Do Local Currency Bond Markets Enhance Financial Stability? Some Empirical Evidence

Introduction

Currency and maturity mismatches are widely viewed as a major source of financial vulnerability in developing markets.[10] If an economy's financial liabilities are denominated in a foreign currency such as United States (US) dollars but its financial assets are denominated in the domestic currency, then a sudden depreciation of the domestic currency damages its balance sheet, destabilizing the financial system and the overall economy. If the maturity of its financial liabilities is shorter than the maturity of its assets, the likelihood of a crisis further increases. In short, borrowing on short term in a foreign currency and lending on long term in the domestic currency is a recipe for instability and even crisis. The double mismatch problem (currency and maturity) was a contributing factor to the devastating 1997/1998 Asian financial crisis.

In the aftermath of the crisis, markets in members of the Association of Southeast Asian Nations (ASEAN) and the People's Republic of China (PRC), Japan, and the Republic of Korea—collectively known as ASEAN+3—prioritized the development of local currency (LCY) bond markets as a major policy objective.[11] In 2003, the finance ministers of the ASEAN+3 economies introduced the Asian Bond Markets Initiative to develop LCY bond markets in the region. Given the region's heavy reliance on bank financing, developing LCY bond markets can contribute to a larger role for capital markets and thus more diversified and balanced financial systems across the region. The painful experience of the 1997/1998 Asian financial crisis highlighted the need for the region's bank-centered financial systems to develop LCY bond markets as a "spare tire" to enhance resilience in the event of shocks.

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

The central objective of this chapter is to empirically investigate the role of LCY bond markets in enhancing financial stability in developing markets by mitigating currency and maturity mismatches. To do so, we analyze and compare the financial vulnerability of developing economies during two episodes of financial stress: the Global Financial Crisis and the so-called Taper Tantrum. We find that economies whose LCY bond markets experienced greater expansion in size between the two episodes also experienced a greater reduction in exchange rate depreciation during the latter episode, indicating the stabilizing role of LCY bond markets. Our evidence indicates that a gradual expansion of bank loans may also contribute to financial stability. On the other hand, we do not find any evidence of a stabilizing effect for stock market development.

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

[11] See, for example, Park (2016) for initiatives to develop LCY bond markets in Asia.

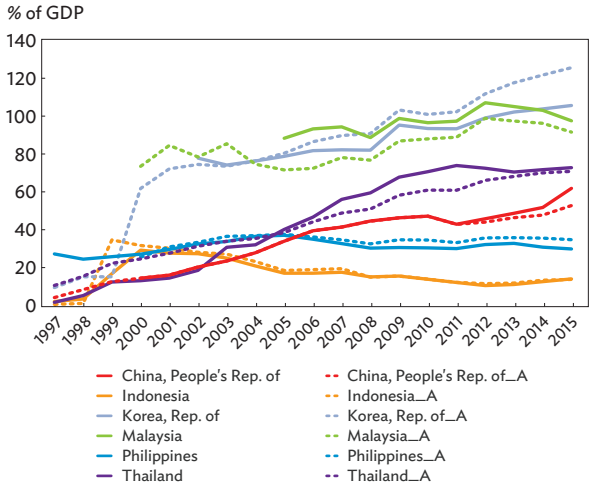
Recent Developments in Asia's Local Currency Bond Markets

Data on the amount outstanding of LCY bond markets are not widely available. *AsianBondsOnline* reports time series data for the following Asian LCY bond markets: the PRC; Hong Kong, China; Indonesia; Japan; the Republic of Korea; Malaysia; the Philippines; Singapore; Thailand; and Viet Nam. To include as many developing economies as possible in this study, we use debt securities statistics from the Bank for International Settlements (BIS) in our main empirical analysis.[12]

The BIS' debt securities statistics report total debt securities (TDS) issued by residents. TDS are divided into domestic debt securities (DDS) and international debt securities (IDS).[13] 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 by those issued in local currencies and those in foreign currencies. We calculate the size of local currency bond markets by adding the outstanding amounts of DDS and IDS that are denominated in local currency. For some markets, only a subset of these statistics is available. If the outstanding amount of IDS denominated in local currency is missing, we use the outstanding amount of DDS only.[14] 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 14 shows the size of LCY bond markets in Asia calculated as a percentage of gross domestic product (GDP).[15] We also plot the size of LCY bond markets using data obtained from the *AsianBondsOnline* website. The amount of LCY bonds outstanding calculated from the two sources is quite similar. The figure shows that since the 1997/1998 Asian financial crisis, the amount of LCY bonds outstanding increased substantially in the PRC, the Republic of Korea, and Thailand. According to *AsianBondOnline*, the size of the LCY bond market as a share of GDP in 1998 in the PRC, the Republic of Korea, and Thailand was 9%, 16%, and 16%, respectively. These shares had increased to 53%, 125%, and 71%, respectively, by 2015. The growth of LCY bond markets in other Asian economies has not been as dramatic. In fact, the relative size of LCY bond markets has been steadily decreasing in Indonesia since 2000 and in the Philippines since 2005.

Figure 14: Size of Local Currency Bond Markets as a Share of Gross Domestic Product for Select Asian Economies



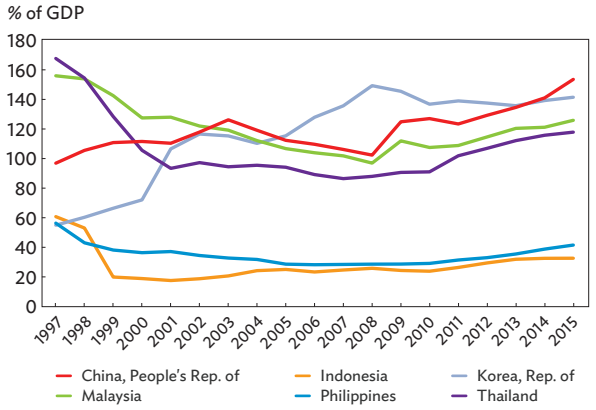
GDP = gross domestic product.
Notes:
1. Hong Kong, China; Japan; and Singapore are not shown since they are advanced economies and/or financial centers.
2. For each market, the solid line represents the size of local currency bond markets based on data collected by the Bank for International Settlements and the dotted lines are based on data from *AsianBondsOnline*. We calculate the size of local currency bond markets by adding the amount outstanding of domestic debt securities and international debt securities that are denominated in local currency. For those markets for which only a subset of these statistics is available, we use the amount outstanding of domestic debt securities or total debt securities after subtracting international debt securities that are not denominated in local currency.

Sources: Authors' calculations based on the Bank for International Settlements' Debt Securities Statistics, World Bank's World Development Indicators, and data from *AsianBondsOnline*.

Figure 15 illustrates the size of bank loans as a percentage of GDP for Asian economies.[16] In contrast to LCY bond markets, the relative size of bank loans as a share of GDP in Asian economies has not increased much since 1998. The Republic of Korea and the PRC are two exceptions,

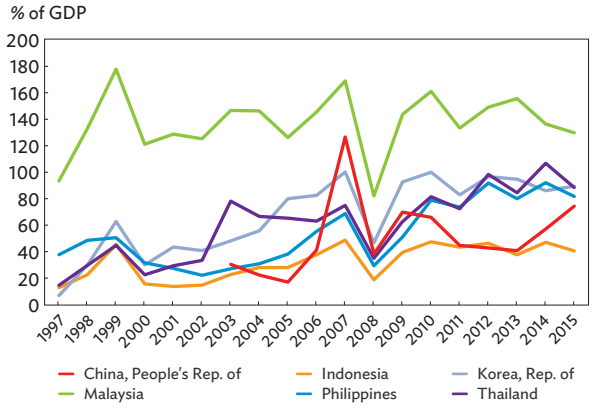
[12] A number of authors used the BIS data to measure the size of LCY bond markets. See, for example, Bae (2012) and Burger and Warnock (2006).
[13] The sum of DDS and IDS is not exactly the same as TDS due to potential overlap between DDS and IDS.
[14] IDS are compiled from a security-by-security database built by BIS and the relevant information is supplied by commercial data providers. IDS are mostly compiled from data reported to BIS by central banks. For a few countries, BIS collects data directly from publicly available sources. BIS does not calculate TDS and its statistics are published only when central banks provide the relevant data to BIS. For more information on debt securities statistics, see the BIS webpage at http://www.bis.org/statistics/about_securities_stats.htm
[15] Hong Kong, China; Japan; and Singapore are not included since they are advanced economies and/or financial centers. The nominal GDP data are collected from the World Bank's World Development Indicators.
[16] Bank loans are domestic credit provided to the private sector by banks. Data were collected from the World Bank's World Development Indicators.

Figure 15: Bank Loans as a Share of Gross Domestic Product for Select Asian Economies



GDP = gross domestic product.
Note: Bank loans are domestic credit provided to the private sector by banks.
Source: World Bank. World Development Indicators. http://data.worldbank.org/data-catalog/world-development-indicators

Figure 16: Stock Market Capitalization as a Share of Gross Domestic Product for Select Asian Economies



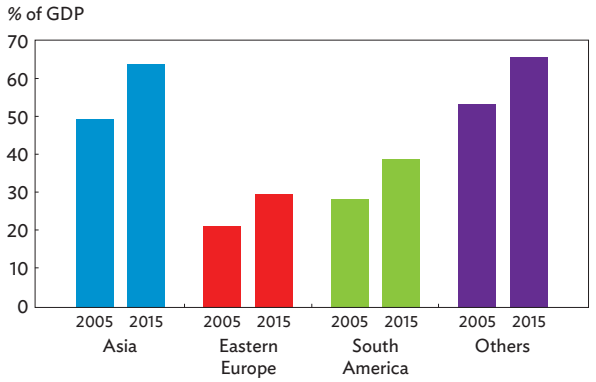
GDP = gross domestic product.
Source: Source: World Bank. World Development Indicators. http://data.worldbank.org/data-catalog/world-development-indicators

but even in these economies bank loans grew more slowly than LCY bond markets. 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 economies, the relative size of bank loans was lower in 2015 than in 1998.

Figure 16 presents stock market capitalization as a percentage of GDP, which has been increasing in most Asian markets in recent decades. Between 1998 and 2015, stock market capitalization increased from 23%–49% to 41%–89% in Indonesia, the Republic of Korea, the Philippines, and Thailand. Generally, the region's stock markets grew more slowly than the region's LCY bond markets during the review period. Taken together, Figures 14–16 show that, on average, LCY bond markets grew more rapidly than both bank loans and stock markets in Asian economies.

Figure 17 shows the size of LCY bond markets as a share of GDP in 2005 and 2015 for various regions. While the relative size of LCY bond markets is larger in Asia than in Eastern Europe and South America in both years, growth is comparable across regions. Hence, we can conclude that the development of LCY bond markets is not an Asia-specific trend.

Figure 17: Growth of Local Currency Bond Markets in Various Regions



GDP = gross domestic product.
Notes:
1. The size of local currency bond markets is based on data collected from the Bank for International Settlements. We calculate the size of local currency bond markets by adding the amount outstanding of domestic debt securities and international debt securities that are denominated in local currency. For those markets for which only a subset of these statistics is available, we use the amount outstanding of domestic debt securities or total debt securities after subtracting international debt securities that are not denominated in local currency.
2. Asia comprises the People's Republic of China, Indonesia, the Republic of Korea, Malaysia, the Philippines, and Thailand. Eastern Europe comprises Croatia, the Czech Republic, Hungary, Latvia, Lithuania, Poland, the Russian Federation, and Turkey. South America comprises Argentina, Brazil, Colombia, Mexico, and Peru. Others comprises South Africa, Israel, Lebanon, and Pakistan.

Source: Authors' calculations based on Bank for International Settlements' Debt Securities Statistics.

Empirical Framework

One main benefit of LCY bond markets is that they foster financial stability by mitigating currency and maturity mismatches. A logical implication is that LCY bond market development reduces the vulnerability of financial markets in developing markets to external shocks. We can test this hypothesis following the empirical approach used by Eichengreen and Gupta (2015) and Park, Ramayandi, and Shin (2016). These studies sought to identify the factors associated with the destabilizing impact of the Taper Tantrum on developing economies. Both studies used exchange rate depreciation as the measure of financial vulnerability and empirically analyzed which factors influence the effects of quantitative easing tapering on exchange rate depreciation.

The basic regression equation estimated by Eichengreen and Gupta (2015) and Park, Ramayandi, and Shin (2016) 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 market i during the Taper Tantrum—defined as the period between the end of April 2013 and the end of August 2013—and X_i is a vector of market-specific factors for the economy i that are associated with exchange rate depreciation.[17] The factors considered by these studies include (i) the deterioration in the current account deficit and real exchange rate appreciation before the Taper Tantrum (2010–2012) 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–M2 ratio as measures of economic fundamentals; and (iv) the exchange rate regime and institutional quality as structural variables. These variables are measured either in 2012 or as their averages from 2010–2012.[18]

We will use the same setup but add the size of LCY bond markets to equation (1) as an additional explanatory variable. We will investigate whether the development of LCY bond markets has any beneficial effect on financial vulnerability in the sense that emerging economies with a larger LCY bond market experienced less exchange rate depreciation during the Taper Tantrum. In particular, we will estimate the effect of LCY bond market size after controlling for the above explanatory variables that were also used in Eichengreen and Gupta (2015) and Park, Ramayandi, and Shin (2016).

Eichengreen and Gupta (2015) and Park, Ramayandi, and Shin (2016) 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 an economy to other financial stress episodes. For example, the same equation can be estimated for the Global Financial Crisis to check if the same factors caused financial vulnerability during both the Global Financial Crisis and the Taper Tantrum. Therefore, we estimate equation (1) for both period 1 (Global Financial Crisis) and period 2 (Taper Tantrum):

$$ERD_{ip} = X_{ip}\beta + \epsilon_{ip}, \qquad \text{p=1 or 2} \quad (2)$$

where p=1 (period 1) is for the Global Financial Crisis and p=2 (period 2) is for the Taper Tantrum.

One advantage of considering both periods is that now we can eliminate market-fixed effects by combining the experiences of the two periods. Since the estimation of equation (1) in Eichengreen and Gupta (2015) and Park, Ramayandi, and Shin (2016) is a cross-section regression, unobservable market-fixed effects, f_i, may not have been completely eliminated, thereby generating biased estimates as follows:

$$ERD_{ip} = X_{ip}\beta + f_i + \epsilon_{ip}, \qquad \text{p=1 or 2} \quad (3)$$

In equation (3), if f_i and ϵ_{ip} are correlated, the estimates of β should be biased. However, if market-fixed effects, f_i, are not time-varying, we can eliminate market-fixed effects by taking the difference of equation (3) across periods and estimating the following equation:

$$\Delta ERD_i = \Delta X_i\beta + \delta_i \quad (4)$$

where $\Delta ERD_i = ERD_{i2} - ERD_{i1}$, $\Delta X_i = X_{i2} - X_{i1}$, and $\delta_i = \epsilon_{i2} - \epsilon_{i1}$. Since f_i is no longer present, estimates of β in equation (4) are not biased.

[17] The list of emerging markets is included in the Appendix as Table A1.
[18] Please refer to Park, Ramayandi, and Shin (2016) for a more comprehensive discussion of the variables and data.

Empirical Findings

The data sources for most explanatory variables are the World Bank's World Development Indicators (WDI) and the IMF's International Financial Statistics (IFS).[19] Specifically, the current account deficit as a percentage of GDP, the foreign reserves–M2 ratio, real GDP growth rate, and inflation are collected from WDI; the real exchange rate is calculated by using the nominal exchange rate against the US dollar; and domestic inflation indexes and the US Consumer Price Index are collected from IFS. Private capital flows data are measured by the net incurrence of liabilities of equity, debt securities, and other debt instruments in the financial account, as reported in the IMF's Balance of Payments Statistics. Exchange rate regime classification follows the categorizations of the 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 5 presents summary statistics of the variables for both periods 1 and 2. On average, the nominal exchange rate depreciation, which is 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

Table 5: Summary Statistics

A. Period 1: Global Financial Crisis

	Observations	Mean	Minimum	Maximum
Percentage 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 Percentage 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 Ratio, 2012	59	0.431	0.059	1.731
Inflation (CPI), 2012	59	6.673	0.510	15.842
Exchange Rate Regime (Annual fine classification of Reinhart and Rogoff), 2010	57	7.860	2.000	13.000
Total Capital Inflows during Quantitative Easing	59	4.863	–0.093	65.581
Size of Local Currency Bonds, 2012	22	0.361	0.000	0.939
Asia	59	0.119	0.000	1.000

B. Period 2: Taper Tantrum

	Observations	Mean	Minimum	Maximum
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 Percentage 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 Ratio, 2007	59	0.388	0.080	1.180
Inflation (CPI), 2007	59	5.540	–0.944	21.069
Exchange Rate Regime (Annual fine classification of Reinhart and Rogoff), 2007	57	7.947	2.000	13.000
Total Capital Inflows before Global Financial Crisis	59	7.082	–1.057	129.918
Size of Local Currency Bonds, 2007	21	0.482	0.111	1.065
Asia	59	0.119	0.000	1.000

CPI = Consumer Price Index, GDP = gross domestic product, M2 = money and quasi-money.
Note: See Table A2 in the Appendix for definitions and sources of variables.
Source: Authors' calculations.

[19] Definitions of variables and data sources are explained in the Appendix in Table A2.

Global Financial Crisis. A comparison of the statistics across periods yields other interesting observations. For example, the deterioration of the current account deficit and capital inflows were larger during period 2 than during period 1. There is not much difference in the other explanatory variables.

Table 6 reports the regression results of equation (1) in period 2. In column (1), we replicate Park, Ramayandi, and Shin (2016), except that we do not include real GDP growth and the rule of law as explanatory variables.[20] While the number of observations increased substantially due to changes in the IFS database, the main results in Park, Ramayandi, and Shin (2016) are preserved.[21] For example, the appreciation of real exchange rates and the increase in the credit-to-GDP ratio are highly significant at the 1% level. While the increase in the 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 LCY bond markets as an explanatory variable. We add an Asia dummy in column (3) that takes the value of one for seven Asian markets and zero otherwise.[22] Irrespective of whether the Asia dummy is included or not, the size of LCY bond markets is not statistically significant, indicating that economies with a larger LCY bond market do not necessarily experience less exchange rate depreciation.

Since data on the size of LCY bond markets are available only for a limited number of markets, it might not be desirable to include too many explanatory variables. The reduction in the number of observations due to the inclusion of LCY bond market size may cause the

Table 6: Local Currency Bond Markets and Exchange Rate Depreciation in Emerging Economies during the Taper Tantrum

Variables	Percentage Change in Nominal Exchange Rate								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Increase in Current Account Deficit (% of GDP), 2010–2012	0.001 [0.001]			0.005 [0.003]					0.009*** [0.003]
Average Annual Percentage Change in Real Exchange Rate, 2009–2012	−0.005*** [0.002]			−0.007*** [0.002]				−0.006** [0.003]	−0.000 [0.003]
Increase in Credit-to-GDP Ratio, 2009–2012	0.002*** [0.001]				0.002* [0.001]			0.002** [0.001]	0.001 [0.001]
Log of Portfolio Liability, 2011	0.001 [0.003]				0.023 [0.016]				−0.013 [0.022]
Reserves–M2 Ratio, 2012	0.032 [0.022]					−0.029 [0.065]			0.005 [0.039]
Inflation (CPI), 2012	0.001 [0.001]					0.012* [0.006]		0.014** [0.005]	0.012* [0.005]
Exchange Rate Regime (Annual fine classification of Reinhart and Rogoff), 2010	0.001 [0.002]						0.002 [0.004]		0.003 [0.008]
Total Capital Inflows during Quantitative Easing	0.002** [0.001]						0.003*** [0.001]	0 [0.000]	0.003** [0.001]
Size of Local Currency Bonds, 2012		−0.004 [0.033]	−0.004 [0.040]	−0.014 [0.038]	−0.034 [0.037]	0.026 [0.050]	−0.040 [0.026]	0.033 [0.029]	−0.002 [0.026]
Asia			−0.000 [0.025]	−0.005 [0.018]	−0.017 [0.026]	0.014 [0.022]	0.026 [0.017]	0.009 [0.018]	0.026 [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, M2 = money and quasi-money.
Note: The dependent variable is the exchange rate depreciation experienced by the developing economy between the end of April 2013 and the end of August 2013. An increase in nominal and real exchange rates represents depreciation. The exchange rate regime is the annual fine classification in Ilzetzki, Reinhart, and Rogoff (2017). Asia is a dummy variable for six Asian markets: the People's Republic of China, Indonesia, the Republic of Korea, Malaysia, the Philippines, and Thailand. Numbers in brackets are robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10%, levels, respectively.
Source: Authors' calculations.

[20] Since the GDP growth and rule of law variables were never significant in Park, Ramayandi, and Shin (2016), we decided to omit them.
[21] The reason the number of observations differs is due to capital inflows data. For this paper, we downloaded the IFS data on 15 March 2017 from http://data.imf.org/?sk=5DABAFF2-C5AD-4D27-A175-1253419C02D1. Park, Ramayandi, and Shin (2016) used data collected from IMF (2013). Interestingly, observations reported as zeros in the IMF (2013) data are reported as missing values on the IFS website. We sum the amounts of bond, equity, and loan flows unless any one of the three flows is missing.
[22] The seven Asian markets are the People's Republic of China, Indonesia, India, the Republic of Korea, Malaysia, the Philippines, and Thailand. Viet Nam is not included in the Asian dummy since the BIS Debt Securities Data are not available.

problem of overfitting if all the explanatory variables are included simultaneously. Hence, in columns (4)–(7), besides the size of LCY bond markets and the Asia dummy, we include two additional explanatory variables. For example, in column (4), we include the increase in the current account deficit and the average annual percent change in the real exchange rate. In column (5), we include the increase in the credit-to-GDP ratio and the log of portfolio liabilities. In column (8), in addition to the size of LCY bond markets and the Asia dummy, we include all significant variables in columns (4)–(7). In the last column, we also report the estimation results when all the explanatory variables are included. The results show that neither the size of LCY bond markets nor the Asia dummy is statistically significant in any column. Hence, the cross-section regression results for period 2 seem to suggest that LCY bond markets did not necessarily mitigate the impact of the Taper Tantrum in emerging economies.

In **Table 7**, we report the same cross-section regression results for period 1. Unlike the results for period 2, the increases in the current account deficit and the average annual percentage change in the real exchange rate are not statistically significant. Instead, the increase in the 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 (7). Like the results in Table 6, however, the size of LCY bond markets remains statistically insignificant in most columns, suggesting that LCY bond markets did not mitigate the impact of the Global Financial Crisis either.

In **Table 8a**, 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 the current account deficit is even more statistically significant. In columns (5) and (6), the increase in the credit-to-GDP ratio, the reserves–M2 ratio, and inflation are all statistically significant with the right sign. The coefficient of average annual percent change in the real exchange rate

Table 7: Local Currency Bond Markets and Exchange Rate Depreciation in Emerging Economies during the Global Financial Crisis

Variables	Percentage Change in Nominal Exchange Rate								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Increase in Current Account Deficit (% of GDP), 2005–2007	0.003 [0.004]			0.008 [0.010]					0.018 [0.011]
Average Annual Percentage Change in Real Exchange Rate, 2004–2007	0.953 [0.716]			−0.678 [0.539]					0.047 [0.500]
Increase in Credit-to-GDP Ratio, 2004–2007	−0.000 [0.002]				0.005*** [0.002]			0.002 [0.002]	−0.001 [0.002]
Log of Portfolio Liability, 2007	−0.026 [0.025]				0.071*** [0.024]			0.012 [0.054]	−0.041 [0.067]
Reserves–M2 Ratio, 2007	0.048 [0.097]					−0.112 [0.155]			−0.227* [0.119]
Inflation (CPI), 2007	0.001 [0.007]					0.010 [0.010]			−0.009 [0.013]
Exchange Rate Regime (Annual fine classification of Reinhart and Rogoff), 2007	0.023*** [0.008]						0.025*** [0.008]	0.022* [0.011]	0.022* [0.011]
Total Capital Inflows before Global Financial Crisis	0.014** [0.006]						0.006*** [0.002]	0.005 [0.004]	0.012 [0.008]
Size of Local Currency Bonds, 2007		−0.004 [0.131]	0.055 [0.161]	0.213 [0.138]	0.064 [0.109]	0.237* [0.133]	0.036 [0.072]	0.049 [0.075]	0.041 [0.105]
Asia			−0.098 [0.079]	−0.094 [0.091]	−0.094 [0.061]	−0.149** [0.065]	−0.049 [0.055]	−0.048 [0.071]	0.045 [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, M2 = money and quasi-money.
Note: The dependent variable is the exchange rate depreciation experienced by the developing economy 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 the annual fine classification in Ilzetzki, Reinhart, and Rogoff (2017). Asia is a dummy variable for six Asian markets: the People's Republic of China, Indonesia, the Republic of Korea, Malaysia, the Philippines, and Thailand. Numbers in brackets are robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.
Source: Authors' calculations.

Table 8a: Growth of Local Currency Bond Markets and Exchange Rate Depreciation during Crisis Periods (India included)

Variables	Difference of Percentage Change in Nominal Exchange Rate								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Difference of Increase in Current Account Deficit (% of GDP)	0.005** [0.002]			0.027*** [0.007]				0.039** [0.013]	0.045*** [0.013]
Difference of Average Annual Percentage Change in Real Exchange Rate	0.007 [0.005]			0.010*** [0.003]				0.009 [0.006]	0.008 [0.007]
Difference of Increase in Credit-to-GDP Ratio	0.001 [0.002]				0.008*** [0.002]			−0.004 [0.003]	−0.006 [0.004]
Difference of Log of Portfolio Liability	−0.017 [0.030]				−0.075 [0.145]				−0.126 [0.143]
Difference of Reserves–M2 Ratio	−0.223 [0.168]					−0.311** [0.115]		−0.489*** [0.152]	−0.413* [0.179]
Difference of Inflation (CPI)	0.000 [0.005]					0.040*** [0.011]		0.039*** [0.012]	0.059*** [0.017]
Difference of Exchange Rate Regime (Annual fine classification of Reinhart and Rogoff)	−0.011 [0.012]						−0.000 [0.008]		0.032** [0.011]
Difference of Total Capital Inflows	0.003 [0.004]						0.005 [0.004]	0.001 [0.001]	0.001 [0.003]
Difference in Size of Local Currency Bonds		−0.262 [0.407]	−0.258 [0.446]	−0.194 [0.334]	0.171 [0.318]	−0.268 [0.367]	−0.327 [0.428]	−0.741* [0.346]	−1.230** [0.431]
Asia			0.084 [0.073]	−0.083 [0.058]	0.024 [0.040]	0.152* [0.074]	0.074 [0.086]	−0.093 [0.062]	−0.169** [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

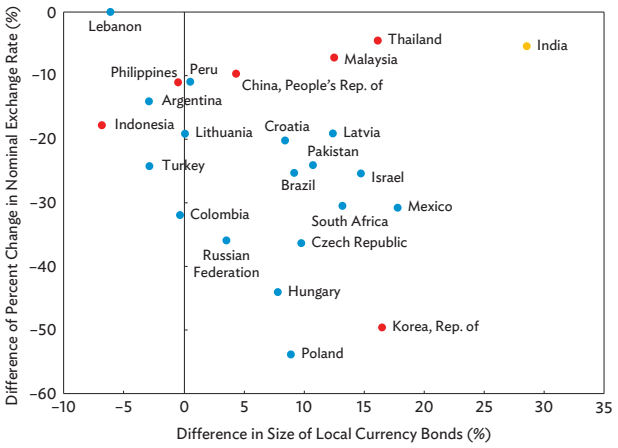
CPI = Consumer Price Index, GDP = gross domestic product, M2 = money and quasi-money.
Note: The dependent variable is the difference of the exchange rate depreciation between period 2 (Taper Tantrum) and period 1 (Global Financial Crisis). All the explanatory variables are similarly calculated by differencing the values between period 2 and period 1. India is included in the sample of emerging economies. Asia is a dummy variable for six Asian markets: the People's Republic of China, Indonesia, the Republic of Korea, Malaysia, the Philippines, and Thailand. Numbers in brackets are robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.
Source: Authors' calculations.

becomes insignificant in column (8), which includes all the variables that are significant in columns (4)–(7). On the other hand, the increase in the current account deficit, the reserves–M2 ratio, and inflation are all statistically significant with the right sign, even in column (8). The coefficient of the size of LCY bond markets 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 LCY bond markets becomes statistically significant at the 10% and 5% levels, respectively, with the right sign. In other words, the results in columns (8) and (9) suggest that economies with a larger LCY bond market in period 2 than in period 1 experienced less exchange rate depreciation, indicating that they have become more resilient to external shocks.

While Table 8a provides some evidence that the development of LCY bond markets enhances financial stability, the evidence is not compelling. **Figure 18** illustrates why this is so by presenting the relationship between the increase in the size of LCY bond markets 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 market, India. While the size of the LCY bond market 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 data problems. **Figure 19** illustrates the size of LCY bond markets based on BIS debt statistics for 24 individual markets. India seems to have a discrepancy in the data that occurred around 2011—a discrepancy that can overstate the increase in the size of an LCY bond market between period 1 and period 2.

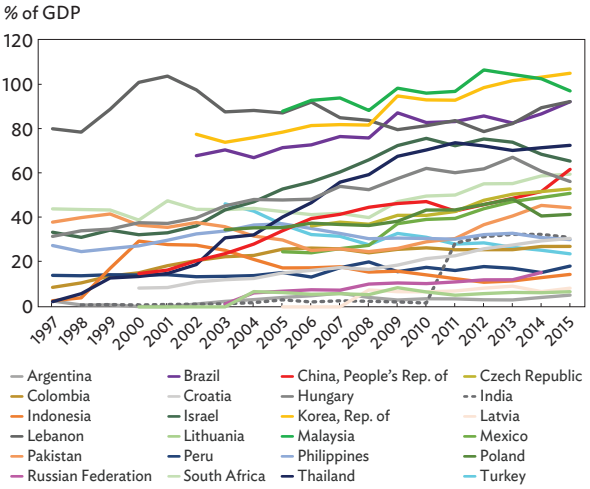
In light of such data problems, we exclude India from the sample and rerun the regression. **Table 8b** reports the ex-India regression results. The coefficient of the size of LCY bond markets becomes much more statistically significant. In columns (2) and (3), irrespective of whether the Asia dummy is included or not, the coefficient of the size of LCY bond markets is negative at the 10% level of significance. Even when other

Figure 18: The Relationship between an Increase in the Size of a Local Currency Bond Market and an Increase in Nominal Exchange Rate Depreciation



Note: Increase in the size of local currency bond markets between two periods (Taper Tantrum and Global Financial Crisis) is on the horizontal axis and the increase in nominal exchange rate depreciation is on the vertical axis. Asian markets are denoted by red dots, except for India, which is yellow-colored.
Source: Authors' calculation.

Figure 19: Size of Local Currency Bond Markets as Percentage of Gross Domestic Product



GDP = gross domestic product.
Note: We calculate the size of local currency bond markets by adding the amount outstanding of domestic debt securities and international debt securities that are denominated in local currency. For markets for which only a subset of these statistics is available, we use the amount outstanding of domestic debt securities or total debt securities after subtracting international debt securities that are not denominated in local currency. If total debt securities minus international debt securities is negative, we make it zero.
Source: Authors' calculation based on the Bank for International Settlements' Debt Securities Statistics.

Table 8b: Growth of Local Currency Bond Markets and Exchange Rate Depreciation during Crisis Periods (India excluded)

Variables	Difference of Percentage Change in Nominal Exchange Rate								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Difference of Increase in Current Account Deficit (% of GDP)	0.005** [0.002]			0.025*** [0.005]				0.035** [0.013]	0.042** [0.013]
Difference of Average Annual Percentage Change in Real Exchange Rate	0.007 [0.005]			0.009** [0.003]				0.007 [0.007]	0.007 [0.008]
Difference of Increase in Credit-to-GDP Ratio	0.001 [0.002]				0.007*** [0.002]			−0.002 [0.004]	−0.005 [0.004]
Difference of Log of Portfolio Liability	−0.011 [0.030]				0.005 [0.141]				−0.075 [0.112]
Difference of Reserves–M2 Ratio	−0.221 [0.167]					−0.219** [0.094]		−0.400** [0.163]	−0.343* [0.180]
Difference of Inflation (CPI)	−0.000 [0.005]					0.034*** [0.010]		0.033** [0.012]	0.053** [0.017]
Difference of Exchange Rate Regime (Annual fine classification of Reinhart and Rogoff)	−0.011 [0.013]						−0.001 [0.009]		0.030** [0.009]
Difference of Total Capital Inflows	0.002 [0.003]						0.003 [0.002]	0.001 [0.001]	0.001 [0.002]
Difference in Size of Local Currency Bonds		−0.684* [0.369]	−0.725* [0.385]	−0.547* [0.278]	−0.216 [0.215]	−0.578 [0.402]	−0.728* [0.400]	−0.818* [0.387]	−1.267** [0.452]
Asia			0.104 [0.070]	−0.061 [0.049]	0.046 [0.036]	0.155** [0.072]	0.095 [0.087]	−0.076 [0.062]	−0.149** [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, M2 = money and quasi-money.
Note: The dependent variable is the difference of the exchange rate depreciation between period 2 (Taper Tantrum) and period 1 (Global Financial Crisis). All the explanatory variables are similarly calculated by differencing the values between period 2 and period 1. India is included in the sample of emerging economies. Asia is a dummy variable for six Asian markets: the People's Republic of China, Indonesia, the Republic of Korea, Malaysia, the Philippines, and Thailand. Numbers in brackets are robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.
Source: Authors' calculations.

explanatory variables are included, the coefficient of the size of LCY bond markets is always negative and, in many cases, statistically significant at either the 10% or the 5% level. Hence, if the outlier (India) is excluded, we obtain more compelling evidence that the development of LCY bond markets enhances financial stability.

Figure 18 demonstrates Asian markets' exchange rate reaction during the Taper Tantrum. It is seen that only the Republic of Korea experienced the largest growth in its LCY bond market and the largest reduction in depreciation. In Malaysia and Thailand, even though LCY bond markets grew substantially between the two stress episodes, nominal exchange rate depreciation did not decline tangibly during the Taper Tantrum. Interestingly, however, in other emerging bond markets, the negative relation between the difference in LCY bond market size and the difference in the nominal exchange rate depreciation is even stronger, implying a beneficial effect of LCY bond markets on financial stability.

In **Table 9**, we report regression results when we replace the difference in the size of LCY bond markets between the two periods with the difference in the size of bank loans as a percentage of GDP. While the coefficient of the difference of bank loans as a percentage 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 the increase in the credit-to-GDP ratio is included as an explanatory variable. This variable measures how rapidly the credit-to-GDP ratio increased before each stress 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 in the banking sector.[23] Hence, a gradual increase in the bank loans-to-GDP ratio that is not accompanied by a rapid increase in

Table 9: Growth of Bank Loans and Exchange Rate Depreciation during Crisis Periods

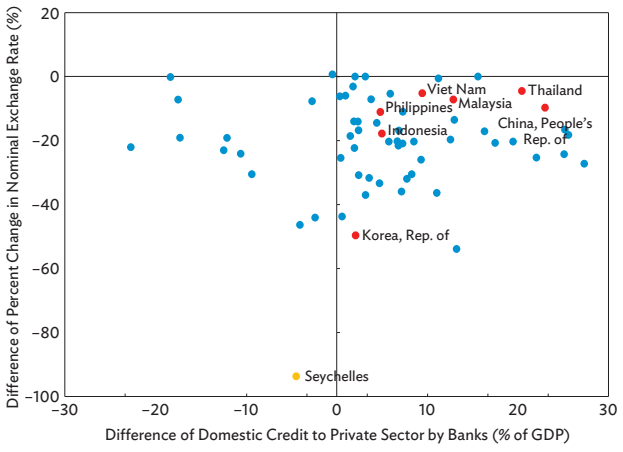
Variables	Difference of Percentage Change in Nominal Exchange Rate								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Difference of Increase in Current Account Deficit (% of GDP)	0.002 [0.002]			0.004** [0.002]				0.001 [0.002]	0.002 [0.002]
Difference of Average Annual Percentage Change in Real Exchange Rate	0.001 [0.003]			0.002 [0.003]					0.003 [0.003]
Difference of Increase in Credit-to-GDP Ratio	0.002 [0.001]				0.004*** [0.001]			0.004*** [0.001]	0.003** [0.002]
Difference of Log of Portfolio Liability	−0.013 [0.034]				0.009 [0.038]				0.005 [0.033]
Difference of Reserves–M2 Ratio	−0.045 [0.126]					−0.049 [0.115]			−0.082 [0.114]
Difference of Inflation (CPI)	0.000 [0.004]					0.001 [0.005]			−0.002 [0.004]
Difference of Exchange Rate Regime (Annual fine classification of Reinhart and Rogoff)	−0.004 [0.008]						−0.004 [0.005]		−0.010 [0.008]
Difference of Total Capital Inflows	0.002 [0.004]						0.004 [0.004]		0.003 [0.003]
Difference of Bank Loans (% of GDP)		−0.000 [0.001]	−0.000 [0.001]	−0.001 [0.001]	−0.004** [0.002]	−0.001 [0.001]	−0.001 [0.001]	−0.004** [0.002]	−0.004** [0.002]
Asia			0.052 [0.062]	0.061 [0.060]	0.056 [0.060]	0.060 [0.065]	0.052 [0.073]	0.053 [0.061]	0.085 [0.078]
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, M2 = money and quasi-money.
Note: The dependent variable is the difference of exchange rate depreciation between period 2 (Taper Tantrum) and period 1 (Global Financial Crisis). All the explanatory variables are similarly calculated by differencing the values between period 2 and period 1. Bank loans are measured as domestic credit provided to the private sector by banks (% of GDP) and collected from the World Bank's World Development Indicators. Asia is a dummy variable for seven Asian markets: the People's Republic of China, Indonesia, the Republic of Korea, Malaysia, the Philippines, Thailand, and Viet Nam. Numbers in brackets are robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.
Source: Authors' calculations.

noncore liabilities can reduce vulnerability to external shocks. **Figure 20** plots the relationship between the increase in bank loans as a percentage of GDP and the increase in nominal exchange rate depreciation.[24] Since the difference in the increase in the credit-to-GDP ratio is not appropriately controlled, no clear negative relationship shows up between the two variables.

Table 10 reports regression results when we replace the difference in the size of LCY bond markets 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 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 LCY bond markets or bank loans. **Figure 21** 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 20: The Relationship between an Increase in Bank Loans and an Increase in Nominal Exchange Rate Depreciation



GDP = gross domestic product.
Note: The increase in bank loans (% of GDP) between two periods (Taper Tantrum and Global Financial Crisis) is on the horizontal axis and the increase in nominal exchange rate depreciation is on the vertical axis. Bank loans are measured as domestic credit provided to the private sector by banks (% of GDP) and collected from the world Bank's World Development Indicators. Asian markets are denoted by red dots. An outlier market, the Seychelles, is denoted by a yellow dot.
Source: Authors' calculation.

Conclusion

According to conventional wisdom, LCY bond markets can enhance financial stability in developing markets. In particular, developing LCY bond markets that offer bonds of varying maturities can mitigate the double mismatch problem (currency and maturity) arising from borrowing short term in a foreign currency and lending long term in a domestic currency that lay at the heart of the 1997/1998 Asian financial crisis. 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 LCY bond markets in reducing vulnerability. Our main finding is that developing economies that experienced a greater expansion of their LCY bond market between the two episodes experienced a greater reduction in exchange rate depreciation, which is a measure of financial vulnerability, during the latter episode. This provides some empirical support for the notion that LCY bond markets protect the financial systems of developing economies from destabilizing external shocks.

The literature points to other benefits of fostering bigger, deeper, and more liquid LCY bond markets in developing markets. 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 economies is the role of LCY bond markets as facilitators of productive long-term investments that can lift long-term economic growth. Well-developed LCY bond markets can also contribute to a more diversified and balanced financial system that is more resilient to shocks. In the future, it will be interesting to empirically examine if the development of LCY bond markets generates these other benefits as well. At a broader level, empirically testing for the effects of LCY bond market development, instead of just assuming them, will give us a more accurate understanding of exactly how LCY bond markets benefit developing economies.

[23] 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 the risk premium and, hence, vulnerability to a crisis.

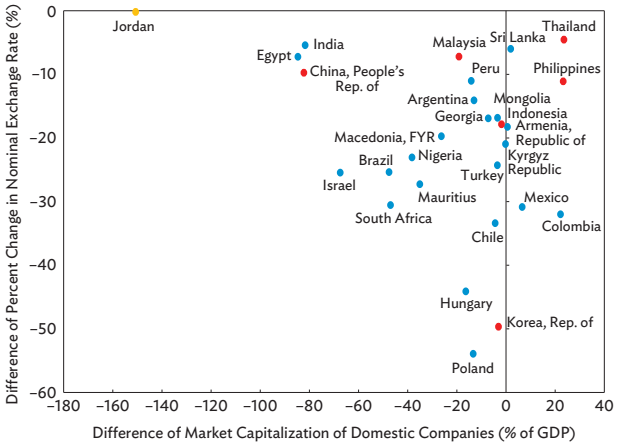
[24] In Figure 20, the Seychelles is an outlier. The regression results do not qualitatively change if we exclude outliers like the Seychelles and Jordan.

Table 10: Growth of Stock Market Capitalization and Exchange Rate Depreciation during Crisis Periods

Variables	Difference of Percentage Change in Nominal Exchange Rate								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Difference of Increase in Current Account Deficit (% of GDP)	0.005* [0.002]			0.006* [0.003]				0.005* [0.002]	0.011** [0.004]
Difference of Average Annual Percentage Change in Real Exchange Rate	0.007 [0.005]			0.008** [0.004]				0.004 [0.004]	0.002 [0.006]
Difference of Increase in Credit-to-GDP Ratio	0.002 [0.002]				0.004** [0.002]			0.003 [0.002]	0.003 [0.003]
Difference of Log of Portfolio Liability	-0.011 [0.031]				-0.022 [0.048]				-0.050** [0.022]
Difference of Reserves–M2 Ratio	-0.216 [0.166]					-0.198 [0.140]			-0.517** [0.211]
Difference of Inflation (CPI)	–0.000 [0.005]					-0.005 [0.007]			-0.009 [0.011]
Difference of Exchange Rate Regime (Annual fine classification of Reinhart and Rogoff)	-0.011 [0.012]						0.010 [0.013]		0.004 [0.010]
Difference of Total Capital Inflows	0.003 [0.004]						0.003 [0.004]		0.000 [0.002]
Difference of Market Capitalization of Domestic Companies (% of GDP)		-0.001 [0.001]	-0.001 [0.001]	-0.001* [0.001]	-0.001 [0.001]	-0.001 [0.001]	-0.001 [0.001]	-0.001 [0.001]	-0.009 [0.001]
Asia			0.076 [0.070]	0.059 [0.061]	0.028 [0.059]	0.084 [0.074]	0.075 [0.101]	0.034 [0.060]	0.005 [0.096]
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, M2 = money and quasi-money.
Note: The dependent variable is the difference of exchange rate depreciation between period 2 (Taper Tantrum) and period 1 (Global Financial Crisis). All the explanatory variables are similarly calculated by differencing the values between period 2 and period 1. Stock market capitalization is measured as a percentage of GDP and the data is collected from the World Bank's World Development Indicators. Asia is a dummy variable for six Asian markets: the People's Republic of China, Indonesia, the Republic of Korea, Malaysia, the Philippines, and Thailand. Numbers in brackets are robust standard errors. ***, **, and * denote the significance at the 1%, 5%, and 10% levels, respectively.
Source: Authors' calculations.

Figure21: Relationship between an Increase in Stock Market Capitalization and an Increase in Nominal Exchange Rate Depreciation



GDP = gross domestic product.
Note: The increase in stock market capitalization (% of GDP) between two periods (Taper Tantrum and Global Financial Crisis) is on the horizontal axis and the increase in nominal exchange rate depreciation, is on the vertical axis. Asian economies are denoted by red dots and an outlier market, Jordan, is denoted by a yellow dot.
Source: Authors' calculation.

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Appendix

Table A1: Sample of Markets

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 Rep. 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, Bolivarian Rep.
India	Nicaragua	Viet Nam

Note: The sample follows Park, Ramayandi, and Shin (2016) by including developing markets covered by Lim, Mohapatra, and Stocker (2014) and then adds other emerging economies included in Eichengreen and Gupta (2015). We also include the People's Republic of China. However, we dropped Hong Kong, China and Singapore as they are financial centers and not considered to be developing economies. We also ended up dropping some markets for reasons of data availability.culations.
Source: Authors' compilation.

Table A2: Definitions of Variables and Data Sources

Variables	Description and Construction	Data Source
Percentage Change in Nominal Exchange Rate, 2013m4–2013m8 and 2007m7–2009m6	Log difference in nominal exchange rate (local currency per US dollar) from April 2013 to August 2013 and from July 2007 to June 2009	IMF's 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's World Development Indicators
Average Annual Percentage 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 market 2012 (or 2007) M12 – Log of nominal exchange rate 2009 (or 2005) M1 * CPI of US 2009 (or 2005) M1 / CPI of each market 2009 (or 2005) M1] /3	IMF's International Financial Statistics
Increase in Credit-to-GDP Ratio, 2009-2012 and 2004–2007	Increase in domestic credit provided to private sector (% of GDP) from 2009 to 2012 and from 2004 to 2007	World Bank's World Development Indicators
Log of Portfolio Liability, 2011 and 2007	Sum of portfolio equity and portfolio debt securities in 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 in 2012 and 2007	World Bank's World Development Indicators
Inflation (CPI), 2012 and 2007	Inflation, consumer prices (annual % change) in 2012 and 2007	World Bank's World Development Indicators
Exchange Rate Regime (Annual fine classification of Reinhart and Rogoff), 2010 and 2007	Exchange rate regime Reinhart and Rogoff—annual fine classification in 2010 and 2007	Reinhart and Rogoff Exchange Regime dataset
Total Capital Inflows during QE and before Global Financial Crisis	Sum of equity, bond, and loan inflows during QE and before Global Financial Crisis	IMF's Balance of Payments database
Size of Local Currency Bonds, 2012 and 2007	Sum of domestic debt securities and local international debt securities in 2012 and 2007	BIS' Debt Securities database
Bank Loans (% of GDP), 2012 and 2007	Domestic credit provided to private sector by banks in 2012 and 2007	World Bank's World Development Indicators
Asia	A dummy of Asian markets	

BIS = Bank for International Settlements, CPI = Consumer Price Index, GDP = gross domestic product, IMF = International Monetary Fund, M2 = money and quasi-money, QE = quantitative easing.
Source: Authors' compilation.