firm's solvency depends on the realization of tomorrow's exchange rate, e_{t+1}.

Lenders. Some competitive risk-neutral lenders have access to dollar funding at a cost equal to the risk-free international interest rate, r_t. Lenders use this source of funding to supply two types of loans: dollar loans with repayments denominated in dollars, and soles loans with repayments denominated in soles. Lenders have *deep pockets*, meaning they can lend any amount of funds as long as they are promised their cost of funds in expected value.

To break even, lenders fund only plans that offer an additional interest-rate premium over their cost of funding, capturing firms' expected probability of repayment. This probability depends on whether the firm is solvent the next period, i.e., $\psi_{t+1} = 1$, or insolvent, i.e $\psi_{t+1} = 0$. And, if the firm is insolvent, repayment depends on the expected share of claims ϕ_{t+1} granted in a bailout. The break-even conditions become

$$Dollar\ lending: \quad \underbrace{E[\psi_{t+1} + (1 - \psi_{t+1})\phi_{t+1}]}_{repayment\ probability\ in\ dollars}(1 + \rho_t) = (1 + r_t) \tag{4}$$

$$Soles\ lending: \quad \underbrace{E[\psi_{t+1} + (1 - \psi_{t+1})\phi_{t+1}]}_{repayment\ probability\ in\ soles}(1 + \rho_t^s) = \frac{(1 + r_t)}{E\left[e_{t+1}\right]} \tag{5}$$

These conditions imply that if the borrower denominates a large enough share of his debt in dollars, insolvency is expected ($\psi_{t+1} = 0$) and the interest rate charged by the lender is given by:

$$(1+\rho_t) = \frac{(1+r_t)}{E\left[\phi_{t+1}\right]} \tag{6}$$

Since debt is only paid in the good state, with probability u, the expected interest rate paid by the borrower is

$$u(1+\rho_t) = \frac{u(1+r_t)}{E\left[\phi_{t+1}\right]} \tag{7}$$

On the other hand, if debt is denominated in soles, the borrower does not go bankrupt ($\psi_{t+1} = 1$). Then, interest rate charged by the lender and paid by the borrower in all the states, becomes:

$$E\left[e_{t+1}\right](1+\rho_t^s) = (1+r_t) \tag{8}$$

The expected interest rate differential, correcting for exchange rate expectations, is (8)-(7):

$$(1+r_t)\left[1 - \frac{u}{E\left[\phi_{t+1}\right]}\right] \tag{9}$$

Where the larger is the probability of the bad state $(1-u)$ or the share of firms' liabilities covered by the bailout ϕ, the larger is the interest rate differential. And, as long as $\phi > u$, dollar borrowing will always be cheaper than soles in equilibrium. Notice that this result did not require any assumption on the underlying macroeconomic UIP deviation as in the standard international-macro-finance literature. In other words, in this very simple framework I am assuming that the lender's cost of funding in different currencies is the same, i.e. $(1+r)$. But the presence of moral hazard arising from bailout expectations is enough to rationalize the relative cheapness of firms' dollar debt as documented in the literature.[16] If, alternatively, I assumed that the lender's cost of funding is different across currencies and that the macro UIP does not hold, it is easy to see that the moral hazard problem described in this model would still be necessary to rationalize why lenders have incentives to pass the UIP deviation to lending rates without charging the insolvency premium.[17]

[16] DiGiovanni et al. (2020), Ivashina et al. (2020)

[17] However, the condition on the size of the expected bailout, i.e. $\phi > u$, to generate cheaper dollar debt would be

Credit market equilibrium. The equilibrium is determined in the following credit-market game: In period t, the entrepreneur takes the current exchange rate, e_t, and the distribution of future exchange rates as given, and proposes a plan $P_t = (I_t, s_t, b_t, b_t^s, \rho_t, \rho_t^s)$, that satisfies budget constraint (1). Lenders decide which of these plans to fund. Finally, the funded entrepreneur makes investment and diversion decisions. Payoffs are determined at $t+1$. First, consider plans that do not lead to funds being diverted. If the firm is solvent, $\pi(e_{t+1}) \geq 0$, the entrepreneur pays L_{t+1} to its lenders, and collects profits $\pi(e_{t+1})$. If firm is insolvent, $\pi(e_{t+1}) < 0$, the lenders receive the bailout, if granted, and the entrepreneur gets nothing. Now consider plans that do entail diversion. If the firm is solvent, the entrepreneur gets revenues net of diversion cost, and its lenders receive nothing. If firm is insolvent, the lenders get nothing. The problem for the entrepreneur is to choose an investment plan P_t and a diversion strategy η_t that solves

$$\max_{P_t, \eta_t} E_t \left\{ \delta\psi_{t+1} \left[e_{t+1} q_{t+1} + (1+r_t)s_t - (1-\eta_t)L_{t+1} \right] - \eta_t h \left[w_t + B_t \right] \right\} \tag{10}$$

subject to (1), where η_t is equal to 1 if the entrepreneur has set up a diversion scheme, and equal to 0 otherwise.

Proposition 1: For a set of low h firms (i.e. small firms), denominating their debt in dollars is always optimal. For high h firms (i.e. large firms), optimal debt denomination depends on the size of their internal funds w_t.[18]

1. *For financially constrained firms with* $\tilde{h} \leq h < u$, *it is optimal to choose a risky financing plan where all debt is denominated in dollars,* $\Delta = 1$. *Dollar debt generates leverage gains relative to the safe plan with soles financing.*[19]

2. *For financially unconstrained firms,* $h \geq 1$, *with low enough internal funds,* $w_t < \underline{w}$, *issuing*

more lax given the presence of a UIP deviation.

[18] Appendix A shows the parametric conditions that validates this equilibrium result. To prove this proposition, I derive the credit market equilibrium of a representative firm for different cases of h. I follow three steps. First, I find the best safe financing plan; that is, I solve for a firm's optimization problem conditional on the firm being solvent in each state. Second, I find the best risky plan; that is, I solve for firm's optimization problem conditional on the firm going bankrupt in the bad state. Third, I define the conditions under which either a safe or a risky financing plan is optimal. I repeat this procedure for each relevant case of h. (See Appendix A for a detailed derivation).

[19] In another case of highly constrained firms, $h < \tilde{h}$, the safe plan is preferred to the risky plan; that is, firms prefer to denominate their debt in soles. In this extreme case, taking on insolvency risk generates no benefit, because allowed leverage is minuscule. This case is not relevant for my empirical analysis because I focus only on firms that issue dollar debt before the tax is implemented.

dollar debt is optimal but does not generate leverage gains relative to the safe plan.

3. *Financially unconstrained firms, $h \geq 1$, that have high enough internal funds, $w_t > \underline{w}$, are indifferent to any debt dollarization ratio: $\Delta \in (0, 1)$. Debt denomination does not affect leverage in equilibrium.*

A firm's optimal decision on debt denomination is driven by two opposing forces: if they denominate their debt in soles, firms avoid insolvency risk. On the other hand, if firms issue dollar debt and take currency mismatch, they might be able to leverage more by exploiting the implicit bailout subsidy and increase their profits. The leverage effect is larger for financially constrained firms; they can borrow much more if they issue dollar debt that it is worth taking on some insolvency risk, relax their borrowing constraints and increase their investment possibilities (Proposition 1.1). Meanwhile, unconstrained firms with low enough internal funds are exposed to insolvency risk by issuing dollar debt, they can profit from the interest rate differential, but they do not perceive leverage gains that improves their optimal investment (Proposition 1.2). And unconstrained firms with sufficiently high internal funds remain indifferent to the composition of their debt, because exchange rate fluctuations are unlikely to expose them to insolvency risk. Again, currency mismatch does not generate leverage gains that improves their optimal investment (Proposition 1.3).[20]

II.B A tax on Dollar Lending

Consider the case where a tax, $\tau \in (0, 1)$, is imposed on the cost of dollar lending. This modifies lender's break-even conditions, increasing expected repayment of dollar loans, as follows:

$$\textit{Dollar lending}: \quad E[\psi_{t+1} + (1 - \psi_{t+1})\phi_{t+1}](1 + \rho_t) = (1 + r_t)(1 + \tau) \tag{11}$$

A tax τ increases the interest rate the lender is willing to accept, ρ_t, to satisfy break-even conditions. If dollar debt becomes more expensive, the firm could find it optimal to switch away from dollar debt to more expensive but risk-free soles debt. However, if the gains of taking on mismatch risk are still high enough after the tax, the firm could find it optimal to keep on issuing dollar debt, and simply

[20] There is an intermediate case where $u < h < 1$. In this case firms are financially constrained if they issue soles debt, but are unconstrained if they issue dollar debt. These firms prefer the safe financing plan in soles as long as their internal funds are large enough ($w_t > \underline{\underline{w}}$). The parametric conditions that determine the equilibrium in this hybrid case are specified in Appendix A and B, but have been omitted here for simplicity.

pay the tax. In either case, firm's cost of borrowing increases after the tax is implemented.

Proposition 2: The effect of a tax, $\tau \in (0,1)$***, on total borrowing, is negative and larger for firms with low*** h ***(i.e. small firms)***

1. *If firms are financially constrained,* $\tilde{h} \leq h < u$*, a tax on dollar lending always reduces their total borrowing. If firms are unconstrained,* $h \geq 1$*, and have sufficiently low internal funds,* $w_t < \underline{w}^{\tau}$*, a tax on dollar lending does not alter their total financing in equilibrium. For both cases, the effect of the tax on the currency composition of debt depends on the size of the tax in the following way:*
   - *If the tax is sufficiently low, 1+* $\tau \leq \frac{\overline{e_{t+1}}}{E(e_{t+1})}$ *there could be a partial switch away from dollar debt to soles debt,* $\Delta^{\tau} \in (\underline{\Delta}, 1)$*, where* $\underline{\Delta} \in (0,1)$*. Or firms completely switch away from dollar debt to soles debt,* $\Delta^{\tau} = 0$*.*
   - *If the tax is high enough,* $1 + \tau > \frac{\overline{e_{t+1}}}{E(e_{t+1})}$*, there is always a complete switch away from dollar debt to soles debt,* $\Delta^{\tau} = 0$*.*
2. *If firms are unconstrained,* $h \geq 1$*, and have sufficiently high internal funds,* $w_t > \underline{w}^{\tau}$*, a tax on dollar lending does not alter their total financing in equilibrium. And there is always a complete switch from dollar debt to soles debt,* $\Delta^{\tau} = 0$*.*

See Appendix B for a detailed derivation of this proposition. The main takeaway in this section is that in an equilibrium where firms are small, not only does the tax might affect the currency composition of firms' debt, but also generates reallocation effects in the economy. Borrowing constraints become tighter after tax, either because dollar debt is more expensive or because switching to soles debt is also more expensive. Then, total borrowing (and therefore investment), decreases. In an equilibrium of large firms, issuing dollar debt is not a means for relaxing borrowing constraints; the tax only generates a change in the currency composition of firm's debt but does not exert reallocation effects.

The effect of the tax on the currency composition of firms' debt depends on the size of the tax, $1 + \tau$, relative to the positive deviations of the exchange rate with respect to its expected value, $\frac{\overline{e_{t+1}}}{E(e_{t+1})}$. The intuition is that, if the firm is paying its debt (good state), larger appreciations increase the attractiveness of dollar debt relative to soles debt (soles value of dollar debt decreases). If the tax on dollar debt is large enough to offset this relative attractiveness, then firms would prefer to switch completely to soles debt, even if they know that they are paying their debt only in the good state. This is always true since we can show that $\frac{\overline{e_{t+1}}}{E(e_{t+1})} > 1 - u$, where $1 - u$ is the expected premium of soles debt when the bailout is complete, $\phi = 1$ (see equation 9). Then, the if $1 + \tau > \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, the tax is also offsetting the expected relative cheapness of dollar debt and the resulting leverage gains.

If the size of the tax is below the positive deviations of the exchange rate, $1+ \tau \leq \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, then the tax reduces the relative attractiveness of dollar debt in the good state, but the overall expected gains of dollar debt could still be larger than a financing plan with soles debt. The parametric conditions that determine the extent of the switch after tax are derived in Appendix B.

III Preliminary Evidence: The Case of Peru

In this section, I provide descriptive empirical evidence that validates the theoretical framework proposed in section II. I start by briefly describing the main features of the Peruvian banking system, and how it is a suitable case to test the implications of my proposed mechanism. Thus, to make a parallel with Propositions 1 and 2, I provide evidence on the relationship between firm size, debt dollarization, cost of financing, and their evolution before and after a tax on dollar lending. I present the core of my empirical analysis later, in Sections IV to VIII, where I provide causal evidence of the effect of a macroprudential FX policy implemented by the Central Bank of Peru, and formally test the implications of Proposition 2.

III.A Background on the Peruvian Banking System

There are three main features of the Peruvian Financial system that make it a suitable case to verify the implications of the proposed mechanism: (1) banks operating in the financial system supply both soles and dollar[21] denominated loans to hedged firms or unhedged firms that are willing to take currency mismatch. (2) Central Bank's exchange rate regime allows for exchange rate fluctuations such that currency mismatch on firms' balance sheets entails insolvency risk. (3) And a macroprudential FX policy that increases banks' cost of lending in dollars should directly affect the supply of dollar loans and indirectly the demand of soles loans.

[21] Dollar is the only foreign currency used for lending by the financial system.

(1) Banks operating in the financial system supply both soles and dollar denominated loans to hedged or unhedged firms. Peru is a partially dollarized economy subject to capital inflows and where households denominate a large share of their deposits in dollars. Deposit dollarization in Peru has been historically high, particularly after episodes of high hyperinflation in the 80s and 70s.[22] The adoption of inflation targeting in 2002 resulted in stable inflation levels that have been ranging between 2 and 3 percent, generating incentives for households to reduce the dollarization of their deposits.[23] However, deposit dollarization has remained stagnant in between 40 and 50 percent in the 2010s and before the announcement of the de-dollarization policy studied in this paper (December 2014). This might reflect structural household preferences for dollar savings (see Figure 1).

This stock of dollar deposits accounts for most of banks dollar liabilities (see Figure 2 Panel A), which banks can use to lend. Since the use of dollar liabilities to fund soles loans exposes banks balance sheets to exchange rate risk, banks in the Peruvian financial system are subject to explicit limits on exchange rate exposure and capital requirements for currency mismatches since 1999.[24] As a result, banks in Peru tend to match the currency denomination of their assets and liabilities and do not carry FX exposure on their balance sheets (see Figure 3).[25] Figure 2 Panel B shows the evolution of Peruvian banks dollarization of deposits and liabilities and Figure 1 shows banks' dollarization of loans and deposits. This suggests that banks' incentives to lend in dollars are strongly related to the structural dollarization of banks deposits.[26]

On the demand side, unhedged firms have incentives to borrow in dollars and take currency mismatch risk on their balance sheets. In fact, I find that 49% of loans granted to nontradable firms are denominated in dollars and 57% of dollar denominated loans are granted to nontradable firms.[27] A possible explanation to this behavior is related to dollar loans being cheaper than soles loans, even after correcting for expectations on exchange rate depreciation. Using data on average loan interest rates I show that, depending on the size segment, this interest rate differential between soles and dollar

[22] See Contreras, Quispe, and Regalado (2016)

[23] Peru is a successful case of market-driven de-dollarizaton. Since the introduction of inflation targeting, dollarization of credits and deposits reduced in around 25 percentage points until 2009. See Garcia-Escribano (2010).

[24] See Canta et al. (2006)

[25] See Keller (2018) for evidence on Peruvian banks, and Canta et al. (2006) and Tobal (2018) for evidence on emerging economies.

[26] Banks can also have access to the derivatives market to hedge their stock of dollar deposits, and lend in soles. However, this is not a common practice since derivative contracts are typically short term. Then, if used to supply soles loans at longer maturities, these instruments may expose banks balance sheets to maturity mismatches (Borio, McCauley, and McGuire (2017)).

[27] As of December 2014.

loans is around 4 and 12 percentage points (see Figure 7). The literature is not conclusive on the roots of this relative cheapness of dollar debt. Some authors point towards deviations from the uncovered interest rate parity (UIP) using government interest rates[28]. Other strands of the literature relate this differential in lending rates to a dollar deposit discount, that is not explained by UIP deviations.[29] [30] What remains unexplained is why banks are willing to transfer either the UIP premium or deposit discount to loan interest rates without pricing firms' exposure to exchange rate risk. One possibility, as captured in my theoretical framework, is that lenders expect that in an episode of a severe depreciation government's best response is to provide loan guarantees or assume debt obligations of firms that go bankrupt.[31] This have been the case in Peru in the last episode of severe unexpected shocks affecting firms revenues and debt repayment possibilities[32].

(2) The exchange rate regime of the Peruvian monetary authority allows for fluctuations in exchange rate such that currency mismatch on firms' balance sheets entails insolvency risk. Monetary policy in Peru can be understood as an open-economy inflation targeting regime, where the central bank have shown a fairly systematic tendency to mitigate sharp and unexpected movements in exchange rates. Central Bank's policy framework relies on sterilised FX intervention, preventive accumulation of international reserves and high reserve requirements on foreign currency liabilities to mitigate liquidity risk[33]. Nevertheless, the Central Bank of Peru does not target any particular exchange rate, allowing it to reflect local and international macroeconomic fundamentals (see Figure 4).[34] The financial regulatory authority of Peru (SBS) estimates firms' exposure to exchange rate risk using balance sheet data of large firms. Using this confidential data, Ivashina et al. (2020) find that firms that default under a depreciatory shock of 20% account for about 25.6% of dollar credit granted to large firms. And those that default under a depreciatory shock of 10% account for 6.5%. While estimates on smaller firms are not available, one can reasonably infer that less severe exchange rate shocks can generate

[28] See for example DiGiovanni et al. (2020), Salomao and Varela (2018)

[29] Households' preferences for dollar deposits -potentially as an insurance arrangement (see Dalgic (2020), Bocola and Lorenzoni (2020))-, might explain why households are willing to receive a lower return on their dollar savings.

[30] Using granular data on loan interest rates for the segment of large firms in Peru, Ivashina et al. (2020), show that 2 percent of the relative cheapness of dollar loans is explained by this deposit discount and not accounted by UIP deviations.

[31] See Schneider and Tornell (2004)

[32] For example, Peruvian government provided a package of guarantees in an effort to combat the effects of the coronavirus pandemic in March 2020. The fund provides banks with a 98% guarantee on loans of up to 9,000 USD, and an 80% guarantee on larger loans ranging from 2.1 million to 2.9 million USD. The idea is that lenders shift the credit risk to the Central Bank by receiving liquidity injections to grant loans, and using these loans as collateral. At the end, lenders do not assume the bankruptcy costs of the shock (See Montoro (2020)).

[33] See Rossini, Armas, Castillo, and Quispe (2019)

[34] The Central Bank has allowed depreciations of up to 7% in a 2-week window, since 2002.

the same insolvency risk on small firms.

(3) Finally, a macroprudential FX policy that increases banks' cost of lending in dollars should directly affect the supply of dollar loans and any effect on soles loans should result from firms switching away from dollar loans to avoid the regulation. Consider the case of a policy that increases the reserve requirement rate on banks' FX liabilities which can be understood as an increase in the effective cost of dollar funding.[35] Because of the limited FX exposure on Peruvian banks' balance sheets, this increase in the cost of dollar funding is reflected in the supply of dollar loans and in an increase in dollar lending interest rates[36] and not on the supply of soles loans. Then, any potential change in soles loans should come from demand pressures resulting from firms switching away from dollar debt.

III.B Debt Dollarization and Firm Size

Throughout the empirical section of this paper, I analyze four firm size categories, based on the definitions used by the regulator of the Peruvian financial system (SBS): *micro, small, medium,* and *large*.[37] I also analyze other potential indicators of firm size and access to credit such as number of workers, age, and sales range.[38]

Table 1, column 1 shows, for each size segment, the share of loans granted to nontradable firms that are denominated in dollars. For the two smallest segments the aggregate loan dollarization is around 30%, and for two largest segments, 50%. Column 2 shows the share of dollar loans that are allocated to nontradable firms, by size segment. Surprisingly, almost 90% of dollar loans allocated to the smallest size segments, are granted to nontradable firms. While less than 50% of large firms' dollar loans are granted to nontradable firms. What is striking is why do we see so much dollarization in size segments that barely have exporters or importers (see column 3).

An implication of Proposition 1 in Section II is that among unhedged firms that optimally decide to issue dollar debt, small firms are more likely to reap the benefits of this cheaper dollar debt.

[35]For example, if the reserve requirement rate is 20 percent, a bank can only lend 80 cents of each dollar of its liabilities. Then, assuming that FX reserve requirements receive a remuneration of 0 percent, and that the interest rate on FX liabilities is on average 4 percent, the effective cost of dollar funding for the bank is 5 percent (4 pc/0.8=5pc).

[36]And depending on how inelastic are dollar deposits, also in the deposit rates.

[37]See Table 2 for a detailed definition.

[38]The relationship between employment and financial constraints is well documented in the literature; see, for example, Beck (2007) and Benmelech, Bergman, and Seru (2011).

Large unconstrained firms also find profitable to take currency mismatch but their debt dollarization decreases with the size of their internal funds.

Figures 5 and 6 reinforce this idea using alternative indicators of firm size. Panel B in Figure 5 plots a binscatter of the mean relationship between a firm's debt-dollarization ratio and the log of the number of workers per firm, for the sample of nontradable firms that decide to issue dollar debt. This relationship is significantly negative: average dollarization is decreasing in worker quantiles. The same relationship arises with firm's age and sales range: younger unhedged firms or firms with lower sales have higher average debt-dollarization ratios (see panels A and B of Figure 6).

III.C Average Loan Interest Rates and Firm Size

The relationship between size and debt dollarization could also be explained by loan interest rate differentials. Figure 7 shows the average interest-rate spread between soles and dollar loans[39] currently on banks' balance sheets, for each size category. This spread is plotted against the deviations from the UIP calculated as the interest rate differentials using government rates, corrected for expected exchange rate depreciation.[40] Consistent with the empirical evidence on UIP deviations and the cost of debt,[41] there seems to be a pass-through of the UIP to loan rates. This pass-through is incomplete for larger firms (see panels C and D). For smaller firms, the spread of soles to dollar loans appears to be even larger than the risk-free rate differentials (see panels A and B). This heterogeneity in the relative "cheapness" of dollar loans across size categories suggests that banks in Peru are not pricing exchange-rate exposure for smaller firms as much as they are for larger firms.

A possible explanation to this finding can be related to heterogeneous expectations on the size of a bailout in crisis times. Given that Central Banks in dollarized economies are unable to print dollars, their ability to provide dollar liquidity or acting as a guarantor of banks' dollar loans in times of crisis is limited. One can argue that the expected share of loans covered in bailout is larger when loans are granted to small firms than when granted to large and highly indebted firms. Moreover, there is a political cost of not providing assistance during episodes of distress to the more vulnerable agents such

[39] Correcting for expected exchange-rate depreciation.

[40] I use year-ahead exchange rate expectations from the Central Bank of Peru survey on macroeconomic expectations. See `https://www.bcrp.gob.pe/estadisticas/encuesta-de-expectativas-macroeconomicas.html`

[41] See, for example, Richers (2019) for evidence on the universe of corporate bonds issuance by nonfinancial firms, and Ranciere et al. (2010) for evidence in emerging economies using survey data on total debt and DiGiovanni et al. (2020) for evidence using Turkish firm-level data.

as SMEs. An example to this behavior can observed in the current coronavirus pandemic, in which the Peruvian government provided a package of loan guarantees that ended up covering 96% of loans granted to small firms and only 4% for loans granted to large firms.[42]

The theoretical framework that I propose can rationalize this argument by assuming that the size of the bailout, ϕ, is larger for a low h economy, with a lower aggregate dollar debt. In an economy of unconstrained firms with high h, the share of total claims that the government is able to account for is arguably smaller. Based on equation (9), the interest rate differential would be larger for the small economy.[43]

An alternative explanation could be that lenders want to limit their exposure to FX risk. Given the relatively lower share of small firms in their portfolio of loans (see Table 5), a massive default of these firms might not be as costly as a massive default of large firms. This might generate incentives for lenders to limit the pass-through of the UIP premium (or deposit discount) to large firms' loan rates.

This evidence on interest rates is only suggestive, due to lack of granular data that would allow me to control for firms' idiosyncratic risk as in DiGiovanni et al. (2020). Moreover, by using aggregate average interest rates per size category, I am also capturing the interest rates on loans to firms that are naturally hedged against exchange rate risk (e.g., exporters) or firms that have access to FX derivatives. Firms that select into exports tend to be larger,[44] and it is possible that removing hedged firms from the sample might alter the observed asymmetries in the interest rate differentials. Despite lack of adequate data, this is, to my knowledge, the first paper that provides suggestive evidence of a size-based bank pass-trough of the risk-free rate differentials to business loan rates.

III.D A tax on dollar lending

Figure 8 shows the evolution of aggregate loans before and after the Central Bank of Peru increased the reserve requirement on dollar liabilities in December 2014. The blue dashed line shows the evolution of the normalized stock of dollar loans for the sample of unhedged firms and for each size category. One year after the policy was announced, dollar loans for the two smallest categories decreased by

[42]See Montoro (2020)

[43]This assumption will exacerbate the dollarization incentives for small firms and limit those of large firms. But the main implications of the model remain unchanged.

[44]See Melitz (2003).

around 50% to 60% relative to the year before the announcement (panels A and B). This reduction in dollar loans is around 15% to 25% for the two largest categories (panels C and D). As Proposition 2 implies, this decrease in the growth of dollar loans might reflect firms switching away from dollar borrowing to soles borrowing or firms issuing new dollar loans at a more expensive interest rate i.e., assuming the burden of the tax.

The red line in Figure 8 shows the evolution of the normalized stock of total loans (in both dollars and soles) of unhedged firms. This plot shows that the growth rate of total loans was almost the same as that of dollar loans before the policy announcement. While dollar and soles loans were growing almost at the same pace before the announcement, they start differing afterwards. This might suggest that firms were switching away from dollar borrowing to soles borrowing to avoid the higher costs of the tax. This substitution, if any, is clearly not complete for the smallest categories (panels A, B, and C). However, firms in the largest category seemed to have completely avoided the tax by switching to soles debt, thus keeping their total financing unaffected relative to the pre-tax trend (panel D). This suggestive evidence is consistent with the implications of Proposition 2.

Figures 5 and 6 are also consistent with this mechanism. First, firms' debt dollarization decreases after the tax (hollow red circles) for all size categories and size indicators. Also, there is a slightly larger decrease in the dollarization ratios of larger firms, which is in line with the higher compositional adjustment of large firms' debt.

The evolution of loan interest rate spreads from soles to dollars is also consistent with the proposed mechanism. Figure 7 shows that only for the smallest size segments (Panels A and B), the interest rate spread decreases a year after the announcement, suggesting that after the tax is imposed, small firms are unable to completely switch from dollar borrowing to soles borrowing. Most of them continue issuing dollar debt at a more expensive interest rate (spread soles to dollar decreases). By contrast, larger firms seemed to completely switch from dollars to soles, avoiding the tax and keeping their cost of borrowing unaffected (panels B and C).

IV Implementing a Macroprudential FX Policy in Peru

In this section I describe the main institutional aspects of a Macroprudential FX policy intervention by the Central Bank of Peru in December 2014. The policy consists of an increase in the remunerated reserve requirement rate on banks dollar liabilities (i.e., FX reserve requirements)[45] [46]. This policy has the macropruduential objective of limiting the aggregate externality generated by individual borrowers' decisions to take on currency mismatch. That is, if nontradable firms issue dollar debt and are not able to hedge against exchange rate risk, they become exposed to credit default in case of a severe depreciation. As a result, the asset portfolio of banks that lent to mismatched firms would be affected, generating risk of a systemic crisis. I choose to analyze this policy intervention as the core of my empirical strategy since its magnitude was unprecedented and arguably unexpected by the financial system (see discussion in Section VI.B).[47]

IV.A The Policy Rule

This increase in the reserve requirement rate- from now on *tax*- is heterogeneous across banks and depends on the size of their stock of dollar loans excluding credit granted to tradable firms. The policy rule works as follows: In December 2014, banks were informed that by December 2015 (deadline), they would be subject to an additional tax rate, τ_b, on their dollar liabilities. The size of the tax increase is proportional to the stock of bank's dollar loans at the deadline, $D_b^{Dec2015}$, normalized relative to their stock of dollar loans in September 2013 (benchmark), $D_b^{Sep2013}$:

$$\tau_b = \begin{cases} 0.3 \times \left(\frac{D_b^{Dec2015}}{D_b^{Sep2013}} - 0.9 \right) & if \quad \frac{D_b^{Dec2015}}{D_b^{Sep2013}} > 0.9 \\ 0 & o/w \end{cases} \tag{12}$$

This rule implies that if by the deadline, banks do not reduce their stock of dollar loans to be at least 90% of what it was at the benchmark date, then they would be subject to an increase in the reserve

[45] FX reserve requirements receive a remuneration equivalent to the London Interbank Offered Rate (LIBOR) for one month minus 50 basic points.

[46] This policy affects all loan segments, including consumption loans, mortgages, and business loans.

[47] This policy intervention is not related to the one analyzed in Keller (2018). This latter was the imposition of capital controls by the regulator of the financial system (SBS) in 2011. She shows that the effect of this policy on debt dollarization was in the opposite direction to the one analyzed in this paper.

requirement rate on its dollar liabilities. This increase is larger the larger is the distance between $D_b^{Dec2015}$ and $D_b^{Sep2013}$[48].

IV.B Banks' Exposure to the Policy

Based on this rule, two sources of bank variation determine banks' exposure to the policy: First, for a given increase in the tax rate, banks that more strongly relied on dollar funding[49] allocate a larger share of their assets to pay the tax. These banks had more incentives to avoid being subject to the regulation, and to shrink the supply of new dollar loans right after the announcement. Thus, banks that at the time of the announcement relied heavily on dollar funding were more exposed to the policy.

Second, for a given degree of reliance on dollar funding, banks that at the time of the announcement were further from the regulatory benchmark had more incentives to avoid being subject to the regulation. Otherwise, they would be subject to a larger increase in the tax rate by the deadline. These banks were more exposed to the policy and had more incentives to reduce the supply of new dollar loans right after the announcement.[50]

The two sources of bank exposure are strongly correlated; banks with a high normalized stock of dollar loans tend to rely heavily on dollar funding to finance their assets, and this is true across time. Figure 9 shows the evolution of the cross-sectional correlation between banks' distance from the regulatory benchmark, $\frac{D^t}{D^{Sep2013}} - 0.9$, and banks' reliance on dollar funding, $\frac{USDLiabilities_t}{Assets_t}$. As explained in Section III.A, this strong correlation can be explained by banks' hedging incentives and by the presence regulatory limits on banks' FX risk exposure. Therefore, this policy ends up functioning as a progressive tax on banks' dollar liabilities, where the tax rate increases as the base increases.

Figure 10 shows the average monthly change in banks' reliance on dollar funding and banks' distance

[48]This is a summarized version of the policy rule. Additional institutional details that are not relevant for my identification strategy (see Section VI) can be found in Circular N° 006 -2015-BCRP, the official regulatory document, available at Central Bank of Peru website (`https://www.bcrp.gob.pe/en`) and analyzed in Castillo, Vega, Serrano, and Burga (2016). In particular, the policy rule had an intermediate, less strict deadline in July 2015, in which the deviation from the benchmark had to be less than 95% instead of 90%. However, since both deadlines (July and December) were announced in December 2014, the effective date for my treatment is December 2014 through the latest deadline, December 2015.

[49]Including dollar funding from foreign financial institutions and dollar-denominated deposits.

[50]To avoid being subject to a large tax, these banks could exploit Central Bank's provision of soles liquidity facilities to convert dollar loans already on a bank's balance sheet to soles loans, and reduce their distance with respect to the benchmark.

from the regulatory benchmark across time. While the first one remains statistically different from zero, before and after the policy announcement, the second one endogenously responded to the policy. To avoid any potential endogeneity bias and because both indicators capture mainly the same source of variation, I use banks' reliance on dollar funding at the time of the announcement as the main exposure indicator in my identification strategy in Section VI. I verify that my results remain qualitatively robust when using distance to the benchmark at the time of the announcement as an exposure indicator in Section VI.D.

V Data and Summary Statistics

To execute my empirical strategy, I combine three datasets. First, a confidential credit register on the universe of all loans to nonfinancial firms collected by the regulator of the financial system (SBS). Second, publicly available data on banks' monthly balance sheets, collected by the regulator of the financial system (SBS). Third, a confidential dataset on the universe of all formally registered firms, collected by the tax collection agency (SUNAT).

Credit Register. This is my main dataset. It allows me to construct the outcome variables: the growth rate of new dollar loans and total loans. This database contains monthly balances for the universe of outstanding business loans, in dollars and soles, made by all entities in the financial system. It also contains a detailed classification of the type of loan; in particular, whether the loan is classified as *credit for trade activities*, granted to finance commercial activities related to exports or imports. It also classifies the loans based on the size of the borrower (the same size classification I use in my empirical analysis).[51] The sample period covers 12 months before the December 2014 policy announcement and 12 months after.[52]

Data on Banks' Balance Sheets. This dataset contains monthly balance sheets for the universe of financial institutions that are periodically reported to the financial regulator (SBS).[53] The main

[51] See Table 2 for a definition.

[52] To avoid capturing potential changes in the demand for loans that may generate threats to my identification strategy, I limit the time dimension of my sample as much as possible. To avoid capturing the effect of previous de-dollarization measures implemented by the Central Bank, I start my sample of analysis in January 2014. At the time of the policy announcement, banks were given a maximum of 12 months to adjust to the rule. By the end of December 2015, the effect of the policy should have been completely internalized by the banks.

[53] Accessible at https://www.sbs.gob.pe/app/stats_net/stats/EstadisticaBoletinEstadistico.aspx?p=1

variables I obtain from this database are banks' total assets, returns on assets, and liquidity ratios[54] in soles and in dollars. I use these variables as time-varying controls in my empirical analysis. The bank exposure indicator also comes from this dataset and is calculated as the sum of dollar deposits and dollar funding from foreign financial institutions, divided by total assets.

Dataset on Formally Registered Firms. This dataset contains annual information on the universe of active firms registered with SUNAT, the tax agency. It contains firms' five-digit industrial classification and six-digit geographic location. As well as firms' sales range[55], number of workers and the year each firm began operations, which I use to construct the firms' age.

Sample construction. The credit register classifies firms based on an "SBS code," while SUNAT classifies firms using a taxpayer identification number (TIN). To merge both datasets, I use a confidential dataset that links the SBS code with the TIN. My empirical strategy relies on the universe of nonfinancial, formally registered firms (i.e., all firms that have a TIN).[56] *Credit for trade activities* is excluded from the regulation, because the macroprudential tax targets nontradable firms that are exposed to currency-mismatch risk. Thus, I exclude all firms that issued dollar loans classified as *credit for trade activities* at least once during the the period of analysis.[57] I also exclude all service exporters operating in the tourism sector.

My analysis focuses only on banks in the financial system, excluding all other financial institutions,[58] most of which target their services to *small* and *micro* firms in specific geographic locations and industrial sectors, and which finance specific types of financial operations (e.g., factoring and leasing). They are not comparable to banks, which have diversified portfolios of borrowers and loans.[59] In addition, these institutions are regularly subject to mergers, fusions, and transfers of equity blocks, which could induce noise and bias to my estimates. For various reasons, excluding these niche financial institutions is not likely to induce an overestimated effect of the policy on small firms. First, these

[54] Defined by the SBS as the ratio of liquid assets to short-term liabilities.

[55] The database defines 15 sales intervals, each one containing between 2% and 13% of the firms in the sample.

[56] I exclude from my empirical analysis borrowers that do not have taxpayer ID, and that are granted business loans using a personal ID. The reason is that it is hard to disentangle which part of the loan goes to finance firm's operations or personal expenses. Lack of formality makes them potentially more vulnerable to the policy. Thus, my findings can be understood as a lower bound of the effect of the tax on small firms' financing.

[57] I do this to limit the possibility that my results capture banks' reclassifying the supply of nontrade credit as credit for trade to sidestep the regulation. This regulatory arbitrage can be done more easily with borrowers that have a history of issuing this type of loan. Granting credit for trade to nonexporters or firms with no history of issuing trade credit is arguably harder, due to regulatory restrictions.

[58] Such as municipal savings and credit unions, rural savings and credit unions, leasing companies, and microenterprise development agencies.

[59] See Table 5.

institutions charge higher interest rates than banks,[60] since they mostly lend to riskier borrowers that lack collateral or significant credit history.[61] They also face higher costs to access foreign funds, which limits their supply of dollar loans.[62] Even after the tax on dollar loans was introduced, the possibility that *small* and *micro* firms would eschew banks to borrow from these financial institutions is limited.

I exclude from the sample state banks, banks that granted only consumption loans, and banks that started operations months before the policy announcement[63]. I also excluded banks that at the time of the announcement received large equity blocks as a result of the absorption or fusion with other nonbank financial institutions; and banks specializing in loans to big corporations.

To verify the quality of the data, I collapse firm-level data and compare it with publicly available data on aggregate loans by size, by currency, and across time. Similarly, I compared granular data on employment per firm and sales with aggregates publicly available at institutional websites.

Additional Datasets. To provide further suggestive evidence on the behavior of interest rates, I rely on average interest rates by firm size, published daily on the publicly available financial regulator's website[64]. I obtain aggregate macro variables such as exchange rates and one-year-ahead expected exchange rates publicly available at BCRP[65]; one-year T-bill rates for Peru from the BCRP website[66]; and one-year U.S. T-bill rates from the Federal Reserve Economic Data (FRED)[67].

Summary Statistics. Table 3 reports the summary statistics for the variables used in my main empirical specification in Section VI. The first four columns show the statistics for the year before the announcement (2014); the next four columns, for the year after the policy announcement (2015). Panel A shows these statistics at the bank-firm level, while Panel B collapses data at the firm level. Consistent with descriptive evidence in Section III.D, the average monthly growth rate of dollar loans and total loans decreases most for the three smallest categories. At the bank-firm level, the average growth rate of new total loans for *micro* firms drops 5 percentage points from 2014 to 2015; for *large* firms, the drop is 2 percentage points. At the firm level, the average growth rate of new loans for

[60] See Appendix C.

[61] see BCRP, Financial Stability report, May 2013.

[62] See Appendix D.

[63] Since their financial ratios in the first months of operation are outliers with respect to the rest of the banking system.

[64] https://www.sbs.gob.pe/estadisticas/tasa-de-interes/tasas-de-interes-promedio

[65] These expectations are calculated as the simple average of one-year-ahead expectations from the financial system and economic analysts. See https://www.bcrp.gob.pe/estadisticas/encuesta-de-expectativas-macroeconomicas.html

[66] https://estadisticas.bcrp.gob.pe/estadisticas/series/

[67] https://fred.stlouisfed.org/series/DGS1

micro firms drops 8 percentage points; for *large* firms, the drop is 3 percentage points.

For *large* firms, the number of observations in panel A is more than double the number in panel B, indicating that *large* firms tend to have on average more bank relationships. This is not the case for the three smallest categories, in which firms are typically clients of a unique bank.[68] Table 4 shows the summary statistics of firm-bank relationships, by size category in 2014. This table shows that *micro* firms have on average relationships with just one bank, while *small* firms have on average relationships with less than two banks. In addition, in my sample, around 98% of *micro* firms, 70% of *small* firms, and 40% of *medium* firms are clients of only one bank. This implies that, for the smaller firms, I am not able to compare how differently exposed banks change lending to the same firm. Or equivalently, to make a within-firm comparison to absorb firm-specific changes in credit demand.[69] I will discuss this threat to my identification strategy in Section VI.B.

VI Identification Strategy

In this section, I test whether Proposition 2 in Section II holds empirically. That is, if after a tax on dollar lending is imposed, small, financially constrained firms reduce their total borrowing: they issue less dollar debt or are not capable of completely switching to soles debt. Large firms on the other hand, are capable of keeping their overall borrowing unaffected: they keep issuing the same amount of dollar debt, or they completely switch to soles debt.

I exploit the cross-sectional variation in bank exposure to the tax (i.e., in their reliance on dollar funding) to identify the bank lending channel of the macroprudential tax to nontradable firms. Simultaneously, I test whether firms borrowing from differently exposed banks respond heterogeneously to this supply shock. As my proposed mechanism implies, an unexpected tax should generate a larger disparity between small and large firms' total loans growth, within the loan portfolio of more exposed banks. Also, after accounting for firms switching from dollar debt to soles debt, the effect of the tax should be negligible on the larger firms, while this switching to soles debt, if any, should be partial for the smaller firms.

[68] The smaller firms are typically young and lack significant credit history. These firms are not able to easily switch from one bank to another, due to a costly process of risk evaluation, which is particularly rigorous for the smaller firms (see BCRP, Financial Stability report, May 2013).

[69] See for example Khwaja and Mian (2008)

The validity of my identification strategy relies on five assumptions that I will discuss in Section VI.B. First, different size firms are randomly allocated across differently exposed banks. This guarantees that my results are not plausibly driven, for instance, by more exposed banks lending mostly to financially constrained firms. Second, the preexisting distribution of banks' relevant observables is balanced across different degrees of bank exposure. Intuitively, this means that exposed banks are a valid counterfactual to unexposed banks. Third, the banking system did not anticipate the imposition of the tax on dollar liabilities. Fourth, the imposition of the tax is exogenous to domestic or external economic conditions that might be correlated with bank exposure. Fifth, *shifts* to firms' demand for loans are uncorrelated with bank exposure.

VI.A Methodology

I use difference-in-differences with continuous treatment to compare the credit supply of banks with different degrees of exposure to the tax before and after implementation of the policy. Bank exposure is the ratio of dollar funding to total assets calculated at the moment of the policy announcement. To determine the extent of the heterogeneity in the tax effect, I analyze the triple interaction of bank exposure with a firm size indicator, and a dummy that captures the timing of the policy.

The main regression specification is as follows:

$$y_{fbt} = \beta_0 + \beta_1 Exposure_b + \beta_2 Shock_t + \beta_3 Exposure_b \times Shock_t \tag{13}$$
$$+ \sum_{s=2}^{4} \beta_s Exposure_b \times shock \times size^s + \Theta X_{bf} + \Phi X_{b,t-1} + Exp_{dep,t} + BankFE + FirmFE + \epsilon_{fbt}$$

where y_{fbt} is the outcome variable for bank b, firm f and month t. This outcome variable can be either (1) *the growth rate of new dollar loans*, or to account for firms switching away from dollar loans to soles loans (2)*the growth rate of new total (dollar + soles)*.[70] $Shock_t$ is a dummy that takes the value of 1 after the policy announcement (December 2014) and 0 before. $Size^s$ is a dummy that takes the value of 1 when firm size is equal to s, where, $s = \{1 : micro, 2 : small, 3 : medium, 4 : large\}$ and

[70] To calculate the total value of loans, dollar loans have been converted to soles loans using the exchange rate of January 2014 across all periods. This valuation adjustment is done to avoid capturing fluctuations in total loans driven by fluctuations in the exchange rate.

$s = 1$ is the omitted category. X_{bf} represents bank-firm relationship controls that can be either the share of loans firm f has with bank b or the share of nonperforming loans firm f has with bank b as of the policy announcement. $X_{b,t-1}$ represents time-varying lagged bank controls such as returns on equity or liquidity ratio.[71] Finally, $Exp_{dep,t}$ captures year-ahead monthly expectations on exchange rate depreciation obtained from the firms survey. I include bank and firm fixed effects to control for additional unobservable variation across banks and firms. Ideally, I would include firm-time fixed effects instead, to isolate demand from supply effects, as in Khwaja and Mian (2008). However, as explained in Section IV, this is problematic because a significant number of *micro*, *small* and *medium* firms lack multiple bank-firm relationships.

VI.B Validity

My first assumption is that firms of different sizes are randomly allocated across differently exposed banks. To validate this assumption, I evaluate the distribution of firm sizes across the sample of banks below and above the median exposure at the time of the announcement. Figure 11 shows the heterogeneity in the exposure indicator across banks. The t-test in Table 5 shows that the average distribution of sizes among the banks below the median is not significantly different from that among banks above the median—nor is the average share of bank loans allocated to firms in each quartile of the age, sales, and number-of-workers distribution. Therefore, there is no sufficient evidence to support the hypothesis that a heterogeneous effect of the tax is driven by an endogenous sorting of firm size across exposed banks.

My second assumption is that differently exposed banks act as valid counterfactuals, that is, the evolution of loans in soles and dollars from differently exposed banks to firms of different sizes would have been the same had the tax not been implemented. I validate this assumption in two ways. First, I check pre-trends by analyzing how the treatment effect changes across time and whether there was already an effect of exposure that is not accounted for bank or firm fixed effects and additional relevant controls. Second, I test balance on relevant observables to rule out that preexisting distribution of banks' characteristics across differently exposed banks might be driving my results.

Figure 12 shows the estimated effect of bank exposure on the growth rate of new loans to firms of

[71] Defined as the ratio of liquid assets to short-term liabilities

different sizes across time. I use the following specification:

$$y_{fbt} = \beta_0 + \beta_1 Exposure_b + \beta_2 Shock_t + \beta_t \sum_{i=2}^{24} Exposure_b \times 1[t=i]$$

$$+ \sum_{s=2}^{4} \beta_{s,t} \sum_{i=2}^{24} Exposure_b \times 1[t=i] \times size^s + \Theta X_{bf} + \Phi X_{b,t-1} + Exp_{dep,t} + BankFE + FirmFE + \epsilon_{fbt}$$

The estimated coefficients show that lending trends of differently exposed banks were not significantly different before the policy announcement. Thus, there is insufficient evidence to reject the hypothesis that the policy generated the differential lending patterns across differently exposed banks.

On the other hand, Table 5 shows that despite significant differences in the reliance on dollar funding, banks above and below the median exposure do not differ significantly in terms of size (total assets) or relevant financial indicators, such as return on assets (ROA) or liquidity ratios.

My third assumption is that banks did not anticipate the implementation of the tax on dollar liabilities. Banks that anticipated the policy could have enacted strategies to reduce their exposure to it. In this case, the policy's estimated effect would be biased. It is unlikely that banks anticipated the regulation, I argue, because the effect of bank exposure on dollar loans becomes statistically significant right after the policy was announced, but not before (see figure 12). Though the policy became effective a full year after the announcement, banks started changing their lending patterns right after that, in January 2015 (see Figure 8). Had banks anticipated the policy, this behavior would have occurred months before the announcement. Also, the policy's novelty makes it particularly suitable as an experiment: it was the first time the BCRP conditioned the increase in the reserve requirement rate on the *reduction* of dollar loans. Even if banks knew that some type of measure was about to be implemented, it was arguably hard for the banking system to anticipate the shape of the policy, and thus behave strategically.

My fourth assumption is that the implementation of the macroprudential FX policy is exogenous: Most monetary policy interventions tend to be endogenous or a response to macroeconomic developments. But I can argue that my results reflect the effects of the policy itself, not the effects of any factor driving its implementation. This policy was implemented in a period of a depreciatory trend of the sol and most currencies in emerging economies. This period started after the US Taper Tantrum announcement in May 2013[72], and ended in December 2015 with the policy *liftoff*. The policy was conveniently implemented in this context to facilitate firms' transition from dollar to soles debt. By ruling out pre-trends, I am showing that there was no significantly different trend of the loans granted by differently exposed banks a year before the policy was announced and after the market was already expecting a depreciation of the sol.

To invalidate this identification assumption, one would need to argue why the growth rate of loans granted by differently exposed banks changed right after December 2014 and not before. Moreover, by evaluating the dynamics of the exchange rate and year-ahead expectations, I find no abnormal change in the trend at the time of the announcement to argue that depreciation is being confounded with the policy itself (see Figure 13).

My fifth assumption is that shifts to firms' demand for loans are uncorrelated with bank exposure. The depreciatory trend of the sol might be associated with firms' incentives to get rid of dollar loans, which can also be driving my results. However, by ruling out pre-trends, I show that there is no correlation between demand shifts in dollar loans and bank exposure, before the policy announcement. Again, to invalidate this identification assumption one would need to argue why firms started to react to the depreciation of the sol right on December 2014 and not before.

The difficulty in isolating loan supply shocks from loan demand shocks is traditional in the literature that studies aggregate credit supply shocks that arise from changes in the macro environment.[73] One way to deal with identification issues in this literature is to use firm fixed effects to absorb demand variation.[74]. My identification strategy is limited by the impossibility of directly isolating banks' loan supply from firms' loan demand through firm-time fixed effects—most *micro*, *small* and *medium* firms have a limited number of banking relationships and are clients of just one bank (see Section IV). Thus, absorbing firm demand variation through firm-time fixed effects would mean losing almost all *micro* and *small* firms. I alleviate this concern by adding five-digit industry-time and five-digit geographic-time fixed effects. This absorbs all variation in loan demand coming from observed and unobserved

[72]This was the first time Fed officials mentioned a possible curtailment of its large-scale asset purchase program. Market participants updated their expectations on when the Federal Reserve starts increasing its policy rate after keeping it at near zero levels in December 2008 as a response to the GFC.

[73]For example, the the global financial crisis of 2007–2008 not only contracted foreign liquidity, reducing the supply of dollar loans, but also contracted credit demand in emerging economies. See, for example, Paravisini et al. (2014), who identify the effects of a bank supply shock on trade credit during the global financial crisis.

[74]See Khwaja and Mian (2008), who first introduced firm fixed effects as a way to deal with loan supply-and-demand identification issues using firm- and bank-level data.

industry and geographic time-varying factors.

VI.C Results

Table 6 shows the estimates of the effect of the policy on new dollar loans (columns 2 to 5) and on new total loans (columns 6 to 9). The first column of each dependent variable shows the estimates controlling only for firm fixed effects and bank controls; in the following columns, relationship controls and bank fixed effects are added gradually. Columns 5 and 9 present the estimates of the main specification in (13).

The effect of the policy shock on the growth rate of new dollar loans is increasing in bank exposure. The interaction between the shock dummy and bank exposure is negative and statistically significant at 1% for the *micro* firms in all specifications. For the *small* and *medium* firms, the effect of the interaction between the shock dummy and bank exposure is not statistically different from that of *micro* firms. In particular, for the *micro*, *small*, and *medium* firms, a 10% increase in bank exposure to the shock (about equivalent to increasing from the median to the 75th percentile of exposure) leads to a reduction of the growth rate of new *dollar* loans of around 4.2% in the year after the policy announcement.

For the *large* firms, the interaction between the shock dummy and bank exposure is significantly lower than that of *micro* firms. However, the overall effect of the interaction for *large* firms, captured by the sum of the coefficients of $Exposure \times Shock$ and $Exposure \times Shock \times Big$, is statistically significant and negative in most specifications (see the joint test for the significance of the sum of these coefficients in Table 6). This effect is around –2% for *large* firms.

The results so far suggest that, after the policy announcement, more exposed banks tended to reduce the growth rate of new dollar loans more than less exposed banks. This reduction is significantly higher for the group of *micro, small* and *medium* firms. *Large* firms that borrow from more exposed banks were also negatively and significantly affected, but to a lesser degree. The size of these coefficients might be capturing two effects: (1) the effect of a higher cost of dollar financing, but also, (2) firms switching from dollar loans toward safe soles borrowing, which became relatively more attractive than before.

Estimates on the growth rate of new *total* (dollar plus soles) loans also account for the second effect. Results remain statistically significant for the smaller firms: a 10% increase in bank exposure to the shock leads to a reduction of the growth rate of new *total* loans to *micro*, *small*, and *medium* firms of around 3.2%. This effect on the *large* firms is significantly different, which supports the proposed mechanism: the estimated effect of exposure on the *large* firms is around 1.4%, but it's imprecise and not statistically significant in most specifications (see the joint test in Table 6).

VI.D Robustness

Alternative indicators of size. Estimates in the previous section rely on the size definitions used by the regulator of the financial system (SBS) to classify business loans. These definitions combine several criteria, including sales, whether firms have access to the capital markets, and loan size (see Table 2). To rule out that my main results are driven by the design of the SBS definitions, I check robustness to alternative predetermined indicators of size. Table 9 shows the estimated effects of the tax using the log number of workers as a firm size indicator. Tables 10 and 11 do the same for the median sales range and firm age, respectively.

My results remain qualitatively robust: more exposed banks are significantly more affected by the tax, and this effect decreases significantly as the number of workers decreases. When accounting for substitution to soles loans, the magnitude of these effects decreases, reflecting some degree of substitution toward soles loans.

Adding bank and date clusters. Though the experiment is at the bank level, I argue that firms are randomly allocated across differently exposed banks (see Table 5). Thus, in my main specification, I cluster only at the firm level. This accounts for the time-series correlation that occurs within firms. To account for potential correlation that might occur at the bank level, and across firms and banks within the same date, I also cluster by date and bank. Table 12 shows that, despite some lost precision in the estimates due to the small number of date and bank observations, the coefficients remain statistically significant under most specifications.

Alternative indicator of bank exposure. Table 13 shows the estimated effects of the policy using an alternative exposure indicator: banks' distance from the regulatory benchmark $\frac{D_b^{Dec2014}}{D_b^{Sep2013}}$. My results remain qualitatively robust.

VI.E Firm-Level Regressions

When the cost of dollar borrowing increases, firms can switch to soles debt not only from the same bank but also from other banks. To account for this additional source of substitution of dollar debt, I aggregate loans at the firm level and estimate the effect that a firm's overall exposure to the policy has on the growth rate of its new loans. I construct the firm's exposure as the weighted sum of the exposure of all banks the firm borrows from, at the time of the policy announcement. The weights are given by the share of dollar debt that firm f has with bank b:

$$exp_f = \sum_b \frac{exp_{bf} \times debt_{bf}}{debt_f} \tag{14}$$

The effect on dollar loans remains quantitatively unaffected relative to the main results (see Table 7). This is expected since switching to dollar loans from less exposed is unlikely: less exposed banks may not have incentives to increase their dollar loan supply above the regulatory benchmark. Then, the most likely way to avoid the tax is by switching to soles loans either from the same bank or from other banks. My results show that, with the exception of *micro* firms, firms are capable of remaining relatively less affected by the tax when accounting for substitution to soles loans from other banks.

VII Conclusions

In this paper, I show theoretically and empirically that macroprudential FX regulations increase financial disparities between small and large firms. I propose a mechanism, unexplored in the literature, through which a tax that increases the cost of dollar borrowing disproportionately hurts small firms' financing.

I show that a risky financing plan, where nontradable firms denominate a large share of their debt in dollars, is cheaper in expectation than a safe plan in which debt is denominated mostly in soles. Then, currency mismatch allows small firms to relax their borrowing constraints and increase their leverage and investment possibilities. By contrast, currency mismatch may entail profit gains for large firms, but it does not affect their leverage and optimal investment. Under this framework, a tax that increases the cost of borrowing in dollars negatively affects small firms' total debt and only has compositional effects on large firms' debt.

To verify this theoretical prediction empirically, I assemble a unique dataset combining (1) confidential data on the universe of loans granted by Peruvian banks to nonfinancial firms. (2) Confidential data on the universe of all formally registered firms. (3) Publicly available data on banks' balance sheets.

I take advantage of an unexpected and aggressive intervention by the Central Bank of Peru to increase the reserve requirement rate (a tax) on banks' FX liabilities. I exploit the cross-sectional variation in bank exposure to this tax to identify the lending channel on nontradable firms. Simultaneously, I test whether firms borrowing from differently exposed banks respond heterogeneously to this supply shock depending on their size.

Consistent with the predictions of my proposed model, the growth rate of new loans for small firms decreases significantly more than it does for large firms. Even after accounting for a potential switch to soles loans, this differential effect persists. Since firms are able to reduce their exposure to the tax by borrowing in soles *also* from other banks, I account for this additional source of substitution. I replicate my empirical strategy at the firm level. I find that *micro* firms remain significantly negatively affected by the tax, while larger size categories are able to exploit their additional bank-relationships to avoid the tax.

This paper provides evidence of an unintended consequence of macroprudential FX policies that can be useful for policy-makers to have more information when designing their policy interventions. For example, the monetary authority can consider providing additional subsidized soles liquidity facilities to banks, conditional on lending to the segment of small firms. This would make the substitution to soles borrowing more smoothly for these firms that are highly constrained. This is arguably not substantially expensive given the low share of small firms in banks' portfolio of loans.

However, this paper does not provide a direct answer to whether or not it is worth indirectly taxing the small firms in order to achieve stability. To formally answer this question one would need to account for this trade-off not only in the good state but also in the bad state. That is, estimate the counterfactual losses of small firms in an episode of a severe depreciation had the tax not been implemented. This implies providing answers to the following questions: What are the overall growth losses of small firms in tranquil times vs. the costs of a major crisis that happens once every decade?

what are the potential spillovers to small firms from a massive collapse of large firms? What is the cost of a general bailout? The answers to these questions are not straightforward and can be tackled in future research.

My findings here may also have important implications for income inequality if we assume that there is a positive correlation between firm size and the average wages they offer. One can argue that by disproportionally hurting financing and growth possibilities of small firms, these policies might also hurt workers in the lower rungs of the income distribution.

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Figure 1. Dollarization of the Peruvian Banking system

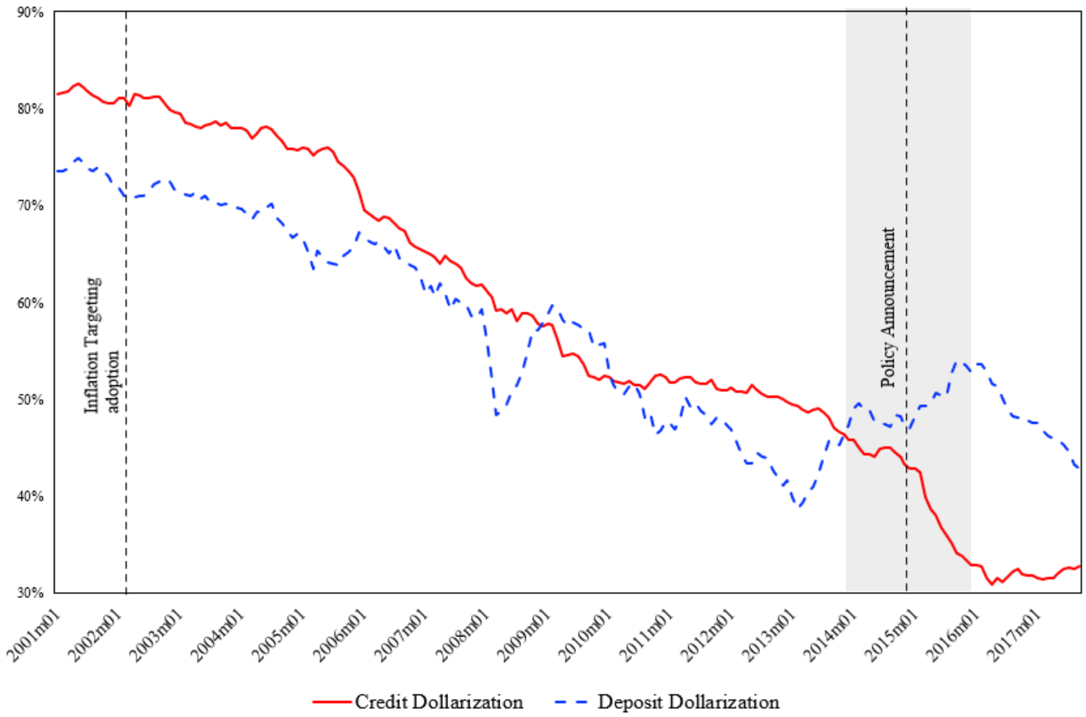
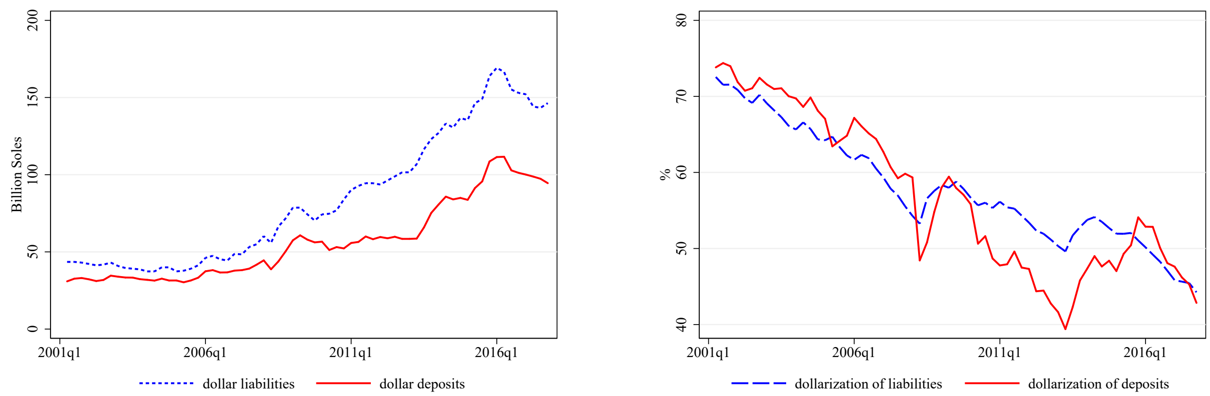


Figure 1 shows the evolution of the dollarization ratio of total credit and deposits of all banks in the financial system, after the adoption of inflation targeting in 2002. In December 2014, a macroprudential FX policy was announced aiming at reducing credit dollarization of nontradable firms. The shaded area highlights the sample period of my analysis, 12 months before and after the policy announcement.

Back to III.A

Figure 2. Dollar deposits and Dollar liabilities of the Peruvian Banking system

A. Stock (Billion of soles) **B. Dollarization ratio**



Panel A of Figure 2 shows the evolution of the stock of dollar liabilities and dollar assets and Panel B shows the dollarization ratio of liabilities and deposits of all banks in the financial system .

Back to III.A

Figure 3. Dollar assets and Dollar liabilities of the Banking System

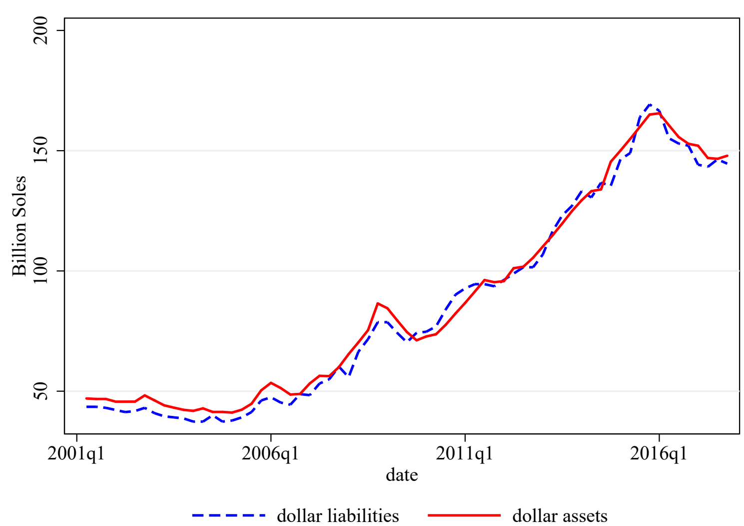


Figure 3 shows the evolution of dollar liabilities and dollar assets of all banks in the financial system. This provides evidence of limited FX exposure in banks' balance sheets.

Back to III.A

Figure 4. Historical Evolution of Exchange rate (1 USD to PEN)

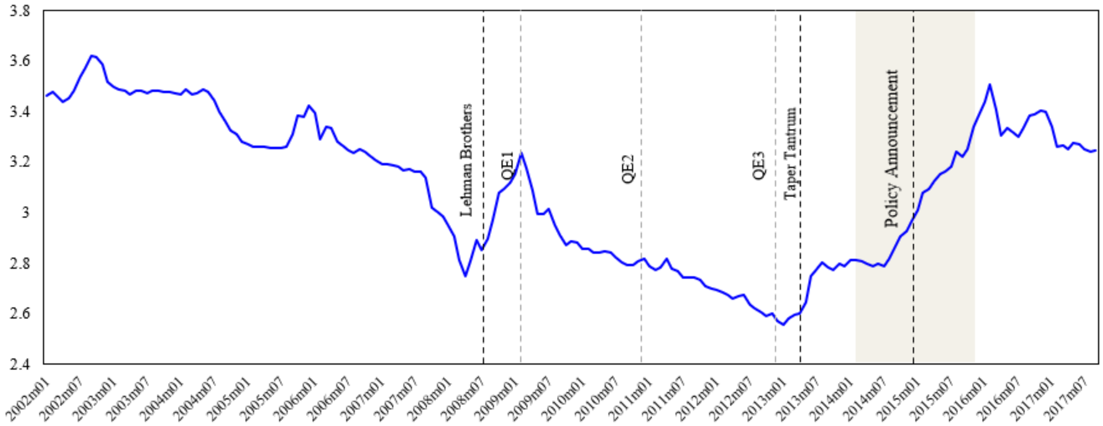


Figure 4 shows the evolution of the exchange rate (soles per dollar) after the adoption of inflation targeting. The Peruvian economy can be understood as an open-economy inflation targeter where the Central bank has shown a fairly systematic tendency to "lean against" significant movements in their exchange rates. But allowing fluctuations and without committing to a particular fixed exchange rate that departs from domestic and external fundamentals.

Back to III.A

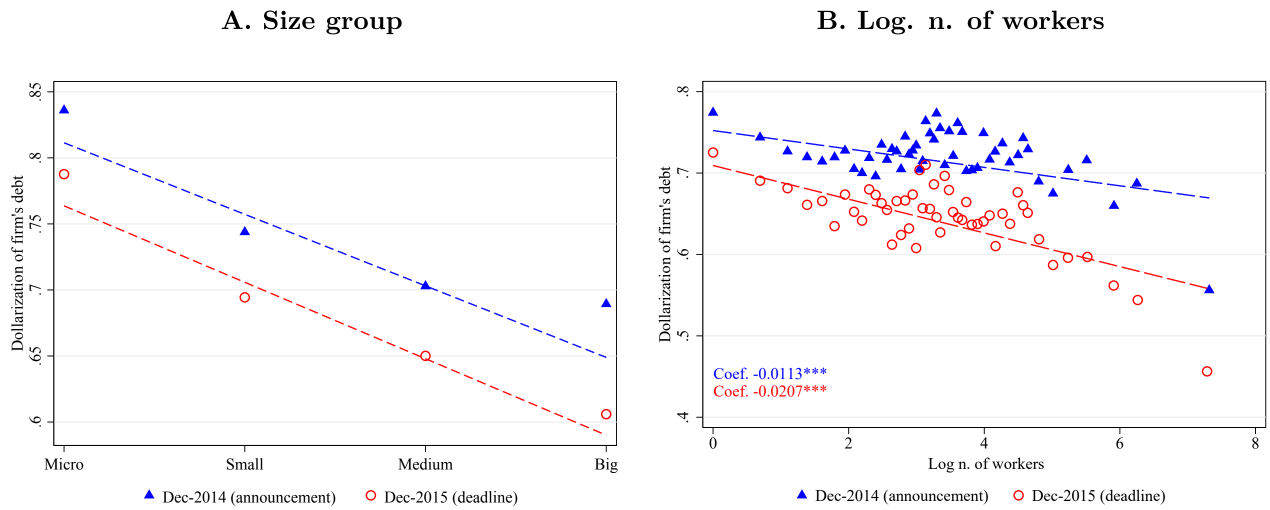
Table 1. Firm size and debt dollarization

Size	% USD debt (NT firms' debt)	% loans to NT firms (USD loans)	% Tradable firms (total nr. of firms)
Micro	36	88	0.2
Small	26	93	0.8
Medium	58	75	9.7
Large	46	46	26.5

Source: SBS, own calculations. Dec. 2014

Column 1 of Table 1 shows the share of loans granted to nontradable firms, that are denominated in dollars. Column 2 shows the share of dollar loans granted to nontradable firms. And column 3 shows the share of firms classified as tradables. Calculations are made using data at December 2014 (policy announcement)

Figure 5. Binscatter (mean value), dollarization ratio of nontradable firms by size

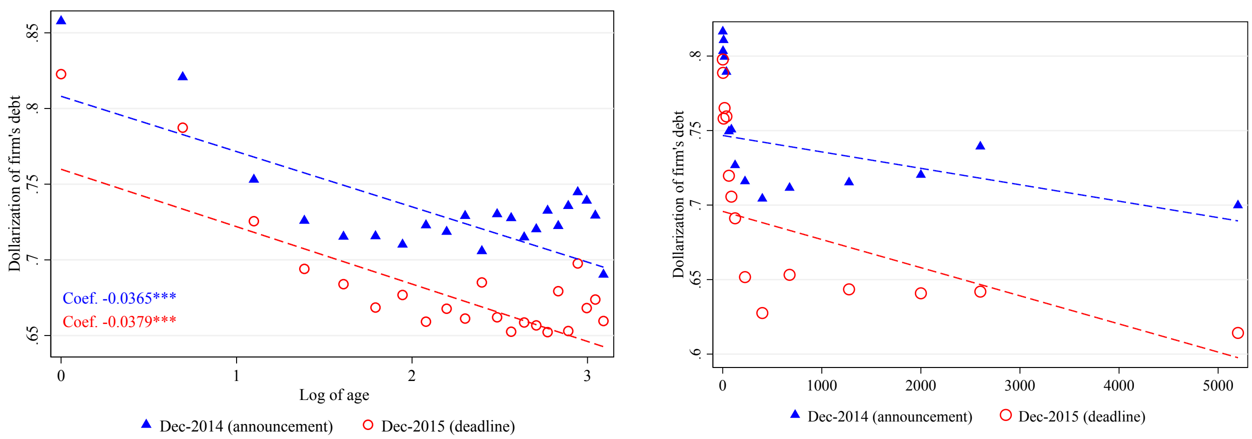


Panel A of figure 5 shows a bin-scatter of firm's debt dollarization ratio (y-axis) against the size category (x-axis). Panel B shows a bin-scatter of firm's debt dollarization ratio (y-axis) against the log of the number of workers per firm. The sample includes all unhedged firms active at the date of de policy announcement, December 2014 (blue filled triangle), and at the date of the policy deadline, December 2015 (red hollow circles). Dashed line represents a linear fit. N. of quantiles in panel B=100. The sample comprises all nontradable firms issuing dollar debt.

Back to III.B

Figure 6. Binscatter (mean value), dollarization ratio of nontradable firms by size

A. Log of Age **B. Sales range**



Panel A of figure 6 shows a bin-scatter of firm's debt dollarization ratio (y-axis) against the log of firm's age (x-axis). Panel B shows a bin-scatter of firm's debt dollarization ratio (y-axis) against firm sales range (discrete). The sample includes all unhedged firms active at the date of de policy announcement, December 2014 (blue filled triangle), and at the date of the policy deadline, December 2015 (red hollow circles). Dashed line represents a linear fit. N. of quantiles in panel A=100. The sample comprises all nontradable firms issuing dollar debt.

Back to III.B

Figure 7. Average interest rate spread soles to dollar loans and UIP deviations.

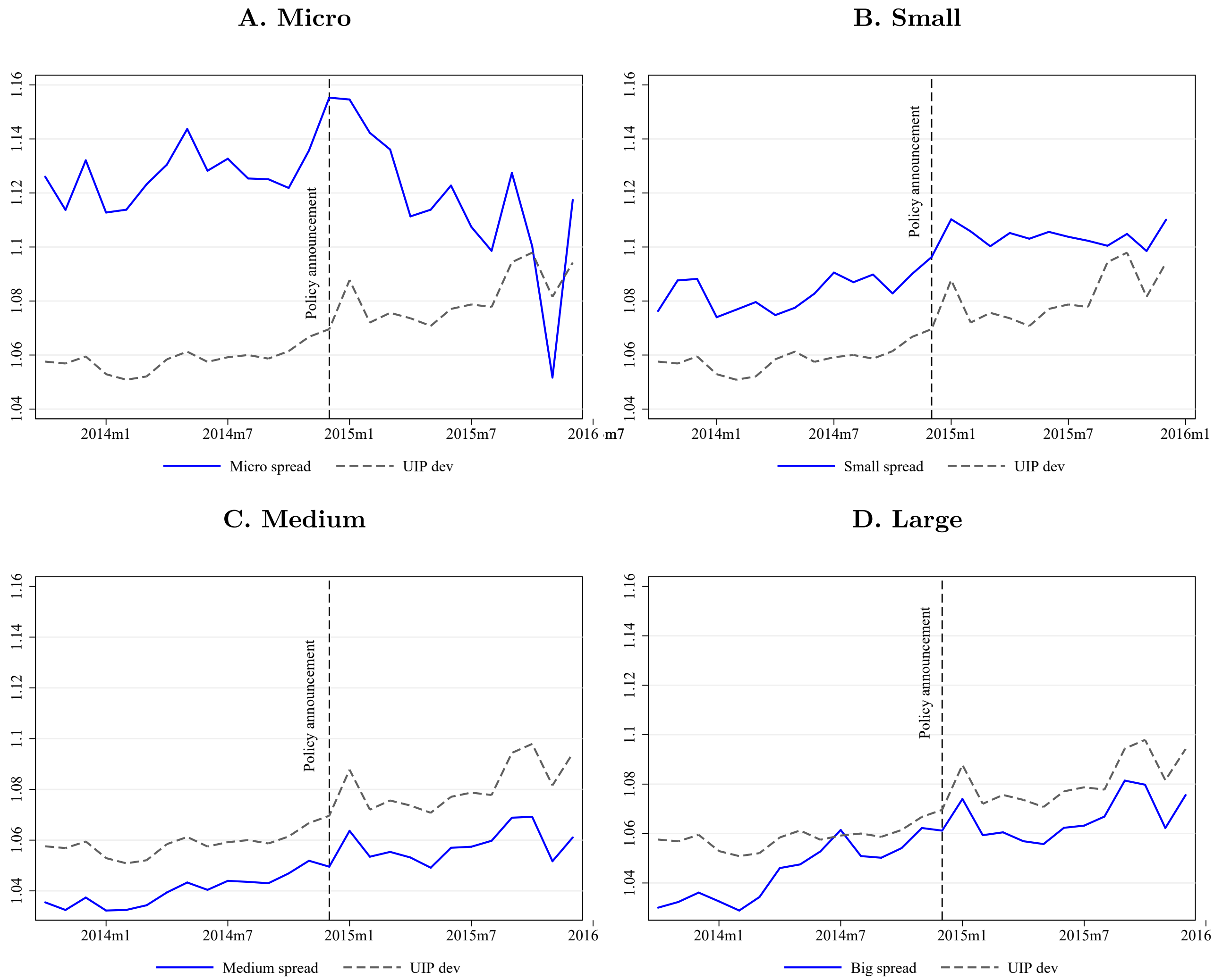


Figure 7 shows the evolution of the deviations from the uncovered interest rate parity relation (dashed gray line) defined as: $UIP_{dev} = \left(\frac{e_t}{E[e_{t+1}]}\right)\left(\frac{1+r_t}{1+r_t^*}\right)$. And the soles-dollar bank credit interest rate spread, correcting for expected depreciation (blue line) defined as: $spread^{size} = \left(\frac{e_t}{E[e_{t+1}]}\right)\left(\frac{1+r_t^{L,size}}{1+r_t^{L^*,size}}\right)$. Where: r_t and r_t^* are the the interest rates on 1 year treasury bills for Peru and the U.S, respectively. $r_t^{L,size}$ and $r_t^{L^*,size}$ are the average soles and dollar credit interest rate in each size segment, respectively. Finally, e_t and $E[e_{t+1}]$ are the dollars per sol exchange rates and the year ahead expected exchange rate (from firms survey), respectively.

Back to III.C

Figure 8. Evolution of dollar and total (soles + USD) loans by size category

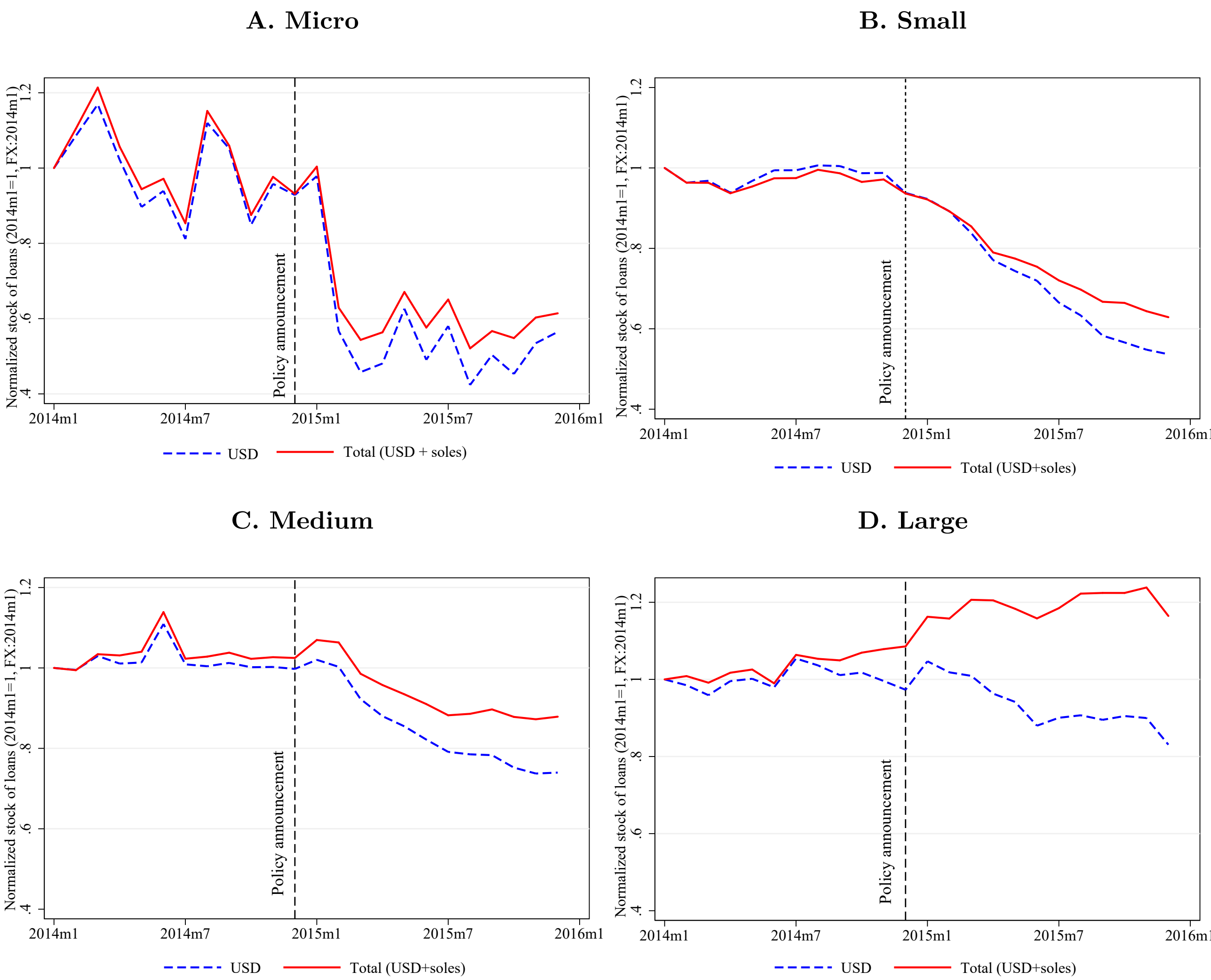


Figure 8 shows the evolution of the normalized stock of outstanding dollar loans for unhedged firms (dashed blue line) and, for the same sample of unhedged firms, the evolution of the normalized stock of outstanding dollar + soles loans (red line). Each panel show the evolution of both variables for each firm size category.

Back to III.D

Table 2. Regulator Firm Size Definition

Size	May include listed firms	annual sales	Total debt (USD) above	Total debt (USD) below
Micro	NO			7,142
Small	NO		7,142	107,142
Medium	NO	below 7 mill. USD	107,142	
Large	YES	above 7 mill. USD		

*Source: SBS

Table 2 describes the size definition used in my empirical analysis. This size classification is based on the one determined by regulator of the financial system (See Resolucion SBS 11356-2008.). The regulator classifies firms in 5 size groups: Corporate, *large, medium, small* and *micro*. Corporate firms are those that have annual sales above 200 million soles (approximately $71.4 million) and *large* firms are those that have annual sales between 20 and 200 million soles or have access to capital markets. For simplicity and because of the limited number of firms classified as corporate, I refer to the corporate and large firms as *large*. Also, *medium* firms are those that have annual sales below 20 million soles and typically have had a total debt balance with the financial system greater than 300,000 soles. Small and *micro* firms have a total indebtedness with the financial system of less than 300,000 soles and 20,000 soles respectively. Also, they are mostly firms with less than 100 workers, and annual sales below 6 million soles and 570 mil soles, respectively (based on information of the Tax Collection Agency (SUNAT)). Each firm size classification remains constant across the sample of analysis. Thus, my classification of size do not respond endogenously to the policy. *Back to III.B*

Figure 9. Cross-sectional correlation β_t (95% CI).

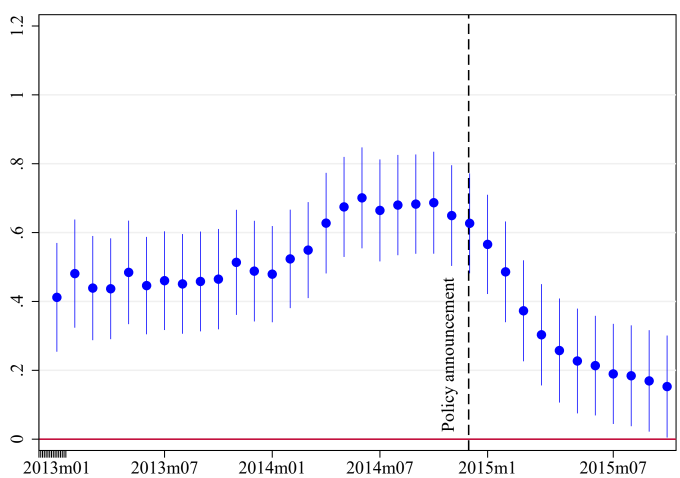


Figure 9 shows the evolution of the cross-sectional correlation between the normalized stock of dollar loans and bank's share of dollar liabilities to total assets, i.e. β_t in:

$$\frac{D_{b,t}}{D_b^{Sep2013}} = \beta_t \sum_{i=1}^{36} \frac{Liab\,USD_{b,t}}{Assests_{b,t}} \times 1[t=i] + \epsilon_{b,t}$$

Back to IV.B

Figure 10. Average change in the norm.stock of USD loans and the share of dollar funding to assets (95% CI)

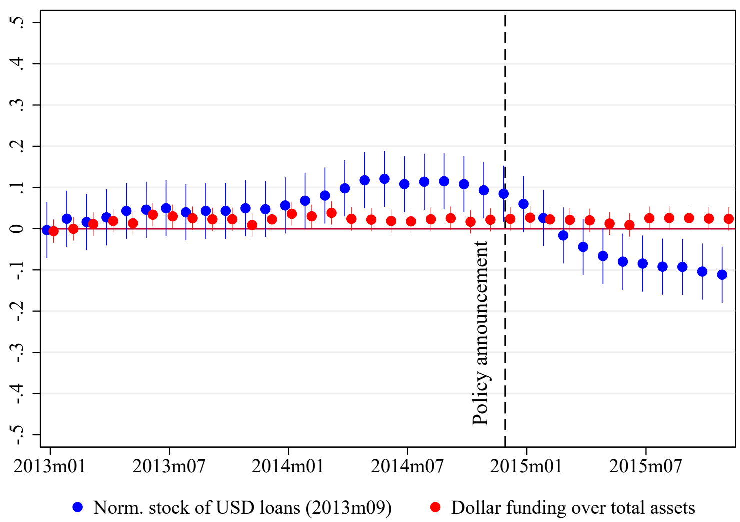


Figure 10 shows the monthly change of average banks' normalized stock of dollar loans (blue dot), i.e. γ_t in:

$$\frac{D_{b,t}}{D_b^{Sep2013}} = \gamma_t \sum_{i=2}^{36} 1[t = i] + BankFE + \epsilon_{b,t}.$$

And the monthly change of average banks' reliance on dollar funding (red dot), i.e. θ_t in:

$$\frac{Liab\,USD_{b,t}}{Assests_{b,t}} = \theta_t \sum_{i=2}^{36} 1[t = i] + BankFE + \varepsilon_{b,t}$$

Back to IV.B

Figure 11. Kernel Density of the share of Dollar Funding to Total Assets (December 2014)

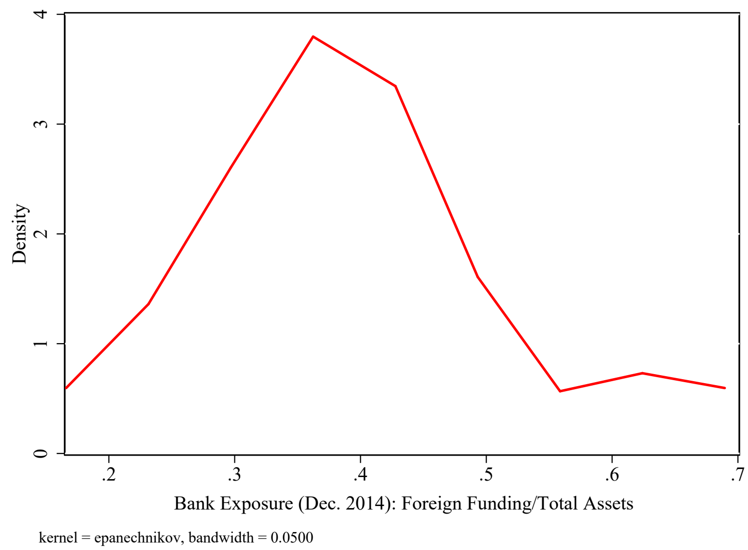


Figure 11 shows the kernel density of the share of dollar funding to total assets of all banks in the sample in December 2014. This shows how heterogeneous was bank exposure to the policy at the moment of the announcement.

Back to VI.B

Table 3. Summary Statistics

Panel A. Bank-Firm level

	2014						2015					
Micro	**mean**	**median**	**SD**	**p5**	**p95**	**N**	**mean**	**median**	**SD**	**p5**	**p95**	**N**
Monthly average growth rate of new dollar loans	0.80	0.56	0.91	0.00	2.46	8,957	0.74	0.52	0.80	0.00	2.25	9,376
Monthly average growth rate of new total loans	0.78	0.55	0.91	0.00	2.41	8,497	0.73	0.50	0.80	0.00	2.20	8,918
Bank-firm controls												
Nonperforming loans/total loans (2014)	0.22	0.11	0.28	0.00	0.99	8,957						
Share of firm total debt per bank (2014)	0.96	1.00	0.16	0.70	1.00	8,957						
Small												
Monthly average growth rate of new dollar loans	0.63	0.38	0.87	0.00	2.13	10,743	0.58	0.33	0.81	0.00	2.00	9,275
Monthly average growth rate of new total loans	0.52	0.25	0.81	0.00	1.89	9,153	0.49	0.18	0.86	0.00	1.84	7,550
Bank-firm controls												
Nonperforming loans/total loans (2014)	0.13	0.00	0.27	0.00	0.89	10,743						
Share of firm total debt per bank (2014)	0.69	0.83	0.35	0.00	1.00	10,743						
Medium												
Monthly average growth rate of new dollar loans	0.57	0.28	0.97	0.00	2.03	13,462	0.52	0.27	0.82	0.00	1.93	12,033
Monthly average growth rate of new total loans	0.47	0.22	0.88	0.00	1.66	12,334	0.43	0.19	0.78	0.00	1.63	10,739
Bank-firm controls												
Nonperforming loans/total loans (2014)	0.08	0.00	0.22	0.00	0.67	13,462						
Share of firm total debt per bank (2014)	0.46	0.39	0.35	0.01	1.00	13,462						
Large												
Monthly average growth rate of new dollar loans	0.64	0.35	0.89	0.01	2.28	2,693	0.66	0.37	0.88	0.01	2.28	2,849
Monthly average growth rate of new total loans	0.51	0.26	0.78	0.01	1.85	2,555	0.49	0.24	0.74	0.01	1.90	2,659
Bank-firm controls												
Nonperforming loans/total loans (2014)	0.03	0.00	0.15	0.00	0.17	2,693						
Share of firm total debt per bank (2014)	0.41	0.31	0.34	0.01	1.00	2,693						

Panel B. Firm level

	2014						2015					
Micro	**mean**	**median**	**SD**	**p5**	**p95**	**N**	**mean**	**median**	**SD**	**p5**	**p95**	**N**
Monthly average growth rate of new dollar loans	0.82	0.62	0.91	0.00	2.45	5,479	0.75	0.55	0.81	0.00	2.19	4,936
Monthly average growth rate of new total loans	0.78	0.58	0.89	0.00	2.36	5,122	0.70	0.49	0.83	0.00	2.12	4,546
Bank-firm controls												
Nonperforming loans/total loans (2014)	0.29	0.00	0.40	0.00	1.00	5,479						
Small												
Monthly average growth rate of new dollar loans	0.66	0.37	1.00	0.00	2.26	8,554	0.56	0.31	0.82	0.00	1.99	7,433
Monthly average growth rate of new total loans	0.49	0.21	0.92	0.00	1.78	6,763	0.41	0.13	0.79	0.00	1.61	5,554
Bank-firm controls												
Nonperforming loans/total loans (2014)	0.12	0.00	0.29	0.00	1.00	8,554						
Medium												
Monthly average growth rate of new dollar loans	0.50	0.22	0.85	0.00	1.94	7,903	0.41	0.16	0.74	0.00	1.68	6,475
Monthly average growth rate of new total loans	0.34	0.16	0.65	0.00	1.22	6999	0.27	0.11	0.57	0.00	1.01	5,326
Bank-firm controls												
Nonperforming loans/total loans (2014)	0.06	0.00	0.20	0.00	1.00	7,903						
Large												
Monthly average growth rate of new dollar loans	0.60	0.30	0.88	0.01	2.19	1,256	0.57	0.27	0.82	0.01	2.12	1,197
Monthly average growth rate of new total loans	0.42	0.19	0.68	0.01	1.54	1,170	0.40	0.16	0.67	0.01	1.54	1,086
Bank-firm controls												
Nonperforming loans/total loans (2014)	0.03	0.00	0.14	0.00	0.01	1,256						

Table 3 reports the summary statistics of the variables used in the main regression specification in Table 6. Panel A. shows these statistics at the bank-firm level and Panel B shows them at the firm level. For both panels, the monthly average growth rate of loans, both dollar and total, are calculated as the average monthly growth rate for the year before the policy announcement (2014) and the year after the announcement (2015). Among bank controls, table reports the average ratio of nonperforming loans to total loans for the year before the policy announcement. And the share of firm debt per bank is calculated as the ratio between firm's debt with a particular bank and firm's stock of total debt. Thus, if the firm only borrows from one bank, this ratio is equal to 1. Naturally, this ratio is not available at the Firm level. *Back to* V

Table 4. Bank-firm relationships (Dec. 2014)

Firm size	mean	median	SD	p5	p95	N
Micro	1.06	1	0.22	1	1.50	5,479
Small	1.69	1.5	0.82	1	3.00	8,554
Medium	2.42	2	1.19	1	4.75	7,903
Large	2.51	2	1.49	1	5.67	1,256

Table 4 reports the summary statistics of the number of bank-firm relationships for each size category.
Back to V

Table 5. Difference of Means Between Banks above and below the median of exposure (Dec. 2014)

	Below median		Above median			
	mean	N	mean	N	T-stat	beta
Exposure: $\frac{\textit{Dollar liabilities}}{\textit{Total Assets}}$	0.324	5	0.483	4	-2.6606	-0.1595**
Financial ratios						
Roa	0.013	5	0.016	4	-0.6027	-0.0025
Assets (billions)	29.7	5	30.1	4	-0.0141	-0.351
Liquidity ratio USD	0.5	5	0.5786	4	-1.3163	-0.0785
Liquidity ratio soles	0.2655	5	0.2043	4	0.9593	0.0611
Structure of the Portfolio of dollar loans						
Micro firms (%)	0.21	5	0.28	4	-0.5459	-0.07
Small firms (%)	2.41	5	4.15	4	-1.1304	-1.74
Medium firms (%)	52.59	5	41.51	4	0.9682	11.08
Large firms (%)	44.77	5	54.04	4	-0.7705	-9.2
Sales						
q1 (%)	4.93	5	3.59	4	0.8244	1.33
q2 (%)	5.23	5	3.94	4	0.6163	1.29
q3 (%)	7.86	5	9.97	4	-0.7258	-2.11
Workers						
q1 (%)	4.46	5	4.54	4	-0.0952	-0.08
q2 (%)	6.76	5	6.63	4	0.0530	0.13
q3 (%)	14.75	5	12.21	4	0.7323	2.53
Age						
q1 (%)	5.18	5	6.23	4	-0.5171	-1.05
q2 (%)	15.82	5	15.19	4	0.2186	0.63
q3 (%)	17.46	5	16.98	4	0.4148	0.48

Table 5 reports the means of banks' observables, for the sample of banks with a degree of exposure below the median, and the sample of banks with a degree of exposure above the median. Relevant observables includes banks financial ratios such as profitability (Roa), liquidity ratios both in soles and dollars. It also shows the share of total loans allocated across firms of different sizes or that belong to different quartiles of the age, workers and sales distribution. The t-test determines whether the difference in means between the two samples is significantly different from zero. This is the case only for the degree of bank exposure. T-test shows that there is no significant difference between the means of relevant observables of each sample.

Back to VI.B

Figure 12. Testing Parallel Trends (95% CI)

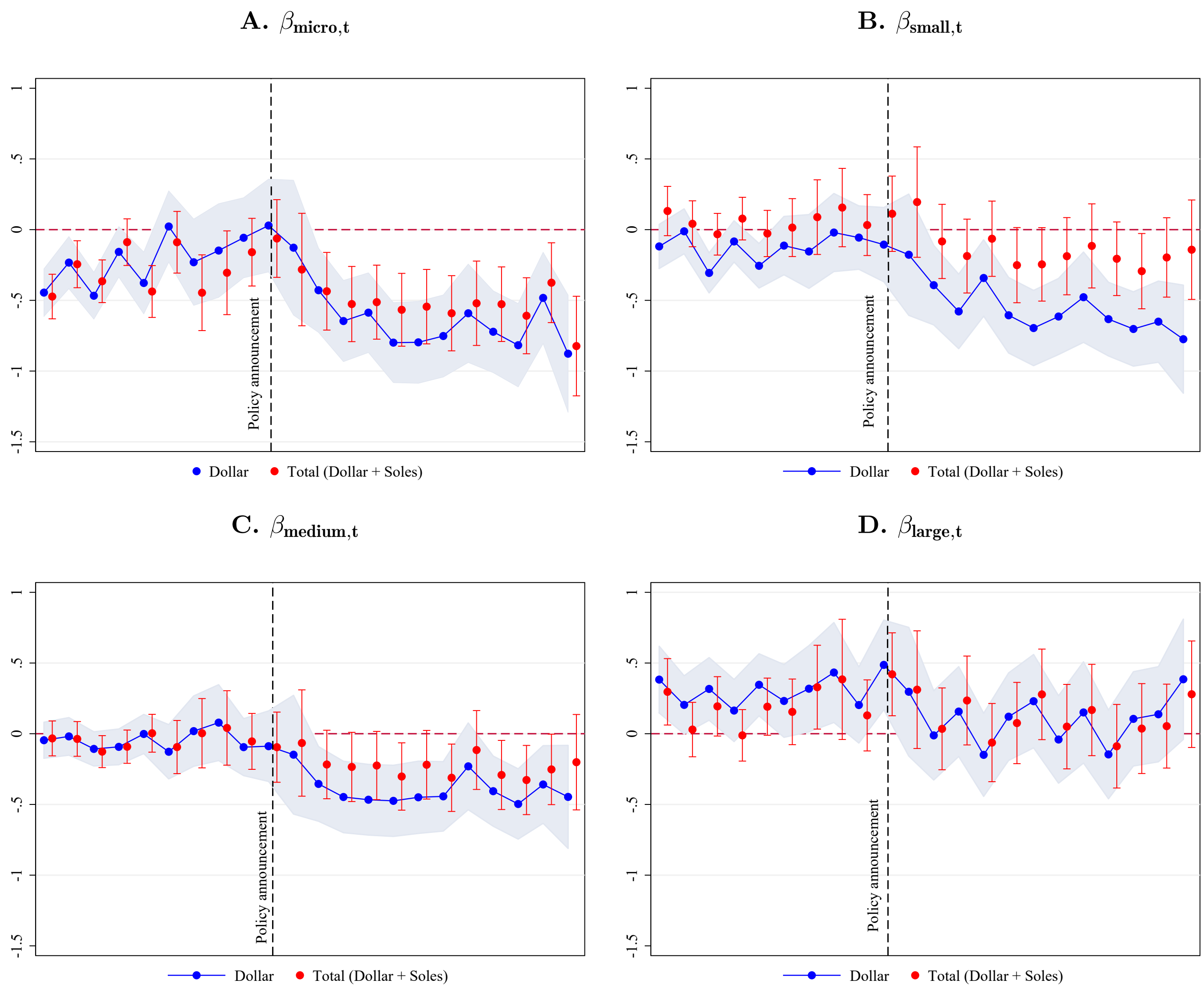


Figure 12 plots the evolution of the effect of bank exposure on the growth rate of new dollar loans (blue dot) and new total loans (red dot) for each size category. In particular, the coefficients $\beta_{s,t}$ is plotted for each size category (where the omitted category is *micro*):

$$y_{fbt} = \beta_0 + \beta_1 Exposure_b + \beta_2 Shock_t + \beta_t \sum_{i=2}^{24} Exposure_b \times 1[t = i]$$

$$+ \sum_{s=2}^{4} \beta_{s,t} \sum_{i=2}^{24} Exposure_b \times 1[t = i] \times size^s + \Theta X_{bf} + \Phi X_{b,t-1} + Exp_{dep,t} + BankFE + FirmFE + \epsilon_{fbt}$$

Back to VI.B

Figure 13. Exchange rate Soles/USD and 12 month ahead expectations

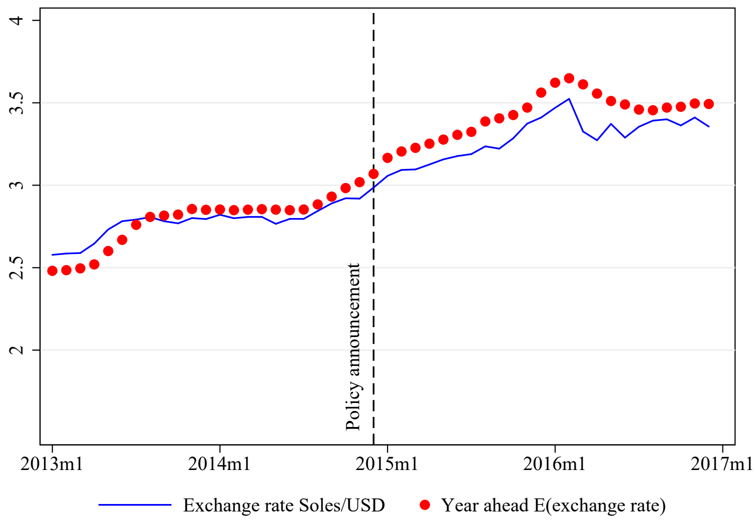


Figure 13 plots the evolution of the nominal exchange rate soles to dollar and the 12 month ahead exchange rate expectations, obtained from firms' survey held by the Central Bank of Peru.

Back to VI.B

Table 6. Effect of a macroprudential FX tax on dollar and total loans - Main specification

	Δ(log New Dollar loans)(FX:2014m1)					Δ(log New Total loans)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exposure*Shock	-0.332***	-0.451***	-0.422***	-0.492***	-0.246**	-0.332***	-0.293***	-0.342***
	(0.117)	(0.117)	(0.116)	(0.116)	(0.115)	(0.114)	(0.112)	(0.111)
Exposure*Shock*small	-0.0173	-0.0156	-0.0315	-0.0301	0.0631	0.0634	0.0381	0.0382
	(0.0437)	(0.0437)	(0.0438)	(0.0438)	(0.0424)	(0.0424)	(0.0421)	(0.0421)
Exposure*Shock*medium	0.0698*	0.0524	0.0277	0.0186	0.0666*	0.0508	0.00505	-0.000991
	(0.0399)	(0.0399)	(0.0399)	(0.0400)	(0.0373)	(0.0374)	(0.0370)	(0.0372)
Exposure*Shock*Large	0.236***	0.225***	0.192***	0.184***	0.172***	0.168***	0.116**	0.115**
	(0.0528)	(0.0531)	(0.0528)	(0.0530)	(0.0490)	(0.0493)	(0.0484)	(0.0486)
Exposure	0.0459		-0.0172		0.157		0.137	
	(0.114)		(0.111)		(0.112)		(0.108)	
Shock	0.0333	0.0991**	0.0742*	0.115***	0.0162	0.0652	0.0492	0.0726*
	(0.0446)	(0.0446)	(0.0441)	(0.0440)	(0.0444)	(0.0442)	(0.0434)	(0.0429)
Joint Test	0.4084	0.0536	0.0452	0.0076	0.5289	0.1587	0.1196	0.0454
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	NO	YES	NO	YES	NO	YES	NO	YES
Bank controls	YES	YES	YES	YES	YES	YES	YES	YES
Relationship controls	NO	NO	YES	YES	NO	NO	YES	YES
Observations	147,353	147,353	145,085	177,933	117,933	115,928	115,928	115,928
R-squared	0.293	0.295	0.304	0.305	0.328	0.329	0.344	0.345
N. of firm clusters	25,035	25,035	24,643	24,643	21,472	21,472	21,104	21,104

Robust Standard errors in parentheses. Standard errors have been clustered by firm. *** p<0.01, ** p<0.05, * p<0.1. Joint test reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Big is equal to 0. Sample includes all firms that are neither exporters nor importers. The sample covers the period from 2014m1 to 2015m12 at a monthly frequency.

Back to VI.C

Table 7. Effect of a macroprudential FX tax on dollar and total loans - Firm level regressions

	Δ(log New Dollar loans)(FX:2014m1)					Δ(log New Total loans)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Exposure_f$*Shock	-0.297***	-0.392***	-0.378***	-0.424***	-0.241**	-0.264***	-0.205**	-0.233**
	(0.0897)	(0.0935)	(0.0950)	(0.0970)	(0.0957)	(0.0987)	(0.100)	(0.102)
$Exposure_f$*Shock*small	-0.0238	-0.0351	-0.0261	-0.0265	0.0952**	0.0884*	0.112**	0.101**
	(0.0499)	(0.0514)	(0.0525)	(0.0535)	(0.0465)	(0.0486)	(0.0485)	(0.0502)
$Exposure_f$*Shock*medium	0.0463	0.0535	0.0559	0.0646	0.0903**	0.115***	0.106**	0.114**
	(0.0443)	(0.0477)	(0.0472)	(0.0497)	(0.0395)	(0.0428)	(0.0428)	(0.0451)
$Exposure_f$*Shock*Large	0.139*	0.171**	0.169**	0.178**	0.186***	0.222***	0.207***	0.222***
	(0.0719)	(0.0774)	(0.0759)	(0.0809)	(0.0633)	(0.0690)	(0.0674)	(0.0726)
Shock	0.00972				0.0294			
	(0.0330)				(0.0370)			
Joint Test Small	0.0002	0.0002	0.0000	0.0000	0.1169	0.0707	0.3393	0.1880
Joint Test Medium	0.1343	0.0026	0.0001	0.0001	0.0958	0.1182	0.3330	0.2289
Joint Test Large	0.1223	0.042	0.0542	0.0305	0.5988	0.7045	0.9868	0.9208
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Firm-bank controls	YES	YES	YES	YES	YES	YES	YES	YES
Geog. location x time FE	NO	NO	YES	YES	NO	NO	YES	YES
Industry x time FE	NO	YES	NO	YES	NO	YES	NO	YES
Observations	100,566	99,695	98,398	97,476	73,647	72,644	71,736	70,697
R-squared	0.372	0.403	0.399	0.429	0.430	0.468	0.455	0.494
N. of firm clusters	20,747	20,634	20,296	20,169	16,492	16,334	16,052	15,892

Robust Standard errors in parentheses. Standard errors have been clustered by firm. *** p<0.01, ** p<0.05, * p<0.1. Joint Test reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*size are equal to 0 for each size. Sample includes all firms that are neither exporters nor importers. The sample covers the period from 2014m1 to 2015m12 at a monthly frequency. The coefficient on $Exposure_f$ was dropped due to collinearity with bank FE.

Back to VI.D

Table 8. Effect of a macroprudential FX tax on dollar and total loans
Adding Industry-time and Geographic location-time FE

	Δ(log New Dollar loans)(FX:2014m1)					Δ(log New Total loans)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exposure*Shock	-0.419***	-0.408***	-0.468***	-0.463***	-0.374***	-0.343***	-0.399***	-0.374***
	(0.123)	(0.120)	(0.121)	(0.119)	(0.123)	(0.121)	(0.119)	(0.118)
Exposure*Shock*small	0.00226	-0.0139	-0.0153	-0.0249	0.0829*	0.0511	0.0530	0.0282
	(0.0458)	(0.0456)	(0.0459)	(0.0457)	(0.0443)	(0.0442)	(0.0440)	(0.0438)
Exposure*Shock*medium	0.0628	0.0625	0.0289	0.0301	0.0433	0.0459	-0.00950	-0.00268
	(0.0424)	(0.0429)	(0.0426)	(0.0431)	(0.0401)	(0.0403)	(0.0400)	(0.0401)
Exposure*Shock*Large	0.240***	0.250***	0.195***	0.206***	0.177***	0.175***	0.123**	0.122**
	(0.0558)	(0.0563)	(0.0557)	(0.0562)	(0.0522)	(0.0538)	(0.0516)	(0.0529)
Joint Test	0.1402	0.1883	0.0234	0.03	0.1167	0.1816	0.0231	0.0388
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank controls	YES	YES	YES	YES	YES	YES	YES	YES
Relationship controls	NO	NO	YES	YES	NO	NO	YES	YES
Geog. location x time FE	YES	NO	YES	NO	YES	NO	YES	NO
Industry x time FE	NO	YES	NO	YES	NO	YES	NO	YES
Observations	145,125	146,660	142,870	144,374	115,897	117,119	113,920	115,095
R-squared	0.313	0.320	0.324	0.331	0.351	0.357	0.367	0.373
N. of firm clusters	24,573	24,952	24,183	24,557	21,001	21,368	20,643	20,998

Robust Standard errors in parentheses. Standard errors have been clustered by firm. *** p<0.01, ** p<0.05, * p<0.1. Joint Test reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Large is equal to 0. Sample includes all firms that are neither exporters nor importers. The sample covers the period from 2014m1 to 2015m12 at a monthly frequency. The coefficient on Exposure was dropped due to collinearity with bank FE. The coef. on Shock, was dropped due to collinearity with Ind×time and Geog×time FE.

Back to VI.D

Table 9. Effect of a macroprudential FX tax on dollar and total loans
Interaction with number of workers

	Δ(log New Dollar loans)(FX:2014m1)				Δ(log New Total loans)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exposure*Shock*log(workers)	0.0356***	0.0447***	0.0309***	0.0387***	0.0281***	0.0281***	0.0214**	0.0202**
	(0.00982)	(0.00979)	(0.00982)	(0.00981)	(0.00929)	(0.00979)	(0.00903)	(0.00950)
Exposure*Shock	-0.500***	-0.538***	-0.558***	-0.606***	-0.410***	-0.386***	-0.445***	-0.425***
	(0.137)	(0.135)	(0.135)	(0.133)	(0.139)	(0.138)	(0.135)	(0.134)
log(workers)	0.0203	0.0145	0.0217*	0.0158	0.0310**	0.0265*	0.0321**	0.0259*
	(0.0132)	(0.0134)	(0.0131)	(0.0133)	(0.0151)	(0.0152)	(0.0150)	(0.0151)
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank controls	YES	YES	YES	YES	YES	YES	YES	YES
Relationship controls	NO	NO	YES	YES	NO	NO	YES	YES
Geog. location x time FE	YES	NO	YES	NO	YES	NO	YES	NO
Industry x time FE	NO	YES	NO	YES	NO	YES	NO	YES
Observations	119,937	121,162	115,893	117,026	95,164	96,124	91,618	92,500
R-squared	0.302	0.312	0.312	0.322	0.339	0.347	0.354	0.362
N. of firm clusters	19,651	19,994	18,558	18,864	16,733	17,058	15,738	16,035

Standard errors in parentheses. Standard errors have been clustered by firm. *** p<0.01, ** p<0.05, * p<0.1. Sample includes all firms that are neither exporters nor importers. The sample covers the period from 2014m1 to 2015m12 at a monthly frequency. The coefficient on Exposure was dropped due to collinearity with bank FE. The coef. on Shock, was dropped due to collinearity with Ind×time and Geog×time FE.

Back to VI.D

Table 10. Effect of a macroprudential FX tax on dollar and total loans
Interaction with sales

	Δ(log New Dollar loans)(FX:2014m1)				Δ(log New Total loans)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exposure*Shock*log(sales)	0.0363***	0.0352***	0.0316***	0.0298***	0.0226***	0.0239***	0.0164***	0.0175***
	(0.00644)	(0.00644)	(0.00643)	(0.00643)	(0.00620)	(0.00628)	(0.00613)	(0.00621)
Exposure*Shock	-0.921***	-0.890***	-0.927***	-0.895***	-0.671***	-0.662***	-0.643***	-0.637***
	(0.151)	(0.147)	(0.150)	(0.146)	(0.144)	(0.142)	(0.141)	(0.140)
log(sales)	0.00243	0.00298	0.00167	0.00285	0.00348	0.00458	0.00244	0.00327
	(0.00549)	(0.00558)	(0.00553)	(0.00561)	(0.00501)	(0.00508)	(0.00492)	(0.00500)
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank controls	YES	YES	YES	YES	YES	YES	YES	YES
Relationship controls	NO	NO	YES	YES	NO	NO	YES	YES
Geog. location x time FE	YES	NO	YES	NO	YES	NO	YES	NO
Industry x time FE	NO	YES	NO	YES	NO	YES	NO	YES
Observations	143,656	145,289	137,816	139,315	114,712	116,058	109,574	110,757
R-squared	0.311	0.319	0.320	0.327	0.350	0.357	0.363	0.369
N. of firm clusters	25,083	25,512	23,359	23,735	21,455	21,871	19,903	20,259

Standard errors in parentheses. Standard errors have been clustered by firm. *** p<0.01, ** p<0.05, * p<0.1. Sample includes all firms that are neither exporters nor importers. The sample covers the period from 2014m1 to 2015m12 at a monthly frequency. The coefficient on Exposure was dropped due to collinearity with bank FE. The coef. on Shock, was dropped due to collinearity with Ind×time and Geog×time FE.

Back to VI.D

Table 11. Effect of a macroprudential FX tax dollar and total loans
Interaction with age

	Δ(log New Dollar loans)(FX:2014m1)				Δ(log New Total loans)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exposure*Shock*log(age)	0.290***	0.299***	0.287***	0.293***	0.164***	0.165***	0.158***	0.156***
	(0.0469)	(0.0467)	(0.0466)	(0.0464)	(0.0451)	(0.0451)	(0.0442)	(0.0442)
Exposure*Shock	-1.043***	-1.061***	-1.114***	-1.129***	-0.685***	-0.668***	-0.743***	-0.720***
	(0.160)	(0.157)	(0.157)	(0.155)	(0.159)	(0.160)	(0.155)	(0.155)
log(age)	0.226**	0.250***	0.235***	0.253***	0.0263	0.0460	0.0332	0.0476
	(0.0893)	(0.0884)	(0.0892)	(0.0886)	(0.0889)	(0.0872)	(0.0880)	(0.0863)
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank controls	YES	YES	YES	YES	YES	YES	YES	YES
Relationship controls	NO	NO	YES	YES	NO	NO	YES	YES
Geog. location x time FE	YES	NO	YES	NO	YES	NO	YES	NO
Industry x time FE	NO	YES	NO	YES	NO	YES	NO	YES
Observations	146,496	148,066	141,289	142,772	117,123	118,423	112,516	113,683
R-squared	0.314	0.321	0.324	0.331	0.351	0.358	0.365	0.372
N. of firm clusters	25,115	25,514	23,662	24,029	21,499	21,896	20,174	20,526

Standard errors in parentheses. Standard errors have been clustered by firm. *** p<0.01, ** p<0.05, * p<0.1. Sample includes all firms that are neither exporters nor importers. The sample covers the period from 2014m1 to 2015m12 at a monthly frequency. The coefficient on Exposure was dropped due to collinearity with bank FE. The coef. on Shock, was dropped due to collinearity with Ind×time and Geog×time FE.

Back to VI.D

Table 12. Effect of a macroprudential FX tax on dollar and total loans
Adding date and bank clusters

	Δ(log New Dollar loans) (FX:2014m1)				Δ(log New Total loans)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exposure*Shock	-0.419***	-0.408***	-0.468***	-0.463***	-0.374**	-0.343**	-0.399***	-0.374***
	(0.0618)	(0.0467)	(0.0651)	(0.0543)	(0.121)	(0.109)	(0.116)	(0.106)
Exposure*Shock*small	0.00226	-0.0139	-0.0153	-0.0249	0.0829***	0.0511	0.0530*	0.0282
	(0.0398)	(0.0437)	(0.0447)	(0.0446)	(0.0239)	(0.0425)	(0.0281)	(0.0341)
Exposure*Shock*medium	0.0628	0.0625	0.0289	0.0301	0.0433	0.0459	-0.00950	-0.00268
	(0.0358)	(0.0441)	(0.0366)	(0.0446)	(0.0387)	(0.0354)	(0.0383)	(0.0369)
Exposure*Shock*Large	0.240***	0.250***	0.195***	0.206**	0.177**	0.175*	0.123*	0.122
	(0.0485)	(0.0573)	(0.0542)	(0.0641)	(0.0739)	(0.0910)	(0.0631)	(0.0682)
Joint Test	0.0836	0.1232	0.028	0.048	0.0334	0.2164	0.0667	0.0641
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank controls	YES	YES	YES	YES	YES	YES	YES	YES
Relationship controls	NO	NO	YES	YES	NO	NO	YES	YES
Geog. location x time FE	YES	NO	YES	NO	YES	NO	YES	NO
Industry x time FE	NO	YES	NO	YES	NO	YES	NO	YES
Observations	145,125	146,660	145,125	146,660	115,897	117,119	115,897	117,119
R-squared	0.313	0.320	0.313	0.320	0.351	0.357	0.351	0.357
N. of firm clusters	24,573	24,952	24,183	24,557	21,001	21,368	20,643	20,998
N. of date clusters	24	24	24	24	24	24	24	24
N. of bank clusters	9	9	9	9	9	9	9	9

Robust Standard errors in parentheses. Standard errors have been clustered by firm, date and bank. *** p<0.01, ** p<0.05, * p<0.1. Joint Test reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Large is equal to 0. Sample includes all firms that are neither exporters nor importers. The sample covers the period from 2014m1 to 2015m12 at a monthly frequency. The coefficient on Exposure was dropped due to collinearity with bank FE. The coef. on Shock, was dropped due to collinearity with Ind×time and Geog×time FE.

Back to VI.D

Table 13. Effect of a macroprudential FX tax on dollar and total loans Alternative bank exposure indicator: $\frac{D_b^{Dec2014}}{D_b^{Sep2013}}$

	Δ(log New Dollar loans)(FX:2014m1)				Δ(log New Total loans)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exposure*Shock	-0.440***	-0.426***	-0.533***	-0.528***	-0.426***	-0.392**	-0.491***	-0.464***
	(0.145)	(0.143)	(0.142)	(0.140)	(0.157)	(0.156)	(0.152)	(0.152)
Exposure*Shock*small	-0.00159	-0.00838	-0.00676	-0.0112	0.0293*	0.0166	0.0197	0.00979
	(0.0170)	(0.0169)	(0.0170)	(0.0169)	(0.0165)	(0.0165)	(0.0164)	(0.0164)
Exposure*Shock*medium	0.0218	0.0214	0.00961	0.00991	0.0136	0.0141	-0.00548	-0.00325
	(0.0157)	(0.0159)	(0.0158)	(0.0160)	(0.0149)	(0.0150)	(0.0149)	(0.0149)
Exposure*Shock*Large	0.0863***	0.0892***	0.0734***	0.0770***	0.0660***	0.0641***	0.0490**	0.0484**
	(0.0207)	(0.0209)	(0.0207)	(0.0209)	(0.0193)	(0.0199)	(0.0191)	(0.0196)
Joint Test	0.0836	0.1232	0.028	0.048	0.0334	0.2164	0.0667	0.0641
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank controls	YES	YES	YES	YES	YES	YES	YES	YES
Relationship controls	NO	NO	YES	YES	NO	NO	YES	YES
Geog. location x time FE	YES	NO	YES	NO	YES	NO	YES	NO
Industry x time FE	NO	YES	NO	YES	NO	YES	NO	YES
Observations	145,125	146,660	142,870	144,374	115,897	117,119	113,920	115,095
R-squared	0.313	0.320	0.324	0.331	0.351	0.357	0.367	0.373
N. of firm clusters	24,573	24,952	24,183	24,557	21,001	21,368	20,643	20,998

Robust Standard errors in parentheses. Standard errors have been clustered by firm, date and bank. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Joint Test reports the p-value of the F-test that the sum of the coefficients of Exposure*Shock and Exposure*Shock*Large is equal to 0. Sample includes all firms that are neither exporters nor importers. The sample covers the period from 2014m1 to 2015m12 at a monthly frequency. The coefficient on Exposure was dropped due to collinearity with bank FE. The coef. on Shock, was dropped due to collinearity with Ind×time and Geog×time FE.

Back to VI.D

Appendix A

Proof of Proposition 1

Proposition 1 (extended version): For a set of low h firms (i.e. small firms), denominating their debt in dollars is always optimal. For high h firms (i.e. large firms), optimal debt denomination depends on the size of their internal funds w_t

1. *For financially constrained firms with* $\tilde{h} \leq h < u$*, it is optimal to choose a risky financing plan where all debt is denominated in dollars,* $\Delta = 1$*. That is, gains from relaxing borrowing constraints by taking on insolvency risk, dominate the risk of going bust. Issuing dollar debt is optimal and generates leverage gains relative to the safe plan with soles financing.*

2. *For slightly constrained firms,* $u \leq h < 1$*, with low enough internal funds,* $w_t < \underline{\underline{w}}$*, currency mismatch entails insolvency risk and generates profit gains relative to a safe soles financing plan. Issuing dollar debt is optimal but does not generate leverage gains relative to the safe plan.*

3. *For slightly constrained firms,* $u \leq h < 1$*, with internal funds,* $\underline{\underline{w}} < w_t < \underline{w}$*, they always prefer a safe plan with low dollarization, even though they can take advantage of the implicit bailout subsidy if choosing high debt dollarization. In equilibrium, firms are indifferent to any debt dollarization ratio that is bounded below* $\overline{\Delta} < 1$*, i.e.* $\Delta \in (0, \overline{\Delta})$*.*

4. *For slightly constrained firms,* $u \leq h < 1$*, with high enough internal funds,* $\underline{w} < w_t$*, there are no profit gains from currency mismatch, since they are unlikely to go bankrupt in the bad state and exploit the implicit bailout subsidy. Therefore, they are indifferent to any debt dollarization ratio:* $\Delta \in (0, \overline{\Delta})$*. Moreover, debt denomination does not affect leverage in equilibrium.*

5. *For financially unconstrained firms,* $h \geq 1$*, with low enough internal funds,* $w_t < \underline{w}$*, currency mismatch entails insolvency risk and generates profit gains relative to a safe soles financing plan. Issuing dollar debt is optimal but does not generate leverage gains relative to the safe plan.*

6. *For financially unconstrained firms,* $h \geq 1$*, with high enough internal funds,* $w_t > \underline{w}$*, there are no profit gains from currency mismatch, since they are unlikely to go bankrupt in the bad state and exploit the implicit bailout subsidy. Therefore, they are indifferent to any debt dollarization ratio:* $\Delta \in (0, 1)$*. Moreover, debt denomination does not affect leverage in equilibrium.*

Admissible parameter set for the existence of equilibria: Before going into the derivation details, I state two main parametric assumptions to guarantee that the credit-market equilibrium implied by each subproposition is valid. First, the following condition on θ is used in Proposition 1.1. as a necessary and sufficient condition for the safe plan return to investment to be larger than the risk-free rate (non-storage) and for the capacity constraint to bind under the safe plan:

$$\delta\theta\frac{E(e_{t+1})}{e_t} \geq 1 \quad \iff \quad \theta > \underline{\theta}^s \equiv \frac{e_t}{\delta E(e_{t+1})} \tag{15}$$

(15) is also sufficient to guarantee that if borrowing constraints arise as in Proposition 1.2, they bind in the safe equilibrium, and that under a risky plan where borrowing constraints do not arise, this condition guarantees that the capacity constraint binds and the non-storage condition holds.

The following condition is necessary and sufficient for the risky return to investment of financially constrained firms in Proposition 1.3 to be larger than the risk-free rate (non-storage):

$$\frac{\delta u\theta\overline{e_{t+1}}}{e_t} > 1 + h\left(1 - \frac{1}{u}\right) \quad \iff \quad \theta > \underline{\theta}^r \equiv \frac{e_t}{\delta u\overline{e_{t+1}}}\left(1 + h(1 - \frac{1}{u})\right) \tag{16}$$

(16) is also sufficient to guarantee that borrowing constraint binds under the risky plan.

Case 1: $h \geq 1$.

Given current and future exchange rates e_t and e_{t+1}, if $h \geq 1$, the cost of diversion per unit of assets is high enough that there are no diversion incentives, and borrowing constraints do not arise in the credit market equilibrium. If firms' internal funds are sufficiently high, $w_t > \underline{w}$, firms always choose a safe plan, where no insolvency risk is taken, UIP holds, and firms remain indifferent between any share Δ of dollar debt; i.e., firms do not go bankrupt regardless of the currency denomination of their debt. The proof proceeds as follows:

Unconstrained firms face the following optimization problem:

$$\max_{\{k_{t+1}\}} E(\pi_{t+1}) = \delta\left\{E(e_{t+1})\theta k_{t+1} + s_t(1 + r_t) - E(e_{t+1})(1 + \rho_t^s)b_t^s - b_t(1 + \rho_t)\right\} \tag{17}$$

s.t

$$e_t I_t \leq w_t + B_t - s_t; \quad B_t = b_t + b_t^s; \quad k_{t+1} = I_t < \overline{I}; \tag{18}$$

Best safe plan: If firms decide not to assume insolvency risk, then optimal debt denomination has to be such that the solvency constraint is satisfied in all states: $\pi(\underline{e_{t+1}}) > 0$ and $\pi(\overline{e_{t+1}}) > 0$. In the absence of bankruptcy, $\psi_{t+1} = 1$, no bailout guarantees are expected and UIP holds, i.e., the cost of dollar debt equals the cost of soles debt in expectation, which is equal to lender's opportunity cost, $1+r_t$ (see (4) and (5)). Since $h > \delta(1+r_t) = 1$, the cost of diversion per unit of firm's assets is smaller than the present value of the marginal cost of paying the debt, there are no diversion incentives and borrowing constraints do not arise in equilibrium.

Since profits are an increasing function of I_t and s_t, the budget constraint binds in equilibrium and the objective function can be expressed as:

$$\max_{\{I_t\}} E(\pi_{t+1}) = \delta \left\{ E(e_{t+1})\theta I_t - (1+r_t)(e_t I_t - w_t) \right\} \tag{19}$$

From first-order conditions and since expected investment returns are sufficiently high (see condition (15)), capacity constraints are binding $I_t = \overline{I}$ and the optimal payoff of the safe investment plan becomes:

$$\pi^{*,s} = \overline{I}\left(\delta\theta E(e_{t+1}) - e_t\right) + w_t \tag{20}$$

Note that in the absence of insolvency risk, the cost of each type of debt is the same in expectation, and the composition of debt, in terms of currency denomination, does not affect optimal payoff. This is true as long as the firm remains solvent in each state. Thus, it is possible to find an upper threshold of dollar debt share, $\overline{\Delta}$, below which the firm remains solvent and indifferent between any composition of its debt.

This upper threshold is obtained from the solvency condition in the bad state,[75] i.e., $\pi(\underline{e_{t+1}}) > 0$. Expressing the firm's profit in the low state as a function of Δ, and assuming for a moment that firms

[75] Verifying solvency condition in the good state is trivial. If firm is assuming currency mismatch risk, the value of the debt repayment increases in the bad state and decreases in the good state. Thus, if firm is solvent in the bad state, it has to be solvent in the good state.

prefer not to store, $s = 0$:

$$\pi(\underline{e_{t+1}}) = \underline{e_{t+1}}\theta\overline{I} - B_t\Delta(1+r_t) - B_t(1-\Delta)(1+r_t)\frac{\underline{e_{t+1}}}{E(e_{t+1})} \tag{21}$$

Thus using budget constraint in (18) and solving for $\overline{\Delta}$, we obtain:

$$\Delta \leq \overline{\Delta} = min\left\{\frac{\theta\overline{I}\underline{e_{t+1}} - (p_t\overline{I} - w_t)\frac{\underline{e_{t+1}}}{\delta E(e_{t+1})}}{\frac{e_t\overline{I}-w_t}{\delta} - (e_t\overline{I} - w_t)\frac{\underline{e_{t+1}}}{\delta E(e_{t+1})}}, 1\right\} \tag{22}$$

Where $\overline{\Delta} = 1$ if

$$\theta\overline{I}\underline{e_{t+1}} > \frac{e_t\overline{I} - w_t}{\delta} \iff w_t > \underline{w_t} = \overline{I}(e_t - \delta\theta\underline{e_{t+1}}) \tag{23}$$

This implies that if firm's internal funds are sufficiently large, given the current and the future exchange rate in the low state, it remains indifferent between any denomination of its debt. In other words, regardless of the size of the exchange rate depreciation in the low state, firms with sufficiently high internal funds will never go bankrupt, even if they denominate all their debt in dollars, $\Delta = 1$.

Best risky plan: If firms assume insolvency risk by denominating a sufficiently large share of their debt in dollars, they could go bankrupt in the low state, and a bailout would be expected, $E(\phi_{t+1}) = \phi$. For simplicity, I assume from now on that $\phi = 1$. Banks' break-even conditions imply $(1+\rho_t) = (1+r_t)$, while firms only pay their debt in the good state. Thus, the expected cost of debt would be cheaper than under a safe plan, $u(1+r_t)$.

The optimization problem becomes:

$$\max_{\{I_t\}} E(\pi_{t+1}) = \delta u\left\{\overline{e_{t+1}}\theta I_t + s_t(1+r_t) - b_t(1+r_t) - b_t^s(1+r_t)\frac{\overline{e_{t+1}}}{E(e_{t+1})}\right\} \tag{24}$$

Subject to (18) and bankruptcy condition, $\pi(\underline{e_{t+1}}) < 0$. Since $\frac{\overline{e_{t+1}}}{E(e_{t+1})} > 1$, firms do not issue soles debt in any optimal risky plan; i.e., $\Delta = 1$. Using a binding budget constraint, the objective function can be expressed as:

$$\max_{\{I_t\}} E(\pi_{t+1}) = \delta u \left\{ \overline{e_{t+1}} \theta I_t - (1 + r_t)(e_t I_t - w_t) \right\} \tag{25}$$

From first-order conditions, and since expected investment returns are high enough, $\delta\theta\frac{\overline{e_{t+1}}}{e_t} \geq 1$,[76] the capacity constraint binds $I_t = \overline{I}$, and the optimal payoff becomes

$$\pi^{*,r} = u \left[\overline{I} \left(\delta\theta\overline{e_{t+1}} - e_t \right) + w_t \right] \tag{26}$$

Note that for this risky plan to exist, firms need to go bankrupt in the bad state to validate bailout expectations. Thus, the bankruptcy condition implies:

$$\pi(\underline{e_{t+1}}) = \underline{e_{t+1}}\theta\overline{I} - (1 + r_t)(e_t\overline{I} - w_t) < 0 \tag{27}$$

Rearranging:

$$w_t < \underline{w} = \overline{I}(e_t - \delta\theta\underline{e_{t+1}}) \tag{28}$$

This implies that for given current and future exchange rate in the low state, if a firm's internal funds are sufficiently low, it will go bankrupt in the bad state, and the risky plan exists.

Optimal plan: A safe plan in which firms do not take insolvency risk is optimal as long as the following two conditions hold. First,

$$\pi^{*,s} > \pi^{*,r} \iff w_t > \underline{w} = \overline{I}(e_t - \delta\theta\underline{e_{t+1}}) \tag{29}$$

Note that if this condition holds, the risky plan does not exist, since the firm will never go bankrupt: (28) does not hold. Thus, unconstrained firms with sufficiently high internal funds, given prices, will always be in a safe equilibrium where they are indifferent to any composition of their debt in terms

[76]This condition is implied by (15)

of currency denomination. Recall that (29) guarantees that $\overline{\Delta} = 1$ (see condition (23)).

Second, the safe plan will only be optimal as long as investment is preferred to saving or $\pi^{*,s} > w_t$. The non-storage condition implies

$$\pi^{*,s} > w_t \iff \delta\theta\frac{E(e_{t+1})}{e_t} \geq 1 \tag{30}$$

which is the parametric assumption in (15).

Thus, if $w_t \geq \underline{w}$, optimal indebtedness, B_t^*, dollar debt share, Δ^*, and the corresponding credit interest rate, ρ_t^s, are given by

$$B_t^* = e_t\overline{I} - w_t; \quad \Delta^* \leq \overline{\Delta} = 1; \quad E\left[e_{t+1}\right](1+\rho_t^s) = (1+\rho_t) = (1+r_t) \tag{31}$$

If $w_t < \underline{w}$, the non-storage condition is given by[77]:

$$\pi^{*,r} > w_t \iff \delta u\theta\frac{\overline{e_{t+1}}}{e_t} \geq \frac{w_t}{e_t\overline{I}}\left(\frac{1-u}{u}\right) + 1 \tag{32}$$

and optimal indebtedness and the corresponding interest rate are given by:

$$B_t^* = e_t\overline{I} - w_t; \quad \Delta^* = 1; \quad (1+\rho_t) = (1+r_t); \tag{33}$$

paid only in the good state. ■

Case 2: $u \leq h < 1$

Given current and future exchange rates, e_t and e_{t+1}, if $u \leq h < 1$, firms that choose a safe plan have incentives to divert and therefore, borrowing constraints arise in the credit market equilibrium. If

[77]This condition can be re-expressed as $\frac{\delta\theta E(e_{t+1})}{e_t} > (1-u)\left(\frac{w_t}{e_t\overline{I}} + \frac{\delta\theta\underline{e_{t+1}}}{e_t}\right) + u$. Using (29), it is easy to show that this condition is less strict than (15).

firms choose a risky plan, the cost of debt decreases and borrowing constraints do not arise. The safe plan is always optimal if internal funds are sufficiently large, $w_t > \underline{\underline{w_t}}$. Thus, UIP holds, and optimal debt denomination keeps the share of dollar debt below a threshold $\overline{\Delta}$ that is decreasing in h. The proof proceeds as follows:

Best safe plan: As in case 1, if firms choose a safe plan where no insolvency risk is taken, the expected cost of soles debt equals the expected cost of dollar debt, which equals lender's cost of funds. Thus, firms have incentives to divert, since

$$h < \delta(1 + r_t) = 1 \tag{34}$$

Lenders only fund plans that do not entail diversion, thus borrowing constraints arise. That is, the expected debt repayment is bounded above by the total cost of diversion

$$\delta\left[E(e_{t+1})(1 + \rho_t^s)b_t^s + (1 + \rho_t)b_t\right] \le h(w_t + B_t) \tag{35}$$

Firms' optimization problem consists of maximizing (17), subject to (18), the solvency condition in each state, $\pi(\overline{e_{t+1}}) > 0$ and $\pi(\underline{e_{t+1}}) > 0$, and borrowing constraints (35) as an additional restriction.

Suppose for a moment that marginal return on investment, $\frac{\delta\theta E(e_{t+1})}{e_t}$, is high enough that it is optimal to borrow up to the limit allowed by the nondiversion condition, i.e., the borrowing constraint binds, and the firm prefers to invest than to save, i.e., $s_t = 0$. Thus, the optimization problem can be expressed as:

$$\max_{\{I_t\}} E(\pi_{t+1}) = \delta\left\{E(e_{t+1})\theta I_t - (1 + r_t)h(w_t + B_t)\right\} \tag{36}$$

s.t (18). The first-order condition implies

$$\frac{\delta\theta E(e_{t+1})}{e_t} > h \tag{37}$$

The assumption in (15) implies (37), validating the initial assumption on binding borrowing constraints. As I will later show, (15) implies that firms always prefer to invest than to save, validating non-storage assumption, $s = 0$.

Conditional on firms being solvent next period ($E(\psi_{t+1}) = 1$) and plugging banks' break-even conditions (4) and (5) into (35), firms' leverage can be expressed as

$$\frac{w_t + B_t}{w_t} = \frac{1}{1-h} \tag{38}$$

From the binding resource constraint, optimal investment satisfies $I_t = \frac{w_t + B_t}{e_t}$. Thus, using (38), the optimal payoff under a safe investment plan can be expressed as

$$\pi^{*,s} = \left[\delta\theta\frac{E(e_{t+1})}{e_t} - h\right]\frac{w_t}{1-h} \tag{39}$$

As in case 1, firms are indifferent to any composition of their debt in terms of currency denomination, as long as solvency conditions are satisfied in each state. Thus, following a similar procedure as in Case 1, a dollar debt share threshold can be obtained. Using (21) and (38), solvency condition in the bad state, $(\pi(\underline{e_{t+1}}) > 0)$, implies:

$$\Delta \leq \overline{\Delta} = min\left\{\frac{\frac{\delta\theta}{h}\frac{\underline{e_{t+1}}}{e_t} - \frac{\underline{e_{t+1}}}{E(e_{t+1})}}{1 - \frac{\underline{e_{t+1}}}{E(e_{t+1})}}, 1\right\} \tag{40}$$

Where $\overline{\Delta} = 1$ if

$$\frac{\theta\delta}{h}\frac{\underline{e_{t+1}}}{e_t} \geq 1 \iff \delta\theta\frac{\underline{e_{t+1}}}{e_t} \geq h \tag{41}$$

Note that the less financially constrained is the firm, i.e larger h, the lower the dollar debt share threshold below which firms remain indifferent.

Best risky plan: As in case 1, since firms default in the bad state, $\psi_{t+1} = 0$, and a bailout is granted, $E(\phi_{t+1}) = 1$, banks lend at an interest rate $(1 + \rho_t) = (1 + r_t)$, while firms only pay their debt in the good state. Expected cost of debt is given by:

$$\delta u(1 + r_t) = u < h \tag{42}$$

In contrast with the safe plan, if firms choose a risky plan, the reduction in the cost of debt eliminates diversion incentives for sufficiently unconstrained firms, $u \leq h < 1$, and borrowing constraints do not arise in equilibrium. Following the same reasoning as in Case 1, the optimal payoff under a risky plan is given by

$$\pi^{*,r} = u\left[\overline{I}\left(\delta\theta\overline{e_{t+1}} - e_t\right) + w_t\right] \tag{43}$$

Again, since $\frac{\overline{e_{t+1}}}{E(e_{t+1})} > 1$, firms do not issue soles debt in any optimal risky plan, i.e. $\Delta = 1$. In order to validate bailout expectations, bankruptcy condition implies

$$w_t < \underline{w} = \overline{I}(e_t - \delta\theta\underline{e_{t+1}}) \tag{44}$$

Optimal plan: If, as in Case 1, internal funds are sufficiently high: $w_t > \underline{w} = \overline{I}\left(e_t - \delta\theta\underline{e_{t+1}}\right)$, a risky plan does not exist, since firms never go bankrupt and bailout expectations are not validated. Thus, UIP always holds and the optimal plan is the safe plan. Again, non-storage condition needs to be satisfied

$$\pi^{*,s} > w_t \iff \delta\theta\frac{E(e_{t+1})}{e_t} \geq 1 \tag{45}$$

which is implied by assumption (15).

If bankruptcy condition in (44) holds, and $\pi^{*,s} > \pi^{*,r}$, then firm always prefer a safe plan, even though they can take advantage of the bailout if they choose a risky plan. In this case, w_t belongs to the following interval:

$$\underline{\underline{w}} < w_t < \underline{w} \tag{46}$$

Where $\underline{\underline{w}} \equiv u\overline{I}\left(\delta\theta\overline{e_{t+1}} - e_t\right)\left(\frac{\delta\theta\frac{E(e_{t+1})}{e_t} - h}{1-h} - u\right)^{-1}$. It is easy to show that, given the assumption in (15), these two conditions can hold simultaneously, i.e., $\underline{w}$ is always larger than $\underline{\underline{w}}$.

Thus, if $w_t > \underline{\underline{w}}$, optimal indebtedness, B_t^*, dollar debt share, Δ^*, and the corresponding credit interest rate, ρ_t^s ,are given by

$$B_t^* = w_t \frac{h}{1-h}; \qquad \Delta^* \leq \overline{\Delta} \leq 1; \qquad (1+\rho_t^s) = \frac{(1+r_t)}{E\left[e_{t+1}\right]} \tag{47}$$

where $\overline{\Delta}$ is decreasing in h.

If $w_t < \underline{\underline{w}}$, non-storage condition is given by

$$\pi^{*,r} > w_t \iff \delta u\theta \frac{\overline{e_{t+1}}}{e_t} \geq \frac{w_t}{e_t\overline{I}}\left(\frac{1-u}{u}\right) + 1 \tag{48}$$

which is implied by assumption (15).[78]

Optimal indebtedness, B_t^*, dollar debt share, Δ^*, and the corresponding credit interest rate, ρ_t ,are given by

$$B_t^* = e_t\overline{I} - w_t; \qquad \Delta^* = 1; \qquad (1+\rho_t) = (1+r_t); \tag{49}$$

paid only in the good state. ■

Case 3: $\tilde{h} \leq h < u$

Given current and future exchange rates, e_t and e_{t+1}, if $\tilde{h} \leq h < u$, firms have incentives to divert and therefore, borrowing constraints arise in the credit market equilibrium. Firms always prefer a risky plan in which insolvency risk is taken, all debt is denominated in dollars, $\Delta = 1$, there are bailout expectations, and dollar debt is cheaper in expectation. The proof proceeds as follows:

[78]This condition can be re expressed as $\frac{\delta\theta E(e_{t+1})}{e_t} > (1-u)\left(\frac{w_t}{e_t\overline{I}} + \frac{\delta\theta\underline{\underline{e_{t+1}}}}{e_t}\right) + u$ which is less strict than (15).

Best safe plan: If firms with $h < u$ choose a safe plan, they have incentives to divert since $h < \delta(1 + r_t) = 1$. Thus, following the exact same procedure as in case 2, the optimal payoff is:

$$\pi^{*,s} = \left[\delta\theta \frac{E(e_{t+1})}{e_t} - h\right] \frac{w_t}{1-h} \tag{50}$$

where the upper threshold on dollar debt share is given by

$$\Delta \leq \overline{\Delta} = min \left\{ \frac{\frac{\delta\theta}{h} \frac{\underline{\underline{e_{t+1}}}}{e_t} - \frac{\underline{\underline{e_{t+1}}}}{E(e_{t+1})}}{1 - \frac{\underline{\underline{e_{t+1}}}}{E(e_{t+1})}}, 1 \right\} \tag{51}$$

And $\overline{\Delta} = 1$ if

$$\frac{\theta\delta}{h} \frac{\underline{\underline{e_{t+1}}}}{e_t} \geq 1 \iff \delta\theta \frac{\underline{\underline{e_{t+1}}}}{e_t} \geq h \tag{52}$$

Best risky plan: Following the same reasoning as in Case 1, and assuming for a moment that firms do not have incentives to save, expected payoff under a risky plan can be expressed as a function only of T-debt, b_t^T (recall that if firms only pay their debt in the good state, it is always optimal to issue only dollar debt: $\Delta = 1$):

$$\max_{\{I_t\}} E(\pi_{t+1}) = \delta u \left\{ \overline{e_{t+1}} \theta I_t - (1 + r_t) b_t \right\} \tag{53}$$

As opposed to case 2, now firms have incentives to divert despite the lower expected cost of debt:

$$h < \delta u (1 + r_t) = u \tag{54}$$

Since lenders only fund plans that do not entail diversion, borrowing constraints arise:

$$b_t \leq \frac{h}{u}(w_t + b_t) \tag{55}$$

And the firm's leverage becomes

$$\frac{w_t + b_t}{w_t} \leq \frac{1}{1 - \frac{h}{u}} \tag{56}$$

Assuming that marginal returns to investment, $\frac{\delta u \theta \overline{e_{t+1}}}{e_t}$, are high enough such that borrowing constraint binds at the optimum, the optimization problem can be expressed as:

$$\max_{\{I_t\}} E(\pi_{t+1}) = \delta u \left\{ \overline{e_{t+1}} \theta I_t - \frac{h}{u}(w_t + b_t) \right\} \tag{57}$$

subject to (18) and bankruptcy condition ($\pi(\underline{e_{t+1}}) < 0$).

The first-order condition implies

$$\frac{\delta u \theta \overline{e_{t+1}}}{e_t} > h \tag{58}$$

Which is implied by assumption in (16), validating assumption on binding borrowing constraints. As I will later show, (16) implies that firms always prefer to invest than to store, validating non-storage assumption, $s_t = 0$.

Thus, using (56) and $I_t = \frac{w_t + b_t^T}{e_t}$, the optimal payoff becomes

$$\pi^{*,r} = \left[\delta u \theta \frac{\overline{e_{t+1}}}{e_t} - h \right] \frac{w_t}{1 - \frac{h}{u}} \tag{59}$$

For this plan to exist, returns in the bad state have to be low enough such that firms go bankrupt and bailout expectations are validated, i.e., the bankruptcy condition has to hold:

$$\pi(\underline{e_{t+1}}) = \underline{e_{t+1}} \theta I_t - (1 + r_t) \frac{h}{u}(w_t + b_t) < 0 \tag{60}$$

which implies

$$\delta u \theta \frac{\underline{e_{t+1}}}{e_t} < h \tag{61}$$

Optimal plan: A risky plan in which firms take insolvency risk is always optimal as long as the following two conditions hold. First,

$$\pi^{*,r} > \pi^{*,s} \tag{62}$$

which can be expressed as the following quadratic inequality:

$$(u-1)h^2 + ((1-u)c + d)\, h - ud > 0 \tag{63}$$

Where $c = \delta u \theta \frac{\overline{e_{t+1}}}{e_t}$ and $d = \delta(1-u)\theta \frac{\underline{e_{t+1}}}{e_t}$

Second, the risky plan will only be optimal as long as investment is preferred to saving. The non-storage condition implies

$$\pi^{*,r} > w_t \iff \frac{\delta u \theta \overline{e_{t+1}}}{e_t} > 1 + h\left(1 - \frac{1}{u}\right) \tag{64}$$

which is the assumption in (16).

Note that $\pi^{*,r}$ and $\pi^{*,s}$ are both continuously increasing in h, but as $h \to u$, $\pi^{*,r} \to \infty$ while $\pi^{*,s}$ remains bounded. Thus, there exists a degree of contract enforceability h^* such that for all $\tilde{h} \leq h < u$, the risky plan is preferred to the safe plan, $\pi^{*,r} > \pi^{*,s}$.

The following expressions solve the quadratic inequality in (63):

$$h_1 = \tilde{h} = \frac{(1-u)c + d - \sqrt{((1-u)c+d)^2 - 4(1-u)ud}}{2(1-u)} \tag{65}$$

$$h_2 = \frac{(1-u)c + d + \sqrt{((1-u)c+d)^2 - 4(1-u)ud}}{2(1-u)} \tag{66}$$

Where, $h_2 = u$ as $c \to u$,

Optimal indebtedness, B_t^*, dollar debt share, Δ^*, and the corresponding credit interest rate, ρ_t ,are given by

$$B_t^* = w_t \frac{h/u}{1-h/u}; \qquad \Delta^* = 1; \qquad (1+\rho_t) = (1+r_t) \tag{67}$$

which are only paid in the good state with probability u. ■

Case 4: $h < \tilde{h}$

It is straightforward to show that for all $h < \tilde{h}$, the quadratic inequality in (63) does not hold; that is, $\pi^{*,s} > \pi^{*,r}$. Thus, if non-storage condition holds (assumption in (15)), the safe plan is optimal. ■

Appendix B

Proof of Proposition 2:

Proposition 2 (extended version): *The average negative effect on firm's total financing of a tax* $\tau \in (0,1)$ *on dollar lending, depends on* h *in the following way:*

1. *If firms are financially unconstrained, i.e.* $h \geq 1$, *a tax on dollar lending does not alter firms total financing, that is, optimal total debt before the tax, remains unchanged* $B^* = B^\tau$. *In addition, if firms have sufficiently high internal funds,* $w_t > \underline{w}^\tau$, *there is always a complete switch from dollar debt to soles debt, that is, the share of dollar debt after tax,* Δ^τ, *is equal to 0. If, on the other hand, firms have sufficiently low internal funds,* $w_t < \underline{w}^\tau$, *the effect of the tax on the composition of debt depends on the size of the tax:*

    - *If the tax rate is not high enough,* $1 + \tau < \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, *firms find optimal to pay the tax and do not switch from dollar debt,* $\Delta^\tau = 1$.
    - *If* $1 + \tau = \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, *firms are indifferent between switching away from dollar debt or not, as long as they remain in the risky equilibrium. Thus, there could be a partial switch from dollar debt,* $\Delta^\tau \in (\underline{\Delta}, 1)$.
    - *If the tax is large enough,* $1 + \tau > \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, *there is a complete switch from dollar debt,* $\Delta^\tau = 0$.

2. *If firms are slightly constrained,* $u \leq h < 1$, *and internal funds are sufficiently large,* $w_t > \underline{\underline{w}}$, *a tax on dollar lending does not alter firms total financing,* $B^* = B^\tau$, *and firms completely switch from dollar debt to soles debt,* $\Delta^\tau = 0$. *If firms internal funds are low enough,* $w_t < \underline{\underline{w}}$, *the effect of the tax on firms financing and debt composition depends on the size of the tax in the following ways:*

    - *If* $1 + \tau < min\left(\frac{\overline{e_{t+1}}}{E(e_{t+1})}, \frac{h}{u}\right)$ *and* $\underline{\underline{w}}^\tau < w_t < \underline{\underline{w}}$, *total debt decreases,* $B^\tau = \frac{w_t h}{1-h} < B^*$ *and firms completely switch from dollar debt,* $\Delta^\tau = 0$. *If internal funds are even lower,* $w_t < \underline{\underline{w}}^\tau$, *firms find optimal to keep on issuing dollar debt,* $\Delta^\tau = 1$, *pay the tax, remain unconstrained and keep their total financing unaffected,* $B^* = B^\tau$.
    - *If* $1 + \tau = \frac{\overline{e_{t+1}}}{E(e_{t+1})} < \frac{h}{u}$ *and* $\underline{\underline{w}}^\tau < w_t < \underline{\underline{w}}$, *total debt decreases,* $B^\tau = \frac{w_t h}{1-h} < B^*$ *and firms completely switch from dollar debt,* $\Delta^\tau = 0$. *And if internal funds are lower,* $w_t < \underline{\underline{w}}^\tau$, *firms*

are indifferent between switching away from dollar debt or not, as long as they remain in the risky equilibrium. Thus, there could be a partial switch from dollar debt, $\Delta^{\tau} \in (\underline{\Delta}, 1)$, but firms remain unconstrained and keep their total financing unaffected, $B^* = B^{\tau}$.

- *If $\frac{h}{u} \leq 1+\tau$, firms are financially constrained after the tax, even if they issue cheaper dollar debt. Their total borrowing always decreases after tax. In particular, if $\frac{h}{u} \leq 1+\tau < \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, there exists an interval of $h \in (u, h')$, such that firms completely switch from dollar debt, $\Delta^{\tau} = 0$, and reduce their total debt, $B^{\tau} = \frac{w_t h}{1-h} < B^*$. If $h \in (h', 1)$, firms do not switch from dollar debt, $\Delta^{\tau} = 1$, pay the tax and reduce their total debt, $B^{\tau} = \frac{w_t \frac{h}{(1+\tau)u}}{1-\frac{h}{(1+\tau)u}} < B^*$. And if $\frac{h}{u} \leq 1+\tau = \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, and $h \in (h', 1)$, there could be a partial switch from dollar debt, $\Delta^{\tau} \in (\underline{\Delta}, 1)$ and a reduction in total debt after the tax, $B^{\tau} = \frac{w_t \frac{h}{(1+\tau)u}}{1-\frac{h}{(1+\tau)u}} < B^*$.*
- *Finally, if the tax is large enough, $1+\tau > \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, the switch is complete, $\Delta^{\tau} = 0$, and total debt decreases, $B^{\tau} = w_t \frac{h}{1-h} < B^*$.*

3. *If firms are financially constrained, $\tilde{h} \leq h < u$, a tax on dollar lending reduces firms total debt and the effect of the tax on the composition of total debt depends on the size of the tax:*

- *If the tax is sufficiently low, 1+ $\tau < \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, there exists an interval of $h \in (\tilde{h}, h')$, such that firms completely switch from dollar debt, $\Delta^{\tau} = 0$, and reduce their total debt, $B^{\tau} = \frac{w_t h}{1-h} < B^*$. If $h \in (h', u)$, firms do not switch from dollar debt, $\Delta^{\tau} = 1$, pay the tax and reduce their total debt, $B^{\tau} = \frac{w_t \frac{h}{(1+\tau)u}}{1-\frac{h}{(1+\tau)u}} < B^*$*
- *If 1+ $\tau = \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, there exists an interval of $h \in (\tilde{h}, h')$ such that firms completely switch from dollar debt, $\Delta^{\tau} = 0$, and reduce their total debt, $B^{\tau} = \frac{w_t h}{1-h} < B^*$. If $h \in (h', u)$, there could be a partial switch from dollar debt, $\Delta^{\tau} \in (\underline{\Delta}, 1)$ and a reduction in total debt after the tax, $B^{\tau} = \frac{w_t \frac{h}{(1+\tau)u}}{1-\frac{h}{(1+\tau)u}} < B^*$.*
- *And if the tax is large enough, $1+\tau > \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, the switch is complete, $\Delta^{\tau} = 0$, and total debt decreases, $B^{\tau} = w_t \frac{h}{1-h} < B^*$.*

Case 1: $h \geq 1$.

If the firm has sufficiently high internal funds $w_t \geq \underline{w}$, firm does not go bankrupt and the expected cost of issuing dollar debt equals that of soles debt. Thus, the firm chooses the safe plan in equilibrium, indifferent between any share of dollar debt $\Delta > 0$ (see proposition 1.1). If a tax $\tau \in (0, 1)$ is implemented on dollar lending, firm's cost of issuing dollar debt increases, to satisfy bank's break-even conditions. Thus, in a safe equilibrium it is never optimal to issue dollar debt: $\Delta^{\tau} = 0$. By completely switching away from dollar debt to soles debt, firms are able to avoid the tax and remain unaffected in their overall financing. Thus, $B^{*} = B^{\tau} = e_t\overline{I} - w_t$.

If firm's internal funds are not sufficiently high, $w_t < \underline{w}$, firm chooses a risky plan in equilibrium with $\Delta = 1$ (see proposition 1.1). Thus, the effect of the tax depends on its size. After the tax is imposed, optimization problem in (43) becomes

$$\max_{\{I_t\}} E(\pi_{t+1}) = \delta u \left\{ \overline{e_{t+1}}\theta I_t + s_t(1+r_t) - b_t(1+\tau)(1+r_t) - b_t^s(1+r_t)\frac{\overline{e_{t+1}}}{E(e_{t+1})} \right\} \tag{68}$$

Subject to (18) and bankruptcy condition in the bad state, $\pi(\underline{e_{t+1}}) < 0$, . Thus, as long as $1+\tau < \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, it is always optimal to issue only dollar debt in a risky plan. Using binding resource and capacity constraints,[79] the optimal payoff in (43) becomes

$$\pi^{*,r,\tau} = u\left[\overline{I}\left(\delta\theta\overline{e_{t+1}} - (1+\tau)e_t\right) + (1+\tau)w_t\right] \tag{69}$$

Since the optimal payoff decreases after the tax, $\pi^{*,r,\tau} < \pi^{*,r}$, firms with sufficiently high internal funds find optimal to switch from dollar debt to soles debt

$$\pi^{*,s} > \pi^{*,r,\tau} \iff w_t > \underline{w}^{\tau} = \overline{I}\left(e_t - \frac{1-u}{1-u(1+\tau)}\delta\theta\underline{e_{t+1}}\right) \tag{70}$$

Where $\underline{w} > \underline{w}^{\tau}$, that is, optimality condition of the safe plan after the tax, becomes more lax.[80] Thus, for firms with $\underline{w}^{\tau} < w_t < \underline{w}$, there is a complete switch from dollar to soles debt, $\Delta^{\tau} = 0$, where total financing remains unaffected: $B^{*} = B^{\tau} = e_t\overline{I} - w_t$. For firms with $w_t < \underline{w}^{\tau}$, the risky plan is still optimal after the tax is implemented, $\Delta^{\tau} = 1$, then firms pay the tax, but are able to keep their overall financing unaffected: $B^{*} = B^{\tau} = e_t\overline{I} - w_t$.

[79] Assuming non-storage, $s_t = 0$, and sufficiently high marginal returns to investment that guarantee binding capacity constraints, which is implied by (15).

[80] It is easy to show that $u(1+\tau) < 1$ since $1+\tau < \frac{\overline{e_{t+1}}}{E(e_{t+1})}$.

If $1+\tau = \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, in a risky plan after tax firm remains indifferent to any debt composition, as long as it goes bankrupt in the bad state. Following a similar procedure as in the proof of proposition 1, the minimum dollar debt share that satisfies the bankruptcy condition after tax, $\pi(\underline{e_{t+1}}) < 0$, is given by

$$\underline{\Delta} = max \left\{ \frac{\frac{\delta \underline{e_{t+1}}}{e_t \overline{I} - w_t} - \frac{\underline{e_{t+1}}}{E(e_{t+1})}}{1 + \tau - \frac{\underline{e_{t+1}}}{E(e_{t+1})}}, 0 \right\} \tag{71}$$

The bankruptcy condition after tax, $\pi(\underline{e_{t+1}}) < 0$, implies, $1+\tau > \frac{\delta \underline{e_{t+1}}}{e_t \overline{I} - w_t}$, which guarantees $\underline{\Delta} < 1$. Thus, if firms remain in the risky plan, i.e., $w_t < \underline{w}^\tau$, firm remains indifferent to any dollar debt share $\Delta^\tau \in (\underline{\Delta}, 1)$ and there could be a partial switch from dollar debt to soles debt after tax. Total financing remains unaffected: $B^* = B^\tau = e_t \overline{I} - w_t$. Again, for firms with $\underline{w}^\tau < w_t < \underline{w}$, there is a complete switch from dollar to soles debt, $\Delta^\tau = 0$, where total financing remains unaffected: $B^* = B^\tau = e_t \overline{I} - w_t$.

Finally, if $1+\tau > \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, soles debt is always cheaper than dollar debt, even if bailouts are granted. Thus, there is a complete switch from dollar to soles debt, $\Delta^\tau = 0$. Again, total financing remains unaffected: $B^* = B^\tau = e_t \overline{I} - w_t$.

Additional optimality conditions of the risky plan, such as non-storage or bankruptcy conditions, are trivially satisfied after the tax. On one hand, the default condition of the risky plan becomes more lax after the tax, since profits decrease. On the other hand, if non-storage condition of the risky plan is violated after the tax is imposed, firms always prefer to switch to a safe plan, which is already preferred to storage under initial assumption in (15). ■

Case 2: $u \leq h < 1$

If the firm has sufficiently high internal funds $w_t \geq \underline{\underline{w}}$, the firm chooses a safe financing plan and is indifferent between any share of dollar debt $\Delta > 0$ that could be bounded below 1 or not (see proposition 1.2). If a tax, $\tau \in (0,1)$, is implemented, the expected cost of issuing soles debt is lower than that of dollar debt. Thus, in a safe plan with tax, issuing dollar debt is never optimal. There is a complete switch from dollar debt to soles debt, $\Delta^\tau = 0$, and the firm's total financing remains unaffected: $B^* = B^\tau = w_t \frac{h}{1-h}$.

If firm's internal funds are low enough $w_t < \underline{\underline{w}}$, the firm chooses a risky plan where borrowing constraints do not arise (see Proposition 1.2). The introduction of a tax increases the cost of paying the debt and, depending on the size of the tax, it may generate incentives to diversion, and therefore, borrowing constraints may arise under a risky plan. Thus, the effect of the tax depends on the following five cases:

First, if $1 + \tau < \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, and $(1 + \tau)u < h$, firm remains unconstrained when choosing the risky plan and always denominate all its debt in dollars. Since profits under a risky plan decrease after the tax is imposed, $\pi^{*,r,\tau} < \pi^{*,r}$, firms with sufficiently high internal funds find optimal to switch from dollar debt to soles debt:

$$\pi^{*,s} > \pi^{*,r,\tau} \iff w_t > \underline{\underline{w}}^{\tau} = \frac{u\overline{I}\delta\theta\overline{e_{t+1}} - u(1+\tau)e_t\overline{I}}{\left(\delta\theta\frac{E(e_{t+1})}{e_t} - h\right)\frac{1}{1-h} - u(1+\tau)} \tag{72}$$

where $\underline{\underline{w}}^{\tau} < \underline{\underline{w}}$.

Thus, if $\underline{\underline{w}}^{\tau} < w_t < \underline{\underline{w}}$, firm switches away from dollar debt to soles debt , $\Delta^{\tau} = 0$, borrowing constraints arise and total financing decreases, $B^{\tau} = w_t\frac{h}{1-h} < B^* = e_t\overline{I} - w_t$. If $w_t < \underline{\underline{w}}^{\tau}$, the firm remains unconstrained in the risky plan, issuing only dollar debt, $\Delta^{\tau} = 1$, paying the tax and keeping its overall financing unaffected, $B^{\tau} = B^* = e_t\overline{I} - w_t$.

Second, if $1 + \tau = \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, and $(1 + \tau)u < h$, the firm is indifferent between issuing dollar debt or soles debt conditional on going bankrupt in the bad state. Thus, in a risky plan where firm is not constrained, firm remains indifferent to any dollar debt share $\Delta^{\tau} \in (\underline{\Delta}, 1)$ after tax, where $\underline{\Delta}$ is equal to (71). Thus, for firms that remain in the risky plan after tax, i.e. $w_t < \underline{\underline{w}}^{\tau}$, there could be a partial switch from dollar debt to soles debt, while total financing remains unaffected: $B^{\tau} = B^* = e_t\overline{I} - w_t$. If $\underline{\underline{w}}^{\tau} < w_t < \underline{\underline{w}}$, the firm switches away from dollar debt completely, $\Delta^{\tau} = 0$, borrowing constraints arise, and total financing decreases, $B^{\tau} = w_t\frac{h}{1-h} < B^* = e_t\overline{I} - w_t$.

If $h < (1 + \tau)u$, the firm is no longer unconstrained when choosing the risky plan and borrowing constraints arise:

$$\frac{\overline{e_{t+1}}}{E(e_{t+1})}b_t^s + (1+\tau)b_t \leq \frac{h}{u}(w_t + B_t) \tag{73}$$

Under parametric assumptions in (16) borrowing constraints are binding. Thus, the optimal payoff of the risky plan become:

$$\pi^{*,r,\tau} = \left(\delta u\theta\frac{\overline{e_{t+1}}}{e_t} - h\right)\frac{w_t}{1 - \frac{h}{(1+\tau)u}} \tag{74}$$

where $\pi^{*,r} > \pi^{*,r,\tau}$.[81] Thus, the optimal condition of the safe plan, $\pi^{*,s} > \pi^{*,r,\tau}$, becomes more lax:

$$\left[\delta u\theta\frac{\overline{e_{t+1}}}{e_t} + \delta(1-u)\theta\frac{\underline{e_{t+1}}}{e_t} - h\right]\frac{w_t}{1-h} > \left[\delta u\theta\frac{\overline{e_{t+1}}}{e_t} - h\right]\frac{w_t}{1 - \frac{h}{(1+\tau)u}} \tag{75}$$

Thus, the third case arises if $1+\tau < \frac{\overline{e_{t+1}}}{E(e_{t+1})}$ and $h < (1+\tau)u$, which implies that for some values of h sufficiently close to its lower bound u, $h \in (u, h')$, it becomes possible to sustain a safe plan after tax, i.e., there is a complete switch from dollar debt to soles debt, $\Delta^\tau = 0$, and total financing decreases, $B^\tau = w_t\frac{h}{1-h} < B^* = e_t\overline{I} - w_t$. If firms remain in the risky plan paying the tax, i.e., $h \in (h', 1)$, they do not switch from dollar debt, $\Delta^\tau = 1$ and total financing decreases, $B^\tau = \frac{w_t\frac{h}{(1+\tau)u}}{1-\frac{h}{(1+\tau)u}} < B^* = e_t\overline{I} - w_t$.

Fourth, if $1+\tau = \frac{\overline{e_{t+1}}}{E(e_{t+1})}$ and $h < (1+\tau)u$, firms that remain in the risky equilibrium paying the tax, i.e $h \in (h', 1)$, are indifferent between issuing dollar debt or soles debt conditional on going bankrupt in the bad state. Thus, firms remain indifferent to any dollar debt share $\Delta^\tau \in (\underline{\Delta}, 1)$, where $\underline{\Delta}$ is equal to

$$\underline{\Delta} = max\left\{\frac{\frac{(1+\tau)\delta u\theta}{h}\frac{\underline{e_{t+1}}}{e_t} - \frac{\underline{e_{t+1}}}{E(e_{t+1})}}{1+\tau-\frac{\underline{e_{t+1}}}{E(e_{t+1})}}, 0\right\} \tag{76}$$

The bankruptcy condition after tax implies $\frac{\delta u\theta}{h}\frac{\underline{e_{t+1}}}{e_t} < 1$,[82] and therefore, $\underline{\Delta} < 1$. Thus, there could

[81] This is obvious, since a risky plan under borrowing constraints and a tax was feasible before the tax, it has to be the case that optimal payoff of the constrained problem after tax is smaller than optimal payoff of the unconstrained problem.

[82] The bankruptcy condition before tax implies the bankruptcy condition after tax, since after-tax profits decrease.

be a partial switch from dollar debt to soles debt, while total financing decreases: $B^{\tau} = \frac{w \frac{h}{(1+\tau)u}}{1-\frac{h}{(1+\tau)u}} < B^{*} = e_t \overline{I} - w_t$.

Finally, if $1+\tau > \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, a risky plan with dollar debt does not exist, since issuing soles debt is always cheaper. Thus, there is a complete switch from dollar debt to soles debt after tax, $\Delta^{\tau} = 0$, and total financing decreases, $B^{\tau} = w_t \frac{h}{1-h} < B^{*} = e_t \overline{I} - w_t$. ■

<u>**Case 3:** $\tilde{h} \leq h < u$</u>

Financially constrained firms, with a degree of contract enforceability $\tilde{h} \leq h < u$, are initially in a risky equilibrium issuing dollar debt. If a tax $\tau \in (0,1)$ is imposed, borrowing constraints are tighter as in (73) and optimal payoff decreases (74).

Following similar reasoning as in Case 2, if $1+\tau < \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, for some values of h sufficiently close to $\tilde{h}$, $h \in (\tilde{h}, h')$, the safe plan is optimal after tax, i.e., there is a complete switch from dollar debt to soles debt, $\Delta^{\tau} = 0$, and total financing decreases, $B^{\tau} = w_t \frac{h}{1-h} < B^{*} = w_t \frac{\frac{h}{u}}{1-\frac{h}{u}}$. If firms remain in the risky plan paying the tax, i.e., $h \in (h', u)$, they do not switch from dollar debt, $\Delta^{\tau} = 1$ and total financing decreases, $B^{\tau} = \frac{w_t \frac{h}{(1+\tau)u}}{1-\frac{h}{(1+\tau)u}} < B^{*} = w_t \frac{\frac{h}{u}}{1-\frac{h}{u}}$.

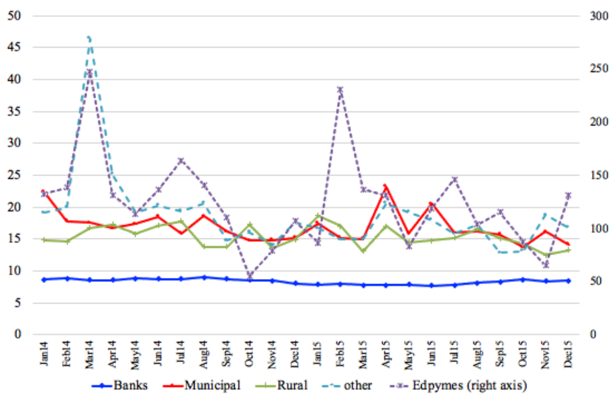
If $1+\tau = \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, firms that remain choosing the risky plan paying the tax, i.e., $h \in (h', u)$, are indifferent between issuing dollar debt or soles debt conditional on going bankrupt in the bad state. Thus, firms remain indifferent to any dollar debt share $\Delta^{\tau} \in (\underline{\Delta}, 1)$, where $\underline{\Delta} < 1$ is given by (76). Thus, there could be a partial switch from dollar debt to soles debt, while total financing decreases: $B^{\tau} = \frac{w_t \frac{h}{(1+\tau)u}}{1-\frac{h}{(1+\tau)u}} < B^{*} = w_t \frac{\frac{h}{u}}{1-\frac{h}{u}}$.

Finally, if $1+\tau > \frac{\overline{e_{t+1}}}{E(e_{t+1})}$, a risky plan where firms issue dollar debt does not exist after tax, since issuing soles debt is always cheaper. Thus, there is a complete switch from dollar debt to soles debt after tax, $\Delta^{\tau} = 0$, and total financing decreases, $B^{\tau} = w_t \frac{h}{1-h} < B^{*} = w_t \frac{\frac{h}{u}}{1-\frac{h}{u}}$. ■

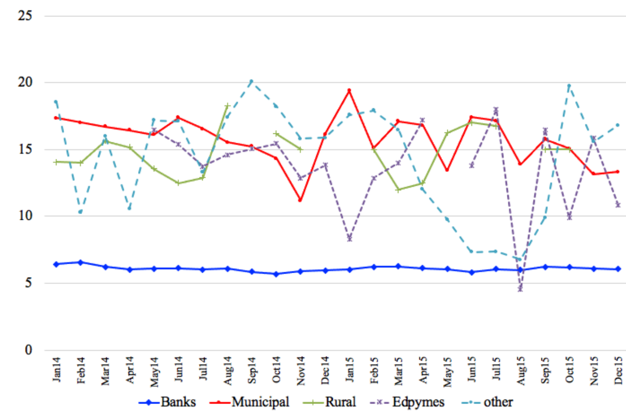
Appendix C

Average Interest Rates by Financial Institution

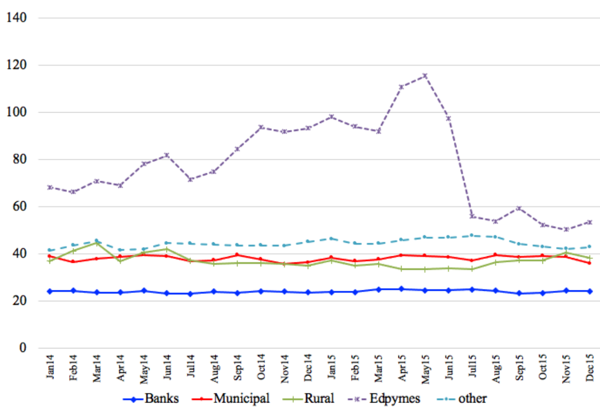
A. Big and Medium firms - Soles Loans



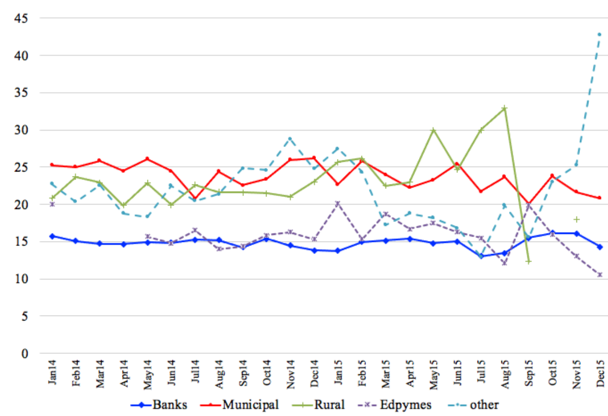
B. Big and Medium firms - Dollar Loans



C. Small and Micro firms - Soles Loans



D. Small and Micro firms - Dollar Loans



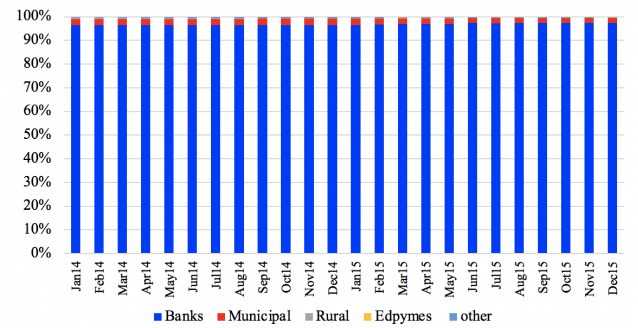
These panels plot the evolution of the average interest rates for each of type of financial institution: Banks; Municipal savings and credit unions (Municipal); Rural savings and credit unions (Rural); Microenterprise development agencies (Edpymes) and other financial institutions (Other). Panel A and B show the average interest rates for the segment of Big and Medium firms in local currency and in dollars, respectively. Panel C and D show the average interest rates for the segment of Small and Micro firms in local currency and dollars, respectively. Source: SBS, own calculations.

Back to V

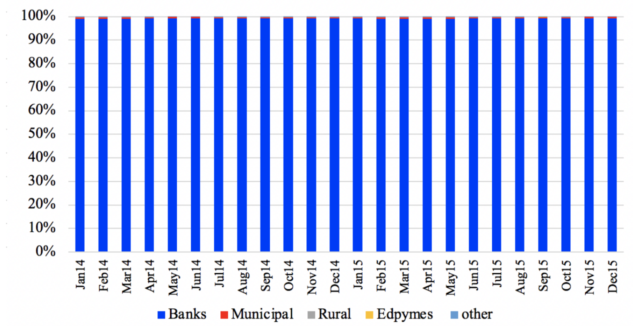
Appendix D

Share of Loans by Type of Financial Institution

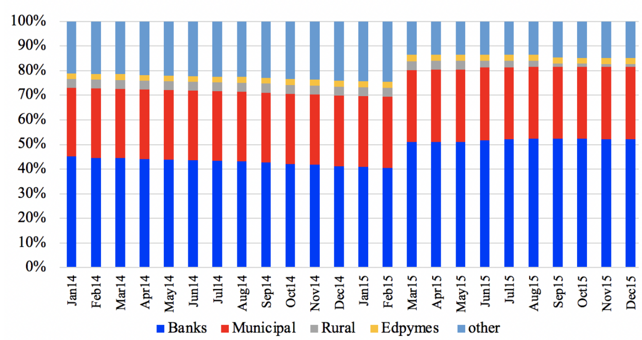
A. Big and Medium firms - Soles Loans



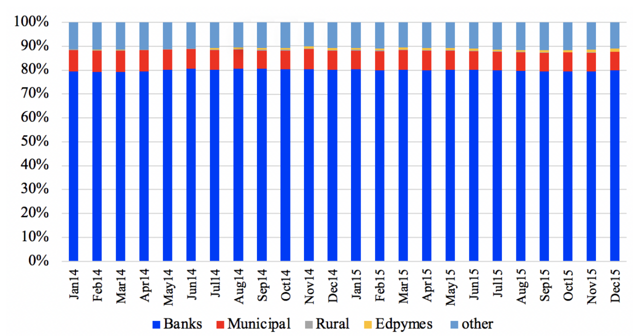
B. Big and Medium firms - Dollar Loans



C. Small and Micro firms - Soles Loans



D. Small and Micro firms - Dollar Loans



These panels plot the evolution of the composition of total loans by type of financial institution: Banks; Municipal savings and credit unions (Municipal); Rural savings and credit unions (Rural); Microenterprise development agencies (Edpymes) and other financial institutions (Other). Panel A and B show the composition of loans for the segment of Big and Medium firms in local currency and in dollars, respectively. Panel C and D show the composition of loans for the segment of Small and Micro firms in local currency and dollars, respectively. Source: SBS, own calculations.

Back to V