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Trilemma revisited with dollar dominance in trade and finance

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Abstract

This paper explores the impact of the US dollar dominance on monetary and exchange rate policies in 51 advanced and developing countries from 1999 to 2021. We introduce a global exposure index to measure countries' dependence on the US dollar. Our study reveals that the dominant currency framework creates a global monetary cycle driven by the US dollar, exposing non-U.S. economies to the U.S. monetary policy. However, we show that countries can reduce their exposure to the U.S. monetary policy by accumulating reserves and intervening in foreign exchange.

JEL classification: F02, F37

Keywords: Dominant currency, Trade invoicing, foreign currency-denominated, Trilemma.

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The data supporting this study's findings are available from the corresponding author upon request.

1. Introduction

Trade and debt issuance, as well as financial transactions, are denominated in very few currencies (Reinhart et al., 2003; Gopinath, 2015; McCauley et al., 2015; Georgiadis and Mehl, 2016; Casas et al., 2016; Davis, 2016; Boz et al., 2017; European Central Bank, 2018; Aizenman et al., 2019; Ilzetzki et al., 2021). During the last decades, the use of international currencies, namely the US dollar, has increased, especially in terms of reserves and international securities (Efstathiou et al., 2018). The surge of financial globalization and cross-border financial links has deepened the dominant currency's influence[1], raising doubt about the Trilemma assumptions.

The Mundell-Fleming *Trilemma* is a well-known concept in international macroeconomics. It suggests that countries cannot simultaneously achieve: monetary independence, exchange rate stability (fixed or flexible), and financial integration. Therefore, they must choose only two of these objectives (for instance, a flexible exchange rate regime is necessary if a country aims for monetary independence and financial integration). However, this model's validity has been questioned in recent years due to new challenges in macroeconomics.

Rey (2015) released interrogations about the monetary autonomy of peripheral countries. Her work reveals a global cycle driven by the U.S. monetary policy (MoPo), which undermines the ability of floating economies, namely Emerging Markets Economies (EMEs), to undertake independent monetary policy. According to Rey (2015), U.S. monetary policy, through the global co-movement in assets, affects monetary policy in non-U.S. economies. In recent years, many have investigated whether a floating exchange rate still ensures monetary autonomy in highly open economies (Shambaugh, 2004; Aizenman et al., 2016, 2017; Nelson, 2017; Farhi and Werning, 2014; Caceres et al., 2016). Another strand of the literature underlined exchange rate interventions and currency manipulations in many economies with flexible exchange rate regimes. Calvo and Reinhart (2002) revealed a common practice of "fear of floating", especially in emerging market economies. They argued that *de jure floating* economies tend to keep their exchange within a fixed band/value to avoid unanticipated or significant depreciation. Georgiadis and Zhu (2021) showed that this fear-of-floating phenomenon is particularly pronounced in small open economies where foreign-currency exposures are more substantial. Levy-Yeyati et al. (2013) described a "fear of appreciation" instead. They argued that authorities' efforts to limit exchange rate appreciation are motivated by the neo-mercantilist view of a depreciated real exchange rate as protection for domestic industries. However, this is highly related to the dominance of a major currency, which increases countries' vulnerabilities to exchange rate fluctuations.

This paper investigates how dominant currency exposure (in trade and finance) affects the traditional Trilemma theoretical perspective. Our analysis enriches the recent and growing literature on the Dominant Currency Paradigm (DCP). It analyses how dollar dominance affects both the exchange rate policy and the monetary autonomy of non-U.S. economies. The paper finds supportive

[1]Gopinath (2015); Gopinath et al. (2020) refer to the dominance of the US dollar in the trade-price setting as the *Dominant Currency Paradigm*. The dollar's dominance in financial transactions is referred to as a *Dominant Currency Financing*.

evidence that the dominant currency leads to a global monetary policy cycle, where U.S. monetary policy is imported via exchange rate pass-through.

We examine the impact of the US dollar's dominance in global trade and finance on domestic exchange rates. We construct an index that summarizes economies' global (financial and trade) exposure to the US dollar. Our findings demonstrate a connection between the well-known "fear of floating" phenomenon and the US dollar's dominance. We then estimate countries' sensitivity to U.S. monetary policy using the Local Projection approach. The study examines how dollar dominance affects countries' exposure to U.S. monetary policy. Using the nonlinear Local Projection approach, our analysis emphasizes the nonlinearity effects of U.S. monetary policy spillovers.

The remainder of the paper is structured as follows. Section 2 discusses the US dollar's dominance in trade and finance. Section 3 explains the methodology used in the study. Section 4 examines how the dollar's dominance affects monetary and exchange rate policies and analyzes the Trilemma. In Section 5, we explore the asymmetry in the U.S. monetary policy spillovers. Finally, the last section concludes the paper.

2. Stylized facts

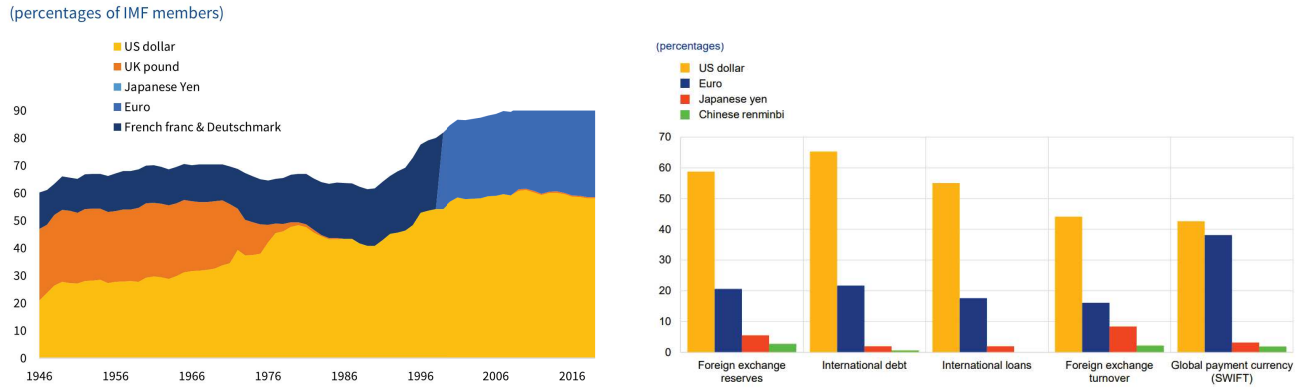
Since the Bretton Woods system collapsed in 1971, the US dollar has become increasingly important in international exchange. It has maintained its dominant position as the international currency, supported by the rise of global value chains, increased financial globalization, and strengthened cross-border financial integration.

Ito and McCauley (2019) and Tovar and Mohd Nor (2018) found that the dollar zone covers around 60% of the global economy. Ilzetzki et al. (2019) 's data confirm that the US dollar is the dominant anchor currency. It serves as an anchor for pegged countries and a soft anchor for most countries in a managed regime. The historical data show that most non-U.S. economies in a fixed regime are pegged against the US dollar. Figure 1a represents the share of countries managing their currencies against the US dollar and other international currencies. The US dollar remains the top choice as a soft anchor. Additionally, the graph shows that more countries have been managing their currencies in relation to the US dollar in recent years, indicating a rise in partial dollarization.

Recent and emerging literature highlights the US dollar's importance in international trade and finance. Gopinath (2015), Casas et al. (2016), and Boz et al. (2017) report that the majority of international trade transactions are mainly invoiced in the US dollar. Gopinath (2015) and Gopinath et al. (2020) find evidence that international prices are set and sticky in U.S. dollars (Dominant Currency Paradigm). Figure 2 confirms that the US dollar is the most used in exports and imports, namely in American and Asian emerging economies. However, the shares of US dollar invoicing in imports and exports are lower in the European economies, reflecting their preference for the Euro.

Figure 1b reveals the preeminent role of the US dollar in the international monetary system. It confirms that the US dollar plays an outstanding role in foreign exchange reserves and in public

Figure 1: Dollar dominance



(a) Share of soft anchoring

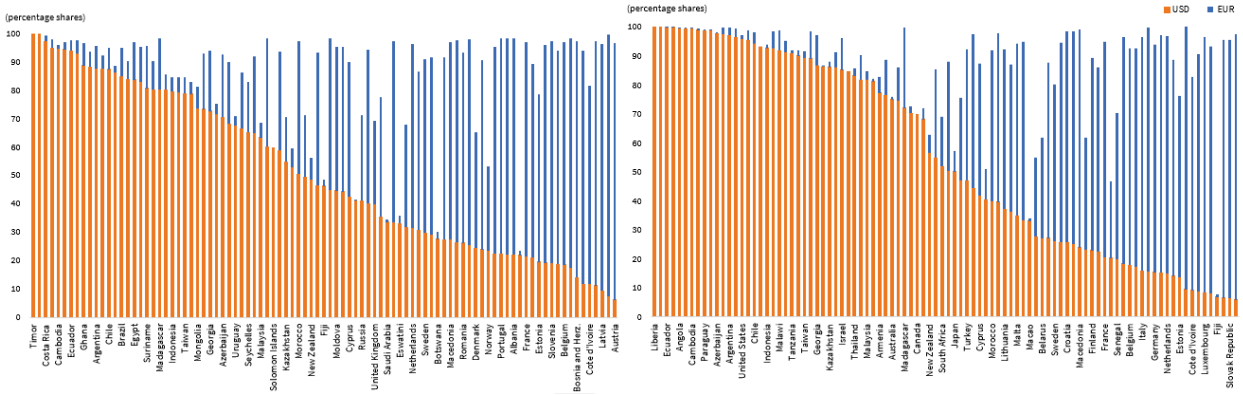
(b) International monetary system

Note: Figure 1a plots the evolution of the share of countries that manage their currencies relative to the international currencies. The US dollar has remained the main anchor currency.
Source: Ilzetzki et al. (2019), Author's calculations, European Central Bank (ECB) 21st annual review of the international role of the euro.

and private debt markets as a global currency. Moreover, the dominance of the US dollar in the international banking system has long been documented, hence the term "Dominant Financing." Indeed, international and foreign currency liabilities (and assets) are mainly denominated in the US dollar. Maggiori et al. (2020) provide evidence of the US dollar's dominance in financial asset denomination, namely in the corporate bond market. Indeed, firms (and some households) outside the United States borrow mainly in U.S. dollars. This trend is fueled by the dollar's broad international role in trade and investment and the need to hedge the currency exposures that arise from these activities (McCauley et al., 2015). Investors also aim to take benefit of interest rate differentials or currency movements.

These dominances have conferred to the US dollar and thus to the United States a central role in the global economic system. They led to a new perspective on traditional macroeconomic frameworks such as the Trilemma. Indeed, the dollar's dominance has several implications related to *de facto* exchange rate stability, currency manipulation, and impact on monetary policy autonomy, and thus to the traditional Trilemma. First, the pricing and financing dominance of the US dollar exposes economies' external balance sheets to movements in their exchange rates. Over the last decades, gross foreign assets and liabilities have substantially increased, reflecting a high degree of integration. The share of domestic assets (liabilities) denominated in foreign currencies has soared, increasing the domestic economies' net foreign currency exposure. The currency composition of countries' cross-border positions has become more important as exchange rate fluctuations can have a significant impact on their balance sheets (Berganza et al., 2004; Berganza and García Herrero, 2004; Georgiadis and Mehl, 2016; Wang, 2019). Balance sheet effects include the rise of Foreign Currency-denominated Debt (FCD) burden, valuation effects on the net foreign asset position,

Figure 2: Trade invoicing currencies

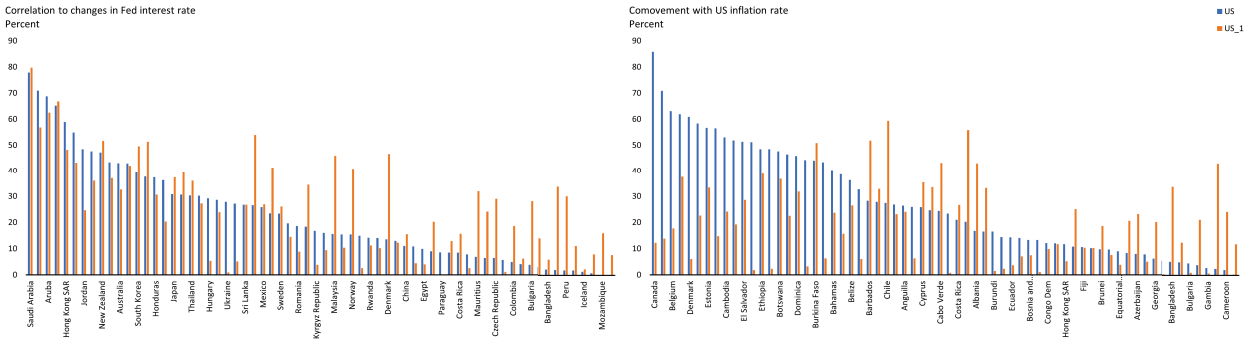


(a) Import invoicing (b) Export invoicing

Note: The figures display the average shares of the US dollar in import and export invoicing between 1990-2019.
Source: Ilzetzki et al. (2019), Author's calculations.

and financial constraints. Berganza et al. (2004) and Berganza and García Herrero (2004) prove that real exchange rate depreciation raises countries' risk through a balance sheet effect, namely in countries with significant financial imperfections. Indeed, if a country has a large amount of foreign-denominated debt, a local currency depreciation leads to an increase in the cost of credit and a contraction in economic activity. Using a New Keynesian Dynamic Stochastic General Equilibrium (DSGE) model, Meier et al. (2013) shows that monetary policy has more potent effects in economies with a net long in foreign currency.

Figure 3: Correlations between national variables and U.S. variables



(a) Comovement of interest rates (b) Comovement of inflation rates

Note: Panel 3a shows the aggregate correlation between the U.S. and non-U.S. economies' interest rates from 1999 to 2021. Panel 3b exhibits co-movement in U.S. and non-U.S. economies' inflation rates. "U.S._1" refers to the correlation with lagged U.S. variable.
Source: Author's calculations.

Second, the dominant currency may amplify the financial and real dependence (spillovers from U.S. policy) of non-U.S. economies. Rey (2015) reveals a global cycle driven by U.S. monetary policy, challenging the Trilemma view. Her finding suggests that the traditional Trilemma has morphed into a dilemma. Since then, several studies have explored the existence and the effect of a global financial cycle. Using data from 1999 to 2021, we compute the aggregate correlation between domestic and U.S. variables as an indicator of the co-movements (Figure 3). Despite a wide heterogeneity across countries, Figure 3 confirms a relatively strong co-movements between the U.S. variables and the rest of the World. These co-movements are consistent with a common global trend (also known as synchronized business cycles, rates' interdependence, or pass-through). Nonetheless, these correlations may also hide foreign-policy spillovers. The vehicle (international) currencies may amplify the magnitude of this synchronization or spillovers.

These stylized facts show dollar dominance has significant implications for non-U.S. economies. In the rest of the paper, we will demonstrate empirically how this dominance can influence other economies and thus constrain policymakers.

3. Empirical methodology

This section outlines the empirical methods used in this study. We describe our index of global exposure to the dollar and the approach used to analyze the impact of the dollar's dominance on exchange rates and monetary policies.

3.1. Global dependence index

We compute a composite index that evaluates global dependence on the US dollar. Our *Global dependence* index scores the importance of the US dollar for international transactions in each country. One can assess the use of a currency by considering the currency composition of reserves, financial claims, and trade invoicing. Nevertheless, due to constraints in data availability, we assess domestic dependence on the US dollar using the share of dollar invoicing in imports and exports, external assets and liabilities denominated in USD, external debt assets, and liabilities in USD. These shares represent the currency weight of the USD dollar in trade and finance.

In line with wide recognition in the literature of index construction, we utilize Principal Components Analysis (PCA). The method seeks linear combinations of the original variables ($X_j, j = 1 \dots p$) such that the derived variables (the principal components PC_k, $k = 1, \dots, p$) capture the maximum variance (summarize the maximum of the original information set). Our US dollar dependence index is set as the first principal component. Indeed, Appendix C shows that the first principal component captures much (83.7%) of the variation of the variables.

US dollar dominance and exchange rate policy

We examine the effects of dollar dominance (in trade, finance, and on a global scale) on exchange rate policy in non-pegged economies. We estimate an Ordinary Least Square (OLS) regression

(equation 1):

$$\mathrm{sd}_i = c + X_i + \epsilon_i \tag{1}$$

where sd_i is the average exchange rate volatility for country i. X is a measure of dollar dependence. It is either the share of the US dollar in import/export invoicing, the share of foreign assets/liabilities denominated in USD, or the global dominance in the USD index. The shares of imports/exports denominated in dollars are strongly correlated with the shares of assets and liabilities denominated in dollars. Hence, this regression introduces the variables separately to prevent multicollinearity issues.

3.2. US dollar dominance and monetary policy

This analysis estimates the response of domestic monetary policy to a tightening MoPo shock in the U.S. (in each country), applying the Local Projection approach as proposed by Jordà (2005). During the last decades, several studies such as those by Plagborg-Møller and Wolf (2019) and Olea and Plagborg-Møller (2020) have documented its validity and flexibility compared to the traditional Structural Vector Autoregressive (SVAR) model. The method allows a more parsimonious specification, avoiding the usual dynamic restrictions embedded in SVAR. It does not constrain the shape of the impulse response function, and confidence bands' computation does not require Monte Carlo simulations or asymptotic approximations. The approach estimates the dependent variable's response (i_t) at each horizon h using ordinary least squares regression. We estimate Equation 2 for each country:

$$\begin{aligned}\Delta i_{t+h} = \alpha_h + \beta_h \mathrm{shock}_t + \sum_{j=1}^{p} \theta_{jh} \Delta i_{t-j} + \sum_{j=1}^{p} \Phi_{jh} \Delta Z_{t-j} + \sum_{j=1}^{q} \gamma_{jh} \Delta VIX_{t-j} \\ + \gamma_h \Delta i^*_{t-1} + \delta_h Crisis_t + u_{t+h},\end{aligned} \tag{2}$$

where i is the domestic short-term interest rate, $shock_t$ is an exogenous U.S. monetary policy shock, and u_{t+h} is the error term. The horizon $h_{(h=1,2,...,H=8)}$ denotes the number of quarters after the shock. The exogenous U.S. monetary policy shock ($shock_t$) is identified using a monetary policy rule-based approach (see Appendix D for details). Z is a vector of domestic macroeconomic variables, including output growth and CPI inflation which capture the domestic real conditions. Following Dees et al. (2007) and Miranda-Agrippino and Rey (2020), we introduce the real effective exchange rate, as it provides a comprehensive measure of a country's currency competitiveness and external imbalances. We also include the global financial uncertainty measure (VIX) and oil prices to account for external conditions (Pesaran et al., 2007; Georgiadis, 2015). i^* denotes the Rest of the World (ROW)'s monetary policy (Equation 3). It is the cross-sectional sum of interest rate changes in the ROW's countries (except the U.S.), weighted by country-specific trade shares (Pesaran et al., 2004; Georgiadis, 2015):

$$\Delta i^*_{it} = \sum_{j=1,\ j \neq (i,\ U.S.)}^{N} w_{ij} \Delta i_{jt}, \tag{3}$$

where w_{ij} represents the bilateral trade share between country i and the counterpart j ($\sum_j w_{ij} = 1$). N is the number of countries in our sample. The foreign policy rate i^* captures the effect of the rest of the World[2] (excluding the U.S.) while avoiding issues related to the curse of dimensionality. The vector $Crisis$ is a dummy variable that equals 1 between 2009 and 2012 and between 2020 and 2021. It controls for the impact of the 2008-2009 global financial crisis, the 2010-2012 European Sovereign Debt Crisis, and the COVID-19 pandemic (2020-2021). The lag order p is selected by minimizing the Akaike Information Criterion (with lagmax = 4). β_h captures the response of the domestic interest rate at time $t+h$ to the U.S. MoPo surprise that happens at time t. The horizons considered are limited to two years after the initial shock ($H = 8$)[3].

Following Diebold and Yilmaz (2012) and Diebold and Yılmaz (2015), we compute a global spillover measure. The *Exposure to U.S. MoPo* is defined as the estimated global spillovers[4] from the U.S. MoPo surprise over the first eight quarters after the shock:

$$\text{Exposure to U.S. MoPo} = \sum_{h=1}^{8} |\beta_h| \tag{4}$$

More generally, the measure captures the domestic monetary policy's aggregate sensitivity to unexpected Fed policy rate variations.

US dollar dependence and monetary policy

We will now analyze how the dominance of the US dollar affects the monetary policies of non-U.S. economies. We examine the correlation between a country's reliance on the US dollar and its exposure to U.S. monetary policy. The analysis estimates a cross-country regression:

$$\text{Exposure to U.S. MoPo}_i = c + \text{USD dependence}_i + \epsilon_i \tag{5}$$

where "Exposure to U.S. MoPo" refers to the spillovers index that was determined using Equation 4. On the other hand, "USD dependence" pertains to the global exposure index, which was previously computed in section 3.1. This index measures a country's reliance on the US dollar and yields higher values for countries with a greater dependence on the US dollar.

[2]Several studies documented that trade is an equally important channel of transmission of monetary policy. Hence, other non-U.S. economies can influence domestic monetary policy, either because the country imports or exports substantial amounts of goods from them.

[3]The domestic policy rate's response to U.S. monetary policy shocks fades after two years. The results merely changed for $H = 12$ and $H = 16$

[4]We focus on the significant values of the estimated spillovers. β is set as missing when not significant. Indeed, when a coefficient is not statistically significant, it does not mean that the analyzed effect is null. It cannot be interpreted. Thus, we choose to set it as missing.

3.3. Asymmetries in the U.S. monetary policy spillovers

Recent literature consistently shows that countries are affected by the U.S. MoPo shock, regardless of their exchange rate regime. However, the stance of these spillovers varies across countries and over time, depending on each country's particular macroeconomic fundamentals, global macroeconomics, and financial conditions. Nevertheless, few studies have explored nonlinearities in the U.S. monetary policy spillovers.

This research aims to understand how the state of the global financial and macroeconomic system affects spillovers. Using nonlinear Local Projection (Auerbach and Gorodnichenko, 2012; Tenreyro and Thwaites, 2016; Ramey and Zubairy, 2018; Iacoviello and Navarro, 2019), we examine and compare U.S. monetary policy spillovers during periods of strengthening US dollar, large stocks of foreign reserves, and large foreign exchange interventions (Equation 6). For each country, we estimate:

$$\begin{aligned}\Delta i_{t+h} = \alpha_h + F(y_{t-1})\beta_{Lh}\text{shock}_t + (1 - F(y_{t-1}))\beta_{Hh}\text{shock}_t + \sum_{j=1}^{p}\Phi_{jh}\Delta z_{t-j} \\ + \sum_{j=1}^{p}\theta_{jh}\Delta i_{t-j} + \sum_{j=1}^{q}\Gamma_{jh}\Delta x_{t-j} + \gamma_h \Delta i^*_{t-1} + u_{t+h}\end{aligned} \tag{6}$$

where $F(x) =$ is a nonlinear smooth transformation function, set here as the logistic odds-ratio function (Auerbach and Gorodnichenko, 2013; Ramey and Zubairy, 2018; Iacoviello and Navarro, 2019). $F(y_t) = \frac{exp(-\gamma y_t)}{1+exp(-\gamma y_t)}$, with $\gamma > 0$. y indicates the state (low or high) of the variable of interest (broad US dollar index, the VIX index, the stock of foreign reserves, volume of Foreign Exchange Intervention (FXI)). y_t is the nonlinearity factor considered, standardized around its mean. Thus, the odds $F(y)$ can be interpreted as the probability that the considered measure (the broad US dollar index, the VIX index, the stock of foreign reserves, FXI) takes values below its average. $F(y)$ is higher for low values of y measures. And $(1 - F(y))$ gives higher odds (likelihood) to high values of y_t. β_H denotes the exposure during the period of high values of y, and β_L the exposure during the period of low values.

The analysis covers 51 economies, including 15 advanced countries, 34 emerging economies, and 2 low-income and developing countries (see Appendix A) from 1999 to 2021. Appendix B presents all data used and the applied transformation.

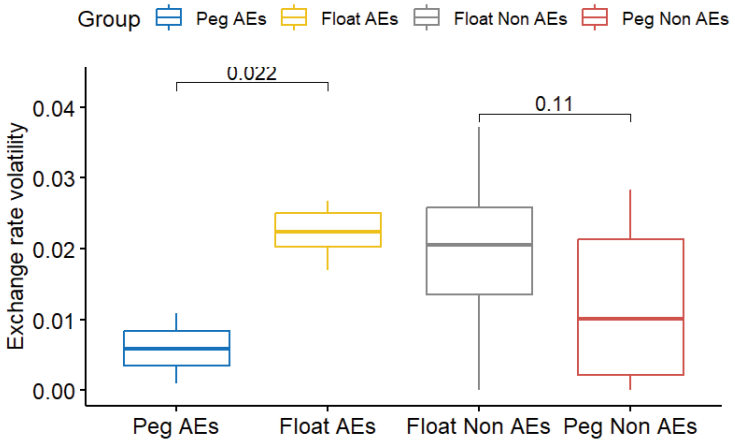
4. Dollar dominance and policy adjustments

This section explores three key topics related to the US dollar. Firstly, we look at its dominance in trade and finance. Secondly, we discuss the negative impact of dollar dominance on exchange rates. Lastly, we suggest a composite index to measure countries' reliance on the US dollar and analyze how this could affect their vulnerability to the Fed policy.

4.1. Dollar dependence and exchange rate policy

Over the past few decades, the role of the US dollar in global transactions has become increasingly essential due to globalization. Consequently, international trade, financial flows, and domestic sectors rely heavily on the US dollar exchange rate, making countries vulnerable to its fluctuations.

Figure 4: Bilateral exchange rate volatility across country groups.



Note: The Figure presents the results of the mean comparison test. It compares the average volatility of the bilateral exchange rates in self-declared pegged arrangements and those in floating arrangements. Official exchange rate regimes are based on the IMF'S Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).
Source: IMF AREAER, Author's calculations.

Using a non-parametric statistic test, Figure4 compares the average exchange rate (against the US dollar) volatility according to the exchange rate regime, and the country groups [5]. The average mean volatility during the considered period is larger and more volatile for Emerging and developing economies (non-AEs). The pairwise comparison p-value between the Pegged non-AEs and Float Non-AEs suggests a "fear of floating." The average exchange rate volatility amid the pegged economies is not statistically different from that of the economies in a floating regime. In a Dominant Currency context, the depreciation of the local currency vis-à-vis the US dollar increases import prices and widens the domestic output gap. This effect is more pronounced in countries with a significant share of imports invoiced in dollars (Boz et al., 2017; Gopinath et al., 2020). Moreover, the negative effect of depreciation is more substantial for countries with high foreign currency-denominated external debt. This is because domestic currency depreciation increases the repayment of foreign currency-denominated external debt, reducing fiscal space and depressing output growth. Consequently, exchange rate fluctuations are costly in the context of the dominant currency. These effects imply that dollar dominance may lead to the "fear of floating" phenomenon. In countries heavily dependent on the dollar, authorities may focus on stabilizing their exchange rates against the US dollar to support the domestic sector. This may lead to currency manipulation

[5] "Pegged" refers to the self-declared "pegged" with the US dollar as their anchor.

in open economies in the floating regime.

Table 2: Impact of U.S. Dollar in trade and finance on exchange rate volatility

	Dependent variable:			
	Dollar exchange rate volatility			
	(1)	(2)	(3)	(4)
Share of imports in USD	-0.015^{***}			
	(0.003)			
Share of exports in USD		-0.013^{***}		
		(0.003)		
Gross financial exposure			-0.022^{***}	
			(0.007)	
Net external USD debt assets				-0.010^{***}
				(0.003)
Constant	0.031^{***}	0.031^{***}	0.032^{***}	0.026^{***}
	(0.002)	(0.002)	(0.002)	(0.001)
Observations	56	58	37	37
R^2	0.256	0.279	0.199	0.214
Adjusted R^2	0.242	0.266	0.176	0.192

Note: *p<0.1; **p<0.05; ***p<0.01. Financial exposure denotes the absolute level of USD dependence in finance. It represents the sum of USD positions and short positions.
Source: Author's calculations.

In the context of a dominant currency, the "fear of floating" implies that the degree of dependence on the dollar would significantly affect the volatility of the exchange rate. This would result empirically in a decreasing relation between dependence and volatility variables. We regress the exchange rate volatility against dollar dependence (in trade, international financial transactions, and all transactions). Table 2 summarizes the impact of US dollar dominance in trade and finance on the exchange rate volatility in floating economies. Columns (1) and (2) report the effect of dollar invoicing in trade on the exchange rate volatility. The estimated coefficients are negative and significant for the share of domestic imports and exports invoiced in USD, suggesting that exchange rate volatility tends to be lower in countries with higher dollar invoicing in trade. Columns (3) and (4) display a negative and statistically significant correlation between dollar dominance in finance and exchange rate volatility. The estimated coefficients indicate that higher dollar exposures are linked with lower volatility in exchange rates.

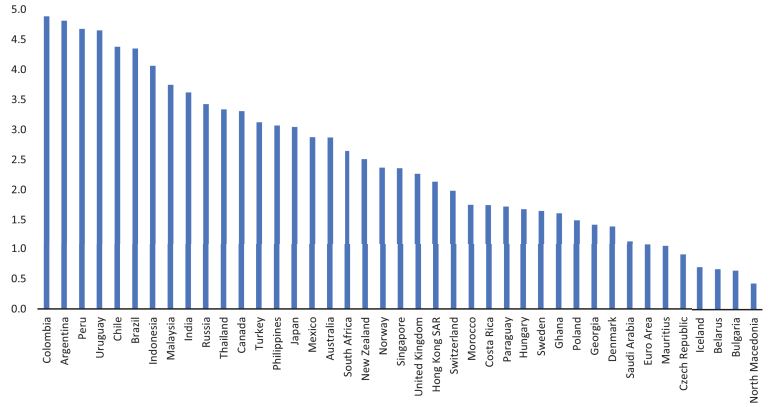
These findings imply that dollar reliance (exposure) is associated with low volatility in floating economies. Indeed, high shares of imports/exports invoiced in the US dollar and foreign assets/liabilities denominated in the USD increase the risk associated with the local currency's loss of value. In the case of sizeable domestic currency depreciation, unhedged financial liabilities denominated in USD (in banks and firms) increase, leading to a currency mismatch between assets and liabilities held in foreign currencies and those in domestic currency. Currency mismatch increases

financial fragilities and systemic banking crisis risk. In an economy highly dependent on the US dollar, the weakening of domestic currencies vis-à-vis the US dollar dampens investment and short-term trade gains. The fear of deflation/devaluation may thus result in central banks' intervention, even in a flexible exchange rate regime.

4.2. Global dependence index

This section discusses countries' dependence on the US dollar as an international currency in trade and finance. To measure the gross exposure to the US dollar, we compute a composite index using Principal Components Analysis based on financial claims and trade invoicing data (Appendix C). The index quantifies the dependence on the US dollar in trade and finance, with higher values indicating a greater reliance on the dollar.

Figure 5: US dollar dependence index



Note: The USD dependence index is computed as the first component of the "Principal Component Analysis" on USD shares in trade and finance. USD shares in trade are used when financial data are unavailable. Trade currency invoicing data are not available for Hong Kong SAR, Mexico, the Philippines, and Singapore. Therefore, the index summarizes the dependence on USD in finance.
Source: Boz et al. (2020); Bénétrix et al. (2020), Author's calculations.

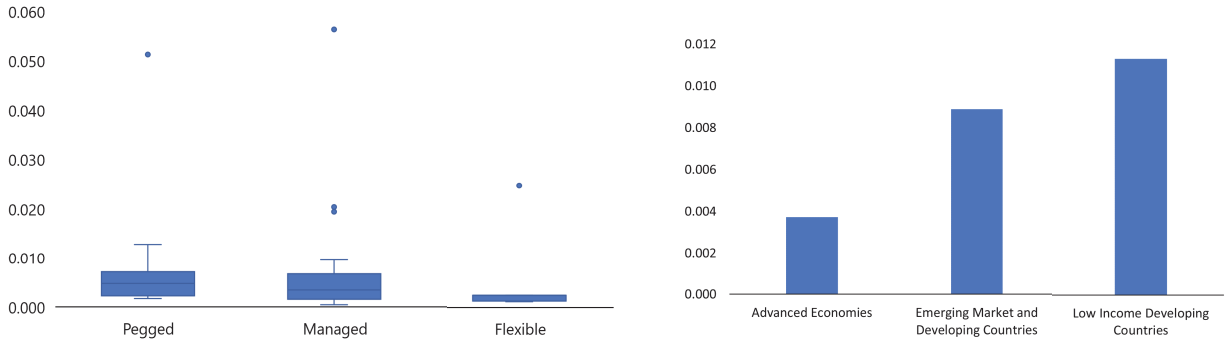
The US dollar is a strong substitute for many emerging markets, particularly those with unstable macroeconomic or political conditions and weak institutions. The trustworthiness and broad acceptance of the US dollar by international investors make it a refuge for governments, corporations, and residents in emerging and developing economies. The index displays large dependence in Latin American and Asian emerging markets, while European emerging countries have a lower dependence. However, Turkey and the Russian Federation are exceptions and are relatively dependent on the US dollar. This is due to their integration with the rest of the World and their unstable macroeconomic and political conditions.

In the next section, we will explore how countries' exposure to the Fed monetary policy varies depending on global and domestic factors.

4.3. US dollar dependence and monetary policy

This section analyzes how the tightening of U.S. monetary policy affects advanced and emerging non-U.S. economies. We determine each country's exposure to the U.S. monetary policy measure by the aggregate movement in domestic interest rates triggered by unexpected changes in the Fed's interest rates.

Figure 6: Global exposure to U.S. MoPo



(a) By *de facto* exchange rate arrangement (b) By country group

Note: The figures display monetary policy response to the Fed monetary tightening in non-U.S. The *de facto* exchange rate arrangements are classified based on Ilzetzki et al. (2019)'s classification. Countries that have a less flexible exchange rate regime (Pegged) and use a currency other than the US dollar as their anchor are classified as having a *de facto* intermediate exchange rate with the US dollar. Income groups are determined using the IMF classification.
Source: Author's calculations

Our findings support previous research and indicate that nearly all non-U.S. economies (advanced, emerging, or low-income) experience significant spillovers from the Fed's policy changes (Figure 6a and 6b), regardless of their exchange rate regime. Contrary to the traditional Trilemma view, countries with flexible exchange rate arrangements are also vulnerable to U.S. monetary policy shocks, which result in a loss of monetary autonomy. Nevertheless, emerging markets and economies with a pegged exchange rate arrangement tend to have larger exposures. A 25 basis point(bp) increase in U.S. monetary policy rate causes an average 86 bp shift in pegged economies' policy rates, compared to only 65 basis points in economies with a managed exchange rate arrangement. Countries with a flexible regime experience the lowest spillovers (50 basis points). Our results confirm that flexible exchange rate regimes do not fully protect against foreign (dominant) monetary policy shocks, but they do offer policymakers more flexibility than the pegged regime. Additionally, intermediary regimes, while ensuring low volatility and more flexibility than the pegged regime, also provide less exposure to the dominant monetary policy shock relative to the fixed exchange rate arrangement.

The exchange rate policy and macroeconomic framework of a country have a significant impact on its exposure to U.S. monetary policy surprises. Low-income and emerging countries are particularly vulnerable, with a positive 25bp shock to the Fed rate resulting in around 81 basis points

variations in emerging economies' monetary policy rates. In comparison, policy rates in advanced economies moved by only about 32 basis points during the first eight quarters after the shock. The degree of vulnerability is also affected by trade and financial linkages with the U.S. Table 3 shows that countries with a high dependence on the USD are more vulnerable to the Fed monetary policy. Emerging Latin American economies are particularly vulnerable due to their heavy reliance on the US dollar. On the other hand, European economies are less exposed to Fed monetary policy spillovers because of their greater dependence on the Euro.

Table 3: US dollar dominance and monetary policy spillovers

	Dependent variable: Exposure to U.S. MoPo		
Global USD dependence	0.003**		
	(0.001)		
Share of USD foreign assets		0.039***	
		(0.013)	
Share of USD foreign liabilities			0.064***
			(0.020)
Constant	−0.0003	−0.013*	−0.011*
	(0.004)	(0.008)	(0.006)
Observations	34	25	25
R^2	0.121	0.262	0.304
F Statistic	4.421** (df = 1; 32)	8.173*** (df = 1; 23)	10.069*** (df = 1; 23)

Note: *p<0.1; **p<0.05; ***p<0.01
Source: Author's calculations.

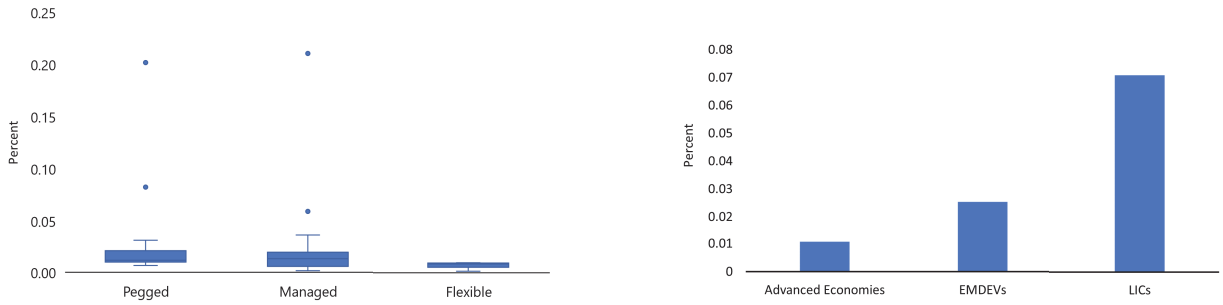
The next section investigates the consistency of the early findings.

4.4. Robustness analysis

In this section, we assess the impact of the Fed policy shock using an alternative shock. We consider the structural shocks identified by (Jarocinski, 2021) for the robustness analysis. Based on high-frequency data on financial market reactions to FOMC announcements, Jarocinski (2021) identifies four shocks: (i) a standard U.S. monetary policy shock, (ii) an (Odyssean) forward guidance shock, (iii) a long-term interest rate policy shock (associated with large-scale asset purchases), and (iv) a Delphic forward guidance shock. To align with the rest of the analysis, we consider the standard monetary policy shock. According to Jarocinski (2021), this shock increases the 2-year Treasury yield, depresses stock prices (SP500), and strengthens the US dollar.

We regress equation 2 with Jarocinski (2021)'s shock. Figures 7b and 7a present the results of the spillovers analysis. Echoing the previous section (section 4.3), the findings confirm that Fed monetary policy affects all countries, regardless of their exchange rate regime (Figure 7b and 7a). Using Jarocinski (2021), the evidence also points out more exposure in emerging Latin American economies.

Figure 7: Exposure to U.S. monetary policy: Jarocinski's shocks



(a) By *de facto* exchange rate arrangement (b) By country group

Note: The charts present the empirical results using Jarocinski (2021)'s monetary policy shock series from 1999Q1-2019Q2, as their series does not include data from the subsequent period.
Source: Jarocinski (2021); Author's calculations.

The following section will discuss the impact of dollar dominance on the Trilemma framework.

4.5. Trilemma in the context of Dominant Currency

The global financial landscape has evolved significantly over the past few decades, resulting in an interdependence among economies and a complex global financial network. This has challenged the traditional perspective on macroeconomics, including the three dimensions of the Mundell-Fleming Trilemma hypothesis. The traditional Trilemma (impossibility triangle) introduces a policy tradeoff between financial integration, monetary autonomy, and exchange rate stability. The Mundellian model assesses that a flexible exchange rate insulates economies from foreign shocks. However, evidence suggests that the dominance of the US dollar may cause non-U.S. economies to fear floating. A broader dollar dominance is associated with lower exchange rate volatility, as shown in Table 2.

Findings in section 4.3 reveal that larger dollar dominance increases non-U.S. economies' exposures to the Fed monetary policy (Table 3). A tightening of the Fed's monetary policy broadens interest rate spreads, causing the US dollar to appreciate against all the other currencies. As a result, returns on foreign assets, such as debt, increase, making emerging economies' debt less attractive and increasing dollar-borrowing costs. This can put pressure on public-sector finances and financial stability, especially in countries with weak domestic financial markets that rely heavily on foreign debt. High foreign indebtedness, low fiscal space, and a weaker local currency reduce investors' confidence in the countries' ability to repay their debts. This leads to a higher risk premium, significant capital outflows, and a considerable weakening of the local currency relative to the USD. Moreover, Gopinath et al. (2020) show that exchange rate pass-through is larger in countries with foreign-denominated trade. The authors document that the dominant currency limits the benefits of a weakening currency for export. Gopinath et al. (2020) reveal that the U.S. monetary policy tightening increases inflationary pressure and depresses trade and output growth in non-U.S. economies via the depreciation of their local currencies. To mitigate these effects,

central banks in countries with high levels of dollar-denominated debt and large dollar-invoiced trade must move their policy rates in line with the dominant monetary policy or prevent the local currency's depreciation through foreign exchange interventions. This suggests that the observed "loss of monetary autonomy" encompasses a co-movement due to common shock (e.g., COVID-19 pandemic), indirect response due to spillovers to the real economy (monetary autonomy), and voluntary relinquishment of monetary autonomy (structural lack of autonomy). The structural lack of autonomy occurs when policymakers *choose to* give up monetary autonomy to mitigate macroeconomic instability or financial stability risks or prevent sovereign debt distress. Emerging and developing economies' response to the Fed rate hikes in 2022-2023 is a stark example of the lack of monetary vs. monetary autonomy. Most emerging markets witnessed large capital outflows following U.S. monetary policy tightening. The induced depreciation in their domestic currency heights debt distress in EMDEVs with large external debts. Policymakers in most EMDEVs respond to the heightening balance sheet vulnerabilities, financial distress, increasing import bills, and inflationary pressure by tightening their monetary policy.

In conclusion, the Trilemma remains a relevant framework for understanding economies' policy choices and constraints. However, its restrictive policy framework fails to address the challenges caused by a dominant currency, such as the US dollar. The dominant currency framework (high US dollar dependence) creates a global monetary cycle driven by the US dollar, which makes non-U.S. economies vulnerable to U.S. monetary policy. Moreover, the prevalence of a single currency in trade invoicing and financial transactions raises financial and macro stability issues that the Trilemma's policy tradeoff does not cover.

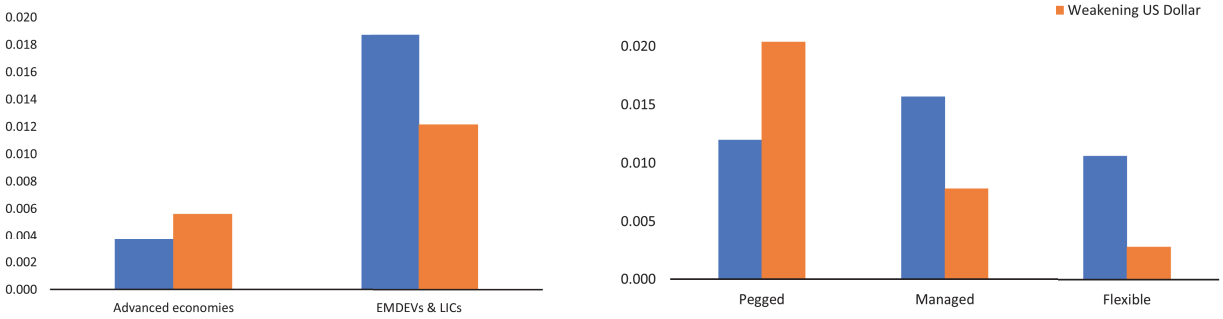
The following section will investigate how domestic and foreign factors affect countries' exposure to U.S. monetary policy and the Trilemma configuration's dynamic.

5. Nonlinear transmission of U.S. monetary policy

Since the 2008-2009 global financial crisis, the World economy has experienced several economic and financial shocks (i.e., the European sovereign debt crisis and the COVID-19 pandemic) with severe global contagion on financial markets, countries' real economies, and price development. These observations suggest that external transmission plays a significant role, particularly that fluctuations in the global economic and financial network influence the state of the economies. Similarly, countries' exposure to unexpected changes in the Fed's policy may depend on the domestic macroeconomic context (business cycles, inflation) and the global financial environment. This section explores spillover asymmetry relative to the US dollar stance, international liquidity, and the foreign exchange intervention stance.

The paper's primary hypothesis is that the US dollar's dominance creates a global cycle in both real and financial sectors driven by the US dollar. The research shows that the Fed's monetary policy transmission is supported by the US dollar's dominance in trade and financial transactions (Table 3). We examine how the US dollar stance affects U.S. monetary policy spillovers. We

Figure 8: US dollar and U.S. monetary policy transmission



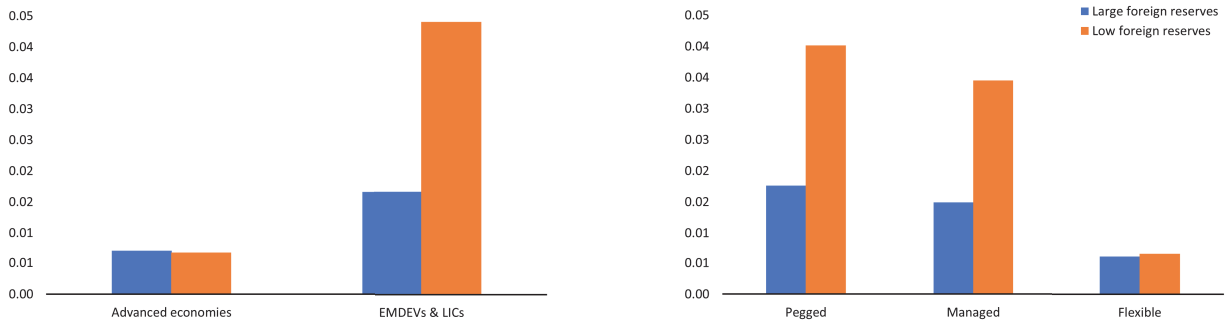
(a) By country group
Source: Author's calculations.

(b) By *de facto* exchange rate regime

consider the Federal Reserve Board trade-weighted nominal dollar index (FRB US dollar index). Higher growth of the FRB US dollar index denotes a global appreciation of the US dollar. The analysis reveals that U.S. monetary policy spillovers tend to be more prominent in emerging markets when the dollar is strong (Figure 8a). As observed in 2020-22, a stronger US dollar has significant macroeconomic (trade, financial, and social) implications for the rest of the World economy. The hiking of the US dollar raises inflationary pressures through higher import prices, resulting in current account imbalances. It also raises the value of domestic debt denominated in dollars, increasing debt sustainability risks in emerging and developing economies. A sharp depreciation of the local currency against the US dollar also heightens bank and nonbank financial intermediaries' (NBFI) vulnerabilities, intensifying financial stability risks. Additionally, a stronger US dollar is often associated with market turmoil and periods of extreme uncertainty. During these times, investors seek safe assets, mainly in dollars, leading to sudden-stop episodes in emerging markets and the depletion of foreign reserves. This further increases local currencies' depreciation against the USD, increasing funding costs, inflation, and current account deficit. Thus, monetary authorities may react to avoid overheating the economy or high inflation or recession. Hence, these exposures may not reflect a loss of monetary autonomy. Many policymakers followed the 2022 Fed monetary policy hiking cycle in an attempt to stabilize their currencies and alleviate external sector pressures.

Global conditions are not the only supportive factors to the Fed monetary policy transmission. Recent crises (i.e., the 2008-2009 global financial crisis, the 2020-2021 COVID-19 pandemic, and the effects of Russia's invasion of Ukraine) have emphasized the importance of international liquidity. Over the past years, foreign exchange reserves, primarily held in U.S. dollars, have been crucial for monetary policy in both pegged and flexible exchange rate regimes. Figures 9a and 9b reveal that the degree of international liquidity significantly impacts the domestic monetary policy exposure to U.S. monetary policy shocks. The figures suggest that monetary policy responses to U.S. monetary policy shock are higher when the stocks of foreign reserves are low. The dollarization of domestic banks in emerging and developing economies over the past decades has increased banks'

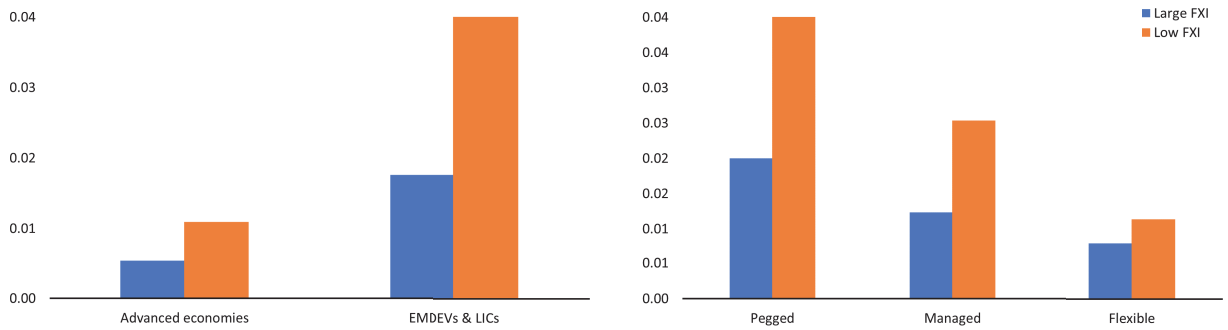
Figure 9: Reserves accumulation as a buffer against U.S. monetary policy spillovers



(a) By country group (b) By Exchange rate regime
Source: Author's calculations.

and financial systems' exposure to movements in the US dollar. However, the empirical results underline that large stocks of foreign reserves help dampen the costs of significant US dollar shocks and large capital outflows through foreign exchange interventions. As a result, large precautionary demand for US dollar reserves emerges as a self-insurance to sudden stops and the inflationary effect of depreciation. The empirical results confirm that large foreign reserve stocks ensure more room for domestic monetary policy. As shown in Figures 9a and 9b, the aggregate responses of domestic monetary policy to U.S. monetary policy shocks are low when the stocks of foreign reserves are large. This suggests that foreign exchange interventions can help dampen foreign monetary policy transmission and increase monetary policy autonomy in non-pegged economies (Figure 10). These findings echo the Quadrilemma assumption (Aizenman and Ito, 2011; Aizenman et al., 2017; Aizenman, 2019), which adds financial stability as the fourth dimension to the traditional Mundell-Fleming Trilemma.

Figure 10: Foreign exchange interventions help ease exposure to U.S. monetary policy



(a) By country group (b) By Exchange rate regime
Note: The analysis does not distinguish between "purchase" and "sale" intervention. We consider for this exercise the absolute volume of the foreign exchange intervention.
Source: Adler et al. (2021), Author's calculations.

The results indicate that policymakers' choices extend beyond the Trilemma model's evaluation

of exchange rate stability versus financial integration. They demonstrate the significance of both domestic and international macroeconomic conditions and emphasize the necessity of having flexible and appropriate policy tools.

Conclusion

The dominance of the U.S. in the international financial system and the spillovers of its monetary policy is a well-documented fact. Recent literature on the dollar's prevalence in trade and finance underscores the need for a better understanding of how it affects other economies and how they can insulate themselves from spillovers. Effective regulatory actions require a grasp of the driving forces behind spillovers and how reliance on the US dollar affects monetary policy in other countries.

This study examines how the US dollar's dominance in trade and finance can impact other countries and their policies, especially foreign exchange and monetary policies. We show that the dollar's dominance can lead to a fear of floating, which can result in currency manipulation. Our results confirm that U.S. monetary policy shocks affect non-U.S. economies regardless of their exchange rate regime. Emerging and developing economies tend to have more significant responses than advanced economies. During periods of US dollar appreciation, exposure to U.S. monetary policy shocks is particularly pronounced in emerging markets, reflecting large dollar dependence. Our analysis of the dominant currency incidence suggests that the level of exposure to U.S. monetary policy in non-U.S. economies is positively associated with the degree of dollar dependence. As a result, policymakers in heavily dollar-dependent economies are more likely to follow U.S. monetary policy to mitigate the adverse effects of their local currency's depreciation. However, large amounts of foreign reserves accumulation can reduce emerging economies' vulnerabilities to U.S. monetary policy.

We conclude that pricing and financing in the dominant currency are key drivers of spillovers. The dominance of the US dollar creates a global real and financial cycle driven by movements in the US dollar. Therefore, the Federal Reserve's policies affect the rest of the World's economies and their activities through their effects on the US dollar. Unlike Trilemma's assumptions, domestic policies may need to be adjusted in response to U.S. monetary policy movements to maintain macroeconomic stability. The analysis underlines that foreign exchange interventions can help mitigate the impact of spillovers. The traditional Trilemma fails to assess countries' current macroeconomic challenges and tradeoffs. The model as proposed is restrained to a narrow framework in which countries choose between only three policies. Our study underlines the need for a broader and more flexible policy framework.

Our paper focuses on the dominant currency paradigm, but future research could explore how digital innovations, cryptocurrencies, and international payments might affect the US dollar's dominance and its impact on non-U.S. economies.

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Appendix

Appendix A. Countries

Advanced Economies		EMDEVs			LICs
Australia	South Korea	Argentina	India	Romania	Ghana
Canada	Sweden	Belarus	Indonesia	Russia	Honduras
Czech Republic	Switzerland	Bolivia	Jordan	Saudi Arabia	
Denmark	United Kingdom	Brazil	Malaysia	Serbia	
Euro Area		Bulgaria	Mauritius	South Africa	
Hong Kong SAR		Chile	Mexico	Thailand	
Iceland		China	Morocco	Turkey	
Japan		Colombia	North Macedonia	Ukraine	
New Zealand		Costa Rica	Paraguay	Uruguay	
Norway		Dominican Rep.	Peru	Venezuela	
Singapore		Georgia	Philippines		
South Korea		Hungary	Poland		

Note: The sample consists of countries for which quarterly data are available for the short-term interest rate, GDP, inflation, and real effective exchange rate variables from 1999-2021. The country grouping follows the FUND. (2023)'s classification.

Appendix B. Variables and transformation

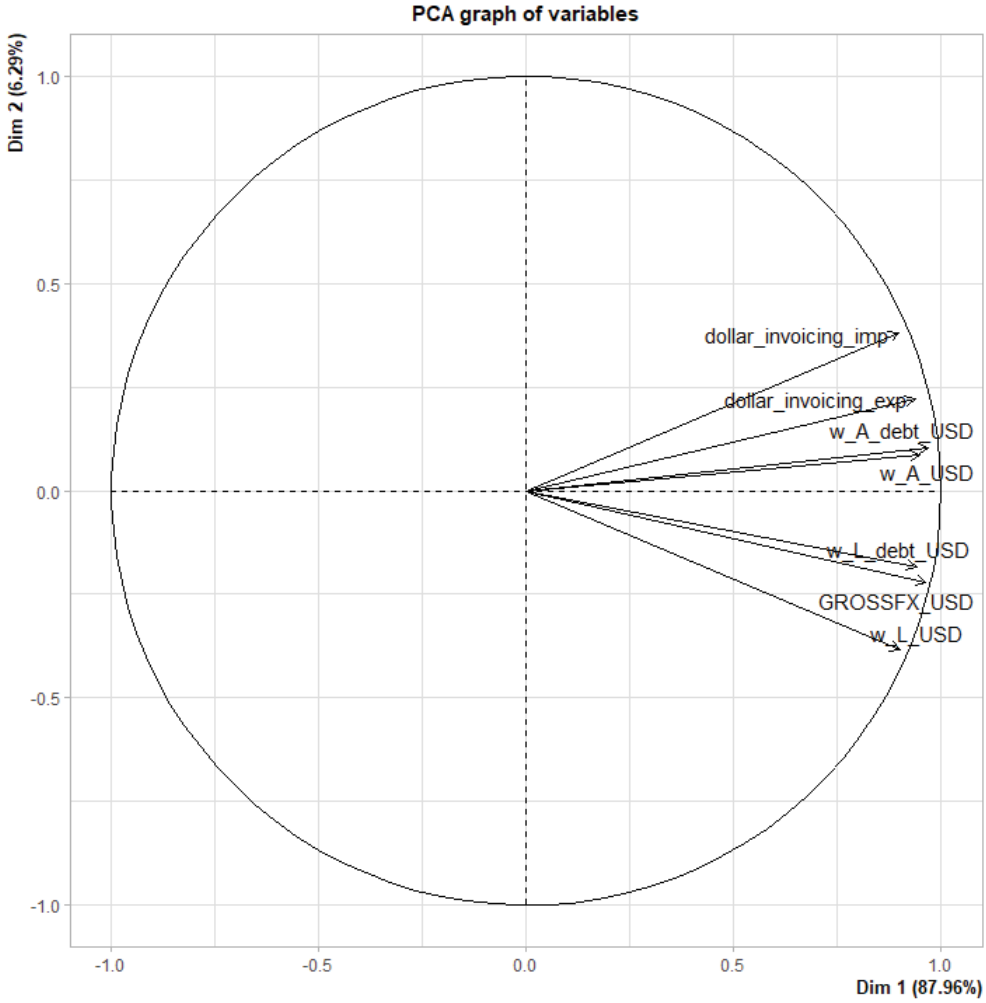
Variable	Source	Transformation
Real Gross Domestic Product	Haver Analytics	Log first difference
Foreign currency reserves	Haver Analytics	Log first difference
Real effective exchange rate	Darvas (2012) and Darvas (2021)	Log first difference
Short term interest rates	Haver Analytics	First difference
Consumer Price Index	IMF IFS	Log first difference
Nominal Broad U.S. Dollar Index	Fred database	
CBOE VIX	Fred database	
Trade invoicing data	Gopinath (2015) and Boz et al. (2020)	
Financial exposure data	Bénétrix et al. (2020)	
Foreign exchange intervention data	Adler et al. (2021)	

Appendix C. USD dependence index

The US dollar dependence index measures how much a country relies on the US dollar in trade and finance. This helps determine how sensitive a country is to sudden changes in the exchange rate between its domestic currency and the US dollar. The aggregate dependence on a dominant currency is determined by the shares of assets and liabilities (domestic and foreign)

that are denominated in that currency, as well as the currency composition of reserves and trade invoicing. Our dependence index combines all of these factors into a single metric that provides a comprehensive understanding of a country's reliance on the USD.

Figure A1: Principal Component Analysis: Variable factor map



Note: w_A_USD = share of foreign assets (derivatives excluded) in USD; w_L_USD = share of foreign liabilities (derivatives excluded) in USD; w_A_debt_USD = share of debt assets (derivatives excluded) in USD; w_L_debt_USD = share of debt liabilities (derivatives excluded) in USD; GROSSFX_USD = Gross exposure to USD; dollar_invoicing_exp = share of exports denominated in USD; dollar_invoicing_imp = share of imports denominated in USD.
Source: Boz et al. (2020); Bénétrix et al. (2020); Author's calculations.

Figure A1 shows how each variable contributes to the principal components and the variance of each component. The first two components account for 92% of the initial dataset, with the first component summarizing about 84% of the original information. The first principal component is the *global dependence index*. As shown in Figure A1, each input variable contributes positively to

the first component: higher values of the variables increase the countries' reliance on the US dollar.

Appendix D. Monetary policy shock

The main challenge when assessing the impact of U.S. monetary policy is the identification of U.S. monetary shocks. This paper uses a monetary policy rule-based approach to identify U.S. monetary policy shocks. Following Romer and Romer (2004), Iacoviello and Navarro (2019), and Brandao-Marques et al. (2020), we estimate the U.S. monetary policy shock as policy rate changes that are not responses to the behavior of the economy:

$$r_{U.S.,t} = \alpha_0 + \beta X_{U.S.,t} + v_t$$

where $r_{U.S.,t}$ is the Federal funds rate. The Federal funds rate ($r_{U.S.,t}$) is replaced with Wu and Xia (2016)'s shadow rate during the zero lower bound periods (2009 to 2015 and 2020 to 2021) to account for unconventional monetary policy. The control variables ($X_{U.S.}$) include contemporaneous and lagged values of the real activity indicators, the price level, financial conditions, and a stock price index. The real activity and price level indicators include domestic output, consumer price index (CPI), 12-month inflation forecast, industrial production index, unemployment rate, and commodity prices (oil and metal). We introduce the nominal effective exchange rate as well. The financial indicators include total nonperforming loans, U.S. long-term interest rates, and corporate spread (the difference between Moody's seasoned Baa corporate bond yield and 10-Year Treasury Constant Maturity). The right-hand side of the equation also includes the VIX index and Euro Area, United Kingdom, and Japan 10-year bonds to account for global financial conditions.

The specified equation with contemporaneous and lagged variables is analogous to a Cholesky identification in a VAR that orders the Fed rate last (Iacoviello and Navarro, 2019). The residual of this regression is the realization of innovations to the U.S. monetary policy rate that is orthogonal to the considered macroeconomic and financial variables and the own lag of the Federal Funds rate. We consider these residuals as a proxy for U.S. unanticipated monetary policy shocks.