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ABSTRACT

The share of US dollar assets in the official foreign exchange reserve portfolios of central banks, at times, is taken as an indicator of the dollar's global status. We provide a decomposition that shows two distinct channels contributing to the changes in the dollar share of reserves aggregated across countries: shifts in preferences for dollar assets, and changes in reserve balances driven by countries whose portfolio allocations differ from the aggregate. We document how the concentrated nature of foreign exchange reserve holdings allows countries that contribute a large share of aggregated reserves to exert substantial influence on aggregate dollar shares over time, potentially dominating the narrative. In recent periods, the key contributors to changes in aggregate preference shifts for dollar assets are changes in bilateral country trade with the United States and dollar debt share, with geopolitics additionally working through the investment tranches of central bank portfolios. Diversification away from dollar assets is more prevalent conditional on official reserves of countries being large enough to satisfy country liquidity needs.

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1. Introduction

Much attention has been focused on the potential loss of status of the US dollar as the world's primary reserve currency. This issue is important, as the US dollar plays many roles in international finance and trade.[1] Dollar use is prevalent in invoicing and pricing international trade transactions, and in denominating international debt issuance. The dollar continues to be widely used as the currency of international transactions, with large shares of dollar currency in circulation abroad, dominating global foreign exchange transactions worldwide, and as the main currency in a robust payments infrastructure (Bank for International Settlements, 2025).[2] US dollar assets, including Treasuries, are widely regarded as liquid and safe assets and held broadly in portfolios of domestic and foreign investors. The dollar remains the most used currency in both *de jure* and *de facto* currency pegs and in the foreign exchange reserves of central banks (International Monetary Fund, 2023; Ilzetzki et al., 2019; ECB, 2023).

Central banks hold official foreign exchange reserve portfolios, in part, to meet precautionary liquidity needs and stabilize their currencies in stress periods or in a managed or pegged exchange rate regime. The reserve adequacy considerations for emerging markets often incorporate the potential need to finance foreign currency imports over some horizon (e.g. three months) and to have sufficient liquidity to cover short-term payments on external debt.[3] For advanced economies, considerations include patterns of movements in flexible exchange rates, the potential use of foreign exchange reserves for smoothing strains against key reference currencies in foreign exchange markets, and the potential scale of funds needed relative to carry costs (Goldberg, Hull and Stein, 2013).[4] After the Global Financial Crisis, additional considerations include access to foreign currency swap lines and repo facilities of other central banks (Bahaj et al., 2024).

The IMF collects information on total foreign exchange reserve holdings from across 147 member countries, with data showing that the total stocks of official reserves in aggregate grew steeply after the Global Financial Crisis, shown in Figure 1(a). Over time, an increasing number of these countries also provided the IMF with information on the currency composition of their reserves assets. The coverage of allocated reserve levels was particularly strong after the inclusion of China's composition in the reported aggregates in 2015 and 2016 as shown in Figure 1(a). The

[1] See discussions in ECB (2023) and Goldberg, Lerman and Reichgott (2022).

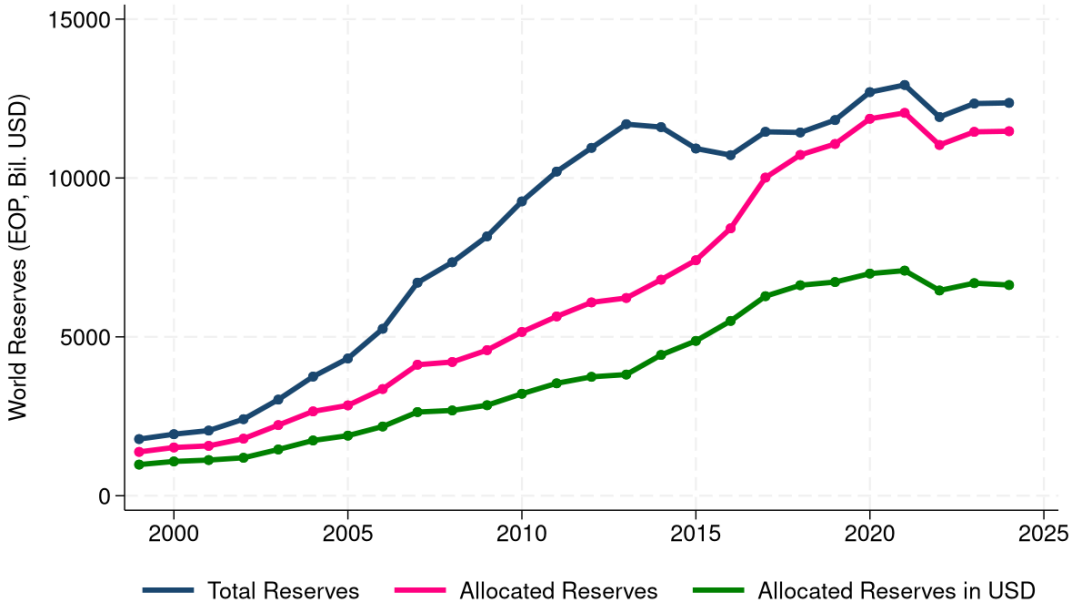
[2] US-owned Clearing House International Payment System (CHIPS) clears and settles $1.8 trillion in domestic and international payments per day. FedWire, operated by the Federal Reserve System, supports global dollar wire transfers amounting to nearly $4 trillion daily. (TheClearingHouse, 2023)

[3] References include International Monetary Fund (2016), Aizenman and Riera-Crichton (2008), Aizenman, Cheung and Qian (2020), Bussière, Cheng, Chinn and Lisack (2015), and Jeanne and Rancière (2011).

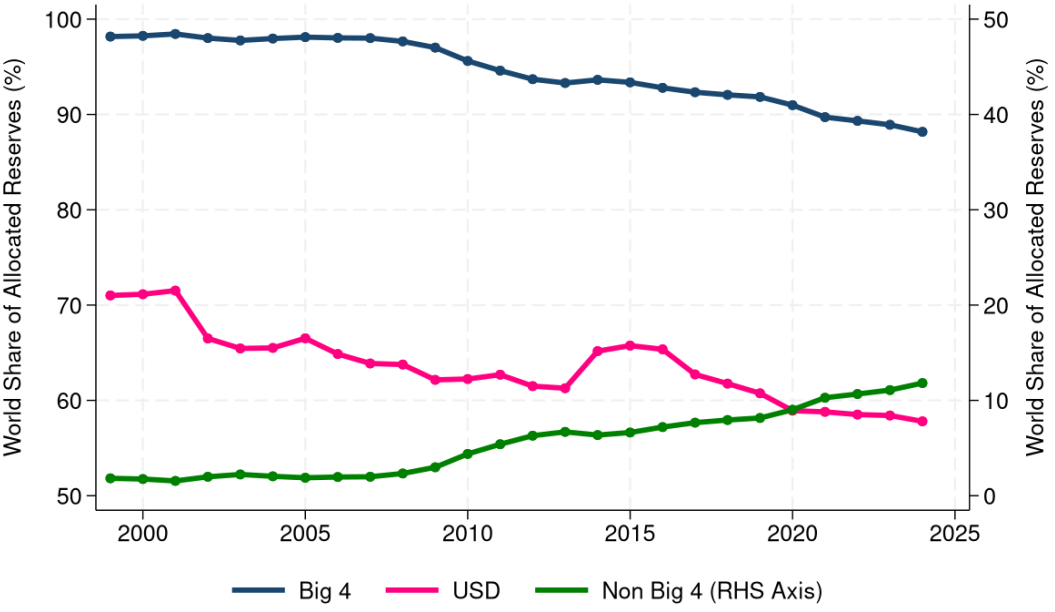
[4] Consistent with the recent literature focused on the global factor in international asset prices and exchange market pressure indices, US monetary policy and risk sentiment are among the most important components (Miranda-Agrippino and Rey, 2020; Goldberg and Krogstrup, 2023; Goldberg, 2024).

Figure 1: Global Foreign Exchange Reserves Over Time

(a) FX Reserve Levels (Billions USD)



(b) IMF COFER Currency Shares (Percentage)



Big 4 currencies include USD, JPY, EUR, and GBP. COFER data covers 149 reporting countries and presents aggregated currency shares across total allocated reserves. In Figure 1(b), the world share of allocated reserves is shown for Big 4 currencies and USD by the left axis, and for Non Big 4 currencies by the right axis. Source: Author's construction using IMF COFER year-end values.

Currency Composition of Official Exchange Reserves (COFER) data published by the International Monetary Fund (IMF), using allocated reserves and based on the reporting countries in each period, suggests the dollar share of official foreign exchange reserves fell from a peak of over 70% of global official foreign exchange reserves in the late 1990s to closer to 60 percent by 2020, as shown in Figure 1(b). This dollar share decline accounts for much of the aggregate decline in the role of the big four currencies– the dollar, yen, euro and pound– over the longer time frame. Meanwhile, the share of nontraditional currencies rose to about 10 percent of reserves.[5]

Narratives around the dollar role's actual or pending declines have varied over time, alternatively emphasizing the introduction and rise of the euro after 2000, the increased size of China in the global economy, the IMF's granting of reserve currency status to the Chinese yuan in 2015, global shifts in international trade patterns, the uncertainty associated with trade policy during the first Trump presidency of the United States, or geopolitical reactions fueled by the Russian war with Ukraine and the resulting imposition of international financial sanctions. Counter-arguments in support of the dollar maintaining its international status emphasize the continued high dollar use in international trade invoicing, synergies across different international roles, the continued liquidity and relative safety of US official assets, persistent convenience yields, and global demand by private and official sector participants, including in periods of elevated risk sensitivity and uncertainty.

How should the changes in the dollar share of central bank reserves across an aggregate of countries be understood? We start by introducing an exact mathematical decomposition of the sources of the global foreign exchange reserve portfolio evolution, providing a clear distinction between the channels working through shares of dollar assets and through the sizes of individual country reserve portfolios. The share change in an aggregate is an exact sum, aggregated across countries, of portfolio preference changes by countries, weighted by country reserve size, and of reserve balance changes, weighted by the ex ante portfolio composition of country reserves relative to the ex ante aggregate share of dollars.This latter component emphasizes that the aggregate statistics are not driven exclusively by changes in country preferences, and leaves open the importance of factors agnostic to country-level dollar preferences that drive overall reserve accumulation or reductions by central banks.

[5]Initially IMF reporting covered shares of the aggregate in USD, GBP, euro, yen, and other currencies. Starting in 2012Q4, COFER separately identified the Australian dollar and the Canadian dollar; starting in 2016Q4, COFER separately identified the Chinese renminbi. Arslanalp et al. (2022) show that, in 2020, the Australian Dollar, Canadian Dollar, Chinese Renminbi, and Swiss Franc together accounted for about three-quarters of the composition not accounted for by the USD, GBP, euro, and yen. Arslanalp et al. (2022) argue that there has been a gradual movement away from the dollar, a modest rise in the role of the renminbi, and changes in market liquidity, relative returns, and reserve management that have made nontraditional reserve currencies more attractive.

As COFER data for individual countries is strictly confidential, we show insights from this decomposition using available data on the dollar share of reserves. We extend, but rely heavily on, the databases of Ito and McCauley (2020); Chinn et al. (2022) and Arslanalp et al. (2022). For a set of 72 countries representing the majority of allocated foreign exchange reserves during the period we examine, our illustration provides a clear and interpretable decomposition of the drivers of an aggregate dollar reserve decline from 2015 to 2020 - a period when the available data coverage is most comprehensive.

To provide broader insights into the drivers of portfolio allocation changes across this aggregate, we use an empirical approach that builds on the standard linear probability regression model contained in the prior literature by including considerations of portfolio investment tranches, relative return differentials, and geopolitical considerations. We then extend this approach to a weighted setting to understand the contributions of drivers at an aggregate level. The weighted setting is particularly informative given the high concentration of total official reserves in a relatively small number of countries. China, for example, held over 25 percent of total official reserves in 2023; 90 percent of the countries together contribute less than a quarter of total official reserves. We complement the weighted estimates using Shapley-Owen values for each regressor to help inform the contributions of economic, financial, and geopolitical forces that drove changes in the preferences for dollars as reflected in compositions of international portfolios.

Examining the countries for which we can observe portfolio composition since 2015 – which account for two-thirds of the world's total reserves and 90 percent of allocated reserves – the first key empirical result we document is that the declining dollar shares in an aggregate across countries is due to a combination of both the portfolio composition channel and the reserve change channel. Within the portfolio composition channel, we show that a small group of countries account for a large part of the aggregate effect, with a particular role for Russia, India and China reducing dollar share of portfolios. We find that the dollar share moved in different directions across countries, in some cases rising, in others falling, and sometimes rising over time after declining. Based on a group of 69 countries for which we observe portfolio preferences for dollar assets between 2015 and 2020, a time when COFER dollar shares fell by 6.8 percentage points, the contribution of the portfolio composition channel to a weighted aggregate is basically a wash.

For the aforementioned sample of countries, we find that a substantial component of the change in the aggregate dollar share over the 2015 to 2020 period came from changes in total reserve levels by countries, interacted with their ex ante portfolio preferences that differed from the aggregate. We observe a strong contribution of Switzerland, which had a significantly lower than aggregate initial dollar share of reserves and experienced strong reserve accumulation during this period.

Our extension of the empirical literature on currency shares in official foreign exchange portfolios is used to inform the forces contributing to country preference changes for dollar portfolio shares. The prior literature on portfolio allocations established that the primary drivers of dollar share include debt denomination, direction of trade by country, proximity to the euro area, and exchange rate regimes. Our specifications also include relative returns on different currencies and geopolitical considerations proxied by measures of country alignment with the United States in United Nations voting (Voeten, 2009), or with financial sanctions being levied by the United States (Felbermayr et al., 2020). We also separate the effects across liquidity and investment tranches of central bank portfolios.

We find that the relative returns on currencies play a statistically significant but quantitatively small role in tilting the composition of overall portfolios, whether defined in terms of key reserve currencies or nontraditional reserve currencies. US dollar shares in portfolios are lower, and roles of nontraditional currencies higher, when the investment tranche share of a portfolio (calculated using short term debt) is larger. On the margin, portfolio composition tilts away from dollars when returns on nontraditional currencies or euros are higher. Our tests do not find significant differences in this dynamic during low or zero lower bound US dollar rate periods.

We find that low geopolitical alignment of a country with the US based on UN voting does not, in general, imply a lower US dollar share in official reserve portfolios. Indeed, countries with lower voting with the US (or subject to financial sanctions) are more likely to have a higher US dollar share in official reserve portfolios, all else equal. However, this relationship is nuanced. A country's low voting alignment with the US reduces the US dollar share of portfolios *after* countries have high enough stocks of reserves to meet their liquidity needs around short term external debt positions and when the investment tranches of their portfolios are larger.

Within our data, what factors significantly contributed to the documented decline in the dollar share of aggregated reserves for the 2015 to 2020 period? Using a linear probability model extended to a weighted setting and Shapley-Owen values to consider the explanatory power of each regressor, we find that changes in key macroeconomic variables of trade exposure to the US and EU, and dollar debt shares were large contributors. Some of these variables evolved differently for countries with low geopolitical alignment with the US. Over 2015 through 2020, these countries were more likely to reduce trade shares with the the US, but also more likely to increase the share of their debt denominated in US dollars. While the majority of countries increased their investment tranche shares over this period, the low alignment countries were less likely to do so. Downward pressure on the aggregate dollar share is concentrated in a few countries that are in the low geopolitical alignment group, including China, India, and Russia. Among other countries, the evidence is mixed about the direction of dollar share changes. Among

these countries the reserves quantity channel dominates effects on the aggregate dollar share.

Taken together, this evidence provides a different interpretation of the declining dollar share in global official reserves than implied by a narrative of a retreat from dollars in the international monetary system.The data available for this period demonstrate a mixture of countries increasing and decreasing the dollar shares of their reserve portfolios. Reserve accumulation by countries that tend to have ex ante lower dollar shares in their portfolios, more trade with countries other than the US, and, in some cases, geopolitical distance from the United States all tend to reduce dollar share in country portfolios and in the aggregate. However, additional direct geopolitical considerations may be material mainly for countries with already large enough reserves to cover their precautionary liquidity needs. The strong concentration of global foreign exchange reserves across countries provides an environment in which a small number of countries have the potential to play a disproportionately large role in shaping a constructed aggregate.

Our work contributes to a rich set of literature that focuses on the structure of the international monetary system, the international roles of the dollar, the safe haven properties and convenience yields properties of assets, and on the contributions of geoeconomics and geofragmentation.

The broader literature has been developing theory and empirics on the international roles of currencies in trade and financial transactions. Work on invoice currency use in international trade transactions (e.g., Goldberg and Tille, 2008, 2009; Gopinath and Itskhoki, 2010; Gopinath et al., 2010; Ito and Chinn, 2015; ECB, 2023; Boz et al., 2022) shows that invoicing selection is associated with the choice of currency in which goods are priced and tied to rigidities and at least short run exchange rate pass through elasticities. De Gregorio, García, Luttini and Rojas (2024) finds distinct supply dynamics over longer time horizons in Chilean production. Regardless, synergies exist across roles, with the choice of currency in debt denomination and imported input denomination tied directly to producer choices of currencies for optimal invoicing. Synergies between currency use in banking and trade activities, for example, could work through currency use as safe stores of value (Gopinath and Stein, 2021). New evidence shows the currency composition and particularly dollars for international financial transactions in lending by global banks in fund portfolios (Aldasoro and Ehlers, 2018)[6] and demonstrates a contribution of the role of asset liquidity in the currency composition of debt choice (Coppola, Krishnamurthy and Xu, 2023).

Empirical analyses on official reserves start with estimates of portfolio composition. The IMF does not directly publish reserve portfolio composition across asset currencies by country, and a

[6]For example, Maggiori (2017), Maggiori, Neiman and Schreger (2020), and Faia, Salomao and Veghazy (2023)

full list of the countries reported within COFER is not even available. Researcher constructions of best estimate databases include Eichengreen and Mathieson (2001) and Ito and McCauley (2020); Chinn, Ito and McCauley (2022)[7]. Drivers of these decisions have been studied, for example with Iancu et al. (2022) showing that country financial linkages have played an increasingly important role and Arslanalp, Eichengreen and Simpson-Bell (2022) documenting the increased use of nontraditional reserve currencies. Other research considers official reserve portfolio size for precautionary demand purposes and concepts of reserve adequacy like the Greenspan-Guidotti rule (Aizenman et al., 2020; Aizenman and Riera-Crichton, 2008; Jeanne and Rancière, 2011; International Monetary Fund, 2016). More historic perspectives on official reserves consider the timing and conditions for a large scale change in reserve currency status. Chiţu, Eichengreen and Mehl (2014) explore the timing of the transition from pound sterling denominated reserve portfolios towards US dollars. Complementary work considers determination of anchor or reference currencies in exchange rate regimes, with Ilzetzki, Reinhart and Rogoff (2019) as one key example. Related issues are addressed in the 2023 symposium on floating exchange rates (Irwin, Obstfeld and Posen, 2023).

Our work also fits into a growing body of research that focuses on geopolitical and geoeconomic fragmentation for international financial markets.[8] Eichengreen, Mehl and Chiţu (2019) argue that military alliances tilt the selection of a safe currency. Kempf, Luo, Schäfer and Tsoutsoura (2023) show that political ideology is an important and generally omitted factor in shaping international capital allocations of syndicated corporate loans and equity mutual funds. Bianchi and Sosa-Padilla (2024) focus on how international sanctions can shape dollar dominance, while Clayton, Maggiori and Schreger (2026) consider how economic coercion arises from a combination of strategic pressure and costly actions. Itskhoki and Mukhin (2023) show the roles of import and export sanctions on trade and exchange rates, including under a regime of financial repression. Cipriani, Goldberg and La Spada (2023) detail specifically how applications of financial sanctions have operated over time across multiple key international currencies, including with respect to international payments and communications systems. Sanctions imposed on countries could either reinforce or detract from incentives to hold US dollars in official portfolios (Dooley et al., 2022; Corsetti et al., 2023). Sanctions have been found to shift trade invoicing activity away from US dollars for Russia, especially for countries with an active yuan swap line with the Peoples Bank of China (Chupilkin et al., 2025).

Section 2 provides an exact mathematical decomposition that presents the contributions of reserve

[7]Prasad (2019) discusses the issue of allocated versus unallocated reserves in the COFER data.
[8]The work of the IMF across this topic is discussed in Aiyar, Presbitero and Ruta (2023).

portfolio expansion versus compositional shifts of portfolios for understanding the evolution of a (dollar) share of an aggregate. We quantify the components of each channel, illustrating insights over the dollar asset share decline across official reserve portfolios between 2015 and 2020. Section 3 focuses on the underlying drivers of country-specific changes in portfolio allocations, both leveraging earlier studies and adding new drivers, including liquidity versus investment tranches, relative asset returns and geopolitical considerations. An expanded weighted methodology is then applied to decompose the relative importance of different drivers in recent history. Section 4 concludes by focusing on the implications for future research and policy questions.

2. The Basic Decomposition

This section introduces the basic decomposition of the contributions of changing preferences for dollar assets versus other factors within global aggregate holdings of official foreign exchange reserves. Denote the world USD share of official reserves as Worldσ, at year t, as:

$$\text{World}\sigma_t = \frac{\sum_{\forall i} \sigma_{i,t} \cdot R_{i,t}}{\text{WorldR}_t}.$$

where $\sigma_{i,t}$ represents country i's portfolio preferences for USD assets, as a share of its total country foreign exchange reserves $R_{i,t}$, and WorldR_t corresponding to the world total of foreign exchange reserves in year t. Now, let $t_2 > t_1$ and define $\Delta X := X_{t_2} - X_{t_1}$ for any time series X_t. Then,

$$\Delta\text{World}\sigma = \frac{\sum_{\forall i} \sigma_{i,t_2} \cdot R_{i,t_2}}{\text{WorldR}_{t_2}} - \frac{\sum_{\forall i} \sigma_{i,t_1} \cdot R_{i,t_1}}{\text{WorldR}_{t_1}}.$$

We derive an exact decomposition of this expression with an additional, and interpretable, second order cross-term.[9]

$$\Delta\text{World}\,\sigma = \underbrace{\frac{\sum_i \Delta\sigma_i \cdot R_{i,t_1}}{WorldR_{t_2}}}_{\substack{(1)\\ \Delta \text{ dollar preferences}}} + \underbrace{\frac{\sum_i \Delta R_i \left(\sigma_{i,t_1} - \text{World}\,\sigma_{t_1}\right)}{WorldR_{t_2}}}_{\substack{(2)\\ \Delta \text{ FX reserves} \times \\ \text{initial dollar preference}}} + \underbrace{\frac{\sum_i \Delta R_i\, \Delta\sigma_i}{WorldR_{t_2}}}_{\substack{(3)\\ \Delta \text{ FX reserves} \times \\ \Delta\text{dollar preferences}}} . \tag{1}$$

The interpretation of Equation 1 derives from its role in explaining how the change in the US dollar share of an aggregated reserve portfolio has two main components. The first component is associated with changes in the portfolio composition preferences of countries around holding

[9]The full derivation of this expression is available in Appendix A2. This exact decomposition replaces the approximation presented in our working paper (Goldberg and Hannaoui, 2024).

dollar assets, shown as $\Delta\sigma_i$, which enters the expression with the ex ante quantity of total reserves in the country's official portfolio. These weighted changes aggregate across countries to provide the contribution to the total of the evolution of changes in preferences for assets denominated in US dollars.

The second component contributing to the dollar asset share of aggregate reserves occurs as the volumes of reserves held by each country – not their preferences – evolve. This component of the decomposition only plays a role in driving the aggregate global composition to the extent that the portfolio composition of each country differs *ex ante* from the weighted average currency share across countries, reflected in the term $(\sigma_{i,t_1} - \text{World}\sigma_{t_1})$. This suggests that large reserve holders who exhibit an initial deviation from the global dollar share have the potential to affect global aggregates for reasons unrelated to their dollar preferences. This second set of drivers is basic but conceptually important, as discussions that argue that the changes in aggregates from across countries reflect a decline in preferences for dollar assets may fully ignore the contribution of this term. The final term is a second order cross-term which captures simultaneous country changes in portfolio size and composition.

2.1. Quantifying the components: the data

Quantifying the contributions of components of Equation 1 over countries and over time requires data on the size of official foreign currency reserve portfolios across countries and on the currency shares of assets in those portfolios. Foreign exchange reserves data are broadly available and sourced from the IMF's International Financial Statistics Database (IFS). The size distribution of foreign exchange reserves across countries is very broad, providing perspective on how important individual country effects can be in an aggregate such as COFER. Nearly 90% of the total of 184 countries for which official reserves data were available as of 2020 had portfolios of official reserves with a value of less than $100 billion. Meanwhile, five countries – China, India, Japan, Switzerland, and Taiwan – held reserve assets spanning in excess of $500 billion to upwards of $3 trillion. Similar characterizations apply when considering the years that follow.

Over recent decades, the occurrence of crises and large shocks have motivated some countries to carry extra insurance and adjust reserves (Dominguez et al., 2012; Bussière et al., 2015). In addition, some reserve changes are associated with central bank efforts to maintain value ranges for exchange rates in the context of more normal conditions. Some country changes have been large in absolute terms, as shown in Figure 2. Between 2010 and 2020, the values of portfolios have increased by over $600 billion for Switzerland and by over $200 billion of additional reserves for each of China, Japan, India and Hong Kong, with portfolio expansions occurring in both the first and second halves of that decade for all but China. During the 2015 to 2020 period, the

mean ratio of foreign exchange reserves to GDP across reporting countries also increased broadly, from 18% to 23%, before declining back to 18% in 2024 as some countries reduced official reserve holdings following the COVID pandemic. The implication is that, as formalized by Equation 1, these types of changes by countries with larger reserve portfolios have the potential to significantly alter the overall COFER composition, adding to or counteracting the portfolio allocation channel.

A comprehensive perspective on the asset composition of the individual portfolio allocations of all of these countries is more difficult to construct. The IMF does not directly publish reserve portfolio composition, nor does it publish the full list of countries included in the COFER aggregates. We use as a primary source the series by Ito and McCauley (2020); Chinn, Ito and McCauley (2022) recently updated through 2021 and 2022, with additional data sourced from Arslanalp, Eichengreen and Simpson-Bell (2022) and Laser, Mihailov and Weidner (2024).[10] While many countries report the breakdown of reserve currencies in the central bank's reserve assets, some central banks only report the shares or breakdowns of reserve currencies for the net assets while others only report the shares of gross assets. Moreover, as some central banks have forward arrangements adjustments, our primary sources incorporate adjustments to the extent that the authors identify them.

These data sources do not span the full group of countries that report currency allocations to the IMF, and the coverage varies across years. The number of reporters by date in the country sample we are utilizing peaks in 2020 at 72, compared to the number of listed COFER reporters which was closer to 100 during the period analyzed (Figure A1). As our application is focused on changes in positions over time, we also consider the time series of availability of countries for which we can do comparisons of the evolution of dollar portfolio shares over one year or five year differences: peak periods also are in 2018 through 2020 (Figure A2).

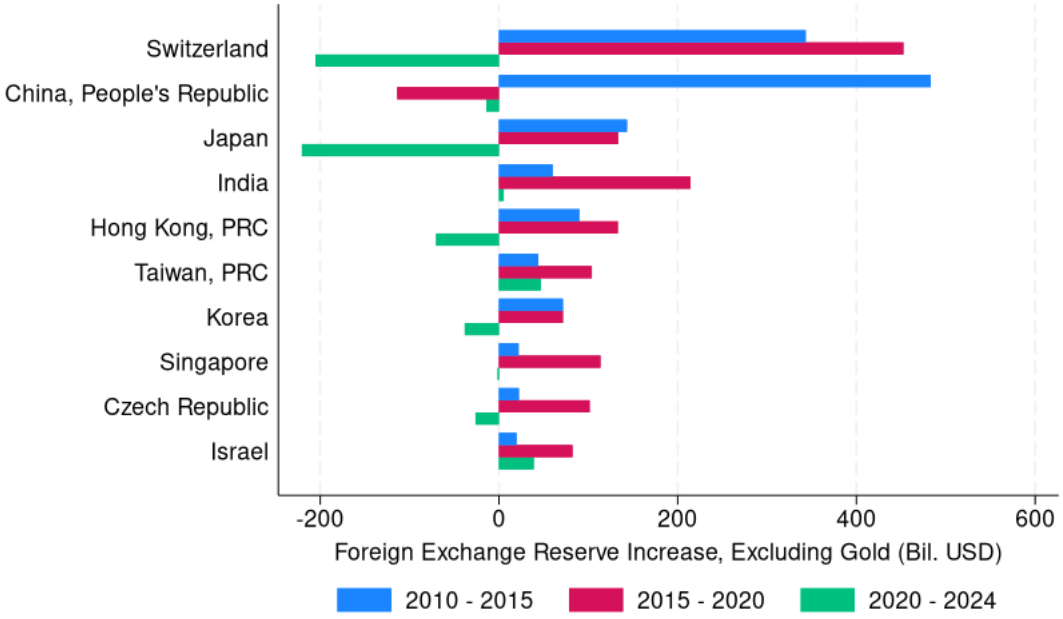
The maximum reporting coverage of official reserves peaks around 2015, at 94.5% percent of allocated reserves (Figure A3). However, while we do not have continued reporting over a 5 year following window for China, India and Nigeria collectively, the inclusion of these countries jointly for hypotheticals, we are still reaching 70.1% of allocated reserves for 2020, as shown by the blue dashed line for 2015 through 2020/2021.[11] We thus set the window for illustrating our decomposition approach to a comparison of 2015 and 2020, capturing a time frame with

[10] Within the Ito and McCauley (2020); Chinn, Ito and McCauley (2022) dataset, the currency share data do not incorporate SDR or gold holdings. As long as the authors find the data on SDR or gold, they recalculate shares to have a base that excludes SDR and gold.

[11] Among the countries missing portfolio allocation data, those with the largest foreign exchange holdings – Japan, Singapore, Mexico, United Arab Emirates, France, Kuwait, Argentina and Hungary – represent most of the gap between our data and COFER allocated reserves for the period examined. We discuss the propensity towards dollar reserves for this missing group of countries (Table 5).

a significant decline in the overall share of dollar assets - from 66 percent to 59 percent in COFER (Figure 1(b)), with dynamism on size of official portfolios $\Delta R_{i,t}$ across countries, and with coverage of currency composition $\sigma_{i,t}$ for 72 countries that account for over 90 percent of the allocated reserves included in the 2015 COFER data.

Figure 2: Country Changes in FX Reserves: 2010-2015, 2015-2020, and 2020-2024



Source: Author's construction using IMF IFS data on official foreign exchange reserves.

2.2. Quantifying the components: hypothetical scenarios

Our example of the strength of Equation 1, which decomposes the relevant channels contributing to the change in the aggregate dollar share of reserves, takes 2015 and 2016 as our starting point, and 2020 as our end point.[12] As China, India and Nigeria are missing dollar share statistics for 2020, we rewrite Equation 1 into an expanded formulation in Equation 2 which separately considers the contribution of the component terms that rely on changes in dollar portfolio shares

[12]Our country sample is increased by 7 countries (Ireland, Costa Rica, West Bank and Gaza, Lesotho, Mauritius, Morocco, and Seychelles) by using 2016 values available for countries when 2015 composition values are missing. Hereafter, we assume the 2016 portfolio weights for these countries apply to 2015 reserve stocks. Our sample is increased by two countries (Tanzania and Uganda) by using 2018 foreign exchange reserve values when both 2020 and 2019 foreign exchange reserve values are missing.

of official reserves collectively across the three countries, showing these unknown terms in blue.

$$\Delta \text{World}\,\sigma_{2020-2015} = \frac{\sum_{i=1}^{69} \Delta\sigma_i \cdot R_{i,2015}}{\text{World}R_{2020}} + \frac{\sum_{i=1}^{72} \Delta R_i \,(\sigma_{i,2015} - \text{World}\,\sigma_{2015})}{\text{World}R_{2020}} + \frac{\sum_{i=1}^{69} \Delta R_i \,\Delta\sigma_i}{\text{World}R_{2020}} + \underbrace{\frac{\sum_{i=70}^{72} \Delta\sigma_i \cdot R_{i,2015}}{\text{World}R_{2020}} + \frac{\sum_{i=70}^{72} \Delta R_i \,\Delta\sigma_i}{\text{World}R_{2020}}}_{(\star)} \tag{2}$$

The final two terms of Equation 2 can be expressed exclusively in terms of one unknown, as the missing information is only on portfolio allocations, given that we have the reserve levels for these countries. Thus the value of $\Delta\sigma_{i\in\{70,71,72\}}$ is pinned down by the value of $\Delta\text{World}\,\sigma_{2020-2015}$. Likewise, for any possible value of the change in aggregate dollar share across all countries, this implies values for the portfolio allocation of the residual (three) countries and the aggregate allocation for all 72 countries in 2020.

$$(\star) \quad \frac{\sum_{i=70}^{72} \Delta\sigma_i \cdot R_{i,2015}}{\text{World}R_{2020}} + \frac{\sum_{i=70}^{72} \Delta R_i \,\Delta\sigma_i}{\text{World}R_{2020}} = \frac{\Delta\sigma_{i\in\{70,71,72\}} \cdot R_{i\in\{70,71,72\},2015}}{\text{World}R_{2020}} + \frac{\Delta R_{i\in\{70,71,72\}}\,\Delta\sigma_{i\in\{70,71,72\}}}{\text{World}R_{2020}}.$$

Using the available data, we next compute the contributions of the respective forces of Equation 2 represented by the first three known terms and for each of the two aggregated country unknown terms, with the latter two terms quantified under different hypothetical values of the left-hand-side change in the 72 country aggregate. Table 1 provides the channels as table columns, with table rows indicating the sample of countries associated with each computation. As an illustration of the importance of the revealed components of our mathematical decomposition, we also highlight the individual behavior of Russia and Switzerland over this period—the two countries with the highest reserve totals whose dollar reserves we fully observe.

Total official reserves correspond to the reserves of the 72 countries taken together. The top row covers 69 of these countries (inclusive of Russia and Switzerland), the next rows in green show the decomposition of that 69 into Russia and then Switzerland and the remaining 67 countries. The rows that follow correspond to the joint contributions by channel of a consolidated China, India, and Nigeria for which we have beginning of period (2015) but not end of period (2020) dollar shares). Each row corresponds to a different hypothetical scenario over the total FX reserves of these 72 countries. One row considers if, hypothetically, this group had a consolidated decline of the dollar share of reserves of 6.8 percentage points, mirroring the COFER decline over the same period. Alternatively, we consider two other hypotheticals– a 4 percentage point decline

Table 1: Contributions to Change in Dollar Share of Foreign Exchange Reserves, 2015 to 2020

$\Delta \text{World}\,\sigma$ = (Scenario)	$\frac{\sum_i \Delta\sigma_i R_{i,2015}}{\text{World}R_{2020}}$ +	$\frac{\sum_i \Delta R_i\,(\sigma_{i,2015} - \text{World}\,\sigma_{2015})}{\text{World}R_{2020}}$ +	$\frac{\sum_i \Delta\sigma_i\,\Delta R_i}{\text{World}R_{2020}}$	Country Sample
	0.3	-2.3	0.3	69
	-0.6	-0.3	-0.3	Russia
	0.3	-1.6	0.2	Switzerland
	0.6	-0.4	0.3	Other 67
-4.0	-2.2	-0.03	-0.1	China+India+Nigeria
-6.8	-4.9	-0.03	-0.1	China+India+Nigeria
-9.0	-7.0	-0.03	-0.2	China+India+Nigeria

$\text{World}\,\sigma_{2015}$ = **61.8** percent (the average 2015 USD share of the 72 country sample). The first four columns are expressed in percentage points. Hypothetical 2015-2020 USD share declines for the 72 country sample range from -4 to -9 percentage points. Country Sample 69 presents the contribution of the 69 countries with known 2020 USD shares, while Country Sample China+India+Nigeria presents the combined contributions of these 3 countries missing 2020 USD shares. We highlight the calculated contribution of Russia and Switzerland to the Country 69 sample in green. We impute the decline in the USD share of China, India, and Nigeria ($\Delta\sigma_{i\in\{70,71,72\}}$ in Equation 2) under the 3 hypothetical scenarios as: -4.9 in the $-$**4.0** scenario, -11.1 in the $-$**6.8** scenario, and -15.9 in the $-$**9.0** scenario.

in the aggregated dollar share and a 9 percentage point decline. We do not know which of these hypotheticals are the true decline for this group of countries. However, we can use our decomposition approach to back out interesting observations. The only unknown is the entry in this approach is the $\Delta\text{World}\sigma$. Conditional of an assumed value (-4.0, -6.8, -9.0, as examples), we can provide perspectives on which countries and which forces are driving the aggregates.

Among the 69 countries, across all three channels, these countries bring down the aggregate dollar share of total reserves (of our 72 country sample) by -1.7 percentage points (0.3 +-2.3 +0.3).[13] Within this group, Russia pulls down the aggregate through all three channels by a total of -1.12 percentage points, as it reduced its dollar share of reserves and increased reserve stocks from an initial base that was lower than the aggregate dollar share in 2015. Switzerland pulls down the aggregate by a similar order of magnitude, but this contribution is the large negative effect exclusively through the reserve change channel, driven by its much lower than aggregate initial dollar share of reserves interacting with its massive reserve accumulation. Despite having raised the dollar share of its official reserve portfolio, Switzerland pulls down the dollar share for the 72

[13]The cross product terms from both changes in reserves and preferences across the 69 countries also contributes little in aggregate (at 0.3 percentage points).

country example - dwarfing Russia's contribution to the decline, which reflects its own reduction in preference for dollar reserves. We believe this provides a nice illustration of the novel insight our decomposition equation reveals.

Then, consider India and China collectively with Nigeria: this consolidated grouping (dominated by the reserves of China and India) contributes quite a lot to the aggregate dollar share across the 72 countries, but very little of that contribution comes via the reserve balance change channel. We solve for the scale of the 3 country aggregated dollar preferences channel under alternative hypothetical scenarios for the "world" total $\Delta\text{World}\sigma$, and find that the imputed change in their dollar preferences is large – collectively twice as important for the aggregate decline in a central scenario (the 6.8 percentage point decline) than the collective consequences of the other 69 countries. Indeed it is so large that the dollar share of official reserves would decline even if Russia and Switzerland were both removed from inclusion in $\text{World}R_{2020}$. The illustrative juxtaposition of Russia and Switzerland showcases how influential sheer reserve volumes can be on the global aggregate. Given the magnitude of China's reserve holdings, it is natural to conclude that the observed decline for this China-India-Nigeria country grouping is primarily driven by China's reserve behavior.

2.3. Unpacking the country-specific details

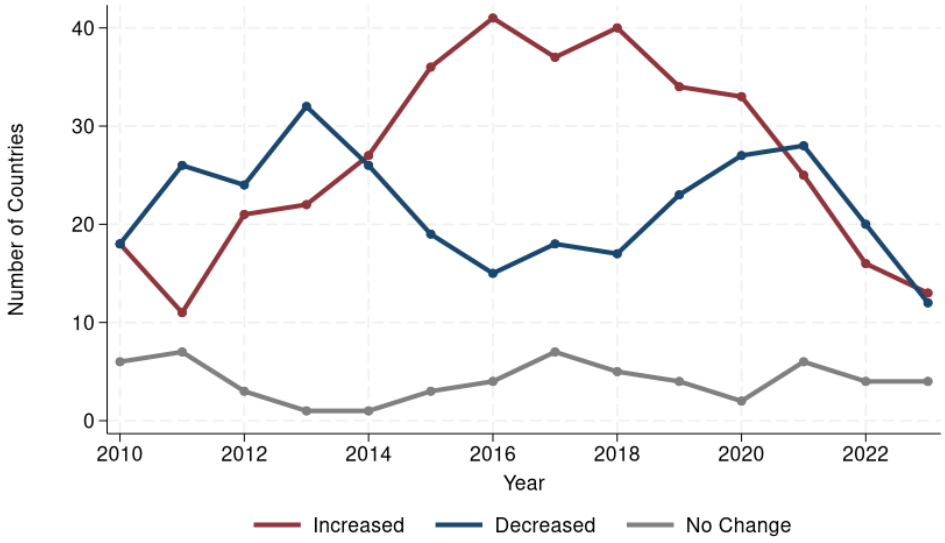
As the prior decomposition exercise combined the portfolio allocation changes across 69 countries for a combined effect close to zero on the aggregate dollar share between 2015 and 2020, and showed that the consolidated China, India and Nigeria translated to a large dollar share decline, we next consider the evolution across individual countries. Using available data, we conclude that the extent of diversification away from dollars depends heavily on the selection of countries and the particular time frame examined. Our analytics remain constrained by the availability of constructed data, for example using our extension of the database of Ito and McCauley (2020); Chinn et al. (2022), with further observations through 2023. The final sample includes 78 countries (excluding the US) over the sample period 1999-2023. This sample of countries is skewed more towards Europe than the broader list of known COFER reporters.[14] For 2015 through 2023, the maximum number of countries included in our analysis at any date is 71 in 2020, compared with the total number of COFER reporters with identities provided that reached 97 in 2019 (Figure

[14]Our sample consists of the set of countries that have at least 1 non-missing US dollar share observation over 1999-2021 in Ito and McCauley (2020); Chinn, Ito and McCauley (2022) or Arslanalp, Eichengreen and Simpson-Bell (2022). Data from Laser, Mihailov and Weidner (2024) are used to extend the existing US dollar share series forward in time for countries that are already included in the base panel. We also supplement any missing "intermediate" observations within the existing sample period using the same Laser, Mihailov and Weidner (2024) data.

A1).[15]

At least for this group of 69 countries for which some data is observable and over a time frame in which the dollar share in aggregate declined, the data disagree with a conclusion that this period is mainly characterized via official sector moves from US dollar assets. Indeed, the evidence shown in Figure 3 suggests a healthy split of countries that increased and decreased dollar share of their reserve portfolios.[16] While many countries reduced their dollar share of official assets, nearly as many countries in this observable sample moved toward dollar assets, and some held their dollar share steady over time.

Figure 3: Counts of Countries by Directional Change in USD Share over 5 Year Windows



The sample includes all countries with available USD share data in a given year and 5 years prior. Countries with 5-year USD share changes < 0.5 percentage points are classified as "No Change".

These changes enter the observed aggregate dollar share so that the small total effect from 69 countries reflects the balance of consequences from both US dollar share declines and increases of individual countries, each interacting with country ex ante reserve levels. Russia, with a large initial reserve balance ($309 billion) and a 15.5 percentage point dollar share decline, and the combined reserves of China, India and Nigeria ($3.4 trillion), driven primarily by China's holdings, and a 11.1 percentage point decline under the central hypothetical scenario, are the

[15]The IMF first provided a list of 96 COFER reporting countries that agreed to disclose their identities in 2015 (Ishikawa et al., 2015). In 2019, 97 agreed to disclose their participation (Prasad, 2019).
[16]Individual country changes are detailed in Table B2.

biggest downward drivers of dollar share through the US dollar preference channel.[17] The upward pressures from individual countries through the dollar asset share channel are smaller, even while quantitatively strongest from Switzerland, Brazil and Hong Kong.

On the reserves level channel, the magnitude of changes by the top ranked accumulators (inclusive of Switzerland, India, Russia, Hong Kong), or those reducing official reserves by large amounts (China and Turkey) clearly dominate the totals of all other countries.[18]

3. Estimating Drivers of Changes in Dollar Portfolio Shares

This section provides empirical insights on drivers of dollar share changes with more cohesive data descriptives and an empirical approach targeted at unpacking the key underlying forces of dollar holdings in central bank reserves. The empirical approach starts with our version of the standard linear probability regression model contained in the prior literature but now inclusive of the portfolio investment tranche, relative return differentials, and geopolitics. Then we extend this approach to a weighted setting to understand the contributions of drivers at an aggregate level. The weighted setting is of particular interest given the strong concentration of total official foreign exchange reserves in a relatively small number of countries. China, for example, held over 25 percent of total official reserves in 2023, while the bottom 90 percent of reserve holders collectively held less than a quarter of total official reserves. We complement these weighted estimates using Shapley-Owen values to quantify each driver's individual contribution.

3.1. Existing Evidence and New Channels

An extensive literature uses panel data estimation to explore the specific structural and cyclical forces associated with country preferences for currency shares in international reserve holdings. Reserve portfolio levels and the shares in portfolios of particular currencies are generally found to be higher when countries have more international trade and financial transactions with reserve-currency issuing countries. Regression analytics include variables to capture *de facto* or *de jure* exchange rate pegs; trade shares with the US, euro area, and Japan, among others; and the currency denomination and levels of external debt positions. Trade shares and country size are

[17] Extreme assumptions give a sense of how to bound the contribution by China to these totals, given the size of ex ante dollar shares and total reserves across countries. In a hypothetical world where India and Nigeria did not reduce their dollar share at all, China's dollar share would have declined by 5.8 percentage points in the 4.0 world decline scenario, by 13.1 percentage points in the 6.8 world decline scenario, and by 18.7 percentage points in the 9 decline world scenario. If India and Nigeria fully left dollars (i.e. their dollar share went to zero), then China's dollar share would have risen by 4.9 percentage points in the 4.0 world decline scenario, declined by 2.5 percentage points in the 6.8 world decline scenario, and declined by 8.1 percentage points in the 9 world decline scenario.

[18] The contributors to changing global quantities of official reserves for individual countries, along with the ex ante shares of dollar assets in portfolios are provided in Table B3.

viewed as indicators of economic influence and exposure to international spillovers. Over the short to medium run, some of these channels can also capture the influence of exchange and interest rate dynamics as cyclical factors that could partly explain dollar shares without active reallocation back to strategic targets by reserve managers. For example, a net depreciation of the dollar over the past two decades, accompanied by a relative appreciation of other major currencies held in foreign exchange reserves, could drive declining dollar shares in portfolios. Returns on portfolios from interest received on sovereign holdings could also play a similar role, especially if accrued interest on foreign exchange assets are used to reinvest into assets of the same currency. The 2023 *International Role of the Euro* report provides evidence that these pure portfolio returns and valuation effects have been contributors (ECB, 2023).

For informing the actual drivers of changes in the dollar share, we start by building on the specifications used in the prior literature, also introducing specific tests of forces that were not formally tested in earlier studies, including the possibility of distinct portfolio management practices applied to reserve tranches, and more extensive data.[19] The new variables we introduce into portfolio allocation regressions start with conjectures related to relative returns offered across currencies, geopolitical considerations, and the possibility that reserve managers differentiate how they manage the parts of their stocks of official reserves that are in liquidity tranches versus investment tranches.

We test whether the roles of return differentials across currencies, while considering whether such roles engage with country- and environment - specific factors in substitution away from US dollar assets. Return differentials across currencies could tilt the composition of portfolios. Thus, the US dollar share of official portfolios could be lower if euro area assets or nontraditional reserve currencies are offering relatively higher (relative) returns. The low interest rate or zero lower bound environment for US dollar assets might be associated with a greater desire of official portfolio managers to generate returns on the full portfolio through more currency (or asset) diversification.

Sensitivities to asset returns or geopolitical considerations may be enhanced for portions of the foreign exchange reserve portfolios considered as part of the "investment tranche". This conditional sensitivity point emphasizes the possibility that the roles of relative returns are low or diminished on the portion of foreign exchange reserves that is mainly associated with foreign currency liquidity and exchange rate stabilization needs. Historically, foreign currency reserve

[19] Arslanalp et al. (2022) is a recent study that contrasts with our results. The working paper version of our paper shows ways that our data sample and pattern of variable inclusion generates different econometric findings on the strength of different drivers of dollar shares.

assets are held to provide liquidity insurance against sudden stops in the availability of global liquidity needed for funding international trade and making payments on foreign currency debt. Reserve adequacy concepts consider these types of forces (International Monetary Fund, 2016). Indeed, after the global financial crisis, foreign exchange intervention has been more actively used as a tool to manage external conditions and has played an increasing role in offsetting pressures on currencies.[20]

Thus, relative returns may play a larger role in reserve manager allocations, for countries whose reserve managers have access to an "investment tranche", which we define to be the amount of excess foreign exchange reserves held by a country above the "liquidity tranche" portion associated with the standard considerations around access to emergency liquidity and exchange rate stabilization. As portfolio managers have access to these extra funds and associated increased risk-bearing capacity, they may partially switch away from safe or traditional reserve currency assets, the majority of which tend to be denominated in dollars due to the strength and liquidity of US Treasury markets, as well as the next deepest market: euros. Further, the tendencies to diversify may be more pronounced during a low-interest rate environment among the "Big Four" currencies, with a quest for returns inducing managers to diversify into high yielding nontraditional reserve currency assets. Survey evidence supports the idea that there is a tendency among central banks to broaden the range of currencies in their portfolio to diversify risks and to avoid low, and even negative, interest rates (Schanz, 2019). Reputation costs or political exposure from major losses or weak capital positions are a potential explanation provided.

Similarly our specifications also introduce geopolitics and geoeconomic fragmentation as potential influences on country portfolio allocations. Reducing the dominance of the US dollar in the international monetary system has been an explicit statement of objectives for some countries, leading to numerous announcements surveyed in ECB (2023). Geopolitical tensions, fueled especially by the Ukraine war and tensions between the United States and China, have the potential to alter portfolio reserve allocation. Arslanalp, Eichengreen and Simpson-Bell (2022) note that financial sanctions imposed on the US via SWIFT may have spurred non-US allied countries to rethink their reliance on the dollar and American-based payment systems. Weiss (2022) argues that geopolitical fragmentation may reduce the role of dollar reserves via export invoice switching as non-Western countries look to reduce their reliance on the US dollar via trade. The expansion of BRICS has been widely discussed as a bid to end dollar dominance as well.[21] Nonetheless, the

[20] See Blanchard, Adler and de Carvalho Filho (2015), Fratzscher, Gloede, Menkhoff, Sarno and Stöhr (2019), Adler, Chang, Mano and Shao (2025), and Goldberg and Krogstrup (2023).

[21] To be specific, this intergovernmental organization is made up of ten countries: Brazil, Russia, India, China, South Africa, Egypt, Ethiopia, Indonesia, Iran, and the United Arab Emirates as of writing.

ECB (2023) reviewed evidence through 2023 and found the support for this development as weak and mainly found in official statements. Our specifications accounts for higher-order behavior overlooked in past research: the interaction between geopolitical distance and liquidity. By doing so, we recognize that geopolitical distance may only drive diversification once a country possesses the excess reserves necessary to satisfy its primary liquidity and stabilization requirements.

3.2. Data

Estimates of dollar shares of official reserve portfolios across countrie rely heavily on Ito and McCauley (2020); Chinn, Ito and McCauley (2022), with their data updated through 2021 and inclusive of some adjustments to earlier share estimates by country-date. Some supplemental observations for countries absent from that database are from Arslanalp, Eichengreen and Simpson-Bell (2022) and Laser, Mihailov and Weidner (2024). Our final dataset is a panel with a total of 1,222 country-year observations, with up to 25 years covered (1999-2023) and spanning 75 countries from all continents. Estimation is over an unbalanced panel across countries (Appendix Table B1). We leverage data on exchange rate regime (US dollar, euro, or Other country peg), international trade shares and the currency composition of external debt following the literature (Appendix Table A1).

Relative to prior studies, we introduce indicators of the scale of the investment tranche (versus liquidity tranche) share of official foreign exchange reserves, proxies for relative returns on currencies for official portfolios, indicators of the zero lower bound period, and measures of geopolitical alignment and financial sanctions levied by the United States.

We construct the share of the official reserves portfolio in the investment tranche $InvTr_{c,t}$ as a residual (share) in excess of the liquidity tranche $Liq_{c,t}$ that is proxied in two alternative ways.[22] The two types of investment tranche variables are positively correlated, but not tightly aligned. First, for each country we use the World Bank Joint External Data Hub (JEDH) to obtain short-term debt data. For each country we define short-term debt as the sum of short-term liabilities to BIS banks and short-term international debt securities by year (in millions of dollars). Bussière, Cheng, Chinn and Lisack (2015) find that countries with higher reserves saw a smaller decline in growth during the great recession, with the ratio of reserves to short-term debt being the most significant reserve adequacy ratio. The second proxy is the traditional indicator of reserve adequacy constructed using 3 months of total goods and services imports.[23] A survey of reserve

[22] While the IMF publishes reserve adequacy metrics, we opt not to use it for our estimates due its scarce coverage of advanced economies.

[23] Yearly totals are divided by four to create a measure of 3 month total imports (in millions of US dollars) sourced from the IMF International Financial Statistics (IFS).

managers conducted by UBS corroborates these measures of reserve adequacy, citing the two most prevalent ways reserve managers measure their reserve adequacy are as months or percentages of imports and as percentage of short-term external debt (Castelli and Salman, 2022). Investment tranche for country c in year t is:

$$InvTr_{c,t} = \begin{cases} 0 & R_{c,t} < Liq_{c,t} \\ \frac{R_{c,t} - Liq_{c,t}}{R_{c,t}} & R_{c,t} \geq Liq_{c,t} \end{cases} \tag{3}$$

The geopolitical series are intended to proxy geopolitical alignment with, or distance from, the United States. The first series is an annual series for the percent of voting in line with the United States on resolutions in the United Nations General Assembly (UNGA) with the original source as Mosler and Potrafke (2020) and Voeten (2009). The alignment patterns for the period from the late 1990s through 2015 are positively correlated with, but also higher for, emerging market countries compared to alignment in the period from 2016 onward. We use thresholds from observing the data for assigning countries into discrete bins of voting alignment, with this approach having the advantage of being less sensitive to the specific items brought up for voting at different points in time. Countries in the *Low US UN Vote Agreement* group have a median US UNGA vote agreement below 0.4, while $Medium$ is between 0.4 and 0.55, and $High$, greater than 0.55. Our associated regression analytics introduce the Low and $Medium$ assignment by country, c, and by year, t, using a rolling window 3 year moving average of the US UNGA vote agreement according to the above thresholds. While specific values of alignment might vary over time, the binning is highly persistent.[24] The effects of residual country-time observations are included in constant terms of regression specifications.

Another geopolitical indicator is whether a country is subject to financial sanctions imposed by the United States during specific years using data from Syropoulos, Felbermayr, Kirilakha, Yalcin and Yotov (2022) and Kirikakha, Felbermayr, Syropoulos, Yalcin and Yotov (2021). Sanctions are defined as binding restrictive measures applied by individual nations, country groups, the United Nations, and other international organizations with the intent of inducing a change in behavior, or a constraint in action, from the targeted country towards the targeted country. Financial sanctions, specifically, are restrictive measures conducted with the intent of restricting, or exerting pressure, on the sanctioned party through financial means. Examples of financial sanctions include freezing foreign assets, restricting direct investment, and reducing the availability of credit for payments in the exchange of commodities. Additionally, recent decades have seen a rise in the

[24] Table A3 contains a time-invariant binning of countries using their median annual US vote agreement over the full sample period. The time comparison is provided in Figure A4.

prominence of sanctions imposed via infrastructures and institutions, like SWIFT, giving rise to a particularly disruptive mode of financial sanctions as described in Cipriani, Goldberg and La Spada (2023). Twenty seven countries have been subject to US (and sometimes joint with other countries) financial sanctions in our sample.[25]

3.3. Empirical Methodology

Our first empirical approach applies a standard linear probability model on an unbalanced panel of data across countries, indexed by c, at time t:

$$\sigma_t^c = \beta_0 + \beta_1^T \mathbf{x}_{c,t} + \beta_2 \text{Ret}_t + \beta_3 \text{InvTr}_{c,t} + \beta_4 \text{Ret}_t \times \text{InvTr}_{c,t} + \beta_5 \text{GP}_{c,t} + \beta_6 \text{GP}_{c,t} \times \text{InvTr}_{c,t} + \epsilon_{c,t} \tag{4}$$

where $\sigma_{c,t}$ is the US dollar share of official foreign exchange reserves of country c at year t. Standard baseline right hand side variables for determinants of currency composition are subsumed by the vector $\mathbf{x}_{c,t}$ and include: the exchange rate regime in year t defined as a dummy variable for a US dollar, Euro, or Other currency peg; the shares of trade with the US or euro area as Big Four currency issuer countries; and the currency composition of external debt in US dollars and euros.

We report baseline specification results, following the prior literature, but instead with the sample of observations from 1999 to 2023 that we have available on dollar share of official portfolios over time and while excluding variables that previously limited country inclusion in the regression results.

We then test for significance of contributions of the additional terms we introduce, starting by embedding effects of relative returns on official US dollar assets versus euro asset returns, or relative returns on USD assets versus nontraditional reserve currencies. The variable Ret_t includes two variations of measures of currency returns. One variation includes the US and EU short-term shadow rates. The other variation includes the interaction between the US zero lower bound (ZLB) and a nontraditional reserve currency (NRC) differential which captures the excess return of nontraditional reserve currencies relative to the US shadow rate. Our specifications allow for the possibility that the effects of higher nontraditional reserve currency returns are pronounced only when the reserve currencies are at at the zero lower bound.

We next allow the possibility of the effects of return differentials and geoeconomic forces to be stronger on the investment tranche portion of the portfolio than on the liquidity tranche portion of reserves: some specifications introduce interactions with the investment tranche $InvTr_{c,t}$ (see

[25] Table B1 describes the full coverage of financial sanctions corresponding to countries included in our estimation.

Equation 3 for construction details) share of the portfolio. The investment tranche is included as a main effect to estimate the level effect of having a higher investment tranche. Specifications include geoeconomic variables denoted $GP_{c,t}$. They are likewise introduced to allow for the possibility of interactions with the investment tranche component of the reserves portfolio. The results from the range of alternative variables and specifications enable us to hone which variables do not contribute explanatory power.

Our choice of a linear probability model is driven by the ease of interpretation of coefficients and the ability to utilize conventional goodness of fit calculations. While concerns of predictions falling outside the feasible region of $[0, 1]$ for such a model are valid, we confirm that this is not an issue in our setting by verifying the predictions in our final model. Estimates are robust to the inclusion of year fixed effects and yield similar estimates to a Tobit regression model (Table 2). Robust clustered standard errors are reported.

We further extend this approach to a *weighted* setting, where the estimated coefficients are obtained via the minimization of the weighted mean square error across observations. The initial LPM approach highlights potential drivers of the US dollar share of foreign exchange reserves of individual countries, implicitly weighting each country equally in our specifications. To understand the relative importance of these drivers at an *aggregate* level – a necessary approach when analyzing a measure like COFER – we implement a weighted least squares approach with each country-year observation weighted by its share of the total foreign exchange reserves that year among all countries included in the regression sample. Thus, the weights across all countries in a given year are all non-negative and sum to 1.[26]

The motivation for this approach is clear given the concentration of global official reserves among a subset of countries. Using a sample of 173 countries in 2023 that accounted for approximately 99 percent of world foreign exchange reserves, 90 percent of countries in the sample contributed less than a quarter of total reserves. Furthermore, 11 countries each held over 2 percent of the total reserves, with 3 contributing over 5 percent each, together accounting for 71 percent of total reserves in 2023.

The final part of our analytics turns to the quantitative question of what drove changes in official reserve allocations across countries for the period 2015 to 2020, mirroring the decomposition exercise that was our illustration in Section 2.2. For this purpose, and as a complement to the weighted estimates, we decompose the relative importance of the drivers within the context of the

[26] Formally, the estimated coefficients are obtained via the minimization of the weighted mean squared error: $WMSE = \sum_{c,t} w_{c,t}(\sigma_{c,t} - \beta^T \mathbf{x}_{c,t})^2$ which is equivalent to estimating the following transformed linear model: $\tilde{\sigma}_{\mathbf{c,t}} = \beta^{\mathbf{T}} \tilde{\mathbf{x}}_{\mathbf{c,t}} + \tilde{\epsilon}_{\mathbf{c,t}}$ with $w_{c,t} = \frac{R_{c,t}}{\sum_c R_{c,t}}$, $\tilde{\sigma}_{c,t} = \sqrt{w_{c,t}}\,\sigma_{c,t}$, $\tilde{\mathbf{x}}_{c,t} = \sqrt{w_{c,t}}\,\mathbf{x}_{c,t}$, $\tilde{\epsilon}_{c,t} = \sqrt{w_{c,t}}\,\epsilon_{c,t}$.

explanatory power of the weighted model using Shapley-Owen values for each regressor. Shapley values provide a more robust approach than the traditional partial R^2 measure in decomposing the contribution of each regressor in the observed R^2 of a fitted model. The values are calculated by taking an average across the marginal effect of a regressor x_j on the R^2 across all possible sub-models.[27] Owen values are a generalization of Shapley values to groups of regressors and are calculated in an identical fashion, ensuring that the marginal R^2 values are calculated relative to the inclusion of each group of regressors, rather than the individual ones.

3.4. Results: Country-level drivers of US dollar share

The linear probability model presented in Equation 4 is interpretable from a *country-average* perspective rather than an *aggregated* one. Specifications including the standard variables in the literature, provided in Table 2, demonstrate that the exchange rate regime matters, as countries that *de facto* peg to the dollar hold a higher share of dollars, while those that *de facto* peg to a currency beside dollars tend to hold lower shares of dollars. Dollar shares of portfolios also show important roles for financial variables like the share of country debt in US dollar and euro currencies, and weaker roles for the US share of country trade. Geographic proximity is important, with a particular role for closeness to the euro area in lowering dollar shares in country portfolios. Column (2) of Table 2 serves as our baseline empirical model upon which we build to test for the incremental contributions of portfolio returns, investment versus liquidity tranches, and geopolitical contributions. Our baseline results are identical to those obtained by estimating a Tobit model (Column 1), but retain the interpretability of OLS. Our results are also robust to the inclusion of year fixed effects (Column 3).

Turning to the effect of geopolitical variables on dollar shares, we sort country voting alignment with the United States for UN member countries - into Low alignment, versus others, which are in medium and high voting groups, or countries that are not voters at the United Nations. The waterfall regression specifications in Table 3 confirm that lower alignment countries have higher dollar share, on the margin, all else equal, even after controlling for other dollar share drivers. The signs of coefficients of other regression coefficients also change.[28]

Columns (2) and (3) of Table 3 show specifications with interactions with the investment tranche share of country portfolios, alternatively constructed using import shares or short-term debt.

[27] See Huettner and Sunder (2012) for an overview on the approach. Specifically, the Shapley value Sh_{x_j}, for a regressor x_j is calculated as $Sh_{x_j}(R^2) = \frac{1}{p!}\sum_{T\subseteq K\setminus\{x_j\}} |T|!\,(p-|T|-1)!\left[R^2(T\cup\{x_j\}) - R^2(T)\right]$ where $K = \{x_1,\ldots,x_p\}$ denotes the set of regressors in the proposed model, and T, the set of sub-models excluding x_j.

[28] We have implemented a range of specifications, respectively introducing the alternative geopolitical alignment terms independently, then interacted with investment tranches, and with controls for nontraditional reserve currency returns or US shadow rates. Our preferred specifications bucket countries into *Low*, *Medium*, or *High* voting alignment with the United States. Specifications using a continuous voting measure provide weaker results.

While both forms enter with a negative sign, statistical significance is clear only with the short-term debt investment tranche construct. The investment tranche share tends to be highest for the *Low* voting alignment group, a strong distinction both in 2015 and 2020 (Figure A5). There is a nuanced relationship between US geopolitical alignment and reserve composition. For Low alignment countries, an expansion in the investment tranche is associated with a predicted decrease in USD share.

Columns (3) and (4) introduce effects of nontraditional currency returns, or the US shadow rate. Higher returns on nontraditional currencies are associated with some diversification away from dollar portfolio share, but only on the investment tranche of official portfolios. The quantitative effects are nonetheless low. Other tests for consequences of US low interest rates or a zero lower bound environment for US dollar assets (not shown) are not associated with reduced dollar shares.

Analytics that instead use financial sanctions as an alternate measure of geopolitical alignment, shown in Columns (5)-(8) of Table 3, do not find that financial sanction incidence *per se* is correlated with dollar share of portfolios after controlling for return differentials or when investment tranche is defined using short-term imports.[29]

Overall, we find that countries with low geopolitical alignment with the United States have higher dollar shares of portfolios and higher investment tranches as shares of their reserve portfolios, especially in comparison with reserve portfolios of countries with higher voting alignment with the United States. Comparing coefficient on Low alignment non-interacted (0.24) and that interacted with investment tranche (-0.21), an interpretation is that countries with low alignment with the US might move away from US dollar asset share in reserve portfolios mainly when their investment tranche shares are significantly higher. The median investment tranche for this group of Low alignment countries is close to 70 percent. This suggests that the countries with higher reserves may reduce some of the "excess" share of portfolios held in dollars, but do not eliminate this gap. Perhaps the low alignment countries have overall worse access to external funding markets in US dollars, leading countries to have higher dollar shares even while accumulating more reserves.

[29]Financial sanctions are a country-year level indicator variable indicating if a country had a financial sanction imposed by the United States according to the Global Sanctions Database. 183 financial sanction observations enter our estimation sample with values equal to 1.

Table 2: Baseline specification for US dollar share of official foreign currency reserves

	(1)	(2)	(3)
U.S. dollar share of official reserves			
Dollar peg	0.116***	0.114***	0.113***
	(7.12)	(7.10)	(7.18)
Euro peg	-0.377***	-0.363***	-0.367***
	(-19.31)	(-20.25)	(-20.32)
Other peg	-0.180***	-0.180***	-0.191***
	(-4.96)	(-4.96)	(-5.51)
Trade with US	0.0145	0.0157	0.00407
	(0.29)	(0.32)	(0.08)
Trade with Euro Area	-0.314***	-0.315***	-0.312***
	(-6.93)	(-7.08)	(-6.69)
Dollar debt share	0.243***	0.240***	0.234***
	(11.24)	(11.41)	(10.96)
Euro debt share	0.0830**	0.0748**	0.0682**
	(3.24)	(3.00)	(2.60)
Euro Area dummy	0.351***	0.350***	0.347***
	(16.58)	(16.76)	(16.28)
Constant	0.521***	0.524***	0.530***
	(23.89)	(24.55)	(24.74)
N obs	1226	1226	1226
N countries	75	75	75
R2		0.552	0.561
Adj R2		0.549	0.549
Year FE	No	No	Yes
Estimation Method	Tobit	OLS	OLS

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The sample period is from 1999 to 2023. The US and Euro Area are dropped from all regressions. Column (1) uses a Tobit model as the dependent variable is bounded between 0 and 1, while Columns (2) and (3) use an OLS specification, without year fixed effects and with year fixed effects respectively.

3.5. Results: Drivers of Aggregated Changes in US dollar share

The results of the weighted OLS specifications provide evidence on drivers of the world *aggregate* US dollar share. In other words, rather than asking what drives dollar shares across all countries equally, the weighted specification asks: what drives dollar allocation among the countries whose decisions dominate the global aggregate? To address this, we begin by focusing on a parsimonious model which includes the main baseline drivers discussed, along with geopolitical and liquidity factors, and their interaction. Table 4 Column (1) presents the results of regular OLS, a special case of weighted OLS with weights uniformly 1, with the weighted model displayed in Column (2). The weighted estimates suggest that, after accounting for the influence of key reserve holders,

bilateral trade and debt denomination emerge as key drivers of US dollar shares. The specific contributions by variable are shown in Column (3), which provides the Owen values across five major variable groups from the weighted specification. In particular, dollar denomination of debt and bilateral trade with the US collectively account for nearly half of the observed R^2 of the weighted specification. With these results in mind, an important limitation warrants emphasis: these estimates can only generalize to world aggregate patterns insofar as our annual coverage spans the relevant reserve holders. The absence of China for many years and major holders like Japan presents some limitations. Nevertheless, this exercise remains valuable. The contrast between weighted and unweighted specifications demonstrates how traditional approaches that focus on typical cross-country patterns might fail to capture the behavior of countries that dominate global reserve aggregates.

Table 3: USD share of foreign exchange reserves and geopolitical alignment

U.S. dollar share of official reserves	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fragment:	Low US UN Vote Agreement				Financial Sanction			
Fragment	0.114***	0.256***	0.259***	0.253***	0.126***	0.043	0.058	0.042
	(5.28)	(9.62)	(9.81)	(9.47)	(4.43)	(1.21)	(1.60)	(1.16)
InvTr	0.057	0.078**	0.112***	0.070**	0.121***	0.012	0.049*	0.009
	(1.65)	(3.11)	(4.19)	(2.76)	(4.86)	(0.55)	(2.06)	(0.39)
InvTr x Fragment	-0.001	-0.246***	-0.244***	-0.242***	-0.221***	-0.012	-0.051	-0.013
	(-0.02)	(-6.11)	(-6.09)	(-6.01)	(-3.77)	(-0.23)	(-0.95)	(-0.24)
NRC return diff.			1.140				0.327	
			(1.16)				(0.32)	
InvTr x NRC return diff.			-7.480***				-6.021***	
			(-4.29)				(-3.30)	
US shadow rate				-0.283				0.045
				(-0.90)				(0.14)
InvTr x US shadow rate				1.277*				1.137
				(2.18)				(1.89)
Constant	0.512***	0.502***	0.509***	0.508***	0.499***	0.515***	0.520***	0.516***
	(15.49)	(15.53)	(15.67)	(15.69)	(21.99)	(21.32)	(21.00)	(21.18)
N obs	1185	1189	1189	1189	1210	1214	1214	1214
N countries	74	74	74	74	75	75	75	75
Adj R2	0.57	0.58	0.59	0.58	0.56	0.55	0.56	0.55
Tranche Measure	Imports (3M)	ST Debt	ST Debt	ST Debt	Imports (3M)	ST Debt	ST Debt	ST Debt

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Columns(1)-(4) use *Low US UN vote agreement* as the measure of geopolitical fragmentation with the US while Columns (5)-(8) use *Financial Sanction*. *Low US UN vote agreement* is equal to 1 if the three year moving average of a country's UN voting agreement with the US is less than 0.4. *Financial Sanction* is an indicator equal to 1 if the US imposes a financial sanction on a country in a given year. *Dollar peg*, *Euro peg*, *Other peg*, *Trade with US*, *Trade with Euro Area*, *Dollar debt share*, *Euro debt share*, and *Euro Area dummy* from Table 2 are included in these specifications.

Having identified key drivers of dollar reserve shares in the weighted specification, we now examine

how these drivers changed for major reserve holders over the 2015-2020 period. For this exercise, we broaden our sample to include countries whose US dollar portfolio shares we do not observe but who rank among the world's most important foreign exchange reserve holders. While their portfolio allocations remain unobserved, we have more complete coverage of the macroeconomic drivers identified as quantitatively important in our weighted OLS estimates. Table 5 presents changes in these drivers for major reserve holders from 2015 to 2020.

Many key countries experienced notable declines in US geopolitical alignment, measured by the percentage point change in their US UN vote agreement. However, most countries did not shift between the "Low" alignment and the other categorical groups. China and Saudi Arabia experienced declines in both trade share with the US and dollar debt share from 2015 through 2020. For Russia and India, dollar debt share declined while trade share with the US either increased or remained stable. Switzerland and Korea increased in both categories.

Table 4: USD share of FX reserves using weighted OLS and corresponding Owen values.

	USD share		Contribution to R^2
	(1)	(2)	(3)
Dollar peg	0.101***	0.021	<0.03
	(0.038)	(0.100)	
Euro peg	-0.344***	-0.220***	<0.03
	(0.053)	(0.067)	
Trade with US	0.149	0.912***	0.15
	(0.128)	(0.262)	
Trade with Euro Area	-0.171	0.231**	0.07
	(0.119)	(0.092)	
Dollar debt share	0.176***	0.262***	0.22
	(0.054)	(0.081)	
Euro debt share	0.056	-0.010	0.04
	(0.053)	(0.063)	
Euro Area dummy	0.391***	0.621***	0.13
	(0.072)	(0.080)	
Low US UN Vote	0.257***	0.376***	0.07
	(0.076)	(0.125)	
InvTr: Short-term debt	0.078	0.294***	0.07
	(0.066)	(0.060)	
InvTr x Low US UN vote	-0.264**	-0.524**	0.04
	(0.116)	(0.235)	
Observations	1189	1189	1189
R^2	0.574	0.853	0.853
Weighted by FXR	No	Yes	Yes

*p<0.1; **p<0.05; ***p<0.01

Column (1) presents unweighted OLS. Column (2) presents weighted OLS. Robust standard errors clustered by country are reported. The third column, Contribution to R^2 of Column (2), presents the Owen values for the linear regression model estimated in Column (2).

These mixed patterns align with our earlier decomposition in Sections 2.2 and 2.3. Some countries' declining dollar shares reflect shifts away from US trade or dollar-denominated debt. However,

changes in reserve balances also played a major role: countries with large reserve accumulations affected the global aggregate through the interaction between their reserve growth and their initial dollar portfolio shares relative to the world average.

Although we lack portfolio data for several major reserve holders-including Japan, Singapore, Mexico, and the United Arab Emirates—we can assess whether their observed characteristics suggest they likely shifted away from dollar reserves during this period. Japan, Singapore, and Mexico all maintain above-median trade shares with the US, while the UAE's commodity exports are predominantly invoiced in USD. The USD serves as the anchor currency for most of these countries, with several maintaining de facto dollar pegs or bands. External debt shares denominated in USD remain high for this group.

The observed changes in these characteristics between 2015 and 2020 suggest these countries were unlikely to have reduced their dollar preferences, though the combination of low UN voting alignment for Singapore alongside high investment tranches could push in the opposite direction. Between 2015 and 2020, this unobserved group accumulated $330 billion in reserves, compared with $1,323 billion for the 72-country observed sample. On balance, this suggests the unobserved group likely supported rather than reduced the aggregate dollar share of COFER reserves during this period.

Table 5: Foreign Exchange Reserves and Drivers for Top Reserve Holders

			Change 2015 to 2020			
Country	FX reserves (USD bn)	Share Total FXR	ΔFX Reserves (USD bn)	ΔUS UN Vote	ΔTrade with US	ΔDollar Debt Share
China, People's Republic	3216.52	0.250	-113.84	-10.03	-1.67	-7.10
Japan	1312.79	0.102	133.29	-12.21	-0.33	2.62
Switzerland	1013.19	0.079	452.56	-9.26	5.35	0.00
India	542.16	0.042	214.32	-1.62	2.52	-3.18
Taiwan, PRC	529.91	0.041	103.88			
Hong Kong, PRC	491.63	0.038	132.97		-1.16	0.00
Russian Federation	444.49	0.035	135.11	-12.94	0.21	-5.11
Saudi Arabia	441.18	0.034	-162.81	-2.21	-4.09	-5.10
Singapore	359.34	0.028	113.62	-1.32	1.94	
Brazil	342.71	0.027	-6.15	9.12	-1.59	2.25

The table above reports data on a set of countries accounting for over 2% of the World's total reserves in 2020. FX reserves are reported in billions of USD, as of 2020. Columns 5-7 report the percentage-point change between 2015 and 2020 in key drivers of US dollar shares for these countries. Shaded cells represent Low UN Voting Alignment with the US.

4. Concluding remarks

Countries hold official foreign exchange reserve portfolios to meet liquidity and international capital needs in the event of disruptions to market access or for spot foreign exchange intervention purposes. While the majority of official reserve holdings is allocated to assets denominated in the big four currencies (dollars, yen, euros, pounds), commentary has focused on the reduced share of US dollar assets in an aggregate from across countries as an indicator of a declining role of the dollar in the international monetary system. Our exact decomposition formula emphasizes that this interpretation is misleading, as it conflates two channels: one arising through change in portfolio preferences of central banks and the other working through changes in official reserve stocks interacting with portfolio preferences. Large portfolio size changes upward or downward by countries with different portfolio allocations than the average across countries will tend to tilt global aggregates of the dollar share of reserve portfolios. This is a basic mechanical result, rather than a shift in preferences around holding US dollar assets. We use available data to show that the declines in the aggregate dollar share of COFER from 2015 through 2020 has been driven by a combination of both of these channels, inclusive of reserve accumulation by countries with a lower *ex ante* dollar share. Moreover, looking across these countries, the data show a distribution of increases and decreases in dollar portfolio shares, not a systematic decline in shares across countries.

We find evidence, from our sample of countries whose US dollar shares we observe, that a few countries with lower geopolitical alignment with the US and relatively large reserve portfolios are responsible for a substantial part of the decline in aggregate dollar shares. Geopolitical considerations do play a role in some of the longer term regression analytics, with these considerations driving some movement away from dollar assets mainly when country reserve portfolios are already large enough to meet their potential foreign currency liquidity needs. These countries start out with higher than average dollar shares in their portfolios. In addition, tilts away from the US in trade and away from USD in debt have shifted some portfolios away from dollars. The relative returns on sovereign assets – whether of traditional or nontraditional reserve currencies – have not played a large role in portfolio moves away from dollar assets.

We have worked within available data for presenting insights on the evolving role of the USD in official reserves. Future data, possibly with more extensive country coverage and a more complete time span, will reveal the contributions of ongoing changes in the global economy as trade patterns, and potentially financial considerations, evolve. Our estimation approach provides an approximation of the underlying dynamics of global demand for dollar reserves, and ways of decomposing the changes over time including by considering the relative importance of major reserve holding countries are taken into account. Monitoring the evolution of key macroeco-

nomic patterns of factors like trade exposure and external debt composition among the major reserve-holding economies may provide valuable insight into future shifts in the global demand for dollar-denominated reserves. Moreover, with liquidity a key consideration for foreign exchange reserve managers and central banks, monitoring of past and future diversification prospects should consider the scale of country investment tranches as that portion of the reserve portfolio may be more prone to diversification given the depth and liquidity of markets for US dollar assets.

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References

Adler, G., Chang, K.S., Mano, R., Shao, Y., 2025. Foreign exchange intervention: A data set of official data and estimates. Journal of Money, Credit and Banking 57, 1241–1273. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/jmcb.13137, doi:https://doi.org/10.1111/jmcb.13137, arXiv:https://onlinelibrary.wiley.com/doi/pdf/10.1111/jmcb.13137.

Aiyar, S., Presbitero, A., Ruta, M., 2023. Geoeconomic fragmentation: The economic risks from a fractured world economy. CEPR Press URL: https://cepr.org/publications/books-and-reports/geoeconomic-fragmentation-economic-risks-fractured-world-economy.

Aizenman, J., Cheung, Y.W., Qian, X., 2020. The currency composition of international reserves, demand for international reserves, and global safe assets. Journal of International Money and Finance 102, 102120. doi:https://doi.org/10.1016/j.jimonfin.2019.102120.

Aizenman, J., Riera-Crichton, D., 2008. Real exchange rate and international reserves in an era of growing financial and trade integration. The Review of Economics and Statistics 90, 812–815. URL: http://www.jstor.org/stable/40043117.

Aldasoro, I., Ehlers, T., 2018. Global liquidity: changing instrument and currency patterns. BIS Quarterly Review URL: https://www.bis.org/publ/qtrpdf/r_qt1809b.htm.

Arslanalp, S., Eichengreen, B., Simpson-Bell, C., 2022. The stealth erosion of dollar dominance and the rise of nontraditional reserve currencies. Journal of International Economics 138, 103656. doi:https://doi.org/10.1016/j.jinteco.2022.103656.

Bahaj, S., Fuchs, M., Reis, R., 2024. Dp19070 the global network of liquidity lines. CEPR Press URL: https://cepr.org/publications/dp19070.

Bank for International Settlements, 2025. Triennial Central Bank Survey of foreign exchange and Over-the-counter (OTC) derivatives markets in 2025. Technical Report. Bank for International Settlements. URL: https://www.bis.org/statistics/rpfx25.htm.

Bianchi, J., Sosa-Padilla, C., 2024. On wars, sanctions, and sovereign default. Journal of Monetary Economics 141, 62–70. doi:https://doi.org/10.1016/j.jmoneco.2023.10.011.

Blanchard, O.J., Adler, G., de Carvalho Filho, I., 2015. Can foreign exchange intervention stem exchange rate pressures from global capital flow shocks? IMF Working Paper URL: https://doi.org/10.5089/9781513585840.001. wP/15/159.

Boz, E., Casas, C., Georgiadis, G., Gopinath, G., Le Mezo, H., Mehl, A., Nguyen, T., 2022. Patterns of invoicing currency in global trade: New evidence. Journal of International Economics 136, 103604. doi:https://doi.org/10.1016/j.jinteco.2022.103604.

Bussière, M., Cheng, G., Chinn, M.D., Lisack, N., 2015. For a few dollars more: Reserves and growth in times of crises. Journal of International Money and Finance 52, 127–145. doi:https://doi.org/10.1016/j.jimonfin.2014.11.016.

Castelli, M., Salman, P., 2022. Ubs reserve manager survey 2022. Zurich: UBS URL: https://www.ubs.com/content/dam/assets/asset-management-reimagined/tw/en/Insights/investment-outlook/docs/annual-reserve-management-seminar-survey.pdf.

Chinn, M.D., Ito, H., McCauley, R.N., 2022. Do central banks rebalance their currency shares? Journal of International Money and Finance 122, 102557. URL: https://www.sciencedirect.com/science/article/pii/S0261560621002084.

Chiţu, L., Eichengreen, B., Mehl, A., 2014. When did the dollar overtake sterling as the leading international currency? evidence from the bond markets. Journal of Development Economics 111, 225–245. doi:https://doi.org/10.1016/j.jdeveco.2013.09.008.

Chupilkin, M., Javorcik, B., Peeva, A., Plekhanov, A., 2025. Dp20471 exorbitant privilege and economic sanctions URL: http://dx.doi.org/10.2139/ssrn.4584974. cEPR Discussion Paper No. 20471.

Cipriani, M., Goldberg, L.S., La Spada, G., 2023. Financial sanctions, swift, and the architecture of the international payment system. Journal of Economic Perspectives 37, 31–52.

Clayton, C., Maggiori, M., Schreger, J., 2026. A framework for geoeconomics. Econometrica 94, 105–136. URL: https://onlinelibrary.wiley.com/doi/abs/10.3982/ECTA23206, doi:https://doi.org/10.3982/ECTA23206, arXiv:https://onlinelibrary.wiley.com/doi/pdf/10.3982/ECTA23206.

Coppola, A., Krishnamurthy, A., Xu, C., 2023. Liquidity, Debt Denomination, and Currency Dominance. Working Paper 30984. National Bureau of Economic Research. URL: http://www.nber.org/papers/w30984, doi:https://doi.org/10.3386/w30984.

Corsetti, G., Eichengreen, B., Vives, X., Zettelmeyer, J., 2023. Barcelona 5: The international economic and financial order after the pandemic and war. URL: https://cepr.org/publications/books-and-reports/barcelona-5-international-economic-and-financial-order-after. iESE Banking Initiative.

De Gregorio, J., García, P., Luttini, E., Rojas, M., 2024. From dominant to producer currency pricing: Dynamics of chilean exports. Journal of International Economics 149, 103934. doi:https://doi.org/10.1016/j.jinteco.2024.103934.

Dominguez, K.M., Hashimoto, Y., Ito, T., 2012. International reserves and the global financial crisis. Journal of International Economics 88, 388–406. doi:https://doi.org/10.1016/j.jinteco.2012.03.003.

Dooley, M.P., Folkerts-Landau, D., Garber, P.M., 2022. US Sanctions Reinforce the Dollar's Dominance. Working Paper 29943. National Bureau of Economic Research. URL: http://www.nber.org/papers/w29943, doi:10.3386/w29943.

ECB, 2023. The international role of the euro. Technical Report. European Central Bank. URL: https://www.ecb.europa.eu/pub/ire/html/ecb.ire202306~d334007ede.en.html.

Eichengreen, B., Mathieson, D.J., 2001. The currency composition of foreign exchange reserves: Retrospect and prospect, in: The Impact of EMU on Europe and the Developing Countries. Oxford University Press. URL: https://doi.org/10.1093/acprof:oso/9780199245314.003.0010, doi:10.1093/acprof:oso/9780199245314.003.0010, arXiv:https://academic.oup.com/book/0/chapter/196636744/chapter-ag-pdf/44609770/book$_2$7187$_s$ection$_1$96636744.ag.pdf.

Eichengreen, B., Mehl, A., Chiţu, L., 2019. Mars or mercury? the geopolitics of international currency choice. Economic Policy 34, 315–363. doi:https://doi.org/10.1093/epolic/eiz005.

Faia, E., Salomao, J., Veghazy, A.V., 2023. Dp17454 granular investors and international bond prices: Scarcity-induced safety. CEPR Press URL: https://cepr.org/publications/dp17454. cEPR Discussion Paper No. 17454.

Felbermayr, G., Kirilakha, A., Syropoulos, C., Yalcin, E., Yotov, Y.V., 2020. The global sanctions data base. European Economic Review 129, 103561. doi:https://doi.org/10.1016/j.euroecorev.2020.103561.

Fratzscher, M., Gloede, O., Menkhoff, L., Sarno, L., Stöhr, T., 2019. When is foreign exchange intervention effective? evidence from 33 countries. American Economic Journal: Macroeconomics 11, 132–156. doi:10.1257/mac.20150317.

Goldberg, L., Hannaoui, O., 2024. Drivers of dollar share in official foreign exchange reserves. Federal Reserve Bank of New York Staff Report .

Goldberg, L., Tille, C., 2009. Macroeconomic interdependence and the international role of the dollar. Journal of Monetary Economics 56, 990–1003. doi:https://doi.org/10.1016/j.jmoneco.2009.09.008.

Goldberg, L.S., 2024. Global liquidity: Drivers, volatility and toolkits. IMF Economic Review URL: https://doi.org/10.1057/s41308-023-00208-9.

Goldberg, L.S., Hull, C., Stein, S.K., 2013. Do industrialized countries hold the right foreign exchange reserves? Federal Reserve Bank of New York: Current Issues in Economics and Finance 19. URL: https://www.newyorkfed.org/medialibrary/media/research/current_issues/ci19-1.pdf.

Goldberg, L.S., Krogstrup, S., 2023. International capital flow pressures and global factors. Journal of International Economics , 103749doi:https://doi.org/10.1016/j.jinteco.2023.103749.

Goldberg, L.S., Lerman, R., Reichgott, D., 2022. The u.s. dollar's global roles: Revisiting where things stand. Federal Reserve Bank of New York Liberty Street Economics URL: https://libertystreeteconomics.newyorkfed.org/2022/07/the-u-s-dollars-global-roles-revisiting-where-things-stand/.

Goldberg, L.S., Tille, C., 2008. Vehicle currency use in international trade. Journal of International Economics 76, 177–192. doi:https://doi.org/10.1016/j.jinteco.2008.07.001.

Gopinath, G., Itskhoki, O., 2010. Frequency of Price Adjustment and Pass-Through*. The Quarterly Journal of Economics 125, 675–727. URL: https://doi.org/10.1162/qjec.2010.125.2.675, doi:10.1162/qjec.2010.125.2.675, arXiv:https://academic.oup.com/qje/article-pdf/125/2/675/5319718/125-2-675.pdf.

Gopinath, G., Itskhoki, O., Rigobon, R., 2010. Currency choice and exchange rate pass-through. American Economic Review 100, 304–36. URL: https://www.aeaweb.org/articles?id=10.1257/aer.100.1.304, doi:10.1257/aer.100.1.304.

Gopinath, G., Stein, J.C., 2021. Banking, trade, and the making of a dominant currency. The Quarterly Journal of Economics 136, 783–830.

Huettner, F., Sunder, M., 2012. Axiomatic arguments for decomposing goodness of fit according to shapley and owen values. Electronic Journal of Statistics 6. doi:ttps://doi.org/10.1214/12-EJS710.

Iancu, A., Anderson, G., Ando, S., Boswell, E., Gamba, A., Hakobyan, S., Lusinyan, L., Meads, N., Wu, Y., 2022. Reserve currencies in an evolving international monetary system. Open Economies Review 33, 879–915. doi:https://doi.org/10.1007/s11079-022-09699-x.

Ilzetzki, E., Reinhart, C.M., Rogoff, K.S., 2019. Exchange arrangements entering the twenty-first century: Which anchor will hold? The Quarterly Journal of Economics 134, 599–646.

International Monetary Fund, 2016. Guidance note on the assessment of reserve adequacy and related considerations URL: www.imf.org/en/Publications/Policy-Papers/Issues/2016/12/31/Guidance-Note-on-the-Assessment-of-Reserve-Adequacy-and-Related-Considerations-PP5046. policy Paper.

International Monetary Fund, 2023. Annual Report on Exchange Arrangements and Exchange Restrictions 2022. IMF. ISBN: 9798400235269.

Irwin, D., Obstfeld, M., Posen, A., 2023. Floating exchange rates at fifty. Peterson Institute for International Economics. URL: https://www.piie.com/events/floating-exchange-rates-fifty.

Ishikawa, J., Galicia-Escotto, A., Angulo, E., 2015. Update on Reserve-Related Initiatives. Balance of Payments Statistics Report 15/23. International Monetary Fund. Washington, DC. URL: https://www.imf.org/external/pubs/ft/bop/2015/pdf/15-23.pdf.

Ito, H., Chinn, M., 2015. The rise of the redback: evaluating the prospects for renminbi use in invoicing. Renminbi internationalization: achievements, prospects, and challenges, Brookings Institution Press and the Asian Development Bank Institute , 111–58.

Ito, H., McCauley, R.N., 2020. Currency composition of foreign exchange reserves. Journal of International Money and Finance 102, 102104. doi:https://doi.org/10.1016/j.jimonfin.2019.102104.

Itskhoki, O., Mukhin, D., 2023. International sanctions and limits of lerner symmetry. AEA Papers and Proceedings 113:, 33–38.

Jeanne, O., Rancière, R., 2011. The optimal level of international reserves for emerging market countries: A new formula and some applications. The Economic Journal 121, 905–930.

Kempf, E., Luo, M., Schäfer, L., Tsoutsoura, M., 2023. Political ideology and international capital allocation. Journal of Financial Economics 148, 150–173.

Kirikakha, A., Felbermayr, G.J., Syropoulos, C., Yalcin, E., Yotov, Y.V., 2021. The global sanctions data base (gsdb): an update that includes the years of the trump presidency. Research Handbook on Economic Sanctions , 62–106.

Köhler, R., 2012. The currency composition of official foreign exchange reserves: Cofer data and reporting to the imf. Presentation, IMF. URL: https://dsbb.imf.org/content/pdfs/SDDSPlus_WS_Presentation_COFER.pdf. special Data Dissemination Standard Workshop.

Krippner, L., 2016. Documentation for measures of monetary policy. Reserve Bank of New Zealand URL: https://www.rbnz.govt.nz/-/media/project/sites/rbnz/files/research/additional-research/leo-krippner/5892888.pdf.

Laser, F., Mihailov, A., Weidner, J., 2024. Currency compositions of international reserves: Recent developments. Bank of Finland Institute for Emerging Economies Policy Brief 6, 1–8.

Maggiori, M., 2017. Financial intermediation, international risk sharing, and reserve currencies. American Economic Review 107, 3038–3071.

Maggiori, M., Neiman, B., Schreger, J., 2020. International currencies and capital allocation. Journal of Political Economy 128, 2019–2066.

Miranda-Agrippino, S., Rey, H., 2020. Us monetary policy and the global financial cycle. The Review of Economic Studies 87, 2754–2776.

Mosler, M., Potrafke, N., 2020. International political alignment during the trump presidency: voting at the un general assembly. International interactions 46, 481–497.

Prasad, E., 2019. Has the dollar lost ground as the dominant international currency. Brookings Institution Report URL: https://www.brookings.edu/wp-content/uploads/2019/09/DollarInGlobalFinance.final_.9.20.pdf.

Schanz, J.F., 2019. Reserve management in emerging market economies: trends and challenges. BIS Paper URL: https://www.bis.org/publ/bppdf/bispap104c_rh.pdf.

Syropoulos, C., Felbermayr, G., Kirilakha, A., Yalcin, E., Yotov, Y.V., 2022. The global sanctions data base–release 3: Covid-19, russia, and multilateral sanctions. Review of International Economics 32, 12–48.

TheClearingHouse, 2023. About chips. URL: https://www.theclearinghouse.org/payment-systems/chips.

Voeten, E., 2009. United Nations General Assembly Ideal Points. Harvard Dataverse V37, UNF:6:1CMqSxsE5nOfylDPJckCqQ== [fileUNF]. URL: https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/LEJUQZ, doi:10.7910/DVN/LEJUQZ.

Weiss, C., 2022. Geopolitics and the us dollar's future as a reserve currency. Federal Reserve Board of Governors URL: http://dx.doi.org/10.17016/IFDP.2022.1359. international Finance Discussion Paper (1359).

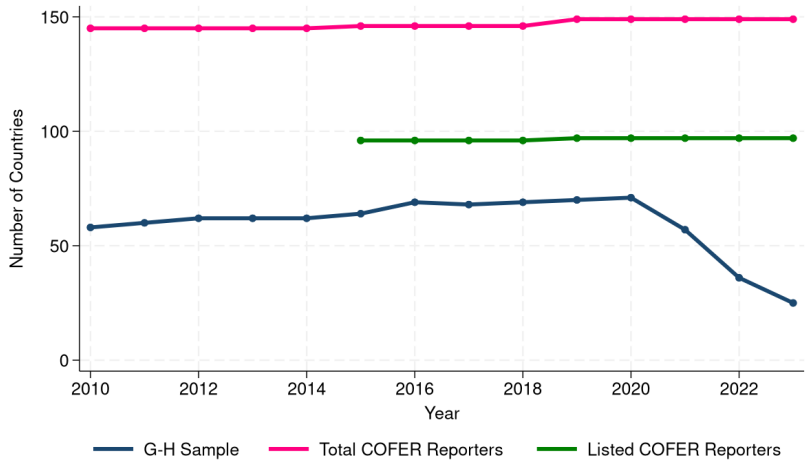
Appendix A. Appendix

A1. Data Sources and Descriptives

Table A1: Data Sources

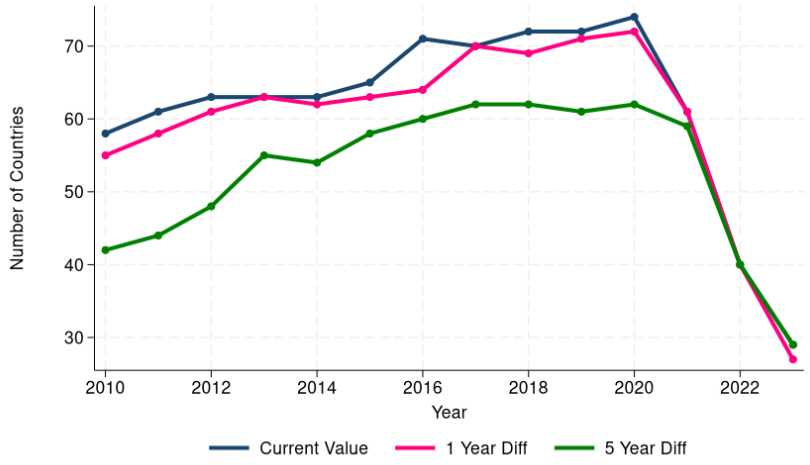
Variable	Description	Data Source
U.S dollar share of official reserves	Share of country official foreign exchange reserves in USD	Primarily Ito and McCauley (2020); Chinn, Ito and McCauley (2022), additional data from Arslanalp, Eichengreen and Simpson-Bell (2022) and Laser, Mihailov and Weidner (2024)
Total foreign exchange reserves (USD Billion)	Total foreign exchange reserves excluding gold	IMF International Financial Statistics (IFS)
Dollar, Euro, Other Peg	Reserve currency to which a country pegs its exchange rate	Ilzetzki, Reinhart and Rogoff (2019)
Share of trade with US, Euro Area, Japan, and UK	Share of external trade (exports plus imports) with each Big Four currency country issuer	IMF Direction of Trade statistics (DOTS)
Dollar and Euro debt share	Share of each country's external debt service payments denominated in US dollars and euros	World Bank International Debt Statistics (IDS) supplemented with BIS Locational Banking Statistics
US and EA Shadow Rate	Measures the stance of monetary policy in the presence of a zero lower bound environment from Krippner (2016)	LJK Macro Finance Analysis
Zero Lower Bound	Indicator that equals 1 if the shadow rate is at or below zero	LJK Macro Finance Analysis
US UN vote agreement share	Country's average alignment with the United States	Voeten (2009)
Financial sanction	Indicator for whether the U.S. imposed a financial sanction on the specified country	Syropoulos, Felbermayr, Kirilakha, Yalcin and Yotov (2022) and Kirikakha, Felbermayr, Syropoulos, Yalcin and Yotov (2021)
Short term debt	Sum of short-term liabilities to BIS banks and short-term international debt securities by year	World Bank Joint External Data Hub (JEDH)
3-months imports	Yearly totals of total goods and services imports divided by four	IMF International Financial Statistics (IFS)
NRC return (percentage)	Weighted average of 5-year government bond yields from Australia, Canada, and South Korea with weights of 40%, 45%, and 10%, respectively	Bank of Korea, Bank of Canada, and Reserve Bank of Australia, with weights from Arslanalp, Eichengreen and Simpson-Bell (2022)
NRC return differential (percentage)	Nontraditional reserve currency return minus the U.S. 5-Year yield	Bank of Korea, Bank of Canada, Reserve Bank of Australia, U.S. Treasury

Figure A1: Number of Countries with Available USD Share Data Relative to the Number of COFER Reporters



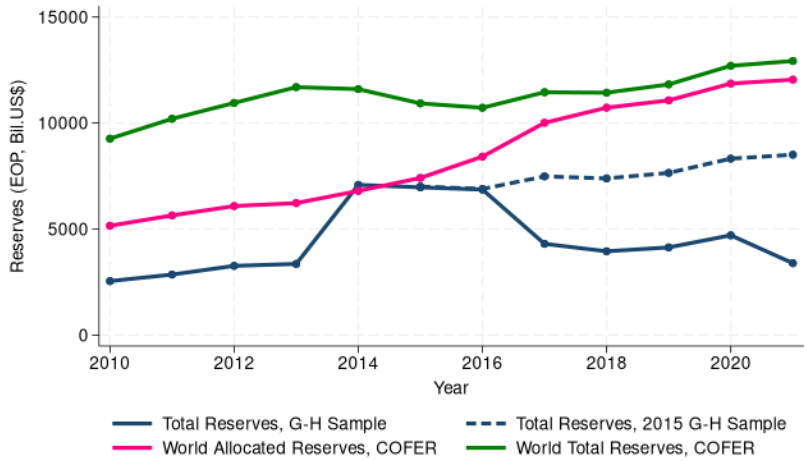
G-H Sample (Goldberg-Hannaoui) refers to countries included in this paper's USD share regression analysis, *Total COFER Reporters* refers to the countries who are included in the COFER data, *Listed COFER Reporters* refers to the countries who volunteer to report their participation in COFER (beginning 2015). While yearly data on the number of COFER reporters is not available, there were 145 reporters as of 2012 (Köhler, 2012), 146 reporters as of 2015 of which 96 disclosed participation (Ishikawa et al., 2015), and 149 reporters as of 2019 of which 97 disclosed participation (Prasad, 2019).

Figure A2: Number of Countries with Available Data on the Dollar Share of FX Reserves: Current Value, 1 Year Difference, and 5 Year Difference



Source: Author construction based on Ito and McCauley (2020); Chinn, Ito and McCauley (2022) supplemented with Arslanalp, Eichengreen and Simpson-Bell (2022) and Laser, Mihailov and Weidner (2024). Current Value indicates whether a country has available USD Share data in a given year, 1 Year Diff indicates whether a country has available USD Share data in a given year as well as in the prior year, and 5 Year Diff indicates whether a country has available USD Share data in a given year as well as in the year five prior.

Figure A3: Dollar Coverage of World Reserves



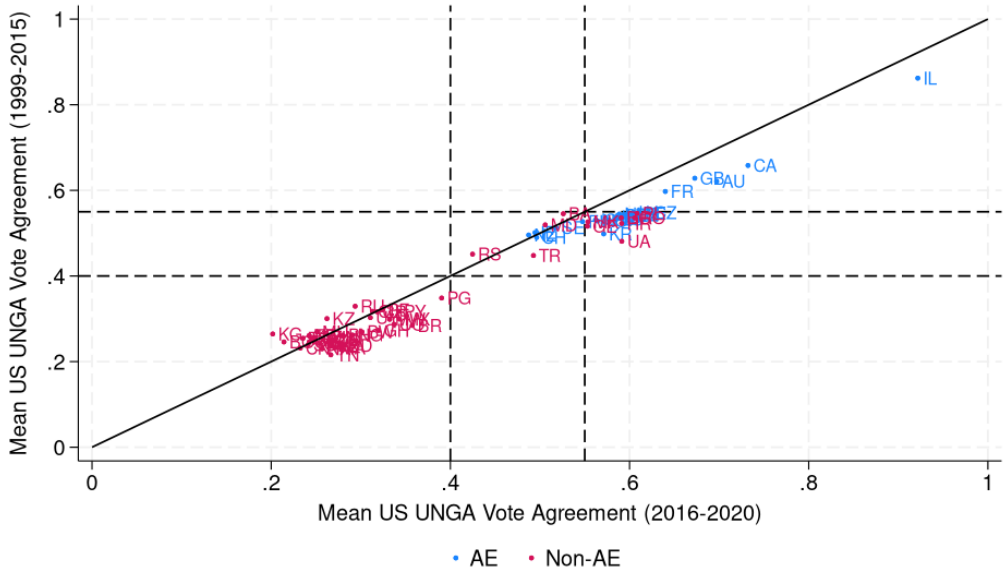
Source: Author construction using IMF COFER year-end values; Ito and McCauley (2020); Chinn, Ito and McCauley (2022) supplemented with Arslanalp, Eichengreen and Simpson-Bell (2022) and Laser, Mihailov and Weidner (2024). Total Reserves, G-H Sample indicates aggregate FX reserves for all countries in *G-H Sample* (see Figure A1). Total Reserves, 2015 G-H Sample indicates post-2015 aggregate FX reserves for the 72 countries included in the decomposition analysis in Section 2.

Table A2: US UNGA vote agreement country groupings

Agreement Level	Country	N
Low ($Agreement \leq 0.4$)	Kyrgyz Republic, Tajikistan, Bolivia, Azerbaijan, Lesotho, South Africa, Morocco, Uganda, Ecuador, Bangladesh, Seychelles, Botswana, Mauritius, Sri Lanka, Tunisia, Ghana, Zambia, Namibia, Philippines, Mozambique, Tanzania, China, Kenya, Costa Rica, Kazakhstan, Malawi, Mexico, Brazil, Chile, Paraguay, Uruguay, Peru, India, Colombia, Nigeria, Russia, Papua New Guinea	37
Middle ($0.4 < Agreement < 0.55$)	Switzerland, Serbia, Turkey, Ireland, New Zealand, Georgia, Bosnia and Herzegovina, Sweden, Ukraine, Finland, Croatia, Moldova, Germany	15
High ($0.55 \leq Agreement$)	Iceland, Netherlands, Belgium, Spain, Bulgaria, Romania, Italy, Denmark, Poland, Macedonia, Korea Republic, Norway, Luxembourg, Portugal, Lithuania, Latvia, Czech Republic, Slovenia, France, Estonia, United Kingdom, Australia, Canada, Israel	22

Source: Author's groupings using UN General Assembly voting data described in Voeten (2009). Time-invariant groupings constructed using median US UNGA vote agreement from 1999-2023. Countries displayed in ascending order of vote agreement. Time-varying groupings in regression specifications were constructed using the annual 3-year moving average of US UNGA vote agreement.

Figure A4: Country Voting Alignment with United States at UNGA



Source: Author's construction using data from the UN General Assembly (UNGA) voting data described in Voeten (2009). Larger values represent greater voting alignment. AE represents Advanced Economies.

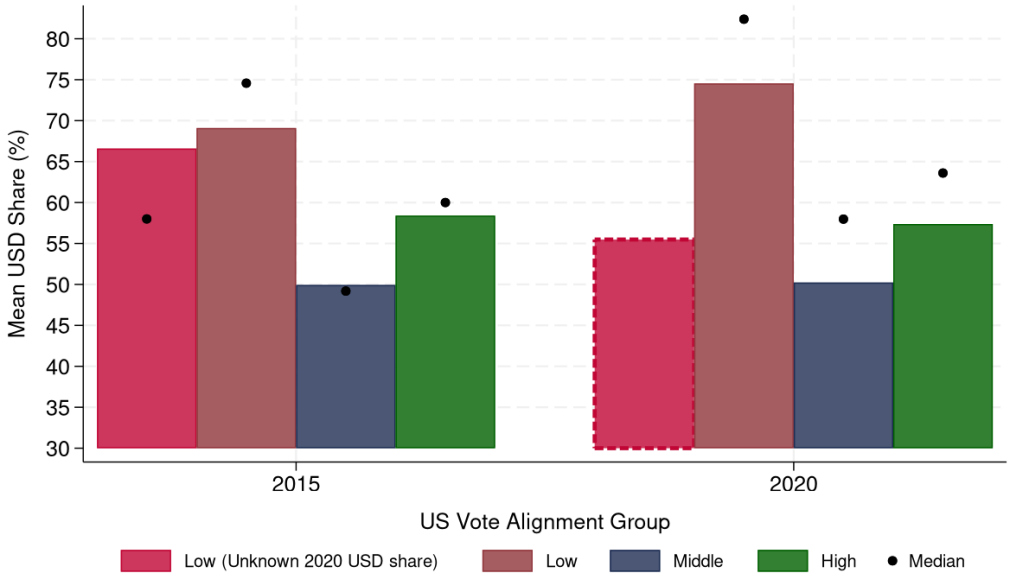
Table A3: 2015-2020 Change in USD Share and Related Variables Based on US UNGA Voting Alignment

Geopolitical Alignment	2015 Country Count	Change from 2015 to 2020											
		USD Share			Investment Tranche			US Trade Share			US Debt Share		
		+	-	N/A	+	-	N/A	+	-	N/A	+	-	N/A
Low Alignment	35	19	13	3	19	14	2	13	22	0	21	13	1
China	1	0	0	1	0	1	0	0	1	0	0	1	0
India	1	0	0	1	1	0	0	1	0	0	0	1	0
Nigeria	1	0	0	1	0	1	0	0	1	0	1	0	0
Russia	1	0	1	0	1	0	0	1	0	0	0	1	0
Medium/High Alignment	35	17	18	0	30	5	0	20	15	0	15	20	0
Unknown Alignment	2	2	0	0	0	1	1	1	1	0	1	0	1

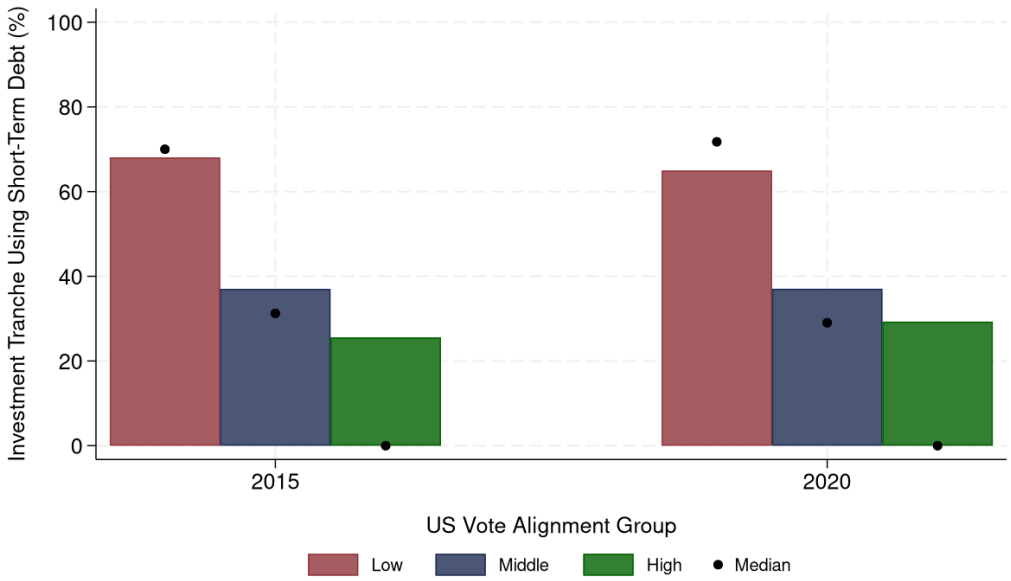
Note: The 72 countries used in Section 2 are grouped by their 2015 US UNGA voting alignment group (based on annual 3-year moving average of US UNGA vote agreement). Investment tranche is constructed using short term debt. West Bank & Gaza and Hong Kong do not have UN voting scores. N/A indicates missing data. Countries with a 3-year moving average of less than 0.4 are considered "Low," all others "Medium & High." Source: Author's groupings using UN General Assembly voting data described in Voeten (2009).

Figure A5: UN alignment differences in US dollar share and short-term debt investment tranche

(a) Average US dollar share (percent), by US UN Vote alignment group



(b) Average investment tranche using short-term debt, by US UN Vote alignment group



Source: Author's construction using country-level US dollar share data from Ito and McCauley (2020); Chinn, Ito and McCauley (2022) supplemented with Arslanalp, Eichengreen and Simpson-Bell (2022) and Laser, Mihailov and Weidner (2024), short-term debt data from the BIS Joint External Debt Hub (JEDH), and UN General Assembly voting data from Voeten (2009). Dashed bar outline in Panel (a) indicates estimated US dollar share for China, India, and Nigeria (all in the Low Alignment group) which are missing 2020 data; their 2020 values are imputed using the estimated -11.1 percentage point decline under the COFER scenario from Table 1.

A2. Exact Decomposition

The following derivation proceeds via a series of simple algebraic manipulations and identities. Recall, the world USD share, denoted Worldσ_t, of Reserves at year t is:

$$\text{World}\sigma_t = \frac{\sum_{\forall i} \sigma_{i,t} \cdot R_{i,t}}{\text{WorldR}_t},$$

where $\sigma_{i,t}$ represents the portfolio preferences for USD assets of country i, as a share of total country foreign exchange reserves $R_{i,t}$. Now let $t_2 > t_1$ and define $\Delta X := X_{t_2} - X_{t_1}$ for any time series X_t. Then,

$$\Delta\text{World}\sigma = \frac{\sum_{\forall i} \sigma_{i,t_2} \cdot R_{i,t_2}}{\text{WorldR}_{t_2}} - \frac{\sum_{\forall i} \sigma_{i,t_1} \cdot R_{i,t_1}}{\text{WorldR}_{t_1}}.$$

After factoring, we have:

$$\Delta\text{World}\sigma = \frac{(\text{WorldR}_{t_1})(\sum_{\forall i} \sigma_{i,t_2} \cdot R_{i,t_2}) - (\text{WorldR}_{t_2})(\sum_{\forall i} \sigma_{i,t_1} \cdot R_{i,t_1})}{\text{WorldR}_{t_1}\,\text{WorldR}_{t_2}}. \tag{A1}$$

Noting that $R_{i,t_2} = R_{i,t_1} + \Delta R_i$, $\sigma_{i,t_2} = \sigma_{i,t_1} + \Delta\sigma_i$, and $\text{WorldR}_{t_2} = \text{WorldR}_{t_1} + \Delta\text{WorldR}$, we expand the **numerator**:

$$\text{World}R_{t_1}\left[\sum_{\forall i}\left(\sigma_{i,t_1} + \Delta\sigma_i\right)\left(R_{i,t_1} + \Delta R_i\right)\right] - \left(\text{World}R_{t_1} + \Delta\text{World}R\right)\left(\sum_{\forall i} \sigma_{i,t_1} R_{i,t_1}\right).$$

Expanding both sums yields:

$$\begin{aligned}
&= (\text{WorldR}_{t_1})(\sum_{\forall i} \sigma_{i,t_1} \cdot R_{i,t_1}) + (\text{WorldR}_{t_1})(\sum_{\forall i} \sigma_{i,t_1} \cdot \Delta R_i) \quad + \\
&\quad (\text{WorldR}_{t_1})(\sum_{\forall i} \Delta\sigma_i \cdot R_{i,t_1}) + (\text{WorldR}_{t_1})(\sum_{\forall i} \Delta\sigma_i \cdot \Delta R_i) \quad - \\
&\quad \left((\text{WorldR}_{t_1})(\sum_{\forall i} \sigma_{i,t_1} \cdot R_{i,t_1}) + (\Delta\text{WorldR})(\sum_{\forall i} \sigma_{i,t_1} \cdot R_{i,t_1})\right).
\end{aligned}$$

Note the $(\text{WorldR}_{t_1})(\sum_{\forall i} \sigma_{i,t_1} \cdot R_{i,t_1})$ term cancels out. We now substitute this back into the numerator of the $\Delta\text{World}\sigma$ formulation from Equation A1. Re-expanding out the sum and factoring out constant terms when possible yields:

$$\begin{aligned}
\Delta\text{World}\sigma = &\frac{\sum_{\forall i}(\sigma_{i,t_1} \cdot \Delta R_i)}{\text{WorldR}_{t_2}} + \frac{\sum_{\forall i}(\Delta\sigma_i \cdot R_{i,t_1})}{\text{WorldR}_{t_2}} \quad + \\
&\frac{\sum_{\forall i}(\Delta\sigma_i \cdot \Delta R_i)}{\text{WorldR}_{t_2}} - \frac{(\Delta\text{WorldR})\sum_{\forall i}(\sigma_{i,t_1} \cdot R_{i,t_1})}{\text{WorldR}_{t_2} \cdot \text{WorldR}_{t_1}}.
\end{aligned}$$

Next, simply note that $\sum_{\forall i}(\sigma_{i,t_1} \cdot R_{i,t_1}) = \text{World}\sigma_{t_1} \cdot \text{WorldR}_{t_1}$ (i.e., global dollar holdings are just the sum of dollar holdings across all countries) so the final term can be simplified:

$$\Delta\text{World}\sigma = \frac{\sum_{\forall i}(\sigma_{i,t_1} \cdot \Delta R_i)}{\text{WorldR}_{t_2}} + \frac{\sum_{\forall i}(\Delta\sigma_i \cdot R_{i,t_1})}{\text{WorldR}_{t_2}} + \frac{\sum_{\forall i}(\Delta\sigma_i \cdot \Delta R_i)}{\text{WorldR}_{t_2}} - \text{World}\sigma_{t_1} \cdot \frac{\Delta\text{WorldR}}{\text{WorldR}_{t_2}}.$$

Adding and subtracting $\frac{\sum_{\forall i}\text{World}\sigma_{t_1}\cdot\Delta R_i}{\text{WorldR}_{t_2}}$, then grouping yields:

$$\Delta\text{World}\sigma = \frac{\sum_{\forall i}\Delta R_i(\sigma_{i,t_1} - \text{World}\sigma_{t_1})}{\text{WorldR}_{t_2}} + \frac{\sum_{\forall i}(\Delta\sigma_i \cdot R_{i,t_1})}{\text{WorldR}_{t_2}} + \underbrace{\frac{\sum_{\forall i}\Delta R_i(\Delta\sigma_i + \text{World}\sigma_{t_1})}{\text{WorldR}_{t_2}} - \text{World}\sigma_{t_1} \cdot \frac{\Delta\text{WorldR}}{\text{WorldR}_{t_2}}}_{(\diamond)}.$$

Noting that $\sum_{\forall i}\Delta R_i = \Delta\text{WorldR}$, we can simplify the final two terms of above, denoted $(\diamond)$, factoring out constant terms when appropriate:

$$\begin{aligned}
(\diamond) \quad & \frac{\sum_{\forall i}\Delta R_i(\Delta\sigma_i + \text{World}\sigma_{t_1})}{\text{WorldR}_{t_2}} - \text{World}\sigma_{t_1} \cdot \frac{\Delta\text{WorldR}}{\text{WorldR}_{t_2}} \\
&= \frac{\sum_{\forall i}\Delta R_i\,\Delta\sigma_i}{\text{World}R_{t_2}} + \frac{\text{World}\sigma_{t_1}}{\text{World}R_{t_2}}(\sum_{\forall i}\Delta R_i) - \frac{\text{World}\sigma_{t_1}}{\text{World}R_{t_2}}\,\Delta\text{World}R \\
&= \frac{\sum_{\forall i}\Delta R_i\,\Delta\sigma_i}{\text{World}R_{t_2}} + \frac{\text{World}\sigma_{t_1}}{\text{World}R_{t_2}}\,\Delta\text{World}R - \frac{\text{World}\sigma_{t_1}}{\text{World}R_{t_2}}\,\Delta\text{World}R \\
&= \frac{\sum_{\forall i}\Delta R_i\,\Delta\sigma_i}{\text{World}R_{t_2}}.
\end{aligned}$$

Hence, the final decomposition is a simple formulation inclusive of a second order cross-term,

$$\Delta\text{World}\sigma = \frac{\sum_{\forall i}\Delta R_i\,(\sigma_{i,t_1} - \text{World}\sigma_{t_1})}{\text{World}R_{t_2}} + \frac{\sum_{\forall i}\Delta\sigma_i\,R_{i,t_1}}{\text{World}R_{t_2}} + \frac{\sum_{\forall i}\Delta R_i\,\Delta\sigma_i}{\text{World}R_{t_2}}.$$

■

Appendix B. Online Appendix

Table B1: Country Coverage in USD Share and Geopolitical Alignment with the U.S.

	USD Share			Geopolitical Alignment with U.S.	
Country	Coverage Period	Min (%)	Max (%)	Sanction Years	US-UNGA (mean)
Australia	1999-2023	40.0	55.0		65.2
Azerbaijan	2001-2022	58.4	97.8	1999-2002, 2022	23.8
Bangladesh	2006-2023	16.4	86.0	2021-2023	26.1
Belgium	1999-2021	84.1	99.5		55.6
Bolivia	2003-2021	58.6	100.0	2011-2021	22.0
Bosnia and Herzegovina	2001-2023	0.0	2.5	2001-2023	53.5
Botswana	2019-2020	49.6	55.5		21.6
Brazil	2002-2023	55.6	90.6	2021-2023	30.4
Bulgaria	1999-2023	0.0	13.9	2001-2023	56.5
Canada	2003-2022	45.9	73.4		70.7
Chile	1999-2023	51.3	79.9		32.2
China	2014-2016	58.0	59.0		28.7
Colombia	2000-2022	80.3	88.8	2000-2022	30.2
Costa Rica	2016-2020	89.7	91.7	2016-2020	31.8
Croatia	2000-2021	11.3	32.6	2021	54.3
Czech Republic	1999-2021, 2023	30.6	30.6		76.6
Denmark	1999, 2001-2023	0.0	10.7		56.8
Ecuador	2018-2020	99.8	99.9		21.2
Estonia	2010-2021	47.9	99.5		60.9
Finland	2001-2023	30.0	86.3		54.2
France	2018-2021	81.1	83.7		60.6
Georgia	2001-2021	44.7	84.9		52.0
Germany	2001-2023	85.0	100.0		57.3
Ghana	2003-2023	69.5	98.4	2018-2023	28.5
Hong Kong, PRC	1999-2023	77.0	91.5	2020-2023	.
Iceland	2005-2023	36.0	57.1		56.1
India	2015-2017	57.8	57.8		31.2
Ireland	2016-2020	0.1	42.7		49.4
Israel	2011-2023	61.0	69.1	2023	92.5
Italy	2005-2021	61.3	71.4		56.3
Kazakhstan	1999-2021	15.2	91.7		29.0
Kenya	2002-2003, 2005-2023	32.7	81.4	2012-2014, 2017-2023	26.2
Korea	2007-2021	57.3	70.3		55.3
Kyrgyz Republic	2003-2021	25.5	79.7	2020-2021	23.6
Latvia	2005-2021	57.1	80.0	2019-2021	57.7
Lesotho	2016-2020	31.1	74.3	2020	26.9
Lithuania	2020-2021	68.0	70.2		59.4
Luxembourg	2003-2020	50.2	98.5		54.5
Macedonia	2008-2022	0.0	59.2	2008-2022	58.4

Note: Continued below.

Table B1 Continued

	USD Share			Geopolitical Alignment with U.S.	
Country	Coverage Period	Min (%)	Max (%)	Sanction Years	US-UNGA (mean)
Malawi	2008-2022	51.4	99.6		33.5
Mauritius	2016-2020	64.6	70.8		25.1
Mexico	2020	93.1	93.1		24.7
Moldova	2011-2022	42.1	73.6	2022	55.1
Morocco	2016-2020	33.6	39.8	2016-2020	27.1
Mozambique	2007-2022	41.5	83.6	2021-2022	26.0
Namibia	2007-2023	12.6	64.0		24.9
Netherlands	1999-2021	51.8	99.7		55.8
New Zealand	2008-2023	18.6	27.6		53.0
Nigeria	2010-2015	82.0	90.7	2013-2015	30.6
Norway	1999-2019	21.9	53.9		54.0
Papua New Guinea	2005-2022	27.4	79.8		37.1
Paraguay	2002-2020	71.7	99.9		31.3
Peru	2000-2022	60.2	93.2	2022	32.0
Philippines	2005-2021	75.4	97.5	2005-2021	27.0
Poland	2001-2022	35.1	51.0		56.6
Portugal	2012-2021	62.8	100.0		57.9
Romania	1999-2022	10.7	88.2		56.2
Russia Federation	2007-2021	13.9	55.3	2014-2021	31.4
Serbia	2006-2021	20.3	36.4	2003, 2005-2021	44.9
Seychelles	2016-2020	90.0	95.5		24.1
Slovenia	2008-2022	67.6	100.0	2021-2022	59.3
South Africa	2004-2023	45.1	87.3	2019-2023	24.0
Spain	1999-2021	67.4	100.0		54.7
Sri Lanka	2008-2013, 2015-2022	25.5	84.6	2022	26.0
Sweden	1999-2023	7.6	62.2		53.1
Switzerland	2005-2020	24.8	36.2	2023	50.0
Tajikistan	2008-2021	26.7	99.1		24.2
Tanzania	2008-2023	48.1	79.9	2016, 2021-2023	28.5
Tunisia	2012-2021	29.9	47.0	2012-2021	25.5
Turkey	2005-2023	30.2	84.0	2018, 2020-2023	48.0
Uganda	2006-2023	17.8	98.1	2021-2023	24.1
Ukraine	2001-2023	46.1	86.7	2014-2023	53.2
United Kingdom	1999-2020	23.9	50.4		63.8
Uruguay	2010-2020, 2023	97.0	97.0		41.8
Zambia	2004-2023	37.1	95.9		25.6

Note: The sample includes the 75 countries used in Section 3. Coverage period refers to the years in which the country's dollar share is included in the database on portfolio composition. Min (%) and Max(%) refer to the minimum and maximum reported USD share of foreign exchange reserves reported by each country. Sanction Years represents the years in which the US imposed a financial sanction on the country, if any, sourced from Felbermayr, Kirilakha, Syropoulos, Yalcin and Yotov (2020). US-UNGA (mean) refers to the country's average alignment with the United States in United Nations General Assembly (UNGA) voting data described in Voeten (2009).

Table B2: Reserve Portfolio Share Changes, 2015 to 2020

	Decrease in σ_i from 2015 to 2020			**Increase in σ_i from 2015 to 2020**		
Rank	Country	2015 FXR (Bil. USD)	σ_i Decline (2015 to 2020)	Country	2015 FXR (Bil. USD)	σ_i Increase (2015 to 2020)
1	Macedonia	2.2	-51.1	Sweden	49.8	51.1
2	Portugal	5.0	-34.9	Sri Lanka	6.5	44.4
3	Spain	38.7	-25.1	Uganda	2.8	43.3
4	Turkey	91.4	-24.2	Ireland	0.7	42.6
5	Namibia	1.7	-22.9	Kyrgyz Republic	1.4	37.7
6	Chile	37.2	-20.2	Papua New Guinea	1.7	30.8
7	Luxembourg	0.2	-18.4	Romania	35.2	24.6
8	Russia Federation	309.4	-15.5	Kazakhstan	19.8	18.2
9	Mozambique	2.3	-13.4	Kenya	7.5	16.1
10	Bolivia	11.4	-11.7	Malawi	0.7	14.4
11	Croatia	14.5	-11.5	Azerbaijan	5.8	14.0
12	China	3330.4	↓	South Africa	38.9	12.8
13	India	327.8	-11.1*	Paraguay	5.5	12.7
14	Nigeria	26.0	↑	Poland	89.4	12.0
15	Georgia	2.3	-10.5	Tanzania	3.9	11.6
16	Netherlands	8.8	-9.8	Iceland	4.8	11.2
17	Germany	36.4	-7.1	United Kingdom	101.6	10.4
18	Serbia	10.7	-7.0	Latvia	3.1	9.6
19	Morocco	21.1	-6.2	Zambia	2.5	8.2
20	Peru	59.4	-5.7	Czech Republic	62.6	8.0
21	New Zealand	13.1	-4.7	Finland	6.2	7.9
22	Lesotho	0.9	-4.3	West Bank and Gaza	0.6	5.4
23	Brunei	2.9	-4.2	Tunisia	7.1	4.1
24	Canada	69.1	-3.9	Switzerland	560.6	3.8
25	Colombia	44.8	-3.1	Uruguay	15.2	3.5
26	Bosnia and Herzegovina	4.7	-2.2	Brazil	348.9	3.5
27	Estonia	0.3	-2.1	Moldova	1.7	3.2
28	Belgium	8.5	-1.3	Hong Kong, PRC	358.7	3.0
29	Tajikistan	0.0	-1.1	Bangladesh	25.8	2.6
30	Costa Rica	7.6	-1.0	Philippines	72.4	2.4
31	Ukraine	12.4	-1.0	Seychelles	0.5	1.7
32	Bulgaria	19.9	-0.7	Ghana	5.2	1.5
33	Israel	88.9	-0.6	Korea	358.5	1.1
34	Mauritius	3.8	-0.2	Italy	34.4	1.0
35	Australia	37.2	0.0	Norway	54.6	1.0
36	Denmark	60.1	0.0	Slovenia	0.3	0.8

Note: Changes in σ_i are shown in percentage points. Foreign exchange reserves (FXR) in 2015 and available changes in USD share from 2015 to 2020 ($\Delta\sigma_i$) are provided for the 72 countries used in Section 2. The 11.1* value represents the aggregate $\Delta\sigma_{i\in\{70,71,72\}}$ for China, India, and Nigeria (which are missing 2020 dollar shares) implied by Equation 1. It is computed under the assumption that the sample's decline in USD share matches the COFER-reported decline (–6.8 percentage points); alternative assumptions would yield different values.

Table B3: Changes in Reserve Levels, 2015 to 2020

	Change in R_i from 2015 to 2020						
Rank	Country	2015 σ_i (%)	Change in R_i (Bil. USD)	Rank	Country	2015 σ_i (%)	Change in R_i (Bil. USD)
1	Switzerland	32.4	452.6	37	Latvia	60.0	1.7
2	India	57.8	214.3	38	Estonia	55.3	1.6
3	Russia Federation	43.1	135.1	39	Mozambique	72.1	1.5
4	Hong Kong, PRC	86.5	133.0	40	Macedonia	59.2	1.5
5	Czech Republic	14.8	101.5	41	Georgia	81.7	1.4
6	Israel	68.4	82.3	42	Tajikistan	97.5	1.3
7	Korea	66.6	71.6	43	Iceland	43.0	1.2
8	Poland	39.0	49.1	44	Tanzania	68.3	1.0
9	United Kingdom	40.0	38.0	45	Papua New Guinea	43.8	0.9
10	Philippines	88.7	24.1	46	Kenya	64.1	0.8
11	Spain	94.1	18.0	47	Uruguay	94.5	0.6
12	Norway	52.8	17.0	48	Chile	71.5	0.6
13	Bangladesh	82.8	15.2	49	Uganda	54.7	0.5
14	Ukraine	81.6	15.2	50	Germany	92.0	0.5
15	Bulgaria	0.8	14.5	51	Brunei	100.0	0.5
16	Morocco	39.8	12.6	52	Namibia	64.0	0.5
17	Peru	77.1	12.2	53	Slovenia	99.1	0.3
18	Italy	67.5	12.2	54	Kyrgyz Republic	35.6	0.2
19	Colombia	88.6	11.9	55	West Bank and Gaza	93.3	0.1
20	Romania	12.3	9.3	56	Luxembourg	93.2	0.0
21	Nigeria	83.9	8.4	57	Seychelles	92.6	0.0
22	Croatia	24.8	8.3	58	Malawi	85.1	-0.1
23	Canada	67.5	7.7	59	Lesotho	35.3	-0.2
24	Denmark	0.0	5.5	60	Portugal	100.0	-0.2
25	South Africa	49.9	5.3	61	Costa Rica	90.7	-0.6
26	Ireland	0.1	4.2	62	New Zealand	24.3	-1.1
27	Bosnia and Herzegovina	2.2	3.8	63	Sri Lanka	40.2	-1.3
28	Serbia	36.4	3.6	64	Zambia	85.9	-1.5
29	Paraguay	87.1	3.0	65	Netherlands	83.6	-2.9
30	Mauritius	66.7	2.6	66	Sweden	8.0	-4.2
31	Belgium	86.3	2.5	67	Australia	55.0	-5.1
32	Tunisia	37.0	2.1	68	Brazil	83.5	-6.2
33	Moldova	62.0	2.0	69	Kazakhstan	15.2	-8.5
34	Ghana	96.0	2.0	70	Bolivia	80.9	-9.0
35	Finland	77.2	1.9	71	Turkey	81.0	-43.0
36	Azerbaijan	78.9	1.7	72	China	58.0	-113.8

Note: The 72 countries used in Section 2 are sorted in descending order by their change in foreign exchange reserves from 2015 to 2020. R_i refers to the total foreign exchange reserves (Bil. USD) of country i, and σ_i refers to the USD share of country i's foreign exchange reserve portfolio (percentage terms). For 7 countries (Ireland, Costa Rica, West Bank and Gaza, Lesotho, Mauritius, Morocco, and Seychelles), missing 2015 σ_i values were filled in using 2016 data.

Table B4: Summary statistics: all variables

	Mean	Median	Min	Max	SD	N Obs
U.S dollar share of official reserves	0.59	0.63	0.00	1.00	0.28	1258
Total foreign exchange reserves (USD B)	57.00	13.00	0.00	3843.00	196.89	1246
Dollar peg (0-1)	0.08	0.00	0.00	1.00	0.27	1258
Euro peg (0-1)	0.11	0.00	0.00	1.00	0.31	1258
Other peg (0-1)	0.03	0.00	0.00	1.00	0.18	1258
Share of trade with US	0.08	0.05	0.00	0.74	0.10	1254
Share of trade with Euro Area	0.31	0.27	0.01	0.86	0.21	1254
Share of trade with Japan	0.03	0.02	0.00	0.36	0.04	1254
Share of trade with UK	0.04	0.03	0.00	0.24	0.03	1251
Dollar debt share	0.49	0.55	0.00	1.00	0.32	1233
Euro debt share	0.31	0.16	0.00	1.00	0.34	1229
Euro Area (indicator)	0.16	0.00	0.00	1.00	0.37	1258
US shadow rate	0.01	0.00	-0.04	0.06	0.03	1258
EA shadow rate	-0.00	-0.01	-0.03	0.04	0.02	1258
US UN vote agreement share	0.44	0.46	0.09	0.97	0.18	1227
Financial sanction (0-1)	0.19	0.00	0.00	1.00	0.39	1258
Investment tranche with short term debt	0.43	0.52	0.00	1.00	0.36	1244
Investment tranche with 3-months imports	0.29	0.28	0.00	0.89	0.27	1239
NRC return differential (percentage)	0.01	0.00	-0.01	0.02	0.01	1258
NRC return (percentage)	0.03	0.02	0.01	0.07	0.01	1258
Risk adjusted NRC return	2.55	1.45	-4.05	12.24	4.40	1258
Observations	1258					

Statistics across the full sample consist of 75 countries, with observations at the year-country level. Most countries do not have observations that span the full 1999-2023 period. Indicator variables take on a value of either 0 or 1.