The Impact of Foreign Currency Exposure on Economic Growth*

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Abstract

We aim to investigate the growth effects of balance sheet vulnerabilities in advanced economies, and emerging and developing economies for the period of 1970-2018. We developed new methods of measuring external vulnerability by exploiting the novel data on currency composition of cross-border bank loans and international debt securities. We find that currency exposure does cause lower growth outcomes, and depreciation amplifies the effect. Unlike previous work, present study demonstrate that the original sin and currency mismatches indeed matter for advanced economies as well. We show that exchange rate movements adversely affect economic activity via the financial channel, blunting the trade channel effects. Results suggest that economies are better off with fixed exchange rates when they have greater external vulnerabilities. Thus, adopting fixed exchange rate regime can avoid the currency risk and growth slowdown. Further, empirical estimations note that the linkage between long-run effects of currency exposure on economic growth.

JEL Classification: C14, F31, F32, F34, F41.

***Keywords*:** Economic growth; balance sheet vulnerabilities, foreign currency debt; original sin; currency mismatches; exchange rate policies.

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1 Introduction

Corporate and sovereign debt denominated in foreign currency is sharply growing in several economies. The renewed surge of foreign currency liabilities is a matter of concern as the countries with such liabilities are exposed to the vicissitudes of the global conditions, which are fast changing. The apprehension is due to experience in developing economies. The foreign currency liabilities were widely perceived as protagonists of currency crises in developing economies (Eichengreen and Hausmann, 1999). The third-generation crisis models show that the currency depreciation against the hard currencies exacerbate such liabilities, dampen investment, erodes net worth, and causes deceleration in output (e.g., Krugman, 1999; Aghion et al., 2001).

The developing economies gleaning from these experiences proactively initiated several reforms such as the effective monetary policy, development of financial markets, accumulation of reserves, and prudential norms. The conjecture of macroeconomic fundamentals, easing of norms, low yields in advanced economies, and global liquidity pivoted the access to the emerging and developing economies (EDEs) to the global fixed income markets. Notwithstanding the macroeconomic reforms, the EDEs still unable to borrow from abroad in their own currency, which is termed as original sin (Eichengreen and Hausmann, 1999). The unprecedented growth in the liabilities denominated in foreign currency without corresponding revenue in foreign currency, causes currency mismatches. The growing currency mismatches add to the vulnerabilities and trigger the fear of widespread insolvency and systemic risk. The credit ratings have been highly sensitive to the external vulnerability of EDEs and quick to downgrade them compared to the advanced economies (AEs) despite fundamentals are strong in the former.[1]

1 For instance, Turkey, Brazil, India, South Africa and Indonesia were termed as fragile given by Morgan Stanley in 2013 due to rise in dollar debt despite the fundamentals were strong in these countries except Turkey.

The inflationary pressure and expected depreciation of local currencies against the hard currencies aggravate the vulnerabilities emanating from mismatches. The conjecture of US dollar dominance[2] in international trade and the recent crisis in Turkey and Argentina affirms the fears of dollar debt ramifications. The strong dollar is curbing private credit, restraining real investment, and impinging the economic growth in emerging economies (Avdjiev et al., 2019; Shousha, 2019). The overall context raises critical questions: whether the growing foreign currency exposure affects economic growth? To what extent, the response of economic growth to external vulnerabilities depends on the exchange rate? Are the original sin and currency mismatches empirically distinct? How these factors affect the economic growth differently? This paper strives to answer these questions based on a compressive data set and new methods of vulnerability.[3]

The question of whether original sin and currency mismatches, which reflect the vulnerability, affect economic growth is critical but not explored before. In this light, the present study inquiries into the impact of foreign currency exposure on economic growth and thus contribute to the literature by providing novel evidence on this relationship in multiple ways. First, we develop the new original sin and currency mismatches indicators to measure the external vulnerability. These newly developed indicators effectively capture the foreign currency exposure. The new indicators include the currency composition of international debt securities and cross-border bank loans.

Second, the previous research on exposure followed a narrow approach and confined to emerging economies. For instance, Eichengreen et al. (2007) find that an increase in the original sin contributes to the growth volatility. Cavusoglu (2009) documents the adverse effects of currency mismatches on economic growth and the volatility in 22 emerging economies. In this context, this study is the first to examine the original sin-growth, currency mismatch-growth

2 See Gopinath and Stein (2021) for a discussion on dollar dominance.

3 We use foreign currency exposure, financial and external vulnerabilities terms interchangeably. In this study, the original sin and currency mismatches are the vulnerability indicators.

nexus for AEs as well. We also estimate narrow original sin and aggregate effective currency mismatch (AECM) for a comparison purpose. We complement the analysis by employing the foreign currency exposure (FCE) and quantitative foreign currency exposure (QFCE) indices for OECD countries.

Third, the present study covers a comprehensive sample of 162 countries, including 34 AEs, and 128 EDEs for a longer period from 1970 to 2018 (see Appendix Table 12). Such a diverse, comprehensive, and more extended period provides an understanding of nuances of vulnerability and insights into exposure-growth dynamics. Fourth, another contribution of the present study is to develop an empirical model based on theoretical propositions, including the neo-classical growth model. Ranciere et al. (2010) assert the advantage of currency mismatches in lowering the borrowers' constraints and enhancing growth. They also empirically validate their model with empirical evidence of enhanced investment due to lower constraints, accelerating economic growth in emerging Europe. Panizza and Presbitero (2014) illustrate that the extant literature on debt-growth nexus hardly controls the potential determinants of economic growth in the multiple regression framework. Thus, the findings on the relationship are incorrect. We address this concern in current research by examining the debt-growth nexus by controlling the potential determinants of growth, and thus fill an important gap in the literature.

The present study does not intend to revisit the growth literature. Instead, we review growth literature to identify a set of control variables to use in the baseline estimation. This approach better captures the impact of currency exposure on economic activity. Fifth, a growth regression model is highly endogenous, which poses challenges to estimate the empirical models to probe currency mismatch-growth nexus. To address this problem, we choose the dynamic panel regression, which is suitable to estimate the growth models (Kripfganz and Schwarz, 2019; Kiviet, 2020). The dynamic panel regression addresses inverse causality, omitted variables, and simultaneity bias in the growth model.

Sixth, the exchange rate policies play a crucial role in determining the devastating effects of balance sheet vulnerabilities on economic activity. In other words, the exchange rate is a pass-through of the balance sheet mismatches to economic growth. Despite its importance, no empirical research has paid attention to this topic. Therefore, we separately assess the impact of currency movements and exchange rate regimes on currency exposure. Finally, we offer important insights into the long-run effects of currency mismatches on economic growth using a unique approach that enriches the extant literature.

In this paper, we show that a higher degree of foreign currency exposure contributes to a slowdown in economic growth. Furthermore, we provide evidence of a contractionary effect of currency depreciation on economic growth through the finance channel. In contrast to the mainstream literature, the peg exchange rate regimes enhance economic growth by limiting the currency mismatch risk. The outline of the paper is as follows: in Section 2, we develop the new original sin and currency mismatch indicators and highlight the primary trends on the nexus between currency exposure and economic growth. Section 3 presents a theory on the effects of currency exposure, the data and empirical strategy. Further, we describe the linear dynamic regression framework and discusses the empirical results. Section 4 concludes the study with policy implications.

2 New measure of original sin and currency mismatches

We develop new measures of original sin and currency mismatches, which are not only distinctive but also comprehensive. The data covers the annual frequency data of 162 countries (34 AEs and 128 EDEs) for the period 1970-2018 (Appendix Table 12). The sample selection is based on the availability of data on the currency composition of international debt securities and cross-border bank loans. The number of observations varies across the countries and years due to data availability.

2.1 Broad original sin index

Original sin is defined as "*the inability of a country to borrow abroad in its own currency*" (Eichengreen and Hausmann, 1999). In an influential work, Eichengreen et al. (2005a,0) develop an original sin index for EDEs that includes international securities denominated in domestic currency regardless of the nationality of the issuer:

$$OSIN_{i,t} = max\left(1 - \frac{Securities\ in\ currency\ i\ in\ year\ t}{Securities\ issued\ by\ country\ i\ in\ year\ t}, 0\right) \tag{1}$$

The $OSIN_{i,t}$ denotes original sin index for country i in a year t. This index not only includes all the securities issued by a country in domestic (foreign) currency, but hedging instruments such as swaps and long-term debt indexed to prices with lower bounds. The principal limitation of this approach is the exclusion of international bonds and cross-border bank loans, which are the mainstay of debt. The narrow original sin is also limited to 44 EDEs and not available for the period the post-2003 period. To overcome the limitations of narrow original sin, we develop the broader version of original sin for 162 countries from 1970 to 2018.

$$BOSIN_{i,t} = max\left(\frac{LBS^{f}_{i,t} + IDS^{f}_{i,t}}{LBS_{i,t} + IDS_{i,t}}, OSIN_{i,t}\right) \tag{2}$$

The $BOSIN_{i,t}$ denotes broad original sin index for country i at period t. This index is the composition of "sum of loans and securities denominated in five-major foreign currencies from the BIS locational banking statistics and international debt securities ($LBS^{f}_{i,t} + IDS^{f}_{i,t}$) to total loans, and securities denominated in all currencies ($LBS_{i,t} + IDS_{i,t}$)." Current index is more comprehensive and thus better captures the currency exposure than narrow original sin. The coverage of sample countries is vast, and the period is longer than the extant indices. The broad original sin index ranges between zero and one: the value closer to one indicates a severe original sin (higher foreign currency risk), whereas the lower value (closer to 0) suggests a secure position in foreign currency.

2.2 New currency mismatch index

Eichengreen et al. (2007) show that original sin and currency mismatches are conceptually as well as empirically distinct. We prepare a new currency mismatch index using a broader version of the original sin. We follow the conceptual framework of Eichengreen et al. (2007):

$$CM_{i,t} = \left(\frac{FR_{i,t} - ID_{i,t}}{\text{Exports}_{i,t}} \right) \times OSIN_{i,t} \tag{3}$$

The $FR_{i,t}$ and $ID_{i,t}$ represent the total foreign exchange reserves and international debt securities, respectively. The limitation of narrow original sin is equally applicable to this index of currency mismatch. Hence, we introduce the broad original sin in Eq. 4 and develop a new currency mismatch index as follows:

$$NCM_{i,t} = \left(\frac{FR_{i,t} - ID_{i,t}}{Exports_{i,t}} \right) \times BOSIN_{i,t} \tag{4}$$

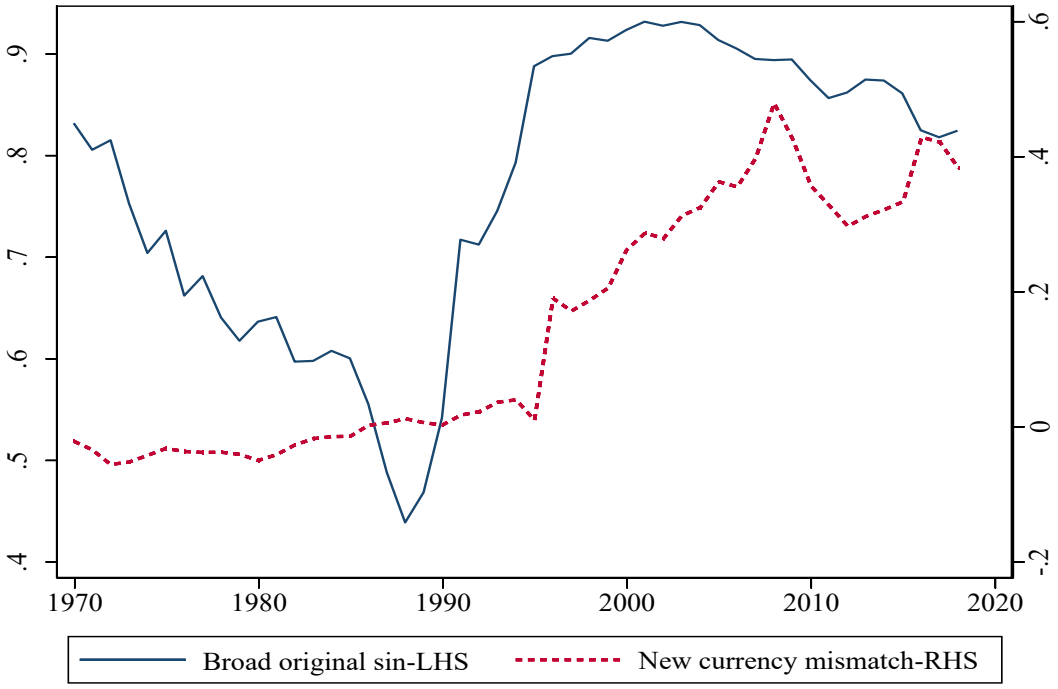
The $NCM_{i,t}$ denotes new currency mismatch index for country i at year t. A positive value of this index implies a larger amount of liability position in foreign currency. In contrast, a negative value denotes a favorable position in foreign currency (high forex reserves). In the present analysis, we reverse the index (-1 $\times NCM_{i,t}$) to make the interpretations identical with extant indices. This index includes a dataset on foreign currency positions of 131 countries from 1970 to 2018.

2.3 Stylized facts: Foreign currency exposure versus economic growth

Figure 1 shows the evolution of broader original sin and new currency mismatch indices for the period 1970-2018. The time series plot indicates the steep fall in the vulnerability until the late 1980s and thereafter sharp rose led debt crisis in many EDEs, especially in Latin America. Nevertheless, the currency mismatches remained stable despite debt fell off the cliff during this period. In the post-liberalization period, both original sin and currency

mismatches swung sharply, turning the economic outlook in EDEs grim and overcast with extreme uncertainty. The values of these indices were unprecedented during the Asian financial crisis and GFC. Although flare of vulnerability subdued to an extent immediately after the GFC, original sin and currency mismatches picking up in recent years. The COVID-19 furthering this renewed surge in external vulnerability. The increasing balance sheet vulnerabilities escalate the currency and insolvency risk, potentially lower economic growth through credit constraints and exchange rate fluctuations.

Figure 1. Evolution of original sin and currency mismatches, 1970-2018

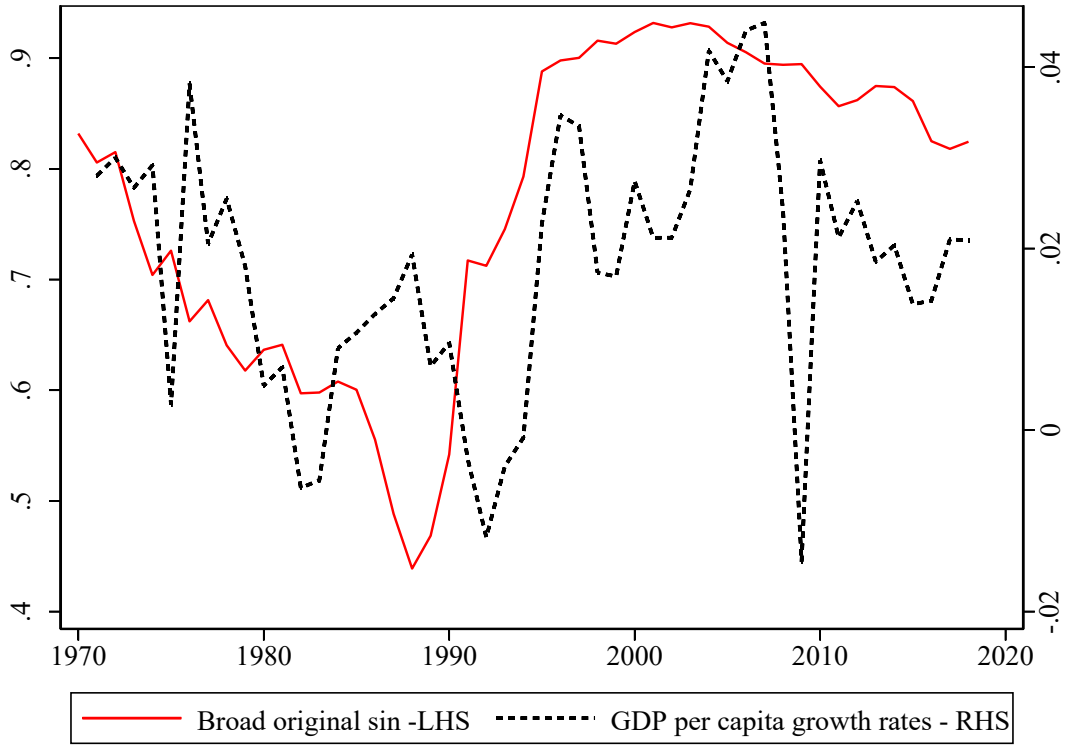


Data sources: Author's own calculations based on information collected from the BIS and IMF.
Notes: The figure presents the evolution of new measures of foreign currency exposure for the full sample. The left-hand side axis shows the broader version of original sin index; higher value generates high foreign currency risk. Similarly, the right-hand side axis presents the new currency mismatch index, positive value denotes the liability position in foreign currency, whereas negative value represents the net asset position in foreign currency. Since 1990s, the foreign currency debt and currency mismatches sharply increased.

We use the GDP per capita data from world development indicators (WDI) to compute the economic growth rate. The average GDP per capita growth rate presented in Figure 2 shows that many countries experienced episodes of economic slowdown between 1970 and 1990 due to oil shock and inflation (1970), Latin American debt crisis (1980), and asset bubble crash and banking crisis in Japan (1986 to 1992). In the early 1990s, the recovery began picking

up due to liberalization in EDEs, and the economic growth rate sharply rebounded to reach unprecedented height until ebullient was dented due to the East Asian financial crisis (1997) and the Argentina crisis (1999 to 2002) and the US tech crash (2002).

Figure 2. Original sin and economic growth, 1970–2018



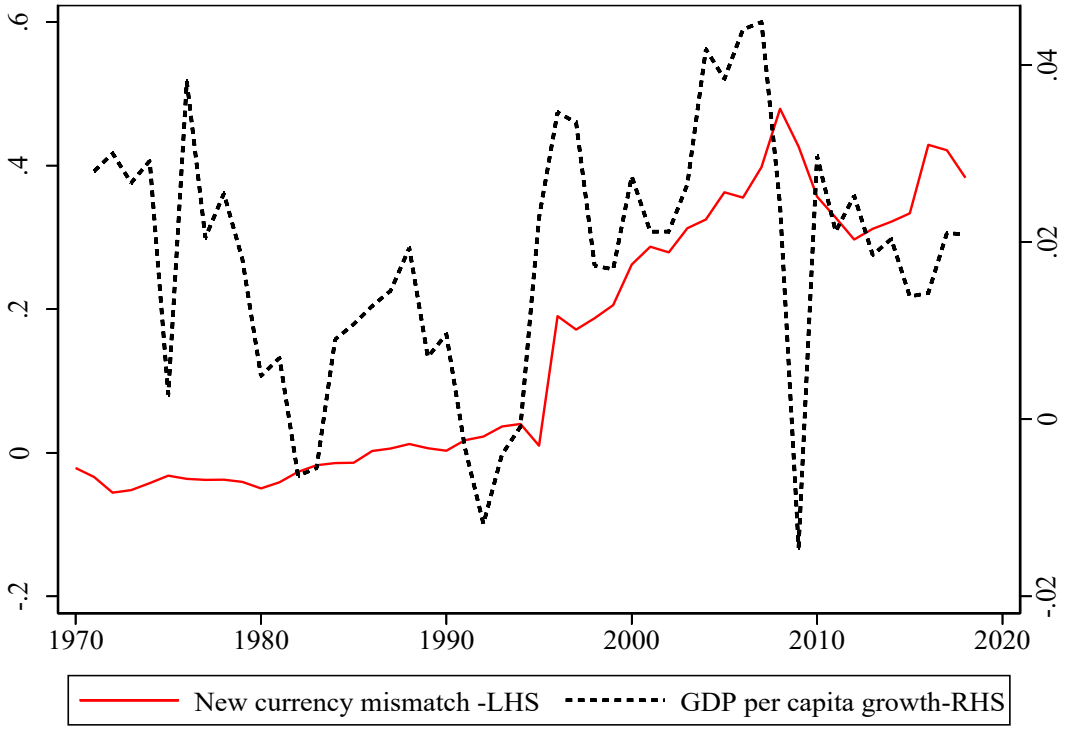
Data sources: Author's own calculations based on information collected from the BIS and IMF.
Notes: The figure presents the association between average original sin and average economic growth for overall sample. The left-hand side axis shows the broader version of original sin index; higher value generates high foreign currency risk. Whereas, the right-hand side axis present GDP per capita growth rate.

Subsequently, the average growth rate experienced a roller coaster ride fueled by the easing policies and asset bubbles, including real estate verve. The growth rate reached a historic high during 2002-07 period, especially in EDEs. However, the sub-prime crisis took down the economies from glide. The average GDP per capita growth rate turned sharply negative in the year 2009 (dropped from 4% to -2%). As a result, the output sank into the steepest contraction, causing a precipitous depression and deep despondency.[4] Therefore, the borrowing costs in EDEs rise sharply that encourages to accumulate the FCD. Goldstein and Turner

4 The outbreak of COVID-19 and consequent lockdown of socio-economic activities to contain the infection ravaged the output and employment and growth rate turned negative.

(2004) identified that the larger amount of FCD as the genesis of the crises in EDEs. Figure 2 shows the inverse co-movement between the broad original sin and economic growth, but economic growth appears volatile than the original sin.

Figure 3. Currency mismatches and economic growth, 1970–2018



Data sources: Author's own calculations based on information collected from the BIS and IMF.
Notes: The figure presents the association between average new currency mismatch index and average economic growth for overall sample. The left-hand side axis shows the new currency mismatch index; higher value generates high foreign currency risk. Whereas, the right-hand side axis present GDP per capita growth rate. The trend of new currency mismatch index shows that no effect on economic growth rate until 1995.

Notwithstanding this association, the new measure of currency mismatch is not in tandem with growth until 1995 because of the lower liability position in foreign currency (Figure 3). Thereafter, the value of the liability position in foreign currency steeply increased, indicating a systemic risk in the whole economy and increasing the probability of financial crisis (see Goldstein and Turner, 2004; Ranciere et al., 2010). The currency mismatch and economic growth rates moved inversely with a couple of brief exceptions as the persistent liabilities deleteriously contracted the growth. Indeed, the new currency mismatch index is negatively correlated with economic growth rate (correlation coefficient is -0.11).

The association between currency mismatches and economic growth varies over the period, indicating a dual role. On the one hand, currency mismatches improve the domestic credit facility, boost investment, and thus positively affect economic growth. The currency mismatches, therefore, act as an engine of economic growth. On the other hand, liabilities in foreign currency are a prime factor responsible for insolvency risk that exposes the economy to systemic and currency risk (Ranciere et al., 2010). In this light, we hypothesis an inverse relationship between currency exposure and economic growth.

3 The effect of foreign currency exposure on economic growth

3.1 Related theory

Capital formation is one of the main drivers for economic growth. In an increasingly globalizing and integrating world economy, capital moves to the markets where returns are higher. The agents prefer a low-cost debt despite an exchange rate risk. The neo-classical theory posits higher growth in borrowing countries due to the transfer of resources from lenders and base effects.[5] External borrowing is expected to lower the cost of capital, supplement domestic savings and facilitate growth. Such debt also finances investment in superior technology and dissemination of knowledge, which steadily improves the total factor productivity. The debt from global markets brings discipline to the host countries and augment capital allocation efficiency (Hiremath, 2016).

Notwithstanding that external debt is an important source of finance and its benefits, EDEs with such debt have not grown faster than those without such obligations (Prasad et al., 2007). The EDEs often borrow in foreign currency due to original sin, which causes currency mismatches. The mismatch froze up the counter-crisis policy options to deal with the

5 The process is known as catching up process.

conditions emanating from the exogenous events causing the collapse of output significantly. A close analysis by Reinhart et al. (2003) shows that the credit ratings for the EDEs fall sharply compared to the AEs when the foreign currency liabilities increases, suggesting wide defaults. Eichengreen et al. (2007) also show the steep fall in the ratings when sin increases. The history of inflation and repayment difficulties in conjunction with weak financial institutions cause increases in the default probabilities in the future. Such defaults are expected to disrupt investments, a cut in imports, and eventually, the output shrinks in the economy.

The three major reasons for the adverse effects of original sin on growth (Eichengreen et al., 2007): a) the sin limits the countercyclical policies, b) the central bank cannot act as a lender of the last resort when original sin levels are high. c) The costs of depreciation increase in the presence of mismatches and thus causes output losses. Eichengreen et al. (2005a,0) empirically show that original sin dents economic growth and adds to its volatility.

In a currency mismatch model, Ranciere et al. (2010) show that the borrowers' lack of enforceable contracts takes on currency mismatches. The government bailout or guarantee in various forms when various borrowers resort to the mismatches further incentivize them to denominate the debt in foreign currency. Since borrowing costs are lower as the insolvency risk premium is not considered, the borrowers find the dollar debt attractive. Currency mismatch thus increases the investment and growth, as constrained firms increasing borrow to finance the investment. However, such borrowings add to the insolvency risk and, combined with costs of bailout, derail the glide path of growth.

The conventional theory of Mundell (1963) – Fleming (1962) posits the expansionary effect of devaluation on economic growth through expenditure switching policy. The currency depreciation improves the trade balance operating through exports only when Marshal–Lerner conditions fulfil.[6] The financial channel of currency depreciation works in the opposite direction of the trade channel. Currency depreciation against the hard currencies increases

6 The sum of price elasticity of exports (e_x) and imports (e_{im}) should be greater than one ($e_x + e_{im} > 1$).

the cost of FCD, diminishes the firms' production because of lower credit opportunities, raises the cost of imports, and induce financial distress. The balance sheet vulnerabilities also weaken the banks and fiscal positions of the governments and mount stress on them.

The effects of currency movements operating through the financial channel are greater than the trade channel because of weak monetary conditions. The financial channel offsets the trade channel in emerging economies, while such effect is weak in AEs (Bruno and Shin, 2015; Kearns and Patel, 2016; Hofmann et al., 2017). A close analysis led Shousha (2019) to attribute contractionary effects on output to the balance sheet vulnerabilities and lack of monetary policy credibility. At the same time, the integration of the emerging economies into the international supply channel weakness the conventional trade channel.

The empirical literature is not unanimous on the effects of foreign currency exposure on economic growth. The foreign currency exposure in the event of depreciation leads to a contractionary effect on economic growth (see Eichengreen and Hausmann, 1999; Reinhart and Calvo, 2000; Eichengreen et al., 2005a; Cavusoglu, 2009). Cavusoglu (2009) tests the relationship between economic growth and currency mismatches using dynamic panel regression for the sample of 22 emerging economies. Their findings suggest lower economic growth and higher growth volatility owing to acute levels of currency mismatches. Ce´spedes et al. (2004) find that currency depreciation can be contractionary only when a country has a considerable amount of FCD with high macroeconomic instability and capital market imperfections.

In contrast, Bebczuk et al. (2010) find evidence of an expansionary effect of depreciation on output and the economic growth in 57 less-dollarized economies during 1976-2003. Furthermore, Ranciere et al. (2010) consider currency mismatches as the engine of economic growth, as the mismatches boost investment and economic growth during normal periods. A growing body of literature questions the validity of the expansionary effect of currency depreciation as conceived by the conventional theory of Mundell–Fleming model. Nevertheless, a few studies show that the Mundell–Fleming model holds even in the country that suffers from greater

balance sheet vulnerabilities. This study attempts to enrich this debate.

3.2 Baseline regression

The primary goal of the study is to quantify the effects of foreign currency exposure on economic growth. To do so, we specify the following dynamic panel regression model:

$$Y_{i,t} = \alpha_i + \beta_1 BOSIN_{i,t} + \beta_2 NCM_{i,t} + \gamma X_{i,t} + \delta Y_{i,t-1} + \epsilon_{i,t} \tag{5}$$

The outcome variable $Y_{i,t}$ is the log of GDP per capita growth in constant local currency units, as defined by the World Bank database. The lagged value of the outcome variable is $Y_{i,t}$. The explanatory variables of interest $BOSIN_{i,t}$ and $NCM_{i,t}$ are the external vulnerable indicators that measure foreign currency exposure. These indicators are expected to be inversely related to economic growth. The α_i is unobserved country-specific effect and $\epsilon_{i,t}$ error term for each country and year, which satisfies the weak exogeneity assumption.

The extant studies on the association between debt and economic growth seldom control the host of variables that are correlated with growth in a multivariate regression set-up.[7] To address this issue, we include $X_{i,t}$ - the vector of control variables, which are expected to influence economic growth.[8] Notably, we follow the neoclassical growth models of Mankiw et al. (1992) and Barro (2003) to choose the control variables such as the differences in human capital, population growth, government expenditure, institutional quality, trade openness, terms of trade, inflation rate, and gross capital formation, which potentially explain cross-country differences in economic growth rate.

In addition, we include financial development, bilateral exchange rate against the US dollar, and financial crisis in the empirical analysis. The description of selected variables and

7 Panizza and Presbitero (2013) surveys the literature on debt, primarily the public and economic growth. They show that debt is not an important policy issue and studies do not control the impact of growth determinants.

8 The variation in number of observations across the countries is dedicated by availability of the data.

data sources are presented in Appendix Table 13. We estimate the dynamic panel regression model using the new approach of Kripfganz and Schwarz (2019) and Kiviet (2020).[9] This method yields efficient and robust estimations, as it incorporates both linear and non-linear moment conditions. We follow the two-step system GMM approach, which produces consistent and asymptotically efficient estimations (Arellano and Bover, 1995; Blundell and Bond, 1998).[10] Further, this approach perfectly addresses the reverse causality, simultaneous and omitted variable bias and problems associated with unobserved country-specific effects on the outcome variable (Arellano and Bond, 1991).

Table 1 presents summary statistics of GDP per capita growth rate, broad original sin, new currency mismatch, and other covariates of economic growth. The sample consists of AEs and EDEs over the 19970 to 2018 period. At a first pass, the average economic growth rate for the whole sample period is 2 percent, with a volatility of 6 percent. Nonetheless, a fifth-percentile of the sample countries registered a negative mean of seven percent, whereas the 75^{th} percentile climbed to a 4 percent growth during the corresponding period. In the same vein, the mean value of broad original sin is 0.82 for the full sample, implying the inability of countries to issue debt in their own currency. Notably, 25 percent of the sample countries suffer from the severe original sin problem (value closer to 0.99), whereas a mere fifth-percentile of economies have low levels of original sin (less than 0.22).

The average value of currency mismatch is 0.22 reflects the net liability position in foreign currency in the sample countries. Further, economies have a diversified position in foreign currency as suggested by the percentile distribution of currency mismatches (fifth-percentile of the sample holds net asset position in foreign currency, 0.68, whereas the 75^{th} percentile shows that net liability positions, 0.24). The pairwise correlation analysis presented in Table 2 suggests no significant correlations among the explanatory variables except the human capital

9 In this approach, we use new STATA package "*xtdpdgmm*" to estimate the two-step system GMM.

10 The system GMM uses the Monte Carlo simulation that improves the estimations based on first difference equation.

Table 1. Descriptive statistics (full sample)

Variable	N	Mean	Median	St.Dev	Min	Max	Skewness	Kurtosis	p5	p75
Economic Growth Rate	6731	0.02	0.02	0.06	-0.98	0.88	-1.10	44.30	-0.07	0.04
Broad Original Sin	4793	0.82	0.95	0.25	0.00	1.00	-1.72	5.11	0.22	0.99
New Currency Mismatch	3633	0.22	-0.001	0.97	-1.58	5.83	3.02	15.47	-0.68	0.24
Human Capital Index	6345	0.72	0.75	0.35	0.01	1.38	-0.23	1.89	0.12	1.03
Population Growth	7856	1.63	1.63	1.35	-9.08	11.01	0.07	5.61	-0.37	2.61
Government Consumption	5279	25.53	25.63	2.89	15.59	34.35	0.31	3.51	21.13	27.06
Institutional Quality	4515	64.31	64.00	14.40	8.50	97.00	-0.25	2.87	39.84	75.00
Trade Openness	6404	72.45	65.25	35.78	13.32	153.68	0.64	2.68	23.63	94.68
Terms of Trade	7125	0.01	0.001	0.12	-0.64	4.41	15.06	494.20	-0.10	0.03
Inflation	5760	-0.02	-0.01	0.92	-2.97	2.75	-0.09	4.75	-1.55	0.41
Investment	6199	23.59	22.84	8.56	-5.74	89.38	0.86	6.34	11.07	27.58
Financial Development	6460	0.02	0.02	0.16	-0.60	0.54	-0.42	6.38	-0.25	0.09
Exchange Rate	7125	0.11	0.01	0.56	-6.34	21.49	9.68	342.66	-0.11	0.10

Notes: Variables sources and definitions' described in Appendix Table 13. This table summarizes the descriptive statistics of crisis indicators and predictors employed in this empirical analysis. The sample consists of 34 advanced economies and 128 emerging and developing economies from 1970-2018 (annual frequency). The data is winsorize at 1% and 99% percentile to remove the extreme outliers in selected observations, The acronym of descriptive statistics - total number of observations (N), standard deviation (SD), minimum and maximum (Min and Max) and 5^{th} & 75^{th} percentiles (p5, p75).

index, which is positively correlated with institutional quality (0.69) and negatively related to population growth (-0.64). Further, the variance inflation factors confirm that the present models do not suffer from the issue of multicollinearity.[11]

The baseline regression results are presented in Table 3. Alvarez and Arellano (2003) argue that GMM estimations produce "*too many instruments' problem*" and lead to an asymptotic bias in case of large value of T (time). Against this backdrop, Roodman (2009) suggests a threshold level of the p-value between 0.1 and 0.4 for the Sargan-Hansen test. We use curtailing approach to address the "*too many instruments problem*" of GMM estimations (Roodman, 2009; Kiviet, 2020). The Sargan-Hansen test results validate asymptotic distribution and over-identifying restrictions of the estimated models. The second-order serial correlation test — AR(2) confirms that estimations do not suffer from autocorrelations.

Moreover, current estimations are consistent and efficient because as we apply the cluster-

11 We reported VIF statistics in Appendix Table 14.

Table 2. Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) *Economic Growth Rate*	1.00												
(2) *Broad Original Sin*	0.02*	1.00											
(3) *New Currency Mismatch*	-0.11*	0.03*	1.00										
(4) *Human Capital Index*	0.09*	-0.09*	0.25*	1.00									
(5) *Population Growth*	-0.11*	0.12*	-0.07*	-0.64*	1.00								
(6) *Government Consumption*	0.01	0.13*	-0.16*	0.01	-0.01	1.00							
(7) *Institutional Quality*	0.14*	-0.19*	0.34*	0.69*	-0.42*	-0.04*	1.00						
(8) *Trade Openness*	0.08*	-0.03*	0.21*	0.33*	-0.16*	-0.32*	0.32*	1.00					
(9) *Terms of Trade*	-0.01	-0.00	0.00	-0.02*	0.01*	0.01*	-0.02*	0.01*	1.00				
(10) *Inflation*	-0.09*	-0.03*	0.01	-0.04*	0.03*	-0.01*	-0.02*	0.01	0.07*	1.00			
(11) *Investment*	0.25*	-0.01	-0.14*	0.19*	-0.11*	0.05*	0.16*	0.24*	-0.01*	-0.01*	1.00		
(12) *Financial Development*	-0.01*	0.05*	-0.04*	-0.00	-0.00	0.01*	0.06*	0.02*	-0.05*	-0.14*	0.09*	1.00	
(13) *Exchange Rate*	-0.18*	0.01	-0.04*	-0.01	-0.02*	-0.01	-0.15*	-0.05*	0.14*	0.10*	-0.06*	-0.09*	1.00

Notes: This table presents pairwise correlation coefficients. * indicates significance at the 0.5 level. Variables sources and definitions' described in Appendix Table 13.

robust standard errors to correct the heteroscedasticity and serial correlation of the error term. We include the lagged outcome variable (GDP per capita growth rate) and constant terms in all regression models. The coefficient on the lagged outcome variable is significant, confirming that the past economic growth determines the current growth.

As a benchmark, we consider financial vulnerabilities as sole explanatory variables in model 1 of Table 3. Woo and Kumar (2015) show the currency composition of debt matters in determining the relationship between economic growth and debt. The large amount of FCD contributes to the adverse effects on productivity and economic growth by reducing investment. The negative sign of the coefficient of broad original sin implies an inverse relationship between original sin and economic growth. The adverse fallout of original sin is because of three reasons. *First*, original sin limits the options of policymakers to implement countercyclical policies. *Second*, it lowers the central bank's ability to act as a lender of last resort. *Third*, the sin exacerbates adverse effects of depreciation on the growth through the financial channel (see Eichengreen et al., 2007; Hausmann and Panizza, 2011). The result suggests that the economic reforms and calibrated policy measures in EDEs come to fruition.

The coefficient of currency mismatches is negative and significant at a 1 percent level, suggesting an inverse relationship with the economic growth (Table 3). A unit rise in currency mismatches lower the GDP per capita growth rate by 1.5 percent. The result implies that the net liability position in foreign currency at the aggregate level, causing a deceleration in the rate of economic growth. In particular, the increased mismatches pose a threat to financial stability by escalating insolvency and systemic risk. Such spur in risk adversely affects the economic performance of a country. Moreover, the coefficient remains significant even after controlling other potential determinants of economic growth (Table 3).[12] This finding elicits support from the work of Cavusoglu (2009), which shows the existence of a significant and negative association between currency mismatches and economic growth. We confound the evidence of Ranciere et al. (2010), who document the favorable influence of currency mismatches on economic performance in emerging European economies.

12 The baseline specifications are in the spirit of Mankiw et al. (1992) and Barro (2003) empirical framework. The covariates in the model are standard variables often discussed in the growth literature.

Table 3. Effect of foreign currency exposure on economic growth
(Two-step system GMM method)

Variables	Foreign currency exposure (1)	Barro Growth Model (2)	Barro + Additional Factors (3)
Broad Original Sin	-0.015	-0.008	-0.004
	(0.031)	(0.010)	(0.010)
New Currency Mismatch	-0.015***	-0.009***	-0.009**
	(0.005)	(0.003)	(0.004)
Human Capital Index		0.126**	0.078
		(0.061)	(0.060)
Population Growth		-0.007	-0.004
		(0.004)	(0.006)
Government Consumption		-0.037**	-0.027**
		(0.015)	(0.013)
Institutional Quality		0.001*	0.001*
		(0.0002)	(0.0003)
Trade Openness		0.0001	0.0001
		(0.001)	(0.002)
Terms of Trade		0.005	0.037*
		(0.016)	(0.019)
Inflation		-0.001	0.001
		(0.001)	(0.001)
Investment		0.002***	0.002***
		(0.001)	(0.001)
Financial Development			0.012
			(0.008)
Exchange Rate			-0.013***
			(0.005)
Financial Crisis			-0.020***
			(0.006)
GDP Per Capita$_{t-1}$	0.108	0.195**	0.039
	(0.171)	(0.089)	(0.085)
Constant	0.036	0.711**	0.529*
	(0.027)	(0.312)	(0.281)
Region Effects	Yes	Yes	Yes
Observations	3,597	2,356	2,315
Countries	131	96	96
Sargan-Hansen (p-value)	0.517	0.175	0.156
AR2 (p-value)	0.548	0.325	0.784

Notes: The dependent variable is the economic growth rate (growth rate of per capita GDP). There are 4793 observations of broad original sin and 3633 observations of currency mismatch index for which growth data is available. The other variables defined in Appendix Table 13. The WC-robust standard errors reported in parentheses adjusted for clustering at the country level to address the heteroskedasticity and autocorrelation problem across the countries. The regional effects are included - Emerging Europe, Asia, Sub-Saharan Africa and Latin America. Model 1: Benchmark model includes only central variables of the study. Model 2: Neo-classical Barro (2003) growth model framework employed. Model 3: Added financial development, exchange rate, and crisis indicator. ***, **, and * denote statistical significance at 1%, 5% and 10% level, respectively.

The original sin and currency mismatches increase financial vulnerability, affect a country's ability to repay the debt, and pose challenges to an independent monetary policy (see Woo and Kumar, 2015). Nonetheless, these two indicators are conceptually as well as empirically distinct. For instance, original sin emphasizes the structure of international portfolios and financial markets, whereas currency mismatches deal with the consequences of those problems (Eichengreen et al., 2007). Further, the original sin problem arises because of the inability of countries to borrow in international markets in their own currencies, whereas the currency mismatch problem results when assets and liabilities are denominated in different currencies.

In line with these distinctions, we empirically differentiate the original sin, and currency mismatches — the accumulation of FCD may not adversely affect economic growth, but when there is a lower forex reserves and liability position in foreign currency, it significantly lower the growth. In other words, a country inability to borrow in local currency does not affect the growth of the economy if the country hedges currency risk through forex reserves. The forex reserves reduce the currency and insolvency risk that lowers the negative effects of currency exposure. Therefore, current empirical findings show that currency mismatch rather than original sin adversely affects economic growth.

In model 2, we include the potential determinants of economic growth as discussed in Mankiw et al. (1992) and Barro (2003). On the one hand, we expect a positive relationship of the human capital index, institutional quality, trade openness, terms of trade, and investment with economic growth. On the other hand, the economic growth rate is expected to be inversely related to the population, government consumption, and inflation. The present approach is consistent with the theory and prior empirical work on economic growth (Mankiw et al., 1992; Barro, 2003; Bebczuk et al., 2010; Camarero et al., 2019).

We employ the human capital index – the composition of years of schooling and returns to education, as a proxy for human capital. The neo-classical growth model posits that human capital leads to higher economic growth (Barro, 2003). We find an inverse relationship

between economic growth and population growth. The unfavorable effects of population on economic growth are because of the inadequate availability of capital as the population rises (Mankiw et al., 1992). Further, we use government consumption expenditure as a proxy of government fiscal position. The higher expenditure by the government distorts the private decisions and tends to depress the steady-state growth. In line with this theoretical prediction, we find that higher government expenditure impinges the economic performance. Bebczuk et al. (2010), and Cavusoglu (2009), however, document the positive influence of government expenditure on private investment.

The role of institutional quality in economic growth is prominent. Therefore, the institutional quality is expected to have a favorable bearing on economic growth. We use an index of a composite of institutional indicators such as bureaucracy quality, corruption, external conflict, government stability, investment profile, internal conflict, military in politics, religious tensions, law and order, ethnic tensions, democratic accountability, and socioeconomic conditions. The higher index value suggests greater institutional quality in a country. The present findings confirm that poor quality institutions impede economic growth because lack of quality institutions hinders the capital inflows and induces the capital fly to countries with better quality institutions. Hence, a country with institutional quality grows stronger and sound outpacing a nation with poor institutional quality. Camarero et al. (2019) also show that countries with healthy institutional systems positively affect economic growth.

The trade-led hypothesis states trade acts as an engine of economic growth. Trade openness potentially stimulates economic growth by providing access to quality goods and services, allocating resources efficiently, and improving productivity through technology diffusion and knowledge dissemination. In this research, trade openness measured as trade percent of GDP shows that trade exposure is directly associated with a country's economic growth. In addition, we also employ the terms-of-trade – growth of export prices relative to import prices. This ratio measures the effect of changes in international prices on the income position

of domestic residents. We find the coefficient positive and significant in model 3. This result suggests economic growth increases with the rise in the real income position of the residents because of higher export prices, whereas higher import prices reduce the growth.

The inflation rate is a proxy to the country's risk and macroeconomic stability. The inflationary pressure slows down the economic growth through several channels including lower savings, higher current account deficit, and a weaker currency. We find a positive relationship between inflation rate and per capita growth rate. The progressive adaption of the inflation targeting framework by several EDEs explains such a weaker impact of inflation pressure on the growth. Finally, the gross capital formation as a percent of GDP is a proxy of investment, which is a crucial determinant of economic growth. The coefficient on investment is positive and statistically significant in all the models, as expected.

Further, we introduce the financial development, exchange rate, and financial crisis as additional regressors in the baseline specification (model 3, Table 3). Financial development plays a vital role in economic growth. In an influential model, Rajan and Zingales (1998) illustrate that financial development helps overcome market imperfections and credit constraints. This reduced constraint lowers the cost of external debt and facilitates economic growth. In particular, Goldstein and Turner (2004) and Eichengreen et al. (2007) suggest that lack of financial development leads to greater balance sheet vulnerabilities, which unleashes debilitating effects on economic growth. The models of Levine (2005), Henderson et al. (2013), and Camarero et al. (2019) also confirm the financial development-growth nexus.

We measure financial development as domestic credit to the private sector as a percent of GDP. Domestic credit is directly related to the economic growth rate, implying that countries confronting a higher level of credit to the private sector fuel economic growth. Current result empirically validates the models of Rajan and Zingales (1998), Goldstein and Turner (2004), Levine (2005), and Eichengreen et al. (2007). We refute the finding of Barro (2003), who suggests an adverse effect of financial development on economic growth.

The precise effect of currency depreciation on growth is a much-debated topic in the literature, but neglected in the neo-classical growth model. One strand of literature finds that depreciation has an expansionary effect on economic growth through increasing exports (Mundell, 1963; Fleming, 1962; Bebczuk et al., 2010). However, the growing body of literature shows that currency depreciation can be a contractionary effect on growth because of financial channel effects (Krugman and Taylor, 1978; Edwards, 1986; Kamin and Klau, 1998; Kearns and Patel, 2016; Avdjiev et al., 2019; Shousha, 2019).

The estimates in Table 3 show that the parameter of the exchange rate (change in the local currency against the US dollar) coefficient is negative and statistically significant. The exchange rate depreciation exacerbates the financial obligations denominated in foreign currency that causes liquidity constraints and insolvency problems, ravaging the firms' growth avenues and contracts output. The balance sheet effects of exchange rate depreciation overweigh the expansionary effect and thus fundamentally alter the economic performance of a country. The result rejects expansionary effects of depreciation on trade and eventually on the growth, as conceived by the Mundell-Fleming model. Rather, the current result supports the contractionary hypothesis.

Financial crisis is considered one of the significant determinants of economic growth in the literature (Barro, 2001; Bordo et al., 2010; Ranciere et al., 2010). Since the original sin and currency mismatches accentuate the systemic risk and cause the crisis, the sin and mismatches indirectly also impede economic performance. Bordo et al. (2010) provide evidence of the higher level of FCD increasing the probability of debt and currency crisis, which eventually leads to loss of output in the economy. Further, they argue that FCD coupled with weak macroeconomic fundamentals causes a contraction of the economy.

Therefore, we include the crisis as a dummy variable as one of the interest variables in the baseline model. The crisis dummy takes value one for the crisis year during which a financial crisis occurred, such as currency, banking, or sovereign debt crisis or zero otherwise. We

identify the crisis years from the dataset of Laeven and Valencia (2020). The coefficient on the financial crisis dummy is negative and statistically significant in all the models, implying that crises erode economic growth. This finding suggests that during financial crises, the value of FCD rises that creates currency risk and debt default, which leads to significant losses in output and economic growth. Lastly, four regional dummies for a group of countries[13] such as Emerging Europe, Asia, Sub-Saharan Africa, and Latin America are included together in the baseline regression model as in Barro's (2003) growth model.

3.3 Advanced versus emerging and developing economies

A sub-sample analysis of AEs and EDEs deserves special attention, given the economic and non-economic differences between these two groups. The countries are classified as AE and EDE based on the IMF-World Economic Outlook methodology.[14] The AEs have an advantage of a strong bedrock of well-developed financial markets, stable currencies, quality institutions, and legal systems over EDEs. Further, AEs' influence on the political economy of world trade and investment is wide and deep and often entrench hegemony. The sub-sample trends show that the economic growth rate and broad original sin move in opposite directions in AEs (Figure 4).

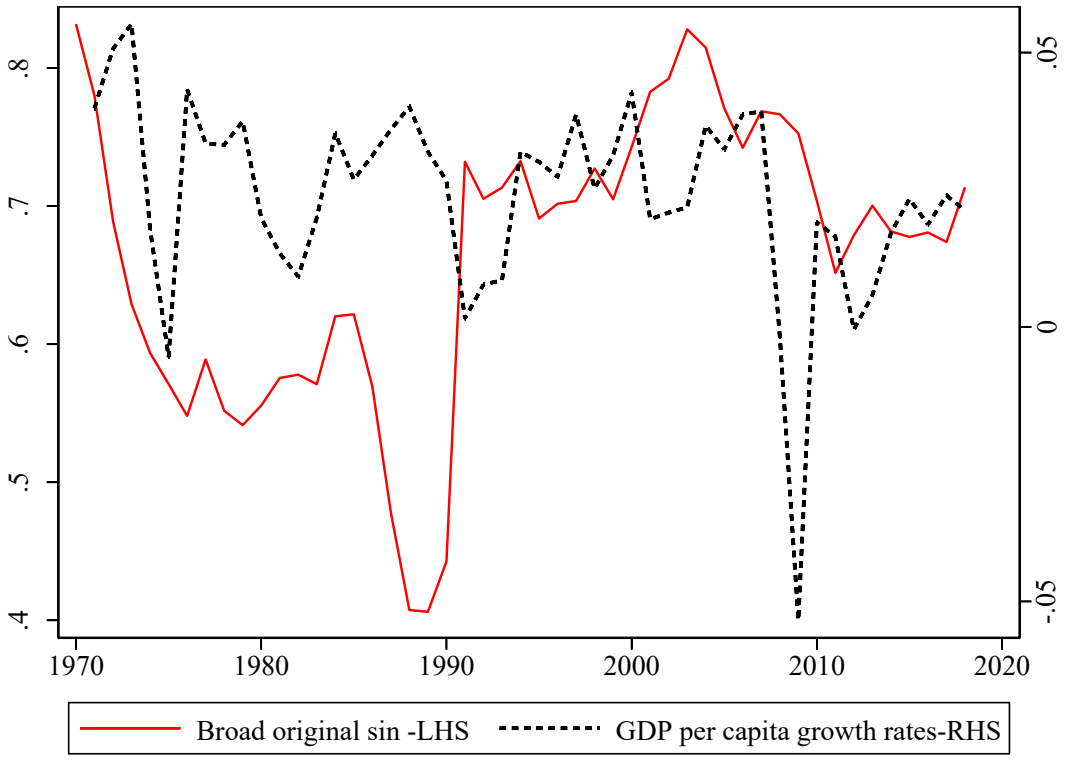
In Figure 5, we observe a strong negative association between economic growth rate and currency mismatches in these economies during GFC. The negative growth rates tend to co-incide with greater liability position in foreign currency during the boom years. For instance, the highest liability position in foreign currency in AEs and the highest negative economic growth rate registered during GFC.

In case of EDEs, we notice both original sin and currency mismatches inversely associated with economic growth during study period (Figure 6 and 7). As the theoretical framework

13 We follow the geographical classification of World Bank to classify the countries into groups.

14 The sample classification criterion is based on per capita income level, export diversification and degree of integration to the global financial system.

Figure 4. Advanced economies: Original sin and economic growth

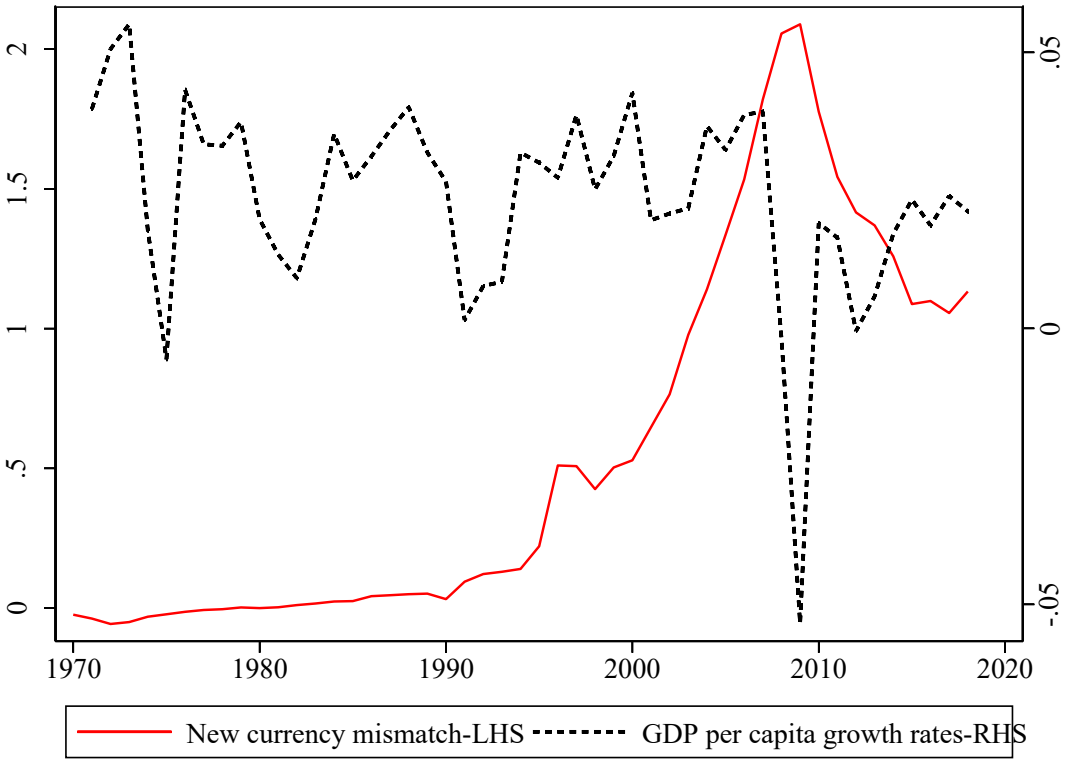


Data sources: Author's own calculations based on information collected from the BIS and IMF.
Note: The figure is based on the sample of 34 AEs.

outlines, the increasing original sin and currency mismatches run into negative growth rates in EDEs. The rapid accumulation of the FCD is the corollary of the financial crises, as a result economic growth slowdown. In contrast to the AEs, the trends of economic growth and currency mismatches in EDEs are highly volatile as these economies are more exposed to external shocks and insolvency risk.

The summary statistics of the sub-sample in Table 4 indicate no difference in average economic growth rates between AEs and EDEs except the latter having high growth volatility of 6 percent, whereas the former register 3 percent. The broad original sin is higher level (0.87) in EDEs outpacing the AEs (0.67), suggesting the former's vulnerability to an elevated level of insolvency and currency risk than advanced counterparts. Such entrenching risk levels increase the probability of crisis and economic slowdown (Goldstein and Turner,

Figure 5. Advanced economies: Currency mismatches and economic growth



Data sources: Author's own calculations based on information collected from the BIS and IMF.
Note: The figure is based on the sample of 34 AEs.

2004; Eichengreen et al., 2007; Bordo et al., 2010).

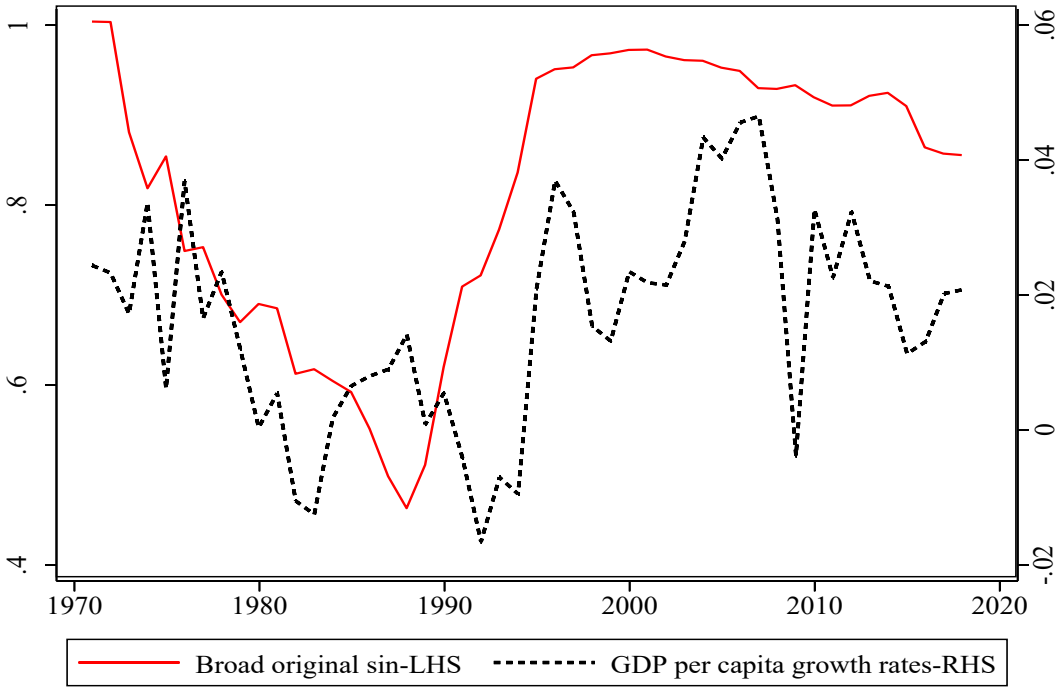
Table 4. Descriptive statistics: Regime classification

	N	Mean	Median	St.Dev	N	Mean	Median	St.Dev
Variable	Advanced Economies				Emerging and Developing Economies			
Economic Growth Rate	4364	0.02	0.02	0.05	2367	0.01	0.02	0.06
Broad Original Sin	3172	0.82	0.95	0.26	1621	0.83	0.93	0.23
New Currency Mismatch	2396	0.24	-0.00	1.06	1237	0.19	0.00	0.76

Notes: Variables sources and definitions' described in Appendix Table 13.

The full sample may not capture these nuances completely, and a sub-sample analysis provides robustness to current inferences. AEs can sustain the original sin, but EDEs suffer from it because the former group is fundamentally stronger than EDEs. The finding reveals the nature of the economy itself makes a marked difference to the sustainability of original

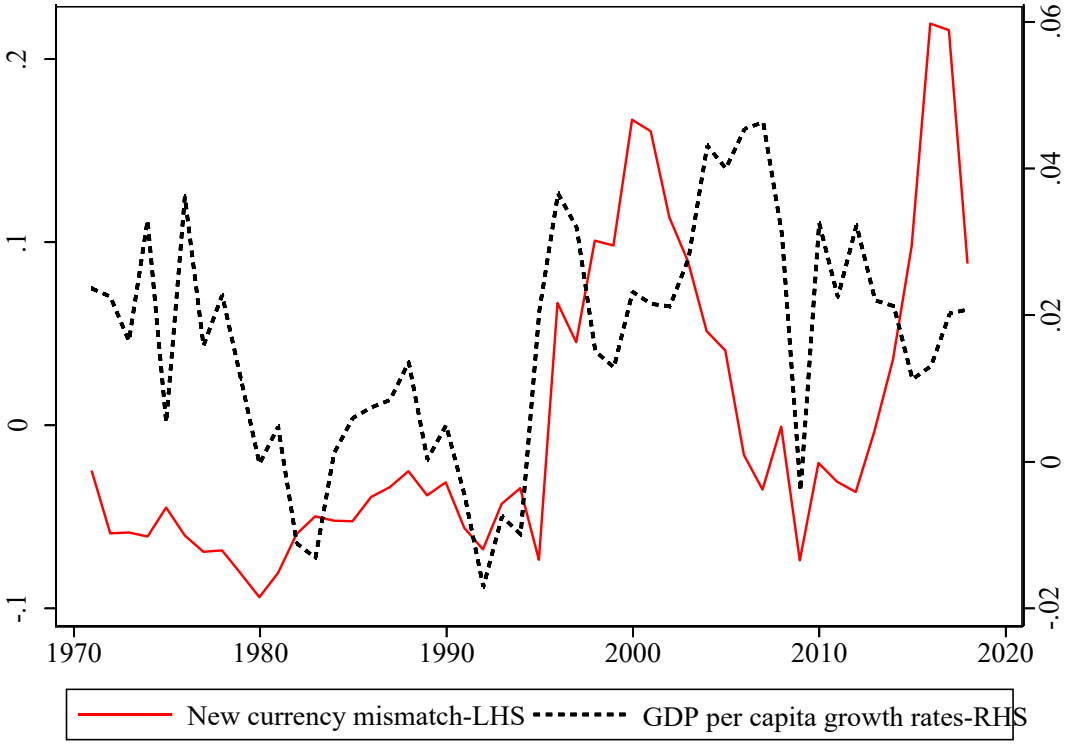
Figure 6. Emerging and developing economies: Original sin and economic growth



Data sources: Author's own calculations based on information collected from the BIS and IMF.
Note: The figure is based on the sample of 128 EDEs.

sin. Therefore, we re-estimate the baseline regression model (Eq. 5) for AEs and EDEs and present the estimates in Table 5 and 6, respectively. This approach is in line with the analysis of Eichengreen et al. (2007), Reinhart and Rogoff (2010), and Benetrix et al. (2020).

Figure 7. Emerging and developing economies: Mismatches and economic growth



Data sources: Author's own calculations based on information collected from the BIS and IMF.
Note: The figure is based on the sample of 128 EDEs.

Table 5. Advanced economies

	Benchmark Model	Barro Growth Model	Barro+ Additional Factors
Variables	(1)	(2)	(3)
Broad Original Sin	-0.043	0.007	0.018
	(0.032)	(0.017)	(0.018)
New Currency Mismatch	-0.005*	-0.012*	-0.013**
	(0.003)	(0.007)	(0.005)
Financial development			0.008
			(0.018)
Exchange Rate			-0.053
			(0.039)
Financial Crisis			-0.011
			(0.015)
Constant	0.043*	-0.625	-0.047
	(0.023)	(1.047)	(0.881)
Controls Included	No	Yes	Yes
Observations	1,092	778	763
Countries	27	27	27
Sargan-Hansen (p-value)	0.305	0.105	0.305
AR2 (p-value)	0.376	0.137	0.865

Notes: This table present the baseline results for advanced economies sample. The dependent variable is the economic growth rate (growth rate of per capita GDP). The WC-robust standard errors reported in parentheses adjusted for clustering at the country level to address the heteroskedasticity and autocorrelation problem across the countries. ***, **, and * denote statistical significance at 1%, 5% and 10% level, respectively.

Similar to the full sample analysis, the sub-sample estimations confirm the adverse effects of currency exposure on economic growth in AEs as well as EDEs. However, the coefficient of broad original sin is positive in the case of AEs (Table 5). The findings suggest that despite borrowing substantially from abroad in foreign currency, AEs are not as vulnerable to external shocks as EDEs. The currency mismatch, unlike original sin, is negatively associated with economic growth in AEs and EDEs, implying that mismatches pose a severe threat to financial stability and sustainable growth irrespective of the income level of the economy. The currency mismatch, therefore, is not a mere weakness of the EDEs. Such adverse influence necessitates the fashioning of policy to control currency mismatches to reinvigorate growth in AEs and EDEs.

Further, financial development is positively associated with economic growth in AEs and EDEs as well. Nevertheless, the impact of exchange rate and financial crises on growth is negative in both AEs and EDEs, but the magnitude of contraction of growth is higher and significant in EDEs than in the AEs. Such divergence makes a case for a calibrated policy to immune the EDEs from shocks.

3.4 Currency mismatches and economic growth: The role of exchange rate policies

In this section, we extend the baseline Eq. 5 to probe the effect of currency mismatches on economic growth in the wake of currency depreciation. We estimate the following model:

$$Y_{i,t} = \alpha_i + \beta_1 BOSIN_{i,t} + \beta_2 NCM_{i,t} + \beta_3 (NCM_{i,t} \times ER_{i,t}) + \gamma X_{i,t} + \delta Y_{i,t-1} + \epsilon_{i,t} \qquad (6)$$

We hypothesize the sign of interaction term, $NCM_{i,t} \times ER_{i,t}$ negative as the currency depreciation against the US dollar increases the liabilities denominated in the dollar and accentuates the problem of currency mismatches. Such flared liabilities are expected to reduce the net worth, lower the output, and thus hampers economic growth (see Goldstein and Turner,

Table 6. Emerging and developing economies

Variables	Benchmark Model (1)	Barro Growth Model (2)	Barro+ Additional Factors (3)
Broad Original Sin	-0.128*	-0.028	-0.023
	(0.069)	(0.018)	(0.018)
New Currency Mismatch	-0.075***	-0.023*	-0.015
	(0.028)	(0.012)	(0.015)
Financial development			0.016
			(0.010)
Exchange Rate			-0.012**
			(0.005)
Financial Crisis			-0.022***
			(0.007)
Constant	0.131**	0.710*	0.552*
	(0.060)	(0.378)	(0.320)
Regional Effects	Yes	Yes	Yes
Controls Included	No	Yes	Yes
Observations	2,471	1,575	1,552
Countries	104	69	69
Sargan-Hansen (p-value)	0.307	0.154	0.114
AR2 (p-value)	0.312	0.462	0.762

Notes: This table present the baseline results for emerging and developing economies sample. The dependent variable is the economic growth rate (growth rate of per capita GDP). The WC-robust standard errors reported in parentheses adjusted for clustering at the country level to address the heteroskedasticity and autocorrelation problem across the countries. ***, **, and * denote statistical significance at 1%, 5% and 10% level, respectively.

2004; Eichengreen et al., 2005a,0). In this model, we find that a unit change in currency mismatches reduce the 0.8 percent growth. Still, the magnitude is relatively lower, whereas the currency depreciation amplifies the negative effect of currency mismatches on economics growth rate by 1.8 percent (Table 7).

Table 7. Currency mismatches and economic growth: The role of interaction effects

Variables	(1)	(2)	(3)
Broad Original Sin	-0.005	-0.004	-0.010
	(0.010)	(0.009)	(0.011)
New Currency Mismatch	-0.008**	-0.014***	-0.011***
	(0.004)	(0.005)	(0.004)
Exchange Rate	-0.013***	-0.011***	0.013
	(0.005)	(0.004)	(0.009)
Trade Openness	0.0001	0.0001	0.0001
	(0.0001)	(0.0002)	(0.0004)
Financial Crisis	-0.020***	-0.020***	-0.020***
	(0.006)	(0.006)	(0.006)
Peg		0.010	
		(0.008)	
New Currency Mismatch × *Exchange Rate*	-0.018***		
	(0.007)		
New Currency Mismatch × *Peg*		0.010*	
		(0.006)	
Trade Openness × *Exchange Rate*			-0.0004***
			(0.002)
Constant	0.434	0.621**	0.643**
	(0.288)	(0.272)	(0.260)
Controls Included	Yes	Yes	Yes
Region Effects	Yes	Yes	Yes
Observations	2,315	2,249	2,315
Countries	96	94	96
Sargan-Hansen (p-value)	0.139	0.311	0.139
AR2 (p-value)	0.759	0.982	0.751

Notes: Variables sources and definitions' described in Appendix Table 13. The dependent variable is the economic growth rate (growth rate of per capita GDP). The WC-robust standard errors reported in parentheses adjusted for clustering at the country level to address the heteroskedasticity and autocorrelation problem across the countries. The regional effects are included - Emerging Europe, Asia, Sub-Saharan Africa and Latin America. ***, **, and * denote statistical significance at 1%, 5% and 10% level, respectively.

When we alternatively employ the interaction term ($BOSIN_{i,t} \times ER_{i,t}$), find a unit change in currency depreciation negatively changes the GDP per capita by 1.7 percent (model 1 in Table 8). Nevertheless, original sin boosts economic growth by 0.3 percent. These estimates show the exchange rate depreciation amplifies the adverse impact of foreign currency exposure on economic growth. Such adverse effect of currency mismatches and original sin in the event of depreciation increases the probabilities of default. These results validate the financial channel effects of exchange rate on the economy (Bruno and Shin, 2015; Kearns and Patel, 2016; Avdjiev et al., 2019; Shousha, 2019).

Table 8. Original sin and economic growth: The role of interaction effects

Variables	(1)	(2)
Broad Original Sin	0.003	-0.006
	(0.012)	(0.016)
New Currency Mismatch	-0.010***	-0.008**
	(0.004)	(0.004)
Exchange Rate	0.002	-0.012***
	(0.010)	(0.004)
Financial Crisis	-0.022***	-0.021***
	(0.006)	(0.006)
Peg		-0.002
		(0.019)
Broad Original Sin × *Exchange Rate*	-0.017**	
	(0.012)	
Broad Original Sin × *Peg*		0.013*
		(0.020)
Constant	0.320	0.507*
	(0.253)	(0.291)
Controls Included	Yes	Yes
Observations	2,321	2,255
Countries	96	94

Notes: Variables sources and definitions' described in Appendix Table 13. The dependent variable is the economic growth rate (growth rate of per capita GDP). The WC-robust standard errors reported in parentheses adjusted for clustering at the country level to address the heteroskedasticity and autocorrelation problem across the countries. The regional effects are included - Emerging Europe, Asia, Sub-Saharan Africa and Latin America. ***, **, and * denote statistical significance at 1%, 5% and 10% level, respectively.

As current results show, the impact of the exchange rate on economic growth is contractionary due to original sin and currency mismatches. In this light, the choice of exchange rate regime is crucial for economic performance, as such choices have a marked bearing on

the exchange rate movements and its management. We classify the regimes as pegged and floating exchange rates based on the classification method of Ilzetzki et al. (2019). They codified the index from 1 to 6 as a hard peg to float. The 63 percent of present sample countries follow a pegged exchange rate regime. At a first pass, the countries under the fixed exchange rate regime outperform those following flexible regime as the annual average GDP per capita growth rate stood 2 percent for the former whereas the latter registered one percent GDP growth rate (Table 9).

Table 9. Descriptive statistics: Regime classification

	N	Mean	Median	St.Dev	N	Mean	Median	St.Dev
Variable	Advanced Economies				Emerging and Developing Economies			
Economic Growth Rate	4364	0.02	0.02	0.05	2367	0.01	0.02	0.06
Broad Original Sin	3172	0.82	0.95	0.26	1621	0.83	0.93	0.23
New Currency Mismatch	2396	0.24	-0.00	1.06	1237	0.19	0.00	0.76

Notes: Variables sources and definitions' described in Appendix Table 13

The literature on exchange rate regimes and economic performance is vast.[15] Notwithstanding the critical importance of the potential influence of exchange rate regimes on currency exposure-economic growth nexus, the issue received no due attention in the literature. A country reduces insolvency and currency risk when it moves from pegged to floating exchange rate regime, since the latter compresses the external vulnerability and enhances economic growth (Goldstein and Turner, 2004). On the contrary, Eichengreen et al. (2005a) argue that floating regimes are associated with greater exchange rate volatility, implying increased hedging costs. On this front, the theoretical literature is not unanimous. We fill this void in the literature by examining the effect of currency mismatches on growth in a particular regime. The following equation is estimated to quantify the impact:

$$Y_{i,t} = \alpha_i + \beta_1 BOSIN_{i,t} + \beta_2 NCM_{i,t} + \beta_3 (NCM_{i,t} \times Peg_{i,t}) + \gamma X_{i,t} + \delta Y_{i,t-1} + \epsilon_{i,t} \quad (7)$$

15 See Bart and Wong (1994), Klein and Shambaugh (2010) among others.

where $Peg_{i,t}$ is a dummy variable, which takes the value one if a country follows the fixed exchange rate regime, while zero implies a floating regime. As mentioned, we follow Ilzetzki et al. (2019) to prepare a dummy variable of $Peg_{i,t}$. We find the coefficient of the interaction term ($NCM_{i,t} \times Peg_{i,t}$) positive and significant in model 2 of Table 7. Hence, a fixed exchange rate regime supports economic growth by allying fears of risk emanating from currency mismatches and imparting stability. The $BOSIN_{i,t} \times Peg_{i,t}$ also confirms similar inference in the case of original sin as envisaged by Eichengreen et al. (2007). This evidence validates *'fear of floating'* (see Calvo and Reinhart, 2002).

The exchange rate depreciation amplifies the adverse impact of the original sin and currency mismatches on growth and blunts the expansionary benefits as observed in preceding estimates (Table 3). We show that the pegged exchange system curbs exchange rate volatility. Commensurate with such stability, FCD augurs well for economic growth. As a result, economies become immune to foreign currency exposure to a great extent. The countries that follow pegged exchange regimes not only outpaced those with the flexible regime in terms of economic growth, but the potential risk emanating from the sin and mismatch is subdued, whereas the financial leverage is eliciting a favorable response from the economic activities.

3.5 Contractionary devaluation hypothesis

To evaluate the contractionary hypothesis, we include the interaction of trade openness with exchange rate in the baseline regression model, following:

$$Y_{i,t} = \alpha_i + \beta_1 BOSIN_{i,t} + \beta_2 NCM_{i,t} + \beta_3 (Trade_{i,t} \times ER_{i,t}) + \gamma X_{i,t} + \delta Y_{i,t-1} + \epsilon_{i,t} \qquad (8)$$

We measure trade openness as the trade share of GDP and use the bilateral exchange rate against the US dollar as an exchange rate variable. The estimated results reported in model 3 of Table 7. The estimated interaction term ($Trade_{i,t} \times ER_{i,t}$) shows that openness is inversely related to economic growth, as expected. The result suggests that the positive effect

of trade openness on growth turns into negative in the event of currency deprecation, which conforms to the contractionary devaluation hypothesis. Thus, currency depreciation contracts economic growth when a nation follows a trade openness policy due to domestic economies suffering from financial vulnerabilities such as original sin and currency mismatches. The financial effect of trade openness is outweighing the trade channel effect of depreciation. The present findings suggest that currency depreciation could influence economic growth via the standard trade channel and through a financial channel, which operates through the impact of financial vulnerabilities. The result is in line with the evidence of Bebczuk et al. (2010).

3.6 Long-run effects of currency mismatches on economic growth

The balance sheet vulnerabilities may have long-run effects on economic activity as well. Therefore, we adopt Acemoglu et al. (2019) and Chen et al. (2019) framework to estimate the long-run effects of currency mismatches on economic growth.

$$Y_{i,t} = \alpha_i + \beta NCM_{i,t} + \sum_{j=1}^{p} \delta_j Y_{i,t-j} + \epsilon_{i,t} \tag{9}$$

Eq. 9 includes p number of lags of the outcome variable to control the dynamics of economic growth. We derive the coefficient of long-run effect (LRE) from the estimated parameters of $\hat{\beta}$ and $\hat{\delta}_j$ as in Eq. 10.

$$LRE = \frac{\hat{\beta}}{(1 - \sum_{j=1}^{p} \hat{\delta}_j)} \tag{10}$$

We control the dynamics of growth rate and include the five lags of the outcome variable (GDP per capita growth rate) to account for the unobserved effects.[16] The GMM estimations of the present study suggest currency mismatches lower the economic growth rate by about 0.6 percent in the short run and 0.5 percent in the long run (model 1 in Table 10). Further, we find the long-run effects of currency mismatch notably higher in EDEs (3.2%) than AEs

16 The lag selection is based on Acemoglu et al. (2019) and Chen et al. (2019).

(1.2%) in models 2 and 3 of Table 10. Empirical results reflect the detrimental effect of currency mismatches on long-run economic growth in AEs and EDEs.

Table 10. Long-run effects of currency mismatches on economic growth

	Full Sample	AEs	EDEs
Variables	(1)	(2)	(3)
Short-Run Effect of Currency Mismatch	-0.006**	-0.008***	-0.013*
	(0.003)	(0.002)	(0.007)
Long-Run Effect of Currency Mismatch	-0.005**	-0.012***	-0.032**
	(0.003)	(0.003)	(0.016)
GDP Per Capita Growth$_{t-1}$	0.152	0.519***	0.234**
	(0.099)	(0.074)	(0.103)
GDP Per Capita Growth$_{t-2}$	-0.172**	-0.254***	0.078
	(0.073)	(0.070)	(0.135)
GDP Per Capita Growth$_{t-3}$	-0.0001	0.180***	0.153**
	(0.075)	(0.060)	(0.075)
GDP Per Capita Growth$_{t-4}$	-0.046	-0.051	0.085
	(0.081)	(0.070)	(0.111)
GDP Per Capita Growth$_{t-5}$	-0.090	-0.064	0.045
	(0.056)	(0.064)	(0.078)
Constant	0.030***	0.021***	0.010***
	(0.005)	(0.003)	(0.003)
Region Effects	Yes	Yes	Yes
Observations	3,421	1,023	2,398
Countries	131	27	104
Sargan-Hansen (p-value)	0.316	0.139	0.352
AR2 (p-value)	0.328	0.174	0.485

Notes: Variables sources and definitions' described in Appendix Table 13. The dependent variable is the economic growth rate (growth rate of per capita GDP). The WC-robust standard errors reported in parentheses adjusted for clustering at the country level to address the heteroskedasticity and autocorrelation problem across the countries. The regional effects are included - Emerging Europe, Asia, Sub-Saharan Africa and Latin America. ***, **, and * denote statistical significance at 1%, 5% and 10% level, respectively.

3.7 Alternative measures of foreign currency exposure

In this section, we examine the implications of alternative measures of financial vulnerabilities to economic growth. First, we estimate the narrow version of the original sin as in Eichengreen et al. (2005a,0) to measure financial vulnerability for a comparison.[17] The results reported in model 1 of Table 11 show that the coefficient on narrow original sin is positive and

17 The exclusion of currency composition of bank loans is the major limitation of this index.

significant. This finding suggests that international debt securities[18] enhance the economic growth in EDEs. This result confounds the adverse impact of broad original sin on growth (Table 3). This distinction is because the cross-border bank loans to EDEs have profound adverse effects on growth than international debt securities.

Table 11. Alternative measures of foreign currency exposure

Variables	(1)	(2)	(3)	(4)	(5)
Narrow Original Sin	0.047***		0.007		
	(0.015)		(0.084)		
AECM ×(-1)		-0.003***	-0.004***		
		(0.0003)	(0.0008)		
Foreign Currency Exposure ×(-1)				-0.027***	
				(0.010)	
Quant. Foreign Currency Exposure ×(-1)					-0.002*
					(0.005)
GDP Per Capita$_{t-1}$	0.238***	0.072	0.096	0.177***	0.464***
	(0.073)	(0.065)	(0.092)	(0.065)	(0.005)
Constant	-0.012	0.013	0.011*	0.015***	0.010***
	(0.010)	(0.004)	(0.004)	(0.003)	(0.003)
Region Effects	Yes	Yes	Yes	Yes	Yes
Observations	1211	451	387	921	921
Countries	54	21	20	42	42

Notes: The dependent variable is the economic growth rate (growth rate of per capita GDP). We prepare a narrow original sin index using influential work by Eichengreen et al. (2005a,0); for currency mismatch index, we follow the Chui et al. (2018) latest methodology, Goldstein and Turner (2004) framework. The dataset on foreign currency exposure index has taken from the IMF external vulnerability database, prepared by Rohn et al. (2015). The definition of these indices are as follows: FCE is between "-1 (zero foreign-currency foreign assets and only foreign-currency foreign liabilities) and 1 (only foreign-currency foreign assets and only domestic-currency foreign liabilities)." The FCE and QFCE indices are available for a few countries (such as 42 countries from 1990 to 2012). ***, **, and * denote statistical significance at 1%, 5% and 10% level, respectively.

Second, we construct the AECM index using the methodology of Goldstein and Turner (2004) and Chui et al. (2018). Original sin focuses on debt liabilities, whereas the accumulation of forex reserves blunt the external shocks considerably. Unlike original sin, thus, the AECM index includes both sides of the balance sheet (currency composition of assets and liabilities) and measures the complete foreign currency exposure of a country. The negative value of the index suggests that country is in a liability position in foreign currency, whereas the positive value indicates an asset position in foreign currency. Further, this index addresses

18 The BIS definition of debt security, "debt security issued in a market other than the local market of the country where the borrower resides, i.e., issued in any market by a non-resident."

the drawbacks of the original sin approach.

We compute the AECM index for 22 emerging economies[19] using Goldstein and Turner (2004) and Chui et al. (2018). Similar to the baseline regression in which we use new currency mismatch index, the empirical estimates presented in model 2 of Table 11 shows that the relationship between AECM and economic growth rate is negative and significant at one percent level (Model 2, Table 11). The greater degree of currency mismatches between assets and liabilities in emerging economies raises the vulnerability and systemic risk that impinges on economic growth. This finding is in line with the theory of Goldstein and Turner (2004).

Further, the new method of currency mismatch (Eq. 4) has relatively larger effects on growth than AECM. The baseline results show that a one-unit increase in new currency mismatch index lowers the 1.5 percent of economic growth. Nevertheless, in case of AECM estimation, we observe that 0.3 percent of growth slowdown due to a one-unit increase in AECM index. Moreover, the baseline estimations have diversified samples (AEs and EDEs) and robust inferences than AECM. Overall, the strong evidence on the relationship between vulnerability and economic growth rationalizes the importance of controlling currency mismatches in EDEs and AEs as well.

Finally, we test the impact of financial vulnerabilities on economic performance in Organization for Economic Co-operation and Development (OECD) countries. We collect the currency exposure indicators such as foreign currency exposure (FCE) and quantitative foreign currency exposure (QFCE) for OECD countries from the IMF external vulnerability database prepared by Rohn et al. (2015). The FCE index is lies between "-1 (zero foreign-currency foreign assets and only foreign-currency foreign liabilities) and 1 (only foreign-currency foreign assets and only domestic-currency foreign liabilities)."

Similarly, the QFCE index is defined as "quantitative exposure of foreign assets and liabilities

19 The required dataset to compute the AECM only available for 22 emerging economies and not available for the rest of the countries.

to a uniform shift in the value of the domestic currency against all foreign currencies." These indicators are available for 42 OECD countries for the period 1990 to 2012. Using these indicators, we examine whether financial vulnerability hurts the economic performance of OECD economies. The findings show that currency exposure indicators (i.e., FCEWe and QFCI) are inversely associated with economic growth in OECD countries (models 4 and 5 in Table 11). Similar to the EDEs, the considerable amount of foreign currency liabilities lowers the economic growth, whereas foreign currency assets and liabilities in domestic currency augment the economic performance in OECD countries.

4 Conclusion and policy implications

We developed new methods of measuring external vulnerability by including the currency composition of cross-border bank loans and international debt securities. Measuring vulnerability helps accurately quantify the macroeconomic effects of currency exposure and fashion the policy measures to revive the economy from the fallout. Using cross-country information on external vulnerabilities, we estimate the impact of foreign currency exposure on economic activity by employing dynamic panel regression. The present results suggest that currency exposure does cause lower growth outcomes and show that currency mismatches indeed matter for emerging and developing economies, and advanced economies as well.

We show that exchange rate movements adversely affect economic activity via the financial channel, blunting the trade channel effects. Further, we also find that currency mismatches are detrimental to long-run economic growth. Countries should implement policies that limit the issuance of foreign currency-denominated debt and substitute it with local currency-denominated bonds. Another important recommendation is that economies are better off with fixed exchange rates when they have more significant financial vulnerabilities.

Policymakers should monitor not only the effects of balance sheet vulnerabilities, but also look for the indirect effects via exchange rate policies. Measuring original sin and currency

mismatch completely can guide policymakers in their efforts to address vulnerabilities at the right time. These two indicators can flag risks of excessive currency mismatches that could call for the implementation of macroprudential policies. Another policy implication stemming from results highlights the paramount need for improvement in institutions to reduce countries' balance sheet vulnerabilities, such as better monetary and fiscal policies. The possible extension of the present study is to account for the non-linear effects of vulnerabilities using machine learning applications and testing firms' liquidity channel.

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Appendix

Table 12. List of sample

Advanced economies (34)
Australia, Austria, Belgium, Canada, China P.R.: Hong Kong, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovak Republic, Slovenia, South Korea, Spain, Sweden, Switzerland, United Kingdom, and United States.
Emerging and developing economies (128)
Albania, Algeria, Angola, Argentina, Armenia, Azerbaijan, Bangladesh, Barbados, Belarus, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Chile, China, Chinese Taipei, Colombia, Comoros, Congo Democratic Republic, Congo Republic, Costa Rica, Croatia, Côte d'Ivoire, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary, India, Indonesia, Iran, Jamaica, Jordan, Kazakhstan, Kenya, Kuwait, Kyrgyz Republic, Lao People's Dem. Rep., Lebanon, Lesotho, Liberia, Libya, Macedonia, Madagascar, Malawi, Malaysia, Maldives, Mali, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Romania, Russia, Rwanda, Sao Tome and Principe, Senegal, Serbia, Seychelles, Sierra Leone, South Africa, Sri Lanka, St. Kitts and Nevis, Sudan, Suriname, Syria, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Uganda, Ukraine, Uruguay, Uzbekistan, Venezuela, Vietnam, Yemen, Zambia, and Zimbabwe.

Notes: The selection of countries based on the availability of data to develop the broader original sin and information on financial crises. The sample consist of 34 advanced countries and 128 emerging and developing countries from 1970 to 2018. The list of countries are classified as advanced countries and emerging and developing countries based on the IMF-WEO methodology.

Table 13. Variables description

Acronym	Variable	Measure	Sources	Sign
Y	*Economic Growth*	GDP per capita growth rate (constant LCU)	WDI	
BOSIN	*Broad Original Sin*	The broad original sin index defined in Eq. 2. The value ranges between 0 and 1	Author's	(-)
NCM	*New Currency Mismatch*	Difference between forex reserves and international debt securities and multiplied with original sin as in Eq. 4	Author's	(-)
HC	*Human Capital Index*	Based on years of schooling and returns to education	PWT9.1	(+)
POP	*Population Growth*	Population growth rate (annually)	PWT9.1	(-)
CON	*Govt.expenditure*	General govt. consumption expenditure ((% of GDP)	WDI	(-)
IQ	*Institutional Quality*	Index value ranges between 0 to 100. The index is based on 12 important indicators.	PRS	(+)
TO	*Trade Openness*	Trade is the sum of exports and imports of goods and services measured as a share of GDP (%)	WDI	(+)
TT	*Terms of Trade*	Price level of exports to imports, growth rate	PWT9.1	(+)
INF	*Inflation*	Rate of price change in the whole economy, GDP deflator (annual %)	WDI	(±)
GCF	*Investment*	Gross capital formation (% of GDP)	WDI	(+)
FD	*Financial Development*	Domestic credit to private sector (% of GDP)	WDI	(+)
ER	*Exchange Rate*	Bilateral exchange rate against the US dollar (change)	WDI	(-)
FC	*Financial Crisis*	Dummy variable – value one for the crisis periods such as currency, banking, and sovereign debt crisis otherwise 0	Laeven and Valencia (2020)	
Peg	*Fixed Exchange Rate*	Dummy hard peg = 1 (includes categories of 1-2 Coarse classification) of exchange rate regime, otherwise 0	Ilzetzki et al. (2019)	(±)
Alternative measures of foreign currency exposure				
OSIN	*Narrow Original Sin*	Defined Eq. 1 (0 to 1)	Author's	(-)
AECM	*Aggregate Effective Currency Mismatch*	Index constructed index based on the methodology of Goldstein and Turner (2004) and Chui et al. (2018)	Author's	(-)
FCE	*Foreign Currency Exposure*	Index between — "1 (zero foreign-currency foreign assets and only foreign-currency foreign liabilities) and 1 (only foreign-currency foreign assets and only domestic-currency foreign liabilities)" (-1 and 1)	Rohn et al. (2015)	(-)
QFCE	*Quantitative Foreign Currency Exposure*	"Quantitative exposure of foreign assets and liabilities to a uniform shift in the value of the domestic currency against all foreign currencies" (% of GDP)	Rohn et al. (2015)	(-)

Notes: This table presents the measure and data sources of the variables. Author's own calculations are based on data obtained from the Bank for International Settlements (BIS), IMF International Financial Statistics (IFS) and World Development Indicators (WDI) and national sources. Other variables data are sourced from PWT9.1: Pen world Table (9.1), PRS: PRS Group, and ICRG.

Table 14. Variance inflation factor

Model	Benchmark Model	Barro Growth Model	Barro + Additional Factors	AEs sample	EDEs sample
Mean VIF	1.00	1.43	1.36	1.20	1.31

Notes: Table reports the mean value of variance inflation factor (VIF) estimations for the baseline models and subsample estimations.