Sovereign Borrowing: Global Dollar Cycle Transmission via Heterogeneous Corporate Balance Sheets

Nan He*

January 24, 2025

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Abstract

Historically, many emerging market (EM) governments were unable to borrow abroad in their own currencies, a phenomenon known as "original sin" (Eichengreen and Hausmann (1999)). This paper finds that over the past decade, EM governments' dollar borrowing patterns are exposed to the global dollar cycle (Jiang et al. (2024)), which is driven by the fluctuating global demand for dollar-denominated safe assets while is beyond the control of individual borrower countries' domestic macroeconomic conditions, as emphasized by most existing literature. During periods of global flight-to-safety, sovereigns tend to shift their currency composition of external debt towards the dollar. Additionally, the impacts of the global dollar cycle on sovereign borrowing in emerging market economies are unequal, with the heterogeneous exposures of EM governments to this cycle being explained by domestic corporate currency mismatches.

Keywords: Original sin, Dollar convenience yield, Currency mismatch
JEL: E44, F34, G15

*He: Shanghai Advanced Institute of Finance, Shanghai Jiao Tong University. Address: 211 West Huaihai Road, Shanghai, China, 200030. Email: nhe.18@saif.sjtu.edu.cn.

I am grateful for the mentorship and support of my PhD dissertation committee: Tan Wang (chair), Hong Yan, Nengjiu Ju and Qiushi Huang. I thank Zhengyang Jiang and Xiang Fang for invaluable advice and suggestions. For helpful conversations and comments, I also thank seminar participants at SAIF and DAFI-SUFE.

1 Introduction

In the 1990s, a significant challenge faced by many emerging market governments, particularly in low-income developing countries, was their inability to borrow from abroad in their own currencies—a phenomenon Eichengreen and Hausmann (1999) termed "original sin". Earlier literature mostly highlighted that weak institutions and policies, as reflected in a country's inflation history, exchange rate regime, and repayment or default record, have confined these economies to borrowing externally only in foreign currencies, predominantly the U.S. dollar. However, reliance on foreign currency borrowing introduces a currency mismatch, as the assets of emerging economies are typically denominated in their own local currency, which can be especially disruptive when the domestic currency rapidly depreciates. An important lesson from the crises afflicting emerging market economies in the 1990s was that borrowing in foreign currency exposes countries to the risk of rising debt burdens and sudden reversals of capital flows, with consequences for the financial system and the macro economy as a whole when their local currencies depreciated. Policy efforts, as urged by researchers since then, have aimed to reduce financial vulnerability to exchange rate fluctuations by promoting more LC borrowing (Krugman (1999); Jeanne and Zettelmeyer (2002); Schneider and Tornell (2004); Aghion et al. (2004)).

Over the last two decades, emerging economies have started to borrow in local currency, gradually overcoming original sin.[1] This progress is attributed not only to sound monetary policies, improved institutions, and stronger fundamentals, but also to the deepening of domestic capital markets, which have drawn global investors to local currency-denominated sovereign debt in emerging markets (Onen et al. (2023)). Given that emerging market sovereigns are now in a stronger position with improved domestic conditions and increased ability to borrow in local currency from abroad in the recent decade, a question naturally arises: what new factors are influencing sovereigns' external borrowing in foreign currency, particularly the U.S. dollar? This paper finds that the global dollar cycle, which is usually irrelevant of individual country's domestic policies and economic conditions, has an impact on EM sovereigns' dollar borrowing pattern over the past decade.

The phenomenon, that the world economy is subject to a synchronized cycle in asset prices, leverage, and capital flows after global financial crisis, labelled as "Global Financial Cycle", has received much attention (Rey (2013)). Besides, in light of the U.S. dollar's specialness as a

[1]This process has helped to reduce currency mismatch on the borrower side but has shifted the mismatch to the balance sheets of foreign investors who measure returns in hard currency. In periods of stress, foreign investors can become reluctant to hold local currency EM bonds, especially when accompanied by exchange rate depreciations, potentially leading to more significant sell-offs. Consequently, countries with a larger proportion of local currency bonds held by foreign flighty investors are more susceptible to volatile capital flows and exchange rate swings. The underlying fragilities associated with "original sin" do not eliminate; rather, they have morphed into what Bertaut et al. (2021) term "original sin redux", indicating that original sin can come back in a different guise.

global safe haven currency, Jiang et al. (2024) formulated a model of the global financial cycle featuring a time varying convenience yield, determined by fluctuating excess demand stemming from world investors for safe dollar assets. Global investors are willing to pay a premium, i.e., a convenience yield, to own U.S. dollar denominated safe assets, due to the safety and liquidity associated with future dollar cash flows.[2] Then, I term the phenomenon in which convenience yield drives comovements in global financial variables related to financial flows and asset prices as the ***Global Dollar Cycle***. The idea is that a flight to safety generates a surge in demand for dollar assets, drives up the convenience yield, and appreciates the dollar. And a stronger dollar is usually associated with a deterioration in macroeconomic aggregates, a decline in the terms of trade, tighter financial conditions, and elevated risk aversion. At the core of the global dollar cycle is the assumption that world investors attribute a safety premium, known as a convenience yield, to holding U.S. dollar-denominated safe assets.

Following the literature, convenience yield is measured by U.S. Treasury premium, defined as the average yield differential between FX-swapped G10 government bonds and U.S. Treasuries at the same tenor, indicating a deviation from covered interest rate parity condition (Du et al. (2018)).[3] The U.S. Treasury premium is positive if investors assign a greater convenience yield to U.S. Treasuries, because they may be willing to accept lower yields to hold them over alternative investments that offer the same cash flows. The left panel of Figure 1 plots the positive and fluctuating convenience yield, as measured by the 1-year U.S. Treasury premium since 2000, which tends to spike during crisis times. Meanwhile, as depicted on the right panel, the change in convenience yield comoves positively with the dollar's appreciation against G10 currencies (corr=0.45) and emerging market currencies (corr=0.43), highlighting the role of convenience yield as a global variable which significantly influences exchange rates and the global economy, including both advanced and emerging economies (Obstfeld and Zhou (2023)).[4]

Henceforth, this paper contributes to the literature by presenting novel facts regarding the impacts of time-varying convenience yield on emerging market sovereigns' cyclical dollar borrowing behavior. Additionally, I propose and test the hypotheses regarding the potential mechanism underlying the observed patterns. The key empirical findings are summarized below.

First, emerging market sovereigns typically respond to a positive shift in the convenience yield by increasing both the amount of dollar borrowing and the dollar share of their external

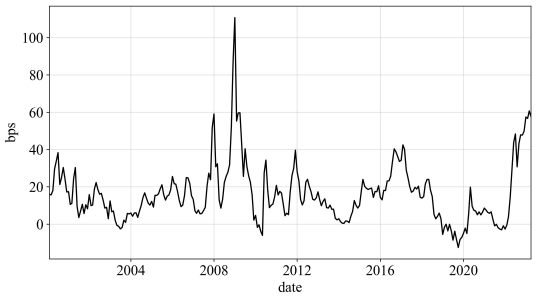
[2] "convenience yield" and "dollar safety premium" are used interchangeably.

[3] See calculations in Equation 1 and Equation 2.

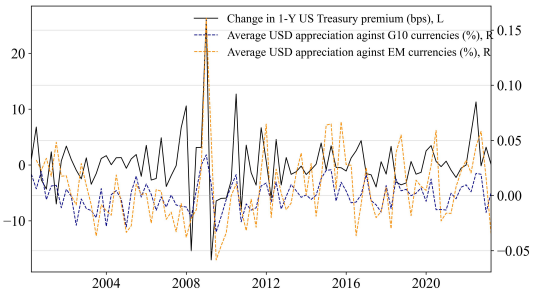
[4] The rising global financial integration accompanied by exploded financial flows in recent decade has significantly accelerated and strengthened the international propagation of shocks through financial linkages and cross-border capital flows, amplifying the presence of such a global dollar cycle while highlighting the fluctuating U.S. dollar exchange rates and demand for dollar assets in transmitting shocks across countries through financial channels.

Figure 1: **Conveneince Yield and Dollar Exchange Rate**

The left panel plots the convenience yield measured by the 1-year U.S. Treasury premium (Du et al. (2018)), which is the average yield spread between 1-year G10 government bonds swapped into the dollar through FX swaps and 1-year U.S. Treasury. The right panel illustrates the quarterly change in the 1-year US Treasury premium and the average quarterly appreciation rate of the USD against G10 currencies, and against a group of 18 EM currencies.



(a) 1-year U.S. Treasury Premium.



(b) Comovements between convenience yield and USD

debt. On average, a one percentage point increase in the convenience yield correlates with a 0.86% rise in sovereign dollar debt, as reflected by the cyclical component of the sovereign dollar-debt-to-GDP ratio.[5] Additionally, the currency composition of external public debt is also tilted to U.S. dollar during times of global flight-to-safety when convenience yield rises. Furthermore, both dollar debt level and dollar share of emerging market sovereigns' external public debt are differentially exposed to the dollar cycle across different countries. Panel (a) of Figure 9 illustrates the country-specific sensitivity β_i of the quarterly change in the cyclical component of sovereign dollar-debt-to-GDP ratio in response to changes in the convenience yield. Most countries exhibit positive β_i, whereas there exists substantial heterogeneity across countries. As implied by the upward slope, the sensitivities of sovereign dollar debt to shifts in the convenience yield are positively correlated with the degree of corporate currency mismatch, proxied by the nonfinancial corporate dollar-debt-to-GDP ratio.[6] A similar pattern is observed for the dollar share of sovereign debt, as evidenced by the positive correlation between the dollar share of sovereign debt-convenience yield β_i and the degree of nonfinancial corporate currency mismatch, as shown in the right panel of Figure 9.[7]

Second, following Ottonello and Perez (2019), I complement the above findings by directly using bond issuance data, since the cyclical component in the share of external debt in dollar

[5]This analysis focuses on sovereigns' cyclical dollar borrowing behavior, with de-trended sovereign dollar debt to GDP ratios and the USD share of external sovereign debt for each country, using the HP-filter to remove underlying trends. See Section 3 for more details.

[6]Following Das et al. (2022), I do not include the USD debt liability of financial institutions since this debt is entirely hedged as several regulatory restrictions have been passed after each financial crisis in emerging markets on open FX positions and/or capital requirements for FX positions, thus not leading to currency mismatch. By now, they ensure FX mismatches on bank and financial intermediary balance sheets are hedged or minimal. See a comprehensive discussion on the measurement of corporate currency mismacth in Section 2.

[7]On the right panel, the correlation is even stronger if I exclude Russia as Russia has been strategically and steadily de-dollarizing its FX reserves over the past few years, with dollar assets made up only around 16 percent of Russia's FX stockpile.

can be driven by differential new issuance decisions by currency, differential changes in the valuation of existing debt by currency, and differential trading between foreign and domestic investors. These issuance data directly measure the changes in dollar share that are due to active issuance decisions of governments, isolating from changes in the currency composition of debt attributed to valuation change of previously issued debt. I show that higher degree of corporate currency mismatch increases the likelihood of issuing USD-denominated sovereign bonds in response to a given increase in convenience yield.

Taken together, the findings presented above suggest that (1) in the time-series, sovereigns tend to accumulate more dollar debt and shift external debt towards the U.S. dollar when convenience yield increases; (2) the impacts of global dollar cycle are unequal across different countries, with sovereigns in nations exhibiting a greater corporate currency mismatch being more exposed to dollar cycle. With these identified dynamic patterns observed in emerging market sovereigns' dollar borrowing, I then propose two hypothses to delve into the potential explanations behind this phenomenon.

The first hypothesis is that corporate balance sheet currency mismatch detoriates governments' fiscal condition in response to a positive convenience yield shock. Indeed, tax revenue forms the backbone of fiscal income for emerging market governments, accounting for nearly 70% from 2014 to 2022 in my sample. I demonstrate that a country experiences a more pronounced decline in tax revenue when convenience yield increases if its private sector is engaged in a higher degree of ex-ante currency mismatch. This evidence suggests that dollar strengthening following a flight-to-safety shock generates a spillover from corporate currency mismatch to sovereigns' financial constraints through the fiscal channel (Wu (2020)). Governments then may extend their borrowing by acquiring more external debt in face of fiscal difficulties during episodes of global flight-to-safety.

The second hypothesis is that emerging market sovereigns extract a dollar convenience yield by issuing debt in dollars, reflected in the differential yield spread between local currency sovereign bonds and U.S. dollar sovereign bonds for the same issuer, after controlling for exchange rate movements. Empirically, I show that the relative borrowing costs for emerging market sovereigns in their home currency compared to the USD are positively associated with the convenience yield. High-frequency identifications around U.S. monetary policy announcements further affirm the causal effects of convenience yield shocks on the relative borrowing costs of LC over USD for governments. During flight-to-safety episodes, both local currency and foreign currency bonds issued by emerging market sovereigns appear riskier to international investors, leading to higher yields compared to normal periods. However, as global investors value safe and liquid dollar cash flows even more during these episodes, the dollar funding relative to LC funding becomes even cheaper for the same sovereign issuer, after controlling for exchange rate movements. This is because dollar sovereign bonds carry a con-

venience yield attached to future dollar cash flows, which drives a greater propensity to tilt their issuance towards the dollar during financial stress. These insights help to understand the cyclical patterns in the dollar borrowing behavior of emerging market sovereigns.

To conclude, the novel evidence presented in this paper suggests that emerging market sovereigns' borrowing behavior is exposed to the global dollar cycle, which is driven by the time-varying excess demand for dollar safe assets by international investors, and may be irrelevant to the domestic business cycles of emerging countries. Meanwhile, the results indicate that the degree of domestic corporate balance sheet currency mismatch in emerging market economies is a significant factor accounting for the wide differences in sovereigns' exposure to the global shocks.

Related literature. This paper contributes to a number of literature in international finance and macroeconomics. First, this paper is related to the vast literature on the optimal currency composition of external debt, and the explanation of original sin.[8] Almost all studies in this literature focused on the lack of monetary policy commitment in emerging economies, see e.g. Jeanne (2003), Ottonello and Perez (2019), Engel and Park (2022), and Du et al. (2020). Most of the studies argue that EM governments with low credibility on monetary policy would choose to conduct inflation or real exchange rate depreciation to lower their real debt payment during stress. As a result, foreign lenders charge governments without commitment a very large risk premium on their LC debt, and these governments thereby face a strong incentive to borrow in FC debt to lower their expected borrowing costs, even if LC debt obligations offer hedging benefits during bad times. One exception is Lee (2024), which documents that foreign currency share of external sovereign debt is positively correlated with exchange rate volatility. The shift occurs because lending in the borrower's local currency exposes the balance sheet of risk-averse international investors to currency risks, subsequently requiring a higher FX risk premium on local currency debt if FX volatility is larger, prompting governments to increasingly favor borrowing in U.S. dollars. Recent empirical studies by Onen et al. (2023) and Du and Schreger (2022) document the gradual dissipation of original sin in emerging markets, as captured by the increasing share of local currency in external sovereign debt over the past two decades. This trend is attributed to significant improvements in monetary policy credibility and increased foreign participation in local bond markets.[9]

This paper differs from the prevailing literature, which predominantly concentrates on domestic factors, such as macroeconomic fundamentals, financial market development, monetary policy credibility, and exchange rate volatility risks, driving sovereigns' external borrowing

[8]This concept was initially introduced by Eichengreen and Hausmann (1999) and further developed by Eichengreen et al. (2007) and Eichengreen et al. (2005), showing that this issue is prominent and highly persistent in emerging market economies, especially for small and low-income countries.

[9]This shift has reduced dependence on foreign currency borrowing of emerging market governments, yet also increased their fragility to foreign financial shocks as more foreign investors bear currency risk, which gives rise to "original sin redux" (Bertaut et al. (2021); Hofmann et al. (2022)).

patterns. Instead, it underscores the significant influence of global shocks, especially the time-varying convenience yield, on their foreign currency borrowing. The borrowing costs of U.S. dollars compared to local currency for emerging market government issuers, as well as their fiscal conditions, fluctuate in tandem with the global dollar cycle, thereby impacting their borrowing behavior in dollars.

Second, this study also contributes to the growing literature investigating how the specialness of the U.S. dollar as a global safe currency affects global asset prices and macroeconomics. Du et al. (2018) and Krishnamurthy and Lustig (2019) find that U.S. Treasury bonds have lower returns than foreign government bonds when swapped into dollars, indicating that a higher convenience yield attached to U.S. Treasury bonds. Additionally, Liao (2020) shows that for safe corporate issuers, currency-hedged dollar funding rates are also smaller than foreign currency funding rates, which indicates that firms with high credit ratings also earn a fraction of the dollar's convenience yield. In addition to the empirical support for the safe dollar phenomenon, there are theoretical models that aim to explain it (He et al. (2019), Gopinath and Stein (2021)). Additionally, recent papers by Jiang et al. (2024) and Kekre and Lenel (2024) take the convenience yield as given and study the implications of convenience yield in international monetary system. Specifically, Jiang et al. (2024) develop a model of the global financial cycle driven by time-varying global excess demand for dollar safe assets, which can match many phenomenal empirical patterns documented in international macroeconomics and finance literature. Besides, Bodenstein et al. (2023) presents a quantitative model to assess the macroeconomic importance and transmission of shifts in global sentiment, which they refer to as global "flight-to-safety" shocks, and account for business cycles more generally. While much of the empirical work has concentrated on the effects of dollar safe asset demand shocks, as reflected in fluctuations in the dollar convenience yield, on developed economies, my study adds to this literature by exploring how these convenience yield shocks propagate to emerging market economies, which is underexplored.

Third, this paper is linked to a large literature examining the impacts of corporate balance sheet currency mismatch arising from excessive dollar debt in emerging market economies. For instance, Krugman (1999), Aghion et al. (2001), Caballero and Krishnamurthy (2003), Schneider and Tornell (2004), Céspedes et al. (2004), and Kalantzis (2015) discuss corporate balance sheet effects and the vulnerability of emerging market economies to currency crises following the Asian Financial Crisis.[10] Specifically, this paper is closely related to Du and

[10]In addition to the impacts of corporate currency mismatch, a more recent literature studies why companies in emerging markets borrow in U.S. dollar after 2008. McCauley et al. (2015) and Bruno and Shin (2017) document that there has been a substantial increase in dollar credit extended to emerging market firms, attributed to the rapid economic growth in these regions, attractive dollar interest rates, and favorable exchange rate expectations since 2008. However, the buildup of excessive unhedged dollar debt liability has induced a severe currency mismatch on corporate balance sheets, which can be especially disruptive and create threats to macro-financial stablity in face of dollar liquidity crunch during stress period. This has raised wide concerns from policymakers around the recent Covid pandemic. See the article published on CEPR.

Schreger (2022), empirically showing that a higher reliance on foreign currency borrowing in the corporate sector is associated with higher sovereign default risk. They argue that when the government faces fiscal difficulties, corporate mismatch therefore raises the risk of outright sovereign default by making the alternative means of reducing real repayment, inflation, less appealing as depreciations are especially contractionary for currency-mismatched firms. The empirical results in this paper contribute to this literature by introducing new insights: corporate sector currency mismatch has implications on sovereigns' new debt issuance behaviors over the dollar cycle by affecting the fiscal condition. Particularly, I show that sovereigns with greater currency mismatches within their domestic corporate sectors are even more encouraged to accumulate dollar-denominated external debt during global flight-to-safety periods in anticipation of a deterioration of fiscal income generating from firms profit tax.

This paper is also closely related to Das et al. (2022), which argues that central banks proactively accumulate dollar reserves ex-ante to deal with potential consequences stemming from a currency mismatch in the corporate sector during crises. Their model assumes that sovereigns finance themselves only through local currency debt and determine the optimal asset structure, whereas I focus on the externality of corporate currency mismatch on sovereigns' borrowing decisions regarding currency denomination, emphasizing the liability structure of governments.

Policy Implications. Lastly, my empirical findings reveal significant policy implications. Firstly, although emerging market sovereigns have gradually overcome "original sin" and borrowed more in LC from foreigners over the past two decades. However, my findings reveal that emerging market sovereigns' dollar borrowing behavior is subject to a global dollar cycle, driven by global demand for safe dollar assets. Governments still borrow more in USD during global flight-to-safety even if they have better institutions and sound macro policies. For the U.S., providing dollar swap lines to other countires is an effective way to counteract safety demand shocks and mitigate the impacts of the global dollar cycle around the world especially during stress time.

Secondly, the results also highlight a dilemma that policymakers in emerging market economies face. The low-interest-rate and favorable financial conditions in global dollar funding markets, along with capital account openness, encourage firms to access cheaper dollar funding. This helps to relax their financing constraints and improve investments and productivity (e.g., Salomao and Varela (2022)). Meanwhile, as this paper argues, the over-accumulation of unhedged dollar debt by corporations during economic booms can impose a more severe fiscal burden on governments. Traditional financial regulation aimed at banks is insufficient to mitigate financial instability because dollar liabilities can shift from the financial sector to the non-financial sector (e.g., Oskolkov and Sorá (2023); Christiano et al. (2021)). Since private firms' finances are less regulated and less transparent than those of

banks, macro-prudential policies are essential to prevent the over-accumulation of unhedged FX debt in the domestic economy during booms, addressing such vulnerabilities. Additionally, developing FX hedging markets would be helpful for firms to manage their FX risks from currency mismatches, reducing their externalities on the broader economy.

Layout. This paper is organized as follows. Section 2 describes the dataset. Section 3 studies the impact of dollar convenience yield shock on sovereigns dollar borrowing behavior conditional on private sector currency mismatch based on debt stock data. Section 4 further validates the features of sovereign external debt by directly examine the sovereign bond issuance decision based on issuance data. Section 5 provides evidence to test hypothesis trying to understand the observed patterns. Finally, Section 6 concludes.

2 Data and Variable Construction

2.1 Data

This study utilizes three types of data: (1) the currency composition of external sovereign debt and a measure of currency mismatch in the private sector, which are the primary variables of interest; (2) macroeconomic variables; and (3) financial market data to conduct the empirical analysis.

Currency and Sectoral Composition of External Debt. External debt throughout this paper is defined as the aggregate of bonds securities and cross-border bank loans held by rest of the world. Besides, external debt liabilities are nationality based statistics.[11] For sovereign external debt statistics, no publicly available dataset provides detailed currency composition (U.S. dollar, local currency, and other major currencies) at a quarterly frequency. To estimate the currency breakdown of external sovereign debt on a quarterly basis, I employ multiple data sources. The basic principle of my calculations involves using BIS data as the baseline for foreign currency-denominated external sovereign debt, as BIS offers nationality-based external debt statistics, and I fill in the gaps by integrating various national data sources, as well as the work of Arslanalp and Tsuda (2014) (updated 2023) to derive the local currency-denominated external sovereign debt. A comprehensive description of the construction method can be found in the online appendix. Subsequently, I scale all debt series by GDP, a common practice to obtain a meaningful sense of the size of the debt.

Measurement of Corporate Sector Currency Mismatch. While the definition of currency mismatch—referring to the sensitivity of the present net worth of an entity to changes

[11] A significant portion of lending to emerging market corporations is intermediated through offshore subsidiaries in tax havens (Coppola et al. (2021)). This form of borrowing is not captured by residency-based statistics, making nationality-based data a more economically meaningful measure of external borrowing for emerging markets.

in exchange rates—is relatively straightforward, empirical quantification is quite complex.[12] A currency mismatch arises when an entity's liabilities are denominated in a currency different from that of the asset intended to service those liabilities. Firms experiencing currency mismatches between their assets and liabilities face value losses (or gains) when the currency of their assets depreciates (or appreciates) relative to that of their liabilities.

In emerging market economies, domestic banks are subject to strict regulations regarding currency mismatches, with such mismatches primarily manifesting in the non-financial sector. With this in mind, I measure currency mismatch as the ratio of foreign currency and dollar-denominated borrowing of the non-financial corporate sector to GDP, following the methodology outlined in Das et al. (2022). Unlike most empirical analyses of foreign currency-denominated corporate debt, my focus specifically centers on dollar-denominated debt liabilities, which I will refer to as ***dollar mismatch*** hereafter. Likewise, the foreign currency and dollar denominated debt liabilities on non-financial corporations are also calculated as summation of outstanding cross-border bank loans and bonds securities from BIS statistics. Admittedly, this would be an imperfect measure of currency mismatch of corporate given that firms, such as exporters, could operationally hedge their foreign currency debt through exoprting revenue usually denominated in US dollar. It would be in principle better to capture only foreign currency debt of non-trade firms, but unfortunately, I am unable to create such a measure due to data limitations. Another concern of this measure is that I omit off-balance sheet positions and the associated financial hedging of FC exposure as it's challenging to capture.[13]

Macroeconomic Variables and Other Data. Macroeconomic variables, including FX reserves, real GDP growth, and inflation are collected from World Bank on a annual basis. Net international investment positions, as well as exports and imports data, are obtained quarterly from the IMF. Capital control index data are taken from Fernández et al. (2016) which offers quarterly capital control indices for various countries spanning 1995 to 2019.[14] For GDP series, where available I use quarterly-adjusted IMF International Financial Statistics (Gross Domestic Product, Nominal, Seasonally Adjusted, Domestic Currency) supplemented

[12] Morris Goldstein and Philip Turner initiated a comprehensive study on currency mismatches in emerging economies based on BIS data, the results of which are detailed in Goldstein and Turner (2004).

[13] It is widely acknowledged that foreign exchange derivatives are extensively used by firms to manage currency risk, hedging a significant portion of their foreign exchange exposures arising from international trade and financing in emerging market economies (Alfaro et al. (2021); Jung (2024)). Furthermore, equity-like foreign currency instruments, such as Foreign Direct Investment (FDI), are excluded as they do not involve repayment obligations. For a comprehensive discussion on measuring corporate currency mismatch in emerging economies, see Chui et al. (2016).

[14] Fernández et al. (2016) provides capital control restrictions on both inflows and outflows of 10 categories of assets for 100 countries over the period from 1995 to 2019. I download the overall restrictions index (all asset categories) indicated by 'ka' in their dataset.

with data collected from National Statistics and World Bank.[15]

The daily spot exchange rates, interest rates, FX swaps data used to calculate dollar convenience yield, and other market pricing are collected from Bloomberg and Datastream.

Countries and Sample Period. The sample consists of 14 countries which is a subset of the countries covered by Arslanalp and Tsuda (2014): Poland, Turkey, Hungary, Peru, Malaysia, South Africa, Indonesia, Ukraine, Mexico, Brazil, Chile, Colombia, Philippines and China. My sample period starts from 2013 q4 since the granular currency and sectoral disaggregation of corporate debt from BIS are available after 2013 q4. Table 1 and Table 3 provide summary statistics of country-level characteristics and country-level currency composition of external sovereign debt.

Convenience Yield. Following literature, I measure convenience yield as the cross-country average of covered interest rate parity deviation between 1-year G10 government bonds and 1-year U.S. Treasury (Du et al. (2018); Jiang et al. (2021)).[16]

Specifically, I use s_t^i to denote the log of spot exchange rate quoted in units of foreign currency per USD for country i, while f_t^i denotes the log of 1-year forward exchange rate. $y_t^{\$}$ and y_t^i represent the 1-year U.S. Treasury yield and 1-year government bond yield in country i, respectively. Thus, at time t, the CIP deviation between government bond yield in country i and U.S. is:

$$x_t^i = (y_t^i - (f_t - s_t)) - y_t^{\$} \tag{1}$$

quantifying the difference in convenience yield of U.S. Treasury and government bond in country i under the assumption that government bond in country i is default-free and international financial markets are frictionless.[17]

Intuitively, $(y_t^i - (f_t - s_t))$ measures the synthetic dollar borrowing costs of swapping the cash flows of foreign currency Treasury bonds into U.S. dollars. Thus, x_t^i measures the difference in dollar borrowing costs between foreign governments and the U.S. Treasury. As G10 government bonds are usually considered as default-free, conceptually, the spread should be 0, as both represent dollar risk free rate at the same tenor. If this deviation x_t^i is positive, which means U.S. Treasury bonds are more expensive. It's reflecting the safety and liquidity offered by the dollar safe bonds. This measure, derived from the CIP deviation between G10 government bond yields and U.S. Treasury yields, is often referred to as the Treasury premium,

[15]The coverage of Russia in that series is incomplete, so I use annual GDP from World Bank to fill the gap. For China and Malaysia, I get quarterly GDP series from national statistics. For Peru and Philippines, I use seasonally-unadjusted quarterly GDP series from IMF IFS.

[16]Jiang et al. (2024) and Kekre and Lenel (2024)) also use the average yield spread between U.S. Treasuries and G10 government bonds swapped into dollars constructed by Du et al. (2018) as a direct measure of safety shocks.).

[17]See more discussions about convenience yield and U.S. Treasury premium in Du et al. (2018).

convenience yield, or safety premium. These terms will be used interchangeably throughout this paper.

Following this literature, the dollar convenience yield or dollar safety premium $x_t^{\$}$ is then calculated as the average CIP deviations between U.S. Treasuries and G10 government bonds:[18]

$$x_t^{\$} = \frac{1}{10} \sum_{i \in G10} x_t^i \tag{2}$$

I take the daily data and calculate convenience yield (in log), then derive a quarterly average value. Note that I measure dollar convenience yield relative to other G10 currencies rather than against all currencies including both G10 and EM. I take this approach because the same measure for EM countries is contaminated by default risk involved in these countries' sovereign bonds (Krishnamurthy and Lustig (2019) and Du and Schreger (2016)). Besides, this measurement of dollar convenience yield or safty premium is also adopted in emerging market studies (Kalemli-Özcan and Varela (2021)).

2.2 Re-emergence of Original Sin after Covid-19

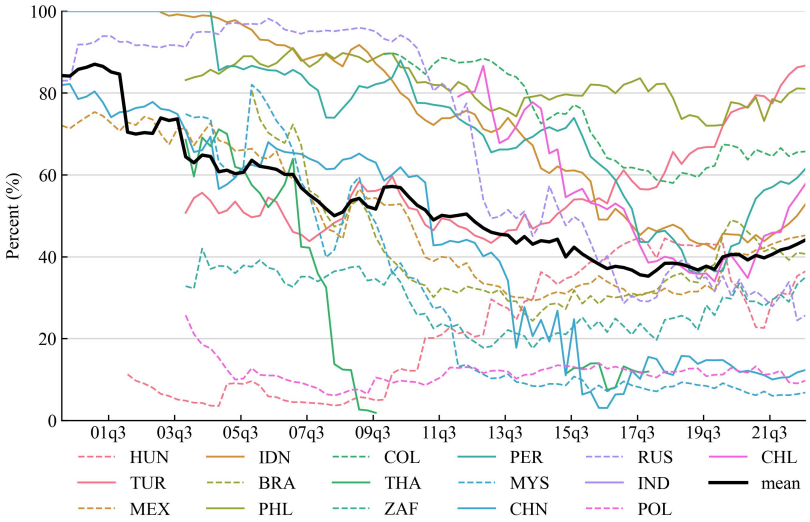
Figure 2 illustrates the evolution of the U.S. dollar share of total external sovereign debt (as a percentage) for each emerging market economy in the sample from 2000Q1 to 2022Q3. This declining trend in dollar share of external public debt in EM countries before 2017 is in favor of the previous findings (Du and Schreger (2022); Onen et al. (2023)), suggesting that emerging market sovereigns gradually overcome original sin. However, this trend reversed somewhat following the onset of the COVID-19 crisis. Specifically, the average U.S. dollar share of external sovereign debt increased by 7%, from 39% in 2019Q4 to 46% in 2022Q3.[19]

Despite the overall decline in the U.S. dollar share of external sovereign debt, Figure 2 reveals substantial cross-country heterogeneity in the cyclical pattern of currency composition in external public debt. Therefore, the following analysis investigates how governments strategically manage their external debt currency denomination over the business cycle, and how pre-existing corporate currency mismatches influence the international transmission of dollar safety shocks to sovereign borrowing decisions on currency denomination.

[18] Empirically, there are two commonly used measurements in the literature to characterize the safety shock: AA-Tbill spread and CIP deviations in government bonds yield between U.S. and G10. They are both scaled measures for safety shock if AA and foreign government bonds are both partially valued for liquidity/safety.

[19] Given that bond securities constitute the majority of total external sovereign debt, a parallel analysis focusing solely on external sovereign bonds is presented in Figure 8 of the appendix. This figure confirms the observed paradigm shift.

Figure 2: **Evolution of Currency Composition of External Sovereign Debt.**
This figure plots the share of total external sovereign debt denominated in U.S. dollar across 16 countries over 2000Q1 to 2022Q3. "mean" reports the cross-country sample average. Source: BIS Internaional Debt Statistics and Locational Banking Statistics, and Arslanalp and Tsuda (2014) (updated June 2023)



3 Sovereign Dollar Debt Exposure to Dollar Convenience Yield Shock

3.1 Specification

To investigate the role of private sector currency mismatch, particularly dollar mismatch, in explaining heterogeneous government dollar debt exposure to dollar convenience yield shocks, I conduct a fixed panel regression on a quarterly basis. The baseline regression specification is

$$\Delta Y_{i,t} = \gamma[\text{USDdebt}_{c,i,t-1} \times \Delta x_t^{\$}] + \beta_1 \text{USDdebt}_{c,i,t-1} + \beta_2 \Delta x_t^{\$} + \eta_i + \epsilon_{i,t} \tag{3}$$

where $USDdebt_{c,i,t-1}$ denotes dollar debt-to-GDP ratio for sector $c \in \{$corporate, non-financial corporate, financial corporate$\}$ in country i in the previous quarter $t-1$; and $x_t^{\$}$ corresponds to daily average of cross-country mean of CIP deviation between 1-year G10 government bond yield and 1-year US Treasury over quarter t measured in percentage points, and $\Delta x_t^{\$}$ is the change of convenience yield from quarter $t-1$ to quarter t. The dependent variable, $Y_{i,t}$, represents the cyclical component of either: (1) the sovereign external dollar debt-to-GDP ratio (stock), or (2) the share of total external sovereign debt denominated in USD (share).[20] The change in the cyclical component of public external dollar debt-to-GDP measures the marginal

[20] Following Ottonello and Perez (2019), I use the Hodrick-Prescott (HP) filter with a smoothing parameter of 100 to de-trend both external sovereign debt-to-GDP ratios and the share of total external sovereign debt denominated in USD. This yields the cyclical components for each emerging market country in the sample, removing any potential trends given the high persistence of external debt.

change in the dollar debt stock level, while the change in the cyclical component of the dollar share in total external public debt measures the marginal change in currency composition. These two measures reflect two aspects of government debt management: borrowing amount and currency composition. Both variables are measured in percentage points. Country fixed effects (η_i) are included in all specifications.

The key coefficient is γ, which captures the differential sensitivity of sovereigns' dollar debt exposure to convenience yield shocks, conditional on the level of private sector currency mismatch. The model predicts that a one-percentage-point increase in the dollar convenience yield will increase the dollar sovereign debt-to-GDP ratio (or the dollar share of external public debt) by $(\gamma \text{USDdebt}_{c,i,t-1} + \beta_2)\%$ over the sample period (2014Q1–2022Q3).

3.2 Main Results

Table 4 presents the main results of the specification 3. The dependent variable in column (1)-(3) is quarterly change in cyclical component of dollar denominated sovereign debt to GDP ratios, whereas the dependent variable is quarterly change in cyclical dollar share of total external public debt in column (4)-(6).

Column (1) shows the estimations of regressing quarterly change in sovereign dollar debt-to-GDP ratio on ex-ante currency mismatch of non-financial corporate sector proxied by dollar debt liability to GDP ratio. First, we can find that emerging market governments on average accumulate more USD debt when dollar convenience yield increases. Particularly, to interpret the magnitude, a one percent increase in dollar convenience yield is associated with increase in public dollar debt/GDP by 0.86% on average, given that the cross-country average of non-financial corporate dollar debt to GDP over the whole sample period is 6.73%. Second, the estimation of coefficient of intersection term γ is positive and significant: government tends to accumulate *even more* dollar debt if its nonfinancial corporate sector is exposed to more severe dollar mismatch when dollar convenience yield increases. Empirically, a one percentage increase in the dollar convenience yield leads to an increase of sovereign dollar debt by 1.55% of GDP in Chile (average $USDdebt_{nonfin} = 21\%$), while it leads to a rise of 0.55% of GDP in sovereign dollar debt in Poland, a country with less dollar mismatch on corporate sector (average $USDdebt_{nonfin} = 0.42\%$).

In column (2), I consider dollar debt held by total corporate sector, including both non-financial and financial sector, as an alternative measure of corporate currency mismatch that would potentially have spillover effects on sovereigns dollar debt exposure to dollar convenience yield. In column (3), I consider only financial sector corporate dollar debt. We can find that the intersection term remain positive with reduced magnitude but become statistically insignificant in column (2). By contrast, as shown in column (3), there is no evidence that

financial sector dollar debt leads to differential exposure of public dollar borrowing to dollar convenience yield as the coefficient of intersection term is negative and not statistically significant. This result implies that currency mismatch rather than dollar debt liability itself of private sector matters, otherwise, the coefficients of non-financial, financial and corporate sector dollar debt should be similar. Given that domestic banks in emerging market economies have limits on how much currency mismatch they can bear, and tend to not run currency mismatch on their balance sheet.[21] That said, the rise in dollar borrowing within the financial sector is accompanied by an increase in dollar assets, and would not generate currency mismatch on balance sheet. Banks themselves are insulated from exchange rate fluctuations. Moreover, this finding are different from Du and Schreger (2022) where they find that the positive effects of non-financial and financial sector foreign currency debt on sovereign CDS spreads are in similar magnitude and both are significant. Therefore, the results further imply that non-financial firms' risk taking behavior, their excess borrowing and credit growth during low-interest-rate period and corporate severe balance sheet currency mismatch rather than dollar debt liability itself on the private sector matters to the transmission of dollar safety shock on sovereigns' dollar borrowing behavior.

Similarly, in column (4), we can see that nonfinancial corporate currency mismatch as measured by its dollar debt liability also generates a positive effect on dollar share of public debt exposure to dollar convenience yield. In terms of magnitude, if dollar convenience yield rise by 1%, government in countries with 30% ex-ante nonfinancial dollar debt to GDP ratio would increase their dollar-denominated sovereign debt by 14.37%, whereas governments of countries without nonfinancial dollar debt even decrease their dollar borrowing share by 2.71%. Additionally, column (5) shows that total corporate dollar debt also have significant positive effects on the sensitivity of share of external sovereign debt in dollar to dollar convenience yield albeit with slightly reduced magnitude than that of nonfinancial dollar debt. However, column (6) suggests that the effect of financial dollar debt on sovereign debt dollar share to dollar convenience yield disappears, which again suggests that currency mismatch instead of gross dollar debt liabilities on private sector that matters for this spillover.

To summarize, my findings suggest that (1) on average emerging market governments tend to accumulate more dollar debt and increase dollar share in total external debt when dollar convenience yield increase; and (2) the impacts of dollar convenience yield on public dollar debt stock and public dollar debt share are both significantly larger in countries with a higher degree of dollar mismatch on non-financial corporate sector.

[21] Bank liabilities in foreign currency are similar in magnitude to loans extended to firms in foreign currency (Oskolkov and Sorá (2023)).

3.3 Robustness Tests

I consider a bunch of robustness checks to address the concern of selection bias and that mechanisms unrelated to private sector currency mismatch are responsible for the differential sensitivity captured by private sector dollar debt.

Alternative measure of convenience yield shock. The robustness of the findings is assessed using the AR(1) innovation of the convenience yield, rather than the simple change, as a measure of shocks. Table 5 presents these results, showing that the main findings remain qualitatively unchanged, although the magnitudes of the interaction term coefficients are slightly smaller across all specifications. Additionally, following Krishnamurthy and Lustig (2019), mean CIP deviations between G10 and U.S. yields for maturities ranging from 1 to 10 years are used as alternative proxies for the dollar safety premium. The results, reported in Table 6, confirm the main findings across different maturities.

External sovereign bonds exposure to dollar safety shock. Given that bond securities constitute the bulk of sovereign debt, the analysis is replicated using the stock and currency composition of external sovereign bonds (Table 7). The main results remain robust.

Non-USD foreign currency corporate debt. I examine the difference between the role associated with USD corporate debt and non-USD foreign currency corporate debt regarding the externality from corporate to sovereigns. Specifically, I ask whether other non-USD foreign currency mismatch on corporate sector create the same spillover effect on the exposure of sovereigns dollar debt exposure to dollar safety shifts by adding non-USD foreign currency corporate debt to GDP ($NUSDFCdebt_{nonfin}$) and its intersection with conveience yield in column (1) and (3) Table 8. Interestingly, the coefficients estimated on the intersection term of dollar-denominated and non-dollar foreign currency firm debt in column (1) are both significant but have opposing signs. This pattern is consistent with trade channel of exchange rate. During global flight to dollar safety, dollar appreciates against not only emerging market currencies but also other major currencies such as Euro and Yen. Thus, non-USD foreign currency debt constitutes a natural hedge for corporate sector during flight-to-dollar-safety which generating opposing impacts on corporate sector compared with its dollar debt. This pattern is further confirmed in column (3) when we test difference between the role of non-USD FC and USD corporate debt on sovereigns' exposure to dollar safety premium change. In column (2) and (4), I aggregate USD- and non-USD FC nonfinancial corporate debt together as a proxy for whole foreign currency mismatch considered in previous literature. The point estimation of intersection of nonfinancial corporate FC debt and dollar safety premium remain positive. This is not surprising given that those of debts denominated in other FC currencies are much smaller than in USD.

This result further affirms that the transmission mechanism of dollar safety premium to

emerging markets that works through dollar exchange rate revaluation.

Add country characteristics controls. Table 9 demonstrates the robustness of the γ coefficient (on the interaction of non-financial dollar debt and the dollar convenience yield) to the inclusion of country-specific macroeconomic controls. These controls include export revenue as a share of GDP, year-over-year real GDP growth, and exchange rate volatility measured as one-year at-the-money option-implied volatility following Bruno and Shin (2017).

Specifically, I see negative but insignificant coefficients of exports in first three columns. This is likely because foreign currency export revenue provides operational hedging, reducing the government's need for dollar borrowing. Regarding exchange rate volatility, the coefficients are positive across all models. However, the effect is statistically significant only for the currency composition of public debt (columns 4–6). This aligns with the findings of Lee (2024), which demonstrate a positive correlation between exchange rate volatility and the dollar share of public external debt. Lee (2024) argues that higher FX volatility increases LC bond risk premium required by risk-averse foreign lender thus decreases LC share in governments' external debt. My results further affirm this finding by showing a positive relationship between exchange rate volatility and the dollar share of external public debt, as dollar-denominated debt comprises the majority of foreign currency public debt.

To summarize, in this section I document important facts linking nonfinancial corporate currency mismatch, specifically dollar mismatch, with the sensitivity of emerging market sovereigns' dollar debt to shifts in dollar safety premium driven by varying demand of dollar assets by global investors. Using data on debt stocks for a panel of 15 emerging countries, I show that: (1) on average, sovereigns in emerging markets accumulate a greater volume of dollar debt and to shift their external debt portfolios towards the US dollar during episodes of flight-to-dollar-safety; (2) there exists notable heterogeneity among countries in how their sovereign borrowing reacts to changes in the dollar convenience yield. Notably, both the stock and share of sovereign dollar debt demonstrate heightened sensitivity to shifts in the dollar convenience yield in countries where the private sector has a more significant degree of debt-dollarization. These empirical insights underscore the pivotal role that unhedged dollar debt in the corporate sector plays in the transmission of global shocks to emerging market economies, particularly in influencing sovereign borrowing behavior.

So far, I have illustrated two aspects of sovereign dollar borrowing behavior over the global dollar cycle: one is related to the level of external public dollar debt and the other is related to the share of debt denominated in dollar based on the data on debt stocks. Given that the currency denomination of sovereign debt is now a relevant active margin of debt management by governments, I focus on the currency composition of external public debt. In my current analysis, the key measure of the marginal change in currency composition of public debt is calculated as the change in cyclical component in the share of external sovereign debt

denominated in dollar following previous literature (Lee (2024)). However, cyclical component in the share of debt in dollar can be driven by differential issuance decisions by currency, differential changes in the valuation of debt by currency, and differential trading between foreign and domestic investors (Ottonello and Perez (2019)). Another disadvantage of this measurement based on debt stocks is that data availability on granular currency breakdown starts in 2013 from BIS.

In the following section, therefore, I repeat the same analysis using data on bond issuance regarding that bond securities account for the bulk of sovereign debt. These issuance data directly measures the changes in debt that are due to active issuance decisions of governments, isolating from changes in the currency composition of debt due to valuations change of previously issued debt.

4 Sovereign Bond Currency Issuance Responses to Dollar Convenience Yield Shock

I complement above empirical analysis by directly examining governments' active debt management of issuing currency choice in response to dollar convenience yield fluctuations. And I show that sovereigns' active issuance decisions are also consistent with the cyclical features of the currency composition of external sovereign debt over the global dollar cycle. Furthermore, these data have an advantage of being available for a longer period.

Bond issuance data come from the SDC Platinum New Issues Database. This database provides a transaction-level information on new bonds securities issued in public capital markets around the globe. I consolidate bond issuance activities at the ultimate parent level and on a nationality basis in keeping with the spirit of our exercise.[22] After collecting data on sovereign bond issuance, I aggregated quarterly issuance proceeds by country and currency denomination. The basic unit of analysis is the "issuance-quarter",with the sample period spanning 2005–2023. This period is constrained by the availability of data on non-financial corporate sector dollar debt stocks from the IIF Global Debt Monitor database.

For the purpose of this study, I classify each sovereign-quarter observation into two categories. The dependent variables are binary, taking on the value of 1 when sovereigns issue USD bonds within the quarter, and 0 when sovereigns do not issue a USD bond within the quarter. I then apply a Logit regression to examine how ex-ante currency mismatch on corporate balance sheet affect the likelihood of government sector in their economy to issue dollar bonds

[22] I use the "Ultimate Parent Nation" field, which corresponds to ultimate parent residency, to identify nationality of the issuer. Governments are identified as issuers whose SIC codes are 999A or 999B. Specifically, 999A refers to central governments, whereas ministries of finance or treasuries are identified as 999B with these entities being part of the sovereign debt issuers as well. I drop bonds issued in perpetuity. 999A refers to issuers which are central governments.

in repsonse to convenience yield shock. In the Logit regression, I keep the same set of major regressors as in specification (3). I also include year-over-year real GDP growth, net exports (% GDP), inflation and reserve holdings (% GDP) to introduce macroeconomic conditions of the home country as a possible influence on public sector's borrowing behavior. Of these control variables, only export revenue shows a significant negative effect on the likelihood of sovereign dollar bond issuance.

Table 10 column (1) illustrates that the coefficient on the intersection term of ex-ante corporate currency mismatch and quarterly change in convenience yield is positive and significant, which implies higher levels of ex-ante nonfinancial corporate dollar debt liabilities increase the likelihood of issuing USD-denominated sovereign bonds in response to an increase in dollar safety premium. The inclusion of country-level macroeconomic controls in column (2) does not materially alter this key result.

Columns (3) and (4) replicate the analysis for sovereign EUR bond issuance. Columns (5) and (6) extend the analysis to sovereign debt issued in currencies other than USD and EUR. However, these results show no significant impact of the dollar safety premium on sovereign borrowing in other currencies expect USD. This finding further underscores the unique role of the U.S. dollar as the global funding currency in driving emerging market business cycles through the financial linkage.

In summary, my results show that EM soveriegns' dollar borrowing behavior is exposed to the dollar cycle which is determined by global shocks stemming from time-varying excess demand of global investors on dollar denominated safe assets. Besides, the impacts of convenience yield shock on sovereign borrowing in emerging market economies are unequal, and the private sector dollar mismatch accounts for the heterogenous impacts.

5 Dissecting the Mechanism

Motivated by the empirical facts regarding the interaction between corporate currency mismatch and sovereigns' dollar borrowing behavior in response to dollar convenience yield shifts presented above, I provide empirical evidence to justify the mechanism behind the above-mentioned patterns. Before I turn to the empirical analysis, I first illustrate the key mechanism in a simplified way.

To make the discussion concrete, consider the one period government budget, and assume that governments only issue one-period debt denominated either in home currency or U.S. dollar. G_t and T_t represent the government expenditure and fiscal revenue at t, respectively. D_t represents the government debt matured at t while issued at $t-1$. r_t denotes the yield of one-period government debt. If government does not default at time t, the intertemporal

government budget condition (IGBC) gives rise to:

$$\underbrace{D_t}_{\text{new issuance at } t} = \underbrace{(1+r_{t-1})D_{t-1}}_{\text{debt matured at } t} + \underbrace{G_t - T_t}_{\text{government deficit}} \tag{4}$$

That said, government debts are issued to fund either debt matured, or government deficit in the current period.

A flight-to-dollar-safety shock accompanied by an immediate appreciation negatively impacts currency-mismatched firms through balance sheet effects. The increased real debt burden (in local currency terms) reduces disposable income, potentially leading to investment cuts and decreased output. Weakened corporate performance further diminishes corporate tax revenue while adds to demands for fiscal stimulus. Consequently, these factors exacerbate the government's fiscal condition, increasing funding needs regardless of debt currency denomination. Put differently, during periods of global flight-to-dollar-safety as identified by spikes in dollar safety premium, currency-mismatched corporate sector suffers wealth loss and responds by cutting investment and production. Tax as a major source of fiscal income in emerging market economies decreases, thus governments expand their borrowing to maintain fiscal solvency. On the other hand, as global investors value liquid dollar payoffs attached dollar bonds, larger convenience yields should be attached to dollar bonds than LC bonds for the same sovereign issuer. During flight-to-safety episodes, this increased convenience yield incentivizes governments to issue more dollar-denominated debt to take advantage of cheaper dollar funding. Consequently, both the level and share of dollar-denominated debt increase in response to positive dollar safety shocks. Furthermore, currency-mismatched corporate sector also gives a role to governments' dollar borrowing behavior through fiscal channel.

In the subsequent exercise, I examine the mechanism through which private sector currency mismatches influence sovereign borrowing behavior during global flight-to-safety episodes. First, I demonstrate that a positive dollar convenience yield shock leads to a greater deterioration in sovereign fiscal conditions when the corporate sector exhibits higher currency mismatches. This finding supports the hypothesis that governments increase borrowing to offset anticipated declines in future fiscal revenues.

Second, I utilize high-frequency pricing data to study the impact of dollar convenience yield shock on the relative borrowing costs in USD and LC facing sovereigns, rationalizing the governments' borrowing decision regarding currency denomination during global-flight-to-safety. Indeed, I show empirically that the relative cost of borrowing in local currency than that in US dollar for emerging market governments is positively correlated with dollar convenience yield.

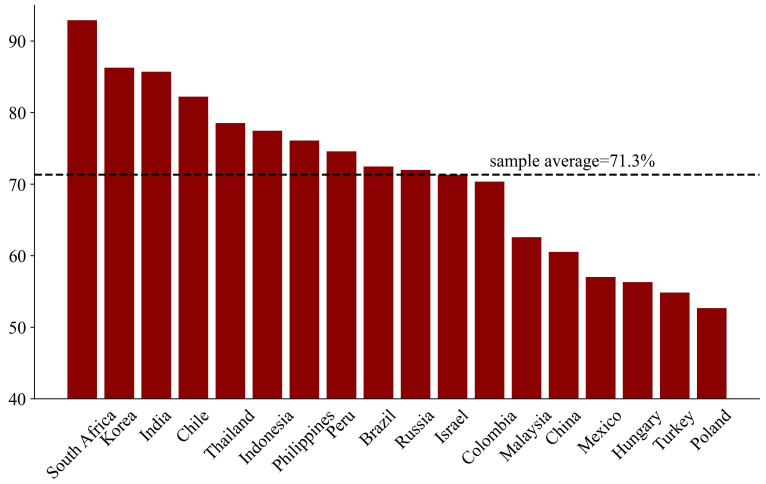
To conclude, this section helps discern the underlying mechanism behind the dollar borrowing pattern of emerging market sovereigns over the dollar cycle and how the cross-country

differences in the exposure to dollar safety shock is explained by the degree of private sector currency mismatch.

5.1 Corporate Dollar Debt, Tax Revenue and Convenience Yield

I first provide supportive evidence on the spillover mechanism from corporate currency mismatch to governments' borrowing constraint through tax revenue. The yearly tax revenue data are from IMF World Revenue Longitudinal Dataset (IMF WRL).[23] I show that emerging markets highly rely on tax revenue as a major source of fiscal income. Figure 3 shows that the 2014-2022 average ratio of tax revenue to fiscal revenue across sample countries is 71.3%.[24] The high reliance on tax revenue as a source of fiscal income implies that fluctuations in tax revenue could affect governments' financial constraints and borrowing decision. Moreover, tax revenue acts as a crucial channel through which corporate performance and profits can directly influence the government's financial condition.

Figure 3: **Tax Revenue to Total Fiscal Revenue Ratio (%).**
This figure reports the average tax revenue to total fiscal revenue from 2014 to 2021. Data source: Author's calculations of the IMF World Revenue Longitudinal dataset.



Then, I perform the following fixed effect panel regression and regress the year-over-year change of tax-to-GDP-ratios on ex-ante corporate currency mismatch, convenience yield change and their intersection term:

$$\Delta Tax_{i,t} = \alpha_i + \gamma \Delta x_t^{\$} \times USDdebt_{nonfin,i,t-1} + \beta_1 \Delta x_t^{\$} + \beta_2 USDdebt_{nonfin,i,t-1} + \epsilon_{i,t} \quad (5)$$

[23] Fiscal revenue is the total income collected by the government through various means, which can be broken down into two components: tax revenue and non-tax revenue. Non-tax revenues are mainly made up of grants and social contributions. Tax revenue consists of excise tax, value-added tax (VAT), corporate income tax, individual income tax, property tax, trade tax, taxes on payroll and workforce, and miscellaneous taxes.

[24] Additionally, emerging countries also have a higher share of corporate income tax in total tax revenue than developed countries.

, where $\Delta Tax_{i,t}$ represents the year-over-year change of tax-to-GDP-ratios from year $t-1$ to t in country i, and $USDdebt_{nonfin,i,t-1}$ refers to country i's corporate dollar-debt-GDP ratio in the fourth quarter of the previous year $t-1$, and Δx_t denotes the yearly change in the dollar convenience yield from $t-1$ to t.

In regression 5, the trade channel and financial channel of exchange rate might have different predictions on the sign of β_1, which captures the unconditional effects of a dollar safety shock on the corporate profit. Regarding the trade channel, specifically, on the one hand, imports become expensive in domestic term as dollar strengthens. On the other hand, strong dollar can be beneficial for exporters by aiding export expansion. Hence, trade channel suggests the effects of dollar safety shock and dollar appreciation on economic output and fiscal revenues can be ambiguous.

However, as predicted by financial channel of exchange rate, a strong dollar forces firms to reduce investments when exposed to more expensive dollar debt liability in local currency terms, resulting in lower corporate profits and subsequent decline in tax revenues, therefore, we expect to see a negative β_1.[25]

In our case, the convenience yield shock arises from global investors' excess demand for dollar safe assets. It's usually related to financial market shock, so the subsequent dollar exchange rate movement impacts the global economy mainly through financial channels by affecting credit flows and asset prices. γ captures the extent to which a higher level of dollar debt issued by nonfinancial corporations changes the impact of dollar convenience yield on taxes.

Hypothesis 1. *A higher level of nonfinancial corporate dollar debt strengthens the financial channel of convenience yield shock and exchange rate movements, leading to even larger decline in tax revenue. We would expect to see* $\gamma < 0$.

Table 11 displays the regressions results. Following Wu (2020), the dependent variables consider two measures of tax revenue: yearly change in corporate profit tax to GDP ratio in column (1)-(2), and yearly change in total tax to GDP ratio in last two columns. Across all specifications, the estimates of γ are significant and have the expect sign. This implies that the impact of a positive shift in the dollar convenience yield, coupled with dollar strengthening, leads to a greater reduction in tax revenue when the corporate sector has a higher level of pre-existing unhedged dollar debt.

To summarize, emerging market sovereigns rely on tax revenue as a main source of fiscal income. In response to a positive dollar safety shock, home currency depreciates, which lowers

[25]For example, Aguiar (2005) considers the large depreciation episode during the 1995 Mexico debt crisis and finds that firms with heavy exposure to short-term FX debt before the devaluation experienced relatively low levels of post-devaluation investment.

down the tax revenue especially when corporate sector has high dollar debt. This tax channel directly links corporate currency mismatch with sovereign's fiscal condition.

5.2 Relative Borrowing Costs of USD over LC for EM Sovereigns

5.2.1 Baseline Analysis

I calculate the relative borrowing costs of USD versus LC using secondary market yields as a proxy for potential borrowing costs encountered by emerging market governments. Following Du and Schreger (2016), the pricing data are zero-coupon yield curves for LC and USD sovereign bonds issued by 6 emerging market governments collected from Bloomberg. The selection of sample countries is limited to those with available dollar bond yield data including Brazil, Colombia, Mexico, Peru, Turkey, and South Korea. Among these 6 countries, South Korea is part of the FTSE World Government Bond Index (WGBI), while the remaining five countries are all included in the JP Morgan EMBI index - an investable index for emerging market local currency bonds for international investors. The base tenor is one-year.

The relative borrowing costs in LC over USD for each sovereign are calculated in logs as:

$$\Psi_{i,t} = \underbrace{y_{i,t}^{LC}}_{\text{one-year LC yield}} - \underbrace{(y_{i,t}^{\$} + s_{i,t+12} - s_{i,t})}_{\text{one-year USD yield in units of LC}} \tag{6}$$

, where $y_{i,t}^{LC}$ is daily average of one-year zero-coupon yield of LC sovereign bond in country i within month t; $s_{i,t}$ is daily average of log of exchange rate defined as units of LC per USD in month t and $s_{i,t+12}$ refers to the exchange rate one year after. Then, I run panel regression of the form

$$\Psi_{i,t} = \gamma x_t^{\$} + \Omega \Gamma_{i,t} + \epsilon_{i,t} \tag{7}$$

, where $x_t^{\$}$ is the average of daily dollar convenience yield within month t. $\Gamma_{i,t}$ refers to macro control variables including real GDP growth, inflation, net international investment position (% GDP), capital openness. Our capital control index are obtained from Fernández et al. (2016).

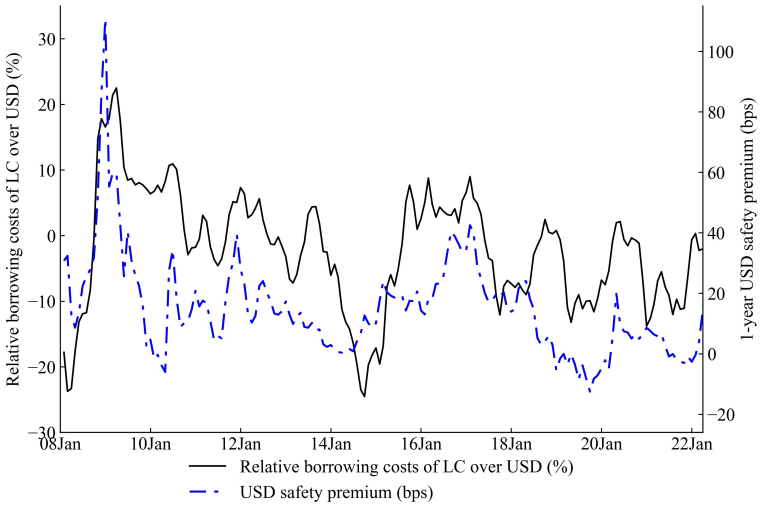
Hypothesis 2. *An increase in convenience yield increases the relative borrowing costs of the LC over USD.*

Under Hypothesis 2, we would expect to see a positive γ. Table 12 presents regression results. In column 1-2, our sample is unbalanced panel since the earliest starting dates of dollar bond yield for each sovereign are different and the earliest starting date is as early as 2002. In column 1, we see that a higher convenience yield are associated with an increase in

relative borrowing costs of LC versus USD. Basically, one basis point increase in the dollar convenience yield is associated with about 19 bps increases of the excess cost of borrowing in local currency relative to U.S. dollar, and adding other macro variables as control variables does not change the results qualitatively nor quantitatively. Besides, I also conduct monthly time-series regression for each sovereign to examine within country variation and regression results are summarized in Table 13.

Figure 4: **Cross-country Mean of Relative Borrowing Costs of LC over USD and Convenience Yield.**

This figure plots cross-country mean of relative borrowing costs of LC over USD and 1-year US Treasury premium. Time period spans from Jan 2008 to Mar 2022.



5.2.2 Monetary Policy Shocks as IV

To further identify the causal effects of dollar convenience yield on the relative borrowing costs of LC and USD for emerging sovereigns, I conduct an event study and use the monetary surprise around FOMC announcements to create exogenous variation in the dollar convenience yield and examine the high-frequency responses of relative yield of USD to LC sovereign bonds. Our monetary policy surprises are measured as policy news shock from Nakamura and Steinsson (2018).[26]

How does U.S. monetary policy shock generate a convenience yield movement? Jiang et al. (2024) theoretically explains the role of U.S. monetary policy in determining dollar convenience yield. They argue that tighter monetary policy shock induces banks to scale down their balance sheet by reducing the supply of dollar safe assets, thus leading to increases of dollar convenience yield given downward-sloping demand curve for safe asset investors.

[26] Acosta (2022) provides the updated shocks series of Nakamura and Steinsson (2018) and Gürkaynak et al. (2005) until Sep 2022. I do not use FFR surprises as monetary policy shock since FFR hits zero lower bound during a long-period after GFC and FFR surprises do not show significant variation which is not a good candidate for instrumental variable.

I run the following form of regressions:

$$\text{First stage:} \quad \Delta x_t^{\$} = \alpha + \beta MPS_t + \varepsilon_t \tag{8}$$

$$\text{Second stage:} \quad \Delta^k \Psi_{i,t} = \gamma^k \widehat{\Delta x_t^{\$}} + \Gamma X_{i,t} + \alpha_i + \epsilon_{i,t} \tag{9}$$

where $\widehat{\Delta x_t^{\$}}$ is the fitted values of change in dollar convenience yield from first-stage regression and $\Delta^k y_t = y_{t+k-1} - y_{t-1}$ represents the k day change in variable y around event. Specifically, our dependent variable $\Delta^k \Psi_{i,t}$ is calculated as

$$\Delta^k \Psi_{i,t} = \left(y_{i,t+k}^{LC} - (y_{i,t+k}^{\$} + s_{i,t+k+1year} - s_{i,t+k})\right) - \left(y_{i,t-1}^{LC} - (y_{i,t-1}^{\$} + s_{i,t-1+1year} - s_{i,t-1})\right). \tag{10}$$

Assume that within short-term event window equilibrium exchange rate in one year does not change as long as economic fundamentals does not change, thus we have

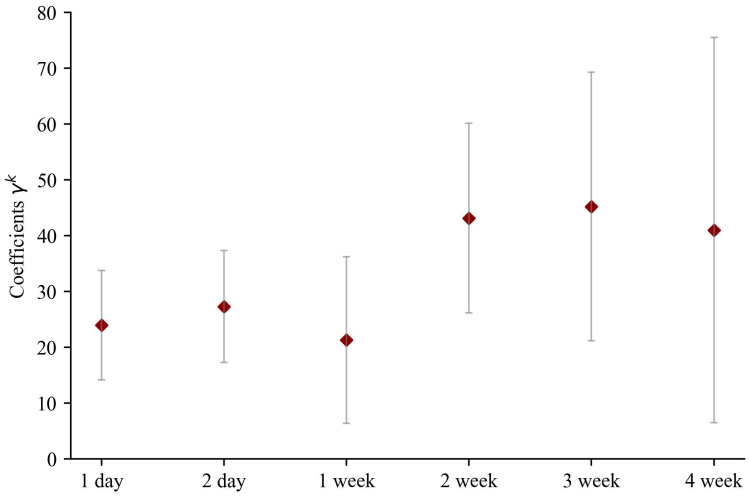
$$\Delta^k \Psi_{i,t} = \Delta^k y_{i,t}^{LC} - \Delta^k y_{i,t}^{\$} + \Delta^k s_{i,t}. \tag{11}$$

In the first stage, I regress change in convenience yield on monetary policy surprises measured as NS policy news shock (MPS_t). I consider 2-day event windows around FOMC announcement in the first stage regression following Krishnamurthy and Lustig (2019) which means that $\Delta x_t^{\$} = x_{t+1}^{\$} - x_{t-1}^{\$}$. The results are reported in top panel of Table 14.

In the second stage, I run a regression of the shifts in relative borrowing costs from the close of trading on the day prior to the event day to the close of trading k days later on the fitted change in convenience yield to measure the causal effect of variation in the convenience yield due to monetary policy shocks on relative borrowing costs between USD and home currency. $X_{i,t}$ represents a vector of country level controls including net international investment position, real GDP growth, inflation and capital controls.

My analysis centers on the coefficient of γ^k, which quantifies the impact on the relative borrowing costs between local currency and U.S. dollar after accounting for exchange rate fluctuations. The results indicate that this coefficient is significantly positive. Figure 5 illustrates the coefficient for the instrumented convenience yield shock in the second-stage regression, revealing a notably persistent effect of a positive convenience yield shock on the relative borrowing costs of LC over USD. Specifically, a one basis point exogeneous increase in convenience yield as instrumented by monetary policy shock results in a 20-40 bps increase in relative borrowing costs over the subsequent month. Furthermore, the magnitude of the one-day response is approximately 24 bps, aligning with our earlier panel regression findings. In that analysis, a 1 bp increase in the convenience yield was linked to a 28 bps increase in the relative borrowing costs of LC over USD for EM sovereign issuers in the post-crisis period.

Figure 5: **Excess Cost of Borrowing in LC over USD to Convenience Yield Shock.** This figure illustrates the estimated changes in relative borrowing cost of LC versus USD for emerging market sovereigns in response to a 1 bp convenience yield shock around FOMC announcements.



Global Dollar Cycle v.s. Global Financial Cycle In the appendix, I use VIX as a proxy to identify change in global risk aversion and global financial cycle (Miranda-Agrippino and Rey (2020)). By contrast, the results do not remain. This comparison suggests that the dollar cycle as identified by shifts in dollar convenience yield is not completely captured by global financial cycle.

6 Conclusion

This study establishes novel evidence and highlights the role of global factors, specifically the existence of the global dollar cycle (Jiang et al. (2024)), in shaping emerging market sovereigns' dollar borrowing patterns, which may be independent of the domestic business cycle within the individual borrower country, as emphasized by existing literature.

Specifically, I find that EM governments issue more USD-denominated debt and tilt the currency composition of external debt towards the U.S. dollar in response to a positive dollar convenience yield shock, usually during global flight-to-safety episodes. Crucially, EM sovereigns' dollar borrowing behaviors exhibit are differentially exposed to this dollar cycle, with private sector dollar mismatches accounting for the heterogenous impacts. Specifically, sovereigns' dollar borrowing is more exposed to the dollar cycle if its domestic firms engage in a larger currency mismatch. Therefore, another contribution of this paper is to empirically validate that currency mismatch within the corporate sector is an intrinsic element of instability and serves as a source of heterogeneous exposures of emerging market sovereigns' external debt to global shocks (Krishnamurthy and Lustig (2019)).

These findings reveal significant policy implications. First, during the stress time, for the center country, the United States, it is necessary to provide dollar swap lines as they counteract safety demand shocks and mitigate the impacts of the global dollar cycle around the world. Dollar swap line could be a globally stimulative policy tool (Kekre and Lenel (2024)). Second, for peripheral countries, particularly emerging markets, the current macroprudential policies mosty concentrate on the banking sector. These policies fall short in addressing risks associated with excessive leverage, as well as currency and maturity mismatches that are often exacerbated and accumulated by non-bank corporations. It is imperative to implement proactive monitoring and regulatory measures to contain excessive buildup of the un-hedged USD debt of non-financial corporations, as individual firms tend to overlook the broader economic implications of their risk-taking behaviors, necessitating regulatory oversight to internalize these externalities and safeguard against systemic risks (Das et al. (2022)).

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Appendix

Appendix A Figures and Tables

Table 1: **Summary Statistics of Countries' Characteristics**
For each country, the overall capital control index is calculated as the average over 2013 to 2019 according to Fernández et al. (2016). I employ the exchange rate regime classification by Ilzetzki et al. (2017).

Country	Group	Currency	Exchange Rate Regime	Capital Control Index
Czech Republic	European EM	CZK	Managed floating	0.40
Russia	European EM	RUB	Managed floating	0.45
Poland	European EM	PLN	Freely floating	0.61
Turkey	European EM	TRY	Managed floating	0.70
Hungary	European EM	HUF	Managed floating	0.08
Peru	other EM	PEN	Freely Floating	0.00
India	other EM	INR	Managed floating	0.95
Malaysia	other EM	MYR	Managed floating	0.88
South Africa	other EM	ZAR	Freely Floating	0.72
Indonesia	other EM	IDR	Freely Floating	0.67
Ukraine	other EM	UAH	Managed floating	0.79
Israel	other EM	ILS	Managed floating	0.10
Thailand	other EM	THB	Managed floating	0.73
Korea	other EM	KRW	Freely Floating	0.16
Mexico	other EM	MXN	Freely Floating	0.62
Brazil	other EM	BRL	Managed floating	0.64
Chile	other EM	CLP	Managed floating	0.23
Colombia	other EM	COP	Managed floating	0.58
Philippines	other EM	PHP	Managed floating	0.91
China	other EM	CNY	Managed floating	0.87

Table 2: **Summary Statistics of External Sovereigns Debt on Aggregate**

This table reports the summary statistics of external sovereign debt denominated in USD, foreign currencies and local currency for each country in the panel data of all countries from 2013Q4 to 2022Q3. Panel (a) reports the external sovereign debt to GDP ratios denominated in different currencies which include all 20 countries in our total sample. Panel (b) reports the USD, FC and LC share in amounts outstanding of total external sovereign debt and 18 countries are covered in this calculation since Korea and Israel are not covered in AT2014.

	Panel (a):External Sovereign Debt to GDP						
	Mean	Std. dev	p10	p25	p50	p75	p90
USD	4.63%	3.47%	0.35%	2.37%	4.04%	6.35%	9.11%
FC	6.46%	4.86%	0.50%	3.12%	5.71%	8.99%	12.94%
LC	0.55%	1.16%	0.01%	0.06%	0.18%	0.59%	1.05%
total	7.01%	5.12%	0.62%	3.34%	6.14%	10.07%	13.90%
	Panel (b): Currency Composition in External Sovereign Debt						
	Mean	Std. dev	p10	p25	p50	p75	p90
USD	42.35%	23.63%	11.04%	24.60%	40.48%	61.57%	76.59%
FC	55.24%	26.35%	12.31%	32.78%	60.75%	72.48%	89.06%
LC	44.76%	26.35%	10.94%	27.52%	39.25%	67.22%	87.69%

Table 3: **Summary Statistics of External Sovereigns Debt at National Level**

This table reports the summary statistics on dollar debt to GDP ratio and the share in debt in USD for each country from 2013Q4 to 2022Q3.

	USD debt to GDP			the share in debt in USD		
	mean	std	rho	mean	std	rho
Russia	2.97%	0.51%	73.39%	37.23%	8.58%	83.80%
Poland	2.50%	0.76%	90.09%	11.90%	1.17%	56.24%
Turkey	7.62%	1.86%	88.91%	63.60%	12.31%	90.14%
Hungary	9.08%	2.30%	91.58%	36.58%	6.51%	83.97%
Peru	6.46%	2.19%	83.78%	54.88%	12.13%	95.12%
Malaysia	1.43%	0.16%	40.18%	8.09%	1.16%	62.54%
South Africa	4.49%	1.18%	80.68%	25.17%	4.37%	73.86%
Indonesia	4.82%	0.45%	73.41%	51.27%	8.20%	86.80%
Ukraine	7.57%	6.42%	78.34%	77.87%	11.51%	81.96%
Mexico	4.48%	0.91%	83.65%	34.90%	5.27%	89.41%
Brazil	2.90%	0.68%	86.90%	34.79%	6.77%	92.24%
Chile	3.89%	2.36%	85.44%	49.52%	12.63%	90.26%
Colombia	8.72%	2.11%	82.44%	66.84%	6.73%	85.02%
Philippines	8.40%	1.01%	26.27%	78.52%	3.29%	69.71%
China	0.05%	0.05%	88.73%	13.50%	5.95%	52.22%

Table 4: **Sovereign Dollar Debt Exposure to Convenience Yield**

This table reports results of regressing quarterly percentage change in cyclical component of USD-denominated sovereign external debt to GDP ratios (column (1) to (3)) and cyclical component of the share of external sovereign debt denominated in dollar (column (4) to (6)) on the dollar convenience yield shock $\Delta x^{\$}$ measured by quarterly change in cross-country average of CIP deviations between 1-year G10 government bond yield and 1-year U.S. Treasury yield, ex-ante USD-denominated debt to GDP ratios of private sector, and their interactions. The dependent variable in columns (1) to (3) is the HP-filtered dollar-denominated external sovereign debt to GDP ratios, and the dependent variable in columns (4) to (6) is the HP-filtered dollar-denominated dollar share of external sovereign debt. USDebt_{cor} is the ex-ante corporate dollar debts to GDP ratios, and we divide corporate dollar debts into non-financial sector (USDebt_{nonfin}) and financial sector (USDebt_{fin}). We include country fixed effects in all specifications. The sample includes 15 emerging countries over 2014Q1 to 2022Q3. Standard errors are clustered at the country level and reported in the parentheses. ***, **, and * represents significance at the 1%, 5% and 10% levels, respectively.

	Sov dollar debt to GDP			Sov dollar debt share		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{USDebt}_{nonfin} \times \Delta x^{\$}$	0.125***			0.569***		
	(0.047)			(0.172)		
$\text{USDebt}_{cor} \times \Delta x^{\$}$		0.055			0.426**	
		(0.037)			(0.166)	
$\text{USDebt}_{fin} \times \Delta x^{\$}$			-0.037			0.597
			(0.091)			(0.417)
USDebt_{nonfin}	-0.077***			-0.142***		
	(0.025)			(0.050)		
USDebt_{cor}		-0.046***			-0.092**	
		(0.010)			(0.041)	
USDebt_{fin}			-0.059***			-0.110
			(0.019)			(0.076)
$\Delta x^{\$}$	0.535	0.606	1.544*	-2.713	-4.500	-2.867
	(0.802)	(0.985)	(0.936)	(2.297)	(3.137)	(3.203)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	512	512	518	512	512	518
R-squared	0.022	0.019	0.014	0.014	0.013	0.007

Table 5: **Sovereign Dollar Debt Exposure to Convenience Yield (AR(1) Innovations)**

This table reports results of regressing quarterly percentage change in cyclical component of USD-denominated sovereign external debt to GDP ratios (column (1) to (3)) and cyclical component of the share of external sovereign debt denominated in dollar (column (4) to (6)) on the dollar convenience yield shock $\Delta x^{\$}$ measured by quarterly AR(1) innovations in the cross-country average of CIP deviations between 1-year G10 government bond yield and 1-year U.S. Treasury yield following Jiang et al. (2021), ex-ante USD-denominated debt to GDP ratios of private sector, and their interactions. The dependent variable in columns (1) to (3) is the HP-filtered dollar-denominated external sovereign debt to GDP ratios, and the dependent variable in columns (4) to (6) is the HP-filtered dollar-denominated dollar share of external sovereign debt. USDebt_{cor} is the ex-ante corporate dollar debts to GDP ratios, and we divide corporate dollar debts into non-financial sector (USDebt_{nonfin}) and financial sector (USDebt_{fin}). We include country fixed effects in all specifications. The sample includes 15 emerging countries over 2014Q1 to 2022Q3. Standard errors are clustered at the country level and reported in the parentheses. ***, **, and * represents significance at the 1%, 5% and 10% levels, respectively.

	sov dollar debt to GDP			sov dollar share		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{USDebt}_{nonfin} \times \Delta x^{\$}$	0.106**			0.465***		
	(0.050)			(0.150)		
$\text{USDebt}_{cor} \times \Delta x^{\$}$		0.046			0.351**	
		(0.032)			(0.142)	
$\text{USDebt}_{fin} \times \Delta x^{\$}$			-0.028			0.523
			(0.079)			(0.356)
USDebt_{nonfin}	-0.075***			-0.130***		
	(0.027)			(0.049)		
USDebt_{cor}		-0.046***			-0.083**	
		(0.011)			(0.040)	
USDebt_{fin}			-0.064***			-0.103
			(0.019)			(0.075)
$\Delta x^{\$}$	0.535	0.610	1.374*	-1.711	-3.176	-2.073
	(0.754)	(0.874)	(0.780)	(2.127)	(2.843)	(2.905)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	512	512	518	512	512	518
R-squared	0.019	0.017	0.012	0.011	0.012	0.006

Table 6: **Sovereign Dollar Debt Exposure to Convenience Yield (Alternative Tenors)**

This table reports results of regressing quarterly percentage change in cyclical component of USD-denominated sovereign external debt to GDP ratios (top panel) and cyclical component of the share of external sovereign debt denominated in dollar (bottom panel) on the dollar convenience yield shock $\Delta x^{\$}$ measured by quarterly change in cross-country average of CIP deviations between k-year G10 government bond yield and k-year U.S. Treasury bond yield, ex-ante USD-denominated debt to GDP ratios of private sector, and their interactions. The convenience yield shocks in each column are calculated as the percentage change in average CIP deviations between G10 government bonds yields and US Treasury bonds yields at the same maturities of one-year, two-year, three-year, five-year and ten-year, respectively. USDebt_{cor} is the ex-ante corporate dollar debts to GDP ratios, and we divide corporate dollar debts into non-financial sector (USDebt_{nonfin}) and financial sector (USDebt_{fin}). We include country fixed effects in all specifications. The sample includes 15 emerging countries over 2014Q1 to 2022Q3. Standard errors are clustered at the country level and reported in the parentheses. ***, **, and * represents significance at the 1%, 5% and 10% levels, respectively.

	sov dollar debt to GDP				
	1Y	2Y	3Y	5Y	10Y
$\text{USDebt}_{nonfin} \times \Delta x^{\$}$	0.125***	0.175*	0.217	0.306**	0.287**
	(0.047)	(0.106)	(0.144)	(0.154)	(0.142)
USDebt_{nonfin}	-0.077***	-0.080***	-0.079***	-0.084***	-0.073***
	(0.025)	(0.026)	(0.027)	(0.025)	(0.022)
$\Delta x^{\$}$	0.535	1.326	1.518	1.389	1.479
	(0.802)	(1.110)	(1.346)	(1.212)	(1.543)
Country FE	Yes	Yes	Yes	Yes	Yes
Observations	512	512	512	512	512
R-squared	0.022	0.026	0.027	0.031	0.035
	dollar share				
	1Y	2Y	3Y	5Y	10Y
$\text{USDebt}_{nonfin} \times \Delta x^{\$}$	0.569***	0.748**	0.851**	1.072***	0.766**
	(0.172)	(0.313)	(0.412)	(0.382)	(0.33)
USDebt_{nonfin}	-0.142***	-0.148***	-0.147***	-0.156***	-0.138***
	(0.050)	(0.049)	(0.048)	(0.052)	(0.05)
$\Delta x^{\$}$	-2.713	-3.396	-4.621	-4.735	-0.913
	(2.297)	(3.096)	(3.250)	(3.186)	(3.617)
Country FE	Yes	Yes	Yes	Yes	Yes
Observations	512	512	512	512	512
R-squared	0.013	0.011	0.010	0.014	0.015

Table 7: **Sovereign Dollar Debt Exposure to Convenience Yield (Sovereign Bonds only)**

This table reports results of regressing quarterly percentage change in cyclical component of USD-denominated external sovereign bonds to GDP ratios (column (1) to (3)) and cyclical component of the share of external sovereign bonds denominated in dollar (column (4) to (6)) on the dollar convenience yield shock $\Delta x^{\$}$ measured by quarterly change in cross-country average of CIP deviations between 1-year G10 government bond yield and 1-year U.S. Treasury yield, ex-ante USD-denominated debt to GDP ratios of private sector, and their interactions. The dependent variable in columns (1) to (3) is the HP-filtered dollar-denominated external sovereign bonds to GDP ratios, and the dependent variable in columns (4) to (6) is the HP-filtered dollar-denominated dollar share of external sovereign bonds. USDebt_{nonfin} and USDebt_{fin} are the ex-ante dollar denominated debts to GDP ratios of the non-financial corporate and financial corporate, respectively. $\text{NUSDFCdebt}_{nonfin}$ and NUSDFCdebt_{fin} are the ex-ante non-USD foreign currencies denominated debts to GDP ratios of the non-financial corporate and financial corporate, respectively. We include country fixed effects in all specifications. The sample includes 15 emerging countries over 2014Q1 to 2022Q3. Standard errors are clustered at the country level and reported in the parentheses. ***, **, and * represents significance at the 1%, 5% and 10% levels, respectively.

	sov dollar bonds to GDP			sov dollar share		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{USDebt}_{nonfin} \times \Delta x^{\$}$	0.143***	0.166***	0.134***	0.579***	0.510***	0.582***
	(0.036)	(0.039)	(0.038)	(0.167)	(0.126)	(0.162)
$\text{USDebt}_{fin} \times \Delta x^{\$}$		-0.060			0.322	
		(0.053)			(0.313)	
$\text{NUSDFCdebt}_{nonfin} \times \Delta x^{\$}$			0.122			0.196
			(0.179)			(0.565)
USDebt_{nonfin}	-0.060***	-0.046***	-0.058***	-0.129**	-0.088**	-0.121**
	(0.017)	(0.017)	(0.017)	(0.052)	(0.042)	(0.051)
USDebt_{fin}		-0.040**			-0.100*	
		(0.017)			(0.065)	
$\text{NUSDFCdebt}_{nonfin}$			-0.062			-0.270
			(0.055)			(0.181)
$\Delta x^{\$}$	-0.239	-0.085	-0.037	-3.225	-4.895	-3.595
	(0.383)	(0.428)	(0.543)	(2.237)	(3.272)	(2.436)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	477	477	477	512	512	512
R-squared	0.052	0.059	0.054	0.012	0.015	0.014

Table 8: **Sovereign Dollar Debt Exposure to Convenience Yield (Non-USD Foreign Currency Debt)**

This table reports results of regressing quarterly percentage change in cyclical component of USD-denominated sovereign external debt to GDP ratios (column (1) to (2)) and cyclical component of the share of external sovereign debt denominated in dollar (column (3) to (4)) on the dollar convenience yield shock $\Delta x^{\$}$ measured by quarterly change in cross-country average of CIP deviations between 1-year G10 government bond yield and 1-year U.S. Treasury yield, ex-ante USD-denominated debt to GDP ratios of private sector, and their interactions. The dependent variable in columns (1) to (2) is the HP-filtered dollar-denominated external sovereign debt to GDP ratios, and the dependent variable in columns (3) to (4) is the HP-filtered dollar-denominated dollar share of external sovereign debt. USDebt_{nonfin} and $\text{NUSDFCdebt}_{nonfin}$ are the ex-ante non-financial corporate debt-to-GDP ratios of debts denominated in USD and non-USD foreign currencies, respectively. FCdebt_{nonfin} are the ex-ante non-financial corporate debt-to-GDP ratios of debts denominated foreign currencies. We include country fixed effects in all specifications. The sample includes 15 emerging countries over 2014Q1 to 2022Q3. Standard errors are clustered at the country level and reported in the parentheses. ***, **, and * represents significance at the 1%, 5% and 10% levels, respectively.

	sov dollar debt to GDP		sov dollar share	
	(1)	(2)	(3)	(4)
$\text{USDebt}_{nonfin} \times \Delta x^{\$}$	0.105**		0.554***	
	(0.052)		(0.169)	
$\text{NUSDFCdebt}_{nonfin} \times \Delta x^{\$}$	-0.279**		-0.145	
	(0.272)		(0.557)	
$\text{FCdebt}_{nonfin} \times \Delta x^{\$}$		0.094**		0.563***
		(0.045)		(0.163)
USDebt_{nonfin}	-0.073***		-0.135***	
	(0.024)		(0.049)	
$\text{NUSDFCdebt}_{nonfin}$	-0.122		-0.224	
	(0.109)		(0.193)	
FCdebt_{nonfin}		-0.076***		
		(0.027)		
$\Delta x^{\$}$	0.995	0.738	-2.494	-0.140***
	(1.150)	(0.895)	(2.481)	(0.054)
Country FE	Yes	Yes	Yes	Yes
Observations	512	525	512	525
R-squared	0.024	0.024	0.014	0.013

Table 9: **Sovereign Dollar Debt Exposure to Convenience Yield (Add Country Characteristics)**

This table reports results of regressing quarterly percentage change in cyclical component of USD-denominated external sovereign bonds to GDP ratios (column (1) to (3)) and cyclical component of the share of external sovereign bonds denominated in dollar (column (4) to (6)) on the dollar convenience yield shock $\Delta x^{\$}$ measured by quarterly change in cross-country average of CIP deviations between 1-year G10 government bond yield and 1-year U.S. Treasury yield, ex-ante USD-denominated debt to GDP ratios of private sector, and their interactions. The dependent variable in columns (1) to (3) is the HP-filtered dollar-denominated external sovereign bonds to GDP ratios, and the dependent variable in columns (4) to (6) is the HP-filtered dollar-denominated dollar share of external sovereign bonds. USDebt_{nonfin} and USDebt_{fin} are the ex-ante dollar denominated debts to GDP ratios of the non-financial corporate and financial corporate, respectively. $\text{NUSDFCdebt}_{nonfin}$ and NUSDFCdebt_{fin} are the ex-ante non-USD foreign currencies denominated debts to GDP ratios of the non-financial corporate and financial corporate, respectively. We include country fixed effects in all specifications. The sample includes 15 emerging countries over 2014Q1 to 2022Q3. Standard errors are clustered at the country level and reported in the parentheses. ***, **, and * represents significance at the 1%, 5% and 10% levels, respectively.

	sov dollar debt to GDP			sov dollar share		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{USDebt}_{nonficor} \times \Delta x^{\$}$	0.156***			0.532***		
	(0.038)			(0.165)		
$\text{USDebt}_{cor} \times \Delta x^{\$}$		0.098***			0.416**	
		(0.030)			(0.188)	
$\text{USDebt}_{fin} \times \Delta x^{\$}$			0.048	-0.221***		0.562
			(0.082)	(0.034)		(0.474)
$\text{USDebt}_{nonficor}$	-0.064***					
	(0.018)					
USDebt_{cor}		-0.047***			-0.160***	
		(0.013)			(0.017)	
USDebt_{fin}			-0.074			-0.197***
			(0.024)			(0.046)
$\Delta x^{\$}$	-0.539	-0.847	0.207	-3.657	-5.832	-4.000
	(0.413)	(0.550)	(0.456)	(2.654)	(3.944)	(4.124)
$Exports/GDP(\%)$	-0.002	-0.004	-0.008	0.030	0.020	0.013
	(0.008)	(0.006)	(0.006)	(0.030)	(0.027)	(0.026)
Real GDP growth (%)	-0.004	-0.007	-0.002	-0.042**	-0.052***	-0.025
	(0.007)	(0.005)	(0.004)	(0.021)	-0.017	(0.018)
$\Delta\sigma_{FX,1y}$	0.058*	0.058*	0.055	0.248***	0.251***	0.242***
	(0.003)	(0.034)	(0.034)	(0.075)	(0.076)	(-0.474)
country FE	Yes	Yes	Yes	Yes	Yes	Yes
No obs	477	477	483	477	477	483
R-squared	0.085	0.089	0.070	0.052	0.057	0.040

Table 10: **Sovereign Debt Currency Issuance Decision to Convenience Yield**

This table shows results from logit regressions. The dependent variables in column (1)-(2) take two values: (1) when sovereign issues dollar bonds within the quarter, (2) when sovereign does not issue dollar bonds within the quarter. Similarly, the dependent variables in column (3)-(4) take two values: when sovereign issues euro bonds within the quarter, (2) when sovereign does not issue euro bonds within the quarter. The dependent variables in columns (5)-(6) are binary, taking on the value of 1 when sovereigns issue bonds denominated in currencies other than USD and EUR within the quarter, and 0 when sovereigns do not issue dollar-denominated bonds within the quarter. The dollar convenience yield shock $\Delta x^{\$}$ measured by quarterly change in cross-country average of CIP deviations between 1-year G10 government bond yield and 1-year U.S. Treasury yield. USDebt_{nonfin} is the non-financial corporate dollar debt-to-GDP ratios in previous quarter. I include country fixed effects in all specifications. The sample includes 8 emerging countries over 2005Q1 to 2022Q3. Standard errors are clustered at the country level and reported in the parentheses. ***, **, and * represents significance at the 1%, 5% and 10% levels, respectively.

	USD		EUR		All other currencies	
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{USDebt}_{nonfin} \times \Delta x^{\$}$	0.160**	0.157**	-0.035	-0.020	-0.036	-0.020
	(0.069)	(0.074)	(0.059)	(0.062)	-0.057	(0.062)
USDebt_{nonfin}	0.006	-0.019	0.065	0.044	0.032	0.044
	(0.024)	(0.026)	(0.053)	(0.052)	(0.038)	(0.052)
$\Delta x^{\$}$	-2.649***	-2.475**	-0.463	-0.275	0.141	-0.275
	(1.125)	(1.146)	(0.898)	(0.821)	(0.776)	(0.821)
Net Exports (% GDP)		-0.074***		-0.156**		-0.156**
		(0.026)		(0.066)		(0.066)
Real GDP Growth (%)		-0.041		-0.033		-0.033
		(0.030)		(0.034)		(0.034)
Inflation		-0.005		-0.091		-0.091
		(0.017)		(0.069)		(0.069)
Reserve (% GDP)		-0.006		0.056		0.056
		(0.032)		(0.044)		(0.044)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
No obs	1207	1195	1207	1195	1207	1195
R-squared	0.217	0.224	0.191	0.216	0.153	0.216

Table 11: **Tax Revenue, Convenience Yield and Corporate Currency Mismatch**

This table reports results of regressing yearly change in corporate tax to GDP ratios (column (1) to (2)) and total tax to GDP ratios (column (3) to (4)) on the dollar convenience yield shock $\Delta x^{\$}$ measured by yearly change in cross-country average of CIP deviations between 1-year G10 government bond yield and 1-year U.S. Treasury yield, USD-denominated debt to GDP ratios of nonfinancial sector in the fourth quarter of previous year $t-1$, and their interactions. I include country fixed effects in all specifications. The sample includes 18 emerging countries over 2015 to 2020. Standard errors in the parentheses are heteroskedasticity autocorrelation spatial correlation robust (Driscoll and Kraay (1998)) with 3-year lag. ***, **, and * represents significance at the 1%, 5% and 10% levels, respectively.

	Corp Tax (1)	Corp Tax (2)	Total Tax (3)	Total Tax (4)
$\text{USDebt}_{nonfin} \times \Delta x^{\$}$	-3.035***	-3.177***	-8.242***	-9.707***
	(1.077)	(1.015)	(2.270)	(2.315)
USDebt_{nonfin}	3.555***	3.545***	-12.246	-10.664***
	(0.918)	(0.850)	(3.272)	(3.200)
$\Delta x^{\$}$	-0.029	0.006	-0.533	0.033*
	(0.147)	(0.110)	(0.685)	(0.333)
GDP growth		0.008		0.106***
		(0.008)		(0.020)
Country FE	Yes	Yes	Yes	Yes
Rsquared	0.0288	0.0312	0.0608	0.1609
Period	2015-2020	2015-2020	2015-2020	2015-2020
Countries	18	18	18	18
Observations	93	93	99	99

Table 12: **Relative Borrowing Costs of LC versus USD Increases with Convenience Yield**

This table reports panel regression results of regressing relative borrowing costs of LC versus USD on the dollar convenience yield shock $x^{\$}$ and other controls variables. $x^{\$}$ is the average in the cross-country average of CIP deviations between 1-year G10 government bond yield and 1-year U.S. Treasury yield following. The sample includes 18 emerging countries over 2005m1 to 2022m3. The sample period in columns (1) to (2) is from 2005m1 to 2022m3, while sample period in column (3) and (4) starts from 2008m1. I include country fixed effects in all specifications. Driscoll and Kraay (1998) standard errors are reported in the parentheses. ***, **, and * represent significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)
$x_t^{\$}$	19.493***	18.927***	34.195***	32.208***
	(7.022)	(7.310)	(6.164)	(6.670)
GDP growth		-0.030		-0.081
		(0.401)		(0.352)
Inflation		0.629		0.975*
		(0.663)		(0.545)
NIIP		7.427***		5.964***
		(1.619)		(1.398)
Capital control		-0.250		-13.757
		(12.758)		(12.529)
Sample period	Whole	Whole	Post GFC	Post GFC
No obs	1289	1020	954	789
Country FE	Yes	Yes	Yes	Yes
Rsquared	0.054	0.112	0.142	0.207

Table 13: **Relative Borrowing Costs of LC versus USD Increases with Convenience Yield by Country**

This table reports time series regression results of regressing relative borrowing costs of LC versus USD on the dollar convenience yield $x^{\$}$ and other controls variables for each country in the sample. $x^{\$}$ is the average in the cross-country average of CIP deviations between 1-year G10 government bond yield and 1-year U.S. Treasury yield following Jiang et al. (2021). Newey-West standard errors with 12-months lag are reported in the parentheses. ***, **, and * represent significance at the 1%, 5% and 10% levels, respectively.

Panel (a): Univariate regression, Jan 2009 to Mar 2022						
	(1) Brazil	(2) Colombia	(3) Korea	(4) Mexico	(5) Peru	(6) Turkey
$x_t^{\$}$	49.929***	47.004***	24.506***	21.229**	21.596***	40.908***
	(17.571)	(8.843)	(7.268)	(8.494)	(4.967)	(21.636)
Macro controls	No	No	No	No	No	No
No obs	159	159	159	159	159	159
R-squared	0.166	0.261	0.224	0.086	0.221	0.106
Panel (b): Add controls, Jan 2009 to Dec 2019						
	(1) Brazil	(2) Colombia	(3) Korea	(4) Mexico	(5) Peru	(6) Turkey
$x_t^{\$}$	11.461	30.574**	17.671***	27.299***	15.726***	8.485
	(7.718)	(11.810)	(5.827)	(10.501)	(2.922)	(11.189)
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
No obs	132	132	132	132	129	132
R-squared	0.657	0.331	0.300	0.491	0.561	0.226

Table 14: **Relative Borrowing Costs of LC versus USD for EM Sovereigns and Convenience Yield Around FOMC Announcements**

This table reports IV regression of changes in relative borrowing costs of USD to LC for on FOMC-induced variation in dollar convenience yield. $\Delta x^{\$}$ measured by quarterly change in the cross-country average of CIP deviations between 1-year G10 government bond yield and 1-year U.S. Treasury yield following Jiang et al. (2021). I include country fixed effects in all specifications in the second stage. The sample includes 6 emerging countries. Driscoll and Kraay (1998) standard errors are reported in the parentheses. ***, **, and * represent significance at the 1%, 5% and 10% levels, respectively.

	1-st stage					
MPS_t	0.021***					
	(0.004)					
Observation	181					
Rsquared	0.148					
	2-nd stage					
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{\Delta x_t^{\$}}$	23.979***	27.303***	21.296***	43.139***	45.215***	40.996**
	(4.998)	(4.900)	(7.596)	(8.644)	(12.254)	(17.577)
NIIP	0.056	0.093	-0.245	-0.264	-0.443	-0.818**
	(0.166)	(0.171)	(0.144)	(0.178)	(0.246)	(0.357)
GDP	0.020	0.010	0.035	0.022	0.024	0.021
	(0.026)	(0.027)	(0.051)	(0.050)	(0.077)	(0.092)
Inflation	0.013	0.017	0.032*	0.059**	0.071**	0.089**
	(0.010)	(0.012)	(0.017)	(0.024)	(0.029)	(0.042)
Capital control	0.414	-0.199	-0.762	-2.476	-3.572	-4.532
	(0.550)	(0.599)	(1.012)	(2.202)	(2.455)	(4.003)
Observation	678	678	678	678	678	678
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Event window	1 day	2 day	7 day	14 day	21 day	28 day
Rsquared	0.110	0.110	0.036	0.074	0.060	0.043

Figure 6: **Instrument composition within each currency group**

This figure plots the average share of international bonds or cross-border bank loans within external sovereign borrowing through 2013Q4 to 2022Q3 for each country. The top panel reports the instrument composition within US dollar denominated sovereign external borrowing and the bottom panel plots it for total FC denominated sovereign external borrowing.

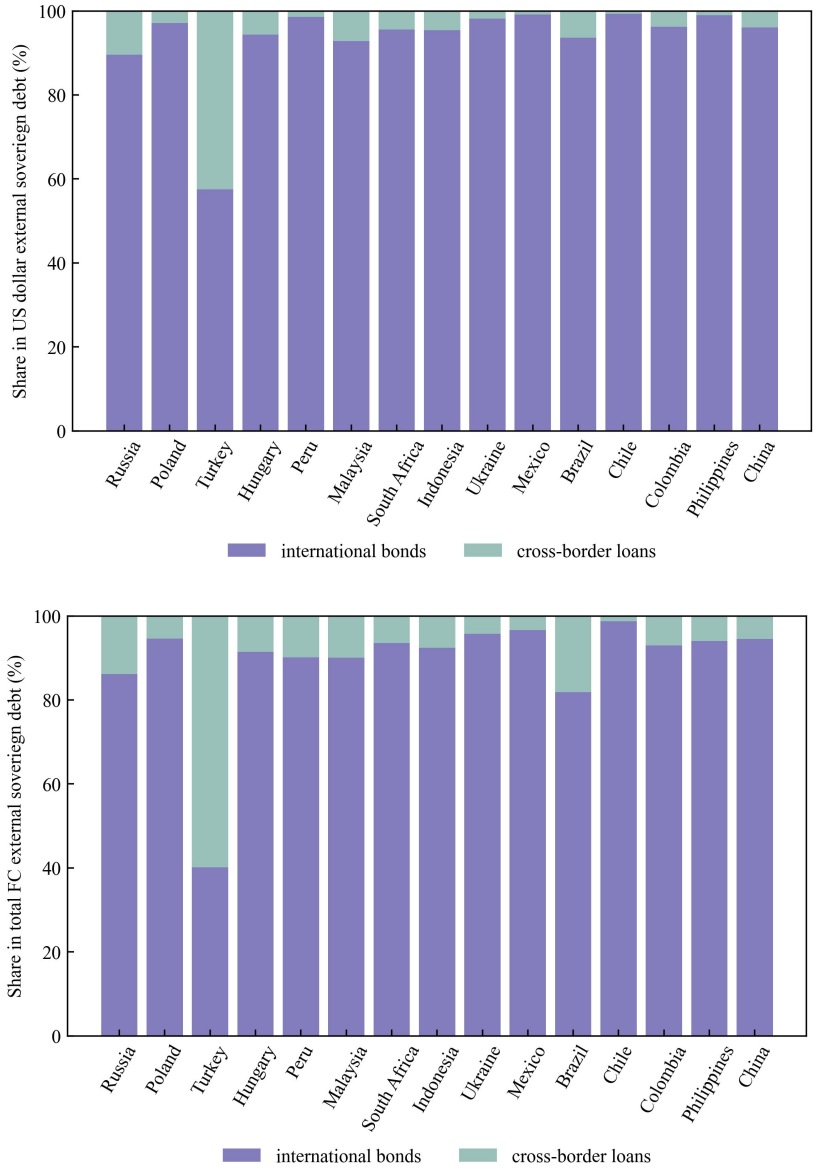


Figure 7: **Evolution of Currency Composition of External Sovereign Bonds.**
This figure plots the share of external sovereign debt denominated different currencies for each economy from 2013Q3 to 2022Q3. The purple area plots the share of USD-denominated bonds in total foreign sovereign bonds. The green area plots the share of sovereign external bonds denominated in other foreign currencies and upper beige area represents the LC-denominated component.

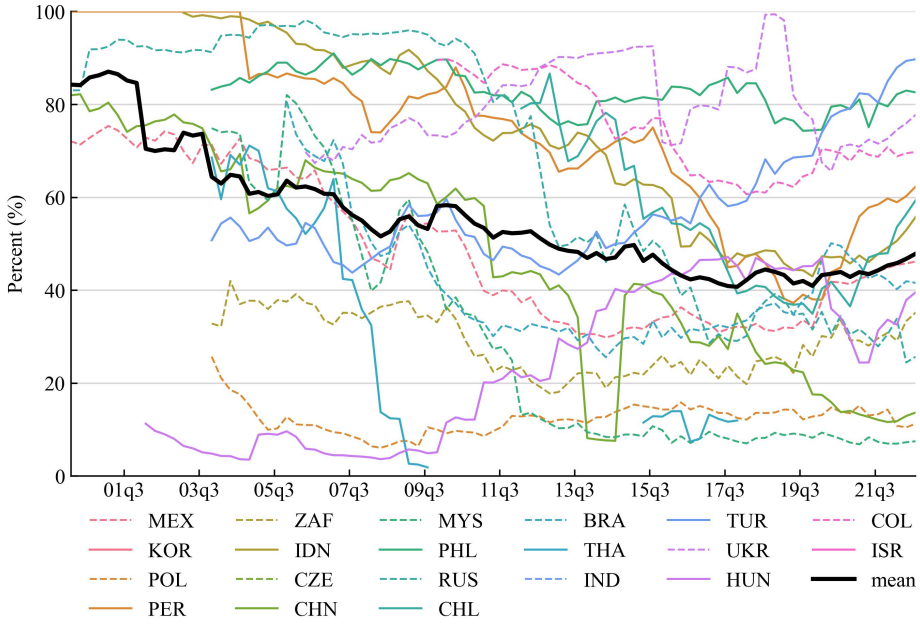


Figure 8: **Currency Composition of External Sovereign Debts.**

This figure plots the share of external sovereign debt denominated different currencies for each economy from 2013Q3 to 2022Q3. The purple area plots the share of USD-denominated bonds in total foreign sovereign bonds. The green area plots the share of sovereign external bonds denominated in other foreign currencies and upper beige area represents the LC-denominated component.

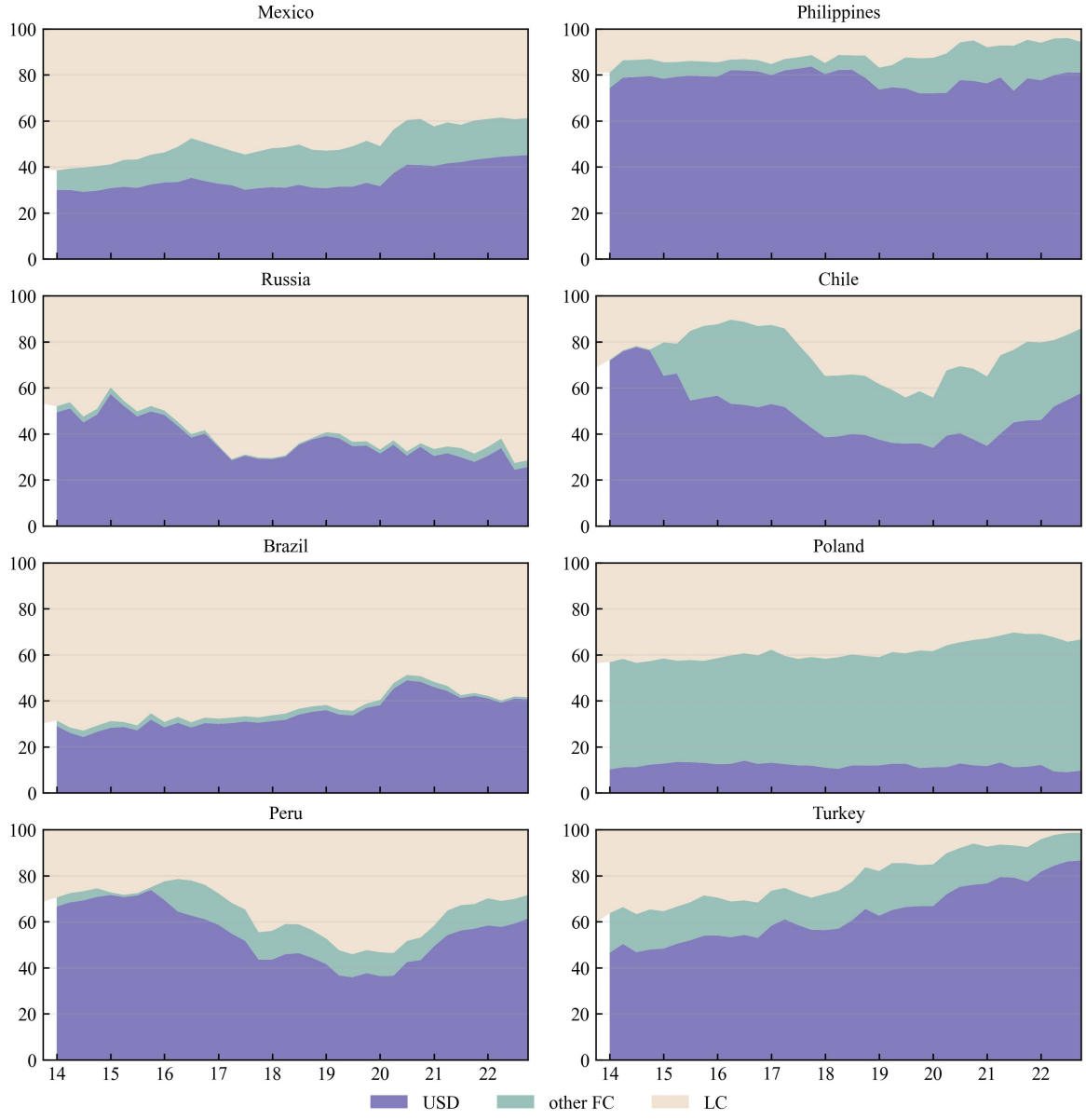


Figure 8: **Currency Composition of External Sovereign Debts. (Continued).**

This figure plots the share of external sovereign debt denominated different currencies for each economy from 2000Q1 to 2022Q3. The purple area plots the share of USD-denominated bonds in total foreign sovereign bonds. The green area plots the share of sovereign external bonds denominated in other foreign currencies and upper beige area represents the LC-denominated component.

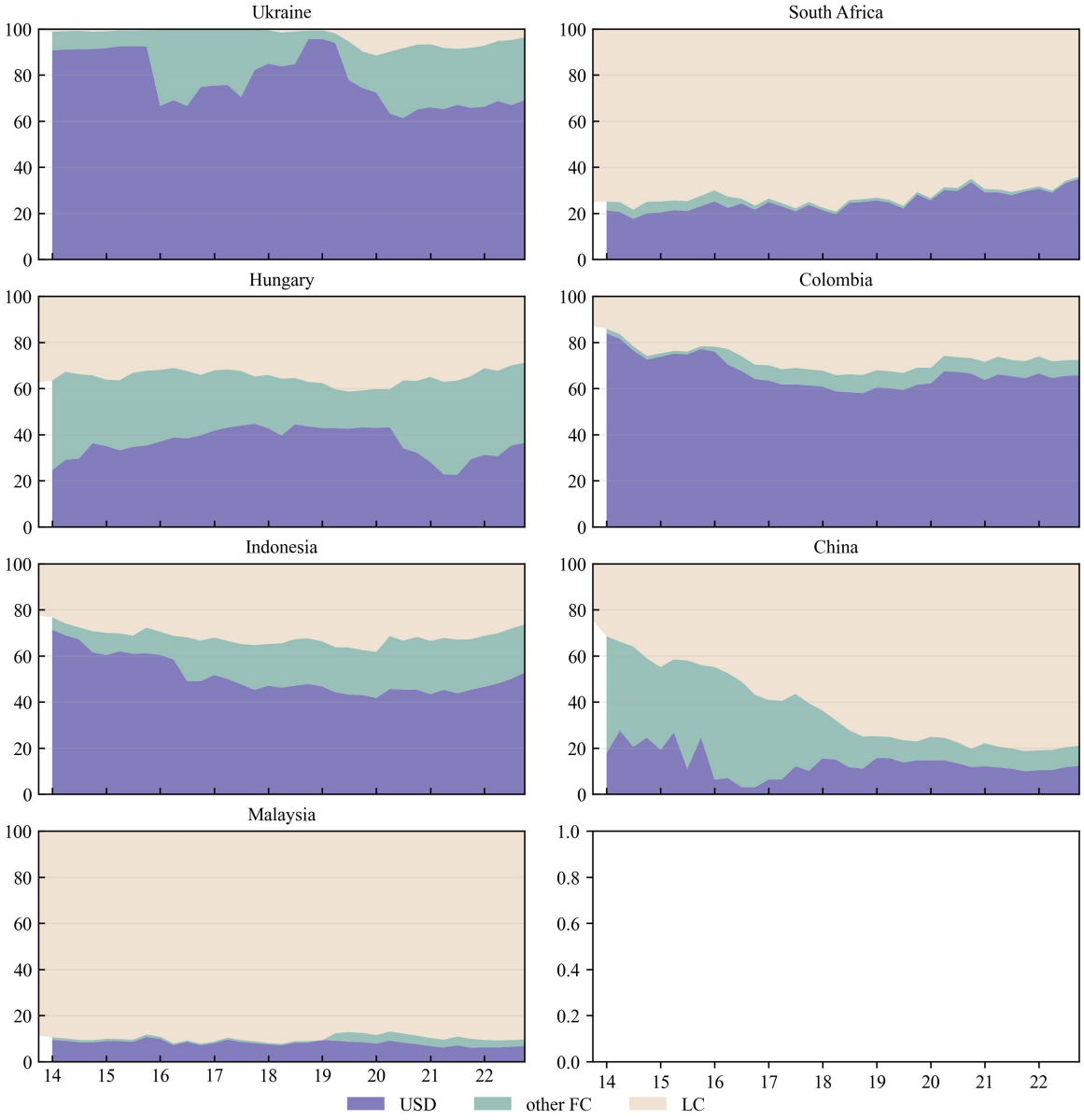
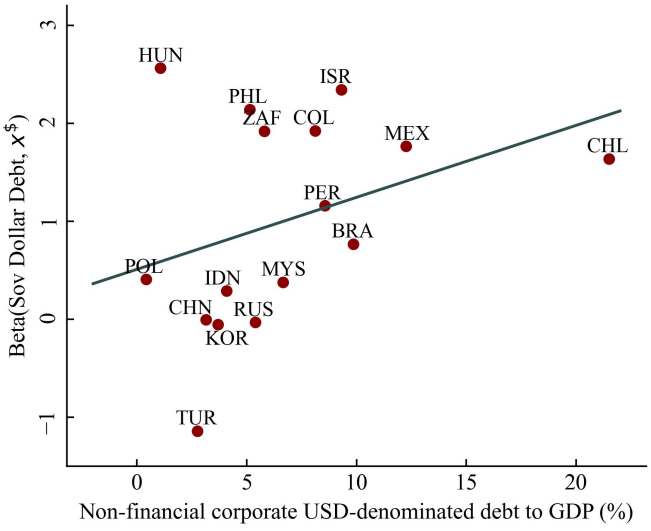
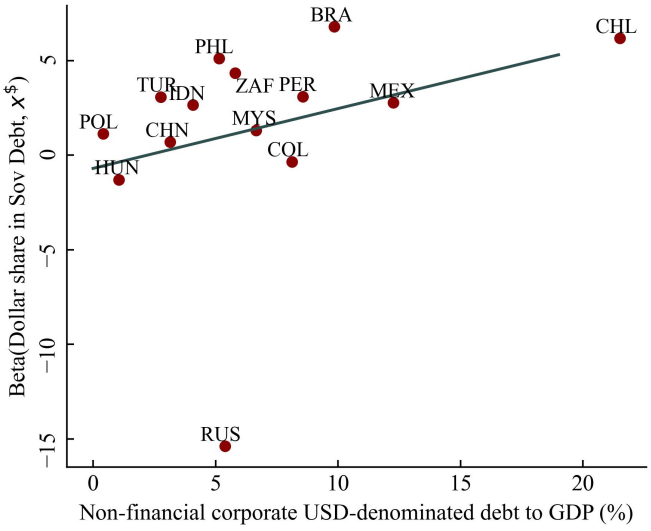


Figure 9: **Sovereign Dollar Debt-Convenience Yield β and Corporate Currency Mismatch: Aggregate patterns**

This figure illustrates the cross-country pattern between the corporate sector's currency mismatch and the sensitivity of sovereigns' external dollar debt to shifts in convenience yield. The convenience yield is calculated as the average spread between 1-year G10 government bonds swapped into dollars and U.S. Treasury bonds. The degree of corporate sector currency mismatch is proxied by the ratio of non-financial corporate dollar debt to GDP. In both panels, the x-axis corresponds to non-financial corporate dollar debt liabilities measured as a percentage of annual GDP, averaged over 2013 Q4 to 2022 Q3. In Panel (a), the y-axis refers to the time-series regression coefficients of the quarterly change in the cyclical component of external sovereign dollar debt to GDP on the quarterly change in the dollar convenience yield for each country. In Panel (b), the y-axis refers to the time-series regression coefficients of the quarterly change in the cyclical component of the dollar share in external sovereign debt on the quarterly change in the dollar convenience yield for each country.



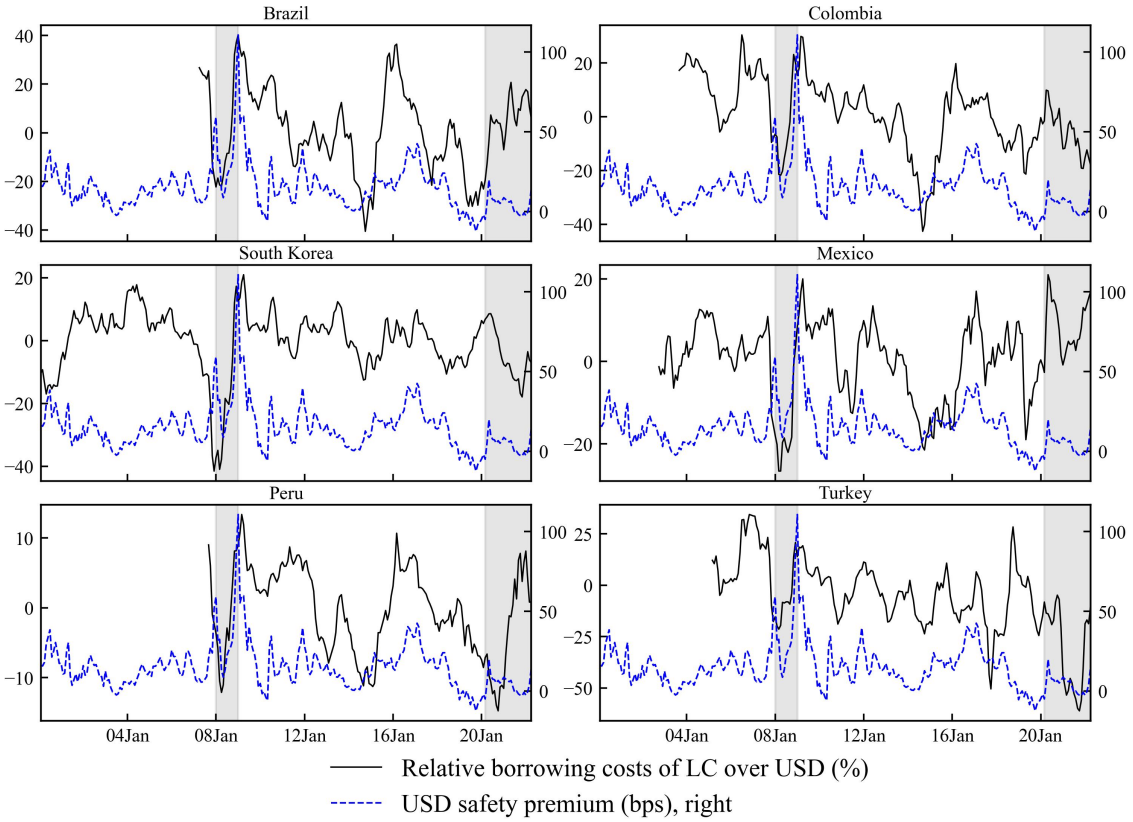
(a) correlation: 0.35



(b) correlation: 0.39

Figure 10: **Relative borrowing costs of LC over USD and 1-year US Treasury premium, by country.**

This figure plots relative borrowing costs of LC over USD of EM sovereigns and 1-year US Treasury premium. The sample is monthly.



Appendix B Empirical Appendix

B1 Estimation Procedure of Currency and Sectoral Composition of External Debt

I employ a two-stage inference procedure to gauge the quarterly currency breakdown of external sovereign debt liabilities for each economy.[27]

In the first step, I construct foreign currency and US dollar denominated external debt issued by each sector as the sum of bonds issued in international capital market and i employ BIS International Debt Securities (IDS) data to directly measure bonds issued in international market and BIS Locational Banking Statistics (LBS) to measure cross-border loans to construct FC external debt and US dollar external debt measure. Following a similar method of Du and Schreger (2022), I calculate the FC and U.S. dollar denominated external sovereign debt across countries and over time.

$$D_{i,s,c,t} = IB_{i,s,c,t} + CBL_{i,s,c,t} \tag{12}$$

where D denotes total external debt, IB are debt securities issued in international markets,[28] DB are bonds issued in domestic markets held by foreigners, and CBL represents cross-border loans. For subscripts, i represents nationality of issuer. t denotes time. c denotes currency and in following analysis I consider three groups of currencies: USD, FC and LC. For sector s, I focus on the comparison between sovereign (general government) and corporate sector, and further disaggregate corporate sector into non-financial and financial corporates.

However, the challenge here is to measure domestically issued debt held by foreigners DB. I make a mild assumption that all foreign currency debt are issued in international market. Thus, in the second step, I employ the quarterly data of FC share of sovereign debt held by foreigners from 2000Q1 to 2022 Q4 from Arslanalp and Tsuda (2014) (updated June 2023) which is widely used in literarure (Lee (2024)) to get LC share of external sovereign debt

[27] Lane and Shambaugh (2010) estimate currency exposure of a country's international international balance sheet. They provide a decomposition of Wiriadinata (2018) estimate the dollar external debt of at the country level in a annual basis. They estimate Jiang et al. (2022) also rely on Coordinated Portfolio Investment Survey (CPIS) provided by IMF to construct cross-country portfolio holdings and apply the reallocation matrices from Coppola et al. (2021) to re-attribute portfolio holdings to their investor nationality as much as possible. IMF International Investment Position (IIP) report also provide currency and sector composition of external debts at a quarterly frequency. But the issues involved in this dataset are (1) the data are not available for some countries and years in sample; (2) IMF's Balance of Payment (BOP) and IIP dataset are both compiled on a residency basis. This residency-based statistics would vastly underestimate the investment positions from developed countries to firms in emerging market countries through debt issuances of offshore subsidiaries mostly shell companies in tax-heaven Coppola et al. (2021).

[28] International debt markets are defined as the markets where the securities are issued outside the local market of the country where the borrower resides. I assume all debt sercurities issued in international markets are held by foreign investors.

liabilities.[29] Table B1 summarizes how I construct our debt variables.

Table B1: **Calculations of currency composition of external sovereign debt**

Sector	Definition	Variable	Data source/Calculations
General Government	FC external debt	F	BIS LBS and IDS
	USD external debt	S	BIS LBS and IDS
	LC external debt	L	$L = D \times (1 - f)$
	Total external debt	D	$D = F/f$, IMF IIP
	FC share	f	AT2014
	USD share	s	$s = S/F \times f$
	LC share	l	$l = 1 - f$

B2 Global Dollar Cycle versus Global Financial Cycle

Day t is considered as an event when the one-day change in VIX is at the top 1% of the sample distribution. Dramatic increase in VIX could be viewed as a sudden increase in global investors' risk aversion which is exogenous to emerging market economies.

$$\text{First stage:} \quad \Delta x_t^{\$} = \alpha + \beta \Delta VIX_t + \varepsilon_t \tag{13}$$

$$\text{Second stage:} \quad \Delta^k \Psi_{i,t} = \gamma^k \widehat{\Delta x_t^{\$}} + \Gamma X_{i,t} + \alpha_i + \epsilon_{i,t} \tag{14}$$

where ΔVIX_t is percentage changes in VIX from day $t-1$ to day t and $\widehat{\Delta x_t^{\$}}$ is the fitted values of change in dollar convenience yield from first-stage regression.

B3 A Snapshot of COVID-19 Pandemic

As we can see from the Figure B2 that during distress, EM sovereign in an economy borrows more in dollar when its corporate sector is more indebted in dollar ex-ante.[30] I decompose corporate sector into non-financial and financial, and Figure B3 shows that larger currency mismatch on non-financial sector instead of financial sector corresponds to a stronger reaction of sovereigns' dollar borrowing during Covid crisis. We can also find the above positive correlation is driven by currency mismatch in the balance sheet of non-financial corporations.

[29] Wu (2020) counts all loans in LBS toward the private sector since loan to public sector is negligible.

[30] Fed provided dollar swap lines to G10 countries and four emerging economies: Brazil, Mexico, South Korea, and Singapore. Due to the risks associated with these swap lines, the Fed has been significantly more cautious in extending them to emerging economies compared to other developed nations.

Figure B1: **Relative Borrowing Costs of LC versus USD Around VIX Hikes. (Global Dollar Cycle versus Global Financial Cycle)**

This figure illustrates the estimated changes in relative borrowing cost of LC versus USD for emerging market sovereigns in response to a 1 bp VIX hikes. The coefficients of γ^k in $\Delta^k \Psi_{i,t} = \gamma^k \widehat{\Delta x_t^{\$}} + \Gamma X_{i,t} + \alpha_i + \epsilon_{i,t}$

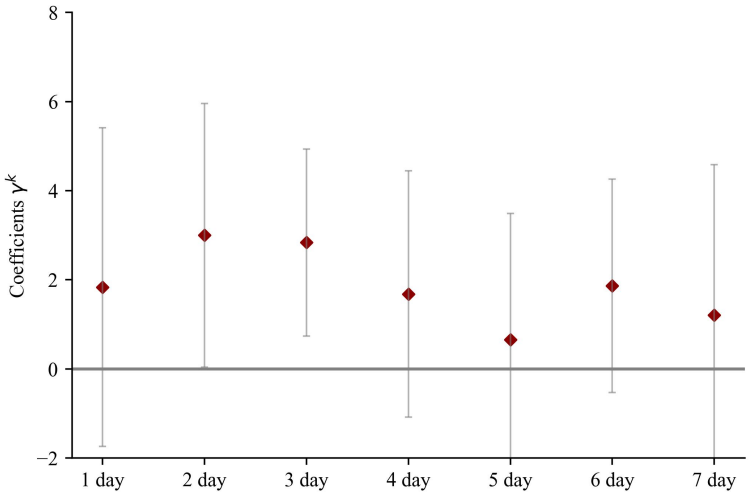


Figure B2: **Increase in USD external debt(% GDP) of EM sovereigns since Covid.**

This chart plots the increase in sovereign dollar debt as a percentage of GDP ratio from 2019Q4 to 2022Q3.

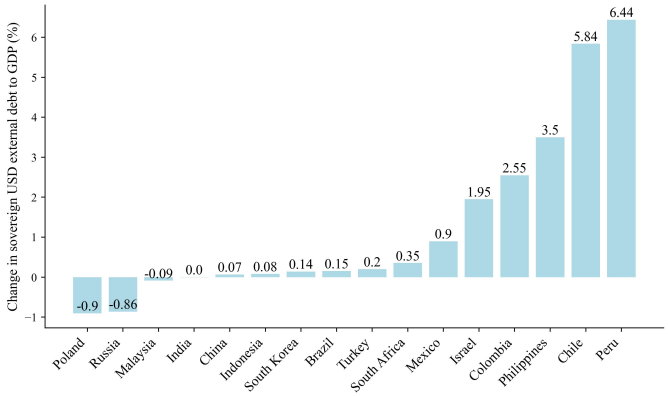


Figure B3: **Sovereigns' dollar debt accumulation and ex-ante corporate currency mismatch.**

This figure displays the change in USD debt-to-GDP of sovereigns from 2019Q4 to 2022Q3, and nonfinancial and fianncial corporate dollar debt-to-GDP ratio in 2019Q4 just prior to the Covid outbreak.

