Currency mismatches in Emerging Market Economies: Measurement, Causes, and Policy Implications*

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Abstract

We examine the financial vulnerabilities of 22 emerging market economies (EMEs). We analyze the currency risk using original sin hypothesis and measure the currency mismatches using a novel data set on foreign currency assets and liabilities. We show that Latin American countries have a higher value of original sin followed by Central European countries. The aggregate effective currency mismatch estimates show that Argentina, Colombia, Chile, Indonesia, Mexico, Poland, and Turkey suffer from high currency mismatch problem. Our investigation of the causes of currency mismatches reveals that global and country-specific characteristics such as country size, trade openness, and level of development explain the cross-country variation in currency mismatches. The recent increase in currency mismatches has gone hand-in-hand with an increase in financial stress of EMEs. The policymakers should monitor and curb foreign currency exposure via targeted country-specific macroeconomic policies. Our findings suggest that EMEs can make significant progress in reducing the currency mismatches by adapting macroprudential policies, monetary independence, stable monetary and fiscal policies, and creating a high-quality institutional environment.

JEL Classification: E44; F30; F34.

Keywords: Original sin; foreign currency debt; currency mismatch; macroprudential policies; monetary independence; Emerging market economies.

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1 Introduction

The open-economy macroeconomic literature shows that high-level foreign currency denominated debt (FCD) increases systematic risk and exacerbate currency and debt crisis in emerging and developing economies (EDEs). In the event of exchange rate depreciation, the cost of FCD increases and cause a negative balance sheet effects. However, currency risk can be hedged by earning foreign currency assets. The EDEs such as China can sustain with a substantial levels of FCD because of higher earnings in foreign currency. Therefore, measuring the net foreign currency position of a country uncovers the extent of gravity of the problem of currency mismatch. The currency mismatches – defined as the mismatch between assets and liabilities in which the liabilities denominated in foreign currency and assets are in local currency.

In this paper, we analyze the evolution of foreign currency exposure and currency mismatches in emerging market economies (EMEs) and investigate the causes of currency mismatches. In international finance architecture, the US dollar plays a key role in transactions and debt contracts. In currency borrowings, the dollar is the dominant currency because the dollar credit to the non-banking sector outside the US rose to 14 percent of world gross domestic product (GDP) from 9.5 percent from 2007 to 2018 (BIS, 2018). The dollar dominance is due to the inability of many EDEs to borrow from abroad in their own currency, and such inability is often called "original sin" and continue to be a source of concern (Eichengreen et al., 2005a; Acharya et al., 2015; Kuruc et al., 2016). The original sin problem can lead to an increase in the use of FCD and is likely to cause the currency mismatches in EDEs. The recent currency and debt crisis in EMEs indicate the importance of controlling the level of sovereign and corporate debt denominated in foreign currency (Mishkin, 1999; Aguiar, 2005).

Similarly, the measurement of currency mismatches is essential because mismatches increase the likelihood of a financial crisis. Eichengreen et al. (2005a,b; 2007), Goldstein

and Turner (2004), Park (2010), and Chui et al. (2018) emphasize the need for a comprehensive method of measuring currency mismatches in EMEs. Hence, the original sin and currency mismatch indicators assume significance and have important implications for economic growth and macroeconomic policy.

We contribute to the literature on open economy macroeconomics in multiple ways. First, we measure of currency mismatches; this computation helps to understand foreign currency exposure by EMEs. The original sin hypothesis (Eichengreen et al., 2005a) and aggregate effective currency mismatch (Goldstein and Turner, 2004) are primary currency mismatch indicators. These indicators suffer from several drawbacks. For instance, the original sin hypothesis (Eichengreen et al., 2005a) considers only the liability side but neglects the assets side. Goldstein and Turner's (2004) method covers both sides of the balance sheets and computes foreign currency exposure by using the residence principal.

Nevertheless, measuring external vulnerabilities should be based on data broken down by currency (nationality approach) rather than the residence principle because the domestic financial relations of the country are associated with the rest of the world (Tobal, 2018). We compare the original sin index with country-level data on the share of foreign currency debt in total debt outstanding. Besides, the recent developments in foreign currency exposure of the EMEs are unexplored before. Gagnon (2014), Tobal (2018), and Chui et al. (2018) document that EMEs lengthened their foreign currency exposure during the recent period, and literature on currency mismatches paid little attention to the currency risks (Baek, 2013; Benetrix et al., 2015). In this context, our study assumes further importance.

Second, we employ diverse and comprehensive data sets on foreign currency exposure, and thus implications of the study are robust. We use the balance sheet information to calculate the net asset position in foreign currency held by EMEs. Further, this study constructs a unique dataset to measure the currency mismatches in EMEs. We follow the methodology of Kuruc et al. (2016) and Chui et al. (2018) to develop the currency mismatch index. Third, we estimate the original sin index for the EMEs using granular data on international

debt securities. We also introduce the panel regression analysis to conduct an empirical analysis on currency mismatches (to capture the heterogeneity across countries). The panel regression methodology accounts for the time-varying and unobserved characteristics of the covariates of currency mismatches.

Our next contribution is to provide evidence on the role of effective monetary and fiscal policy on controlling currency mismatches. The first school of thought holds international factors such as transaction costs, externalities, and global market imperfections, causing currency mismatch problem. On the other hand, the second school holds domestic factors such as lack of monetary policy credibility, ineffective macroeconomic policy, and institutions as the leading causes of financial instability and currency mismatches. The fiscal policy also plays a crucial role in the management of external debt (Reinhart et al., 2003b). However, no study empirically tests these propositions with a complete measure of currency mismatches.

Finally, this study is the first to examine the effects of macroprudential policy and monetary independence on controlling currency mismatches. We examine a wide range of macroeconomic and institutional factors which were not analyzed in the context of currency mismatches in the previous work. Ostry et al. (2012), Terrier et al. (2012), Tobal (2014; 2018), and Purnawan et al. (2015) highlight that macroprudential policy measures enhance the exchange rate stability and financial system. In the same vein, the macroprudential policy instruments play a crucial role in controlling currency mismatches. Therefore, we estimate the association between prudential policy instruments and currency mismatches. Our study has substantial research and policy implications.

In this paper, we find that EMEs face severe financial fragilities and currency mismatches problem in the presence of a high value of original sin. The present work proves significant role of monetary and fiscal policies in controlling currency mismatches. We also document effects of monetary independence and macroprudential policy on currency mismatches. The finding of the study implies that quality institutional environment and exchange rate policy are the crucial factors to reduce the currency mismatches in EMEs.

The rest of the paper is organized as follows. The next section reviews the conceptual framework and analytical issues for the measurement and causes of currency mismatches. The following section presents the evaluation of foreign currency exposure and highlights the key stylized facts on foreign currency exposure by EMEs. The data and methodology used in the empirical analysis are reported in Section 4. The penultimate section presents the evidence on the factors explaining currency mismatches while final sections conclude the paper with policy implications.

2 Conceptual Framework and Analytical Issues

The researchers view currency risk in three ways – debt intolerance, original sin, and currency mismatch. These three concepts focus on the open economy balance sheet effects with varied directions. Reinhart et al. (2003) in their seminal paper, define debt intolerance as the inability of many EDEs to handle external debt levels. They hold history of economic mismanagement of debt capacity, institutional weakness, and high inflation as the root causes of debt intolerance. Eichengreen et al. (2005b) develop the original sin hypothesis and find those intrinsic characteristics of global financial markets and the structure of international portfolios as the sources of the original sin problem. Moreover, these factors are beyond the control of EDEs. Nonetheless, the proponents of debt intolerance argue that original sin is the cause of past and present domestic institutional weakness. Indeed, both the original sin and debt intolerance explain the volatility of EDEs and inability to repay their debt, but the concepts are not identical.

The term 'currency mismatch' introduced by Goldstein and Turner (2004) is the difference between the currency composition of liabilities and assets. The currency mismatch is the consequence of original sin and debt intolerance problem. Eichengreen et al. (2007) argue that these three concepts are analytically distinct and focus on the problem of the structure of global financial markets, which lead to original sin. In light of these arguments, this

study emphasizes the importance of measuring currency risk and investigate the factors determining the currency mismatches.

2.1 Original sin hypothesis

Eichengreen et al. (2005a) define original sin as "the inability of a country to borrow abroad in its own currency".[1] The sin occurs when the economies exhibit the lack of monetary creditability, poor credit ratings, and the higher volatility of capital flows and output. Overall, the incompleteness in financial markets is the cause of original sin. Many EMEs are even unable to borrow in long-term interest rates within the domestic market known as the domestic original sin, whereas the inability of the country to raise the credit from the international market is international original sin. Eichengreen et al. (2005a) construct three indices of original sin (OSIN):

$$OSIN1 = \left(1 - \frac{\text{Securities issued by country i in currency i}}{\text{Securities issued by country i}}\right) \tag{1}$$

If the county issues all the securities in domestic (foreign) currency, then OSIN1 is zero (one). However, OSIN1 does not include swaps. Hence, the OSIN2 index includes hedging instruments such as swaps. Finally, the OSIN3 includes OSIN2 and long-term debt indexed to prices and impose lower bounds,

$$OSIN3 = \text{Max}\left(1 - \frac{\text{Securities in currency i}}{\text{Securities issued by country i}}, 0\right) \tag{2}$$

The original sin index ranges between 0 and 1. The value close to one is a severe original sin position, and the lower value suggests a secure position. However, Goldstein and Turner (2004) criticize the original sin indices as a measure of currency mismatches on several grounds. First, original sin indicators consider the liability side of the balance sheet effect, whereas both assets and liabilities can be used to hedge foreign exchange positions. Second,

[1] Earlier, Eichengreen and Hausmann (1999) introduced the concept of original sin.

the original sin framework ignores the essential inputs, such as the differences in export openness across the nations, the size of the foreign assets, and reserve holdings of the countries to assess currency risks. Third, original sin indicators exclude foreign currency assets and receipts over time. Finally, the original sin index does not consider international bonds and bank loans.

2.2 Currency mismatches

In seminal work, Goldstein and Turner (2004) define the currency mismatches as "how the change in the exchange rate will affect the present discounted value of the future income and expenditure flows". In other words, the currency mismatches refer to the mismatches between assets and liabilities of a country or sector or firm, where the liabilities denominated in foreign currency and assets or revenue in domestic currency. In the event of exchange rate depreciation, the value of liabilities increase, and the currency mismatch problem aggravate further. As a result, currency mismatches lead to financial instability in EMEs. Moreover, the change in the exchange rate affects the financial position of a country in two ways, such as stock and flow. The sensitivity of the balance sheet to change in exchange rate called a '*stock aspect of currency mismatches*.' On the other hand, the sensitivity of income statement to change in exchange rate known as '*flow aspect of currency mismatches*.'

2.3 The measurement of currency mismatches

The literature discusses the various methods of measuring currency mismatches. The earliest measure of currency mismatches in the literature is the original sin hypothesis. Later, Goldstein and Turner (2004) construct an aggregate effective currency mismatch (AECM) index to overcome the drawbacks of original sin indicators. They consider external vulnerability indicators at the aggregate level using the residence principle and include both sides of the balance sheet items. The AECM is calculated as follows:

$$AECM = \frac{NFCA}{M} \times FC\%TD \quad \text{if NFCA} > 0 \tag{3}$$

$$AECM = \frac{NFCA}{X} \times FC\%TD \quad \text{if NFCA} < 0 \tag{4}$$

where *NFCA* is the net foreign currency assets.[2] M and X are respectively the country's imports and exports of goods and services; *FCTD* represents foreign currency share of the total debt.[3] $AECM > 0$ indicate net asset position in foreign currency of a country whereas the $AECM < 0$ suggest the net liability position; $AECM = 0$ (no currency mismatch) when foreign currency liabilities equal assets. The exchange rate depreciation causes a negative balance sheet as well as a competitive effect when there is a net liability position. On the other hand, the net asset position can have a positive balance sheet and competitive effect.

AECM method has some limitations. First, the external vulnerabilities should be based on currency denomination rather than residence principal because the country's financial relations are associated with the rest of the world (Levy-Yeyati, 2006; Eichengreen et al., 2007; Tobal, 2013). Second, AECM method underestimates the balance sheet problem with the net foreign currency position. Third, Lane and Shambaugh (2010) argue that AECM neglects the components of capital flows, such as foreign direct investment (FDI) and portfolio investment.[4] Hence this method does not capture the full currency composition of an international balance sheet. Further, the trade-weighted exchange rate indices are insufficient to understand the financial impact of currency mismatches. Therefore, Lane and Shambaugh (2010a) consider the dual role of the exchange rate and its variation in

[2]The positive *NFCA* denotes net asset position in foreign currency, and negative value implies net liability position in foreign currency. The negative *NFCA* leads to negative currency mismatches in EDEs. The *NFCA* includes net foreign assets of monetary authorities and deposits of money banks, and foreign currency assets of non-banks held with BIS reporting banks minus foreign currency liabilities of non-banks to BIS reporting banks and international debt securities outstanding.

[3]The *FCTD* is the composite of liabilities of non banks and non-banks to BIS reporting, domestic credit to the private sector, international and domestic debt securities outstanding.

[4]However, the equity related instruments like FDI and portfolio investment are excluded in AECM because the instruments may not have the characteristics of FCD and FCA.

international currency exposure.[5] Moreover, AECM covers the internal foreign currency exposure, i.e., one resident to another resident's bond and bank financing in foreign currency, and does not include the offshore finance vehicles.

Unlike the Goldstein and Turner's (2004) measure of currency mismatch, Kuruc et al. (2016) and Chui et al. (2018) develop a new method that combines two distinct components of currency mismatches. The following indicators for measuring currency mismatches to overcome the above limitations of AECM are as following:

$$MR_{i,t} = \frac{FCTD_{i,t}}{XGDP_{i,t}} \tag{5}$$

$$AECM_{i,t} = MR_{i,t} \times (\frac{NFCA_{i,t}}{GDP_{i,t}}) \tag{6}$$

where $MR_{i,t}$ is the mismatch ratio; $FCTD_{i,t}$ and $XGDP_{i,t}$ are denoted as the foreign currency share of total debt and the ratio of exports of goods and services to overall GDP for country i and year t. The $FCTD_{i,t}$ is a much broader component than external debt denominated in foreign currency. The $NFCA_{i,t}$ stands for net foreign currency asset position.[6] Further, Kamil (2012), and Montoro and Rojas-Suarez (2012) use the proxies for measuring currency mismatches, such as a ratio of dollar debt to the sum of exports and dollar assets; ratio of foreign currency share of total debt to share of exports in GDP. However, these mismatch ratios hardly capture the complete foreign currency exposure.

The measurement of currency mismatches is a challenging task due to the lack of data, and a comprehensive method that captures complete foreign currency exposure is elusive. The AECM method covers internal foreign currency exposure and it is based on residence principal. Kuruc et al. (2016) and Chui et al. (2018) extends the AECM methodology but empirically yet to be tested.

[5]The innovative contribution of Lane and Shambaugh (2010a) is the construction of financial weight of exposure for relevant currency and every country.

[6]*NFCA* computed as "the sum of (i) the net foreign assets of the central banks and other depository corporations *plus* (ii) non-bank foreign currency cross-border assets with BIS reporting banks *minus* (iii) non-bank foreign currency cross-border liabilities (excluding debt securities) to BIS reporting banks and *minus* (iv), non-bank international debt securities outstanding in foreign currency."

2.4 Causes of Currency Mismatches: Theoretical and Empirical Framework

The theoretical framework of the present study builds on moral hazard and original sin hypotheses. The pegged exchange rate regime offers an implicit guarantee to the borrowers against foreign currency debt. Such guarantee leads to a moral hazard problem by incentivizing excessive risk (Eichengreen and Hausmann, 1999). The fixed exchange rate regime increases the unhedged foreign currency debt.[7] The government's bailout and rescue packages of international financial institutions act as the implicit guarantee to external debt and furthers financial fragility. The original sin hypothesis shows that the flexible exchange rate regime lowers the FCD and enhances financial stability. Eichengreen and Hausmann (1999) suggest dollarization as an acceptable solution to control the moral hazard problem. However, Goldstein and Turner (2004) and Tobal (2013) refute the idea of dollarizing the economy. They argue that dollarization increases the currency mismatches in EMEs.

We find two schools of thought which discusses the causes of currency mismatches in EMEs. The first school opines that currency mismatch is because of the international factors such as the imperfection in global capital markets, transaction costs, and network externalities rather than inefficient domestic policies (Eichengreen et al., 2005a,b; Hausman and Panizza, 2003). On the other hand, Goldstein and Turner (2004) and Özmen and Arinsoy (2005) argue that domestic factors are the primary causes of currency mismatches.

Baek (2013) empirically tests the determinants of currency mismatches using data of Lane and Shambaugh (2010a) foreign currency exposure. Nevertheless, the data overestimates within-country foreign currency exposure and inappropriate for the partially dollarized economies. Further, the author fails to prove the influence of monetary and fiscal policies and exchange rate regimes on currency mismatches. Goldstein and Turner (2004) argue that these factors are significant causes of currency mismatches.

[7] See, Mishkin (1996); Obstfeld (1998).

3 Foreign Currency Exposure and Currency Mismatches: Stylized Facts

To measure the foreign currency exposure and mismatches, we selected a group of 22 EMEs period from 2008 to 2017 based on data availability (see Table 1 for country coverage). The measurement of foreign currency risk and currency mismatches in EME is a challenging task due to the insufficient data. We adopt the new methodology suggested by Kuruc et al. (2016) and Chui et al. (2018) to measure the currency mismatches in EMEs, i.e., AECM. To achieve this objective, we collected data from BIS, IMF, and World Bank databases. We follow a two-step procedure to measure the currency mismatches. First, we construct the mismatch ratio (Eq. 5), i.e., the share of foreign currency in total debt outstanding (FCTD). Second, we estimate the foreign currency exposure as the difference between foreign currency assets and liabilities, i.e., NFCA.

3.1 Original sin

We present the first measure of currency mismatch, i.e., original sin. Eichengreen et al. (2007) argue that the greater value of original sin leads to high currency mismatches. Table 2 presents the OSIN value for a sample of 20 EMEs. We find that greater value of original sin for the Latin American economies: Argentina, Chile, and Venezuela have OSIN value near to one implies greater currency mismatch. Similarly, Hungary, Chinese Taipei, Malaysia, Philippines, and Israel countries suffer from greater original sin problem.

Overall, EMEs have raised their original sin value after the taper tantrum crisis in 2013, except India has reduced its sin from 0.98 to 0.54. The drop in original sin in India as a result of India has started issuing rupee-denominated bonds, i.e., masala bonds in international market. Using OSIN as a measure of currency mismatch would be incomplete on many grounds. First, the index does not include cross-border bank loans. Second, it considers

only liability side of the balance sheet does not include the forex reserve holdings and export openness. Therefore, it is difficult to assess the currency risk of a country without taking into account foreign currency assets.

3.2 Foreign currency debt

The financial instability still exists in EMEs because of financial vulnerabilities such as high leverage risk and foreign currency exposure (IMF, 2017). The recent report on financial stability (2019) suggests that EMEs have financial vulnerabilities in sovereign, corporates, and non-banking financial sector firms. Moreover, the dollar debt issuance of EMEs has grown significantly over the last decade because of the cheapest source of capital. However, this comes at the cost of higher foreign currency exposure to currency risk by EMEs since dollar debt has risen from $1.57 trillion in 2008 to $3.67 trillion in 2018 (BIS, 2018) in these economies. The FCD in EDEs primarily denominated in US dollar ($3.67 trillion), Euro ($792 billion), and Japanese yen ($72 billion).

The first indicator of currency mismatches, FCTD presented in Fig. 1 under the assumption of both domestic bonds and bank loans are exclusively denominated in local currency. The FCTD is much lower than the international debt securities and cross-border bank loans in EMEs. Fig. (1) suggests that the FCTD reduced moderately over the period 2008 to 2017 in Central Europe. The Asian economies such as China, Chinese Taipei, India, Malaysia, South Korea, and Thailand have the lowest share of foreign currency in total debt than the other EMEs. On the other hand, the FCTD is much higher in the Latin American region (Argentina, Mexico, and Colombia have raised FCTD to 43.7, 25.1, and 20.5 per cents in 2017, respectively).

The Venezuelan economy has a successfully registered a drop in FCTD to 0.3 per cent from the highest 45.5 per cent. However, Indonesia, South Africa, and Turkey have peaked in FCTD recently. This finding holds that these economies are more exposed to foreign currency risk. The rapid accumulation of FCD by EMEs increase the severe threat to the

global economy with the presence of strong financial conditions in the US. It further narrows the central banks and policymaker's intervention in the debt market because the FCD directly related to the monetary policy of issuing country. For example, the appreciation of the US dollar and interest rate increases the refinancing cost of dollar debt in EMEs.

3.3 Net foreign currency assets position

We present estimates NFCA position, the second component of currency mismatch in Fig. (2). The NFCA helps to address the question of how large size currency mismatches can be a problem and how a country sustain even if it has high FCD and original sin. An economy with a high net foreign liability (asset) position faces the adverse balance sheet effect (positive) in the case of exchange rate depreciation. On the other hand, currency appreciation has a positive balance sheet effect for the net liability position of foreign currency assets vis-à-vis.

The eight EMEs have a net liability position in their aggregate balance sheet over the past decade (Fig. 2). In our sample, we observe that the negative NFCA position in Argentina, Chile, Colombia, Indonesia, Hungary, Mexico, Poland, and Turkey. It is also evident that many EMEs raise the NFCA position since 2008 (Brazil, Czech Republic, China, Chines Taipei, India, Israel, Philippines, South Korea, Russia, Thailand, and Venezuela). This positive NFCA is because of higher foreign exchange earnings in many EMEs. Moreover, the rise in "cross-border bank deposits of nonbanks with BIS reporting banks" is another significant reason for the positive NFCA position in some economies (Chui et al., 2016). However, since 2013, a positive NFCA turned into negative and increased the liability position of foreign currency in Argentina, Mexico, and Indonesia. The reason behind this shift is that the share of foreign currency debt in total debt has increased in these economies (see Fig. 1).

Hungary is the only country that succeeded in moving from the liability to asset position in foreign currency. It reduced the liabilities position from $47.6 billion to a positive asset position of $4.4 billion in foreign currency because of the current account surplus and export-led growth. On the other hand, many EMEs reached the highest negative NFCA position

in 2017, Turkey ($168.9 billion), Mexico ($69.9 billion), Argentina ($64.6 billion), Chile ($45.3 billion), Indonesia ($43.3 billion), Poland ($20.1 billion) and Colombia ($11.1 billion) possess largest negative NFCA position. In Argentina and Turkey, the new lira and peso crises further lead to raise a negative position in foreign currency.

3.4 Aggregate effective currency mismatches (AECM)

AECM is the combination of two indicators, FCTD and NFCA normalized with either exports or imports. If the economy has a net liability position (NFCA < 0) or FCA $<$ FCL, then we use the exports as the denominator in the AECM (Eq. 6); otherwise, imports. A negative value of AECM suggests a net liability position of the economy, and in the event of exchange rate deprecation, it leads to a negative balance sheet effect (net worth falls) and positive competitiveness effect (imports falls and exports rise). On the other hand, currency appreciation generates positive balance sheet effect and competitiveness effect; both will go in the same direction.

The magnitude of currency mismatch problem becomes severe in the case of the larger negative value of AECM (Fig. 3). On this count, three Latin American countries such as Argentina, Chile, and Mexico suffered from high currency mismatches. Although Mexico has larger levels of export earnings which greater than dollar debt, the country has registered larger currency mismatches during 2013-17 due to the high value of original sin (86%) (Table 2). The unstable monetary policy and larger dollarization are responsible for such mismatches. In Central Europe, Poland has a higher currency mismatch problem during the period 2008-17. On the other hand, Hungary succeeded in reducing the larger currency mismatches in its balance sheet by cutting down the external debt from 54.6 to 13.3 per cent of GDP between 2010 and 2017. Besides, the government of Hungary has strategically refinanced the debt in forint.

Currency mismatches tend to increase prior to the financial crises. The recent currency crisis in Turkey and Argentina are the result of the greater currency mismatches in their

balance sheets. This evidence is consistent with the argument that currency mismatches increase the likelihood of a financial crisis (see Goldstein and Turner, 2004; Eichengreen et al., 2007; Gagnon, 2014; Chui et al., 2018). However, our estimates also show that Venezuela has a positive asset position in foreign currency at the aggregate level, but still, it is in crisis. It seems that Venezuela is in crisis due to another source of vulnerability, i.e., foreign currency exposure by non-financial corporations. Therefore, the greater currency mismatches in EMEs suggest that the economies are highly vulnerable to the financial crises (exacerbate the currency, debt, and banking crisis) (Fig. 3). For example, it did so during the Tequila crisis in 1994 and the Asian financial crisis in 1997.

Overall, the evidence shows that Latin American countries suffer from a high currency mismatch problem. Colombia in the region never had currency mismatches till 2016; a smaller value of AECM turned into negative in 2017 that created financial vulnerabilities. Interestingly, Asian economies such as China, Chinese Taipei, India, and South Korea have successfully controlled the currency mismatches except for Indonesia who have currency mismatch problem since 2013. The Indonesian economy is now facing an external vulnerability risk, which is a similar kind of risk in the Asian crisis in 1997 (eg., greater original sin, 89%, and high currency mismatches).

In summary, the estimation of the AECM method shows that Argentina, Mexico, Chile, Colombia, Indonesia, Poland, and Turkey have a higher degree of currency mismatch problem. On the other hand, many EMEs reduced original sin problem in their aggregate balance sheet due to financial distress. This evidence contradicts the view that EMEs are successful in converting FCD into local currency-denominated debt and developed their bond market (Gagnon, 2014; Chui et al., 2016, 2018). However, India, Indonesia, Malaysia, and Thailand have started to develop the local bond market, but still, they are in the early stage of development (Park, 2017).

4 Data and Methodology

4.1 Data

The data covers 22 EMEs in Latin America, Asia, and Central Europe for the period from 2008 to 2017. The data and its coverage have some crucial advantages. First, the EMEs are under stress during the post-GFC period.[8] Second, the recent currency depreciation of EMEs against the US dollar is due to high inflation and current account deficit, which possibly lead to an increase in the currency mismatch problem. The exchange rate depreciation is a good barometer to measure the EMEs' stress (Fig. 4). Third, the series of events occurred in EMEs throughout the study period, such as the taper tantrum crisis, currency devaluation, and a slowdown in China, trade tensions escalation and lira, and peso crises created the financial stress in these markets (Fig. 4).

Furthermore, the tight financial conditions such as equity loss and currency deprecation create pressure on EMEs and lower their access to borrow in domestic currency in international markets. The focus on data after 2008 ensures that the complete currency mismatch indicators are available after 2008. Moreover, our AECM estimates confirm the net liability position of these EMEs in foreign currency since 2013 (Fig. 5). Such liability indicates that AECM has significantly moved from positive to negative position.

4.2 Empirical model

We use the panel regression models to investigate the effects of global and country-specific macroeconomic factors on currency mismatches. Goldstein and Turner (2004), Eichengreen et al. (2007), and Baek (2013) suggest association of monetary credibility, exchange rate volatility, country size, trade openness, institutional quality, and financial development with currency mismatches. The other important policy factors – monetary independence, macro-

[8]See, BIS Quarterly review, September 2018.

prudential measures, original sin, and debt intolerance are relevant for liability position in foreign currency. We describe the variables and data sources in Table 3. We estimate the following panel regression model:

$$CM_{i,t} = \alpha_i + \beta_1 Size_{i,t} + \beta_2 INF_{i,t} + \beta_3 ERV_{i,t} + \beta_4 TO_{i,t} + \beta_5 Quality_{i,t} + \beta_6 MII_{i,t} + \epsilon_{i,t} \quad (7)$$

where the dependent variable is $CM_{i,t} \in \{(AECM_{i,t} * (-1)), (MAECM_{i,t} * (-1))\}$; $AECM_{i,t}$ is the aggregate effective currency mismatch computed using Eq. (6); $MAECM_{i,t}$ denotes the modified currency mismatch indicator for country i at time t (annual). The $MAECM_{i,t}$ estimate includes the domestic bank loans and bonds which are denominated in foreign currency. To facilitate the comparison, we convert the *AECM* and *MAECM* into *CM* and *MCM*, and therefore, a high value of CM indicates high currency mismatches (net liability position in foreign currency).[9] α_i is a country-specific fixed-effect which controls the time-invariant unobserved characteristic of country i. $Size_{i,t}$ is the country size measured as the log levels of GDP; $INF_{i,t}$ denotes the inflation rate; $ERV_{i,t}$ refers to the standard deviation of the first log difference of quarterly local currency against the US dollar rate over the current and the past year; $TO_{i,t}$ and $Ka\_open_{i,t}$ are the indicators of trade openness (trade as a percentage of GDP) and capital openness (Chinn-Ito's capital account openness index).

The institutional quality index value ranges from 0 to 100; and comprises of 12 indicators ($Quality_{i,t}$); $MII_{i,t}$ is the monetary independence index constructed by Aizenman et al. (2013); $Peg_{i,t}$ - the dummy variable which takes the value of one for the countries following peg exchange rate regime (Ilzetki et al., 2018); the macroprudential policy indicators - limits on foreign currency loans and limits on debt to income ratio are denoted as $FC_{i,t}$ and $DTI_{i,t}$. $LD_{i,t}$ and $M2_{i,t}$ are the GDP per capita in log levels and broad money supply as a percentage of GDP respectively; We include additional variables such as original sin hypothesis ($OSIN_{i,t}$) and debt intolerance ($DI_{i,t}$) in regression. $\epsilon_{i,t}$ is the error term. The

[9]We assume that domestic bonds and loans are denominated in domestic currency in all EMEs while computing $CM_{i,t}$.

measurement of all covariates is straightforward except currency mismatch indicators and original sin index. The panel regression approach uses the cross-sectional and time variation of information on currency mismatches across the countries. In this empirical framework, some covariates overlap, but such variables are measured differently.

Previous studies predicted monetary policy as a significant determinant of currency mismatches in EDEs (Eichengreen et al., 2003; Goldstein and Turner, 2004; Jeanne, 2005; Tobal, 2013). The lack of effective monetary policy makes the EDEs prone to systemic risk and adversely affect the domestic borrowers having FCD. Therefore, foreign and domestic investors insist on lending in domestic currencies because of higher inflation and lesser protection in the domestic market. Specifically, Ilzetzki et al. (2003a), Goldstein and Turner (2004), and Jeanne (2005) hold monetary policy credibility – a measure of inflation volatility as a leading cause of currency mismatch. Thus, countries with high and volatile inflation have a greater tendency to issue debt in foreign currency. Empirically, Baek (2013) find a positive association between inflation and currency mismatches.

Besides the monetary policy, the extant literature shows the prominence of fiscal policy as a cause of currency mismatch. The weak government policies (debt management) allow the monetary officials to devalue the domestic currencies to lower the real value of debt obligations. Goldstein and Turner (2004) opine that the fiscal prudence helps to reduce the currency mismatches; they argue that neither the local government nor international financial institutions have an effective policy on public debt management. In a similar vein, Reinhart et al. (2003b) prove fiscal policy as a critical factor for the management of external debt. Moreover, Hausmann and Panizza (2003) predict that governments address the fiscal solvency issues through a rising inflation rate and FCD. Hence, the larger share of sovereign debt and high inflation pose a severe threat to borrow in domestic currency, i.e., domestic original sin (vicious circle). However, they fail to prove the significant relationship between original sin and fiscal policy.

The exchange rate policy is closely related to the monetary policy of the economy and an

essential factor that prompts the high currency mismatches. The exchange rate depreciation can raise the value of FCD and increases currency mismatches. Baek (2013) finds a positive association between exchange rate volatility and currency mismatch, and result implies that higher exchange rate volatility raises the FCD and hedging cost. Nonetheless, Eichengreen et al. (2005a) find no such relationship. In fixed exchange rate regimes, firms are unable to internalize their exchange rate risk, whereas the flexible exchange rate regime can reduce currency risk and mismatches (Martínez and Werner, 2002). For example, Mexico had a currency mismatch problem because of the fixed exchange rate regime. Using the de-facto exchange rate regime, Hausmann and Panizza (2003) empirically show a positive association between original sin and exchange rate regimes.

Trade and capital openness also influence currency mismatches. Trade openness increases domestic consumption and foreign currency assets through imports and exports. The foreign currency assets in the domestic market can increase the credit facilities and decrease the FCD, which lowers the currency mismatches. Empirically, Eichengreen et al. (2005a) and Baek (2013) document the role of trade openness in reducing currency mismatches. The countries with a free capital account hold substantial debt in foreign currency; hence, the increase in currency mismatches (Barajas and Morales, 2003).

In EMEs, capital openness increases the volatility in all levels of investment such as FDI, portfolio investment, and loans. Park and An (2012) investigate the effect of capital openness in economies with and without original sin. They show how capital openness tends to increase capital volatility and original sin problem in EMEs. The authors caution EMEs about capital openness because their currencies are not internationalized. However, Hausmann and Panizza (2003) opine that capital controls may discourage a foreign investor from investing in the domestic market in local currency. Baek (2013) estimates the relationship between currency mismatches and capital openness and find an inverse relationship between capital account liberalization and currency mismatches.

The literature discusses how the weakness of domestic institutions in EDEs lowers the

local currency debt resulting in borrowing in foreign currency. The countries with high-level institutional quality can issue debt in domestic currency and generate more foreign currency assets. Thus, the strength of the institution is a crucial factor to reduce currency mismatches. In an influential paper, Lane and Shambaugh (2010b) investigate the determinants of foreign currency exposure in cross-country balance sheets. They document the inverse association of institutional quality with currency mismatches.

Nonetheless, Baek (2013) find a positive relationship between institutional quality and currency mismatches. The better institutional strength induces the domestic agents to borrow in foreign currency. Moreover, large size economies can limit foreign currency exposure due to cost advantage. These economies can borrow in domestic currency compared to that of the small countries (see Lane and Milesi-Ferrentti, 2001; Hausmann and Panizza, 2003; and Eichengreen et al., 2005a,b).

In the aftermath of the global financial crisis (GFC), many EDEs opted the macroprudential policy measures to limit the external shocks and lowered the capital controls. The pertinent literature emphasizes the importance of macroprudential policy in controlling currency mismatches. In EDEs, monetary independence allows the central banks to freely operate and maintain the stability of the economy to limit the currency mismatches. Another important cause of currency mismatches is the financial depth of the market. The lack of financial development in EDEs dries up the available liquidity. The weak financial development in the domestic market allows the economies to borrow in foreign markets. Theoretically, Caballero and Krishnamurthy (2003) illustrate how lower financial depth in the domestic market results in larger dollar-denominated debt in EMEs. Hausmann and Panizza (2003), and Baek (2013) measure the financial depth as an outstanding credit to the private sector as a share of GDP. They find higher propensity for currency mismatches when the level of domestic credit to the private sector is lower.

4.3 Descriptive statistics and correlation analysis

The summary statistics and correlations for all the variables are presented in Table 4 and 5, respectively. The mean and median values of the dependent variables CM and MCM are negative, whereas all other explanatory variables are positive. The average negative values of CM and MCM suggest that overall average net asset position in foreign currency in EMEs. The CM exhibits high cross-sectional variability ranging from - 33.31 to 24.91 with a mean value of - 3.74. Similarly, the MCM shows a larger deviation ranging from -55.78 to 38.20 with a mean value of -5.91. The results indicate a greater variation in foreign currency exposure across the sample countries.

The currency mismatch indicators reveal that Argentina, Chile, Hungary, Poland, and Turkey as the countries with an average net liability position in foreign currency in our sample. On the other hand, Chinese Taipei, Peru, Russia, and Venezuela are economies with the net asset position in foreign currency. The sample countries with an average of 0.76 original sin are still unable to issue debt in their own currency. Likewise, many EMEs have external debt more than their GDP (up to 156.1 percent), leading to the debt intolerance. Finally, factors such as CM, MCM, Quality, MII, LD, and OSIN are negatively skewed, indicating an extended left tail distribution; and rest variables are positively skewed.

The correlation analysis confirms weak correlations among the explanatory variables, which indicate the low possible multicollinearity. Further, the currency mismatch indicators are significantly correlated with country size, exchange rate volatility, trade openness, institutional quality, monetary independence, peg exchange rate, macroprudential policies, financial development, and debt intolerance. The correlation coefficient between the CM and MCM indicates that former is almost identical to the latter indicating no significance of change in assumption on the estimation. Further, the results show a positive and significant correlation between currency mismatch and exchange rate volatility (see Goldstein and Turner, 2004; Baek, 2013).

4.4 Model specification and expected outcome

Based on the theoretical literature, the expected relationships are as follows. Country size is the global factor or important control variable of currency mismatch, and its sign of the coefficient is ambiguous. The large size countries in terms of either GDP or total population may lower the FCTD, and hence they reduce the currency mismatches. However, large size countries also issue more foreign currency debt leading to a net liability position in foreign currency (Benetrix et al., 2015). The sign of the coefficient on inflation is expected to be positive, implying higher currency mismatches or perceived currency risk due to the greater level of inflation.

The expected sign of exchange rate volatility is positive. The exchange rate volatility can raise the value of foreign currency debt and increases the liability position in foreign currency. Further, economies with a higher degree of trade openness have better access to foreign currency assets and international financial markets than the closed economies. Therefore, the expected association between currency mismatch and trade openness is negative. The institutional quality and monetary independence aggravate the currency mismatches because a country with better institutional quality lowers the FCD and increases the share of domestic currency in foreign debt.

In EMEs, financial openness increases the volatility in all levels of investment, such as FDI, portfolio investment, and loans. Thus, countries with an open capital account hold more debt in foreign currency, so the increase in the currency mismatches. Therefore, we may expect a positive sign of the coefficient. Further, the effect of the exchange rate regime on currency mismatches is ambiguous – the floating exchange rate regime entails the hedging facility and lowers the currency risk but increases the currency risk through the inflationary economy. The macroprudential policies are designed to limit the external shocks and systemic risks, which are frequently used in EMEs. Thus, we expect a drop in the currency mismatches with better policy measures. Countries with a high level of

development and financial development are expected to have lower currency mismatches. Finally, the original sin hypothesis and debt intolerance have a positive and negative influence on currency mismatches, respectively.

The cross-section dependence test (Pesaran, 2015) examines the null hypothesis of cross-sectional independence in panel data. The preliminary results reject the null hypothesis at 1% significance level, suggesting that all factors are cross-sectional dependent (Table 6). In the presence of cross-sectional dependence, the standard errors of the panel regression do not produce reliable and unbiased estimates due to the occurrence of the multi-factor structure of the error term.

Moreover, we further test the random-effects (against pooled OLS), heteroscedasticity, and autocorrelation in panel regression models. The test statistics reject the null hypothesis for the estimated baseline regression models (1) to (5). The fixed-effect and random-effect estimators are consistent, but the estimated standard errors are biased in the presence of cross-sectional dependence, heteroscedasticity, and serial correlation (Table 7). Therefore, we estimate the panel regression models with Driscoll and Kraay (1998) standard errors , which are robust in the presence of a serial correlation, heteroscedasticity, and cross-sectional dependence. Further, these estimates are suitable to deal with specifically short panel data models, where N is large, and T is small. Finally, the results of the Sargan-Hansen and Hausman specification statistics suggest the suitability of fixed-effect models than random-effects.

5 Results and Discussion

5.1 Baseline regression results

Table 8 reports the baseline regression Eq. (7) estimates of the coefficients using currency mismatch as the dependent variable. We estimate the five specifications of the models and report the fixed-effects. In the first model, we examine whether the currency mismatches

are associated with high inflation, exchange rate volatility, trade openness, institutional quality, monetary independence, and country size. We find a positive relationship between currency mismatch and country size. The result shows that large size EMEs in terms of GDP hold more significant liability position in foreign currency. Nevertheless, this evidence contrasts the finding of Lane and Milesi-Ferrentti (2001), Hausmann and Panizza (2003), and Eichengreen et al. (2007). Alternatively, we use the total population as a measure of the country size; the estimates show that that larger size countries have more significant currency mismatch.

A stronger monetary policy framework can lower the incentives to borrow in foreign currency and reduce the currency mismatch problem. Thus, the lower inflation as a result of stronger monetary policy is associated with the greater use of domestic currency debt. The estimated results suggest a positive and statistically significant effect of inflation on currency mismatch. This positive association is consistent with the idea that countries with high inflation have a greater tendency to issue more FCD and lead to currency mismatch problem.

We also estimate the inflation volatility and find its positive association with high currency mismatches in the model (2) and (3). This finding is consistent with earlier studies, including Baek (2013), Lane and Shambaugh (2011b), and Benetrix et al. (2015). In terms of the currency risk measured by the exchange rate volatility, we find a link between volatility in the bilateral exchange rate and liability position in foreign currency. The exchange rate volatility accounts both currency risk and domestic instability. The variable is positive and significant in all models. The results support the view that currency risk can raise foreign currency debt and raise the liability position in foreign currency.

The association between currency mismatch and trade openness is negative and significant in model (5). This evidence suggests that a country with high imports and exports is associated with a low currency mismatch problem. For instance, higher trade openness increases foreign currency earnings and reduce the liability position in foreign currency.

Moreover, the countries with trade openness have better access to foreign currency assets and international financial markets compared to that of the closed economies. Alternatively, we include exports to find a significant relationship between currency mismatch and trade openness. The results confirm a negative and significant relationship between currency mismatch and exports.

We further investigate the institutional and policy factors. These variables include institutional quality, monetary independence, capital controls, exchange rate regimes, and macroprudential policies. A robust institutional quality can govern the working of microeconomic incentives, pursue good macroeconomic and exchange rate policy, and nurture the confidence in the economy (Goldstein and Turner, 2004). We expect EMEs with better institutions can control currency mismatches.

The institutional quality index used in this study is the sum of 12 indicators, namely government stability, socio-economic conditions, and others (see Table 3). These index values vary from zero to 100; higher value implies better quality institutions in the country. We find strong evidence of institutional factors relevant to controlling currency mismatches. The results indicate that a country with better institutional quality can issue debt in its own currency and limit the currency mismatch problem. Therefore, many Asian economies have high-quality institutions and associated with low levels of currency mismatches. This finding supports the theoretical priories and refutes the results of Baek (2013) who argue that good institutional quality aggravates the FCD and currency mismatches in EMEs.

One of the critical contributions of the present study is analyzing the impact of monetary independence on currency mismatches. The lack of monetary independence in EMEs aggravates the sovereign debt crisis and increases the vulnerability to roll over debt crisis (Bianchi and Mondragon, 2018). On the other hand, pursuing a floating exchange rate policy can enable monetary independence (see Obstfeld and Taylor, 2004). Therefore, we examine the association between currency mismatches and monetary independence in EMEs. We use the index of monetary independence developed by Aizenman et al. (2013). The index is "the

reciprocal of annual correlation between monthly interest rates of the home country and the base country." The estimated coefficient on monetary independence is negative and significant, which implies that lack of monetary independence in EMEs aggravates the currency mismatch problem. However, this effect is insignificant after adding the other explanatory variables in the model (3) and (5). This result is due to an association between interest rates and choice of exchange rate regimes.

In the second model, we include the capital openness index (Chinn and Ito, 2006), exchange rate pegs (Ilzetki et al., 2018), the macroprudential policy indices developed by Cerutti et al. (2017) and inflation volatility to examine whether these factors cause the currency mismatches in EMEs. The index of capital openness measures the country's degree of capital account openness. Ka_open is the binary dummy variable – codifies the tabulation of restrictions on cross-border financial transactions reported in IMF. The coefficient of capital openness is positive, implying a higher degree of currency mismatch problem for financially liberalized countries. The greater financial openness by EDEs increases the volatility in all levels of investment, such as FDI, portfolio investment, and loans. Therefore, the countries pursuing capital account liberalization hold more foreign currency debt because of better access to such loans. This finding supports the work of Barajas and Morales (2003) on the dollarization of liabilities in Latin America.

In fixed exchange rate regimes, inadequate incentives to hedge foreign currency risk creates the currency mismatches in EMEs. Dell'Ariccia et al. (2012) argue that countries with fixed exchange rate regimes do not have an effective monetary policy instrument and have limited scope for supervising foreign currency exposure. In model (2), we find the coefficient of the peg positive but statistically insignificant. We find no strong evidence on the effect of the pegged exchange rate regime on currency mismatches. Nonetheless, we examine in model (3) how the choice of exchange regime affects currency mismatches by employing an index prepared by Ilzetki et al. (2018). The index is based on coarse classification from pegged to a more flexible exchange rate regime, and index value starts

from one to six. We find economies with flexible exchange rate policies reduce the currency mismatch problem.

Recently, macroprudential measures assuming importance as the best policy to mitigate external shocks and systemic risks, which are frequently used in EMEs. Unlike the existing literature, this study empirically tests the role of macroprudential norms on controlling currency mismatches. We include two instruments of prudential policies in baseline regression – limits on foreign currency loans (FC) and debt to income ratio (DTC). These are binary variables – one for the country which has limits on the FC and DTC and zero otherwise. They find limits on FC and DTC reduce the vulnerability to foreign currency risk and household indebtedness.

The estimates confirm that greater limitations on foreign currency loans and debt-income ratio reduce the net liability position in foreign currency. The coefficient on DTC is economically and statistically significant across all models. Moreover, FC is inversely associated with currency mismatches but significant in model (4). The limits on FC loans reduces the vulnerability of foreign currency risk. Similarly, enforcing the constraints on household debt to income ratios lower their indebtedness. These results are in line with Dell'Ariccia et al. (2012) who found the significant impact of macroprudential policy instruments on credit booms in Central and Eastern European countries. Moreover, evidence on the effects of macroprudential policies on currency mismatches is the key contribution of our article.

In model (3), we use alternative proxies to check the robustness of the baseline results further. We use $POP_{i,t}$, $INFV_{i,t}$, $EXP_{i,t}$, and $Regime_{i,t}$, to measure the country size, inflation, trade openness, and exchange rate regimes, respectively. The results are significant and in line with the model (1) and (2). In model (4), we include the level of development and the financial development indicators measured by GDP per capita and broad money supply (M2), respectively. The level of development is an alternative control variable; we find a negative association between the level of GDP per capita and currency mismatches. This finding suggests that a well-developed EMEs in terms of GDP per capita can control

the currency mismatches.

Likewise, we examine the relationship between financial development and currency mismatches in a model (4). The development of the domestic bond market plays a vital role to limit currency mismatches in EMEs (see, Goldstein and Turner, 2004). We use the broad money supply (M2) as a proxy for financial development, as discussed in Goldstein and Turner (2004), and Baek (2013). The negative coefficient of M2 indicates the relation between liquid assets and the low level of currency mismatches, but the result is statistically insignificant.

Finally, we consider the debt-related variables, namely, original sin and debt intolerance in the baseline model (5), to investigate whether these factors determine the level of currency mismatches. In this model, we exclude the level of development and financial development factors due to plausible correlation with the original sin. We collect the debt securities data sets from international debt statistics of BIS and construct the original sin index as in Eq. (3). The estimates show a positive association of original sin index with currency mismatches. This result implies that greater the FCD, higher will be the original sin, and thus severe the problem of currency mismatches. This finding supports the view of Tobal (2018). Moreover, the effect of original sin on currency mismatches is high due to greater securities denominated in foreign currency.

The relationship between external debt levels and sovereign risks are documented in Reinhart et al. (2003b) and Reinhart and Rogoff (2011). The authors coin the term 'debt intolerance' in their influential work. Interestingly, we find the coefficient of debt intolerance negative and significant, suggesting that a considerable share of total external debt in GDP lowers the extent of currency mismatch. This evidence indicates that the high debt intolerant economies not even able to access loans in foreign currency. Therefore, they do not have the liability position in foreign currency. Earlier, Reinhart et al. (2003b) argue that the consequence of debt intolerance results in slower growth and higher macroeconomic volatility. However, constrained access to foreign currency loans is often best symptom. Thus, the

authors describe that "debt intolerance is not a cause of disease."

5.2 Robustness tests and endogeneity issues

First, we test the alternative covariates of benchmark regression to evaluate the robustness of our findings. Second, we repeat the econometric analysis with a modified currency mismatch measure. Third, we address the potential endogeneity problem.

We further investigate the issue including the variables such as $POP_{i,t}$, $INFV_{i,t}$, $EXP_{i,t}$, and $Regime_{i,t}$, to assess the effect of country size, inflation, trade openness, and exchange rate regimes respectively on currency mismatches. The results presented in Table 8 confirm that large size EMEs in terms of the population have a currency mismatch problem. The coefficient of inflation volatility is positive and significant; it measures the degree of monetary credibility. The higher inflation volatility raises currency risk and mismatches. As an alternative measure of trade openness, we include the exports; results are identical to the benchmark estimations. For the exchange regime, we use the Ilzetki et al. (2018) classification of exchange rate regimes. The findings confirm the association of the flexible exchange rate regime with lower currency mismatches in EMEs. The evidence is concurrent with that of Goldstein and Turner (2004) and Baek (2013).

The currency mismatch ($CM_{i,t}$) method assumes that domestic bank loans and bonds are denominated in domestic currency. Nevertheless, a few country's private bank loans and bonds are issued in foreign currency. Therefore, we include "the share of foreign currency in domestic bank loans to the private sector, and the share of exchange rate linked instruments in domestic public debt" in the modified version of currency mismatch (Goldstein and Turner, 2004). As expected, the inclusion of these two instruments increases the share of foreign currency in total debt and the size of currency mismatches in our sample. Moreover, the correlation between the first version of currency mismatch and the modified currency mismatch is 0.97.

To examine how current findings may change when we modify the assumption, we re-

estimate Eq. (7) using an alternative version of currency mismatch ($MCM_{i,t}$) as the dependent variable. Table 9 presents the same set of model specifications and regressors as in the benchmark models. Although the modification of assumption slightly changes the statistical significance of the regressors, the rest of the results are identical to the benchmark estimations. In other words, results confirm a similar association between a set of factors and modified currency mismatch. However, the coefficient of monetary independence is significant in model (1). Similarly, we fail to find the significant effect of capital openness and pegged exchange rate on modified currency mismatch, but the coefficient on the flexible exchange rate regime is significant in model (3).

To avoid endogeneity, we re-estimate all benchmark specifications using one-year lagged values of all country-specific factors except country size as instruments to correct for the possible endogeneity (Baek, 2013; Park and Mercado, 2014; Gadanecz et al., 2018). The results reported in Table 10 and 11 confirm that the robustness of our estimates. In-depth, when explanatory variables are lagged by one-year, the sign and significance of coefficients remain broadly unchanged. Nonetheless, the coefficients of the lagged peg exchange rate, limits on foreign currency loans, inflation volatility, and level of development become statistically insignificant in all specifications.

6 Conclusion and Policy Implication

We measure the currency mismatches and original sin in 22 EMEs for the period from 2008 to 2017. The original sin index reveals that Latin American economies have greater original sin than that of the other regions. We document weaknesses in domestic macroeconomic policy and institutions as the primary factors to cause currency mismatch. The empirical results confirm that fiscal and monetary policy factors critical in controlling currency mismatches. We find that global and country-specific characteristics such as country size, trade openness, and level of development explain the cross-country variation in currency mismatches.

Our findings suggest that EMEs can make significant progress in reducing the net liability position in foreign currency by adapting monetary independence and stable monetary and fiscal policies. Unlike the original sin hypothesis, our results prove that the floating exchange rate policy is a necessary condition to limit the currency mismatches in EMEs. Our empirical results suggest that EMEs should create a better institutional environment to reduce currency mismatches. Such a quality environment also contributes to the macroeconomic stability and development of the domestic bond market. Moreover, the empirical analysis suggests the effectiveness of macroprudential measures in curbing currency mismatches. Therefore, the EMEs should introduce further limits on foreign currency loans and debt to income ratios to reduce the systemic risk and currency mismatches.

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Tables

Table 1. Sample of 22 EMEs

Latin America (7)	**Central Europe** (3)	**Asia** (8)	**Other EMEs** (4)
Argentina	Czech Republic	China	Russia
Brazil	Hungary	Chinese Taipei	Israel
Chile	Poland	India	Turkey
Colombia		Indonesia	South Africa
Mexico		Malaysia	
Peru		Philippines	
Venezuela		South Korea	
		Thailand	

Note: The sample classification is based on Goldstein and Turner (2004) methodology and BIS data sets availability

Table 2. Original Sin Index

Country/Region	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Latin America	**0.83**	**0.86**	**0.87**	**0.85**	**0.86**	**0.86**	**0.87**	**0.91**	**0.91**	**0.91**	**0.92**
Argentina	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Brazil	0.72	0.75	0.71	0.65	0.67	0.67	0.68	0.77	0.73	0.75	0.80
Chile	0.96	0.96	0.94	0.92	0.91	0.93	0.95	0.97	0.97	0.97	0.98
Colombia	0.79	0.80	0.78	0.74	0.76	0.77	0.80	0.86	0.89	0.88	0.87
Mexico	0.66	0.75	0.79	0.81	0.83	0.81	0.83	0.86	0.90	0.89	0.88
Venezuela	0.84	0.94	0.98	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Central Europe	**0.49**	**0.55**	**0.63**	**0.70**	**0.77**	**0.81**	**0.82**	**0.86**	**0.86**	**0.85**	**0.85**
Czech Republic	0.00	0.00	0.22	0.37	0.49	0.61	0.63	0.71	0.72	0.73	0.73
Hungary	0.89	0.92	0.93	0.95	0.97	0.97	0.98	0.98	0.97	0.96	0.95
Poland	0.58	0.72	0.75	0.79	0.85	0.86	0.86	0.90	0.90	0.88	0.88
Asia	**0.84**	**0.80**	**0.75**	**0.65**	**0.63**	**0.67**	**0.69**	**0.70**	**0.73**	**0.76**	**0.78**
China	0.63	0.50	0.38	0.01	0.00	0.00	0.00	0.00	0.11	0.37	0.47
Chinese Taipei	0.85	0.76	0.75	0.86	0.89	0.94	0.94	0.96	0.97	0.98	0.98
India	0.98	0.98	0.97	0.90	0.86	0.87	0.85	0.76	0.73	0.59	0.54
Indonesia	0.85	0.86	0.78	0.68	0.72	0.78	0.81	0.84	0.86	0.87	0.89
Malaysia	0.86	0.83	0.81	0.78	0.78	0.83	0.87	0.92	0.93	0.95	0.96
Philippines	0.99	0.99	0.97	0.92	0.91	0.91	0.91	0.92	0.93	0.93	0.94
Thailand	0.74	0.67	0.60	0.39	0.27	0.34	0.48	0.50	0.58	0.62	0.70
Other EMEs	**0.55**	**0.59**	**0.57**	**0.57**	**0.55**	**0.57**	**0.60**	**0.68**	**0.69**	**0.68**	**0.72**
Israel	0.85	0.91	0.90	0.92	0.95	0.96	0.97	0.97	0.98	0.97	0.98
Russia	0.79	0.80	0.78	0.72	0.66	0.71	0.75	0.83	0.85	0.82	0.85
South Africa	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.17	0.11	0.11	0.21
Turkey	0.55	0.64	0.61	0.63	0.57	0.61	0.69	0.77	0.81	0.82	0.83

Note: This table provides the estimates of original sin index values based on a sample of 20 EMEs for the period 2008 to 2018. The original sin index is calculated as in Eq.(3). Authors calculate the index employing the data on international debt securities of BIS. The original sin value closer to 1 indicates serious original sin problem implying that the country has little ability to issue international debt in its own currency.

Table 3. Variables Definition and Sources

Acronym	Variable name	Exp. sign	Description	Source
CM	Currency mismatch	NA	CM > 0 indicates liability position in foreign currency (%). $CM_{i,t}$ =($AECM_{i,t}$)*(-1); AECM denote aggregate effective currency mismatch constructed in Eq.(6)	Authors' own calculations
MCM	Modified currency mismatch	NA	Revised CM estimates include the domestic bank loans and domestic bonds denominated in foreign currency. In CM, we assume that domestic bonds and loans are denominated in domestic currency in all EMEs.	Authors' own calculations
Size	Country size	(±)	GDP in log levels (current, millions of US dollars).	IFS
INF	Inflation	(+)	Percentage change, end of period consumer prices (%).	WDI
ERV	Exchange rate volatility	(+)	The standard deviation of the first log difference of quarterly local currency against the US dollar rate over the current and the past year, annualized (%).	IFS
TO	Trade openness	(-)	Trade (% of GDP).	WDI
Quality	Institutional quality index	(-)	Index value ranges between 0 and 100; it comprises 12 indicators, namely government stability, socioeconomic conditions, investment profile, internal conflict, external conflict, corruption, military in politics, religious tensions, law and order, ethnic tensions, democratic accountability, and bureaucracy quality.	PRS Group, ICRG
MII	Monetary independence index	(-)	Calculated as the reciprocal of the annual correlation between the monthly interest rates of the home country and the base country.	Aizenman et al. (2013)
Ka_open	Capital openness	(+)	The index measures the country's degree of capital account openness. Ka_open is the binary dummy variable that codifies the tabulation of restrictions on cross-border financial transactions reported in IMF's annual report on exchange rate arrangements and exchange rate restrictions.	Chinn and Ito (2006)
Peg	Hard peg exchange rate regime	(+)	Binary dummy hard peg = 1 (includes categories of 1-2 coarse classification) of exchange rate regime of Ilzetki et al., 2018) otherwise 0.	Ilzetki et al. (2018)
FC	Limits on foreign currency loans	(-)	The macroprudential policy of limits on foreign currency loans. It reduces the vulnerability to foreign currency risk (index value 0 and 1)	Cerutti et al. (2017)
DTI	Limits on debt to income ratio	(-)	The macroprudential policy constrains the household indebtedness by enforcing or encouraging a limit (index value 0 and 1)	
INFV	Inflation volatility	(+)	The standard deviation of the first log difference of quarterly consumer price index over the current and past year, annualized (%).	IFS
POP	Population	(±)	Total population in log levels (in millions)	WDI
EXP	Exports	(-)	Exports of goods and services (% of GDP)	WDI
Regime	Exchange rate regimes	(-)	Coarse classification starts from rigid regime to a more flexible exchange rate regime (index value 1 to 6)	Ilzetki et al. (2018)
LD	Level of development	(-)	GDP per capita in log levels (current, US dollars)	WDI
M2	Financial development	(-)	Broad money supply (% of GDP).	WDI
OSIN	Original sin	(+)	The Original Sin hypothesis measured as in Eq.(3)	Authors' own calculations
DI	Debt intolerance	(-)	Total external debt (% of GDP).	IIF

Notes: Authors' calculations are based on data obtained from BIS: Bank for International Settlements; IFS: International Financial Statistics, IMF; World Bank; and National sources. Other variables are sourced from WDI: World Development Indicators. PRS Group, ICRG: International Country Risk Guide; IIF: Institute of International Finance.

Table 4. Summary Statistics

Variables	N	Mean	Median	St.Dev	Min	p25	p75	Max
CM	220	-3.74	-3.00	8.39	-33.31	-5.32	-0.63	24.91
MCM	220	-5.91	-4.07	14.04	-55.78	-9.96	-0.77	38.20
Size	220	13.22	12.95	0.99	11.70	12.54	13.91	16.30
INF	220	5.42	3.62	6.06	-1.51	2.02	6.49	30.90
ERV	220	12.52	10.85	8.17	0.00	6.39	16.40	42.43
TO	220	74.29	59.24	40.12	22.11	46.80	96.96	176.67
Quality	220	65.65	64.27	8.84	44.00	59.95	74.31	80.62
MII	220	0.51	0.52	0.17	0.04	0.40	0.63	0.97
Ka_open	210	0.50	0.45	0.32	0.00	0.17	0.72	1.00
Peg	220	0.31	0.00	0.47	0.00	0.00	1.00	1.00
FC	210	0.30	0.00	0.46	0.00	0.00	1.00	1.00
DTI	210	0.32	0.00	0.47	0.00	0.00	1.00	1.00
INFV	200	1.64	1.22	1.79	0.18	0.65	1.98	20.35
POP	220	4.10	3.89	1.33	1.99	3.37	4.79	7.24
EXP	210	36.97	29.71	21.77	10.71	22.57	45.34	99.50
Regime	220	2.71	3.00	0.73	1.00	2.00	3.00	5.00
LD	220	9.12	9.26	0.75	6.90	8.71	9.56	10.60
M2	210	73.92	67.00	39.71	23.49	42.89	82.93	208.46
OSIN	210	0.76	0.85	0.27	0.00	0.70	0.96	1.00
DI	200	42.24	34.00	26.93	8.22	26.80	47.00	156.10

Notes: This table summarizes the descriptive statistics of currency mismatch indicators and all other covariates employed in the empirical model. The estimation period is from 2008 to 2017. Variables and data are as defined in Table 3. We include the log values of GDP (size), Population (POP), and GDP per capita (LD); Standard deviation of consumer price index, and Exchange rate in our regressions. Therefore, the values in descriptive statistics are presented in log levels and Standard deviation values.

Table 5. Pairwise Correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(1) CM	1																			
(2) MCM	0.97*+	1																		
(3) Size	-0.03	-0.12*	1																	
(4) INF	-0.02	0.03	0.06*	1																
(5) ERV	0.30*	0.30*	-0.11*	0.16*	1															
(6) TO	0.08*	0.11*	-0.46*	-0.40*	0.02	1														
(7) Quality	0.13*	0.10*	-0.23*	-0.54*	0.06*	0.53*	1													
(8) MII	-0.13*	-0.15*	0.18*	0.06*	-0.04	-0.18*	-0.07*	1												
(9) Ka_open	0.00	-0.02	-0.39*	-0.47*	0.06*	0.35*	0.54*	-0.08*	1											
(10) Peg	0.05*	0.05*	0.06*	0.08*	-0.01	0.07*	0.02	-0.09*	0.06*	1										
(11) FC	0.35*	0.31*	0.22*	0.04	0.09*	-0.19*	0.06*	0.07*	-0.05*	0.00	1									
(12) DTI	0.35*	0.29*	0.10*	-0.24*	0.03	0.01	0.22*	0.03	0.20*	-0.04	0.50*	1								
(13) INFV	-0.04	-0.04	-0.04	0.43*+	0.15*	-0.11*	-0.29*	-0.05	-0.22*	-0.01	-0.16*	-0.13*	1							
(14) POP	-0.03	-0.08*	0.83*+	0.07*	-0.14*	-0.50*	-0.42*	0.11*	-0.55*	0.11*	0.03	-0.09*	0.07*	1						
(15) EXP	0.13*	0.17*	-0.45*	-0.39*	0.05*	0.99*+	0.51*	-0.16*	0.35*	0.12*	-0.19*	0.01	-0.11*	-0.48*	1					
(16) Regime	0.01	-0.02	0.01	0.19*	-0.03	-0.18*	-0.23*	0.16*	-0.10*	-0.73*+	-0.01	-0.04	0.17*	-0.02	-0.17*	1				
(17) LD	0.02	-0.01	-0.15*	-0.05*	0.10*	0.28*	0.44*	0.04	0.45*	-0.12*	0.25*	0.31*	-0.18*	-0.68*	0.26*	0.05*	1			
(18) M2	0.01	-0.06*	0.41*	-0.39*	-0.16*	0.30*	0.19*	0.14*	-0.16*	-0.04	0.08*	0.29*	-0.13*	0.27*	0.33*	-0.04	0.06*	1		
(19) OSIN	-0.02	0.03	-0.29*	0.18*	-0.04	0.04	0.11*	0.01	0.25*	-0.11*	0.13*	0.06*	0.11*	-0.30*	0.01	0.10*	0.17*	-0.36*	1	
(20) DI	0.18*	0.20*	-0.50*	0.05*	0.11*	0.57*	0.26*	-0.07*	0.30*	0.13*	-0.04	0.09*	-0.04	-0.61*	0.53*	0.08*	0.40*	-0.14*	0.28*	1

Notes: This table presents pairwise correlation coefficients between currency mismatch and all covariates employed in the empirical model. The variables are as defined in Table 3. * denotes significance at the 5 % level. '+' indicates that the variables in the model are alternative proxies and ensure robustness. The estimation period is from 2008 to 2017.

Table 6. Cross-Sectional Dependence Test

Variable	CD	Variable	CD
CM	10.43***	*FC*	05.46***
MCM	10.26***	*DTI*	04.99***
Size	48.06***	*INFV*	34.13***
INF	38.95***	*POP*	48.06***
ERV	39.95***	*EXP*	45.31***
TO	47.73***	*Regime*	46.38***
Quality	48.01***	*LD*	48.06***
MII	43.82***	*M2*	45.64***
Ka_open	40.96***	*OSIN*	41.67***
Peg	05.94***	*DI*	42.02***

Notes: This table presents estimates of the cross-sectional dependence test of Pesaran (2015). *** denote the rejection of null about parameters at 1% significance level. The variables are as defined in Table 3.

Table 7. Model Specification Tests

Tests	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Breusch-Pagan LM	497.23***	310.71***	303.87***	203.35***	266.60***
Modified Wald	6444.64***	5004.30***	2140.46***	1526.69***	1546.82***
Wooldridge Autocorrelation	26.09***	21.85***	32.09***	21.74***	13.62***

Notes: This table presents model specification test statistics and regression diagnostic checks such as random-effects, heteroscedasticity, and autocorrelation. The Breusch-Pagan Lagrangian multiplier (1980) test is suitable for random-effects vs. pooled OLS regression.

Table 8. Baseline Regression Results

$CM_{i,t}$	(1)	(2)	(3)	(4)	(5)
Size	3.977***	4.240**		36.056***	5.505***
	(0.808)	(1.385)		(6.152)	(1.293)
INF	0.348**			0.303**	0.256*
	(0.116)			(0.111)	(0.116)
ERV	0.129***	0.115***	0.093***	0.127***	0.112**
	(0.027)	(0.027)	(0.025)	(0.029)	(0.037)
TO	-0.046	-0.069		-0.043	-0.071**
	(0.027)	(0.042)		(0.033)	(0.023)
Quality	-0.199***	-0.383***	-0.391***	-0.140	-0.316***
	(0.039)	(0.023)	(0.043)	(0.105)	(0.054)
MII	-3.385**	-1.546*	-0.890	-1.406*	1.612
	(1.126)	(0.743)	(0.510)	(0.717)	(2.232)
Ka_open		0.924	1.503	3.606*	1.975
		(1.946)	(1.367)	(1.717)	(1.780)
Peg		0.956		-1.518	-3.164*
		(1.106)		(1.057)	(1.480)
FC		-2.352	-2.162	-1.294	-2.513**
		(1.353)	(1.209)	(1.217)	(1.010)
DTI		-3.020**	-3.183**	-3.712**	-2.595*
		(1.005)	(1.092)	(1.305)	(1.273)
INFV		0.594***	0.621**		
		(0.144)	(0.218)		
POP			17.328***		
			(2.109)		
EXP			-0.122**		
			(0.039)		
Regime			-1.254*		
			(0.664)		
LD				-34.003***	
				(6.967)	
M2				-0.017	
				(0.030)	
OSIN					7.465***
					(1.643)
DI					-0.078*
					(0.042)
Constant	-41.559***	-30.235	-42.904***	-159.947***	-54.022**
	(11.542)	(20.925)	(10.654)	(24.331)	(22.563)
Observations	220	200	200	210	190
Number of countries	22	20	20	21	19
Hausman test	10.50	474.47***	19.34**	94.94***	200.20***
Sargan-Hansen statistic	20.06***	54.42***	78.68***	87.04***	33.07***
R-squared	0.173	0.272	0.268	0.292	0.349

Notes: The table shows the estimates (fixed effect) of the baseline regression Eq. (7). The Driscoll-Kraay standard errors are in parentheses. The statistical significance levels are denoted as *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is the currency mismatch. The variables are as defined in Table 3.

Table 9. Modified Currency Mismatch: Robustness Checks

$MCM_{i,t}$	(1)	(2)	(3)	(4)	(5)
Size	8.357***	8.533***		52.956***	9.481***
	(0.833)	(1.795)		(7.109)	(1.314)
INF	0.602***			0.579**	0.528**
	(0.181)			(0.209)	(0.215)
ERV	0.215***	0.206***	0.144**	0.215***	0.165**
	(0.053)	(0.059)	(0.053)	(0.054)	(0.063)
TO	-0.036	-0.110		-0.082	-0.111**
	(0.041)	(0.061)		(0.050)	(0.037)
Quality	-0.132***	-0.430***	-0.520***	-0.146	-0.459***
	(0.034)	(0.048)	(0.050)	(0.117)	(0.086)
MII	-6.965***	-2.834	-1.259	-2.247	2.987
	(1.078)	(1.916)	(1.412)	(1.651)	(2.867)
Ka_open		0.147	1.601	4.899	1.331
		(3.971)	(2.717)	(2.946)	(3.585)
Peg		3.196		-0.393	-3.706
		(1.935)		(1.485)	(2.287)
FC		-4.041*	-3.799*	-2.025	-4.143**
		(2.112)	(1.867)	(1.916)	(1.478)
DTI		-3.757*	-3.957*	-4.541**	-5.205*
		(1.837)	(1.979)	(1.833)	(2.449)
INFV		0.808***	0.933**		
		(0.222)	(0.340)		
POP			31.555***		
			(5.582)		
EXP			-0.248**		
			(0.082)		
Regime			-3.550**		
			(1.174)		
LD				-46.512***	
				(8.067)	
M2				-0.092*	
				(0.048)	
OSIN					12.743***
					(2.484)
DI					-0.164**
					(0.067)
Constant	-107.448***	-83.243**	-84.780**	-265.609***	-97.332***
	(14.131)	(29.076)	(28.378)	(26.307)	(25.423)
Observations	220	200	200	210	190
Number of countries	22	20	20	21	19
Sargan-Hansen statistic	26.67***	37.49***	36.97***	71.34***	29.47***
Hausman test	21.42***	51.19***	117.61***	246.66***	127.29***
R-squared	0.167	0.255	0.284	0.291	0.404

Notes: This table presents the estimates of robustness tests. We re-estimate Eq. (7) using an alternative version of currency mismatch ($MCM_{i,t}$). We include "the share of foreign currency in domestic bank loans to the private sector and the share of exchange rate linked instruments in domestic public debt" in the modified version of currency mismatch. The Driscoll-Kraay standard errors are in parentheses. Statistical significance levels are denoted as *** p<0.01, ** p<0.05, * p<0.1. The variables are as defined in Table 3.

Table 10. Endogeneity Check: Baseline Regression Results

$CM_{i,t}$	(1)	(2)	(3)	(4)	(5)
Size	5.749***	4.261***		9.983***	8.179***
	(0.884)	(1.238)		(2.944)	(0.708)
INF_1	0.445**			0.444*	0.363*
	(0.173)			(0.216)	(0.190)
ERV_1	0.153***	0.147***	0.109***	0.151***	0.151***
	(0.032)	(0.031)	(0.024)	(0.024)	(0.027)
TO_1	-0.028	-0.042		-0.043	-0.047*
	(0.020)	(0.038)		(0.033)	(0.023)
Quality_1	-0.177***	-0.297***	-0.328***	-0.239***	-0.278***
	(0.046)	(0.050)	(0.055)	(0.042)	(0.075)
MII_1	-4.471***	-1.654**	-0.594	-2.806***	0.144
	(0.567)	(0.624)	(0.656)	(0.812)	(0.551)
Ka_open_1		2.736	2.615	3.922**	2.423**
		(2.030)	(1.457)	(1.615)	(1.051)
Peg_1		0.978		0.117	-2.090
		(1.979)		(1.692)	(1.620)
FC_1		-1.842	-1.698	-1.341	-1.246
		(1.049)	(0.995)	(1.233)	(1.411)
DTI_1		-3.956***	-4.110**	-3.641***	-3.548***
		(1.143)	(1.266)	(0.731)	(0.922)
INFV_1		0.184	0.389		
		(0.211)	(0.246)		
POP			17.473***		
			(2.701)		
EXP_1			-0.096*		
			(0.042)		
Regime_1			-1.828*		
			(0.948)		
LD_1				-3.923	
				(2.749)	
M2_1				0.012	
				(0.041)	
OSIN_1					9.124***
					(1.276)
DI_1					-0.088***
					(0.022)
Constant	-68.083***	-38.618*	-47.379***	-85.312***	-95.861***
	(11.365)	(20.041)	(11.495)	(16.043)	(12.042)
Observations	220	200	200	210	190
Number of countries	22	20	20	21	19
Sargan-Hansen statistic	27.62***	54.40***	59.44***	139.43***	86.99***
Hausman test	10.04	23.88***	50.48***	46.85***	44.35***
R-squared	0.239	0.249	0.281	0.312	0.412

Notes: This table shows the findings of baseline regression with lagged explanatory variables. To avoid endogeneity, we re-estimate all benchmark specifications using one-year lagged values of all country-specific factors except variable country size as instruments to correct for the possible endogeneity. The Driscoll-Kraay standard errors are in parentheses. The statistical significance levels are denoted as *** p<0.01, ** p<0.05, * p<0.1. The variables are as defined in Table 3.

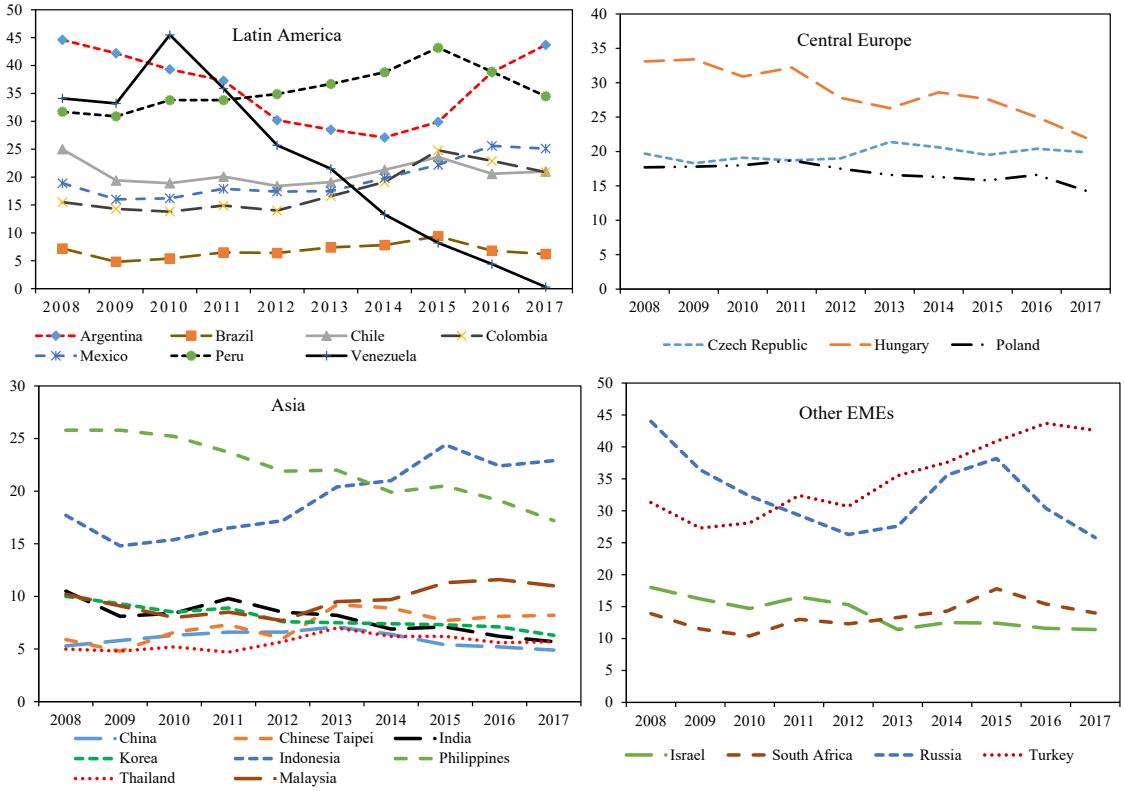
Table 11. Endogeneity Check: Modified Currency Mismatch

$MCM_{i,t}$	(1)	(2)	(3)	(4)	(5)
Size	10.783***	8.558***		17.809***	12.995***
	(1.712)	(2.194)		(4.546)	(1.140)
INF_1	0.685**			0.714**	0.571**
	(0.214)			(0.302)	(0.250)
ERV_1	0.240***	0.235***	0.158***	0.238***	0.208***
	(0.058)	(0.044)	(0.038)	(0.042)	(0.037)
TO_1	-0.030	-0.083		-0.086	-0.085*
	(0.033)	(0.068)		(0.059)	(0.045)
Quality_1	-0.076	-0.278**	-0.348***	-0.213**	-0.436***
	(0.066)	(0.101)	(0.087)	(0.075)	(0.125)
MII_1	-8.565***	-2.299	-1	-3.919*	1.786
	(1.874)	(1.805)	(1.313)	(2.091)	(1.259)
Ka_open_1		4.599	4.243	6.625*	2.436
		(4.527)	(3.406)	(3.181)	(2.999)
Peg_1		3.008		1.819	-2.523
		(2.797)		(1.955)	(1.659)
FC_1		-2.737	-2.419*	-1.84	-1.867
		(1.712)	(1.267)	(1.922)	(2.169)
DTI_1		-6.002**	-6.230**	-5.475**	-6.914**
		(2.37)	(2.588)	(1.701)	(2.277)
INFV_1		0.216	0.635		
		(0.331)	(0.361)		
POP_1			35.715***		
			(4.968)		
EXP_1			-0.172**		
			(0.062)		
Regime_1			-4.067***		
			(1.216)		
LD_1				-6.314	
				(4.830)	
M2_1				4	
				(0.056)	
OSIN_1					15.028***
					(3.150)
DI_1					-0.216***
					(0.045)
Constant	-143.678***	-97.065**	-116.154***	-170.164***	-148.532***
	(25.144)	(34.813)	(25.712)	(23.691)	(18.034)
Observations	220	200	200	210	190
Number of countries	22	20	20	21	19
Sargan-Hansen statistic	36.07***	31.28***	32.27***	214.90***	74.33***
Hausman test	6.80	10.41	418.52***	228.60***	144.82***
R-squared	0.200	0.231	0.290	0.300	0.481

Notes: This table shows the findings of modified currency mismatch regression with lagged explanatory variables. To avoid endogeneity, we re-estimate all benchmark specifications using one-year lagged values of all country-specific factors except variable country size as instruments to correct for the possible endogeneity. The Driscoll-Kraay standard errors are in parentheses. The statistical significance levels are denoted as *** p<0.01, ** p<0.05, * p<0.1. The variables are as defined in Table 3.

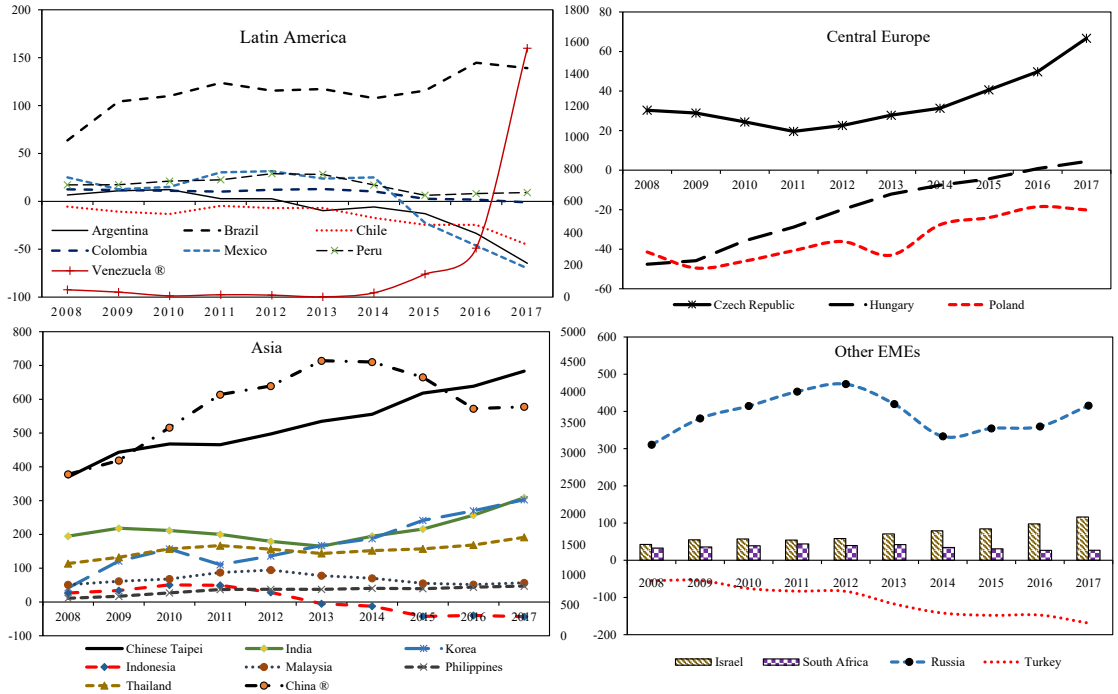
Figures

Figure 1. Foreign currency shares of total debt outstanding (FCTD in %)



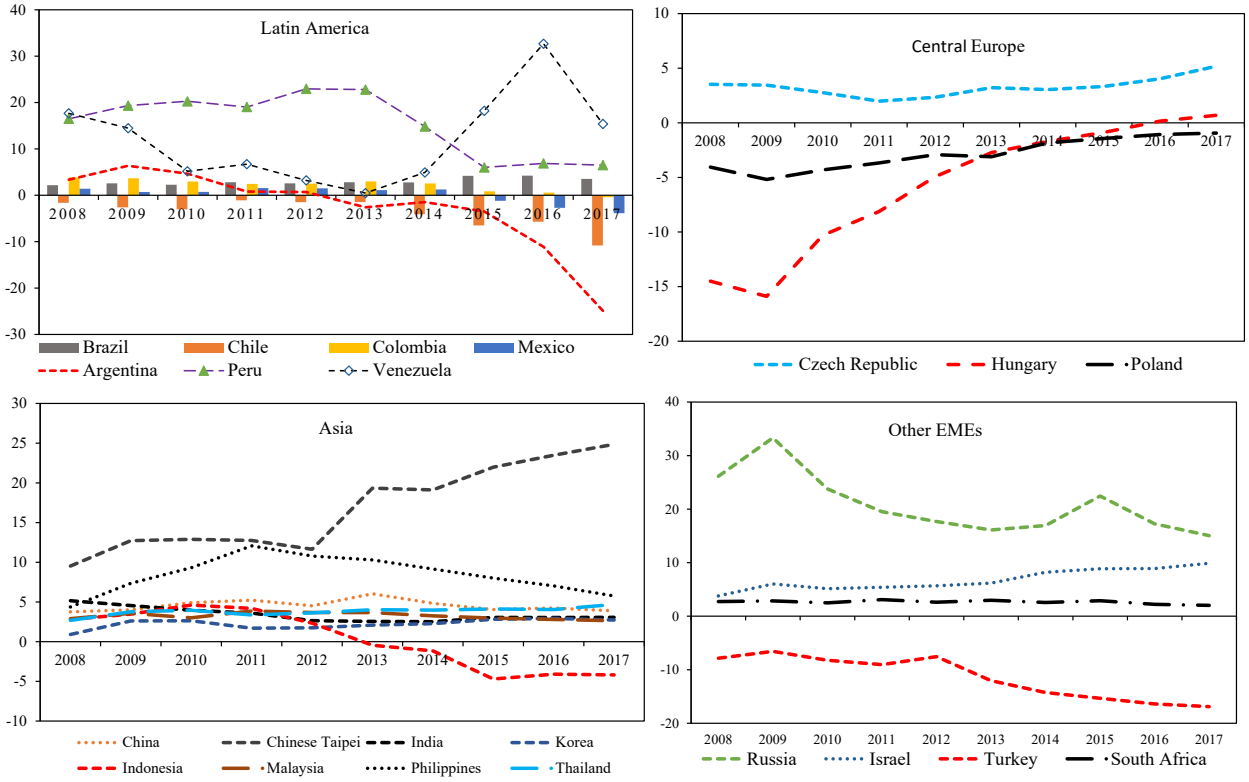
Data Sources: BIS locational banking statistics and debt securities statistics; IMF.

Figure 2. Net foreign currency asset position (NFCA in billion $)



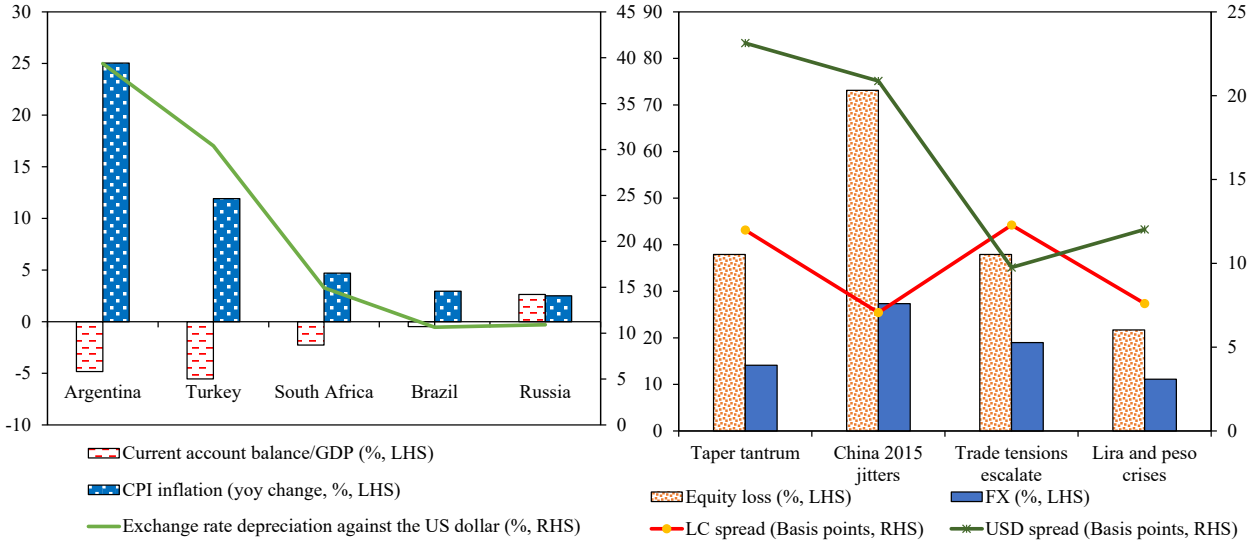
Data Sources: BIS locational banking statistics and debt securities statistics; IMF. China foreign currency assets measured in right-side

Figure 3. The aggregate effective currency mismatches (AECM in %)



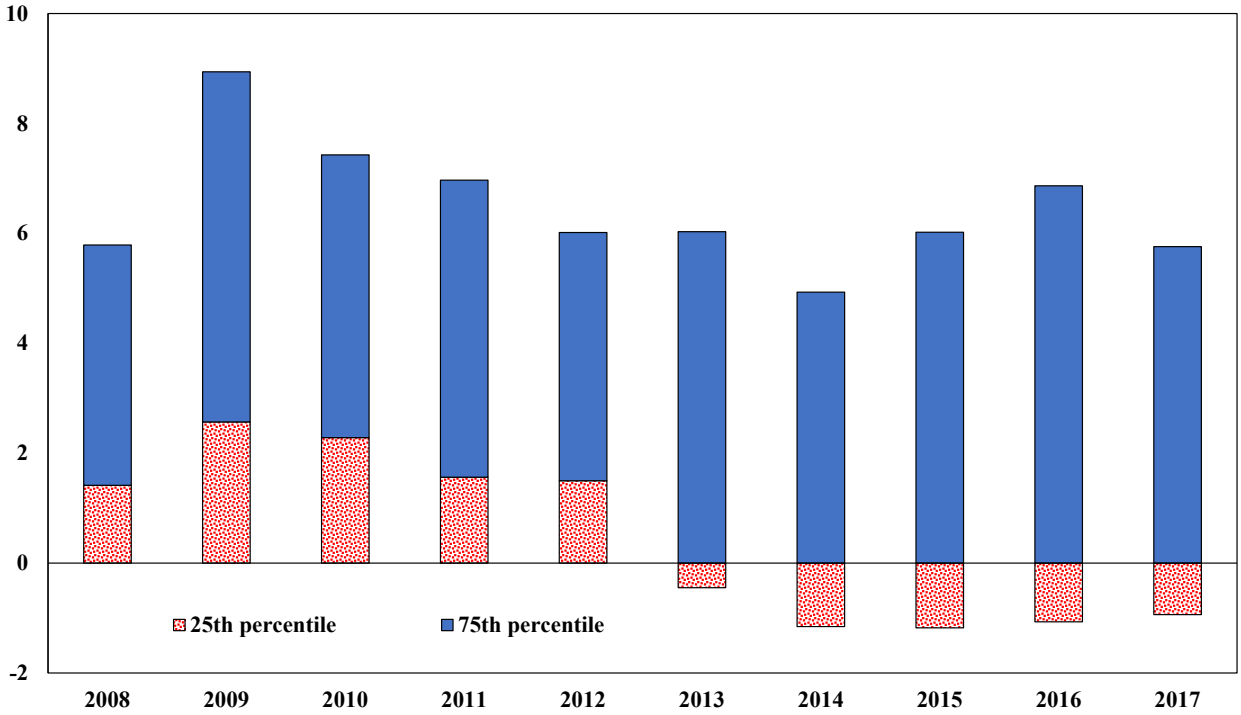
Data Sources: Author's calculations based on BIS, IMF, and World Bank data. scriptsize
Note: X-axis measures AECM (%). The negative values show that EMEs have high-level currency mismatches.

Figure 4. EMEs Stress and Macroeconomic Vulnerabilities



Notes: The figure presents recent financial stress and vulnerabilities in EMEs. The left-hand panel shows that macroeconomic vulnerabilities of EMEs generate high exchange rate depreciation against the US dollar (31 July 2018 to 12 September 2018). The right-hand panel corresponds to the EMEs' financial stress in series of events such as taper tantrum crisis (May to September 2013), China's currency devaluation and slowdown (August 2015 to January 2016), trade tensions escalate (March to July 2018) and Lira and peso crises (August to September, 2018). Equity loss measured with MSCI EMEs index (in $). Foreign currency depreciation (FX) based on the trade-weighted $ index. LC and USD represent the local currency and US dollar-denominated spreads, respectively. Data is from the Bank of International Settlements (BIS) reports.

Figure 5. Cross-Sectional Distribution of AECM (%)



Notes: This figure shows the cross-sectional distribution of the 25th and 75th percentile of aggregate effective currency mismatch (AECM) for 22 EMEs from 2008 to 2017 (y-axis). Source: Authors' own calculations.