DO LOCAL CURRENCY BOND MARKETS ENHANCE FINANCIAL STABILITY?

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ABSTRACT

It is widely believed that local currency bond markets (LCBMs) can promote financial stability in developing countries. For instance, they can help mitigate the currency and maturity mismatch that contributed to the outbreak of the Asian financial crisis of 1997–1998. In this paper, we empirically test such conventional wisdom on the stabilizing effect of LCBMs. To do so, we analyze and compare the financial vulnerability of developing countries during two episodes of financial stress—global financial crisis and taper tantrum. During the two episodes, we find a negative association between the growth of LCBMs and the degree of currency depreciation in emerging economies. Similar association is found of bank loans but not for the stock market.

Keywords: Asian financial crisis, bonds, currency mismatch, developing countries, financial stability, local currency bond markets, maturity mismatch

JEL codes: E44, F34, F38, F42, F62

I. INTRODUCTION

Currency and maturity mismatches are widely viewed as a main source of financial vulnerability in developing economies.[1] If a country's financial liabilities are denominated in a foreign currency such as the United States (US) dollar but its financial assets are denominated in domestic currency, then a sudden depreciation of the domestic currency damages its balance sheet, destabilizing the financial system and economy. If the maturity of financial liabilities is shorter than that of assets, the likelihood of a crisis further increases. In short, borrowing short-term in a foreign currency and lending long-term in domestic currency is a recipe for instability and even crisis. It is well known that the "double mismatch" of currency and maturity mismatch was a contributing factor behind the devastating Asian financial crisis of 1997–1998.[2]

In the aftermath of that crisis, the Association of Southeast Asian Nations and the People's Republic of China (PRC), Japan, and the Republic of Korea (ASEAN+3 countries) have prioritized the development of local currency bond markets (LCBMs) as a major policy objective.[3] In 2003, the finance ministers of the ASEAN+3 countries introduced the Asian Bond Markets Initiative (ABMI) to develop LCBMs in the region. In light of the region's heavy reliance on bank finance, developing LCBMs can contribute to a larger role for capital markets and a more balanced financial system. The painful experience of the Asian crisis highlighted the need for the region's bank-centered financial systems to develop LCBMs as a spare tire which would enhance resilience in the event of shocks. Also see Jeanneau and Tovar (2008) for the role of LCBMs in enhancing financial stability in Latin American countries.

The literature points to other benefits of LCBM development in developing economies. For example, Caballero, Farhi, and Gourinchas (2008) argued that the chronic excess demand for US assets which contributed to global imbalances is due to financial underdevelopment in emerging markets. Vibrant LCBMs of varying maturities, in addition to mitigating the double mismatch problem, can increase the supply of Asian financial assets and thus help channel the region's ample savings into the region's own investments. Prasad (2011) argues that a more developed financial system which effectively channels funds into productive uses and enables better risk sharing would promote growth in Asia by encouraging more entrepreneurial activity. IMF (2016) emphasizes the increasingly important role of LCBMs as a source of long-term funding for long-term investments such as infrastructure and housing.

The central objective of our paper is to empirically investigate the role of LCBMs in enhancing financial stability in developing economies by mitigating currency and maturity mismatches. To do so, we analyze and compare the financial vulnerability of developing countries during two episodes of financial stress—global financial crisis and taper tantrum.[4] We find a negative relationship between the growth in LCBMs and the level of exchange rate depreciation. Such evidence sheds some light on the stabilizing role of LCBMs. Similar evidence also holds for bank loans but not the stock market.

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1 Eichengreen and Hausmann (1999) emphasized that most emerging economies suffer from "original sin" that refers to the case where the domestic currency cannot be used to borrow abroad or to borrow long term. Later, Eichengreen, Hausmann, and Panizza (2005) focused more on the problem of currency mismatch.

2 See, for example, Lee (2017).

3 See, for example, Park (2016) for the Asian region's initiatives to develop local currency bonds markets.

4 There are a few studies on financial vulnerability during the taper tantrum. See Eichengreen and Gupta (2015) and Park, Ramayandi, and Shin (2016).

The remainder of the paper is as follows. In the next section, we explore recent developments in LCBMs in Asia. In section III, we lay out our empirical framework. In section IV, we report and discuss the empirical findings of the paper. Section V concludes.

II. RECENT DEVELOPMENTS IN ASIA'S LOCAL CURRENCY BOND MARKETS

Data on the amount outstanding of LCBMs are not widely available. While AsianBondsOnline reports time series data for the size of LCBMs, it covers only 10 Asian economies: Hong Kong, China; Indonesia; Japan; Malaysia; People's Republic of China; Philippines; Republic of Korea; Singapore; Thailand; and Viet Nam.[5] In this paper, to include as many developing economies as possible, we use the Bank for International Settlements (BIS) debt securities statistics in our main empirical analysis.[6]

The BIS debt securities statistics reports total debt securities (TDS) issued by residents. TDS are divided into domestic debt securities (DDS) and international debt securities (IDS).[7] Since DDS are not separately reported for different currency denominations, we assume that all DDS issued by residents are denominated in local currencies. On the other hand, IDS are separately reported for those issued in local currencies and in foreign currencies. Then we calculate the size of local currency bond markets by adding the amount outstanding of DDS and IDS that are denominated in local currency. However, for some countries, only a subset of these statistics is available.[8] If the amount outstanding of IDS denominated in local currency is missing, we use the amount outstanding of DDS only. If the amount of DDS is missing, we use the amount of TDS by residential issuers after subtracting IDS that are not denominated in local currency.

Figure 1 shows the size of LCBMs calculated in this way, as a percentage of gross domestic product (GDP), for Asian countries.[9] We also plot the size of LCBMs obtained from the AsianBondsOnline. The size of LCBMs calculated from the two sources is quite similar. The figure shows that since the Asian financial crisis of 1997–1998, the size of LCBMs increased substantially in the PRC, the Republic of Korea, and Thailand. According to the AsianBondsOnline, the size of LCBMs in percentage of GDP of the PRC, the Republic of Korea, and Thailand was 8%, 16%, and 23%, respectively, in 1998 but increased to 53%, 125%, and 71%, respectively, in 2015. The growth of LCBMs in other Asian countries is not as dramatic. In fact, the relative size of LCBMs has been steadily decreasing in Indonesia since 2000 and in the Philippines since 2005.

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5 AsianBondsOnline: https://asianbondsonline.adb.org.

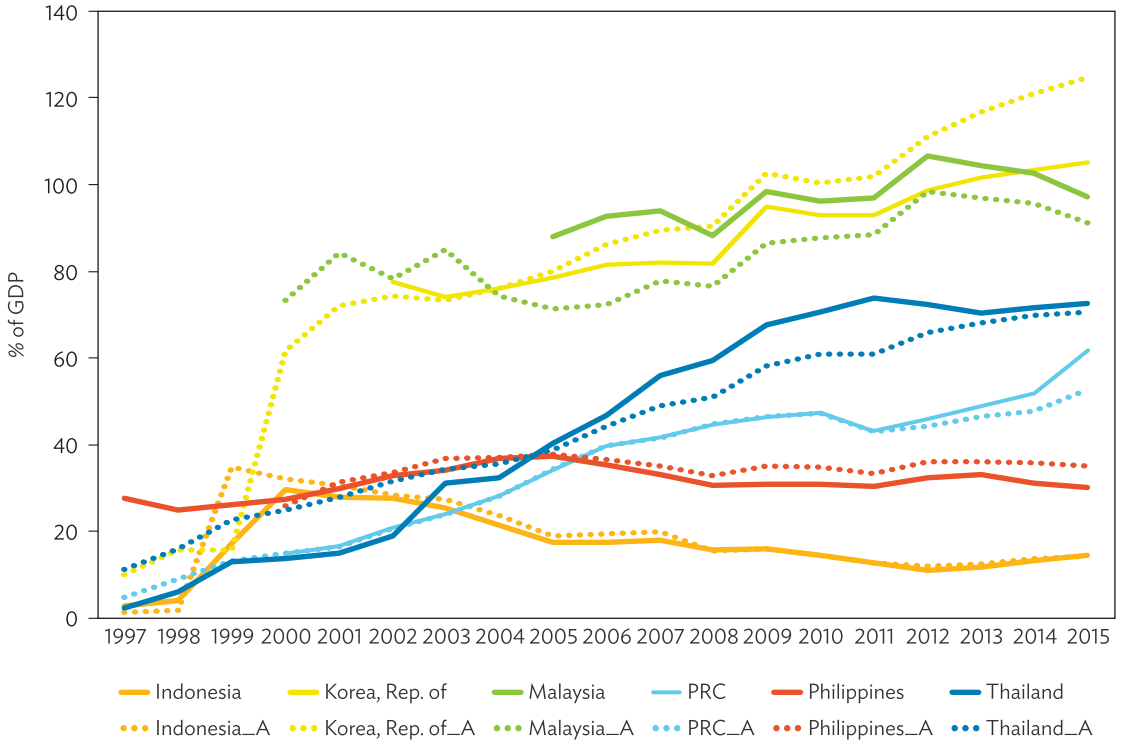
6 A number of authors used the BIS data to measure the size of LCBMs. See, for example, Bae (2012) and Burger and Warnock (2006).

7 The sum of DDS and IDS is not exactly the same as TDS due to potential overlaps between DDS and IDS.

8 IDS are compiled from a security-by-security database built by the BIS and the relevant information is supplied by commercial data providers. IDS are mostly compiled from data reported to the BIS by central banks, but for a few countries, the BIS collects data directly from publicly available sources. The BIS does not calculate TDS and their statistics are published only when central banks provide the relevant data to the BIS. See more about the debt securities statistic on the BIS webpage: http://www.bis.org/statistics/about_securities_stats.htm.

9 Hong Kong, China; Japan; and Singapore are not included since they are advanced countries and/or financial centers. The nominal GDP data are collected from the World Development Indicators (WDI).

Figure 1: The Size of Local Currency Bond Markets for Asian Countries

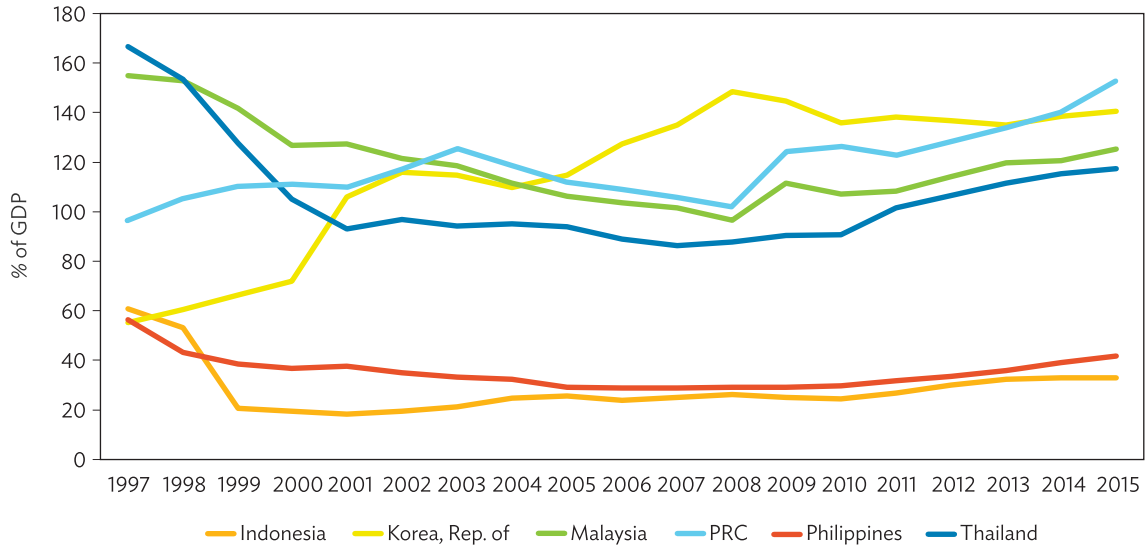


GDP = gross domestic product, PRC = People's Republic of China.
Notes: Japan; Hong Kong, China; and Singapore are not shown as they are advanced economies and/or financial centers. For each country, the solid line represents the size of local currency bond markets collected from the Bank for International Settlements and the dotted line, from the AsianBondsOnline. We calculate the size of local currency bond markets by adding the amount outstanding of domestic debt securities (DDS) and international debt securities (IDS) that are denominated in local currency. For some countries, for which only a subset of these statistics is available, we use the amount outstanding of DDS or total debt securities (TDS) after subtracting IDS that are not denominated in local currency.
Sources: Authors calculations based on the Bank for International Settlements Debt Securities Statistics and the AsianBondsOnline.

Figure 2 illustrates the size of bank loans, as a percentage of GDP, for Asian countries.[10] In contrast to LCBMs, the relative size of bank loans in percentage of GDP in Asian countries has not increased much since 1998. The Republic of Korea and the PRC are two exceptions, but even in those countries, bank loans grew more slowly than LCBMs. Between 1998 and 2015, bank loans grew from 60% of GDP to 141% of GDP in the Republic of Korea, and from 105% to 153% in the PRC. In other countries, relative size of bank loans was lower in 2015 than in 1998.

[10] Bank loans are domestic credit to the private sector by banks, collected from the WDI.

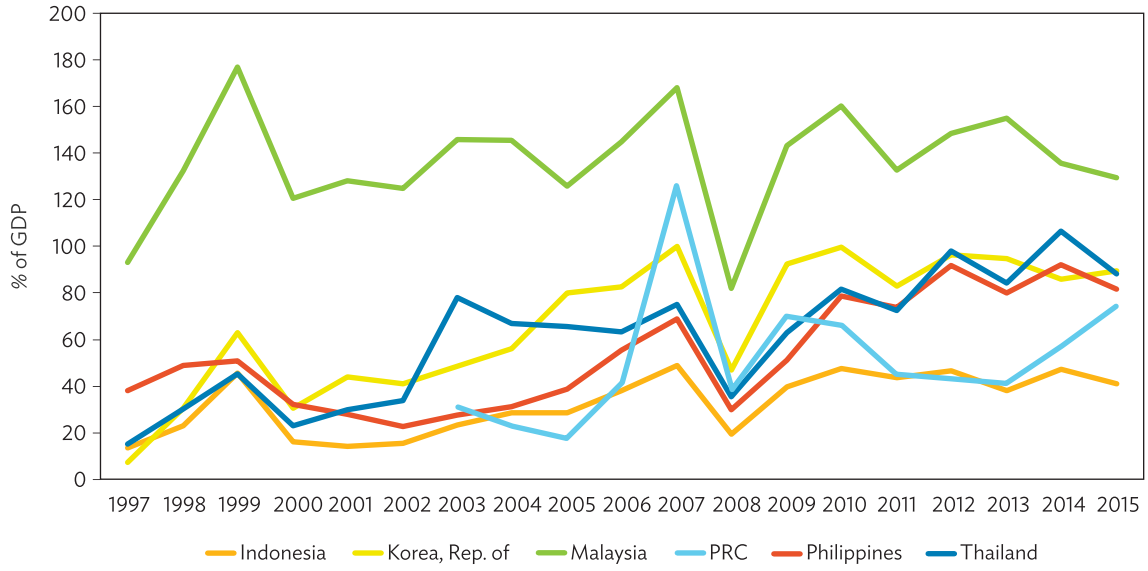
Figure 2: The Size of Bank Loans for Asian Countries



GDP = gross domestic product, PRC = People's Republic of China.
Note: Bank loans are domestic credit to the private sector by banks.
Sources: World Bank. World Development Indicators. https://data.worldbank.org/products/wdi.

Figure 3 presents the size of stock market capitalization, as a percentage of GDP. It has been increasing in most Asian countries. Between 1998 and 2015, it increased from the 23%–49% range to the 41%–89% range in Indonesia, the Philippines, the Republic of Korea, and Thailand. However, the region's stock markets grew more slowly than the region's LCBMs. Put together, Figures 1–3 show that on average LCBMs grew more rapidly than banks and stock markets in Asian countries.

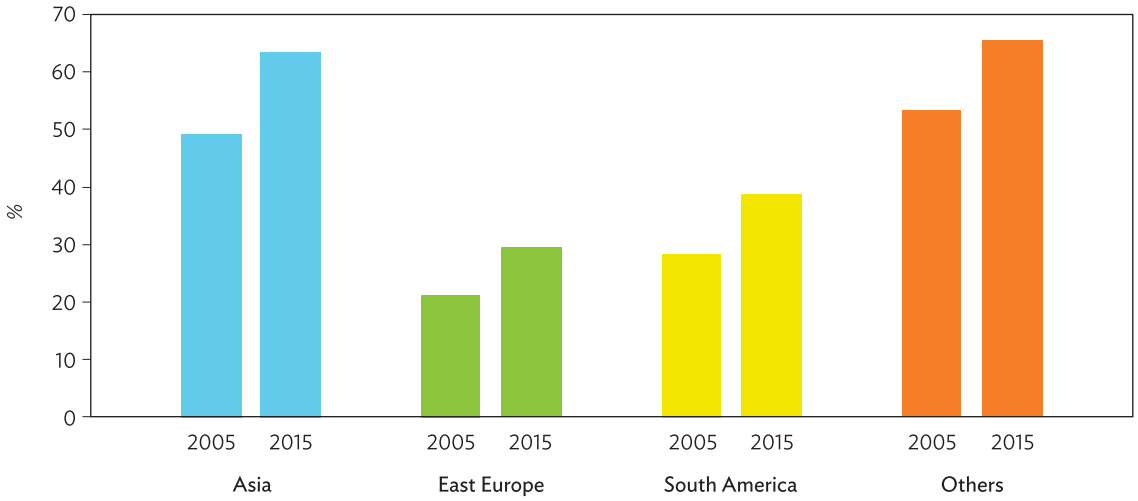
Figure 3: The Size of Stock Market Capitalization for Asian Countries



GDP = gross domestic product, PRC = People's Republic of China.
Sources: World Bank. World Development Indicators. https://data.worldbank.org/products/wdi.

Figure 4 shows the size of LCBMs, as percent of GDP in 2005 and 2015, for countries in various regions. While the relative size of LCBMs is larger in Asian countries, growth is comparable across regions. Hence we can conclude that the development of LCBMs is not an Asia-specific trend.

Figure 4: Growth of Local Currency Bond Markets in Various Regions



Notes: The size of local currency bond markets is collected from the Bank for International Settlements (BIS). We calculate the size of local currency bond markets by adding the amount outstanding of Domestic Debt Securities (DDS) and International Debt Securities (IDS) that are denominated in local currency. For some countries, for which only a subset of these statistics is available, we use the amount outstanding of DDS or Total Debt Securities (TDS) after subtracting IDS that are not denominated in local currency. The grouping of countries is as follows. Asia: Indonesia, Malaysia, People's Republic of China, Philippines, Republic of Korea, Thailand; East Europe: Croatia, Czech Republic, Hungary, Latvia, Lithuania, Poland, Russian Federation, Turkey; South America: Argentina, Brazil, Colombia, Mexico, Peru; Others: Israel, Lebanon, Pakistan, South Africa.
Sources: Authors calculations based on the BIS Debt Securities Statistics.

III. EMPIRICAL FRAMEWORK

As emphasized, one main benefit of LCBMs is to foster financial stability by mitigating currency and maturity mismatches. LCBMs serve a stable source for long-term finance in local currency. Such financing source not only allows borrowers to access funding to a longer tenor compared to bank loans, but also make domestic borrowers less prone to exchange rate risks. A logical implication is that LCBM development reduces the vulnerability of financial markets in developing countries to external shocks. We can test this hypothesis following the empirical approach used by Eichengreen and Gupta (EG) (2015) and Park, Ramayandi, and Shin (PRS) (2016). Those studies sought to identify the factors associated with the destabilizing impact of the taper tantrum on developing economies. More specifically, both studies used exchange rate depreciation as a proxy for financial vulnerability, and empirically analyzed which factors influence the effect of quantitative easing tapering on exchange rate depreciation.

The basic regression equation estimated by EG and PRS takes the following linear form:

$$ERD_i = X_i\beta + \epsilon_i \quad (1)$$

where ERD_i is the nominal exchange rate depreciation against the US dollar experienced by an emerging country i during the taper tantrum, i.e. between the end of April and the end of August 2013, and X_i is a vector of country-specific factors for country i that are associated with exchange rate depreciation.[11] The factors considered by these studies include (i) deterioration in the current account deficit and real exchange rate appreciation before the taper tantrum, i.e. from 2010 to 2012, as measures of local market impact and loss in competitiveness; (ii) cumulative private capital inflows and the stock of portfolio liabilities as measures of capital inflows and the size of the financial market; (iii) real GDP growth, inflation, and the foreign reserves-to-M2 ratio as measures of economic fundamentals; and (iv) exchange rate regime and institutional quality as structural variables. These variables are measured in 2012 or as their averages from 2010 to 2012.[12]

We will use the same setup but add the size of LCBMs to equation (1) as an additional explanatory variable. We will investigate whether the development of LCBMs has any beneficial effect on financial vulnerability in the sense that emerging economies with larger LCBMs experience less exchange rate depreciation during the taper tantrum. In particular, we will estimate the effect of LCBM size after controlling for the above explanatory variables in EG and PRS.

EG and PRS estimated equation (1) to identify factors associated with the adverse impact of the taper tantrum. In principle, the same equation can be used to analyze factors responsible for the vulnerability of the economy in other financial stress episodes. For example, the same equation can be estimated during the global financial crisis and check if the same factors cause financial vulnerability during the global financial crisis and taper tantrum. In other words, we estimate equation (1) for both periods 1 (global financial crisis) and 2 (taper tantrum).

One advantage of considering both periods is that now we can eliminate unobserved country fixed effects by combining the experiences in the two periods. Since the estimation of equation (1) in EG and PRS is a cross-section regression, unobservable country fixed effects may not have been completely eliminated, generating biased estimates. If country fixed effects, f_i, are not time varying, we can eliminate country fixed effects by taking the difference of equation (1) across periods and estimating the following equation:

$$\Delta ERD_i = \Delta X_i \beta + \delta_i \quad (2)$$

Note that since unobserved country fixed effects that are not time varying are no longer present, estimates of β in (2) are not biased.

IV. EMPIRICAL FINDINGS

The data sources for most explanatory variables are from the World Development Indicators (WDI) of the World Bank and the International Financial Statistics (IFS) of the International Monetary Fund (IMF).[13] More specifically, the current account deficit as a percentage of GDP, the foreign reserves-to-M2 ratio, real GDP growth rate, and inflation are collected from the WDI. The real exchange rate is calculated by using the nominal exchange rate against the US dollar and both domestic and the US consumer price indices (CPI), collected from the IFS. Private capital flows data are measured by net

[11] The list of emerging countries is in Appendix Table A.1.
[12] Please refer to Park, Ramayandi, and Shin (2016) for a more comprehensive discussion of the variables and data.
[13] Definitions of variables and data sources are explained in Appendix Table A.2.

incurrence of liabilities of equity, debt securities, and other debt instruments in financial accounts reported in the IMF's Balance of Payments Statistics. Exchange rate regime classification follows the categorizations of annual fine classification in Ilzetzki, Reinhart, and Rogoff (2017). The stock of portfolio liabilities is obtained from the Lane and Milesi-Ferretti dataset that extends Lane and Milesi-Ferretti (2007).

Table 1 presents summary statistics of the variables for both periods 1 and 2. On average, the nominal exchange rate depreciation, the dependent variable of equation (1), is much lower in period 2 than in period 1, indicating that the impact of the taper tantrum on emerging economies was much less severe than the global financial crisis. Comparison of the statistics across periods yields other interesting observations. For example, deterioration of the current account deficit and capital inflows were larger during period 2 than during period 1. There is not much difference in other explanatory variables.

Table 1: Summary Statistics

(a) Period 1: The global financial crisis

	Observations	Mean	Min	Max
Percent change in nominal exchange rate	59	0.259	0.000	0.960
Increase in current account deficit (% of GDP), 2010–2012	59	1.959	–19.056	15.936
Average annual percent change in real exchange rate, 2009–2012	59	–5.400	–14.295	10.598
Increase in credit-to-GDP ratio, 2009–2012	59	9.398	–12.903	33.922
Log of portfolio liability, 2011	59	10.093	5.980	13.656
Reserves/M2, 2012	59	0.431	0.059	1.731
Inflation (CPI), 2012	59	6.673	0.510	15.842
Exchange rate regime, 2010	57	7.860	2.000	13.000
Total capital inflows during QE	59	4.863	–0.093	65.581
Size of LCBMs, 2012	22	0.361	0.000	0.939
Asia	59	0.119	0.000	1.000

(b) Period 2: The taper tantrum

	Observations	Mean	Min	Max
Percent change in nominal exchange rate	59	0.047	0.000	0.205
Increase in current account deficit (% of GDP), 2005–2007	59	2.324	–9.740	31.436
Average annual percent change in real exchange rate, 2004–2007	59	–4.046	–11.481	4.779
Increase in credit-to-GDP ratio, 2004–2007	59	2.339	–26.583	27.266
Log of portfolio liability, 2007	59	10.470	6.763	14.079
Reserves/M2, 2007	59	0.388	0.080	1.180
Inflation (CPI), 2007	59	5.540	–0.944	21.069
Exchange rate regime, 2007	57	7.947	2.000	13.000
Total capital inflows before global crisis	59	7.082	–1.057	129.918
Size of LCBMs, 2007	21	0.482	0.111	1.065
Asia	59	0.119	0.000	1.000

CPI = consumer price index, GDP = gross domestic product, LCBM = local currency bond market, QE = quantitative easing.
Notes: See Appendix Table A.2 for definitions and sources of variables. The exchange rate regime is annual fine classification in Ilzetzki, Reinhart, and Rogoff (2017).
Sources: Authors' calculation.

Table 2 reports the regression results of equation (1) in period 2. In column (1), we replicate PRS except that we did not include real GDP growth and the rule of law as explanatory variables.[14] While the number of observations increased substantially due to changes in the IFS database, the main results in PRS are preserved.[15] For example, the appreciation of real exchange rates and increase in credit-to-GDP ratio are highly significant at the 1% level. While the increase in current account deficit is not significant in column (1), it is highly significant at the 1% level in the last column. In column (2), we use only the size of LCBMs as an explanatory variable. We add an Asia dummy that takes the value of 1 for seven Asian countries and zero otherwise in column (3).[16] Irrespective of whether the Asia dummy is included or not, the size of LCBMs is not statistically significant, indicating that countries with larger LCBMs do not necessarily experience less exchange rate depreciation.

In columns (4)–(7), besides the size of LCBMs and the Asia dummy, we include two additional explanatory variables in turn. In column (4), for example, we include the increase in current account deficit and the average annual percent change in real exchange rate and, in column (5), the increase in credit-to-GDP ratio and the log of portfolio liabilities, and so on. In column (8), in addition to the size of LCBMs and the Asia dummy, we include all significant variables in (4)–(7). In the last column, however, we also report the estimation results when all the explanatory variables are included. The results show that neither the size of LCBMs or the Asia dummy is statistically significant in any column. Hence the cross-section regression results for period 2 seem to suggest that LCBMs did not necessarily mitigate the impact of the taper tantrum in emerging economies.

In Table 3, we report the same cross-section regression results for period 1. Unlike the results for period 2, the increase in current account deficit and the average annual percentage change in real exchange rate are not statistically significant. Instead, the increase in credit-to-GDP ratio and the log of portfolio liability are statistically significant in column (5) and the exchange rate regime and total capital inflows are statistically significant in column (6). Like the results in Table 2, however, the size of LCBMs is not statistically significant in any column, suggesting that LCBMs did not mitigate the impact of the global financial crisis either.

[14] Since the GDP growth and the rule of law were never significant in PRS, we decided to omit them.

[15] The reason the number of observations differs is due to capital inflows data. For this paper, we downloaded the data on 14 March 2017 from the web site, http://data.imf.org/?sk=5DABAFF2-C5AD-4D27-A175-1253419C02D1, while PRS used the IMF International Financial Statistics, published as a CD-ROM in December 2013. Interestingly observations reported as zeros in the CD-ROM are reported as missing values in the web site. We sum up the amounts of bond, equity, and loan flows unless any of the three flows is missing.

[16] The seven Asian countries are India, Indonesia, Malaysia, the Philippines, the PRC, the Republic of Korea, and Thailand. Viet Nam is not included in the Asian dummy since the BIS debt securities data are not available for it.

Table 2: Local Currency Bond Markets and Exchange Rate Depreciation in Emerging Economies during the Taper Tantrum

	Percent Change in Nominal Exchange Rate								
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Increase in current account deficit (% of GDP), 2010–2012	0.001			0.005					0.009***
	[0.001]			[0.003]					[0.003]
Average annual percent change in real exchange rate, 2009–2012	−0.005***			−0.007***				−0.006**	−0.000
	[0.002]			[0.002]				[0.003]	[0.003]
Increase in credit-to-GDP ratio, 2009–2012	0.002***				0.002*			0.002**	0.001
	[0.001]				[0.001]			[0.001]	[0.001]
Log of portfolio liability, 2011	0.001				0.023				−0.013
	[0.003]				[0.016]				[0.022]
Reserves/M2, 2012	0.032					−0.029			0.005
	[0.022]					[0.065]			[0.039]
Inflation (CPI), 2012	0.001					0.012*		0.014**	0.012*
	[0.001]					[0.006]		[0.005]	[0.005]
Exchange rate regime, 2010	0.001						0.002		0.003
	[0.002]						[0.004]		[0.008]
Total capital inflows during QE	0.002**						0.003***	0.000	0.003**
	[0.001]						[0.001]	[0.000]	[0.001]
Size of LCBMs, 2012		−0.004	−0.004	−0.014	−0.034	0.026	−0.040	0.033	−0.002
		[0.033]	[0.040]	[0.038]	[0.037]	[0.050]	[0.026]	[0.029]	[0.026]
Asia			−0.000	−0.005	−0.017	0.014	0.026	0.009	0.026
			[0.025]	[0.018]	[0.026]	[0.022]	[0.017]	[0.018]	[0.020]
Observations	57	25	25	24	23	22	24	21	20
R-squared	0.598	0.001	0.001	0.266	0.235	0.316	0.502	0.651	0.821

CPI = consumer price index, GDP = gross domestic product, LCBM = local currency bond market, QE = quantitative easing.
Notes: The dependent variable is exchange rate depreciation experienced by the developing country between the end of April and the end of August 2013. An increase in nominal and real exchange rates represents depreciation. The exchange rate regime is annual fine classification in Ilzetzki, Reinhart, and Rogoff (2017). Asia is a dummy variable for six Asian countries: Indonesia, Malaysia, People's Republic of China, Philippines, Republic of Korea, and Thailand. Numbers in parentheses are robust standard errors. ***, **, and * denotes the significance levels of 1%, 5%, and 10%, respectively.
Sources: Authors' calculations.

Table 3: Local Currency Bond Markets and Exchange Rate Depreciation in Emerging Economies during the Global Financial Crisis

	Percent Change in Nominal Exchange Rate								
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Increase in current account deficit (% of GDP), 2005–2007	0.003			0.008					0.018
	[0.004]			[0.010]					[0.011]
Average annual percent change in real exchange rate, 2004–2007	0.953			−0.678					0.047
	[0.716]			[0.539]					[0.500]
Increase in credit-to-GDP ratio, 2004–2007	−0.000				0.005***			0.002	−0.001
	[0.002]				[0.002]			[0.002]	[0.002]
Log of portfolio liability, 2007	−0.026				0.071***			0.012	−0.041
	[0.025]				[0.024]			[0.054]	[0.067]
Reserves/M2, 2007	0.048					−0.112			−0.227*
	[0.097]					[0.155]			[0.119]
Inflation (CPI), 2007	0.001					0.010			−0.009
	[0.007]					[0.010]			[0.013]
Exchange rate regime, 2007	0.023***						0.025***	0.022*	0.022*
	[0.008]						[0.008]	[0.011]	[0.011]
Total capital inflows before global crisis	0.014**						0.006***	0.005	0.012
	[0.006]						[0.002]	[0.004]	[0.008]
Size of LCBMs, 2007		−0.004	0.055	0.213	0.064	0.237*	0.036	0.049	0.041
		[0.131]	[0.161]	[0.138]	[0.109]	[0.133]	[0.072]	[0.075]	[0.105]
Asia			−0.098	−0.094	−0.094	−0.149**	−0.049	−0.048	0.045
			[0.079]	[0.091]	[0.061]	[0.065]	[0.055]	[0.071]	[0.072]
Observations	57	24	24	22	24	23	23	23	21
R-squared	0.337	0.000	0.079	0.389	0.494	0.344	0.628	0.643	0.740

CPI = consumer price index, GDP = gross domestic product, LCBM = local currency bond market.

Notes: The dependent variable is exchange rate depreciation experienced by the developing country between the end of July 2007 and the end of June 2009. An increase in nominal and real exchange rates represents depreciation. The exchange rate regime is annual fine classification in Ilzetzki, Reinhart, and Rogoff (2017). Asia is a dummy variable for six Asian countries: Indonesia, Malaysia, People's Republic of China, Philippines, Republic of Korea, and Thailand. Numbers in parentheses are robust standard errors. ***, **, and * denotes the significance levels of 1%, 5%, and 10%, respectively.

Sources: Authors' calculations.

In Table 4a, we report the regression results of equation (4) by differencing all the variables from period 2 to period 1. In column (1), only the increase in current account deficit is statistically significant with the right sign. In column (4), the increase in current account deficit is even more statistically significant. In columns (5) and (6), the increase in credit-to-GDP ratio, the reserves-to-M2 ratio, and inflation are all statistically significant with the right sign. While the coefficient of average annual percent change in real exchange rate has a wrong sign in column (4), it becomes insignificant in column (8), which includes all the variables that are significant in columns (4)–(7). On the other hand, the increase in current account deficit, the reserves-to-M2 ratio, and inflation are all statistically significant with the right sign even in column (8). The coefficient of the size of LCBMs is mostly negative but not statistically significant in columns (2)–(7). However, in columns (8) and (9), which includes more explanatory variables, the size of LCBMs becomes statistically significant at the 10% and the 5% levels, respectively, with the right sign. In other words, the results in columns (8) and (9) suggest that countries with larger LCBMs in period 2 than in period 1 experienced less exchange rate depreciation, indicating that they have become more resilient to external shocks.

While Table 4a provides some evidence that development of LCBMs enhances financial stability, the evidence is not compelling. Figure 5 illustrates the reason why this is so. The figure presents the relation between the increase in the size of LCBMs on the horizontal axis and the increase in nominal exchange rate depreciation on the vertical axis. There is a clear negative relationship between the two if we exclude one outlier country, India. While the size of LCBMs in India increased substantially from period 1 to period 2, there is not much improvement in exchange rate depreciation. We believe that this may be due to some data problems. Figure 6 illustrates the size of LCBMs collected from the BIS debt statistics for 24 individual countries. India seems to have a discrepancy in the data that occurred around 2011, a discrepancy that can overstate the increase in the size of LCBM between period 1 and period 2.

In light of such data problems, we exclude India from the sample and rerun the regression. Table 4b reports the ex-India regression results. Now the coefficient of the size of LCBMs becomes much more statistically significant. In columns (2) and (3), irrespective of whether the Asia dummy is included or not, the coefficient of the size of LCBMs is negative at the 10% level of significance. Even when other explanatory variables are included, the coefficient of the size of LCBMs is always negative and, in many cases, statistically significant at either the 10% or the 5% level. Hence, if the outlier of India is excluded, we obtain more compelling evidence that development of LCBMs enhances financial stability.

However, Figure 5 also suggests a need for caution in making such conclusions, particularly for Asia. Even after excluding India, if we look only at Asian countries, in red circles, Figure 5 suggests that the expansion of LCBMs did not visibly reduce exchange rate depreciation during the taper tantrum. The only exception is the Republic of Korea, which, among Asian countries, experienced the largest growth in LCBM and the largest reduction in depreciation. In Malaysia and Thailand, even though LCBMs grew substantially between the two stress episodes, nominal exchange rate depreciation did not decline tangibly during the taper tantrum. Interestingly, however, if we exclude all Asian countries, the negative relation between the difference in LCBM size and the difference in nominal exchange rate, is even stronger, implying a beneficial effect of LCBM on financial stability.

Table 4: Growth of Local Currency Bond Markets and Exchange Rate Depreciation during Crisis Periods

(a) India included

	Difference of Percent Change in Nominal Exchange Rate								
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Difference of increase in current account deficit (% of GDP)	0.005**			0.027***				0.039**	0.045***
	[0.002]			[0.007]				[0.013]	[0.013]
Difference of average annual percent change in real exchange rate	0.007			0.010***				0.009	0.008
	[0.005]			[0.003]				[0.006]	[0.007]
Difference of increase in credit-to-GDP ratio	0.001				0.008***			−0.004	−0.006
	[0.002]				[0.002]			[0.003]	[0.004]
Difference of log of portfolio liability	−0.017				−0.075				−0.126
	[0.030]				[0.145]				[0.143]
Difference of reserves/M2	−0.223					−0.311**		−0.489***	−0.413*
	[0.168]					[0.115]		[0.152]	[0.179]
Difference of inflation (CPI)	0.000					0.040***		0.039***	0.059***
	[0.005]					[0.011]		[0.012]	[0.017]
Difference of exchange rate regime	−0.011						−0.000		0.032**
	[0.012]						[0.008]		[0.011]
Difference of total capital inflows	0.003						0.005	0.001	0.001
	[0.004]						[0.004]	[0.001]	[0.003]
Difference of size of LCBMs		−0.262	−0.258	−0.194	0.171	−0.268	−0.327	−0.741*	−1.230**
		[0.407]	[0.446]	[0.334]	[0.318]	[0.367]	[0.428]	[0.346]	[0.431]
Asia			0.084	−0.083	0.024	0.152*	0.074	−0.093	−0.169**
			[0.073]	[0.058]	[0.040]	[0.074]	[0.086]	[0.062]	[0.051]
Observations	55	24	24	22	22	21	23	20	19
R-squared	0.263	0.025	0.093	0.557	0.540	0.381	0.144	0.824	0.878

CPI = consumer price index, GDP = gross domestic product, LCBM = local currency bond market.
Notes: The dependent variable is the difference of the exchange rate depreciation between period 2 (the taper tantrum) and period 1 (the global financial crisis). All the explanatory variables are similarly calculated be differencing the values between period 2 and period 1. The exchange rate regime is annual fine classification in Ilzetzki, Reinhart, and Rogoff (2017). India is included in the sample of emerging economies. Asia is a dummy variable for six Asian countries: Indonesia, Malaysia, People's Republic of China, Philippines, Republic of Korea, and Thailand. Numbers in parentheses are robust standard errors. ***, **, and * denotes the significance levels of 1%, 5%, and 10%, respectively.
Sources: Authors' calculations.

Table 4: Growth of Local Currency Bond Markets and Exchange Rate Depreciation during Crisis Periods *(continued)*

(b) India excluded

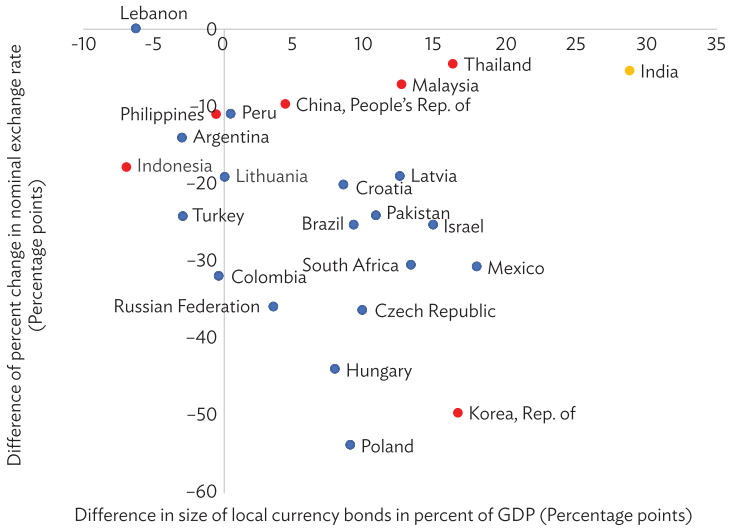
	Difference of Percent Change in Nominal Exchange Rate								
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Difference of increase in current account deficit (% of GDP)	0.005**			0.025***				0.035**	0.042**
	[0.002]			[0.005]				[0.013]	[0.013]
Difference of average annual percent change in real exchange rate	0.007			0.009**				0.007	0.007
	[0.005]			[0.003]				[0.007]	[0.008]
Difference of increase in credit-to-GDP ratio	0.001				0.007***			−0.002	−0.005
	[0.002]				[0.002]			[0.004]	[0.004]
Difference of log of portfolio liability	−0.011				0.005				−0.075
	[0.030]				[0.141]				[0.112]
Difference of reserves/M2	−0.221					−0.219**		−0.400**	−0.343*
	[0.167]					[0.094]		[0.163]	[0.180]
Difference of inflation (CPI)	−0.000					0.034***		0.033**	0.053**
	[0.005]					[0.010]		[0.012]	[0.017]
Difference of exchange rate regime	−0.011						−0.001		0.030**
	[0.013]						[0.009]		[0.009]
Difference of total capital inflows	0.002						0.003	0.001	0.001
	[0.003]						[0.002]	[0.001]	[0.002]
Difference of size of LCBMs		−0.684*	−0.725*	−0.547*	−0.216	−0.578	−0.728*	−0.818*	−1.267**
		[0.369]	[0.385]	[0.278]	[0.215]	[0.402]	[0.400]	[0.387]	[0.452]
Asia			0.104	−0.061	0.046	0.155**	0.095	−0.076	−0.149**
			[0.070]	[0.049]	[0.036]	[0.072]	[0.087]	[0.062]	[0.050]
Observations	54	23	23	21	21	20	22	19	18
R-squared	0.260	0.133	0.242	0.625	0.621	0.412	0.251	0.832	0.890

CPI = consumer price index, GDP = gross domestic product, LCBM = local currency bond market.

Notes: The dependent variable is the difference of exchange rate depreciation between period 2 (the taper tantrum) and period 1 (the global financial crisis). All the explanatory variables are similarly calculated be differencing the values between period 2 and period 1. The exchange rate regime is annual fine classification in Ilzetzki, Reinhart, and Rogoff (2017). India is excluded from the sample of emerging economies. Asia is a dummy for six Asian countries: Indonesia, Malaysia, People's Republic of China, Philippines, Republic of Korea, and Thailand. Numbers in parentheses are robust standard errors. ***, **, and * denotes the significance levels of 1%, 5%, and 10%, respectively.

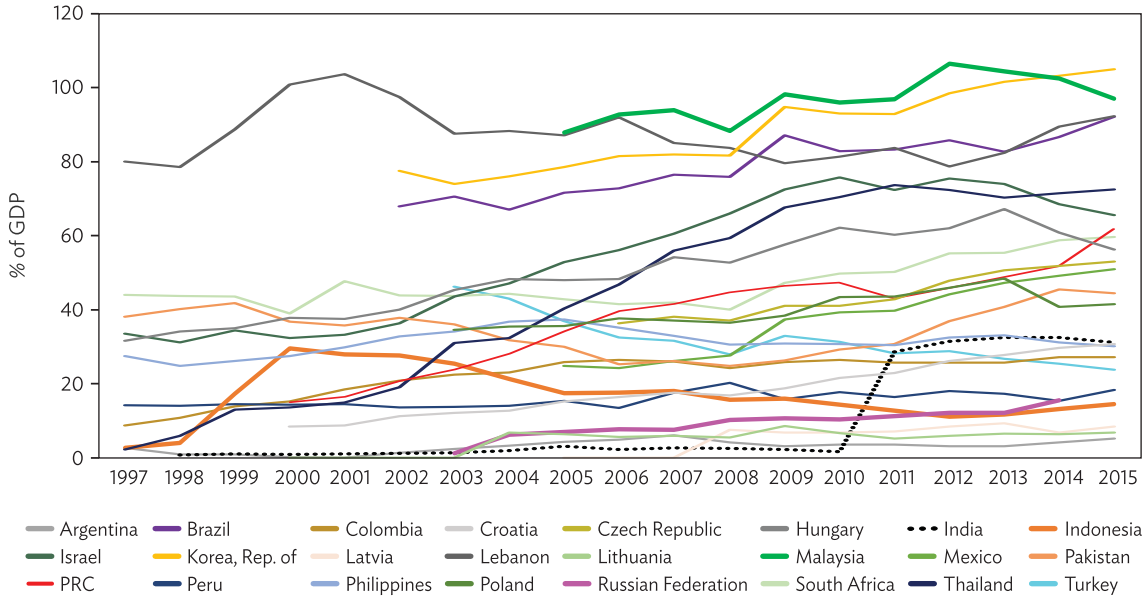
Sources: Authors' calculations.

Figure 5: The Relation between Increase in the Size of Local Currency Bond Markets and Increase in Nominal Exchange Rate Depreciation



Notes: Increase in the size of local currency bond markets between two periods (the taper tantrum and the global financial crisis) is on the horizontal axis and increase in nominal exchange rate depreciation, on the vertical axis. Asian countries are denoted by red dots except for India which is yellow-colored.
Sources: Authors' calculation.

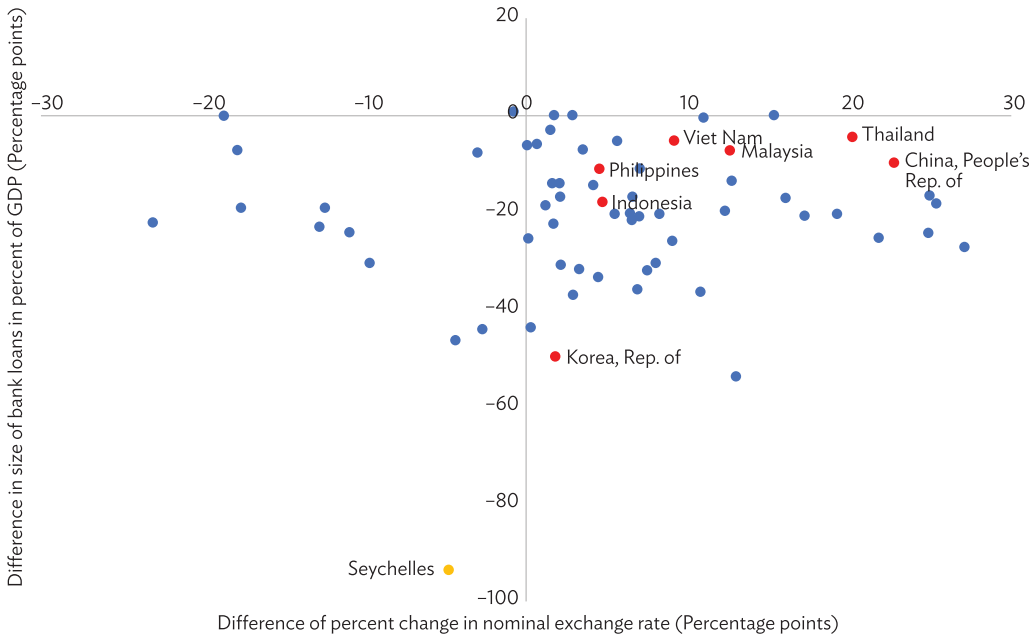
Figure 6: The Size of Local Currency Bond Markets Collected from the Bank for International Settlements Debt Securities Statistics



GDP = gross domestic product, PRC = People's Republic of China.
Notes: We calculate the size of local currency bond markets by adding the amount outstanding of domestic debt securities (DDS) and international debt securities (IDS) that are denominated in local currency. For some countries, for which only a subset of these statistics is available, we use the amount outstanding of DDS or total debt securities (TDS) after subtracting IDS that are not denominated in local currency. If (TDS-IDS) is negative, we make it zero.
Source: Authors' calculation based on the BIS Debt Securities Statistics.

In Table 5, we report regression results when we replace the difference in the size of LCBMs between the two periods with the difference in the size of bank loans, as percent of GDP. While the coefficient of the difference of bank loans in percent of GDP is always negative, it is statistically significant only in columns (5), (8), and (9). One common element of these columns is that the difference in increase in credit-to-GDP ratio is included as an explanatory variable. Note that this variable measures how rapidly the credit-to-GDP ratio increased before each stressed period. Hence the results suggest that if the increase in the credit-to-GDP ratio before the stress period is appropriately managed, the increase in the size of bank loans itself can be stabilizing. Usually a rapid increase in the credit-to-GDP ratio is accompanied by a rapid increase in noncore liabilities that mostly consist of foreign borrowings of the banking sector.[17] Hence a gradual increase in the bank loans-to-GDP ratio which is not accompanied by rapid increase in noncore liabilities can reduce vulnerability to external shocks. Figure 7 plots the relation between the increase in bank loans, as percent of GDP, and the increase in nominal exchange rate depreciation.[18] Since the difference in increase in credit-to-GDP ratio is not appropriately controlled, no clear negative relationship shows up between the two variables.

Figure 7: The Relation between Increase in Bank Loans and Increase in Nominal Exchange Rate Depreciation



Notes: Increase in bank loans between two periods (the taper tantrum and the global financial crisis) is on the horizontal axis and increase in nominal exchange rate depreciation, on the vertical axis. Bank loans is measured by domestic credit to the private sector by banks collected from the World Development Indicators. Asian countries are denoted by red dots and an outlier country, Seychelles, is denoted by yellow.
Sources: Authors' calculation.

[17] See Shin and Shin (2011) for the concept of noncore liabilities. They classify retail deposits as core liabilities and the other components of bank funding as the noncore liabilities. Hahm, Shin, and Shin (2013) show that the noncore liabilities are mostly banking sector liabilities of the foreign sector and a large stock of noncore liabilities serves as an indicator of the erosion of risk premium and hence of vulnerability to a crisis.

[18] In Figure 7, Seychelles is an outlier. The regression results do not qualitatively change if we exclude Seychelles or not. Table 7 reports the regression results where Seychelles is excluded in the sample.

Table 5: Growth of Bank Loans and Exchange Rate Depreciation during Crisis Periods

	Difference of Percent Change in Nominal Exchange Rate								
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Difference of increase in current account deficit (% of GDP)	0.002			0.004**				0.001	0.00212
	[0.002]			[0.002]				[0.002]	(0.00179)
Difference of average annual percent change in real exchange rate	0.001			0.002					0.00250
	[0.003]			[0.003]					(0.00345)
Difference of increase in credit-to-GDP ratio	0.002				0.004***			0.004***	0.00345**
	[0.001]				[0.001]			[0.001]	(0.00169)
Difference of log of portfolio liability	−0.013				0.009				0.00461
	[0.034]				[0.038]				(0.0333)
Difference of reserves/M2	−0.045					−0.049			−0.0823
	[0.126]					[0.115]			(0.114)
Difference of inflation (CPI)	−0.000					0.001			−0.00200
	[0.004]					[0.005]			(0.00427)
Difference of exchange rate regime	−0.004						−0.004		−0.00974
	[0.008]						[0.005]		(0.00806)
Difference of total capital inflows	0.002						0.004		0.00299
	[0.004]						[0.004]		(0.00307)
Difference of bank loans (% of GDP)		−0.000	−0.000	−0.001	−0.004**	−0.001	−0.001	−0.004**	−0.00447**
		[0.001]	[0.001]	[0.001]	[0.002]	[0.001]	[0.001]	[0.002]	(0.00194)
Asia			0.052	0.061	0.056	0.060	0.052	0.053	0.0845
			[0.062]	[0.060]	[0.060]	[0.065]	[0.073]	[0.061]	(0.0777)
Observations	54	63	63	58	61	59	61	61	54
R-squared	0.122	0.000	0.016	0.083	0.186	0.025	0.043	0.187	0.216

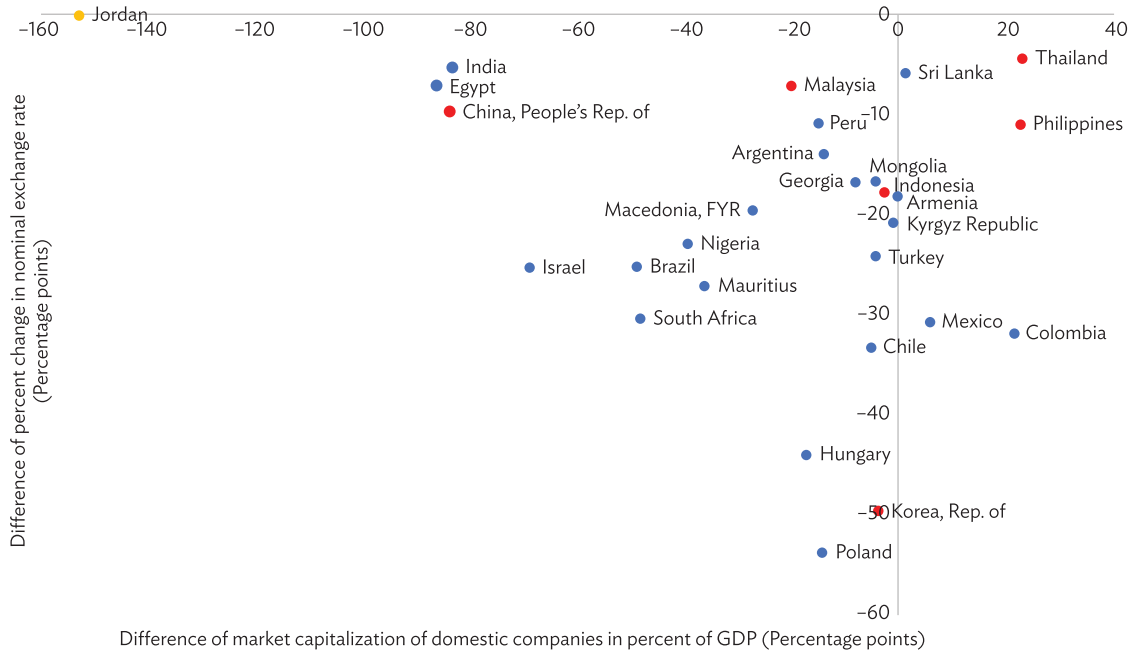
CPI = consumer price index, GDP = gross domestic product.

Notes: The dependent variable is the difference of exchange rate depreciation between period 2 (the taper tantrum) and period 1 (the global financial crisis). All the explanatory variables are similarly calculated be differencing the values between period 2 and period 1. Bank loans is measured by of domestic credit to the private sector by banks (% of GDP) collected from the World Development Indicators. The exchange rate regime is annual fine classification in Ilzetzki, Reinhart, and Rogoff (2017). Asia is a dummy variable for seven Asian countries: Indonesia, Malaysia, People's Republic of China, Philippines, Republic of Korea, Thailand, and Viet Nam. Numbers in parentheses are robust standard errors. ***, **, and * denotes the significance levels of 1%, 5%, and 10%, respectively.

Sources: Authors' calculations.

Finally, Table 6 reports regression results when we replace the difference in the size of LCBMs between the two periods with the difference of stock market capitalization, as a percentage of GDP. While the coefficient of the difference of stock market capitalization in percentage of GDP is always negative, it is statistically significant only in column (4), at the 10% level. Hence, the evidence of a contribution to financial stability is much weaker for stock markets than for LCBMs or bank loans.[19] Figure 8 plots the relation between the increase in stock market capitalization, as a percentage of GDP, and the increase in nominal exchange rate depreciation. The figure fails to show any clear relationship between the two variables.

Figure 8: The Relation between Increase in Stock Market Capitalization and Increase in Nominal Exchange Rate Depreciation



FYR = Former Yugoslav Republic.
Notes: Increase in stock market capitalization between two periods (the taper tantrum and the global financial crisis) is on the horizontal axis and increase in nominal exchange rate depreciation, on the vertical axis. Asian countries are denoted by red dots and an outlier country, Jordan, is denoted by yellow.
Sources: Authors' calculation.

[19] Since Jordan is an outlier, we report the results in Table 7 without including it in the sample of countries.

Table 6: Growth of Stock Market Capitalization and Exchange Rate Depreciation during Crisis Periods

	Difference of Percent Change in Nominal Exchange Rate								
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Difference of increase in current account deficit (% of GDP)	0.005*			0.006*				0.005*	0.0114**
	[0.002]			[0.003]				[0.002]	(0.00421)
Difference of average annual percent change in real exchange rate	0.007			0.008**				0.004	0.00200
	[0.005]			[0.004]				[0.004]	(0.00555)
Difference of increase in credit-to-GDP ratio	0.002				0.004**			0.003	0.00340
	[0.002]				[0.002]			[0.002]	(0.00257)
Difference of log of portfolio liability	−0.011				−0.022				−0.0495**
	[0.031]				[0.048]				(0.0220)
Difference of reserves/M2	−0.216					−0.198			−0.517**
	[0.166]					[0.140]			(0.211)
Difference of inflation (CPI)	−0.000					−0.005			−0.00942
	[0.005]					[0.007]			(0.0110)
Difference of exchange rate regime	−0.011						0.010		0.00362
	[0.012]						[0.013]		(0.01000)
Difference of total capital inflows	0.003						0.003		−0.000127
	[0.004]						[0.004]		(0.00211)
Difference of market capitalization of domestic companies (% of GDP)		−0.001	−0.001	−0.001*	−0.001	−0.001	−0.001	−0.001	−0.000876
		[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	(0.000809)
Asia			0.076	0.059	0.028	0.084	0.075	0.034	0.00543
			[0.070]	[0.061]	[0.059]	[0.074]	[0.101]	[0.060]	(0.0958)
Observations	54	27	27	25	27	27	25	25	23
R-squared	0.262	0.027	0.085	0.295	0.303	0.155	0.127	0.362	0.601

CPI = consumer price index, GDP = gross domestic product.

Notes: The dependent variable is the difference of exchange rate depreciation between period 2 (the taper tantrum) and period 1 (the global financial crisis). All the explanatory variables are similarly calculated be differencing the values between period 2 and period 1. Stock market capitalization is measured as a percentage of GDP, collected from the World Development Indicators. The exchange rate regime is annual fine classification in Ilzetzki, Reinhart, and Rogoff (2017). Asia is a dummy variable for six Asian countries: Indonesia, Malaysia, People's Republic of China, Philippines, Republic of Korea, and Thailand. Numbers in parentheses are robust standard errors. ***, **, and * denotes the significance levels of 1%, 5%, and 10%, respectively.

Sources: Authors' calculations.

V. CONCLUSION

According to conventional wisdom, LCBMs can enhance financial stability in developing economies. In particular, developing LCBMs of varying maturities can mitigate the double mismatch of currency mismatch and maturity mismatch—i.e., borrowing short term in foreign currency and lending long term in domestic currency—that lay at the heart of the Asian financial crisis. In this paper, we empirically test this conventional wisdom by analyzing and comparing financial vulnerability during two episodes of financial stress—global financial crisis and taper tantrum—and the role of LCBM in reducing vulnerability. Our main finding is that developing economies which experienced greater expansion of their LCBMs between the two episodes experienced a greater reduction of exchange rate depreciation, a measure of financial vulnerability. This provides a possibility that LCBMs protect the financial systems of developing countries from destabilizing external shocks.

The literature points to other benefits of fostering bigger, deeper, and more liquid LCBMs in development economies. They include mitigation of global imbalances, better risk sharing, and long-term financing of long-term investments such as infrastructure and housing. Of particular interest for developing countries is the role of LCBMs as facilitators of productive long-term investments that can lift long-term economic growth. Well-developed LCBMs can also contribute to a more diversified and balanced financial system which is more resilient to shocks. In the future, it will be interesting to empirically examine if the development of LCBMs generates these other benefits as well. At a broader level, empirically testing for the effects of LCBM development, instead of just assuming them, will give us a more accurate understanding of exactly how LCBMs benefit developing economies.

APPENDIX

Table A.1: Sample of Countries

Albania	Indonesia	Nigeria
Armenia	Israel	Pakistan
Bangladesh	Jamaica	Paraguay
Brazil	Jordan	Peru
Bulgaria	Kenya	Philippines
Cape Verde	Kazakhstan	Poland
Chile	Korea, Republic of	Romania
China, People's Republic of	Kyrgyz Republic	Russian Federation
Colombia	Latvia	Seychelles
Costa Rica	Lesotho	South Africa
Croatia	Lithuania	Sri Lanka
Czech Republic	Macedonia, FYR	Suriname
Dominican Republic	Malaysia	Tanzania
Egypt	Mauritius	Thailand
Georgia	Mexico	Turkey
Ghana	Moldova	Uganda
Guatemala	Mongolia	Ukraine
Honduras	Morocco	Uruguay
Hungary	Mozambique	Venezuela, Rep. Bol
India	Nicaragua	Viet Nam

FYR = Former Yugoslav Republic.
Notes: The sample follows Park, Ramayandi, and Shin (2016) that start by including developing economies covered by Lim, Mohapatra, and Stocker (2014) and adds other emerging economies in Eichengreen and Gupta (2015). We also include the People's Republic of China. However, we dropped Hong Kong, China and Singapore as these two financial centers are not considered as developing economies. We also ended up dropping some countries for reasons of data availability.
Source: Authors' compilation.

Table A.2: Definitions of Variables and Data Sources

Variables	Description and Construction	Data Source
Percent change in nominal exchange rate, Apr 2013–Aug 2013 and Jul 2007–Jun 2009	Log difference in nominal exchange rate (National Currency per US dollar) from April 2013 to August 2013 and from July 2007 to June 2009	IMF International Financial Statistics
Increase in current account deficit (% of GDP), 2010–2012 and 2005–2007	Difference in current account deficit from 2010 to 2012 and from 2005 to 2007	World Bank World Development Indicators
Average annual percent change in real exchange rate, 2009–2012 and 2005–2007	[Log of nominal exchange rate 2012 (or 2007) M12 * CPI of US 2012 (or 2007) M12 /CPI of each country 2012 (or 2007) M12 – Log of nominal exchange rate 2009 (or 2005) M1 * CPI of US 2009 (or 2005) M1 /CPI of each country 2009 (or 2005) M1] /3	IMF International Financial Statistics
Increase in credit-to-GDP ratio, 2009–2012 and 2004–2007	Increase in domestic credit to the private sector (% of GDP) from 2009 to 2012 and from 2004 to 2007	World Bank World Development Indicators
Log of portfolio liability, 2011 and 2007	Sum of portfolio equity and portfolio debt security 2011 and 2007	Lane and Milesi-Ferretti dataset that extends Lane and Milesi-Ferretti (2007)
Reserves/M2, 2012 and 2007	Inverse of money and quasi money (M2) to total reserves ratio 2012 and 2007	World Bank World Development Indicators
Inflation (CPI), 2012 and 2007	Inflation, consumer prices (annual%) 2012 and 2007	World Bank World Development Indicators
Exchange rate regime (Annual fine classification in Ilzetzki, Reinhart, and Rogoff (2017), 2010 and 2007	Exchange rate regime Annual fine classification in Ilzetzki, Reinhart, and Rogoff (2017), 2010 and 2007	Ilzetzki, Reinhart, and Rogoff (2017)
Total capital inflows during QE and before global financial crisis	Sum of equity, bond, loan during QE and before global financial crisis	IMF Balance of Payments database
Size of LCBMs, 2012 and 2007	Sum of domestic debt securities and local international debt securities 2012 and 2007	BIS Debt Securities database
Bank loans (% of GDP), 2012 and 2007	Domestic credit to the private sector by banks 2012 and 2007	World Bank World Development Indicators
Asia	A dummy of Asia countries	

BIS = Bank for International Settlements, CPI = consumer price index, GDP = gross domestic product, IMF = International Monetary Fund, LCBM = local currency bond market, QE = quantitative easing, US = United States.
Source: Authors' compilation.

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Do Local Currency Bond Markets Enhance Financial Stability?

This publication analyzes the financial vulnerability of developing countries during the global financial crisis and taper tantrum. It finds that currency depreciation, as a measure of financial vulnerability, was more limited in countries with faster growing local currency bond markets.

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