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ABSTRACT

More than 20 years after the Asian financial crisis, the region's continued high reliance on United States (US) dollar-denominated funding has significant implications for the transmission of global financial conditions to domestic financial and macroeconomic circumstances. Given limited domestic capital market-based financing solutions, a high reliance on funding denominated in US dollars renders countries vulnerable to changing global financial and liquidity conditions. Using a dynamic panel and a vector autoregression model to assess the exchange rate as a possible transmission channel, we find that changes in bilateral US dollar exchange rates can have a significant impact on sovereign credit risk. In particular, a depreciation of the domestic currency against the US dollar leads to a widening of the sovereign bond spread. This finding suggests a significant relationship between US dollar funding exposure, US dollar liquidity conditions, and domestic financial conditions in some emerging Asian economies, and thus highlights one source of structural vulnerability. Given that the magnitude of the effects varies across countries, policy makers need to monitor closely the interplay between the exchange rates and local financial market conditions with tailored prescriptions for domestic financial resilience.

Keywords: bond spread, emerging Asian economies, exchange rate, US dollar funding conditions

JEL codes: F15, F31, F62, F65, G12, G15

I. INTRODUCTION

The difficulties emerging market economies have faced in borrowing internationally in their domestic currencies are well-documented and are collectively referred to as the "Original Sin" phenomenon, a term coined by Eichengreen, Hausmann, and Panizza (2005), and referred to in a number of studies (Reinhart, Rogoff, and Savastano 2003; Eichengreen and Hausmann 2005; Lane and Shambaugh 2010).

Over the past decade, a prolonged low interest rate environment in advanced economies—coupled with considerable foreign currency denominated debt in emerging market economies and increasingly interconnected financial markets globally—has triggered a line of research seeking to assess the impact of changes in global dollar funding conditions on global financial markets and their underlying transmission channels. For instance, Bruno and Shin (2015) find evidence of United States (US) monetary policy spillovers associated with cross-border banking capital flows and changes in the US dollar exchange rate. The findings are based on a model of cross-border banking proposed by Bruno and Shin (2014), in which regional banks borrow in US dollars from global banks in order to lend to local corporate borrowers. The global banks, in turn, finance their cross-border lending by tapping US dollar money market funds from financial centers. As another example, Rey (2013, 2016) suggests that monetary policy shocks from advanced economies could spill over into financial conditions in other places, even under a floating exchange rate regime.

These issues are particularly relevant for Asian economies since the region is rapidly integrating both regionally and globally.[1] Furthermore, many Asian economies have significant debt denominated in foreign currencies—of which the US dollar plays a dominant role (Park, Rosenkranz, and Tayag 2020). The focus of our paper therefore is: (i) to provide stylized facts about dollar funding conditions in selected Asian economies, and (ii) to empirically investigate the effect of the bilateral exchange rate against the US dollar on the financial conditions in the region.

Our results suggest that changes in the bilateral exchange rate against the US dollar affect the risk-taking behavior of foreign investors, highlighting the important role global dollar funding conditions play on domestic financial conditions. To this end, we identify two competing effects through which the exchange rate influences financial conditions in emerging markets: (i) the trade channel, which tends to loosen domestic financial conditions by improving external competitiveness; and (ii) the financial channel, which tends to tighten domestic financial conditions by worsening the economy's balance sheet. We then empirically assess the importance of these effects, whereby changes to bilateral exchange rates against the US dollar affect financial conditions largely through the financial channel, while movements in nominal effective exchange rates act via the trade channel. We find a significant role of the domestic exchange rate against the US dollar in influencing domestic financial conditions, whereby a bilateral depreciation against the US dollar significantly decreases sovereign bond spreads. While country-specific vector autoregressive model estimations are

[1] Asia's intraregional trade share in 2018 was strong, rising to 57.5%, up from an average of 56.3% from 2012 to 2017. The region also saw rising intraregional investment linkages (rising 2.8% from $262.7 billion in 2017) and substantial outward foreign direct investment (accounting for 49.4% of global foreign direct investment in 2018, its highest thus far). Cross-border banking activity in the region also saw a steady increase in 2018, with cross-border bank claims totaling $4.7 trillion and bank liabilities amounting to $2.5 trillion, both records. More details are in the *Asian Economic Integration Report* 2019/2020 (ADB 2019).

qualitatively in line with the results, we also identify cross-county heterogeneity with regard to the effects of the financial and trade channels of the exchange rate on domestic financial conditions.

The organization of the paper is as follows. In section II, we briefly review related literature. In section III, we highlight some facts about the current dollar funding situation in emerging Asia in order to lay motivations for our empirical work. In section IV, we implement an empirical exercise with a focus on emerging Asian economies (EAEs) using a dynamic panel analysis similar to Hofmann, Shim, and Shin (2017) as well as a vector autoregressive approach. Our results suggesting that an appreciation in the bilateral exchange rate against the US dollar indeed improves the domestic financial condition for EAEs, while we also find the presence of financial and trade channels of the exchange rate working in opposite directions. Finally, conclusions and some policy considerations are presented in section V.

II. REVIEW OF RELATED LITERATURE

The significant level of dollar credit and its fast growth in emerging market economies has recently been documented by McCauley, McGuire, and Sushko (2015). In their paper, the authors use the term "dollar mountain" to point to the stocks of dollar credit outside the US. Specifically, they note that dollar credit to non-US nonbank borrowers increased from $4.5 trillion to $10.5 trillion from the fourth quarter (Q4) 2006 to Q4 2016, with only a small dip after the global financial crisis. For emerging Asia, this number increased from around $0.2 trillion to $1.6 trillion during the same period and at an accelerating speed.[2]

Literature on the reason excessive dollar debt is ubiquitous among emerging market economies comprises two main strands. The first focuses on the incentives for governments to devalue their currency and reduce the real value of their debt when external debt is denominated in local currency. Foreign lenders form their expectations accordingly, and hence refrain from investing heavily in local currency debt (Calvo and Guidotti 1990, Calvo 1996, and Allen and Gale 2000). However, Caballero and Krisnamurthy (2003) propose a second strand in the literature, in which the limited financial development of these economies explains excessive dollar debt exposure. The authors illustrate how financial constraints affecting borrowing and lending conditions among domestic agents can lead agents to undervalue the insurance afforded by borrowing in a domestic currency rather than in dollars. The frictions arising from a lack of financial development prevent agents with excess insurance from selling their resources to those who need it, thereby prompting underinsurance. The ensuing excessive dollar debt among domestic agents is exacerbated by the limited foreign lending in domestic currency available to countries with limited financial development. In this way, finance sector development, rather than the moral hazard problem associated with sovereign debt, as described by Calvo and Guidotti (1990) and Calvo (1996), accounts for excessive dollar-denominated debt.

The link between dollar funding conditions and monetary policy spillovers is investigated by Bruno and Shin (2015). In their model, a decrease in the US policy rate decreases dollar funding costs, leading to looser financial conditions in other economies through cross-border bank-to-bank lending. Using a vector autoregression model, they demonstrate that a positive shock to the US federal funds target rate has a negative and significant impact on domestic bank leverage and cross-border banking

[2] Emerging Asia includes India, Indonesia, Malaysia, the People's Republic of China, the Philippines, and the Republic of Korea.

flows, also resulting in an appreciation of the US dollar. These results highlight that cross-border banking exposures act as an important channel through which monetary policy shocks in the US are transmitted globally, with notable influences on financial conditions in receiving economies.

Hui, Lo, and Chau (2018) present a theoretical framework to explain how the exchange rate and US risk-free interest rate play a fundamental role in determining US dollar-denominated sovereign bond prices of emerging market economies. The idea is simple and similar to the structural framework for pricing corporate bonds by Black and Scholes (1973) and Merton (1974). Specifically, the economy is treated as a firm with foreign debt being the "actual" liability, while domestic debt and fiat money act as equity. In this environment, the exchange rate (i.e., currency price) against the US dollar behaves analogously to the stock price of a firm. When there is instability in the economy, the currency devalues and effectively reduces the equity-to-liabilities ratio. Such a reduction deteriorates the economy's credit quality and widens sovereign bond spread. In short, this model provides a justification for positive linkages between currency return and sovereign bond spreads.

Hofmann, Shim, and Shin (2017) use a panel dataset of 20 emerging market economies to provide evidence of changes in investors' risk-taking behavior due to a local currency appreciation against the US dollar.[3] They find that an appreciation in the bilateral exchange rate against the US dollar increases foreign fund flows into sovereign bonds, suppresses yield spreads between bonds denominated in local currency and foreign currency, and lowers a country's credit risk premium.[4] Hofmann, Shim, and Shin (2017) posit a balance sheet approach toward understanding this risk-taking channel as an underlying mechanism that explains the impact of changes in a bilateral exchange rate against the US dollar on domestic financial conditions. Essentially, an appreciation of the local currency would improve a country's balance sheet capacity due to a decrease in the value of dollar-denominated liabilities relative to assets. This, in turn, would lead to a stronger balance sheet among borrowers as well as higher creditworthiness and an influx of credit. Ultimately, these favorable financial conditions can have expansionary effects on the overall economy, highlighting the presence of a financial channel of the exchange rate. On the other hand, a stronger dollar (i.e., a local currency depreciation) would work in the opposite direction and tighten financial conditions within the country, also having contractionary effects on the economy. This underlying mechanism is similar to the corporate bond pricing approach suggested by Hui, Lo, and Chau (2018). Avdjiev et al. (2018) also find evidence that a stronger dollar is linked to slower growth in dollar-denominated cross-border bank flows and lower real investment in emerging market economies, further reinforcing the contractionary real macroeconomic effects transmitted through the financial channel.

It is worth noting that the evidence documented in Hofmann, Shim, and Shin (2017) seems to suggest a working channel of the exchange rate that diverges from the traditional trade channel. As implied by the well-known Mundell–Fleming model (Mundell 1963, Fleming 1962), a currency appreciation hampers trade by making exports more expensive to foreign buyers, and thus negatively affects output through the trade channel. On the other hand, a currency depreciation promotes exports, yielding an expansionary impact on output. Hofmann, Shim, and Shin (2019) examine a local linear projection regression to estimate dynamic responses to exogenous shocks in the bilateral and the trade-weighted exchange rate, confirming earlier results that an appreciation of an emerging market economy's bilateral exchange rate is associated with loosening domestic financial conditions by lowering credit risk spreads.

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3 Sometimes, only subsets of this data are exploited across specifications, due to availability of data for new variables. See Hofmann, Shim, and Shin (2017) for details.

4 This credit risk premium is a pure measure of a country's credit risk (i.e., excluding currency risk) constructed by Du and Schreger (2016).

III. UNITED STATES DOLLAR FUNDING CONDITIONS IN EMERGING ASIAN ECONOMIES

The US dollar has traditionally played a vital role as the major funding currency of international debt. This is particularly relevant for Asia since the share of dollar-denominated debt securities in overall outstanding international debt securities for major EAEs, on average, stood above 77% as of Q2 2019.[5] Table 1 presents this share for selected EAEs from 2011 to 2019. For India, Indonesia, Malaysia, and the Philippines, this share remained at around 85%. The People's Republic of China (PRC) meanwhile experienced a remarkable increase from 56% to 79% over the same period. Furthermore, the Bank for International Settlements (2019) global liquidity indicators reveal that the total outstanding US dollar credit to emerging Asia and the Pacific economies reached 1.4 trillion by Q2 2019. This constitutes a fourfold increase on levels before the global financial crisis, and accounts for 37% of total dollar credit to all emerging market economies, up from 31% in Q4 2006.

Table 1: Share of Outstanding International Debt Securities Denominated in United States Dollars for Selected Emerging Asian Economies

(%)

Economy	2011	2012	2013	2014	2015	2016	2017	2018	2019[a]
India	89	89	88	87	88	89	83	82	84
Indonesia	96	97	97	95	92	84	83	82	82
Korea, Republic of	74	71	71	71	74	76	78	78	78
Malaysia	90	89	89	86	85	85	86	86	82
Philippines	85	87	87	88	89	90	91	90	88
PRC	56	40	39	44	60	70	73	76	79
Singapore	65	67	64	61	63	70	72	69	71
Thailand	67	67	73	75	74	72	70	71	66
Average	78	76	76	76	78	80	79	79	79

PRC = People's Republic of China.

[a] Data until Q2 2019.

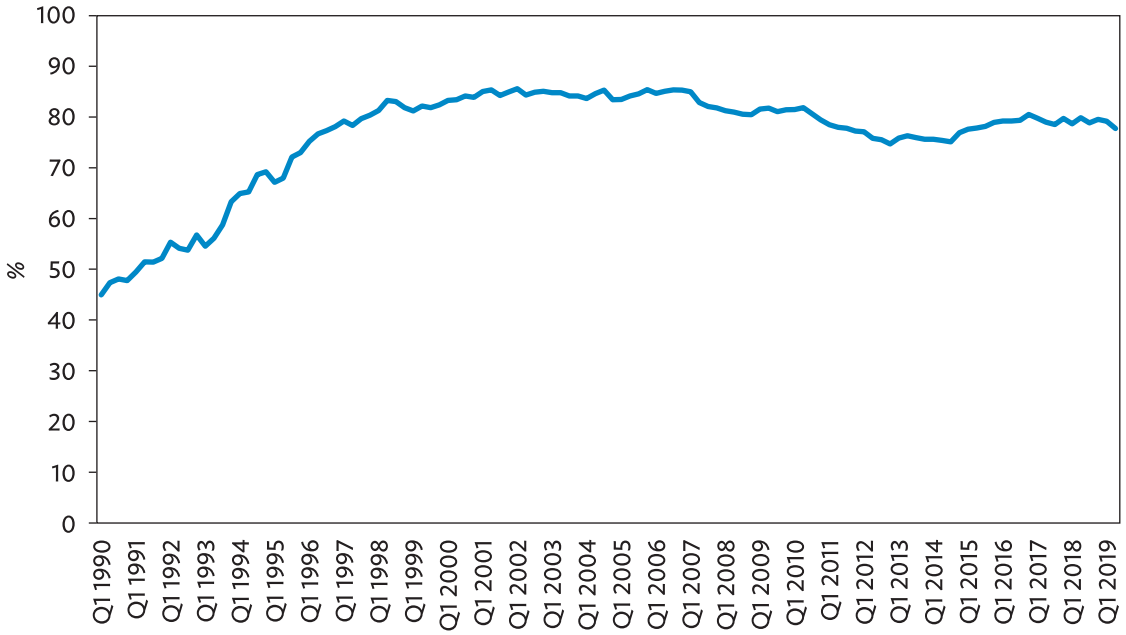
Sources: Bank for International Settlements. Debt Securities Statistics. https://www.bis.org/statistics/full_bis_debt_sec2_csv.zip (accessed 12 November 2019); authors' calculation.

A deeper examination of the US dollar-denominated international debt securities share over the past 20 years reveals an interesting pattern for EAEs (Figure 1). A steady increase in the average US dollar share is evident prior to the two major financial crises affecting the region over the past 2 decades—the Asian financial crisis (AFC) and the global financial crisis. In particular, the pick-up

[5] These include India, Indonesia, Malaysia, the PRC, the Philippines, the Republic of Korea, Singapore, and Thailand.

starts from Q1 1995 in the case of the AFC and from Q2 2008 in the global financial crisis. And while the rise in the US dollar share cannot be characterized as having causal impact on the financial crises, Figure 1 illustrates a correlation between the onset of the crises and the increase in the US dollar-denominated share of total international debt securities. Similarly, in recent years the proportion of outstanding US dollar-denominated international debt securities in total external debt has been mounting across selected EAEs (Figure 2).

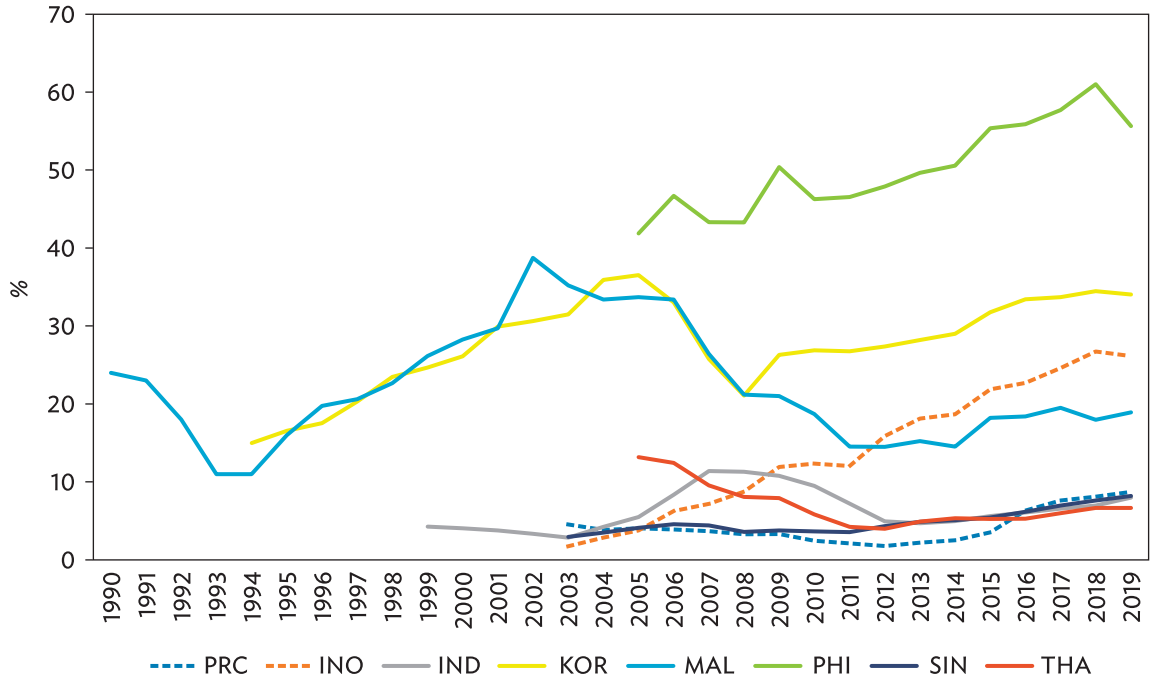
Figure 1: Share of Outstanding International Debt Securities Denominated in United States Dollars in Emerging Asia (Average)



Q = quarter.
Notes: This figure includes India, Indonesia, Malaysia, the People's Republic of China, the Philippines, the Republic of Korea, Singapore, and Thailand.

Sources: Bank for International Settlements. Debt Securities Statistics. https://www.bis.org/statistics/full_bis_debt_sec2_csv.zip (accessed 12 November 2019); authors' calculation.

Figure 2: United States Dollar-Denominated International Debt Securities as a Percentage of External Debt

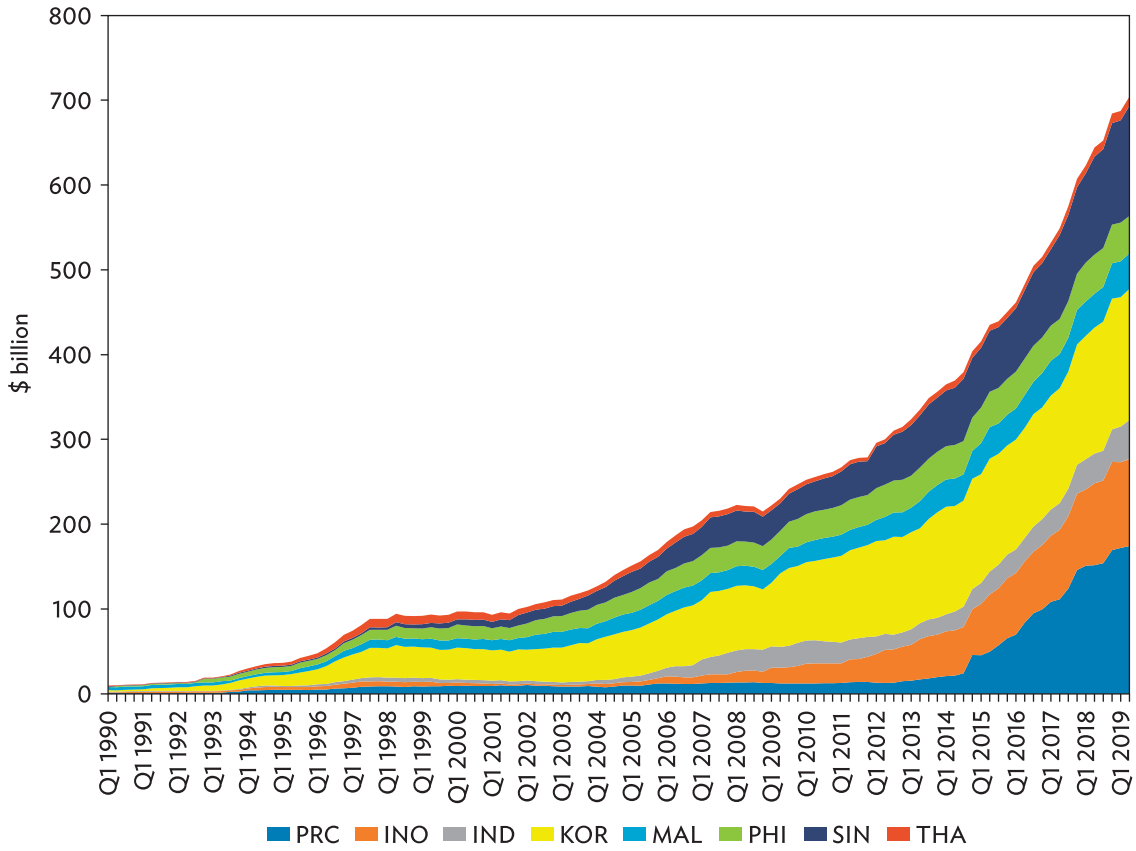


IND = India, INO = Indonesia, KOR = Republic of Korea, MAL = Malaysia, PHI = Philippines, PRC = People's Republic of China, SIN = Singapore, THA = Thailand.

Sources: Bank for International Settlements. Debt Securities Statistics. https://www.bis.org/statistics/full_bis_debt_sec2_csv.zip; CEIC (both accessed 12 November 2019); authors' calculation.

Slight increases in share may mask the substantial hikes in absolute terms. In fact, the total amount of US dollar-denominated securities of selected EAEs increased from $179 billion before the global financial crisis (Q1 2006) to $574 billion in Q2 2019, with accelerated speed during the past few years. Figure 3 shows the stacked sum of the dollar-denominated debt securities for eight EAEs from Q1 1990 to Q2 2019. According to this figure, the Republic of Korea has been the largest US dollar borrower among the eight EAEs over the past 2 decades. Though the PRC has traditionally played a small role in total Asian dollar liabilities, its share has surged in recent years, overtaking the Republic of Korea as the largest US dollar borrower, with $174 billion in outstanding US dollar-denominated international debt securities as of Q2 2019. The similar upward trend is also evident for other economies, however at a relatively slower speed than that of the PRC.

Figure 3: Aggregate Level of United States Dollar Debt Securities among Selected Emerging Asian Economies



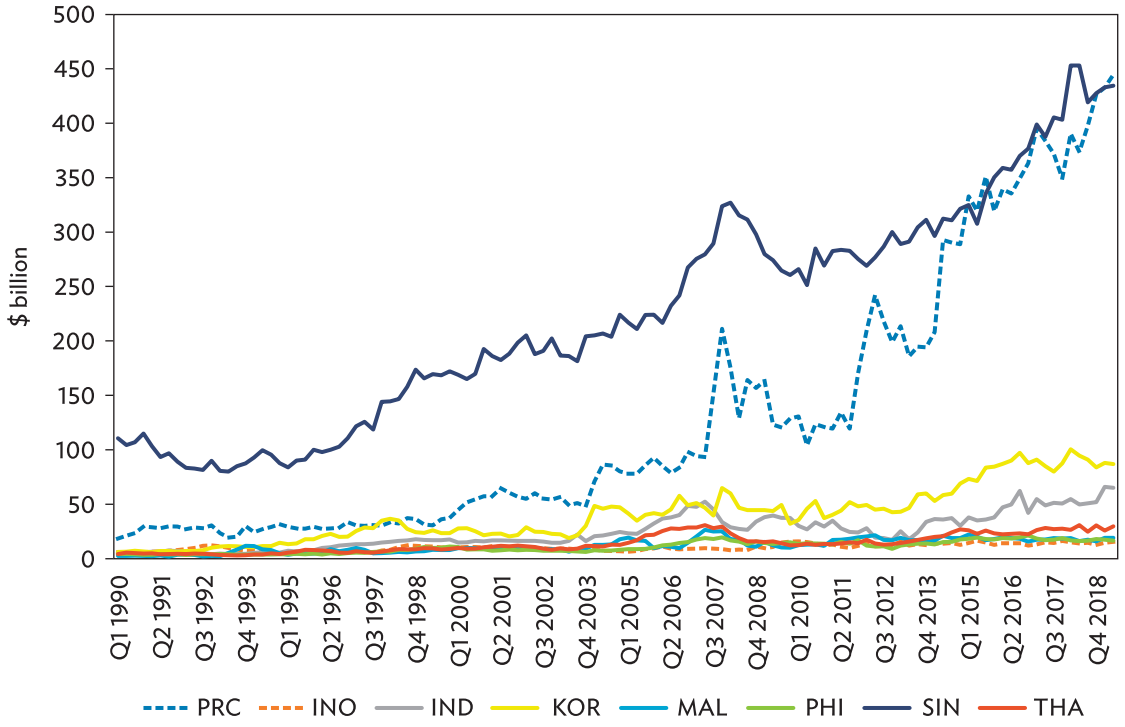
IND = India, INO = Indonesia, KOR = Republic of Korea, MAL = Malaysia, PHI = Philippines, PRC = People's Republic of China, Q = quarter, SIN = Singapore, THA = Thailand.

Sources: Bank for International Settlements. Debt Securities Statistics. https://www.bis.org/statistics/full_bis_debt_sec2_csv.zip (accessed 12 November 2019); authors' calculation.

The US dollar-denominated loans and deposits of selected EAEs have likewise seen a steady increase in recent years, most prominently for the PRC and Singapore, further illustrating the central role played by the US dollar in Asian financial systems (Figure 4).[6]

[6] This instrument category also includes repurchase transactions (repos), financial leases, promissory notes, nonnegotiable debt securities (e.g., nonnegotiable credit default swaps), endorsement liabilities arising from bills rediscounted abroad, and subordinated loans (including subordinated nonnegotiable debt securities) and reporting banks' holdings of notes and coins that are in circulation.

Figure 4: United States Dollar-Denominated Loans and Deposits of Selected Emerging Asian Economies



IND = India, INO = Indonesia, KOR = Republic of Korea, MAL = Malaysia, PHI = Philippines, PRC = People's Republic of China, Q = quarter, SIN = Singapore, THA = Thailand, US = United States.

Notes: The figures correspond to the US dollar-denominated outstanding amounts of loans and deposits of selected emerging Asian economies on the liabilities side. This reflects all claims on the reporting bank that reflect evidence of deposit and borrowing (loans) from others, including borrowing from the bank's own affiliates, head office or controlling parent institution, and working capital received from the head office or controlling parent institution.

Source: Bank for International Settlements. Locational Banking Statistics. https://www.bis.org/statistics/full_bis_lbs_diss_csv.zip (accessed 12 November 2019).

Overall, the developments documented above underpin the prominent role the US dollar and its funding conditions play in Asian financial markets, thereby highlighting the emergence of the bilateral exchange rate against the US dollar as a potential determinant of financial conditions in EAEs. A high concentration of foreign borrowing in a single currency leaves the region's financial systems open to increased vulnerability as sudden changes in global liquidity conditions or sudden capital flow reversals could have significant impacts upon domestic financial or macroeconomic conditions. This is moreover compounded by the increased financial vulnerability accompanying greater financial integration.

As documented in ADB (2017), growing financial interconnectedness, increased cross-border exposure of banks, and the emergence of a global financial cycle characterized by comovements in credit, asset prices, and financial conditions across economies are among the factors contributing to increased financial volatility in the region. Such findings motivate an empirical investigation identifying the direction and the magnitude of the impact that changes in the US dollar bilateral exchange rate could exert on domestic financial conditions in emerging Asia.

IV. HOW BILATERAL UNITED STATES DOLLAR EXCHANGE RATES AFFECT FINANCIAL CONDITIONS

A. Influence of United States Dollar Funding Conditions on Asian Financial Markets

In order to identify how the bilateral exchange rate against the US dollar affects local financial conditions, we employ a predictive dynamic panel model where the dependent variable represents domestic financial conditions, while the covariates include the exchange rates of interest and other control variables. The financial conditions are measured by the local currency (LC) spread, which is defined as the difference between the 5-year sovereign LC bond yield and 5-year US Treasury yield, following the definition of Hofmann, Shim, and Shin (2017). An increase in the LC spread indicates a tightening of local financial conditions relative to the US financial market. On the other hand, a decrease of this spread implies a loosening of domestic financial conditions relative to those in the US. The exchange rates being employed are the bilateral exchange rate against the US dollar and the nominal effective (trade-weighted) exchange rate of the local currency. As suggested by the related literature (e.g., Hofmann, Shim, and Shin 2017), these two exchange rates might work through different channels to influence the local financial conditions, that is, through the "financial channel" or the "trade channel." In the context of this empirical analysis, we approximate the impact of the bilateral exchange rate against the US dollar as the "financial channel" and the impact of the nominal effective exchange rate as the "trade channel." These exchange rates are defined as indirect quotation, where increases indicate appreciations of the local currency.

Monthly data is collected for eight EAEs, including India, Indonesia, Malaysia, the Philippines, the PRC, the Republic of Korea, Singapore, and Thailand from January 2006 to August 2020 (N = 8, T = 164).[7] The empirical base specifications are as follows:

$$\Delta y_{i,t} = \delta \Delta y_{i,t-1} + \alpha \Delta \boldsymbol{BER_{i,t-1}} + \beta \Delta CPI_{i,t-1} + \gamma \Delta IP_{i,t-1} + \theta \Delta r_{i,t-1} + \eta_1 \Delta VIX_{t-1} + \eta_2 \Delta CPIUS_{t-1} + \eta_3 \Delta IPUS_{t-1} + \eta_4 \Delta MMUS_{t-1} + \mu_i + \varepsilon_{i,t} \quad (1)$$

$$\Delta y_{i,t} = \delta \Delta y_{i,t-1} + \alpha \Delta \boldsymbol{NEER_{i,t-1}} + \beta \Delta CPI_{i,t-1} + \gamma \Delta IP_{i,t-1} + \theta \Delta r_{i,t-1} + \eta_1 \Delta VIX_{t-1} + \eta_2 \Delta CPIUS_{t-1} + \eta_3 \Delta IPUS_{t-1} + \eta_4 \Delta MMUS_{t-1} + \mu_i + \varepsilon_{i,t} \quad (2)$$

In the above specifications, $\Delta y_{i,t}$ denotes the month-on-month change in LC spread, ΔBER is the monthly logarithmic change of the bilateral exchange rate against the US dollar, $\Delta NEER$ is the monthly logarithmic change of the nominal effective exchange rate, ΔCPI is the monthly change of year-on-year inflation rate, ΔIP is likewise the monthly change of year-on-year growth in industrial production index, Δr is the monthly change of lending rate where the lending rate is defined as the average short-term (1-year) lending rate of the commercial banks in the economies, ΔVIX is the monthly logarithmic change in the volatility index, and $\Delta CPIUS$, $\Delta IPUS$, $\Delta MMUS$ are common shocks respectively defined as the monthly change in the year-on-year inflation rate, the year-on-year growth in industrial production index, and the 3-month money market rate in the US. It is also important to note that all covariates are lagged by one period. In this way, we seek to make these covariates as predetermined as possible, thereby eliminating large potential endogeneity caused by contemporaneous correlation between the dependent and the independent variables. Furthermore,

[7] Appendix 3 details all the data sources.

fixed effects are also specified in the equations in order to control for country-specific heterogeneity across the economies.

In the base specifications (1) and (2), ΔBER and $\Delta NEER$ enter the equations separately, owing to our initial interest in examining the effect of these two exchange rates on local financial conditions independently. However, ΔBER and $\Delta NEER$ might work through different (or opposing) channels, that is, through the "financial channel" or the "trade channel" while affecting the financial conditions in emerging market economies.[8] Consequently, omitting one of the two in each regression equation could lead to omitted variable bias. In evaluating how these two channels work together, we focus on the "horse-race" specifications (3), (4), and (5), where both exchange rates are included in each regression equation.

$$\Delta y_{i,t} = \delta \Delta y_{i,t-1} + \alpha_1 \Delta \boldsymbol{BER_{i,t-1}} + \alpha_2 \Delta \boldsymbol{NEER_{i,t-1}} + \beta \Delta CPI_{i,t-1} + \gamma \Delta IP_{i,t-1} + \theta \Delta r_{i,t-1} + \eta_1 \Delta VIX_{t-1} + \eta_2 \Delta CPIUS_{t-1} + \eta_3 \Delta IPUS_{t-1} + \eta_4 \Delta MMUS_{t-1} + \mu_i + \varepsilon_{i,t} \quad (3)$$

$$\Delta y_{i,t} = \delta \Delta y_{i,t-1} + \alpha_1 \Delta \boldsymbol{BER_{i,t-1}} + \alpha_2 \Delta \boldsymbol{NEERorth_{i,t-1}} + \beta \Delta CPI_{i,t-1} + \gamma \Delta IP_{i,t-1} + \theta \Delta r_{i,t-1} + \eta_1 \Delta VIX_{t-1} + \eta_2 \Delta CPIUS_{t-1} + \eta_3 \Delta IPUS_{t-1} + \eta_4 \Delta MMUS_{t-1} + \mu_i + \varepsilon_{i,t} \quad (4)$$

$$\Delta y_{i,t} = \delta \Delta y_{i,t-1} + \alpha_1 \Delta \boldsymbol{BERorth_{i,t-1}} + \alpha_2 \Delta \boldsymbol{NEER_{i,t-1}} + \beta \Delta CPI_{i,t-1} + \gamma \Delta IP_{i,t-1} + \theta \Delta r_{i,t-1} + \eta_1 \Delta VIX_{t-1} + \eta_2 \Delta CPIUS_{t-1} + \eta_3 \Delta IPUS_{t-1} + \eta_4 \Delta MMUS_{t-1} + \mu_i + \varepsilon_{i,t} \quad (5)$$

In specification (3), both ΔBER and $\Delta NEER$ are included in the equation to disentangle the impacts of the two exchange rates. In specification (4), we include ΔBER and $\Delta NEERorth$, where the latter is the residual from the predictive regression of $\Delta NEER$ on ΔBER. In other words, it is the component of $\Delta NEER$ that is orthogonal to ΔBER. We use this component to approximate the "pure" trade channel. Likewise, in specification (5), we include $\Delta NEER$ and $\Delta BERorth$ where $\Delta BERorth$ is the component of ΔBER that is orthogonal to $\Delta NEER$. We use this component to approximate the "pure" financial channel.[9]

For dynamic panel models with a small N and large T, simple estimation methods such as fixed effects estimations are recommended. This is due to the fact that the well-known Nickell (1981) bias in dynamic panel models diminishes as T grows larger. However, since the number of countries in the dataset is relatively small, the estimation could lead to large standard errors and hence, less reliable inferences. In order to deal with this problem, we first implement the bias-corrected least squares dummy variable (LSDV) estimator with a bootstrapped variance–covariance matrix, using 500 repetitions and the Anderson–Hsiao (1982) estimator in the first stage.[10] Whereas the coefficient estimates do not change much, the inference based on a bootstrapped variance–covariance matrix turns out to be more reliable. Second, we adopt the recommended Anderson–Hsiao (1982) estimator to solve the endogeneity problem, while alleviating the risk of model misspecifications. With a small N, generalized methods of moments estimators exploiting too many moment conditions are biased of order 1/N and are therefore not recommended (Bun and Kiviet 2006).

[8] The overall correlation between ΔBER and $\Delta NEER$ is about 0.8. However, the within-correlation in each economy varies from 0.3 to 0.9.

[9] We obtain $\Delta NEERorth$ by regressing $\Delta NEER$ on ΔBER separately for each economy. A similar procedure is applied in obtaining $\Delta BERorth$. Note that implementing this for the whole set of economies would not give substantially different results from specification (3), due to the Frisch–Waugh–Lovell theorem.

[10] Literature on the bias-corrected LSDV method can be found in Bun and Kiviet (2003) and Bruno (2005).

Table 2 reports the fixed effect regression results for all five specifications. The results show that when examining the exchange rates independently in specifications (1) and (2), the coefficient of ΔBER is negative, while the coefficient of $\Delta NEER$ is almost zero. When controlling for both channels, the effects now are disentangled into two clearly opposite directions. Specifically, for ΔBER, the coefficient becomes more negative, increasing in absolute value from 0.017 to 0.037. Furthermore, the t-statistic increases from 1.24 to 2.56 in absolute value, signaling a more significant impact when controlling for the trade channel. The effect of ΔBER even becomes significant in specifications (3) and (5). Similar changes are also observed for $\Delta NEER$. The coefficient of the effective exchange

Table 2: Fixed Effects Estimation Results

	(1)	(2)	(3)	(4)	(5)
$\Delta y_{i,t-1}$	0.129**	0.132**	0.138**	0.135**	0.141**
	(3.05)	(2.48)	(2.92)	(2.96)	(3.04)
$\Delta BER_{i,t-1}$	−0.0174		−0.0370**	−0.0181	
	(−1.24)		(−2.56)	(−1.29)	
$\Delta NEER_{i,t-1}$		−0.00454	0.0284		−0.00594
		(−0.28)	(1.33)		(−0.37)
$\Delta NEERorth_{i,t-1}$				0.0229	
				(1.09)	
$\Delta BERorth_{i,t-1}$					−0.0514**
					(−2.63)
$\Delta CPI_{i,t-1}$	0.000344**	0.000364**	0.000357**	0.000351**	0.000347**
	(2.88)	(2.97)	(3.01)	(2.95)	(2.94)
$\Delta IP_{i,t-1}$	0.00204	0.00187	0.00213	0.00210	0.00218
	(0.70)	(0.65)	(0.74)	(0.73)	(0.74)
$\Delta r_{i,t-1}$	−0.000397	−0.000385	−0.000425	−0.000426	−0.000479
	(−0.91)	(−0.90)	(−0.97)	(−1.01)	(−1.11)
ΔVIX_{t-1}	−0.00000606	0.00000988	−0.0000141	−0.0000119	−0.0000159
	(−0.23)	(0.43)	(−0.64)	(−0.53)	(−0.73)
$\Delta CPIUS_{t-1}$	0.000450	0.000345	0.000562	0.000541	0.000597
	(1.50)	(0.98)	(1.54)	(1.46)	(1.63)
$\Delta IPUS_{t-1}$	0.00628	0.00512	0.00639	0.00624	0.00654
	(0.60)	(0.48)	(0.61)	(0.59)	(0.63)
$\Delta MMUS_{t-1}$	−0.00173**	−0.00172**	−0.00188**	−0.00183**	−0.00193**
	(−2.51)	(−2.56)	(−2.71)	(−2.67)	(−2.73)
$N \times T$	1,387	1,387	1,387	1,387	1,387

ΔBER = monthly log change of the bilateral exchange rate against the US dollar (an increase indicates local currency appreciation), ΔCPI = monthly change of the year-on-year inflation rate, $\Delta CPIUS$ = monthly change of the year-on-year inflation rate of the US, ΔIP = monthly change of the year-on-year growth in industrial production index; $\Delta IPUS$ = monthly change of the year-on-year growth in industrial production index of the US, $\Delta MMUS$ = 3-month money market rate in the US, $\Delta NEER$ = monthly log change of the nominal effective exchange rate (an increase indicates local currency appreciation), $\Delta r =$ monthly change of the lending rate, ΔVIX = monthly log change of the volatility index, US = United States.

Notes: Data refers to January 2006 to August 2020. See Appendix 3 for data sources. t-statistics are reported in brackets, calculated based on cluster-robust standard errors. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Sources: Authors' calculations using data from the Bank for International Settlements (BIS). Effective exchange rate indices. https://www.bis.org/statistics/full_bis_eer_csv.zip; BIS. Consumer prices. https://www.bis.org/statistics/full_webstats_long_cpi_dataflow_csv.zip; Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H15; Bloomberg; Haver Analytics; International Monetary Fund. International Financial Statistics. https://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B&sId=1390030341854; and World Bank. Global Economic Monitor. https://datacatalog.worldbank.org/dataset/global-economic-monitor (all accessed October 2019).

rate becomes positive and the *t*-statistic rises sharply from 0.28 to 1.33 in absolute value. These observations suggest the risk of omitted variable bias embedded in specifications (1) and (2). Thus, we choose specifications (3), (4), and (5) as the main point of interpretation of our results. Although few of the coefficients in the fixed effect estimation results are significant, they provide a good indication of the direction the two channels of exchange rate take and so provide the motivation for additional and more robust estimation methods.

The lack of significance in the fixed effect estimation could be due to small sample issues (N = 8). We respond to this by deploying a more credible bias-corrected LSDV estimation method with a bootstrapped variance–covariance matrix based on 500 repetitions (Table 3).

The results in Table 3 show that, individually, ΔBER has significant impact on the LC spread while $\Delta NEER$ does not. When controlling for both channels, the measures for ΔBER and $\Delta NEER$ become strongly significant, with opposite signs. In particular, the results in specification (3) indicate that an appreciation of the bilateral exchange rate by 1% decreases the LC spread by 3.7 basis points, while an appreciation of the nominal effective exchange rate by 1% increases the LC spread by 2.8 basis points. These impacts are significant at the 1% level for the ΔBER, and at the 5% level for the $NEER$. The specifications in (4) and (5) shed further light on these interpretations since the "pure" trade channel ($\Delta NEERorth$) has a positive, weakly significant impact on the LC spread, the "pure" financial channel ($\Delta BERorth$) has a strongly negative and significant impact on the LC spread. The coefficients of ΔBER and $\Delta NEER$ in specifications (4) and (5) are not as strongly significant as in specification (3), as each exchange rate still reflects in part the other, that is, they still contain the "nonorthogonal" component of the other exchange rate. These results provide strong evidence that an appreciation of the bilateral exchange rate against the US dollar is associated with loosening of domestic financial market conditions, and hence generally more accommodating financial conditions in EAEs.

To further support our empirical analysis, we also apply the consistent instrumental Anderson–Hsiao (1982) estimator for the above specifications, explicitly addressing the endogeneity issue through the inclusion of the lagged dependent covariate and fixed effects. These results are reported in Table 4. The results based on the instrumental variable (Anderson–Hsiao) estimator attribute a stronger effect to the △NEER compared to the △BER, in comparison to the fixed effects and bias-corrected LSDV estimations. In particular, the estimation suggests that, on average, a 1% bilateral depreciation against the US dollar decreases sovereign bond spreads by 6.0 basis points, while a 1% currency depreciation in nominal effective exchange rate terms tends to increase sovereign bond spreads by approximately 7.8 basis points (specification 3). When controlling for both channels in the horse-race specifications, the results confirm the strong negative and significant impact of the △BER and strong positive and significant impact of the △NEER on the LC spread. These estimation results constitute further support to our empirical findings that an appreciation of the local currency against the US dollar induces a loosening of local financial conditions, and that the financial channel and the trade channel of the exchange rate work in opposite directions in their influence on domestic financial conditions.

As robustness checks, we perform the same exercise using a bigger dataset of 15 global emerging market economies. The two exercises deliver similar results, both qualitatively and quantitatively. These results are reported in Appendix 1. As additional robustness checks, we also extend the analysis to include Du–Schreger spreads (Du and Schreger 2016; Du, Im, and Schreger 2018) and foreign currency spreads, in addition to LC spreads, as was also done by Hofmann, Shim, and Shin (2017 and 2019). Results are in Appendix 2 and are largely in line with the ones for LC spread, pointing toward two opposing effects of the trade and financial channel of the exchange rate.

Table 3: Bias-Corrected Least Squares Dummy Variable Estimation Results

	(1)	(2)	(3)	(4)	(5)
$\Delta y_{i,t-1}$	0.137***	0.140***	0.146***	0.143***	0.149***
	(5.23)	(5.34)	(5.57)	(5.45)	(5.66)
$\Delta BER_{i,t-1}$	−0.0176**		−0.0370***	−0.0181**	
	(−2.45)		(−3.25)	(−2.51)	
$\Delta NEER_{i,t-1}$		−0.00472	0.0281**		−0.00610
		(−0.62)	(2.35)		(−0.81)
$\Delta NEERorth_{i,t-1}$				0.0227*	
				(1.78)	
$\Delta BERorth_{i,t-1}$					−0.0514***
					(−4.33)
$\Delta CPI_{i,t-1}$	0.000343*	0.000364*	0.000356*	0.000350*	0.000346*
	(1.85)	(1.94)	(1.92)	(1.88)	(1.87)
$\Delta IP_{i,t-1}$	0.00202	0.00185	0.00212	0.00208	0.00217
	(1.22)	(1.11)	(1.28)	(1.26)	(1.31)
$\Delta r_{i,t-1}$	−0.000405	−0.000392	−0.000431	−0.000433	−0.000486
	(−0.77)	(−0.74)	(−0.83)	(−0.83)	(−0.94)
ΔVIX_{t-1}	−0.00000584	0.0000101	−0.0000140	−0.0000118	−0.0000157
	(−0.23)	(0.42)	(−0.54)	(−0.45)	(−0.63)
$\Delta CPIUS_{t-1}$	0.000446*	0.000340	0.000561**	0.000540**	0.000596**
	(1.79)	(1.40)	(2.23)	(2.13)	(2.40)
$\Delta IPUS_{t-1}$	0.00597	0.00476	0.00601	0.00588	0.00612
	(0.68)	(0.54)	(0.68)	(0.67)	(0.70)
$\Delta MMUS_{t-1}$	−0.00172**	−0.00170**	−0.00187**	−0.00182**	−0.00192**
	(−2.04)	(−2.02)	(−2.22)	(−2.16)	(−2.30)
$N \times T$	1,382	1,382	1,382	1,382	1,382

ΔBER = monthly log change of the bilateral exchange rate against the US dollar (an increase indicates local currency appreciation), ΔCPI = monthly change of year-on-year inflation rate, $\Delta CPIUS$ = monthly change in the year-on-year inflation rate of the US, ΔIP = monthly change of year-on-year growth in industrial production index, $\Delta IPUS$ = year-on-year growth in industrial production index of the US, $\Delta MMUS$ = 3-month money market rate in the US, $\Delta NEER$ = monthly log change of the nominal effective exchange rate (an increase indicates local currency appreciation), $\Delta r =$ monthly change of lending rate, ΔVIX = monthly log change in the volatility index, US = United States.

Notes: Data refers to January 2006 to August 2020. See Appendix 3 for data sources. *t*-statistics are reported in brackets, calculated based on bootstrapped standard errors. *, **, and *** indicates significance levels of 10%, 5%, and 1%, respectively.

Sources: Authors' calculations using data from the Bank for International Settlements (BIS). Effective exchange rate indices. https://www.bis.org/statistics/full_bis_eer_csv.zip; BIS. Consumer prices. https://www.bis.org/statistics/full_webstats_long_cpi_dataflow_csv.zip; Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H15; Bloomberg; Haver Analytics; International Monetary Fund. International Financial Statistics. https://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B&sId=1390030341854; and World Bank. Global Economic Monitor. https://datacatalog.worldbank.org/dataset/global-economic-monitor (all accessed October 2019).

Table 4: Instrumental Variable (Anderson–Hsiao) Estimation Results

	(1)	(2)	(3)	(4)	(5)
$\Delta y_{i,t-1}$	0.418**	0.432**	0.425**	0.424**	0.418**
	(2.31)	(2.33)	(2.35)	(2.34)	(2.37)
$\Delta BER_{i,t-1}$	−0.00481		−0.0597**	−0.00672	
	(−0.33)		(−2.52)	(−0.46)	
$\Delta NEER_{i,t-1}$		0.0270*	0.0782***		0.0212
		(1.86)	(3.04)		(1.45)
$\Delta NEERorth_{i,t-1}$				0.0669***	
				(2.77)	
$\Delta BERorth_{i,t-1}$					−0.0800***
					(−3.00)
$\Delta CPI_{i,t-1}$	−0.000192	−0.000187	−0.000136	−0.000155	−0.000125
	(−0.97)	(−0.98)	(−0.69)	(−0.79)	(−0.64)
$\Delta IP_{i,t-1}$	0.00277*	0.00249	0.00275*	0.00268*	0.00272*
	(1.76)	(1.64)	(1.78)	(1.74)	(1.79)
$\Delta r_{i,t-1}$	−0.00170	−0.00174	−0.00180	−0.00179	−0.00183
	(−1.09)	(−1.10)	(−1.16)	(−1.15)	(−1.19)
ΔVIX_{t-1}	−0.000127**	−0.000108**	−0.000120**	−0.000121**	−0.000116**
	(−2.36)	(−2.13)	(−2.27)	(−2.29)	(−2.27)
$\Delta CPIUS_{t-1}$	0.00102**	0.00102**	0.000906**	0.000938**	0.000890**
	(2.32)	(2.40)	(2.18)	(2.23)	(2.16)
$\Delta IPUS_{t-1}$	0.00707	0.00480	0.00644	0.00678	0.00667
	(0.63)	(0.43)	(0.58)	(0.61)	(0.61)
$\Delta MMUS_{t-1}$	−0.00164	−0.00149	−0.000731	−0.000899	−0.000507
	(−1.05)	(−0.92)	(−0.47)	(−0.59)	(−0.33)
$N \times T$	1,379	1,379	1,379	1,379	1,379

ΔBER = monthly log change of the bilateral exchange rate against the US dollar (an increase indicates local currency appreciation), ΔCPI = monthly change of the year-on-year inflation rate, $\Delta CPIUS$ = monthly change of the year-on-year inflation rate of the US, ΔIP = monthly change of the year-on-year growth in industrial production index, $\Delta IPUS$ = monthly change of the year-on-year growth in industrial production index of the US, $\Delta MMUS$ = 3-month money market rate in the US, $\Delta NEER$ = monthly log change of the nominal effective exchange rate (an increase indicates local currency appreciation), $\Delta r =$ monthly change of the lending rate, ΔVIX = monthly log change of the volatility index, US = United States.

Notes: Data refers to January 2006 to August 2020. See Appendix 3 for data sources. *t*-statistics are reported in brackets, calculated based on cluster-robust standard errors. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

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B. Endogenizing the Exchange Rates

The results discussed above are based on single equation estimations to explain how changes in exchange rates affect LC sovereign bond spreads. Although the results in Table 4 attempted to resolve potential endogeneity, the problem is only dealt with implicitly by exploiting an instrumental variables approach. Here, we exploit a full feedback of all the domestic variables in model (3) by endogenizing them in a vector autoregression setup, while keeping the external variables exogenous. The approach also provides a solution to orthogonality issues between the monthly log change of the bilateral exchange rate against the US dollar and the monthly log change of the nominal effective exchange rate found in the single equation estimation approach. The vector autoregression with exogenous variables (VAR-X) is specified according to the logic of equation (3):

$$Y_t = A(L)Y_t + BX_t + Cu_t \tag{6}$$

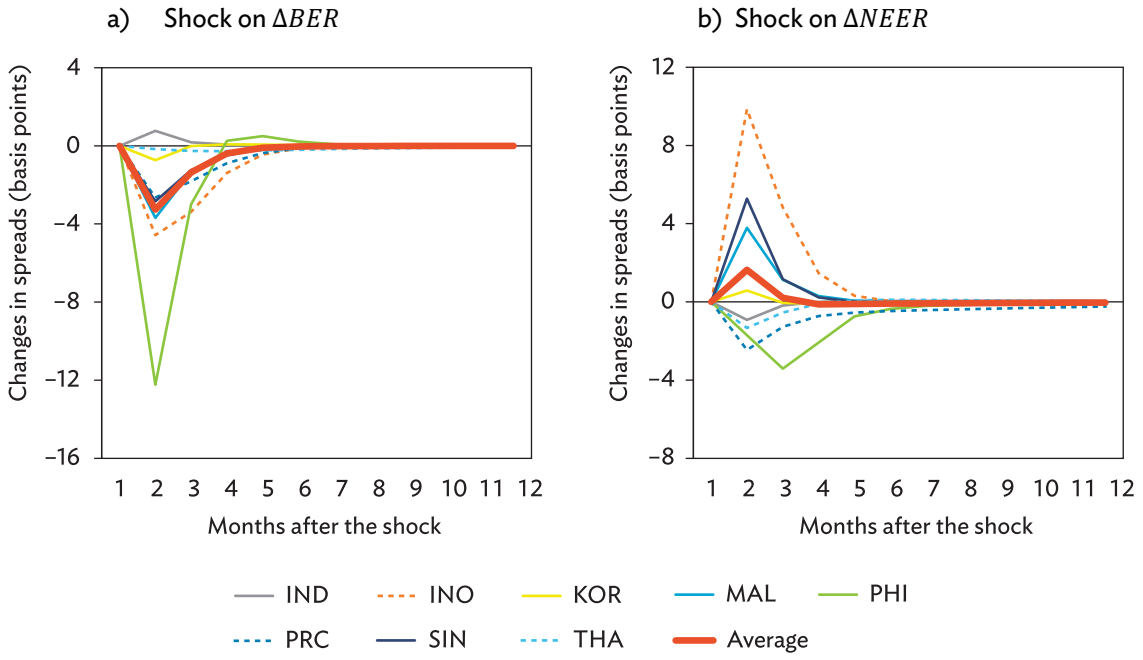
Y_t is a vector of domestic endogenous variables that include the change month on month in the LC spread, the change month on month in the bilateral exchange rate against the US dollar, the change month on month in the nominal effective exchange rate, consumer price inflation year on year, growth year on year in industrial production, and changes month on month in the domestic lending rate. X_t is a vector of exogenous external indicators as in equation (3), which are assumed to be independent to those in Y_t, and u_t is a vector of six residuals that represent relevant shocks to Y_t.

Given our sufficiently long date range for each of the eight EAEs, we estimate the VAR-X for each economy individually and avoid estimating a panel VAR to get a sense of the cross-country variability in the effect of an exchange rate shock. For each economy, the impulse responses to shocks that alter the exchange rates are identified based on Cholesky decomposition, which happens to be insensitive to the ordering of the variables. To enable comparability with the results in the previous part of this section, we grouped the impulse responses for all the eight economies and use their mean to compute for the average group effect of the shocks.

On average, the VAR-X results confirm the findings of single equation estimation (Figures 5a and 5b). An appreciation of the local currency against the US dollar induces a loosening of local financial conditions and that the financial channel and the trade channel of the exchange rate work in opposite directions in their influence on domestic financial conditions. However, there is heterogeneity in the individual country impulse responses, particularly in the impact of the shock that moves the nominal effective exchange rate.

On average, an exogenous shock that depreciates the local currency in bilateral exchange rate terms by 1% tends to loosen financial conditions by narrowing sovereign bond spreads by 3.3 basis points in a month after the shock. The impact stabilized after 6 months and the effect would amount to about a 5.2 basis point reduction in LC spread after a year. The impact of the bilateral exchange rate shock on LC spread is largest in the Philippines and smallest and insignificant in India. By contrast, an exogenous shock that depreciates the local currency in nominal effective exchange rate terms by 1% is followed by a spread widened by 1.7 basis points post impact, indicating a tightening of domestic financial conditions. The impact is much smaller but lasts longer than that of bilateral exchange rate. The impact begins to stabilize after 3 quarters, bringing the LC spread to increase by 1.2 basis points after a year.

Figure 5: Shock on Exchange Rates: Local Currency Spread Response



ΔBER = monthly log change of the bilateral exchange rate against the US dollar (an increase indicates local currency appreciation), $\Delta NEER$ = monthly log change of the nominal effective exchange rate, IND = India, INO = Indonesia, KOR = Republic of Korea, MAL = Malaysia, PHI = Philippines, PRC = People's Republic of China, SIN = Singapore, THA = Thailand, US = United States.

Sources: Authors' calculations using data from the Bank for International Settlements (BIS). Effective exchange rate indices. https://www.bis.org/statistics/full_bis_eer_csv.zip; BIS. Consumer prices. https://www.bis.org/statistics/full_webstats_long_cpi_dataflow_csv.zip; Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H15; Bloomberg; Haver Analytics; International Monetary Fund. International Financial Statistics. https://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B&sId=1390030341854; and World Bank. Global Economic Monitor. https://datacatalog.worldbank.org/dataset/global-economic-monitor (all accessed October 2019).

The nominal effective exchange rate impact is also more heterogenous across economies, with half reporting dominance of the trade channel and the other half reporting dominance of the financial channel. Trade channel dominance is seen primarily in Indonesia, Malaysia, and Singapore, while the dominance of the financial channel is seen mainly in the Philippines, the PRC, and Thailand. Effects on LC spreads following a shock to the bilateral exchange rate tend to be more uniform across economies, with only India found to have an effect that is nonnegative. On average, however, results align with the single equation estimation. Vector autoregression analysis also highlights that an exogenous increase in sovereign bond spreads tightens domestic lending conditions by increasing lending rates.

V. CONCLUSION AND POLICY CONSIDERATIONS

Building upon existing literature and accounting for emerging economies' heavy reliance on US dollar funding, we examine the impact of changes in the bilateral exchange rate against the US dollar on local financial conditions for eight Asian economies and check for a feedback effect from sovereign bond spreads. Overall, the empirical analysis shows that an appreciation in the bilateral exchange rate against the US dollar narrows LC spreads, which is generally associated with loosening local financial conditions. Furthermore, the results suggest that the exchange rates work through two different channels, the *financial channel* and the *trade channel*, and concurrently exert opposite impacts on domestic financial conditions. Though appreciation of the bilateral exchange rate against the US dollar improves an economy's balance sheet capacity and attracts an influx of credit, an appreciation in the nominal effective exchange rate reduces the economy's competitiveness and causes damage to the economy. While results vary quantitatively across empirical specifications, we find that the evidence on the *trade channel* of the exchange rate is not as strong as the evidence on the *financial channel*. These results are qualitatively aligned with earlier findings of Hofmann, Shim, and Shin (2017).

A key implication of the empirical results is that the reliance on US dollar funding is a nontrivial matter for EAEs. As documented in section III, the outstanding amount and the increasing trend of international debt denominated in US dollars are considerable for the region. Our empirical exercise finds a significant impact of the bilateral exchange rate against the US dollar on local financial conditions in selected EAEs. Specifically, the results highlight that bilateral exchange could act as a transmission channel for global dollar funding conditions, which is particularly relevant for economies that are heavily reliant on US dollar funding. In addition, the positive relationship between the bilateral US dollar exchange rate and local financial conditions suggests the existence of a self-reinforcing feedback loop that could amplify the transmission of global financial conditions and any associated volatilities. The heterogeneities identified in the country-specific analysis further highlight the need to tailor domestic policy prescriptions for financial resilience accordingly.

An appropriate policy mix and regional policy dialogue can strengthen domestic financial resilience and limit the impact of shocks from external funding conditions. The results highlight the important implications of US dollar funding conditions on the economic policies implemented in economies that are heavily reliant on dollar funding, pointing to the role of smoothing exchange rate fluctuations to reduce uncertainty regarding domestic financial conditions. To this end, both monetary and macroprudential policies need to take into consideration the effects exchange rate movements have on domestic financial conditions through both the financial channel and the trade channel. Given the region's elevated exposure to US dollar-denominated debt, policy makers could consider complementing existing macroprudential tools with a foreign currency dimension, for example, a foreign currency liquidity dimension. Such a tool could strengthen the economy's resilience against abrupt changes in global dollar funding conditions.

More broadly, it is important to cultivate an investor base at home and deepen capital markets in the region, in particular by further developing local currency bond markets to limit the dependence on US dollar funding in the region, and so reduce vulnerabilities to external shocks. These policies should go hand-in-hand with strengthened policy dialogue across borders to monitor macrofinancial conditions. Further, capital flow management measures must be considered to mitigate disruptive spillovers in an increasingly interconnected regional and global financial system.

Lastly, regional financial cooperation including policy dialogue about regulatory cooperation on cross-border resolution mechanisms and the review and strengthening of existing financial safety nets—such as the Chiang Mai Initiative Multilateralisation—during times of growing cross-border banking activities could further strengthen the region's resilience.

While the analysis strongly suggests the existence of the financial channel of the bilateral exchange rate against the US dollar, it also highlights other possible supplementary analyses for consideration. First, to shed more light on the risk-taking behavior of foreign investors, one could apply similar exercises to bond flow data. Second, to identify the specific channel through which the bilateral exchange rate affects financial conditions, one could consider examining additional control variables, such as those related to the domestic banking system, for example, to account for EAEs' heavily bank-based financial systems. Last, the inclusion of foreign exchange reserves or swap lines could capture information on the economies' financial vulnerabilities and resilience to tightening US dollar funding conditions.

APPENDIX 1: DYNAMIC PANEL MODEL USING RESULTS FOR 15 EMERGING MARKET ECONOMIES

This section presents the dynamic panel estimation results for a sample of 15 emerging market economies comprising Brazil, Chile, Colombia, the Czech Republic, Hungary, India, Indonesia, Malaysia, the People's Republic of China, the Philippines, Poland, the Republic of Korea, Singapore, South Africa, and Thailand (N = 15, T = 131). The results provide further support to the empirical findings for emerging Asian economies discussed in the main text.

Table A1.1. Fixed Effects Estimation Results

	(1)	(2)	(3)	(4)	(5)
$\Delta y_{i,t-1}$	0.137***	0.139***	0.143***	0.141***	0.144***
	(4.44)	(4.00)	(4.37)	(4.40)	(4.42)
$\Delta BER_{i,t-1}$	−0.0144**		−0.0267**	−0.0147**	
	(−2.61)		(−2.83)	(−2.68)	
$\Delta NEER_{i,t-1}$		−0.0121	0.0179		−0.0126
		(−1.60)	(1.39)		(−1.69)
$\Delta NEERorth_{i,t-1}$				0.0122	
				(0.93)	
$\Delta BERorth_{i,t-1}$					−0.0268*
					(−2.13)
$\Delta CPI_{i,t-1}$	0.000297*	0.000302*	0.000305*	0.000296*	0.000278*
	(2.06)	(2.06)	(2.10)	(2.04)	(1.93)
$\Delta IP_{i,t-1}$	0.00134	0.00120	0.00144	0.00139	0.00139
	(0.38)	(0.34)	(0.41)	(0.40)	(0.40)
$\Delta r_{i,t-1}$	0.00000470	0.0000244	−0.0000113	−0.00000606	−0.0000119
	(0.02)	(0.12)	(−0.06)	(−0.03)	(−0.06)
ΔVIX_{t-1}	0.00222***	0.00241***	0.00215***	0.00217***	0.00219***
	(3.65)	(3.87)	(3.70)	(3.71)	(3.59)
$\Delta CPIUS_{t-1}$	0.000852***	0.000726**	0.000940***	0.000908***	0.000905***
	(3.30)	(2.84)	(3.28)	(3.31)	(3.52)
$\Delta IPUS_{t-1}$	−0.0123	−0.0115	−0.0135	−0.0129	−0.0130
	(−0.87)	(−0.81)	(−0.92)	(−0.90)	(−0.91)
$\Delta MMUS_{t-1}$	−0.00287***	−0.00290***	−0.00293***	−0.00289***	−0.00291***
	(−4.41)	(−4.40)	(−4.31)	(−4.34)	(−4.38)
$N \times T$	1,897	1,897	1,897	1,897	1,897

ΔBER = monthly log change of the bilateral exchange rate against the US dollar, ΔCPI = monthly change of year-on-year inflation rate, $\Delta CPIUS$ = monthly change in the year-on-year inflation rate of the US, ΔIP = monthly change of year-on-year growth in industrial production index, $\Delta IPUS$ = year-on-year growth in industrial production index of the US, $\Delta MMUS$ = 3-month money market rate in the US, $\Delta NEER$ = monthly log change of the nominal effective exchange rate, $\Delta r =$ monthly change of lending rate, ΔVIX = monthly log change in the volatility index, US = United States.

Notes: Data refers to January 2006 to November 2016. *t*-statistics are reported in brackets, calculated based on cluster-robust standard errors. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Sources: Authors' calculations using data from the Bank for International Settlements (BIS). Effective exchange rate indices. https://www.bis.org/statistics/full_bis_eer_csv.zip; BIS. Consumer prices. https://www.bis.org/statistics/full_webstats_long_cpi_dataflow_csv.zip; Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H15; Bloomberg; Haver Analytics; International Monetary Fund. International Financial Statistics. https://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B&sId=1390030341854; and World Bank. Global Economic Monitor. https://datacatalog.worldbank.org/dataset/global-economic-monitor (all accessed August 2017).

Table A1.2. Bias-Corrected Least Squares Dummy Variable Estimation Results

	(1)	(2)	(3)	(4)	(5)
$\Delta y_{i,t-1}$	0.149***	0.151***	0.155***	0.153***	0.156***
	(6.61)	(6.68)	(6.90)	(6.79)	(6.96)
$\Delta BER_{i,t-1}$	−0.0144***		−0.0265***	−0.0146***	
	(−3.88)		(−3.19)	(−3.91)	
$\Delta NEER_{i,t-1}$		−0.0121**	0.0176*		−0.0126***
		(−2.56)	(1.69)		(−2.68)
$\Delta NEERorth_{i,t-1}$				0.0120	
				(1.05)	
$\Delta BERorth_{i,t-1}$					−0.0266***
					(−2.85)
$\Delta CPI_{i,t-1}$	0.000298*	0.000304*	0.000306*	0.000297*	0.000280*
	(1.79)	(1.80)	(1.83)	(1.78)	(1.67)
$\Delta IP_{i,t-1}$	0.00136	0.00122	0.00146	0.00141	0.00141
	(0.70)	(0.61)	(0.74)	(0.72)	(0.72)
$\Delta r_{i,t-1}$	0.00000591	0.0000262	−0.00000993	−0.00000491	−0.0000107
	(0.03)	(0.12)	(−0.05)	(−0.02)	(−0.05)
ΔVIX_{t-1}	0.00223***	0.00241***	0.00215***	0.00217***	0.00219***
	(4.86)	(5.28)	(4.65)	(4.67)	(4.74)
$\Delta CPIUS_{t-1}$	0.000846***	0.000719***	0.000938***	0.000905***	0.000902***
	(4.01)	(3.45)	(4.31)	(4.13)	(4.12)
$\Delta IPUS_{t-1}$	−0.0121	−0.0114	−0.0134	−0.0128	−0.0129
	(−1.35)	(−1.25)	(−1.47)	(−1.41)	(−1.42)
$\Delta MMUS_{t-1}$	−0.00280***	−0.00283***	−0.00287***	−0.00284***	−0.00285***
	(−3.97)	(−3.94)	(−4.02)	(−3.98)	(−3.99)
$N \times T$	1,897	1,897	1,897	1,897	1,897

ΔBER = monthly log change of the bilateral exchange rate against the US dollar, ΔCPI = monthly change of year-on-year inflation rate, $\Delta CPIUS$ = monthly change in the year-on-year inflation rate of the US, ΔIP = monthly change of year-on-year growth in industrial production index, $\Delta IPUS$ = year-on-year growth in industrial production index of the US, $\Delta MMUS$ = 3-month money market rate in the US, $\Delta NEER$ = monthly log change of the nominal effective exchange rate, $\Delta r =$ monthly change of lending rate, ΔVIX = monthly log change in the volatility index, US = United States.

Notes: Data refers to January 2006 to November 2016. *t*-statistics are reported in brackets, calculated based on bootstrapped standard errors. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Sources: Authors' calculations using data from the Bank for International Settlements (BIS). Effective exchange rate indices. https://www.bis.org/statistics/full_bis_eer_csv.zip; BIS. Consumer prices. https://www.bis.org/statistics/full_webstats_long_cpi_dataflow_csv.zip; Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H15; Bloomberg; Haver Analytics; International Monetary Fund. International Financial Statistics. https://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B&sId=1390030341854; and World Bank. Global Economic Monitor. https://datacatalog.worldbank.org/dataset/global-economic-monitor (all accessed August 2017).

Table A1.3. Instrumental Variable (Anderson–Hsiao) Estimation Results

	(1)	(2)	(3)	(4)	(5)
$\Delta y_{i,t-1}$	0.396***	0.420***	0.417***	0.413***	0.419***
	(5.23)	(5.23)	(5.66)	(5.51)	(5.35)
$\Delta BER_{i,t-1}$	0.00558		−0.0545***	0.00263	
	(0.54)		(−4.21)	(0.25)	
$\Delta NEER_{i,t-1}$		0.0262**	0.0855***		0.0226*
		(2.16)	(5.10)		(1.84)
$\Delta NEERorth_{i,t-1}$				0.0803***	
				(4.41)	
$\Delta BERorth_{i,t-1}$					−0.0641***
					(−3.61)
$\Delta CPI_{i,t-1}$	−0.000331	−0.000337	−0.000329	−0.000347	−0.000352
	(−1.45)	(−1.52)	(−1.47)	(−1.54)	(−1.57)
$\Delta IP_{i,t-1}$	0.000746	0.000697	0.00106	0.000876	0.00108
	(0.22)	(0.20)	(0.31)	(0.26)	(0.31)
$\Delta r_{i,t-1}$	−0.000340	−0.000378	−0.000434	−0.000402	−0.000438
	(−0.88)	(−0.91)	(−1.07)	(−1.01)	(−1.06)
ΔVIX_{t-1}	0.00146***	0.00155***	0.00142***	0.00139***	0.00137***
	(3.18)	(3.25)	(2.96)	(2.98)	(2.95)
$\Delta CPIUS_{t-1}$	0.000887***	0.000951***	0.00129***	0.00123***	0.00129***
	(3.36)	(3.28)	(4.77)	(4.35)	(4.56)
$\Delta IPUS_{t-1}$	−0.0413**	−0.0396**	−0.0407**	−0.0405**	−0.0391**
	(−2.52)	(−2.42)	(−2.54)	(−2.54)	(−2.46)
$\Delta MMUS_{t-1}$	−0.00494***	−0.00519***	−0.00427***	−0.00426***	−0.00419***
	(−4.59)	(−4.07)	(−3.43)	(−3.69)	(−3.57)
$N \times T$	1,882	1,882	1,882	1,882	1,882

ΔBER = monthly log change of the bilateral exchange rate against the US dollar, ΔCPI = monthly change of year-on-year inflation rate, $\Delta CPIUS$ = monthly change in the year-on-year inflation rate of the US, ΔIP = monthly change of year-on-year growth in industrial production index, $\Delta IPUS$ = year-on-year growth in industrial production index of the US, $\Delta MMUS$ = 3-month money market rate in the US, $\Delta NEER$ = monthly log change of the nominal effective exchange rate, $\Delta r =$ monthly change of lending rate, ΔVIX = monthly log change in the volatility index, US = United States.

Notes: Data refers to January 2006 to November 2016. *t*-statistics are reported in brackets, calculated based on cluster-robust standard errors. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Sources: Authors' calculations using data from the Bank for International Settlements (BIS). Effective exchange rate indices. https://www.bis.org/statistics/full_bis_eer_csv.zip; BIS. Consumer prices. https://www.bis.org/statistics/full_webstats_long_cpi_dataflow_csv.zip; Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H15; Bloomberg; Haver Analytics; International Monetary Fund. International Financial Statistics. https://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B&sId=1390030341854; and World Bank. Global Economic Monitor. https://datacatalog.worldbank.org/dataset/global-economic-monitor (all accessed August 2017).

APPENDIX 2: ESTIMATION RESULTS: LOCAL CURRENCY, DU-SCHREGER, AND FOREIGN CURRENCY SPREADS

Table A2.1. Fixed Effects Estimation Results

Dependent Variable	Local Currency Spread	Du–Schreger Spread	Foreign Currency Spread
$\Delta \boldsymbol{BER}_{i,t-1}$	−0.0174	−0.00340	0.0129
	(−1.24)	(−0.40)	(0.56)
$\Delta \boldsymbol{NEER}_{i,t-1}$	−0.00454	0.00736	0.0360
	(−0.28)	(0.47)	(1.38)
$\Delta \boldsymbol{BER}_{i,t-1}$	−0.0370**	−0.0239	−0.0321
	(−2.56)	(−1.88)	(−1.61)
$\Delta \boldsymbol{NEER}_{i,t-1}$	0.0284	0.0289	0.0624
	(1.33)	(1.06)	(1.87)
$\Delta \boldsymbol{BER}_{i,t-1}$	−0.0181	−0.00362	0.00955
	(−1.29)	(−0.44)	(0.43)
$\Delta \boldsymbol{NEERorth}_{i,t-1}$	0.0229	0.0266	0.0613
	(1.09)	(0.96)	(1.92)
$\Delta \boldsymbol{BERorth}_{i,t-1}$	−0.00594	−0.0329*	−0.0404*
	(−0.37)	(−2.64)	(−2.48)
$\Delta \boldsymbol{NEER}_{i,t-1}$	−0.0514**	0.00511	0.0339
	(−2.63)	(0.35)	(1.40)

ΔBER = monthly log change of the bilateral exchange rate against the US dollar (an increase indicates local currency appreciation), $\Delta NEER$ = monthly log change of the nominal effective exchange rate (an increase indicates local currency appreciation), US = United States.

Notes: Data refers to January 2006 to August 2020. Data for the Du–Schreger spread is until December 2019. See Appendix 3 for data sources. t-statistics are reported in brackets, calculated based on cluster-robust standard errors. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Sources: Authors' calculations using data from the Bank for International Settlements (BIS). Effective exchange rate indices. https://www.bis.org/statistics/full_bis_eer_csv.zip; BIS. Consumer prices. https://www.bis.org/statistics/full_webstats_long_cpi_dataflow_csv.zip; Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H15; Bloomberg; Haver Analytics; International Monetary Fund. International Financial Statistics. https://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B&sId=1390030341854; and World Bank. Global Economic Monitor. https://datacatalog.worldbank.org/dataset/global-economic-monitor (all accessed October 2020).

Table A2.2. Instrumental Variable (Anderson–Hsiao) Estimation Results

Dependent Variable	Local Currency Spread	Du–Schreger Spread	Foreign Currency Spread
$\Delta BER_{i,t-1}$	−0.00481	0.0263*	0.0583**
	(−0.33)	(1.79)	(2.49)
$\Delta NEER_{i,t-1}$	0.0270*	0.0421***	0.0711***
	(1.86)	(2.78)	(2.88)
$\Delta BER_{i,t-1}$	−0.0597**	−0.0120	0.0178
	(−2.52)	(−0.66)	(0.79)
$\Delta NEER_{i,t-1}$	0.0782***	0.0526***	0.0557**
	(3.04)	(2.71)	(2.15)
$\Delta BER_{i,t-1}$	−0.00672	0.0255*	0.0568**
	(−0.46)	(1.76)	(2.52)
$\Delta NEERorth_{i,t-1}$	0.0669***	0.0447**	0.0407
	(2.77)	(2.36)	(1.61)
$\Delta BERorth_{i,t-1}$	−0.0800***	−0.0210	0.00373
	(−3.00)	(−1.14)	(0.17)
$\Delta NEER_{i,t-1}$	0.0212	0.0400**	0.0713***
	(1.45)	(2.55)	(2.87)

ΔBER = monthly log change of the bilateral exchange rate against the US dollar (an increase indicates local currency appreciation), $\Delta NEER$ = monthly log change of the nominal effective exchange rate (an increase indicates local currency appreciation), US = United States.

Notes: Data refers to January 2006 to August 2020. Data for the Du–Schreger spread is until December 2019. See Appendix 3 for data sources. *t*-statistics are reported in brackets, calculated based on cluster-robust standard errors. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Sources: Authors' calculations using data from the Bank for International Settlements (BIS). Effective exchange rate indices. https://www.bis.org/statistics/full_bis_eer_csv.zip; BIS. Consumer prices. https://www.bis.org/statistics/full_webstats_long_cpi_dataflow_csv.zip; Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H15; Bloomberg; Haver Analytics; International Monetary Fund. International Financial Statistics. https://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B&sId=1390030341854; and World Bank. Global Economic Monitor. https://datacatalog.worldbank.org/dataset/global-economic-monitor (all accessed October 2020).

Table A2.3: Bias-Corrected Least Squares Dummy Variable Estimation Results

Dependent Variable	Local Currency Spread	Du–Schreger Spread	Foreign Currency Spread
$\Delta BER_{i,t-1}$	−0.0176**	−0.00350	0.0128
	(−2.45)	(−0.50)	(1.31)
$\Delta NEER_{i,t-1}$	−0.00472	0.00721	0.0359***
	(−0.62)	(0.92)	(3.29)
$\Delta BER_{i,t-1}$	−0.0370***	−0.0238**	−0.0321**
	(−3.25)	(−2.08)	(−2.15)
$\Delta NEER_{i,t-1}$	0.0281**	0.0288**	0.0623***
	(2.35)	(2.26)	(3.70)
$\Delta BER_{i,t-1}$	−0.0181**	−0.00372	0.00943
	(−2.51)	(−0.53)	(0.97)
$\Delta NEERorth_{i,t-1}$	0.0227*	0.0265**	0.0611***
	(1.78)	(2.01)	(3.48)
$\Delta BERorth_{i,t-1}$	−0.00610	0.00496	−0.0406**
	(−0.81)	(0.63)	(−2.55)
$\Delta NEER_{i,t-1}$	−0.0514***	−0.0328***	0.0338***
	(−4.33)	(−2.86)	(3.10)

ΔBER = monthly log change of the bilateral exchange rate against the US dollar (an increase indicates local currency appreciation), $\Delta NEER$ = monthly log change of the nominal effective exchange rate (an increase indicates local currency appreciation), US = United States.

Notes: Data refers to January 2006 to August 2020. Data for the Du–Schreger spread is until December 2019. See Appendix 3 for data sources. *t*-statistics are reported in brackets, calculated based on cluster-robust standard errors. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Sources: Authors' calculations using data from the Bank for International Settlements (BIS). Effective exchange rate indices. https://www.bis.org/statistics/full_bis_eer_csv.zip; BIS. Consumer prices. https://www.bis.org/statistics/full_webstats_long_cpi_dataflow_csv.zip; Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H15; Bloomberg; Haver Analytics; International Monetary Fund. International Financial Statistics. https://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B&sId=1390030341854; and World Bank. Global Economic Monitor. https://datacatalog.worldbank.org/dataset/global-economic-monitor (all accessed October 2020).

APPENDIX 3: DATA SOURCES

Table A3: Data Sources

Variable	Description	Sources
Local currency spread	5-year local currency sovereign bond yields subtracting 5-year United States (US) Treasury yield (monthly geometric means)	Bloomberg
Bilateral exchange rate	Bilateral exchange rate against the US dollar (monthly geometric means)	Haver Analytics
Nominal effective exchange rate	Nominal effective exchange rate (monthly average)	Bank for International Settlements Effective Exchange Rate Indices
Volatility index	Chicago Board of Exchange volatility index	Bloomberg
Consumer price index	Year-on-year inflation	Bank for International Settlements Long Series Consumer Prices, World Bank Global Economic Monitor
Industrial production index	Industrial production	Haver Analytics
Lending rate	Average short-term lending rate of commercial banks	Haver Analytics
US money market rate	US 3-month money market rate	Board of Governors of the Federal Reserve System

Source: Authors' compilation.

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The Influence of US Dollar Funding Conditions on Asian Financial Markets

Amid high reliance on United States (US) dollar-denominated funding, this paper empirically shows that changes in exchange rates affect sovereign credit risk premiums in selected emerging Asian economies. In particular, a depreciation of the domestic currency against the US dollar leads to a widening of the sovereign bond spread. This finding suggests a significant relationship between US dollar funding exposure, US dollar liquidity conditions, and domestic financial conditions in some emerging Asian economies. Given that the magnitude of the effects varies across economies, policy prescriptions should be tailored individually.

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