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Lending and exchange rates: The role of banks' foreign exchange position and hedging policies

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ABSTRACT

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This study delves into the balance sheets of banks and shows that the transmission of exchange rate movements on bank lending is not straightforward but depends on banks' net open foreign currency (FX) position. A domestic currency depreciation could reduce bank lending and is thus contractionary if banks are in a negative net open FX position, but could increase bank lending and is thus expansionary if banks are in a positive net open FX position. Using the case of the Philippine banking system, results of this study show that a depreciation of the domestic currency by itself and a positive net open FX position alone each tends to lower lending growth. However, for banks with positive net open FX position, there is evidence that depreciations prompt them to increase lending. Thus, a domestic currency depreciation could amplify instead of offset the trade channel. Moreover, hedging instruments appear to dampen the adverse effects of depreciation on bank lending.

JEL Classification Number : G15; G21; F30; F65

Keywords : financial channel, exchange rate, bank lending channel, macroprudential policy, banking regulation

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1. Introduction

The exchange rate works through both the trade channel and the financial channel and exerts opposite impacts on the economy. The traditional Mundell–Fleming model tells us that a currency depreciation is expansionary through the trade channel as it makes exports more competitive (Mundell, 1963; Fleming, 1962). However, a growing number of studies have provided evidence that the financial channel[1] can be a significant offset to the trade channel (Kearns and Patel, 2016; Lee et al., 2021). The financial channel operates through borrowers' and lenders' balance sheets and risk-taking capacity. Basically, exchange rate movements cause valuation effects on corporate and sovereign balance sheets that, in turn, can affect real economic outcomes. A currency depreciation is likely to have contractionary effects when a country or its firms are heavily exposed to unhedged foreign currency liabilities (Banerjee, Hofmann, and Mehrotra, 2020; Banerjee and Mohanty, 2021; Avdjiev, Bruno, Koch, and Shin, 2019; Bernoth and Herwartz, 2021).

This study touches on two related strands of the exchange rate literature: first, on how economies are affected by exchange rates, and second, on how economies respond to exchange rate movements. It attempts to contribute to the literature in several ways: First, this study provides evidence of the financial channel operating through bank balance sheets. This channel has often been referred to in the literature as the bank lending channel of exchange rate transmission (Agarwal, 2021). A number of studies have looked at the financial channel of the exchange rate using either macroeconomic data (e.g., different components of the gross domestic product (GDP)), financial market data (e.g., sovereign bond yield and probability of default) or non-financial firm-level data (e.g., firm leverage). There are fewer studies that provide evidence of the financial channel using bank-level data due largely to the confidentiality of some bank-level variables. Second, this study takes a step further by examining the impact of a macroprudential FX policy that seeks to limit the impact of exchange rate movements on bank balance sheets. Using banks' net open foreign currency (FX) position (NOFP) that is calculated based on a regulation issued by the Philippine central bank, this study shows the impact of a specific macroprudential policy on bank lending. Finally, this study shows that banks' net FX open position matter for the transmission of exchange rate movements on bank lending. This highlights that the impact of a depreciation on bank lending is not straightforward – it could reduce bank lending and is thus contractionary if banks are in negative net open FX position, but could increase bank lending and is thus expansionary if banks are in positive net open FX position. Thus, a domestic currency depreciation could amplify instead of offset the trade channel.

The banking system plays a significant role in the Philippine financial system as it comprises about 82.7 percent (as of end-January 2022) of the total resources of the financial system. In this respect, banks play a pivotal role in providing financing to firms and consumers. Thus, preserving the stability of the banking system is tantamount to preserving the stability of the financial system and the economy. Given that the Bangko Sentral ng Pilipinas (BSP) implements a flexible exchange rate regime, bank balance sheets, and the economy, in general, are subject to exchange

[1] In the literature, the financial channel has also been referred to as the risk-taking channel of exchange rates (Bruno and Shin, 2015; Hofmann, Shim, and Shin, 2017).

rate fluctuations. To help insulate bank balance sheets from the adverse effects of exchange rate movements, the BSP, like many other central banks, has adopted various FX-related macroprudential measures. An example of such measure is the limit on banks' NOFP.[2]

This study finds that a local currency depreciation does not necessarily adversely affect banks. While depreciation, by itself, appear to reduce bank lending, this effect disappears when hedging instruments are accounted for. Furthermore, the impact of a currency depreciation on bank lending is contingent on the net open FX position of banks. In particular, when a bank's foreign assets exceed its foreign liabilities, a depreciation will increase a bank's net worth and can prompt a bank to increase lending. There are likewise some indications that the regulation on NOFP limit bank lending.

The paper is structured as follows: Section 2 provides a review of the literature of the financial channel of the exchange rate. Section 3 describes the data and methodology employed. Section 4 discusses the empirical results. Section 5 concludes and provides some policy implications.

2. Review of Related Literature

This study is related to two strands of the literature on how economies are affected and respond to exchange rate movements. First, this study is related to the strand that examines the impact of exchange rate variations on domestic macroeconomic and financial conditions via the financial channel. These studies examine the financial channel both at the country- and firm-levels.

Using cross-country and non-financial firm-level data, a number of studies examine the impact of exchange rate movements on investment – a finance-intensive form of spending. Based on a sample of 44 advanced economies and emerging market economies (EMEs), Kearns and Patel (2016) find that investment is substantially more sensitive to exchange rate[3] changes than the other components of aggregate demand. Similarly, Banerjee et al. (2020), using firm-level data for 18 major global advanced economies and EMEs, find that exchange rate depreciation dampens corporate investment through firm leverage and FX debt. Higher leverage

[2] The limit on NOFP was first imposed by the then Central Bank of the Philippines (CBP) in 1992 via CBP Circular No. 1327 as part of the economic liberalization in the 1990s. In previous decades, strict controls on foreign exchange activities of banks were implemented following several crises episodes (Fonacier, 2019). A number of amendments to the NOFP regulation were made throughout the years. FX rules were gradually eased to allow banks to provide ample liquidity in the foreign exchange market to support the growth in trade and investment activities following the country's economic liberalization efforts. Nonetheless, the BSP maintains a limit in the NOFP to ensure that FX risk does not threaten a bank's safety and soundness. Adjustments are done, based on the BSP's assessment of market needs with due consideration of market stability. The last amendments were in 2021 via BSP Circular No. 1124 and 1120. See further discussion of NOFP in Annex 1.

[3] Kearns and Patel (2016) used the debt-weighted exchange rates (DWERs) constructed by the BIS, which are calculated based on the geometric average of the economy's bilateral exchange rate against each of the five major global funding currencies (US dollar, euro, Japanese yen, pound sterling and Swiss franc), weighted by the shares of these currencies in the country's total foreign currency debt (see Berger (2016) for details).

and FX debt reflect higher financial vulnerability that increases a firm's difficulty to access credit, which, in turn dampens investment activity.

Nonetheless, Bleakley and Cowan (2008), using a sample of over 450 nonfinancial firms from five Latin American countries, find that dollar-indebted firms do not necessarily invest less following a depreciation due to firms' practice of currency matching. Firms' risk aversion prompts them to systematically match the currency composition of their income with that of their debt, and by doing so hedge exchange rate risk. As a result of this matching, firms with high levels of FX debt are also those which see larger relative increases in their current and future earnings following a depreciation. Thus, in the wake of a depreciation, the reduction in investment induced by the increase in indebtedness is more than offset by current and future income.

Several studies highlight the role of lenders in examining the real effects of exchange rate movements. For instance, Bruno and Shin (2015) present a "double-decker" banking model where global banks raise wholesale US dollar funding from financial centers and then lend to local banks in other jurisdictions. In turn, the local banks lend to local corporate borrowers. The local banks are assumed to be hedged in their currency exposure, but the local borrowers have a currency mismatch, financing local currency assets with US dollar borrowing.[4] When the US dollar appreciates (or depreciation of borrowing countries' domestic currencies) the balance sheets of local borrowers become weaker. From the perspective of banks, this increases their credit risk, reducing their appetite for risk, and hence their willingness to lend. Thus, global banks deleverage. Bruno and Shin (2015) empirically validate their model in a sample of 46 developed and developing/emerging economies, where they find that an appreciation of borrowers' domestic currencies (or depreciation of the US dollar) increases cross-border loans to these countries.

Similarly, Avdjiev et al. (2019) emphasize the role of cross-border lending on real investment. Following a depreciation of the local currency, cross-border lending to a country contracts, where the impact is greater for firms that are more dependent on external financing. A stronger US dollar reduces the creditworthiness of currency-mismatched EME borrowers as debt servicing of dollar-denominated liabilities increases. From the perspective of creditors, this weakens the ability of borrowers to pay, reducing the willingness of creditors to provide additional credit. Thus, a depreciation of the local currency triggers a decline in cross-border bank lending, which, ultimately results in a contraction in real investment.

Both studies (Bruno and Shin (2015) and Avdjiev et al. (2019)) suggest that the behavior or response of creditors to exchange rate movements is as important as the response of borrowers. Carstens and Shin (2019) emphasize that exchange rate fluctuations give rise to valuation effects on the lenders' assets, influencing their credit supply. This is confirmed by Agarwal (2021) and Agarwal et al. (2020) in their studies using domestic bank credit instead of cross-border loans.

[4] The motive for the currency mismatch could be to hedge US dollar receivables when costs are in local currency, or the mismatch may be due to speculative motive. In practice, distinguishing hedging from speculation is challenging (Bruno and Shin, 2015).

Agarwal (2021) shows how banks' foreign currency exposure affects the transmission of exchange rate shocks to the real economy. In particular, the 2015 appreciation shock of the Swiss franc against the euro enabled banks in Switzerland with net foreign liability position to increase lending, allowing firms to increase investment. In addition, using a sample of 43 advanced economies and EMEs, Agarwal (2021) provides evidence that countries with banking sectors that have net foreign liability exposure see a larger decline in real GDP growth following depreciation episodes. Similarly, in a sample of five European EMEs (Hungary, Poland, Romania, Serbia, and Turkey), Agarwal et al. (2020) show that following a home currency depreciation, banks with net foreign liability position lend less relative to banks with net foreign assets. The mechanism works through the valuation effects of exchange rate changes on banks' net worth. With an appreciation, banks with net foreign liabilities find the domestic value of their foreign liabilities decline more than their foreign assets, which increases their net worth, and, in turn increases their willingness to extend credit. Conversely, with a depreciation, banks with net foreign liabilities find the domestic value of their foreign liabilities increase more than their foreign assets, which decreases their net worth and capacity to lend. Both Agarwal et al. (2020) and Agarwal (2021) emphasize that the impact of exchange rate changes on domestic bank lending is contingent on the net FX exposure of banks.

The aforementioned studies generally highlight that the financial channel is more pronounced in EMEs, reflecting their greater dependence on FX or external funding, less developed financial systems, and lack or unavailability of hedging markets, making their balance sheets more vulnerable to exchange rate movements and their economies more susceptible to sudden stops and financial and banking crises. It is in this vein that many EMEs have implemented FX macroprudential measures such as limits on netor gross open FX positions, FX exposures, FX funding, or currency mismatches. However, this is not taken into account by the preceding studies. Based on the International Monetary Fund's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER), as of 2018, 147 out of 192 countries have imposed limits on their financial sector's open FX positions. Of these, 27 are advanced economies. Meanwhile, of the 98 EMEs, 74 are using macroprudential FX regulations (Jung, 2020).

This study examines a specific FX-related measure – the limit on the NOFP of banks – and is, thus, related to the literature that examines the impact of macroprudential measures on economic outcomes. In general, a bank always faces an FX risk when it has more than one currency in operation, and the bigger the FX exposure, the higher the risk that the bank faces. While banks strategize to reduce their vulnerability to FX risk, regulators also implement measures to ensure banks' FX exposure risks are attenuated. However, some studies show that while such measures mitigate vulnerabilities to the financial sector, they could likewise adversely affect real outcomes for non-financial firms or unregulated sectors and the broader economy (Ahnert et al., 2021; Keller, 2019; Jung, 2020). As typically mentioned in the literature, macroprudential regulations can have unintended consequences.

For instance, Jung (2020) shows that the regulation requiring all banks located in Korea to maintain their ratio of FX derivatives to capital below a certain level caused a reduction in the supply of FX derivatives. This reduced exporters' hedging activities with banks, which, in turn, substantially reduced exports of firms relying on FX derivatives as a hedging tool. Meanwhile, Keller (2019) shows that limits on

Peruvian bank's currency forward contracts against foreigners[5] induced banks to shift their foreign currency lending to local firms. However, most of the local firms have revenues in local currency, thus, the regulation shifted the risk away from foreign investors, who are willing to take exchange rate risk, to local firms that do not have revenues in dollars.[6] Hence, banks have indirectly increased their exposure to FX risk, where in the event of a depreciation, banks may face repayment difficulties from local firms that are non-dollar earners.

In a cross-country setting, Ahnert et al. (2021) show that FX regulations reduced banks' cross-border FX borrowing, implying that the former are successful in accomplishing their direct goals of reducing FX exposure and the sensitivity of banks to currency movements. However, they find that FX regulations have the unintended consequence of causing the unregulated sectors (such as investors and non-bank financial institutions) to partially shift their FX funding toward international debt issuance. This dampens the reduction in the aggregate exposure of the economy to FX risk. Nevertheless, FX regulations still result in a meaningful reduction in the aggregate FX borrowing of countries as the reduction in cross-border FX bank borrowing is substantially greater than the increase in FX corporate debt issuance. Similarly, Ayyagari et al. (2018) provide evidence that macroprudential measures lower credit growth, suggesting that these policies can enhance financial stability. However, macroprudential policies have potentially adverse real effects, as they are associated with lower investment and sales growth, particularly in micro-, small and medium-sized enterprises (MSMEs).

Given the foregoing, this study attempts to contribute to both strands of the literature. Using bank-level data, this study examines whether exchange rate movements affect bank lending and whether banks' net FX exposure is important in the transmission of exchange rate movements to the real economy. This is investigated using the case of the banking system of the Philippines, an emerging market economy. The Philippine banking system is a good case study for several reasons: First, the BSP has a flexible exchange rate policy, thus, banks are exposed to exchange rate risks. Second, the BSP has implemented a limit on banks' NOFP, which is a macroprudential policy aimed to limit exchange rate risks. Third, Philippine universal and commercial banks (U/KBs) appear to adhere to the NOFP limit but they have divergent net FX exposures. The interplay of these features of the Philippine banking system may provide insights that may be useful for policy. In addition, apart from the study of Agarwal et al. (2020) on five European EMEs, there are no studies that cover other EMEs that provide bank-level evidence of the financial channel operating through banks' domestic lending behavior, at least to the best of the authors' knowledge.

Findings may have important implications for central bank policies such that effects of exchange rate movements on domestic economic conditions through the financial channel may have to be considered when crafting banking regulations and macroprudential and monetary policies.

[5] Since the measure is targeted towards foreign investors, it is classified as a capital control.

[6] Banks in Peru have foreign currency liabilities mostly in the form of foreign currency deposits that they need to match with foreign currency assets, per regulation.

3. Data and Methodology

To explore whether exchange rate movements and FX macroprudential measures affect bank lending, equation (1) is estimated:

$$L_{b,t} = \alpha + \gamma er_t + \varphi NOFP_{b,t} + \lambda(er_t \times NOFP_{b,t}) + \mu \mathbf{X}_{b,t-1} + \nu \mathbf{Y}_t + \psi_b + \varepsilon_{b,t} \quad (1)$$

where, $L_{b,t}$ is a measure of bank lending of bank b in time t. er_t is the change in bilateral exchange rate,$NOFP_{b,t}$ is a measure of bank b's net FX position, and $(er_t \times NOFP_{b,t})$ is the interaction between the exchange rate and net FX position. $\mathbf{X}_{b,t-1}$ is a vector of bank-level control variables and $\mathbf{Y}_t$ is avector of macroeconomic control variables. ψ_b is an unobserved time-invariant characteristic of bank b. $\varepsilon_{b,t}$ is an error term, which is assumed to be a normally distributed random variable. er_t, $NOFP_{b,t}$, and $er_t \times NOFP_{b,t}$ are the main variables of interest. This study uses quarterly balanced panel data of 35 Philippine universal/commercial banks, covering the period Q12012-Q42019.

The dependent variable is a bank's total loan portfolio. Its lag is included as an explanatory variable to account for the possible persistence of bank lending (Kashyap and Stein, 2000).

The exchange rate variable, er_t, is specified as the Philippine peso (PhP) relative to the US dollar (USD); hence, an increase signifies a depreciation. A depreciation of the domestic currency relative to the US dollar is typically associated with tightening domestic financial conditions (Lee et al., 2021; Banerjeeand Mohanty, 2021); thus, the coefficient of the exchange rate variable, γ, is expected to be negative.

Figure 1a shows the annual and quarterly changes in the exchange rate for the period Q12012-Q42019. While there is no clear trend in the direction of the exchange rate, at least during the sample period, it is apparent that in most instances, the exchange rate has moved within one standard deviation from the mean. On an annual basis, the peso has depreciated in 22 out of the 32 quarters (or 69 percent) during the sample period. On a quarterly basis, the peso has depreciated in 16 out of the 32 quarters (50 percent).

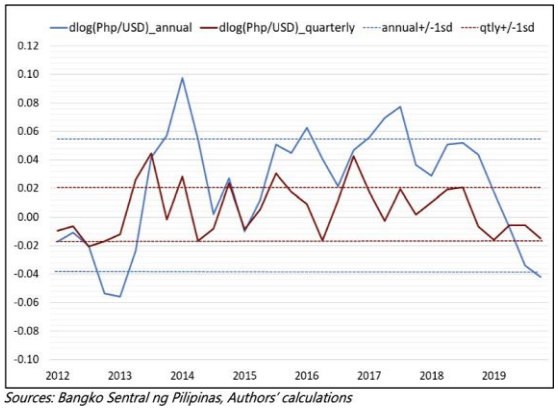
The net FX position variable, $NOFP_{b,t}$, is the net open FX position of a bank relative to its unimpaired capital. Under BSP regulations,[7] "banks' allowable open foreign exchange position (either overbought or oversold) shall be the lower of 20 percent of their unimpaired capital or USD50 million."[8] Banks' FX exposure forms part of market risk of banks and FX assets are generally assigned higher riskweights. A higher risk-weighted asset implies that banks will have to increase capital. This, in turn, couldtranslate to less allocation for lending, assuming all other factors remain constant. Thus, the coefficient of $NOFP_{b,t}$, φ, is expected to be negative.

[7] As stated in Section 98 of the BSP Manual of Regulations on Foreign Exchange Transactions (as of December 2020). See Annex 1 for details.

[8] This regulation was amended in 2021, with the limit changed to "25 percent of its Qualifying Capital or USD150 million, whichever is lower" (BSP Circular No. 1120, dated 7 June 2021).

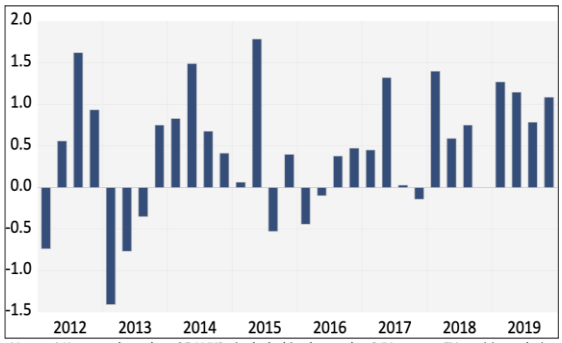
Figure 1. Foreign exchange movement, and Net open FX position of Philippine U/KBs, 2012Q1-2019Q4

(a) Annual and Quarterly Changes in PhP/USD



Sources: Bangko Sentral ng Pilipinas, Authors' calculations

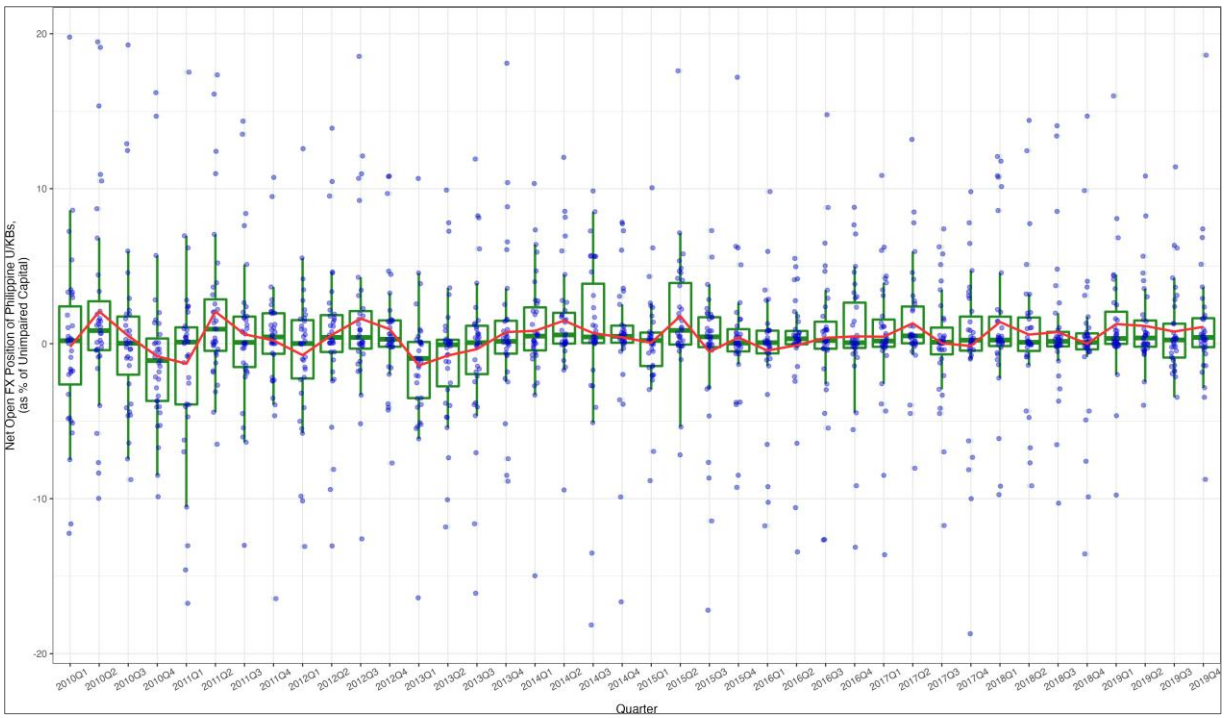
(b) Average Net Open FX Position of U/KBs,[1/2/]



Notes: 1/Average based on 35 U/KBs included in the study. 2/Net open FX position relative to unimpaired capital, calculated based on Section 99 of the BSP Manual of Regulations on Foreign Exchange Transactions (as of December 2020).
Source: Bangko Sentral ng Pilipinas

Figure 1b shows the aggregate net open FX position of U/KBs in the Philippines for the period Q12012-Q42019. It is evident that during the sample period, there were more instances that banks had net FX asset position ($NOFP > 0$), at least in the aggregate. On a per bank basis, there is greater variation on the NOFP of banks, as seen in Figure 2. It would also seem that when Philippine banks are able to have positive NOFP, the magnitude tend to be significant (as, generally, mean > median). In addition, in 2019, banks' NOFP are less dispersed and the outliers tended to be above the upper whisker compared to earlier periods.

Figure 2: Net Open FX Position of Philippine U/KBs,Q12010-Q42019



Note: The boxplots show the outliers (blue dots above/below the whiskers of the boxplots), and the median (the green horizontal line within the interquartile range). The red line connects the mean NFOP of each quarter. The blue dots are the NOFPs of each bank. The NOFPs are measured as a percent of unimpaired capital.
Source: Bangko Sentral ng Pilipinas

The sign of the coefficient of the interaction term between the exchange rate and net open FX position, λ, is ambiguous. One of the following cases is possible:

Case 1. If a bank is in net FX asset (or long/overbought) position, then a domestic currency appreciation will cause a greater decrease in the domestic value of a bank's foreign assets than foreign liabilities. This will decrease a bank's net worth and propensity to lend, thus, λ will be negative.

Case 2. If a bank is in net FX asset position but the domestic currency depreciates, then, the increase in the domestic value of a bank's foreign assets will be greater than the increase in the domestic value of its foreign liabilities. This will increase a bank's net worth and propensity to lend, thus, λ will be positive.

Case 3. If a bank is in net FX liability (or short/oversold) position, then a domestic currency appreciation will cause a greater reduction in the domestic value of a bank's foreign liabilities than foreign assets. This will increase a bank's net worth and propensity to lend, thus, λ will be positive. This was seen in the impact on bank lending in Switzerland of the appreciation shock in 2015 (Agarwal, 2021).

Case 4. If a bank is in net FX liability position but the domestic currency depreciates, then the increase in the domestic value of a bank's foreign liabilities will be greater than the increase in the domestic value of its foreign assets. This will decrease a bank's net worth and propensity to lend, thus, λ will be negative. This case is more pronounced in EMEs where FX assets typically fall short of FX liabilities and the occurrence of currency depreciations are more frequent (Agarwal et al., 2020).

Table 1. Joint Impact of Exchange Rate and NOFP on Bank Lending

	Depreciation	Appreciation
NOFP > 0	+	−
NOFP < 0	−	+

The four cases above, as summarized in Table 1, are very instructive. For one they imply that the impact of exchange rate movements on bank lending behavior is not clear cut and may depend on the net FX position of banks. For instance, Case 2 suggests that a domestic currency depreciation may not necessarily be adverse if banks are in net FX asset position. However, if banks are in net FX asset position but an appreciation occurs, as in Case 1, then banks may be worse off. The cases above highlight the challenge faced by banks in ensuring that their balance sheets are not unduly exposed to large currency mismatches so as not to be too vulnerable to sudden currency movements.

For ease of interpretation of λ, either the exchange rate variable or the net FX position could be set as a dummy variable. This study uses the actual values of the net open FX position of banks and defines a dummy variable, $depdummy$ equal to 1, for periods when the Philippine peso has depreciated against the US dollar on an annual basis, and equal to zero, otherwise.[9]

$\mathbf{X}_{b,t-1}$ is a set of bank-level control variables - size, liquidity, capitalization, credit risk, and hedging instruments. The use of the first three variables is in line with the literature on the bank-lending channel of monetary policy (Kashyap and Stein, 1995, 2000). The ratio of each bank's non-performing loans (NPLs) relative to total loans is likewise included as a control variable to capture credit risk (Espinoza and Prasad, 2010).

In addition, the ratio of each bank's FX derivatives contracts relative to FX assets is included to possibly capture the impact of hedging instruments on bank lending.[10] Including a control for hedging instruments is important in order not to overstate the impact of exchange rate movements or FX exposure on bank lending. An FX derivatives contract is an off-balance sheet item that may be used for hedging purposes or speculative activities. We use this variable with this caveat in mind. Nonetheless, the BSP has implemented regulations that minimize the use of such instruments for speculative purposes.[11]

$\mathbf{Y}_t$ is a set of macroeconomic, policy and global control variables. The consumer price index (CPI) and real GDP were considered as proxy for overall macroeconomic conditions and thus loan demand (Jonas, 2014; Ananchotikul and Seneviratne, 2015).[12,13] The reverse repurchase (RRP) rate is included to capture the impact of monetary policy on bank lending. Exchange rate volatility is also included to consider the possibility that the volatility of the exchange rate maybe more important than the degree of currency appreciation or depreciation.

[9] Standard deviation of annual and quarterly changes in log(Php/USD) is at 0.039 and 0.018, respectively; while standard deviation of annual and quarterly changes in net open FX position is at 0.051 and 0.048, respectively. Since the net open FX position variable provides greater variation than the exchange rate variable, its actual values were used in the interaction term.

[10] In many EMEs, markets to hedge exchange rate risk are thin so that hedging is more difficult and more costly (Upper and Valli, 2016) relative to in advanced economies. The extent of FX hedging in EMEs is also often limited sometimes completely absent (Chui et al., 2016).

[11] For instance, Section 88 of the BSP FX Manual provides hedging rules using FX derivatives involving the Philippine Peso. It provides that "Customers may, through FX forwards with Authorized Agent Banks (AABs), hedge their market risks arising from FX obligations or exposures; provided, that forward sale of FX (deliverable and non-deliverable) may only be used when the underlying transaction is eligible for servicing using FX resources of AABs or AAB forex corps." Section 622 of the Manual or Regulations for Banks as amended by BSP Circular 1119 dated 7 June 2021, limits bank's total gross exposures to all forms of Peso NDF transactions, to a fixed percentage of the bank's unimpaired capital.

[12] Since information on borrowers' balance sheets are absent, there is no direct control for demand effects in the model. This study follows the typical practice in the literature of using macroeconomic conditions as proxy for demand effects. While macroeconomic conditions affect the strength of borrowers' balance sheets, they may likewise affect lenders' (in the case of this study, banks') balance sheets. This study uses macroeconomic conditions as proxy for demand factors with this caveat in mind.

[13] Baseline specifications eventually use CPI only. Including both CPI and real GDP in a single regression makes both variables statistically insignificant. Real GDP is used in the robustness checks.

Annex 2 reports the description and summary statistics of the variables used in the estimations.

The dynamic panel two-step difference Generalized Method of Moments (GMM)[14] is used to estimate equation (1). Given that the explanatory variables used in equation (1) may introduce endogeneity issues – unobserved heterogeneity,[15] simultaneity,[16] and dynamic endogeneity,[17] this approach is considered appropriate as it removes endogeneity by internally transforming the data (Roodman, 2009).

First, the presence of a lagged dependent variable and other possible endogenous explanatory variables is addressed by the use of appropriate internal instruments, i.e., lags of instrumented variables. Second, the bank unobserved fixed effect is addressed by the differencing approach. Third, the GMM approach uses standard errors that are robust to heteroskedasticity and autocorrelation within the cross-sectional units (Roodman, 2009).

The validity of the internal instruments used in the GMM approach is verified in two ways. First, the Hansen test of overidentifying restrictions checks whether the instruments, as a group, are exogenous. The null hypothesis is that the instruments used are not correlated with the residuals. An acceptance of the null hypothesis implies that the instruments are valid. Second, the autoregressive (AR) test verifies whether there is a second-order serial correlation in disturbances. The null hypothesis is that the errors exhibit no second-order serial correlation (Roodman, 2009).

4. Empirical Results

The results provide evidence of the existence of the financial channel in the Philippine banking system. The estimates provide two important dimensions to the evidence of a financial channel. First, the importance of the financial channel is dampened by hedging instruments. Second, the existence of the financial channel hinges on whether the NOFP is positive or negative.

4.1 Baseline estimates

Table 2 presents the baseline specifications. Specification (1) excludes FX contracts as a control for hedging instruments, while Specification (2) considers FX contracts. Specification (1) shows that, holding other things equal, a currency deprecation could have, on average, a contractionary effect on bank lending, at least in the short-term. A possible explanation for this is that banks are cognizant that their borrowers may have currency mismatch, specifically financing local currency assets with foreign currency borrowing.[18] Thus, in the face of a local currency depreciation, balance sheets of

[14] Windmeijer (2005) found that two-step GMM performs better than one-step GMM in estimating coefficients, with lower bias and standard errors.

[15] The presence of unobserved time-invariant characteristic of banks may be associated with the observable bank-level characteristics.

[16] For instance, changes in bank lending, exchange rate, and other explanatory variables may be simultaneously affected by the same event.

[17] Inclusion of lagged dependent variable as an explanatory variable

[18] This follows the argument of Bruno and Shin (2015).

corporate borrowers become weaker. This, in turn, may reduce banks' willingness to lend. Based on the Philippines' International Investment Position, Other Sectors, which include corporate borrowers, among others,[19] are in net external liability position during the period covered by this study. This could help explain the negative coefficient of the depreciation dummy. Nonetheless, the negative effect of depreciation on bank lending wanes when banks' use of FX contracts is accounted for, as seen in Specification (2).

Table 2. Impact of exchange rates and FX exposure on bank lending

	Specification	
Dependent variable: log(loan)	(1)	(2)
$\log(\text{loan})_{t-1}$	0.141 (0.106)	0.158 (0.102)
depdummy	-0.040** (0.016)	-0.024 (0.015)
NOFP_{t-1}	-1.725** (0.759)	-1.550** (0.601)
depdummy*NOFP_{t-1}	2.175* (1.124)	2.190** (0.996)
ER volatility	-0.041 (0.033)	-0.057 (0.035)
FX contracts		35.321** (15.920)
size_{t-1}	0.281 (0.247)	0.433* (0.221)
liquidity_{t-1}	0.084*** (0.025)	0.017 (0.033)
$\text{capitalization}_{t-1}$	-1.198 (1.278)	-0.624 (1.385)
NPL ratio	-9.055*** (2.469)	-8.665*** (2.179)
RRP	-0.038*** (0.014)	-0.040** (0.015)
log(CPI)	2.608*** (0.870)	2.010** (0.964)
No. of observations	1,050	1,050
No. of instruments	27	29
AR(2) (p-value)	0.242	0.284
Hansen (p-value)	0.662	0.614

Note: All regressions are estimated with the two-step difference GMM estimator for dynamic panels. Robust standard errors (in parentheses) are clustered by bank. The null hypothesis of the Hansen test is that the instruments used are not correlated with the residuals (overidentifying restrictions). The null hypothesis of the serial correlation test is that the errors exhibit no second-order serial correlation. ***, **, and * denote statistical significance at the 1%, 5%, and 10%, respectively.
Source: Authors' estimates.

[19] Other Sectors cover the following economic sectors: (a) other financial corporations, which include private and public insurance corporations, holding companies, government financial institutions, investment companies, other financial intermediaries except insurance, trust institutions/corporations, financing companies, securities dealers/brokers, lending investor, Authorized Agent Banks forex corporations, investment houses, pawnshops, credit card companies, offshore banking units; (b) non-financial corporations, which refer to public and private corporations and quasi-corporations, whose principal activity is the production of market goods or non-financial services; and (c) households and non-profit institutions serving households (BSP International Investment Position Report, 4th Quarter 2021).

Meanwhile, the regulation on NOFP appears to limit bank lending, as indicated by the negative coefficient of NOFP. Nonetheless, the negative impact of NOFP is slightly reduced when FX contracts are accounted for. On average, holding other things equal, a positive change in last quarter's NOFP of banks tends to lower loan growth in the succeeding period. However, such impact turns positive during periods of depreciation if banks' foreign assets exceed their foreign liabilities, as indicated by the positive coefficient of the interaction term between the depreciation dummy and NOFP. Thus, in periods of depreciating peso, the impact of NOFP would depend on whether a bank has more foreign assets or more foreign liabilities: the direction of the impact on lending follows the sign of the NOFP. This means that a depreciation when banks have more foreign liabilities than foreign assets would, on average, exacerbate the contraction in loan growth.

The foregoing results imply that the impact of exchange rate movements on bank lending depends on the NOFP of banks. A peso depreciation can result in increased lending when a bank's NOFP is positive, but in decreased lending when the NOFP is negative. These are consistent with Cases 2 and 1, respectively, as discussed in the previous section.

Among the bank-level control variables, bank size and liquidity appear to have some positive impact on bank lending growth. In addition, a positive change in a bank's NPL ratio has a negative and statistically significant impact on loan growth, indicating that higher bank risk reduces a bank's propensity to lend.

Among the macroeconomic control variables, an increase in the policy rate exerts a negative impact on bank lending growth. Meanwhile, a higher inflation rate appears to increase bank lending, which may signify that a robust economy, as indicated by higher inflation, induces banks to lend more. It can be noted that during the period covered by the sample, annual inflation has averaged at 2.7 percent, well within the BSP inflation target of 3.0 percent ± 1.0 percentage point.

Anent this, it must be noted that changes in $log(er)$ does not Granger cause changes in $log(cpi)$, regardless of the data frequency used (quarter-on-quarter or year-on-year), consistent with the low exchange rate pass-through (ERPT) calculated by the BSP. Meanwhile, changes in $log(cpi)$ Granger causes changes in the exchange rate, albeit at low levels of significance (10 percent). Nonetheless, the fact that independent changes in the exchange rate does not significantly affect bank lending suggests that the direct impact of $log(cpi)$ on bank lending overwhelms the impact of $log(cpi)$ on changes in the exchange rate.

4.2 Robustness checks

The first set of robustness check considers real GDP as a control for macroeconomic factors or demand conditions, and VIX to capture global financial market uncertainty that may have not been captured by exchange rate movements. The second set of robustness checks uses a different definition of the depreciation dummy, where the dummy is set to "equal 1 when the peso has depreciated relative to the US dollar quarter-on-quarter," instead of year-on-year; and include interaction terms between bank-level variables (size, liquidity, and capitalization) and the depreciation dummy. These interaction terms rule out any omitted variable biases by absorbing any variation in loan growth that could be driven by bank characteristics associated with exchange rate changes (Agarwal et al., 2020). The

third set of robustness checks includes the U.S. Dollar Index (DXY)[20] as an external instrument. DXY goes up when the U.S. dollar appreciates relative to other global currencies. It is intended to instrument for the PhP/USD bilateral exchange rate. While the GMM estimation technique assumes that the only available instruments are internal – based on lags of the instrumented variables, it nonetheless allows inclusion of external instruments (Roodman, 2009). DXY satisfies the two conditions for a variable to be considered a valid instrument: instrument relevance and instrument exogeneity (Stock and Watson, 2015).[21]

Results of robustness checks are shown in Tables 3-5. For brevity, only the coefficients of the variables of interest are displayed.

Table 3. Robustness checks: with real GDP and VIX

	Specification			
Dependent variable: $log(loan)$	(3)	(4)	(5)	(6)
depdummy	-0.046**	-0.031	-0.033*	-0.022
	(0.017)	(0.019)	(0.018)	(0.017)
$NOFP_{t-1}$	-1.711*	-1.126	-0.962	-0.857
	(0.853)	(0.793)	(0.728)	(0.685)
depdummy*$NOFP_{t-1}$	1.960*	1.412	1.084	1.094
	(1.164)	(1.162)	(0.985)	(0.996)
FX contracts		35.296**		35.705**
		(16.402)		(15.669)
No. of observations	1,050	1,050	1,050	1,050
No. of instruments	29	31	27	29
AR(2) (p-value)	0.244	0.242	0.160	0.166
Hansen (p-value)	0.494	0.427	0.669	0.554
Variable added to the baseline specifications	log(real GDP)	log(real GDP)	VIX	VIX

Note: All regressions are estimated with the two-step difference GMM estimator for dynamic panels. Robust standard errors (in parentheses) are clustered by bank. The null hypothesis of the Hansen test is that the instruments used are not correlated with the residuals (overidentifying restrictions). The null hypothesis of the serial correlation test is that the errors exhibit no second-order serial correlation. ***, **, and * denote statistical significance at the 1%, 5%, and 10%, respectively.
Source: Authors' estimates.

[20] DXY tracks the strength of the dollar against a basket of major currencies. The currencies (with correspondingweights) used to calculate the index include the Euro (57.6 percent), Japanese yen (13.6 percent), Pound sterling (11.9 percent), Canadian dollar (9.1 percent), Swedish krona (4.2 percent), and Swiss franc (3.6 percent). DXYwas originally developed by the U.S. Federal Reserve in 1973 to provide an external trade-weighted average value of the U.S. dollar against global currencies.

[21] DXY and Php/USD are highly correlated (ρ= 0.74). Meanwhile, DXY is highly uncorrelated with the dependent variable, log(loan) (ρ= 0.13), and when directly used as an explanatory variable for log(loan), it is statistically insignificant. Thus, DXY satisfies both conditions for instrument validity.

Table 3 shows that the negative impact of exchange rate depreciation and NOFP on bank lending becomes muted once FX contracts are accounted for. Meanwhile, results in Table 4 suggest that even when the definition of the depreciation dummy was changed and the interactions between bank-level variables and depreciation were considered, a depreciation coupled with positive NOFP could increase bank lending, offsetting the independent negative effect of the NOFP regulation. These results are consistent with the baseline estimates. Furthermore, results in Table 5 are close to the results in the baseline equation, suggesting that the addition of the external instrument DXY does not substantially change the implications for the main variables of interest. Nonetheless, it is noted that exchange rate volatility has become statistically significant, suggesting that exchange rate volatility may also affect the lending behavior of banks.

Table 4. Robustness checks: with alternative depreciation dummy variable and interaction terms

	Specification	
Dependent variable: $log(loan)$	(7)	(8)
depdummy	-0.011	2.229
	(0.016)	(3.485)
$NOFP_{t-1}$	-1.048**	-1.497*
	(0.394)	(0.750)
depdummy*$NOFP_{t-1}$	1.729*	1.959*
	(1.019)	(1.100)
FX contracts	41.644**	45.923**
	(17.336)	(17.587)
No. of observations	1,050	1,050
No. of instruments	29	35
AR(2) (p-value)	0.300	0.633
Hansen (p-value)	0.564	0.473
Variable included in the baseline specifications	q-o-q $depdummy$	Interaction terms: $depdummy$ and bank characteristics

Note: All regressions are estimated with the two-step difference GMM estimator for dynamic panels. Robust standard errors (in parentheses) are clustered by bank. The null hypothesis of the Hansen test is that the instruments used are not correlated with the residuals (overidentifying restrictions). The null hypothesis of the serial correlation test is that the errors exhibit no second-order serial correlation. ***, **, and * denote statistical significance at the 1%, 5%, and 10%, respectively.
Source: Authors' estimates.

Table 5. Robustness checks: with alternative depreciation dummy variable, exchange rate volatility, and interaction terms

	Specification	
Dependent variable: $log(loan)$	(9)	(10)
depdummy	-0.036*	-0.019
	(0.018)	(0.016)
NOFPt-1	-1.650**	-1.679***
	(0.769)	(0.576)
depdummy*NOFPt-1	2.307*	2.535*
	(1.216)	(0.867)
ER volatility	-0.053*	-0.070**
	(0.031)	(0.031)
FX contracts		30.889*
		(16.078)
No. of observations	1050	1050
No. of instruments	28	30
AR(2) (p-value)	0.236	0.253
Hansen (p-value)	0.415	0.572

Note: All regressions are estimated with the two-step difference GMM estimator for dynamic panels. Robust standard errors (in parentheses) are clustered by bank. The null hypothesis of the Hansen test is that the instruments used are not correlated with the residuals (overidentifying restrictions). The null hypothesis of the serial correlation test is that the errors exhibit no second-order serial correlation. ***, **, and * denote statistical significance at the 1%, 5%, and 10%, respectively.
Source: Authors' estimates.

Additional robustness checks were conducted.[22]

First, foreign banks were distinguished from domestic banks[23] because they may respond to exchange rate changes differently compared to their domestic counterparts. For instance, foreign-owned banks may have easier access to external funds, or the composition of their balance sheets may be different. A foreign bank

[22] Results not shown in the paper but may be requested from the authors.

[23] In the sample of 35 U/KBs included in the study, there are 19 domestic banks and 16 foreign banks.

dummy equal to 1 was defined for foreign banks and interacted with the exchange rate and net FX exposure variables, but these variables were not statistically significant.[24]

Second, banks listed in the Philippine Stock Exchange were distinguished from unlisted ones.[25] Listed banks may have more options on how to raise funds, thus, may find themselves less affected by exchange rate movements. A listed bank dummy equal to 1 was defined for listed banks and interacted with theexchange rate and net FX exposure variables, but these variables were not statistically significant.[26]

Third, an appreciation dummy equal to 1 was defined for periods when the Philippine peso has appreciated against the US dollar on an annual basis, and equal to zero, otherwise. The coefficient of the appreciation dummy is statistically insignificant, regardless of whether there is a control for FX contracts. In addition, the interaction term between the appreciation dummy and NOFP is negative. This means that the decline in banks' net worth following an appreciation may prompt banks to reduce lending, consistent with Case 1 discussed earlier. However, the coefficient of the interaction term is statistically insignificant, whether FX contracts are accounted for or not. This result is in contrast to the baseline results where the interaction term between depreciation and NOFP is statistically significant. These results suggest that during depreciation episodes, banks with positive NOFP respond to the increase in their net worth by lending more, regardless of their FX contracts. However, during appreciation episodes, the decrease in banks' net worth does not prompt them to decrease their lending. These findings imply that there is asymmetry on how banks react to depreciations and appreciations,[27] given their NOFP and hedging activities.

Finally, the log value of the actual exchange rate is used instead of a dummy variable for periods with depreciations (Annex 3). The estimates imply that in the presence of FX contracts, a depreciation can increasebank lending. Meanwhile, the interaction term between the log of the actual exchange rate and NOFP is statistically insignificant. Nonetheless, an interaction between these variables does not provide clear identification as to what variable actually changed, precluding any useful interpretation.

All reported specifications satisfy two necessary conditions for the two-step difference GMM estimation. First, the AR(2) p-values accept the null hypothesis that the errors in the equations are uncorrelated, an assumption that ensures that the orthogonality conditions and the specifications are correct. Second, the Hansen-test p-value accept the null hypothesis that the instruments are valid, i.e., they are not correlated with the residuals.

[24] Separate regression including foreign banks only was conducted. However, given the limited number of foreign banks in the sample, the number of instruments in the regression exceeded the number of cross-sectional units. Thus, results may not be valid.

[25] Of the 35 U/KBs in the sample, 12 are listed.

[26] A separate regression including listed banks only was likewise conducted. Similar to the case for the foreign bank sample, the number of instruments in the regression exceeded the number of cross-sectional units.

[27] This finds support in the asymmetric exchange rate effects on different macroeconomic and financial market variables found in the literature. See for instance Bahmani-Oskooee and Saha (2016) and Bahmani-Oskooee and Mohammadian (2018).

5. Conclusion

The results of this study provide evidence that the transmission of exchange rates on bank lending is not straightforward. Changes in the exchange rate have effects on domestic bank lending, in particular, during domestic currency depreciation episodes, banks with net foreign asset positions could increase lending due to an increase in their net worth. An important implication of this result is that a currency depreciation need not be contractionary for a small, open, emerging economy like the Philippines if banks can be influenced to maintain net FX asset positions overall.

Depreciation by itself and a positive NOFP alone, on average, each have a tendency to lower lending growth in the short term. But together, because of valuation effects caused by exchange rate changes, their individual contractionary effects are muted by the increase in net worth that encourages lending. Meanwhile, hedging, as part of the BSP's macroprudential policy toolkit, appear to have been useful in countering the ill effects of depreciation on bank lending.

Overall, the results of this study have important policy implications for emerging market economies with flexible exchange rates and where the banking system plays a significant role in the financial system. With adequately hedged bank balance sheets, the negative effect of domestic currency depreciation on bank lending can be muted. Moreover, for banking systems at net foreign asset positions, there is evidence that depreciations could be expansionary, amplifying the trade channel.

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Annexes

Annex 1. BSP Manual of Regulations on Foreign Exchange Transactions – Chapter II. Open Foreign Exchange Position of Banks

(as of December 2020)

Section 98. Allowable Open Foreign Exchange Position. Banks' allowable open foreign exchange position (either overbought or oversold) shall be the lower of 20 percent (20%) of their unimpaired capital or USD50 million. Any excess of the allowable limit shall be settled on a daily basis. Penalties on excess overbought and oversold positions of banks when PDS trading is suspended shall be waived.

Section 99. Computation of Foreign Exchange Position. Banks' open foreign exchange position shall be computed daily based on their FX Form 1. The guidelines on the computation of foreign exchange position of banks and reporting requirements are outlined in Appendix 19.

Appendix 19 - Implementing Guidelines on the Computation of Open FX Positions

1. The following AABs shall render a daily report to the Supervisory Data Center (SDC) of the Supervision and Examination Sector (SES), on their net foreign exchange positions using Schedule 13 of FX Form 1:

   a) Universal Banks (UBs); and

   b) Commercial Banks (KBs)

2. The FX Form 1 together with all schedules shall be reported in USD equivalent except for Schedules 8 and 13 which shall be in multi-currency. All reports shall be submitted in accordance with Section 101 of the Manual.

   In addition, an end of month report (Schedule 14) which shall be in multi-currency shall be submitted not later than, fifteen (15) banking days from end of reference month.

3. The data shall be reported in whole currency units (e.g. nearest USD1; EURO1, etc.). The original currencies to be reported in Schedule 13 and Schedule 14 shall be converted to USD using the foreign exchange rates provided in the BSP Reference Exchange Rate Bulletin. The report for a particular banking day shall use the foreign exchange rates in the said BSP Bulletin issued the next banking day.

4. The balances to be reported in Schedules 13 and 14 shall be sourced from the banks' Multi Currency Control Ledgers (MCCL) or such other control records maintained by the reporting bank which contain the breakdown of foreign exchange assets and liabilities in their original currencies. The data from such MCCL or other control records should be equal to the balance of the corresponding accounts in the reporting bank's general ledger.

5. All transactions for the reference date shall be included. Transactions with deficient documents shall be reflected in the schedules with appropriate footnotes.

6. For purposes of computing the net FX position of reporting banks, AABs shall use the total USD equivalent of their net FX position as reflected in Item E of Schedule 13 and as computed in item 3 above.

7. The reporting bank's unimpaired capital as used in Schedule 13, shall be in accordance with the definition under the pertinent provisions of the Manual of Regulations for Banks (MORB) and shall be converted to USD as provided in Item 3 above. AABs shall use the Unimpaired Capital Accounts as of the month-end two (2) months prior to reference month. For instance, for the October 2016 report, end of August 2016 balances shall be used for this purpose.

8. The following shall likewise be observed in the computation of banks' net open FX position limit:

   a. A bank shall have the option to exclude from its FX assets the following:

      i. its foreign exchange holdings resulting from original investments in New Money Bonds(NMB);
      ii. "Due from Head Office/Branches/Agencies Abroad-Assigned Capital" account, to the extent of the lower of assigned capital approved by the BSP or the amount of capital actually remitted; and
      iii. Amount of foreign currency-denominated assets pertaining to the net proceeds of out- standing issues of foreign currency denominated Hybrid Tier 1 (HT1) capital instruments.

      Banks shall signify in writing to the BSP their intention whether to exclude or to include theirabove assets from the computation of their net open FX position. Once a bank has opted to include (or to exclude) said assets, the option signified can no longer be subsequently reversed or changed.

   b. The following accounts shall be excluded:

      i. 100% FX cover required by the foreign Monetary Authority to be deposited by Philippine UBs/KBs with its advising/confirming bank in the foreign country for letters of credit issued;
      ii. Equity investments in foreign subsidiaries; and
      iii. Investments in Global Peso Notes issued by the Republic of the Philippines.

   c. Banks shall submit a supporting schedule in prescribed format (Annex O) on the Details of Accounts Excluded in the Computation of Net Open Exchange Position, which is an attachment to Schedule 13 of the FX Form I report.

Annex 2. Description and Summary Statistics of Variables

Variable	Description	Mean	Standard Deviation	Min	Max
Dependent variable:					
Loan	total loan portfolio, equal to the sum of (i) loans to BSP, (ii) loans to other banks, (iii) loans and receivables-others, and (iv) loans and receivables arising from repurchase agreements/certificate of assignment/participation with recourse/securities lending and borrowing transactions, net of amortization.	24.760	1.543	20.284	28.413
Variables of interest					
Exchange rate	dummy = 1, when year-on-year change of log(PHP/USD) > 0; 0, otherwise	0.688	0.464	0	1
Net FX position	ratio of net overbought or oversold position to unmpaired capital (calculated based on Section 99 of the BSP MOFX Transactions)	0.005	0.043	-0.187	0.186
Bank-level control variables					
Size	log of total assets	25.506	1.452	22.174	28.753
Liquidity	ratio of liquid assets to deposits and short-term funding	0.912	0.446	0.008	8.817
Capitalization	ratio of total capital to total asset	0.082	0.066	0.004	0.618
NPL ratio	ratio of non-performing loans to total loans	0.021	0.026	0.000	0.155
FX contracts	ratio of FX contracts to FX assets	0.001	0.003	0.000	0.041
Macroeconomic variables					
CPI	log of consumer price index	4.691	0.059	4.592	4.798
RRP	BSP overnight reverse repurchase rate	3.699	0.508	3.000	4.750
ER volatility	30-day exchange rate volatility	0.294	0.179	0.080	0.870
Real GDP	real gross domestic product	15.171	0.158	14.883	15.475
VIX	Chicago Board Options Exchange (CBOE) market volatility index	15.526	3.456	9.510	25.420

Note: Data covers 35 U/KBs for the period 2010Q1-2019Q4
Sources: BSP Financial Reporting Package, BSP Statistical Database, Bloomberg

Annex 3. Robustness checks: using actual exchange rate

	Specification	
Dependent Variable: log(loan)	(1)	(2)
$log(er_t)$	0.315	0.584**
	(0.371)	(0.284)
$NOFP_{t-1}$	-2.403	15.568
	(23.496)	(24.164)
$log(er_t)$*$NOFP_{t-1}$	0.599	-4.041
	(6.092)	(6.272)
FX contracts		38.654**
		(15.950)
No. of observations	1,050	1,050
No. of instruments	27	29
AR(2) (p-value)	0.142	0.253
Hansen (p-value)	0.375	0.354

Note: All regressions are estimated with the two-step difference GMM estimator for dynamic panels. Robust standard errors (in parentheses) are clustered by bank. The null hypothesis of the Hansen test is that the instruments used are not correlated with the residuals (overidentifying restrictions). The null hypothesis of the serial correlation test is that the errors exhibit no second-order serial correlation. ***, **, and * denote statistical significance at the 1%, 5%, and 10%, respectively.

Source: Authors' estimates.