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Abstract

The share of U.S. dollar assets in the official foreign exchange reserve portfolios of central banks, at times, is taken as an indicator of dollar status. We show that the observed decline in aggregate U.S. dollar shares is not from a systematic decline in preferences for dollar assets. Instead, it is explained by a small group of countries, both due to monetary policies executed vis-à-vis euros and due to a small group of large foreign exchange reserve balance countries. Regression analysis shows that relative interest rates of reserve currencies and nontraditional currencies can tilt portfolio composition, particularly in relation to the scale of investment tranches within overall central bank portfolios. Geopolitical distance from the United States and financial sanctions are associated with lower U.S. dollar shares mainly if the primary foreign currency liquidity needs of the central bank are already satisfied.

JEL classification: F3, F31, F33
Key words: foreign exchange reserves, dollar, liquidity, convenience yields, currency of international debt, foreign exchange reserve management

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1 Introduction

Much attention has been focused on the potential loss of status of the US dollar as a primary international currency. Narratives around its decline vary over time, whether around the introduction and rise of the euro after 2000, the increased size of China in the global economy, and the IMF's granting of reserve currency status to the Chinese yuan in 2015, the uncertainty associated with trade policy during the Trump presidency of the United States, or with geopolitical reactions fueled by the Russian war with Ukraine and the resulting imposition of international financial sanctions. Counter-arguments emphasize the high dollar use in international trade invoicing, synergies across different international roles, the continued liquidity and relative safety of U.S. official assets, persistent convenience yields, and global demand by private and official sector participants, including in periods of elevated risk sensitivity and uncertainty.

This issue is important, as the U.S. dollar plays many roles in international finance and trade.[1] Dollar use is strong 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, use on 88 percent of global foreign exchange transactions worldwide (BIS, 2019), and in a robust payments infrastructure.[2] U.S. 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 (IMF, 2023; Ilzetzki, Reinhart, and Rogoff, 2019) and in the foreign exchange reserves of central banks. As shown in Figure 1(a), these are material financial flows, at close to $12 trillion by 2022.

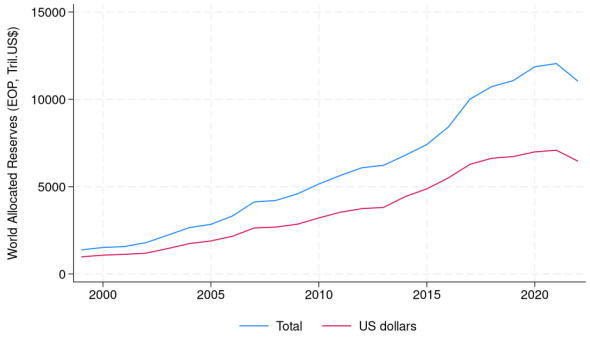
This paper provides new evidence that questions the narrative that the dollar's status has started to decline in central banks portfolios of foreign currencies. The dollar share of official foreign exchange reserves fell from a peak of over 70% of total global official foreign exchange reserves in the late 1990s to closer to 60 percent by 2022, as shown in Figure 1(b), according to the Currency Composition of Official Exchange Reserves (COFER) data published by the International Monetary Fund (IMF). These portfolios are held in part as countries hold assets to meet precautionary liquidity needs and sometimes stabilize their currencies in stress periods or in a managed or pegged exchange rate regime. Adequacy considerations for emerging markets often incorporate financing of foreign currency imports over some horizon (e.g. three months) and having sufficient liquidity

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

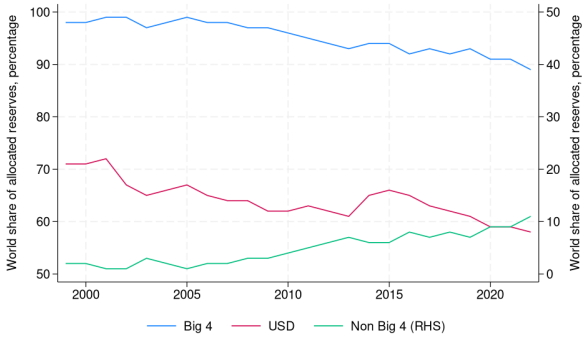
[2] US-owned Clearing House International Payment System (CHIPS) clears and settles $1.8 trillion in domestic and international payments per day. FedWire, operated by the Federal Reserve System, supports global dollar wire transfers amounting to nearly $4 trillion daily. (TheClearingHouse, 2023)

Figure 1: Global Foreign Exchange Reserves

(a) Allocated FX Reserve Levels



(b) IMF COFER Currency Shares



Source: Author's construction using IMF COFER year-end values. Big 4 currencies include USD, JPY, EUR, and GBP. COFER data covers 149 reporting countries and presents aggregated currency shares across total allocated reserves.

to cover short-term payments on external debt.[3] For advanced economies, considerations have included patterns of movement 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]. In the post GFC period, other considerations could include the types of access to foreign currency swap and repo facilities of other central banks (Bahaj, Fuchs, and Reis, 2024).

Our analysis on this declining dollar share of COFER uses two methodological approaches that push against the interpretation that there has been a broad shift in preferences away from holding dollar assets. The first approach utilized is an intuitive mathematical decomposition of the sources of foreign exchange reserve portfolio evolution with a distinction between shares of dollar assets (Ito and McCauley, 2020; Chinn, Ito, and McCauley, 2022) and sizes of specific country portfolios. The second approach is an extension of the empirical literature on currency shares in official foreign exchange portfolios (Arslanalp, Eichengreen, and Simpson-Bell, 2022). We test new conjectures related to relative returns on different currencies and geopolitical considerations.[5] We introduce explicit consideration of how these forces engage with the size of reserve portfolios of central banks, divided into liquidity and investment tranches.

The first key result is that the declining dollar shares in the overall COFER over the past decade

[3]References include IMF (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, 2023).

[5]Established drivers include debt denomination, direction of trade by country, and exchange rate regimes.

does not reflect a systematic retreat from the dollar share in official reserve portfolios, at least for a large group of countries for which portfolio composition estimates are available. Indeed, the majority of countries included in the database of (Ito and McCauley, 2020; Chinn, Ito, and McCauley, 2022) maintained similar dollar shares in their portfolios over the past decade. Instead, the dollar share changes in official reserve aggregates for 72 countries accounting for two-thirds of the world's total reserves are driven by a small group of countries and the dynamics are not exclusively due to changes in portfolio allocations away from dollar assets. Russia, which in 2015 had large ex ante official foreign exchange reserves and a high dollar share, sharply reduced its dollar share according to currency composition estimates. Switzerland, which has a large portfolio and had a large increase in total foreign exchange reserves during this period and has a much higher euro share of assets in its portfolio when compared with many other countries, would have significantly reduced the dollar share within the COFER aggregates had it not also increased the dollar share of its own portfolio. Based on available data, the decomposition suggests that a small number of other countries for which portfolio composition estimates are not available, including China and India, explain much of the remaining decline. This type of decomposition approach illustrates the strength of this simple tool, although without more extensive country reporting of portfolio composition data it cannot unpack all of the patterns within the global COFER aggregates.

The second set of key results establish a larger importance of some drivers previously tested and find the nuanced importance of conjectured contributors about the roles of asset returns. Our results demonstrate a stronger role for euro area economic proximity, which ultimately increased euro shares in some country portfolios, consistent with ECB (2023) evidence and relative to Arslanalp, Eichengreen, and Simpson-Bell (2022). 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 the 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. This suggests that the higher share of nontraditional reserve currencies in COFER data, discussed in detail by Arslanalp, Eichengreen, and Simpson-Bell (2022), is likely not driven by this specific channel of working through substitution away from US dollar assets.

The third novel set of results speak to the role of geopolitics and geoeconomics as as a driver of overall official portfolio composition. Our analytics introduce geopolitics in two ways: patterns

in country voting relative to the United States at the United Nations General Assembly (Voeten, Strezhnev, and Bailey, 2009), and financial sanctions applications by the United States (Felbermayr et al., 2020). 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 - not lower - US dollar share in official reserve portfolios, all else equal. Instead, the regression results show that 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.

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.[6] Reserve accumulation by countries that tend to have more euros in their portfolios, increased country trade with the euro area, and geopolitical distance from the United States can reduce dollar share. The geopolitical considerations may be material mainly for countries already with large enough reserves to cover their precautionary liquidity needs.

Our work contributes to a rich set of literature. These focus 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, Itskhoki, and Rigobon, 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 dynamics of supply over longer time horizons in the case of Chilean production. Regardless, synergies exist across roles, with 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 of international financial transactions in lending by global banks in fund portfolios (Aldasoro and Ehlers, 2018)[7] and demonstrates a contribution of the role of asset liquidity in the currency composition of debt choice (Coppola, Krishnamurthy, and Xu, 2023).

[6]The Economist (2022), J.P. Morgan (2023), and Corsetti, Eichengreen, Vives, and Zettelmeyer (2023)
[7]For example, Maggiori (2017), Maggiori, Neiman, and Schreger (2020), and Faia, Salomao, and Veghazy (2022)

Empirical analyses on official reserves start with estimates of portfolio composition, as the IMF does not directly publish reserve portfolio composition across asset currencies by country, and indeed a full list of the countries reported within COFER is not even available. Researcher constructions of best estimate databases include Eichengreen and Mathieson (2000) and Ito and McCauley (2020); Chinn, Ito, and McCauley (2022)[8]. 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 also considers the size of official reserve portfolios for precautionary demand purposes and concepts of reserve adequacy like the Greenspan-Guidotti rule (Aizenman, Cheung, and Qian, 2020; Aizenman and Riera-Crichton, 2008; Jeanne and Rancière, 2011; IMF, 2016). More historic perspectives on official reserves consider the timing and conditions for a large scale change in the reserve currency status of currencies. 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. An expansive set of 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 has a focus on geopolitical and geoeconomic fragmentation for international financial markets[9]. 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 (2023) consider how economic coercion arises from a combination of strategic pressure and costly actions, and 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 add to incentives to hold US dollars in official portfolios (Dooley, Landau, and Garber, 2022; Corsetti, Eichengreen, Vives, and Zettelmeyer, 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, Javorcik, Peeva, and Plekhanov, 2023).

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

Section 2 provides a basic and intuitive mathematical decomposition of the roles of reserve portfolio expansion versus compositional shifts of portfolios. This approach is followed by an example of applicability to the dollar asset share decline across official reserve portfolios between 2015 and 2021. Section 3 presents new conjectures of drivers of US dollar shares of portfolios, focusing in particular on relative asset returns and geopolitical considerations. Section 4 provides empirical results from extending the type of estimation in Arslanalp, Eichengreen, and Simpson-Bell (2022), using some methodological and data differences, and adding specific tests of our conjectures. Section 5 focuses on implications for research and policy questions.

2 A Basic Decomposition

This section introduces a basic decomposition that provides insights into the contributions of changing preferences for dollar assets versus other factors within global aggregate holdings of official foreign exchange reserves.

2.1 Derivation

The basic mathematical formula for the US dollar share of the foreign official reserves across countries is the sum of the product of quantities of individual country foreign reserves and the associated portfolio allocations of these reserves to US dollar assets, across countries. Denoting R_t^c as the total level of foreign exchange reserves (minus gold) in year t for country c, and denoting σ_t^c as the US dollar share, the overall formula for the US dollar share of reserves aggregated across countries, $USRSH_t$, is given by:

$$USRSH_t = \frac{\sum_1^N \sigma_t^c R_t^c}{\sum_1^N R_t^c} \tag{1}$$

where N is the total number of countries included in the aggregation. For understanding the changes in $USRSH_t$ over time the differential is provided by equation 2

$$d(USRSH_{t2,t1}) = \frac{(\sum_{c=1}^N (d\sigma_{t2,t1}^c R_{t1}^c + \sigma_{t1}^c dR_{t1}^c)) \left(\sum_{c=1}^N R_{t1}^c\right) - \left(\sum_{c=1}^N \sigma_{t1}^c R_{t1}^c\right) \left(\sum_{c=1}^N dR_{t2,t1}^c\right)}{\left(\sum_{c=1}^N R_{t1}^c\right)^2} \tag{2}$$

where $d(.)$ is the difference in a variable from date t_1 to t_2. Expanding and then combining terms,

this expression can be rewritten as a neat and intuitive basic decomposition:

$$d(USRSH_{t2,t1}) = \frac{\sum_{c=1}^{N} d\sigma_{t2,t1}^{c} R_{t1}^{c}}{\sum_{c=1}^{N} R_{t1}^{c}} + \frac{\sum_{c=1}^{N} (\sigma_{t1}^{c} - USRSH_{t1}) dR_{t2,t1}^{c}}{\sum_{c=1}^{N} R_{t1}^{c}} \tag{3}$$

The logic of equation 3 explaining the components of the change in the US dollar share of an aggregated reserve portfolio is straight-forward and has two components[10]. The first component is associated with changes in the portfolio composition preferences of countries around holding dollar assets, shown as $d\sigma_{t2,t1}^{c}$, which enters the expression in line 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 evolution of changes in preferences for assets denominated in US dollars. The second set of contributions to the overall 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 $(\sigma_{t1}^{c} - USRSH_{t1})$. Thus, the country's initial deviation from the global dollar share materially effects global aggregates. This second set of drivers is basic but important, as discussions that argue that the changes in COFER aggregates reflect a decline in preferences for dollar assets may fully ignore this contribution.

2.2 Quantifying the components

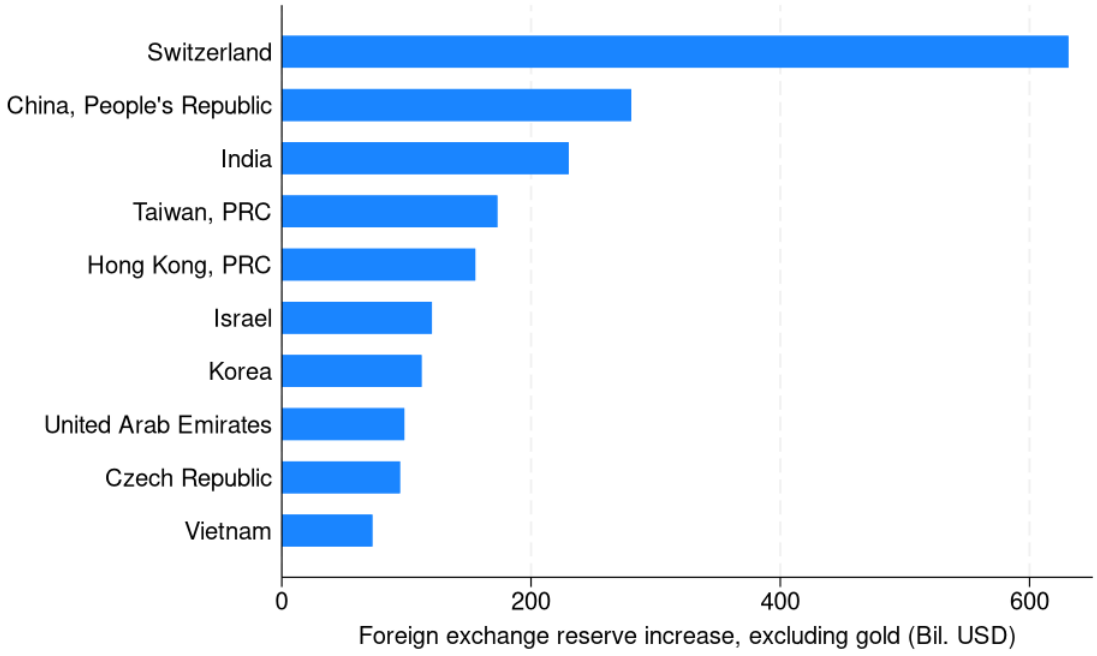
Quantifying the components of equation 3 requires data on the size of official foreign currency reserve portfolios across countries and on the currency shares of assets in those portfolios. Foreign exchange reserves data are sourced from the IMF's International Financial Statistics Database (IFS). The size distribution of foreign exchange reserves across countries is very broad. Nearly 90% of the total of 205 countries for which official reserves data is available as of 2022 have portfolios of official reserves that are less than $100 billion, while four countries – China, Japan, Switzerland, and Taiwan – holding reserve assets spanning in excess of $500 billion to upwards of $3 trillion.

These magnitudes hint at how changes in either the composition or the size of the official portfolios of larger reserve portfolios have the potential to significantly alter the overall COFER composition. Some changes have been large in absolute terms, as shown in Figure 2. Between 2010 and 2022 the values of portfolios have increased by over $600 billion for Switzerland, and by over $200 billion of additional reserves for each of China and India. During the 2015 to 2021 period, the

[10]The differential is formally correct for small changes in dates. We interpretation this calculus expression as an approximation.

mean ratio of foreign exchange reserves to GDP ratio across reporting countries increased from 18% to 22%. The occurrence of crises and large shocks have motivated some countries to carry extra insurance and adjust reserves (Dominguez, Hashimoto, and Ito, 2012; Bussière, Cheng, Chinn, and Lisack, 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.

Figure 2: Country Changes in FX Reserves, 2010 to 2022



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

It is more difficult to provide a comprehensive perspective on the asset composition of the individual portfolio allocations of all of these countries. 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)[11]. While many countries report the breakdowns of reserve currencies contained 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 gross assets' shares. Moreover, as some central banks have forward arrangements adjustments,

[11]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.

our primary source incorporates adjustments to the extent that information of such arrangements are identified by those authors.

Our illustration of the decomposition considers the decline in dollar shares of official reserves from 2015 through 2021. We are able to implement the decomposition of equation 3 with data for 72 countries, selected according to the availability of estimated or reported values of the US dollar share of foreign exchange reserves at least for 2015 or 2016.[12] This group of 72 countries does not reflect the full group of countries in the IMF COFER aggregates, but does represent nearly 70 percent of allocated reserves as of 2021. Of these 72 countries, 54 have US dollar share values available for both 2015 and 2021. Foreign exchange reserve levels are available for the full sample of countries for both periods.[13]

As 18 of the 72 included countries with portfolio composition information for 2015 do not have estimates available for 2021, we adjust our decomposition approach by dividing the first right hand side element of equation 3 into two parts, one taking into account the 54 countries and then the second part of the portfolio composition change term for countries for which data on changes in US dollar share of reserves is not spanned. Taking the change $d(\cdot)$ as capturing the difference between 2015 and 2021 values of terms, which we label 21 and 15 respectively, and using the initial observations dated 2015, the empirical decomposition is rewritten as:

$$d(USRSH_{21,15}) = \frac{\sum_{c=1}^{54} d\sigma_{21,15}^{c} R_{15}^{c}}{\sum_{c=1}^{72} R_{15}^{c}} + \frac{\sum_{c=55}^{72} d\sigma_{21,15}^{c} R_{15}^{c}}{\sum_{c=1}^{72} R_{15}^{c}} + \frac{\sum_{c=1}^{72} (\sigma_{15}^{c} - USRSH_{15}) dR_{21,15}^{c}}{\sum_{c=1}^{72} R_{15}^{c}} \quad (4)$$

Year end IMF COFER statistics for the full balance of allocated reserves shows that the change in the US dollar share of official allocated foreign exchange reserves dropped from 0.66 in 2015, to 0.59 in 2021, reflecting a decline of 7 percentage points. For our application using 72 countries, this overall decline is not known. For illustrative purposes we explore what could be learned if the baseline decline tracked the aggregate and takes the value of 7 percentage points. If the analysis were limited to just 54 countries, the decline is instead just 3.5 percentage points.

Within equation 4, the first right-hand-side term reflects the contribution to the change in dollar share over time across countries for which estimated composition series are available, the second term reflects countries for which there are data gaps associated with portfolio composition

[12] Our country sample is increased by 7 countries by using 2016 values available for countries when 2015 composition values are missing. Hereafter, we assume the 2016 weights for these countries apply to 2015 reserve stocks.

[13] For the following 6 countries: Peru, Malawi, Lesotho, Papua New Guinea, Tanzania, and Uganda, 2021 foreign exchange reserve levels are replaced with the most recent data available. If the analytics were limited to the 54 countries, the share of COFER reserves covered would be closer to 40 percent of COFER reserves.

changes, and the third term reflects the full set of countries' growth in country reserve portfolios across these dates, interacting with *ex ante* composition of reserve portfolios. A more expansive discussion of data gaps and additional unknowns is provided in Appendix B. An interesting use of this expression is for approximating the contribution of non-reporting countries to the COFER change. As the value of $d(USRSH_{t2,t1})$ is assumed, and two of the three right side terms in this expression are observable, we can compute, as a residual, the second right-side term's contribution to the decline of COFER that is associated with portfolio composition shifts. This term will capture the aggregate of the 16 countries in that grouping, which includes China, India, and Turkey, and which collectively accounted for 30% of world foreign exchange reserves in 2021.

The first right-hand-side term computes as a negative summation of the dollar shares across 54 countries which, weighted by the 2015 country reserve balance. This component sums to 0.29 percentage points across countries – so approximately zero overall relative to the overall percentage point change (7 percentage points if similar to COFER, or above the 3 percentage point change of the 54 countries)[14].

Across countries, this small total effect from 54 countries reflect the balance of consequences from both US dollar share declines and increases of individual countries, each interacting with country ex ante reserve levels. Drilling down within the composition, 23 countries reduced dollar shares in portfolios and 29 countries increased dollar shares. The top changes in each direction are presented in Table 1, along with *ex ante* reserve balances by country. The single most impactful country on this total is Russia, with its 29 percentage point decline in the US dollar share of its portfolio according to Ito and McCauley (2020); Chinn, Ito, and McCauley (2022) and with initial reserves an order of magnitude larger than those of the the other countries. Still, the increased dollar shares by the broader group of countries offset this preference component within equation 4 in aggregate.

[14]The Appendix explores how the overall decomposition changes if the remainder of countries in COFER were taken into account. The countries in the 55 to 72 group with the largest reserve balances are India, China and Turkey. 52 of the missing reporters have not agreed to have their names released. Working with the named countries in COFER, we are missing reporters 73 to 97, with the largest reserve balance countries in this group inclusive of Japan, Singapore and Mexico. Our appendix discussion suggests that these countries are unlikely to have had large shifts away from dollar assets. One implication of including more countries despite data gaps is that this effect of preference changes for 54 countries is quantitatively smaller, as the denominator of each of the terms in the decomposition starting point of a lower dollar (and higher euro) share of reserves.

Table 1: Reserve Portfolio Share Changes, 2015 to 2021

	Largest USD Share Declines			Largest USD Share Increases		
Rank	Country	2015 FXR Levels (Bil. USD)	USD Share Decline	Country	2015 FXR Levels (Bil. USD)	USD Share Increase
1	Macedonia	2	0.42	Kazakhstan	20	0.64
2	Portugal	5	0.37	Kyrgyz Republic	1	0.44
3	Namibia	2	0.35	Sweden	50	0.34
4	Russia	309	0.29	Papua New Guinea	2	0.31
5	Spain	39	0.27	Romania	35	0.20
6	Bolivia	11	0.22	Malawi	1	0.14
7	Sri Lanka	6	0.15	Kenya	7	0.14
8	Croatia	15	0.14	South Africa	39	0.12
9	Serbia	11	0.11	Iceland	5	0.11
10	Georgia	2	0.11	Czech Republic	63	0.11
Global USD Share Decline: -0.07						
Mean 2015 FXR Level (Bil. USD): 97						

Source: Author's construction using IMF IFS data on official foreign exchange reserves (FXR) and Chinn, Ito, and McCauley (2022) data on portfolio shares with additional observations from Arslanalp, Eichengreen, and Simpson-Bell (2022).

The last term of equation 4 provides the contribution of changes in official reserve amounts to the total aggregate dollar share across countries, computed using data over all 72 countries. If countries increase reserves over this period, the US dollar share of the aggregate will increase only if the countries accumulating reserves tend to have higher dollar shares compared to the (weighted) average ex ante dollar shares in their portfolios. This last summation equals 3.8 percentage points[15] .

Table 2 lists the largest increases and declines in reserves from 2015 to 2021. The strongest contributor to this overall component through changes in reserve balances is Switzerland. The *ex ante* dollar share of the Swiss official portfolio is estimated at 0.32, well below the 0.65 *ex ante* average in COFER reports. Switzerland's reserves almost doubled over this period from $560 billion to over $1 trillion, with a $473 billion increase. This type of observation illustrates why changes in the COFER data are not analogous to a decline in preferences for US dollars. Reserve accumulation is a byproduct of the monetary policy regime in Switzerland, as during this period foreign exchange interventions were used to limit the appreciation of the Swiss franc

[15] When 2015 US dollar (USD) share values are missing, 2016 USD share values are used for the following 7 countries: Ireland, Costa Rica, West Bank and Gaza, Lesotho, Mauritius, Morocco, and Seychelles, who, collectively, account for less than 0.5% of total foreign exchange reserves in our 72 country sample.

against the euro in the presence of inward exchange market pressures. Switzerland's overall contribution to the aggregate change in dollar share actually ended up being more muted since Switzerland also increased the share of dollar assets in its overall portfolio during this time frame. Within the reserve change component of equation 4, Russia's accumulation of reserves from 2015 through 2021 also would have pulled down the dollar share of the aggregate given the *ex ante* lower than average share of dollars its official foreign exchange reserve portfolio (Table 2). India's contribution through this specific channel is less material, as it's starting point is closer to the dollar share of the full sample of countries.

Table 2: Reserve balance changes, 2015 to 2021

	Largest Reserve Declines			Largest Reserve Increases		
Rank	Country	2015 USD Share	FXR Decline (Bil. USD)	Country	2015 USD Share	FXR Increase (Bil. USD)
1	China	0.58	80	Switzerland	0.32	473
2	Turkey	0.81	28	India	0.58	242
3	Brazil	0.84	18	Russia	0.43	159
4	Kazakhstan	0.15	11	Hong Kong	0.87	138
5	Bolivia	0.81	10	Israel	0.68	119
6	Sweden	0.08	6	Czech Republic	0.15	106
7	Sri Lanka	0.40	4	Korea	0.67	80
8	Netherlands	0.84	4	Poland	0.39	56
9	Costa Rica	0.91	1	United Kingdom	0.40	26
10	Zambia	0.86	1	Philippines	0.89	22
Global Mean 2015 USD Share: 0.65						
Total FXR Change (Tril. USD): +1.54						

Author's construction using IMF IFS data on official foreign exchange reserves (FXR) and Ito and McCauley (2020); Chinn, Ito, and McCauley (2022) data on portfolio shares and additional observations from Arslanalp, Eichengreen, and Simpson-Bell (2022). When 2015 US dollar (USD) share values are missing, 2016 USD share values are used for the 7 countries.

As an example, if the change in dollar reserve share for the 72 country group is 7 percentage points (tracking the aggregate COFER), the components for the quantified components of equation 4 can be used to compute the magnitude of the contribution of portfolio preference shifts for the remaining 18 (72-54) countries in aggregate. Using 0.070, the inputs to the equation imply that: $0.070 = .003 + \frac{\sum_{c=55}^{72} d\sigma^c_{21,15} R^c_{15}}{\sum_{c=1}^{72} R^c_{15}} + 0.038$. With this example, the magnitude of the remaining term, which has reserves dominated by China, India and Turkey, among others, is $\frac{\sum_{c=55}^{72} d\sigma^c R^c_{2015}}{\sum_{c=1}^{72} R^c_{2015}} =$

0.029[16]. This latter value is dependent on the size of the left hand side total.

These computations together illustrate how reserve level and some preference changes by a few countries with larger reserve portfolios can be responsible for the changes in headline aggregate numbers. For the broader group of 54 countries for which portfolio composition estimates are available over both dates, portfolio preference changes against holding US dollar assets are not, on average, large drivers of aggregate patterns.

3 Conjectures and testing drivers

Many researchers used 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 viewed as indicators of economic influence and exposure to international spillovers. Over the short to medium run, some of these channels also can 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).

3.1 New conjectures on drivers of USD share

Our new variables introduced into portfolio allocation regressions start with conjectures related to relative returns offered across currencies and geopolitical considerations. The potential magnitudes of these changes are illustrated within Figure 1(b), showing that the share of reserves allocated to currencies other than the "Big Four" (US dollar, euro, Japanese yen, and Great Britain's pound) rose from 2 percent in 2000 to 6 percent in 2015, with a further rise to 9 percent

[16]In our decomposition, we take the difference between 2015 and 2021 values. Thus, positive values in the decomposition indicate a contributed *decline* (e.g. the 0.07 left-hand side term indicates the decline in COFER from 2015 to 2021).

by 2020. Since 2010, small components of overall portfolios had been increasingly allocated to assets denominated in Chinese renminbi, Canadian dollars, Australian dollars, and other currencies like the Korean won. Arslanalp, Eichengreen, and Simpson-Bell (2022) observe that overall official reserve portfolios have tilted toward smaller and nontraditional reserve currencies. They posit and discuss possible explanations, including that some of this diversification may occur through a search for higher yield on the overall foreign currency official portfolio, and also as some of the assets denominated in nontraditional reserve currencies have trading liquidity that has improved over time.

We test conjectures about 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, regardless of whether these are returns on traditional or nontraditional reserve currencies. Thus, the US dollar share of official portfolios could be lower if euro area assets or non-traditional reserve currencies are offering relatively higher (relative) returns. Specifically, our empirical tests explore:

Conjecture 1: The share of official reserve assets allocated to US dollar assets will be lower when returns on alternative currencies are higher. This tilt can be magnified in a low US dollar interest rate environment.

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 may be enhanced for portions of the foreign exchange reserve portfolios consider 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 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 precisely consider these types of forces (IMF, 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.[17]

Thus, relative returns may play a larger role in reserve manager allocations, particularly out-

[17] See Blanchard, Adler, and de Carvalho Filho (2015), Fratzscher, Gloede, Menkhoff, Sarno, and Stöhr (2019), Adler, Chang, Mano, and Shao (2021), and Goldberg and Krogstrup (2023).

side of the "Big Four" (USD, EUR, JPY, and GBP), only after the strategic allocations of the full portfolio towards currency liquidity purposes are satisfied. This effect might be especially pronounced 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 and in the next deepest market in euros. Further, the tendencies to diversify may be more pronounced during a low-interest rate environment among the "Big Four", with a quest for returns inducing managers to diversify into high yielding nontraditional reserve currencies assets. Survey evidence supports the idea that there is a tendency of 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.

Next, geopolitics and geoeconomic fragmentation may influence 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. BRICs expansion has been widely discussed as a bid to end dollar dominance. Nonetheless, the ECB (2023) reviewed evidence through 2023 and found the support for this development as weak and mainly found in official statements. We formally investigate within the official reserves data, testing the following:

Conjecture 2: the share of official reserve assets allocated to US dollar assets will be lower for countries that are geopolitically distant from the United States, relative to shares that would otherwise be suggested by standard drivers such as patterns of international trade, debt finance, and currency regimes.

We further consider whether geopolitical considerations play a stronger role only after countries

have sufficient reserves to meet their liquidity and exchange rate stabilization needs.

3.2 Empirical Methods

Our empirical methods start with the approach of Arslanalp, Eichengreen, and Simpson-Bell (2022), although we focus our reported analytics only on the changing US dollar share of portfolios instead of investigating shares of each Big Four currency. Our empirical tests introduce small variations in estimation technique relative to that study's baseline approach, and include additional variables, conditional response considerations through interactions, and extended data coverage. The starting empirical specification is:

$$\sigma_t^c = \beta_0 + \beta_1^{'}\mathbf{X}_t^c + \epsilon_t^c \tag{5}$$

where σ_t^c is the US dollar share of official foreign exchange reserves, R_t^c, of country c at year t. The standard baseline right hand side variables for determinants of currency composition are subsumed by the vector $\mathbf{X_t^c}$ and includes: the exchange rate regime in year t defined as a dummy variable for a US dollar, euro, or Other country peg; the shares of trade with each Big Four currency issuer country; and the currency composition of external debt in US dollars and euros. Specifics on data sources and distributions are covered in Section 3.3.

Our variations directly address the strength of evidence from these established channels and introduce evidence to test conjectures 1 and 2. Accordingly we test several variations of the saturated model, provided as equation 6:

$$\sigma_t^c = \beta_0 + \beta_1^{'}\mathbf{X}_t^c + \beta_2\mathbf{Ret}_t + \beta_3\mathbf{InvTr}_t^c + \beta_4\mathbf{Ret}_t \times \mathbf{InvTr}_t^c + \beta_5\mathbf{GP}_t^c + \epsilon_t^c \tag{6}$$

The extended specification embeds effects of relative returns on official US dollar assets versus euro asset returns, and further consider differentials between the returns on USD assets and those of nontraditional reserve currencies. The vector $\mathbf{Ret}_t$ 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 non-traditional (NRC) differential which captures the excess return of non-traditional reserve currencies relative to the US shadow rate. Tests 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.

As our conjectures allow for 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 $InvTr_t^c$ share of the portfolio, as well as allowing a level effect of having a higher investment tranche. The investment tranche is constructed as the fraction of total reserves that is in excess of that part of the portfolio needed for foreign currency liquidity. Liq_t^c denotes a measure used by reserve managers to assess their foreign exchange reserve liquidity; These liquidity needs are alternatively proxied by standard measures associated with short-term foreign currency debt or 3 months of import coverage.

$InvTr_t^c$ is a piece-wise measure defined as:

$$InvTr_t^c = \begin{cases} 0 & R_t^c < Liq_t^c \\ \frac{R_t^c - Liq_t^c}{R_t^c} & R_t^c > Liq_t^c \end{cases} \tag{7}$$

and specifications include a vector of geoeconomic variables $\mathbf{GP_t^c}$. These variables cover geopolitical distance from the United States and applications of financial sanctions. They are likewise introduced to allow for the possibility of interactions with the investment tranched component of the reserves portfolio.

We employ a linear probability model (LPM) with robust standard errors to address potential heteroskedasticity. Given the lack of corner cases in US currency composition holdings, the estimated coefficients are nearly identical as those estimated using a Tobit model. Ordinary least squares allows for ease of interpretation of coefficients and conventional goodness of fit calculation. We start our analytics by exactly replicating the results of Arslanalp, Eichengreen, and Simpson-Bell (2022), then extending that database in time and several directions, and sequentially compare the results using different estimation techniques. We perform similar incremental comparisons as we change the mix of country-time observations and variables included in specifications.

3.3 Data

The countries and years included in this section's empirical estimations are determined by the availability of estimates of US dollar shares of official reserve portfolios across countries. We 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). Our final dataset is a panel with a total of 1160 country-year observations, with up to 23 years covered (1999-2021) and spanning 75 countries from all

continents.[18] Estimation is over an unbalanced panel across countries.

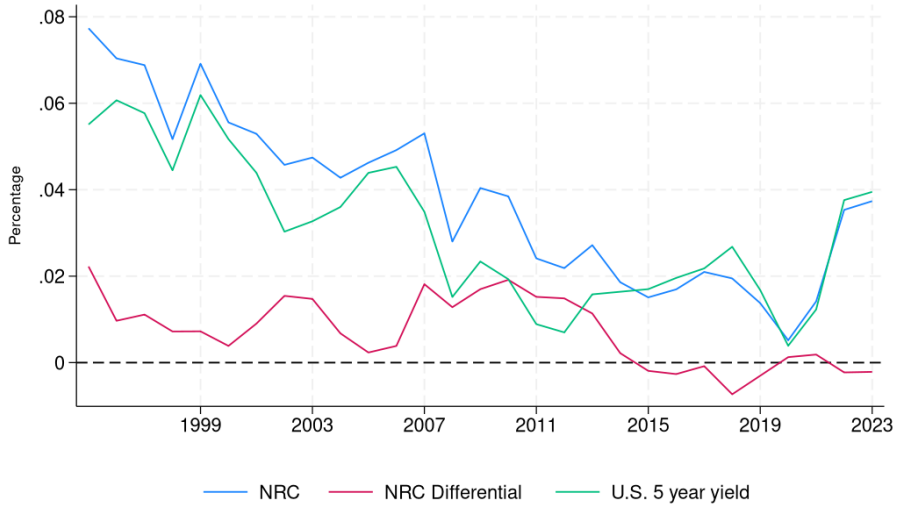
The traditional explanatory variables included in specifications for US dollar shares of official reserve portfolios exactly follow the data and data construction methods of Arslanalp, Eichengreen, and Simpson-Bell (2022). For monthly or quarterly data, we take the last period available in a given year. All variables vary by year and country unless otherwise stated. Summary statistics are presented in Table A1. Currency Regime refers to the reserve currency to which a country pegs its exchange rate. Following Ilzetzki, Reinhart, and Rogoff (2019), this includes three separate indicator variables: *Dollar peg*, *Euro peg*, or *Other peg*. Share of Bilateral Trade refers to the share of external trade (exports plus imports) with each Big Four currency country issuer, with data sourced from the IMF Direction of Trade statistics, and with constructed variables spanning *Trade with US*, *Trade with euro area*, *Trade with Japan*, and *Trade with UK*. As the distribution of countries included in the full unbalanced sample disproportionately represents Europe, this implies the estimation sample tends to have higher average trade shares with the euro area and lower average trade shares with the United States compared a sample that would have a more balanced representation of other regions. Currency composition of external debt is the share of each country's external debt service payments denominated in US dollars and euros, *Dollar debt share* and *Euro debt share*, sourced from the World Bank International Debt Statistics (IDS). Across countries, dollars are the dominant currency of denomination of external debt, but the dollar shares have evolved over time with country conditions and institutional strength in line with evidence on "original sin" and market access in external finance.

The next data series introduce proxies for relative returns on currencies for official portfolios, indicate the investment tranche (versus liquidity tranche) share of official reserves, and indicate the zero lower bound period. First, Shadow Short Interest Rate (SSR) measures the stance of monetary policy in the presence of a zero lower bound environment from Krippner (2016) and available from LJK Macro Finance Analysis for all Big Four currencies, represented by *US shadow rate* and *EA shadow rate*. A Zero Lower Bound (ZLB) indicator variable is constructed for the US and euro area and takes on the value of one if the shadow rate is at or below zero, and the value is zero otherwise. As nontraditional reserve currencies entered official portfolios in the post GFC time frame, we construct a measure of nontraditional Reserve Currency (NRC) return to explore this as a driver of potentially lower US dollar shares in portfolios. Nontraditional reserve currency return, *NRC return*, is calculated by taking a weighted average of 5-year government bond yields

[18] Table A2 provides details on the span of countries, sorted by size of foreign exchange reserve portfolios in 2015. For insights into this data, we also present the scale of reserves by country in 2021, and indicate US dollar reserve shares using these indicated sources, noting whether those shares are in Ito and McCauley (2020); Chinn, Ito, and McCauley (2022) and Arslanalp, Eichengreen, and Simpson-Bell (2022), and in our final sample used in estimation.

from Australia, Canada, and South Korea with weights of 40%, 45%, and 10%, respectively.[19] A nontraditional reserve currency differential *NRC return differential* is calculated by subtracting the U.S. 5-Year yield from the nontraditional reserve currency return. For robustness checks, we construct a risk-adjusted return measure as a Sharpe Ratio measure computed by dividing yearly excess returns of nontraditional reserve currencies by the yearly standard deviation of excess returns of NRCs. Patterns in these returns are presented in Figure 3. While NRC rates dominated dollar returns through 2014, the gap closed or reversed in the subsequent years.

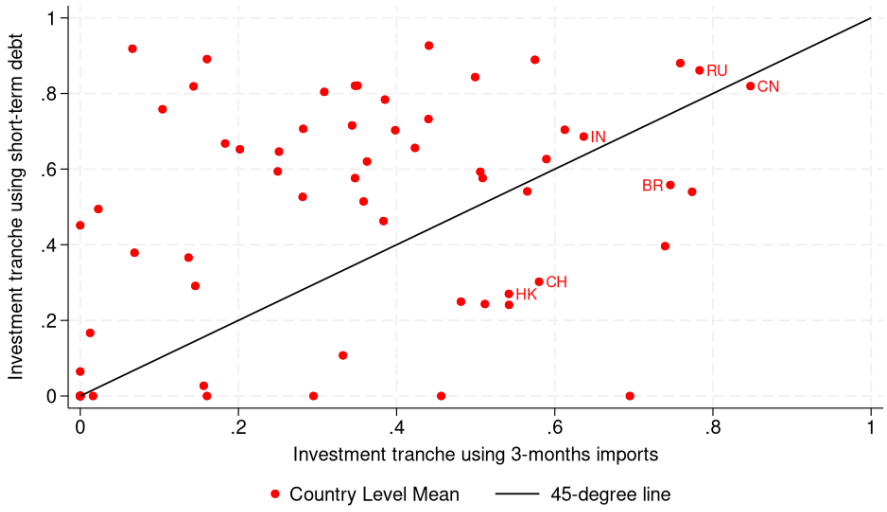
Figure 3: Nontraditional Reserve Currency Interest Rate Differential



Source: Author's construction using data from the Reserve Bank of Australia, Central Bank of Canada, Bank of Korea, United States Treasury, and LJF Macro Analysis.

[19] Weights are derived from Table 5, on nontraditional reserve currencies in global foreign exchange reserves, end-2020 from Arslanalp, Eichengreen, and Simpson-Bell (2022).

Figure 4: Investment Tranche Using Imports or Short-Term Debt



Source: Author's construction using data from the BIS JEDH and the IMF IFS, country means 1999 through 2021.

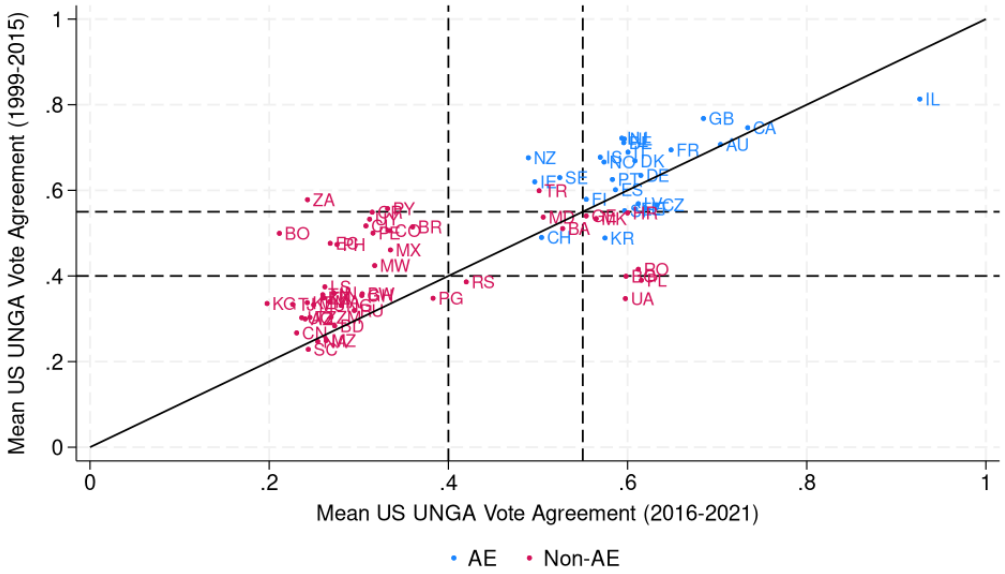
Our measure of the share of the official reserves portfolio in the investment tranche is a residual (share) in excess of the liquidity tranche proxied in two alternative ways. First, we leverage the World Bank Joint External Data Hub (JEDH) to obtain short-term debt data. For each country we define short-term 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.[20] A survey of reserve 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). Accordingly, equation 7 is computed either using short-term debt or imports, and both measures are considered in respective regression specifications for the roles of the piecewise $InvTr_t^c$.[21] The two types of investment tranche variables are positively correlated, but not tightly aligned (Figure 4).

The geopolitical series are intended to proxy geopolitical alignment with or distance from the

[20] 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).

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

Figure 5: Country Voting Alignment with United States at UNGA



Source: Author's construction using data from the UN General Assembly voting data described in Voeten, Strezhnev, and Bailey (2009).

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, Strezhnev, and Bailey (2009). Patterns in alignment for the period from the late 1990s through 2015, shown on the vertical axis, are positively correlated with, but also higher for, emerging market countries compared to alignment in the period from 2016 onwards. We use thresholds from observing the data of Figure 5 for assigning countries into discrete groups 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. For illustration, Table A3 contains a time-invariant binning of countries using the median annual US vote agreement over the full sample period. 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 c and by t using a time-varying 3 year moving average of US UNGA vote agreement according to the above thresholds. The effects of residual country-time observations are included in constant terms of regression specifications.

The second series captures whether countries are 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).[22] 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 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, at times, been subject to US (and sometimes joint with other countries) financial sanctions in our sample [23].

4 Regression Results: Drivers of US Dollar Share of Reserves

US dollar shares in portfolios across countries and over time have been well informed by prior analytical work. We use Arslanalp, Eichengreen, and Simpson-Bell (2022) specifications and data as our jumping off point and then introduce differences in data inclusion and empirical methods in order to create a new baseline specification. Most of our baseline results align with their findings, with differences in in our baseline findings stemming from the composition of countries and time period included for estimation. Below, this initial baseline work is followed by specific tests of the roles of new conjectured drivers around relative returns on assets, geopolitical distance from the United States, and behaviors within reserve portfolio tranches that might be divided according to function.

Baseline. The changes that we introduce are sequenced through the respective columns of Table 3. Column (1) exactly replicates the Arslanalp, Eichengreen, and Simpson-Bell (2022) dollar share results, showing the importance for country portfolio allocations of currency pegs, trade with different countries, external debt shares, and being within the euro area. Our first modification is dropping the United States from the estimation sample. Shown in column (2), this exclusion sharply reduces the coefficient on trade with the United States, and raises the marginal significance of trade with the euro area. Columns (3) and (4) alter the regression specification, first dropping year fixed effects and then using an ordinary least squares (OLS) estimator in lieu of the Tobit estimator. These changes do not have incremental material effects.

[22] The incidence of financial sanctions in our sample is presented in Table A5.
[23] Table A5 describes the full coverage of financial sanctions corresponding to countries included in our estimation.

Next, we observe that the inclusion of yen and pound debt shares in the initial specification led to a significant decline in the country observations included in the analytics. Accordingly, Table 3 columns (5) through (7) replicate columns (2) to (4), except now excluding yen and pound debt shares. This modification adds 14 countries and about 350 country-year observations to the specifications and generates significant differences in the pattern of significance across explanatory variables. *Trade with US* is not statistically important, while *Trade with Euro Area* has a more prominent role in reducing dollar shares of country reserve portfolios. This modification raises the importance of financial considerations through dollar debt share and euro debt share, now entering with positive signs and stronger statistical significance, consistent with financial arguments about reserve composition to meeting financial liquidity needs of countries. The composition of countries in the analytical sample matters for the strength of explanations of dollar share evolution, which is a point that is important for the generality of any study of drivers of portfolio composition. Finally, column (8) presents the incremental effects of including 122 additional country-year observations made feasible by data updates at least through 2021 for most countries (by Ito and McCauley, 2020; Chinn, Ito, and McCauley, 2022) and the inclusion of some additional earlier observations that were not previously available. Inclusion of these extra observations (with updates to all other input series) does not materially change results relative to columns (5) through (7).

Our baseline shows that countries hold a higher share of reserves in dollars as their share of debt denominated in dollars increases. The exchange rate regime matters significantly, 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 dollar tend to hold lower shares of dollars. Compared with Arslanalp, Eichengreen, and Simpson-Bell (2022), our baseline results on dollar shares of portfolios ascribe larger roles to financial variables like the share of US dollar and euro currencies in country debt, and weaker roles for the US share of country trade. Geographic proximity is also important, with a particular role for closeness to the euro area in lowering dollar shares in country portfolios. These resuls are aligned with official liquidity holdings from strategic allocations tilting portfolios towards the currencies where it is needed, consistent with potential interventions when exchange market pressure is high (Goldberg and Krogstrup, 2023). Column (8) serves as our baseline empirical model and is used as a jumping off point for testing the new conjectures on incremental contributions of portfolio returns, investment versus liquidity tranches, and geopolitical contributions.

Table 3: Baseline specification for US dollar share of official foreign currency reserves

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
U.S. dollar share of official reserves								
Dollar peg	0.104***	0.0856***	0.0869***	0.0853***	0.129***	0.130***	0.129***	0.118***
	(5.23)	(4.67)	(4.47)	(4.42)	(7.63)	(7.35)	(7.34)	(7.02)
Euro peg	-0.424***	-0.421***	-0.407***	-0.404***	-0.395***	-0.391***	-0.376***	-0.353***
	(-14.70)	(-15.19)	(-14.73)	(-14.83)	(-18.80)	(-18.56)	(-19.52)	(-17.89)
Other peg	-0.141***	-0.152***	-0.126***	-0.126***	-0.153***	-0.140***	-0.140***	-0.160***
	(-3.65)	(-4.27)	(-3.38)	(-3.34)	(-4.36)	(-3.74)	(-3.72)	(-4.15)
Trade with US	1.034***	0.457***	0.482***	0.484***	0.0562	0.0706	0.0735	0.0846
	(6.17)	(4.01)	(4.49)	(4.47)	(1.17)	(1.41)	(1.47)	(1.72)
Trade with Euro Area	-0.156	-0.212*	-0.253**	-0.248**	-0.282***	-0.293***	-0.289***	-0.338***
	(-1.76)	(-2.50)	(-3.02)	(-2.94)	(-4.70)	(-5.01)	(-4.95)	(-5.95)
Trade with Japan	-1.037*	0.343	0.256	0.252	-0.203	-0.251	-0.255	-0.302
	(-2.57)	(1.17)	(0.85)	(0.84)	(-0.88)	(-1.11)	(-1.13)	(-1.39)
Trade with UK	-1.283*	-0.817	-0.731	-0.709	-0.521*	-0.517*	-0.475	-0.654**
	(-2.03)	(-1.43)	(-1.30)	(-1.25)	(-2.02)	(-2.08)	(-1.94)	(-2.77)
Dollar debt share	-0.189*	0.0557	0.0819	0.0838	0.191***	0.197***	0.197***	0.197***
	(-2.46)	(0.91)	(1.33)	(1.35)	(7.31)	(7.58)	(7.78)	(7.86)
Euro debt share	-0.184*	-0.0243	0.00785	0.00457	0.0677*	0.0759*	0.0668*	0.0710*
	(-2.08)	(-0.31)	(0.10)	(0.06)	(2.16)	(2.48)	(2.25)	(2.52)
Yen debt share	-0.0210	-0.165	-0.196	-0.195				
	(-0.17)	(-1.41)	(-1.64)	(-1.62)				
Pound debt share	-2.920	-3.889	-4.211*	-4.242*				
	(-1.21)	(-1.90)	(-2.04)	(-2.03)				
Euro Area dummy	0.256***	0.268***	0.278***	0.279***	0.313***	0.317***	0.317***	0.353***
	(6.26)	(6.76)	(7.34)	(7.32)	(13.70)	(14.16)	(14.29)	(16.82)
Constant	0.735***	0.548***	0.630***	0.628***	0.544***	0.553***	0.552***	0.573***
	(7.33)	(7.02)	(11.88)	(11.78)	(8.85)	(16.80)	(16.95)	(17.62)
N obs	696	675	675	675	1030	1030	1030	1160
N countries	62	61	61	61	75	75	75	75
Year FE	Yes	Yes	No	No	Yes	No	No	No
Estimation Method	Tobit	Tobit	Tobit	OLS	Tobit	Tobit	OLS	OLS
US included	Yes	No	No	No	No	No	No	No
GBP and JPY Debt Shares	Yes	Yes	Yes	Yes	No	No	No	No
Extended Sample	No	No	No	No	No	No	No	Yes

t statistics in parentheses

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

Notes: Arslanalp, Eichengreen, and Simpson-Bell (2022) baseline is specification (1). Specification (2) drops observations for the US. Specifications (5) - (8) drop yen debt share and pound debt share, accordingly adding observations for the following countries: Australia, Belgium, Canada, Chile, Croatia, Czech Republic, Denmark, Finland, France, Germany, Hong Kong, Iceland, Ireland, Israel, Italy, Korea Rep, Luxembourg, Namibia, Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom, and Uruguay. Our baseline specification (8) includes an extended sample through 2021, and with added prior country-time observations.

Initial contributions of new explanatory variables. Before testing conjectures, we present the results of contributions to the US dollar share specifications from new explanatory variables. Table 4 shows sequential findings using a waterfall view of regressions relative to the baseline reproduced in column (1). First consider the statistical significance and increments to the adjusted R^2 of specifications. Column (2) shows that the non-traditional reserve currency (NRC) return is not statistically important, although the sign is consistent with the interpretation that higher NRC returns are associated with marginally lower shares of dollars in country portfolios. Column (3) shows that the NRC reserve returns relative to US dollar returns are a more significant contributor. Likewise, column (4) provides a potential role for reserve portfolios to tilt across dollars with euros, depending on the returns across these currencies and with shadow interest rates introduced to capture more unconventional monetary policy, finding that the dollar share rises with higher US returns, and declines with higher euro area returns. The overall explanatory power of the regression is little changed. The results are similar for introducing zero lower bound indicators for the US and euro area (column 5).

Columns (6) and (7) introduce the two alternative ways of measuring the size of the investment tranche of official reserve portfolios. Both measures are correlated with other regression variables and change the size of coefficients of interest. The investment tranche construction using short-term debt in particular raises the R^2 of specifications, while the tranche constructed using imports data also is statistically significant and increases the precision of estimates on trade and debt share variables. Column (8) presents a first pass introduction of geopolitical variables. When country observations are placed in buckets of low or middle voting alignment with the US at the United Nations, there is strong statistical significance for low alignment countries, relative to the baseline of high alignment countries. The positive coefficient estimate on this term hints at the importance of investigating mechanisms further, as the lower political alignment countries have higher dollar share, on the margin, all else equal. The signs of coefficients of other regression coefficients also change. The last column introduces financial sanctions application, with this term neither entering with statistical significance or adding explanatory power to these specifications.

Table 4: Baseline for USD share of official foreign exchange reserves, with waterfall of added determinants

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
U.S dollar share of official reserves									
NRC return		-0.325							
		(-0.79)							
NRC return differential			-2.519***						
			(-3.68)						
US shadow rate				1.037***					
				(3.82)					
EA shadow rate				-0.784*					
				(-2.34)					
US ZLB					-0.041***				
					(-3.66)				
EA ZLB					0.012				
					(0.99)				
InvTr						0.101***	0.044		
						(4.17)	(1.83)		
Low US UN vote agreement								0.110***	
								(6.70)	
Middle US UN vote agreement								-0.014	
								(-0.94)	
Financial sanction									0.025
									(1.51)
Constant	0.573***	0.580***	0.592***	0.573***	0.591***	0.563***	0.624***	0.494***	0.574***
	(17.62)	(17.98)	(18.51)	(17.32)	(16.78)	(17.15)	(15.97)	(14.27)	(17.72)
N obs	1160	1160	1160	1160	1160	1144	1052	1137	1160
N countries	75	75	75	75	75	75	70	74	75
R2	0.54	0.54	0.54	0.54	0.54	0.55	0.57	0.55	0.54
Adj R2	0.53	0.53	0.54	0.54	0.54	0.54	0.56	0.55	0.53
AIC	-550.53	-549.20	-562.03	-560.36	-560.18	-566.57	-540.11	-572.12	-550.78
BIC	-494.91	-488.52	-501.36	-494.63	-494.45	-506.07	-480.61	-506.65	-490.11
Tranche Measure	N/A	N/A	N/A	N/A	N/A	Imports (3M)	ST Debt	N/A	N/A
p-val: b[Low UN] = b[Medium UN]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS

t statistics in parentheses

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

Notes: Selected variables from Table 3 column (8) are included in these specifications. Specifically these are: *Dollar peg*, *Euro peg*, *Other peg*, *Trade with US*, *Trade with Euro Area*, *Trade with Japan*, *Trade with UK*, *Dollar debt share*, *Euro debt share*, and *Euro Area dummy*.

Conjectures for Nontraditional Reserve Currency Returns. We have conjectured that the share of official reserve assets allocated to US dollar assets will be lower when returns on alternative currencies are higher. We test this point, and that this tilt could be magnified in a

low US dollar interest rate environment or at the zero lower bound, or when foreign exchange reserve managers have a larger investment tranche (Table 5). A parallel set of testing results instead utilizes a risk-adjusted nontraditional reserve currency return constructed as a Sharpe Ratio measure computed by dividing yearly excess returns of nontraditional reserve currencies by the yearly standard deviation of excess returns of NRCs (Table A8). Text tables present only results for the relevant variables, suppressing reporting of the estimated coefficients on the traditional drivers of US dollar share with the full specifications provided in the Appendix. All specifications shown use OLS estimation, and have columns that vary by respective investment tranche proxies (using 3 months of imports or short term debt).

Statistically significant roles of NRC returns appear in Table 5 columns (1) and (4). A higher return on NRCs works in the direction of reducing the dollar share of the central bank reserves portfolio, consistent with the conjecture of substituting away from dollars in this situation. However, we find that the size and significance of this type of effect are not large or robust across specifications. The main increase in regression explanatory power instead comes from having investment tranches included in the specifications. NRC return differentials *per se* do not contribute much explanatory power, and consequences are only weakly magnified when countries have higher investment tranches of their portfolios using the debt criteria, without magnified consequences at the US zero lower bound. Specifications using the risk-adjusted nontraditional reserve currency return yield similar patterns of results.[24]

Conjectures for Traditional Reserve Currency Returns. Conjecture 1 also considers whether the US dollar shares of portfolios rise with US asset returns, and decline with higher euro area returns. Such portfolio changes could be due to active portfolio investment decisions, or could be passive results if managers do not optimize portfolios to return to *ex ante* strategic portfolio allocation targets. The roles of asset returns on traditional reserve currencies, like the NRC returns, could potentially be different in periods of low interest rates or at the zero lower bound, or stronger on the investment tranches of official portfolios. Columns of Table 6 explore the potential interactions. First, the shadow rate on euro assets is not found to play a significant role on dollar shares across central bank portfolios. The US shadow rate, however, consistently enters with a positive sign (column 1), with importance that is weakly magnified on the investment tranche of portfolios when the investment tranche is computed using short term debt (column 4). The shadow interest rates do not enter with altered significance at the zero lower bound. Quantitatively, traditional reserve currency returns do not appear as important drivers of portfolio allocations towards dollar assets.

[24] As our specifications focus on dollar asset shares of portfolios, our findings do not preclude larger roles for NRC in substitution in and out of assets denominated in other currencies.

Table 5: USD share of foreign exchange reserves and nontraditional reserve currency returns

	(1)	(2)	(3)	(4)	(5)	(6)
U.S dollar share of official reserves						
NRC return differential	-2.361***	-2.219	-1.364	0.457	-1.688*	-1.330
	(-3.46)	(-1.96)	(-1.91)	(0.38)	(-1.98)	(-1.24)
InvTr	0.098***	0.101***	0.041	0.066*		
	(4.08)	(3.49)	(1.72)	(2.48)		
InvTr x NRC return differential		-0.469		-4.642*		
		(-0.18)		(-2.26)		
US ZLB					-0.025	-0.017
					(-1.78)	(-0.84)
NRC return differential x US ZLB						-1.001
						(-0.58)
Constant	0.581***	0.580***	0.632***	0.626***	0.602***	0.602***
	(17.96)	(17.28)	(16.21)	(16.17)	(18.41)	(18.42)
N obs	1144	1144	1052	1052	1160	1160
N countries	75	75	70	70	75	75
R2	0.55	0.55	0.57	0.57	0.54	0.54
Adj R2	0.55	0.55	0.57	0.57	0.54	0.54
AIC	-576.63	-574.67	-541.78	-544.95	-563.35	-561.71
BIC	-511.08	-504.07	-477.32	-475.53	-497.62	-490.92
Tranche Measure	Imports (3M)	Imports (3M)	ST Debt	ST Debt	N/A	N/A
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS

t statistics in parentheses

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

Notes: Selected variables from Table 3 column (8) are included in these specifications. Specifically these are: *Dollar peg*, *Euro peg*, *Other peg*, *Trade with US*, *Trade with Euro Area*, *Trade with Japan*, *Trade with UK*, *Dollar debt share*, *Euro debt share*, and *Euro Area dummy*.

Table 6: USD share of foreign exchange reserves and reserve currency returns

	(1)	(2)	(3)	(4)	(5)	(6)
U.S dollar share of official reserves						
US shadow rate	1.065***	1.209**	0.827**	0.159	0.529	0.628
	(3.94)	(2.76)	(2.94)	(0.36)	(1.11)	(0.93)
EA shadow rate	-0.590	-0.665	-0.168	0.408	-0.656	-0.426
	(-1.74)	(-1.25)	(-0.48)	(0.72)	(-1.09)	(-0.38)
InvTr	0.104***	0.107***	0.044	0.032		
	(4.22)	(4.25)	(1.86)	(1.31)		
InvTr x US shadow rate		-0.503		1.707*		
		(-0.50)		(2.14)		
InvTr x EA shadow rate		0.247		-1.423		
		(0.21)		(-1.44)		
US ZLB					-0.027	-0.034
					(-1.30)	(-1.54)
EA ZLB					-0.002	-0.021
					(-0.10)	(-0.66)
US shadow rate x US ZLB						-0.819
						(-0.78)
EA shadow rate x EA ZLB						-1.356
						(-0.93)
Constant	0.565***	0.565***	0.629***	0.635***	0.589***	0.586***
	(16.98)	(16.97)	(15.87)	(15.86)	(15.43)	(14.52)
N obs	1144	1144	1052	1052	1160	1160
N countries	75	75	70	70	75	75
R2	0.55	0.55	0.57	0.57	0.54	0.54
Adj R2	0.55	0.55	0.57	0.57	0.54	0.54
AIC	-577.11	-573.35	-545.75	-546.14	-558.29	-556.51
BIC	-506.52	-492.67	-476.33	-466.81	-482.44	-470.56
Tranche Measure	Imports (3M)	Imports (3M)	ST Debt	ST Debt	N/A	N/A
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS

t statistics in parentheses

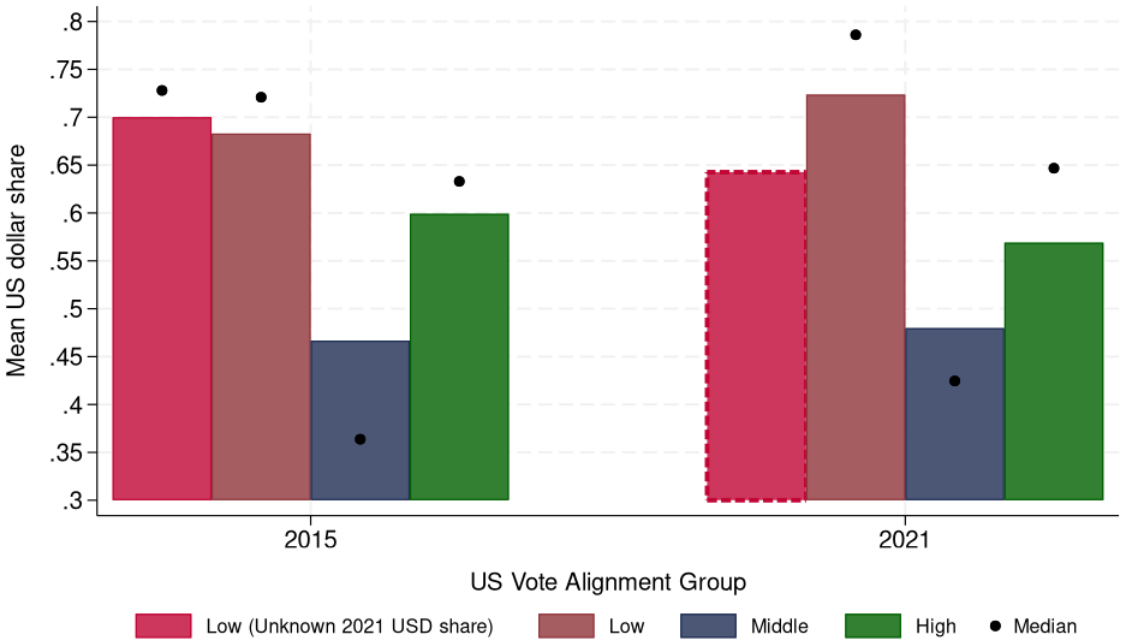
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Selected variables from Table 3 column (8) are included in these specifications. Specifically these are: *Dollar peg*, *Euro peg*, *Other peg*, *Trade with US*, *Trade with Euro Area*, *Trade with Japan*, *Trade with UK*, *Dollar debt share*, *Euro debt share*, and *Euro Area dummy*.

Conjectures for Geopolitical Drivers. The next set of regression tests on US dollar shares of reserve portfolios considers the roles of geopolitical considerations, both reflecting distance from the United States. For context,country voting alignment with the United States, with sorting into low, medium and high voting groups are visualized alongside dollar portfolio shares (unweighted by portfolio size) for 2015 and 2021 in Figure 6. Shown on the left using 2015 data, countries with lower voting alignment (i.e. higher geopolitical distance) relative to the US on average have *higher* dollar shares of reserve portfolios.

As dollar shares are missing for 2021 for some countries, we present separate bars for the countries where there is data on shares across the two dates versus those with data in 2015 and without data in 2021. For this latter group, we use the logic of equations (1) and (4), and construct an estimate of the weighted average dollar share for the group with unknown shares in 2021.[25]

Figure 6: Average US dollar share, by US UN Vote alignment group

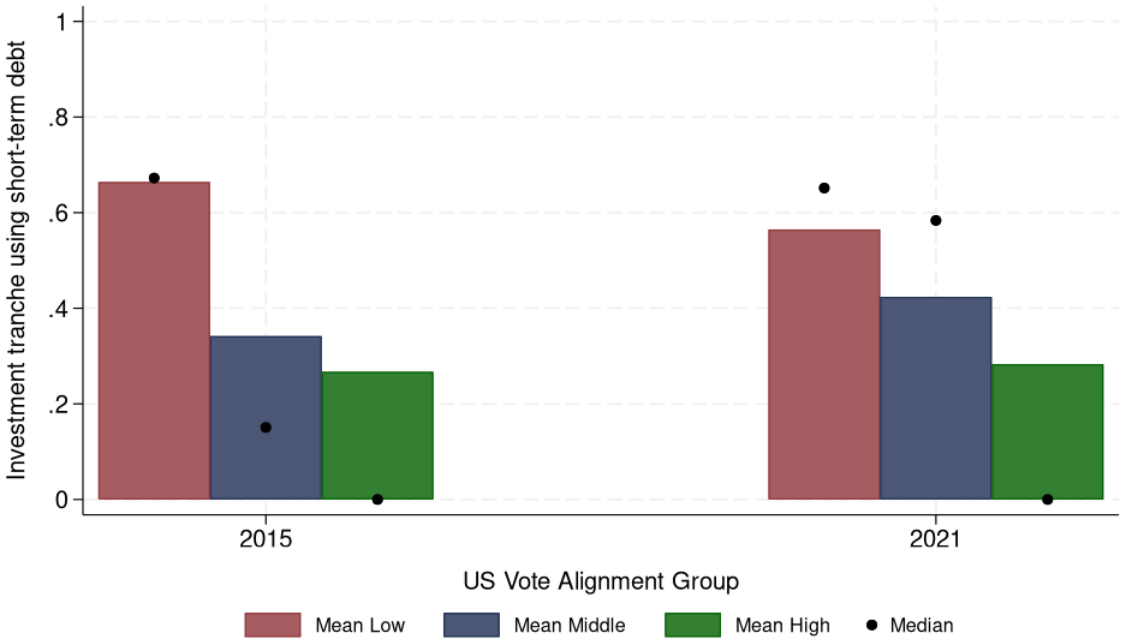


Source: Author's construction using country-level US dollar share data from Ito and McCauley (2020); Chinn, Ito, and McCauley (2022) with additional observations from Arslanalp, Eichengreen, and Simpson-Bell (2022) and UN General Assembly voting data described in Voeten, Strezhnev, and Bailey (2009). Dashed bar outline indicates estimated US dollar share.

[25]The majority of unknown observations for 2021, and the vast majority of reserves of this group, are in the *Low* alignment group, so we assign the resulting value to this category and the red bar for 2021 (in contrast to unweighted averages for the other bars).] The mean US dollar portfolio shares of High alignment countries are lower and for the Middle alignment group countries slightly higher. On average, low alignment group countries with known US dollar share in 2021 increased their (unweighted) dollar shares over time, while estimated (weighted) 2021 US dollar share for countries with unknown 2021 values may have declined by 5 percentage points.

Additional context for geopolitical results is provided by considering the relative size of the investment tranches for countries sorted according to geopolitical alignment with the United States. Using unweighted averages, Figure 7 shows that the investment tranche share tends to be highest for the *Low* voting alignment group. It may be that such countries need both more reserves and a higher share of dollars in their portfolios. This type of observation reinforces the relevance of having regression specifications that introduce geopolitical considerations in relationship to a portion of reserves that might have differential treatment by portfolio managers.

Figure 7: Investment tranche using short-term debt, by US UN Vote alignment group



Source: Author's construction of investment tranche share using short-term debt data from the BIS Joint External Debt Hub (JEDH) and UN General Assembly voting data described in Voeten, Strezhnev, and Bailey (2009).

The next set of regression results, presented in columns of Table 7, respectively introduce the alternative geopolitical alignment terms independently, then interacted with investment tranches, and with controls for nontraditional reserve currency returns or U.S. shadow rates[26]. The most interesting results from these specifications are shown in columns (1) and (3). From column (1), results show the statistical significance of voting alignment with the *Low* alignment countries distinguished from other countries. Confirming the patterns from the visuals, on average, the *Low*

[26]Our preferred specifications, provided in this table, bucket countries into *Low*, *Medium*, or *High* voting alignment with the United States. Specifications using a continuous voting measure provide weaker results and are provided in Table A11.

US UN Vote Agreement group of countries tends to hold statistically *higher*, not *lower*, shares of dollars relative to the $High$ group, while the $Middle$ group is slightly but not significantly holding lower dollar shares than $High$. Tests of equality of coefficients between Low and $Middle$ vote agreement groups are rejected across all specifications.The differences between middle alignment countries and high alignment countries are not statistically significant once controls are in place for the other drivers of dollar share in portfolios.

Next, columns (2) and (3) of Table 7 show specifications with interactions with the investment tranche share of country portfolios, alternatively constructed using import shares or short-term debt. While both forms enter with a negative sign, statistical significance is clear only with the short-term debt investment tranche construct. Columns (4) and (5) show that these particular relationships are unchanged when nontraditional returns or US interest rates are included in specifications along with the investment tranche considerations.

These results provide an interesting and novel set of insights into the role of geopolitical considerations for official reserve portfolio allocations to US dollar assets. Countries with low geopolitical alignment with the United States have higher dollar shares of portfolios compared with other countries included in the regression analytics. These countries also tend to have 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. Descriptive statistics for investment tranche share show the median 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. It may be that 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.

Table 7: USD share of foreign exchange reserves and geopolitical alignment

	(1)	(2)	(3)	(4)	(5)
U.S dollar share of official reserves					
Low US UN vote agreement	0.110***	0.105***	0.236***	0.240***	0.228***
	(6.20)	(4.14)	(7.73)	(7.88)	(7.33)
Middle US UN vote agreement	-0.014	-0.016	-0.010	-0.017	-0.012
	(-0.93)	(-0.82)	(-0.56)	(-0.92)	(-0.62)
InvTr		0.075	0.081*	0.105**	0.077*
		(1.61)	(2.42)	(3.05)	(2.32)
InvTr x Low US UN vote agreement		-0.013	-0.209***	-0.207***	-0.202***
		(-0.21)	(-4.20)	(-4.15)	(-4.02)
InvTr x Middle US UN vote agreement		0.014	-0.006	0.022	-0.009
		(0.24)	(-0.13)	(0.50)	(-0.20)
NRC return differential				1.612	
				(1.48)	
InvTr x NRC return differential				-6.354**	
				(-3.10)	
US shadow rate					0.072
					(0.20)
InvTr x US shadow rate					1.056
					(1.48)
Constant	0.494***	0.490***	0.546***	0.542***	0.553***
	(14.46)	(13.43)	(14.07)	(13.94)	(14.14)
N obs	1137	1121	1029	1029	1029
N countries	74	74	69	69	69
R2	0.55	0.56	0.60	0.60	0.60
Adj R2	0.55	0.55	0.59	0.60	0.59
AIC	-572.12	-573.29	-587.06	-594.53	-588.78
BIC	-506.65	-492.94	-508.08	-505.68	-499.93
Tranche Measure	N/A	Imports (3M)	ST Debt	ST Debt	ST Debt
Estimation method	OLS	OLS	OLS	OLS	OLS

t statistics in parentheses

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

Notes: Selected variables from Table 3 column (8) are included in these specifications. Specifically these are: *Dollar peg*, *Euro peg*, *Other peg*, *Trade with US*, *Trade with Euro Area*, *Trade with Japan*, *Trade with UK*, *Dollar debt share*, *Euro debt share*, and *Euro Area dummy*.

We perform similar analytics that instead use financial sanctions as an alternate measure of geopolitical alignment. 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 that overlap with the coverage of US dollar portfolio shares enter our estimation sample with values equal to 1 (Table A5). We find that financial sanction incidence *per se* is not correlated with dollar share of portfolios after controlling for other regression drivers. The incidence of financial sanctions is only statistically important interacted with investment tranche defined using short-term imports, with patterns consistent with the voting agreement results. Financially sanctioned countries have higher dollar shares, or close to otherwise predicted values when investment tranche is in the range of median values for low alignment countries (Table A12). Compared with the geopolitical indicators, financial sanctions indicators are not as robustly related to dollar shares of reserve portfolios.

5 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 tended to focus 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 analytics provide a more nuanced, and somewhat different, interpretation of the aggregates. The analytics rely on country-level data on official reserves and estimates of portfolio composition, a simple and intuitive accounting approach, and regression analysis.

First, we use available data for 72 individual countries to show that there has not been a common shift in portfolio composition away from US dollar asset shares in central bank reserves. Instead, the declines in the aggregate dollar share of COFER from 2015 through 2021 has been driven by a combination of factors. One factor is reserve accumulation by countries with a lower *ex ante* dollar share. 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.

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. A few countries with lower geopolitical alignment with the U.S. and relatively large reserve portfolios likely are responsible

for much of the decline in dollar shares. Geopolitical considerations do play a ro le 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, proximity to the euro area in trade and debt continues to tilt 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 tilts away from dollar assets.

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A Appendix Exhibits

Table A1: Summary statistics: all variables

	Mean	Median	Min	Max	SD
U.S dollar share of official reserves	0.59	0.62	-0.09	1.26	0.28
Dollar peg (0-1)	0.08	0.00	0.00	1.00	0.27
Euro peg (0-1)	0.11	0.00	0.00	1.00	0.31
Other peg (0-1)	0.02	0.00	0.00	1.00	0.15
Trade with US	0.08	0.05	0.01	0.74	0.10
Trade with Euro Area	0.31	0.29	0.01	0.80	0.20
Trade with Japan	0.03	0.02	0.00	0.17	0.03
Trade with UK	0.04	0.03	0.00	0.20	0.03
Dollar debt share	0.49	0.54	0.00	1.00	0.32
Euro debt share	0.30	0.16	0.00	1.00	0.34
Euro Area (indicator)	0.17	0.00	0.00	1.00	0.38
US shadow rate	0.00	0.00	-0.04	0.06	0.02
EA shadow rate	-0.00	-0.01	-0.03	0.04	0.02
US UN vote agreement share	0.44	0.46	0.09	0.97	0.18
Financial sanction (0-1)	0.43	0.00	0.00	1.00	0.50
Investment tranche with short term debt	0.39	0.43	0.00	1.00	0.35
Investment tranche with 3-months imports	0.29	0.27	0.00	0.89	0.27
NRC return differential (percentage)	0.01	0.00	-0.01	0.02	0.01
NRC return (percentage)	0.03	0.02	0.01	0.07	0.01
Risk adjusted NRC return	2.83	2.15	-4.07	12.24	4.39
Observations	1160				

Notes: 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 1999-2021 period. Indicator variables take on a value of either 0 or 1.

Table A2: Country Coverage in USD Share

Country-year Observations				USD Share		FX Reserves ($Bil)	
Country	C-I-M	A-E-S	G-H	2015	2021	2015	2021
China	1	3	3	0.58	N/A	3330.36	3250.17
Switzerland	16	16	16	0.32	0.39	560.63	1033.80
Hong Kong, China	23	22	23	0.87	0.87	358.66	496.73
Korea, Rep.	15	14	15	0.67	0.68	358.51	438.32
Brazil	20	19	20	0.84	0.82	348.86	330.86
India	3	3	3	0.58	N/A	327.84	569.89
Russian Federation	15	14	15	0.43	0.14	309.39	468.07
Mexico	0	1	1	N/A	N/A	168.37	180.77
United Kingdom	22	22	22	0.40	0.46	101.59	127.80
Turkey	14	14	14	0.81	N/A	91.43	63.18
Poland	21	20	21	0.39	0.36	89.42	145.15
Israel	11	10	11	0.68	0.67	88.94	208.32
Philippines	16	16	17	0.89	0.91	72.35	94.72
Canada	19	18	19	0.68	0.70	69.08	78.15
Czech Republic	23	22	23	0.15	0.25	62.63	168.67
Denmark	23	22	23	0.00	0.00	60.10	70.64
Peru	22	21	22	0.77	0.71	59.40	71.44
Norway	21	21	21	0.53	0.54	54.58	75.33
Sweden	23	22	23	0.08	0.42	49.83	43.62
Colombia	22	21	22	0.89	0.87	44.78	53.47
South Africa	18	17	18	0.50	0.62	38.92	43.15
Spain	23	22	23	0.94	0.67	38.71	54.86
Chile	22	22	23	0.72	0.71	37.21	47.13
Australia	23	22	23	0.55	0.55	37.19	37.42
Germany	21	20	21	0.92	0.86	36.39	36.98
France	4	3	4	N/A	0.81	36.37	53.63
Romania	23	22	23	0.12	0.33	35.16	41.99
Italy	17	16	17	0.68	0.71	34.44	48.60
Nigeria	6	6	6	0.84	N/A	25.96	34.91
Bangladesh	16	15	16	0.83	0.86	25.80	42.85
Morocco	0	5	5	0.40	N/A	21.14	32.10
Bulgaria	23	22	23	0.01	1.00	19.89	34.59
Kazakhstan	23	22	23	0.15	0.79	19.79	8.51
Uruguay	0	11	11	0.94	N/A	15.16	15.91
Croatia	22	21	22	0.25	0.11	14.54	26.92
New Zealand	14	13	14	0.24	0.28	13.10	12.66
Ukraine	21	20	21	0.82	0.85	12.36	29.36
Bolivia	19	18	19	0.81	0.59	11.36	1.65
Serbia, Rep. of	16	15	16	0.36	0.25	10.71	15.47
Netherlands	23	22	23	0.84	0.74	8.84	5.29
Belgium	23	22	23	0.86	0.87	8.45	11.20

Source: Author's construction using IMF IFS, Ito and McCauley (2020); Chinn, Ito, and McCauley (2022), and Arslanalp, Eichengreen, and Simpson-Bell (2022). C-I-M (Chinn-Ito-McCauley) sample denotes data from Ito and McCauley (2020); Chinn, Ito, and McCauley (2022), A-E-S (Arslanalp-Eichengreen-Simpson-Bell) denotes data from Arslanalp, Eichengreen, and Simpson-Bell (2022), and G-H (Goldberg-Hannaoui) is the final sample used in regression specifications.

Table A2 continued

Country-year Observations				USD Share		FX Reserves ($Bil)	
Country	C-I-M	A-E-S	G-H	2015	2021	2015	2021
Costa Rica	0	5	5	0.91	N/A	7.62	6.21
Kenya	19	18	19	0.64	0.79	7.48	8.78
Botswana	0	2	2	N/A	N/A	7.39	4.38
Tunisia	10	9	10	0.37	0.45	7.08	8.22
Sri Lanka	14	13	14	0.40	0.26	6.47	2.77
Finland	21	20	21	0.77	0.86	6.23	8.20
Azerbaijan	20	20	20	0.79	N/A	6.08	7.57
Paraguay	0	19	19	0.87	N/A	5.48	8.98
Ghana	19	18	19	0.96	0.97	5.20	8.30
Portugal	10	9	10	1.00	0.63	4.98	5.73
Iceland	17	16	17	0.43	0.54	4.79	6.27
Bosnia and Herzegovina	21	20	21	0.02	0.00	4.69	9.30
Tanzania	14	13	14	0.68	0.74	3.94	4.94
Mauritius	0	5	5	0.67	N/A	3.77	7.47
Latvia	17	16	17	0.60	0.70	3.05	4.49
Uganda	16	15	16	0.55	1.07	2.84	3.30
Zambia	18	17	18	0.86	0.95	2.53	1.26
Georgia	21	20	21	0.82	0.71	2.32	3.78
Mozambique	15	14	15	0.72	0.73	2.30	3.20
Macedonia, FYR	14	13	14	0.59	0.17	2.23	3.72
Ecuador	0	3	3	N/A	N/A	2.02	6.02
Moldova	10	10	10	0.62	N/A	1.74	3.89
Namibia	15	14	15	0.64	0.29	1.68	2.51
Papua New Guinea	17	16	17	0.44	0.75	1.68	2.23
Kyrgyz Republic	19	18	19	0.36	0.80	1.45	2.01
Lithuania	5	4	5	N/A	0.70	1.31	4.28
Lesotho	0	5	5	0.35	N/A	0.93	0.74
Ireland	0	5	5	0.00	N/A	0.74	5.89
Malawi	13	12	13	0.85	1.00	0.67	0.58
Seychelles	0	5	5	0.93	N/A	0.53	0.66
Slovenia	14	13	14	0.99	0.96	0.35	0.73
Estonia	12	11	12	0.55	0.52	0.30	1.91
Luxembourg	18	18	18	0.93	N/A	0.19	0.19
Tajikistan	14	13	14	0.98	0.97	0.03	2.12

Table A3: 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, Namibia, Zambia, Mozambique, Philippines, Tanzania, China, Kenya, Costa Rica, Kazakhstan, Malawi, Mexico, Brazil, Chile, Paraguay, Uruguay, Peru, India, Colombia, Nigeria, Russia, Papua New Guinea	37
Middle ($0.4 < Agreement < 0.55$)	Serbia, Turkey, Ireland, Switzerland, New Zealand, Georgia, Bosnia and Herzegovina, Sweden, Ukraine, Finland, Croatia, Moldova, Luxembourg, Norway, Germany	15
High ($0.55 \leq Agreement$)	Iceland, Belgium, Spain, Netherlands, Bulgaria, Romania, Italy, Poland, Denmark, Macedonia, Korea Republic, 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, Strezhnev, and Bailey (2009). Time-invariant groupings constructed using median US UNGA vote agreement from 1999-2021. Countries displayed in ascending order of vote agreement. Time-varying groupings in regression specifications constructed using annual 3-year moving average of US UNGA vote agreement.

Table A4: Correlation table across key regression variables

	USDShare	PegUSD	PegEUR	TradeUS	TradeEA	DebtUSD	DebtEUR	EuroArea	ssrUS	ssrEA	VoteUS	InvTrTrade	InvTrDebt	NRCretdiff
USDShare	1.00													
PegUSD	0.19***	1.00												
PegEUR	-0.58***	-0.10***	1.00											
TradeUS	0.16***	0.05	-0.17***	1.00										
TradeEA	-0.26***	-0.23***	0.34***	-0.34***	1.00									
DebtUSD	0.21***	0.22***	-0.16***	0.21***	-0.65***	1.00								
DebtEUR	-0.07*	-0.21***	0.22***	-0.20***	0.72***	-0.70***	1.00							
EuroArea	0.35***	-0.13***	-0.16***	-0.12***	0.49***	-0.46***	0.59***	1.00						
ssrUS	0.01	-0.00	0.01	0.05	0.08**	-0.09**	0.03	0.01	1.00					
ssrEA	-0.09**	-0.00	0.00	0.05	0.11***	-0.16***	0.03	-0.02	0.56***	1.00				
VoteUS	-0.19***	-0.22***	0.20***	0.06*	0.48***	-0.46***	0.46***	0.32***	-0.14***	-0.12***	1.00			
InvTrTrade	-0.12***	0.15***	0.20***	0.09**	-0.20***	0.33***	-0.25***	-0.49***	-0.08**	-0.12***	-0.17***	1.00		
InvTrDebt	-0.06	0.18***	0.09**	-0.10**	-0.30***	0.43***	-0.28***	-0.50***	-0.09**	-0.16***	-0.37***	0.50***	1.00	
NRCretdiff	-0.11***	-0.01	-0.02	-0.01	0.03	-0.08**	-0.01	-0.04	-0.36***	0.51***	0.02	-0.02	-0.08**	1.00
Observations	1160													

t statistics in parentheses

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

Author construction. Statistics across full sample consisting of 75 countries using observations at the year-country level per inclusion in regression sample. USDShare denotes U.S dollar share of official foreign exchange reserves; PegUSD denotes a dollar peg indicator; PegEUR denoets a euro peg indicator; TradeUS denotes share of Trade with US; TradeEU denotes share of trade with euro area; DebtUSD denotes debt denominated in dollars; DebtEUR denotes debt denominated in euros; EuroArea denotes a Euro Area indicator variable; ssrUS denotes the US shadow rate; ssrEA denotes the euro area shadow rate; VoteUS denotes UN general assembly vote agreement with US; InvTrTrade denotes investment tranche measured with 3-months imports; InvTrDebt denotes investment tranche measured with short-term debt; NRCretdiff denotes the NRC return differential.

Table A5: Countries subject to financial sanctions by the US, by inclusion date in regression sample

Sanctioned State	Years Sanctioned
Azerbaijan	2001, 2002
Bangladesh	2021
Bolivia	2011-2021
Bosnia and Herzegovina	2001-2021
Brazil	2021
Bulgaria	2001-2021
Colombia	2010-2021
Costa Rica	2016-2020
Ghana	2018-2021
Hong Kong	2020, 2021
Kenya	2012-2014, 2017-2021
Kyrgyzstan	2020, 2021
Latvia	2019, 2020, 2021
Lesotho	2020
Macedonia	2008-2021
Morocco	2016-2020
Mozambique	2021
Nigeria	2013, 2014, 2015
Philippines	2005-2021
Russia	2014-2021
Serbia	2006-2021
South Africa	2019, 2020, 2021
Tanzania	2016, 2021
Tunisia	2012-2021
Turkey	2018
Uganda	2021
Ukraine	2014-2021

Source: Author's construction using data from Kirikakha et al. (2021), and Syropoulos et al. (2022).

Table A6: Full regression specifications, baseline for USD share of official foreign exchange reserves with waterfall of added determinants

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
U.S dollar share of official reserves									
Dollar peg	0.118***	0.118***	0.118***	0.117***	0.116***	0.110***	0.104***	0.071***	0.115***
	(7.02)	(7.06)	(7.13)	(7.08)	(7.08)	(6.48)	(5.78)	(3.94)	(6.82)
Euro peg	-0.353***	-0.354***	-0.357***	-0.355***	-0.356***	-0.366***	-0.348***	-0.335***	-0.364***
	(-17.89)	(-18.04)	(-18.25)	(-18.07)	(-18.17)	(-18.93)	(-17.45)	(-17.35)	(-17.69)
Other peg	-0.160***	-0.161***	-0.168***	-0.167***	-0.165***	-0.151***	-0.194***	-0.195***	-0.159***
	(-4.15)	(-4.22)	(-4.60)	(-4.56)	(-4.46)	(-4.17)	(-3.99)	(-5.30)	(-4.11)
Trade with US	0.085	0.089	0.084	0.080	0.076	0.090*	0.062	0.167***	0.084
	(1.72)	(1.80)	(1.75)	(1.61)	(1.53)	(1.96)	(1.13)	(3.63)	(1.72)
Trade with Euro Area	-0.338***	-0.330***	-0.328***	-0.339***	-0.342***	-0.348***	-0.420***	-0.229***	-0.342***
	(-5.95)	(-5.69)	(-5.74)	(-5.84)	(-5.92)	(-6.16)	(-6.96)	(-3.96)	(-6.03)
Trade with Japan	-0.302	-0.269	-0.254	-0.309	-0.311	-0.460*	-0.595*	-0.287	-0.329
	(-1.39)	(-1.21)	(-1.20)	(-1.41)	(-1.42)	(-2.18)	(-2.57)	(-1.40)	(-1.58)
Trade with UK	-0.654**	-0.635**	-0.649**	-0.669**	-0.688**	-0.667**	-0.743**	-0.528*	-0.621**
	(-2.77)	(-2.62)	(-2.71)	(-2.73)	(-2.83)	(-2.82)	(-2.79)	(-2.20)	(-2.60)
Dollar debt share	0.197***	0.196***	0.188***	0.192***	0.191***	0.172***	0.158***	0.163***	0.192***
	(7.86)	(7.86)	(7.51)	(7.71)	(7.65)	(6.52)	(5.82)	(6.28)	(7.68)
Euro debt share	0.071*	0.069*	0.066*	0.069*	0.070*	0.058*	0.051	0.090**	0.069*
	(2.52)	(2.44)	(2.30)	(2.43)	(2.45)	(2.06)	(1.72)	(3.19)	(2.46)
Euro Area dummy	0.353***	0.351***	0.347***	0.350***	0.350***	0.382***	0.376***	0.361***	0.355***
	(16.82)	(16.46)	(16.39)	(16.46)	(16.37)	(16.31)	(14.82)	(17.02)	(16.87)
NRC return		-0.325							
		(-0.79)							
NRC return differential			-2.519***						
			(-3.68)						
US shadow rate				1.037***					
				(3.82)					
EA shadow rate				-0.784*					
				(-2.34)					
US ZLB					-0.041***				
					(-3.66)				
EA ZLB					0.012				
					(0.99)				
InvTr						0.101***	0.044		
						(4.17)	(1.83)		
Low US UN vote agreement								0.110***	
								(6.70)	
Middle US UN vote agreement								-0.014	
								(-0.94)	
Financial sanction									0.025
									(1.51)
Constant	0.573***	0.580***	0.592***	0.573***	0.591***	0.563***	0.624***	0.494***	0.574***
	(17.62)	(17.98)	(18.51)	(17.32)	(16.78)	(17.15)	(15.97)	(14.27)	(17.72)
N obs	1160	1160	1160	1160	1160	1144	1052	1137	1160
N countries	75	75	75	75	75	75	70	74	75
R2	0.54	0.54	0.54	0.54	0.54	0.55	0.57	0.55	0.54
Adj R2	0.53	0.53	0.54	0.54	0.54	0.54	0.56	0.55	0.53
AIC	-550.53	-549.20	-562.03	-560.36	-560.18	-566.57	-540.11	-572.12	-550.78
BIC	-494.91	-488.52	-501.36	-494.63	-494.45	-506.07	-480.61	-506.65	-490.11
Tranche Measure	N/A	N/A	N/A	N/A	N/A	Imports (3M)	ST Debt	N/A	N/A
p-val: b[Low UN] = b[Medium UN]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS

t statistics in parentheses

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

Table A7: Full regression specifications, USD share of foreign exchange reserves and nontraditional reserve currency returns

	(1)	(2)	(3)	(4)	(5)	(6)
U.S dollar share of official reserves						
Dollar peg	0.110***	0.110***	0.106***	0.110***	0.117***	0.116***
	(6.58)	(6.57)	(5.94)	(6.09)	(7.12)	(7.11)
Euro peg	-0.370***	-0.370***	-0.350***	-0.352***	-0.357***	-0.357***
	(-19.33)	(-19.30)	(-17.62)	(-17.91)	(-18.17)	(-18.16)
Other peg	-0.158***	-0.159***	-0.194***	-0.190***	-0.168***	-0.168***
	(-4.61)	(-4.63)	(-4.15)	(-3.95)	(-4.59)	(-4.58)
Trade with US	0.089*	0.089*	0.062	0.062	0.076	0.074
	(1.98)	(1.98)	(1.14)	(1.13)	(1.56)	(1.51)
Trade with Euro Area	-0.339***	-0.338***	-0.413***	-0.418***	-0.338***	-0.340***
	(-5.97)	(-5.91)	(-6.79)	(-6.90)	(-5.86)	(-5.88)
Trade with Japan	-0.413*	-0.410*	-0.562*	-0.579*	-0.296	-0.301
	(-1.99)	(-1.97)	(-2.43)	(-2.49)	(-1.37)	(-1.40)
Trade with UK	-0.664**	-0.664**	-0.740**	-0.754**	-0.681**	-0.687**
	(-2.77)	(-2.77)	(-2.75)	(-2.84)	(-2.81)	(-2.83)
Dollar debt share	0.164***	0.164***	0.154***	0.151***	0.189***	0.189***
	(6.24)	(6.22)	(5.74)	(5.64)	(7.59)	(7.59)
Euro debt share	0.054	0.054	0.049	0.047	0.068*	0.068*
	(1.86)	(1.87)	(1.67)	(1.59)	(2.37)	(2.37)
Euro Area dummy	0.376***	0.376***	0.371***	0.373***	0.349***	0.349***
	(15.87)	(15.84)	(14.52)	(14.62)	(16.41)	(16.40)
NRC return differential	-2.361***	-2.219	-1.364	0.457	-1.688*	-1.330
	(-3.46)	(-1.96)	(-1.91)	(0.38)	(-1.98)	(-1.24)
InvTr	0.098***	0.101***	0.041	0.066*		
	(4.08)	(3.49)	(1.72)	(2.48)		
InvTr x NRC return differential		-0.469		-4.642*		
		(-0.18)		(-2.26)		
US ZLB					-0.025	-0.017
					(-1.78)	(-0.84)
NRC return differential x US ZLB						-1.001
						(-0.58)
Constant	0.581***	0.580***	0.632***	0.626***	0.602***	0.602***
	(17.96)	(17.28)	(16.21)	(16.17)	(18.41)	(18.42)
N obs	1144	1144	1052	1052	1160	1160
N countries	75	75	70	70	75	75
R2	0.55	0.55	0.57	0.57	0.54	0.54
Adj R2	0.55	0.55	0.57	0.57	0.54	0.54
AIC	-576.63	-574.67	-541.78	-544.95	-563.35	-561.71
BIC	-511.08	-504.07	-477.32	-475.53	-497.62	-490.92
Tranche Measure	Imports (3M)	Imports (3M)	ST Debt	ST Debt	N/A	N/A
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS

t statistics in parentheses

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

Table A8: Full regression specifications, US dollar share of foreign exchange reserves and risk-adjusted NRC returns

	(1)	(2)	(3)	(4)	(5)	(6)
U.S dollar share of official reserves						
Dollar peg	0.110***	0.110***	0.105***	0.109***	0.116***	0.116***
	(6.54)	(6.53)	(5.92)	(6.02)	(7.09)	(7.08)
Euro peg	-0.369***	-0.369***	-0.350***	-0.353***	-0.356***	-0.356***
	(-19.23)	(-19.21)	(-17.58)	(-17.87)	(-18.08)	(-18.05)
Other peg	-0.159***	-0.160***	-0.195***	-0.192***	-0.168***	-0.168***
	(-4.61)	(-4.62)	(-4.18)	(-3.98)	(-4.58)	(-4.55)
Trade with US	0.086	0.086	0.061	0.061	0.075	0.073
	(1.91)	(1.91)	(1.11)	(1.10)	(1.54)	(1.48)
Trade with Euro Area	-0.343***	-0.343***	-0.415***	-0.419***	-0.341***	-0.343***
	(-6.06)	(-6.00)	(-6.82)	(-6.94)	(-5.90)	(-5.92)
Trade with Japan	-0.437*	-0.436*	-0.574*	-0.592*	-0.310	-0.318
	(-2.11)	(-2.09)	(-2.50)	(-2.56)	(-1.44)	(-1.47)
Trade with UK	-0.669**	-0.669**	-0.744**	-0.752**	-0.681**	-0.687**
	(-2.79)	(-2.79)	(-2.76)	(-2.84)	(-2.81)	(-2.81)
Dollar debt share	0.165***	0.166***	0.155***	0.153***	0.191***	0.191***
	(6.27)	(6.24)	(5.74)	(5.68)	(7.63)	(7.66)
Euro debt share	0.054	0.054	0.049	0.048	0.068*	0.068*
	(1.88)	(1.88)	(1.66)	(1.62)	(2.39)	(2.40)
Euro Area dummy	0.378***	0.378***	0.372***	0.373***	0.350***	0.350***
	(16.04)	(16.02)	(14.62)	(14.69)	(16.57)	(16.55)
Risk Adjusted NRC return	-0.005***	-0.004*	-0.003*	0.001	-0.003	-0.002
	(-3.71)	(-2.20)	(-2.32)	(0.26)	(-1.94)	(-0.90)
InvTr	0.099***	0.100***	0.041	0.063*		
	(4.12)	(3.65)	(1.73)	(2.44)		
InvTr x Risk adjusted NRC return		-0.000		-0.009*		
		(-0.09)		(-2.40)		
US ZLB					-0.022	-0.017
					(-1.43)	(-0.95)
Risk adjusted NRC return x US ZLB						-0.002
						(-0.48)
Constant	0.581***	0.580***	0.633***	0.627***	0.600***	0.600***
	(17.95)	(17.42)	(16.28)	(16.23)	(18.21)	(18.19)
N obs	1144	1144	1052	1052	1160	1160
N countries	75	75	70	70	75	75
R2	0.55	0.55	0.57	0.57	0.54	0.54
Adj R2	0.55	0.55	0.57	0.57	0.54	0.54
AIC	-577.77	-575.78	-543.30	-546.63	-563.07	-561.32
BIC	-512.22	-505.18	-478.84	-477.21	-497.34	-490.53
Tranche Measure	Imports (3M)	Imports (3M)	ST Debt	ST Debt	N/A	N/A
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS

t statistics in parentheses

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

Table A9: Full regression specifications, USD share of foreign exchange reserves and reserve currency returns

	(1)	(2)	(3)	(4)	(5)	(6)
U.S dollar share of official reserves						
Dollar peg	0.109***	0.109***	0.103***	0.106***	0.117***	0.116***
	(6.49)	(6.48)	(5.79)	(5.92)	(7.09)	(7.08)
Euro peg	-0.368***	-0.368***	-0.348***	-0.350***	-0.356***	-0.356***
	(-19.12)	(-19.09)	(-17.37)	(-17.58)	(-18.19)	(-18.14)
Other peg	-0.158***	-0.158***	-0.195***	-0.192***	-0.167***	-0.168***
	(-4.55)	(-4.54)	(-4.08)	(-3.92)	(-4.57)	(-4.60)
Trade with US	0.080	0.080	0.050	0.052	0.077	0.072
	(1.73)	(1.72)	(0.90)	(0.93)	(1.55)	(1.46)
Trade with Euro Area	-0.356***	-0.358***	-0.437***	-0.438***	-0.340***	-0.343***
	(-6.14)	(-6.12)	(-7.06)	(-7.07)	(-5.85)	(-5.91)
Trade with Japan	-0.503*	-0.508*	-0.672**	-0.682**	-0.305	-0.314
	(-2.34)	(-2.35)	(-2.84)	(-2.82)	(-1.39)	(-1.43)
Trade with UK	-0.697**	-0.700**	-0.789**	-0.794**	-0.679**	-0.695**
	(-2.85)	(-2.84)	(-2.89)	(-2.90)	(-2.77)	(-2.82)
Dollar debt share	0.168***	0.167***	0.157***	0.155***	0.191***	0.190***
	(6.43)	(6.37)	(5.86)	(5.77)	(7.61)	(7.61)
Euro debt share	0.057*	0.057*	0.053	0.051	0.069*	0.069*
	(1.99)	(2.00)	(1.79)	(1.73)	(2.41)	(2.43)
Euro Area dummy	0.382***	0.382***	0.377***	0.377***	0.350***	0.350***
	(15.84)	(15.73)	(14.68)	(14.64)	(16.35)	(16.38)
US shadow rate	1.065***	1.209**	0.827**	0.159	0.529	0.628
	(3.94)	(2.76)	(2.94)	(0.36)	(1.11)	(0.93)
EA shadow rate	-0.590	-0.665	-0.168	0.408	-0.656	-0.426
	(-1.74)	(-1.25)	(-0.48)	(0.72)	(-1.09)	(-0.38)
InvTr	0.104***	0.107***	0.044	0.032		
	(4.22)	(4.25)	(1.86)	(1.31)		
InvTr x US shadow rate		-0.503		1.707*		
		(-0.50)		(2.14)		
InvTr x EA shadow rate		0.247		-1.423		
		(0.21)		(-1.44)		
US ZLB					-0.027	-0.034
					(-1.30)	(-1.54)
EA ZLB					-0.002	-0.021
					(-0.10)	(-0.66)
US shadow rate x US ZLB						-0.819
						(-0.78)
EA shadow rate x EA ZLB						-1.356
						(-0.93)
Constant	0.565***	0.565***	0.629***	0.635***	0.589***	0.586***
	(16.98)	(16.97)	(15.87)	(15.86)	(15.43)	(14.52)
N obs	1144	1144	1052	1052	1160	1160
N countries	75	75	70	70	75	75
R2	0.55	0.55	0.57	0.57	0.54	0.54
Adj R2	0.55	0.55	0.57	0.57	0.54	0.54
AIC	-577.11	-573.35	-545.75	-546.14	-558.29	-556.51
BIC	-506.52	-492.67	-476.33	-466.81	-482.44	-470.56
Tranche Measure	Imports (3M)	Imports (3M)	ST Debt	ST Debt	N/A	N/A
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS

t statistics in parentheses

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

Table A10: Full regression specifications, USD share of foreign exchange reserves and geopolitical alignment

	(1)	(2)	(3)	(4)	(5)
U.S dollar share of official reserves					
Dollar peg	0.071**	0.071**	0.071**	0.078**	0.070**
	(2.92)	(2.91)	(2.71)	(3.00)	(2.69)
Euro peg	-0.335***	-0.346***	-0.328***	-0.332***	-0.330***
	(-15.92)	(-16.14)	(-16.00)	(-16.23)	(-16.10)
Other peg	-0.195***	-0.183***	-0.221***	-0.216***	-0.219***
	(-4.93)	(-4.56)	(-5.11)	(-5.01)	(-5.08)
Trade with US	0.167**	0.173**	0.137*	0.140*	0.130*
	(2.76)	(2.74)	(2.14)	(2.20)	(2.03)
Trade with Euro Area	-0.229***	-0.242***	-0.299***	-0.298***	-0.310***
	(-4.38)	(-4.51)	(-5.34)	(-5.34)	(-5.48)
Trade with Japan	-0.287	-0.389	-0.550*	-0.548*	-0.588*
	(-1.24)	(-1.62)	(-2.26)	(-2.25)	(-2.39)
Trade with UK	-0.528**	-0.555**	-0.698***	-0.703***	-0.710***
	(-2.71)	(-2.80)	(-3.41)	(-3.45)	(-3.46)
Dollar debt share	0.163***	0.150***	0.098**	0.090**	0.100**
	(5.59)	(5.02)	(3.22)	(2.96)	(3.28)
Euro debt share	0.090**	0.079**	0.044	0.040	0.045
	(3.10)	(2.71)	(1.48)	(1.35)	(1.52)
Euro Area dummy	0.361***	0.384***	0.401***	0.401***	0.400***
	(17.95)	(16.23)	(17.99)	(17.95)	(17.98)
Low US UN vote agreement	0.110***	0.105***	0.236***	0.240***	0.228***
	(6.20)	(4.14)	(7.73)	(7.88)	(7.33)
Middle US UN vote agreement	-0.014	-0.016	-0.010	-0.017	-0.012
	(-0.93)	(-0.82)	(-0.56)	(-0.92)	(-0.62)
InvTr		0.075	0.081*	0.105**	0.077*
		(1.61)	(2.42)	(3.05)	(2.32)
InvTr x Low US UN vote agreement		-0.013	-0.209***	-0.207***	-0.202***
		(-0.21)	(-4.20)	(-4.15)	(-4.02)
InvTr x Middle US UN vote agreement		0.014	-0.006	0.022	-0.009
		(0.24)	(-0.13)	(0.50)	(-0.20)
NRC return differential				1.612	
				(1.48)	
InvTr x NRC return differential				-6.354**	
				(-3.10)	
US shadow rate					0.072
					(0.20)
InvTr x US shadow rate					1.056
					(1.48)
Constant	0.494***	0.490***	0.546***	0.542***	0.553***
	(14.46)	(13.43)	(14.07)	(13.94)	(14.14)
N obs	1137	1121	1029	1029	1029
N countries	74	74	69	69	69
R2	0.55	0.56	0.60	0.60	0.60
Adj R2	0.55	0.55	0.59	0.60	0.59
AIC	-572.12	-573.29	-587.06	-594.53	-588.78
BIC	-506.65	-492.94	-508.08	-505.68	-499.93
Tranche Measure	N/A	Imports (3M)	ST Debt	ST Debt	ST Debt
Estimation method	OLS	OLS	OLS	OLS	OLS

t statistics in parentheses

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

Table A11: USD share of foreign exchange reserves and geopolitical alignment using continuous *US UN vote agreement* measure

	(1)	(2)	(3)	(4)	(5)
U.S dollar share of official reserves					
Dollar peg	0.078**	0.075**	0.064*	0.070**	0.065*
	(3.15)	(3.05)	(2.39)	(2.62)	(2.45)
Euro peg	-0.345***	-0.358***	-0.339***	-0.343***	-0.341***
	(-16.33)	(-16.85)	(-16.27)	(-16.48)	(-16.39)
Other peg	-0.178***	-0.168***	-0.209***	-0.205***	-0.204***
	(-4.46)	(-4.16)	(-4.72)	(-4.66)	(-4.62)
Trade with US	0.162**	0.166**	0.154*	0.154*	0.152*
	(2.59)	(2.58)	(2.33)	(2.35)	(2.28)
Trade with Euro Area	-0.283***	-0.295***	-0.363***	-0.360***	-0.366***
	(-5.43)	(-5.60)	(-6.43)	(-6.39)	(-6.40)
Trade with Japan	-0.331	-0.470	-0.632*	-0.618*	-0.633*
	(-1.42)	(-1.96)	(-2.55)	(-2.50)	(-2.53)
Trade with UK	-0.635**	-0.662***	-0.835***	-0.849***	-0.830***
	(-3.23)	(-3.30)	(-3.98)	(-4.05)	(-3.95)
Dollar debt share	0.190***	0.167***	0.135***	0.128***	0.135***
	(6.53)	(5.58)	(4.40)	(4.17)	(4.40)
Euro debt share	0.083**	0.071*	0.048	0.044	0.047
	(2.85)	(2.39)	(1.60)	(1.47)	(1.55)
Euro Area dummy	0.358***	0.385***	0.390***	0.387***	0.390***
	(17.66)	(16.85)	(17.56)	(17.39)	(17.62)
US UN vote agreement	-0.182***	-0.180**	-0.336***	-0.338***	-0.335***
	(-4.59)	(-3.14)	(-5.13)	(-5.19)	(-4.89)
InvTr		0.078	-0.086	-0.062	-0.098
		(1.33)	(-1.54)	(-1.11)	(-1.71)
InvTr x US UN vote agreement		0.029	0.255*	0.256*	0.275*
		(0.23)	(2.36)	(2.38)	(2.48)
NRC return differential				0.563	
				(0.52)	
InvTr x NRC return differential				-4.878*	
				(-2.39)	
US shadow rate					-0.222
					(-0.59)
InvTr x US shadow rate					1.498*
					(2.05)
Constant	0.629***	0.621***	0.773***	0.777***	0.776***
	(17.99)	(15.87)	(15.30)	(15.36)	(15.20)
N obs	1137	1121	1029	1029	1029
N countries	74	74	69	69	69
R2	0.54	0.55	0.58	0.58	0.58
Adj R2	0.54	0.54	0.57	0.58	0.57
AIC	-542.64	-552.69	-542.52	-547.94	-544.45
BIC	-482.21	-482.38	-473.41	-468.95	-465.47
Tranche Measure	N/A	Imports (3M)	ST Debt	ST Debt	ST Debt
Estimation method	OLS	OLS	OLS	OLS	OLS

t statistics in parentheses

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

Table A12: USD share of foreign exchange reserves and geopolitical alignment using financial sanctions

	(1)	(2)	(3)	(4)	(5)
Dollar peg	0.115***	0.106***	0.104***	0.110***	0.102***
	(5.33)	(4.93)	(4.60)	(4.87)	(4.51)
Euro peg	-0.364***	-0.375***	-0.352***	-0.353***	-0.355***
	(-16.38)	(-16.99)	(-15.91)	(-16.02)	(-16.08)
Other peg	-0.159***	-0.147***	-0.192***	-0.190***	-0.191***
	(-4.00)	(-3.67)	(-4.35)	(-4.30)	(-4.33)
Trade with US	0.084	0.097	0.059	0.063	0.048
	(1.40)	(1.63)	(0.91)	(0.98)	(0.73)
Trade with Euro Area	-0.342***	-0.355***	-0.424***	-0.416***	-0.442***
	(-6.70)	(-6.96)	(-7.48)	(-7.35)	(-7.76)
Trade with Japan	-0.329	-0.395	-0.615*	-0.575*	-0.697**
	(-1.42)	(-1.69)	(-2.45)	(-2.29)	(-2.76)
Trade with UK	-0.621**	-0.663***	-0.737***	-0.748***	-0.766***
	(-3.14)	(-3.39)	(-3.51)	(-3.58)	(-3.64)
Dollar debt share	0.192***	0.168***	0.157***	0.151***	0.157***
	(6.82)	(5.89)	(5.35)	(5.14)	(5.38)
Euro debt share	0.069*	0.057*	0.051	0.046	0.053
	(2.37)	(1.97)	(1.74)	(1.56)	(1.82)
Euro Area dummy	0.355***	0.395***	0.375***	0.373***	0.376***
	(17.51)	(18.12)	(17.12)	(17.03)	(17.23)
Financial sanction	0.025	0.127***	0.004	0.018	0.004
	(1.50)	(3.76)	(0.08)	(0.39)	(0.08)
InvTr		0.130***	0.039	0.068*	0.034
		(4.98)	(1.59)	(2.45)	(1.40)
InvTr x Financial sanction		-0.246***	0.009	-0.022	0.016
		(-3.58)	(0.13)	(-0.32)	(0.23)
NRC return differential				0.488	
				(0.45)	
InvTr x NRC return differential				-4.714*	
				(-2.27)	
US shadow rate					0.369
					(1.04)
InvTr x US shadow rate					1.098
					(1.52)
Constant	0.574***	0.553***	0.626***	0.624***	0.634***
	(18.17)	(17.47)	(16.34)	(16.17)	(16.58)
N obs	1160	1144	1052	1052	1052
N countries	75	75	70	70	70
R2	0.54	0.55	0.57	0.57	0.57
Adj R2	0.53	0.55	0.56	0.57	0.57
AIC	-550.78	-577.22	-536.43	-541.11	-544.40
BIC	-490.11	-506.63	-467.01	-461.78	-465.06
Tranche Measure	N/A	Imports (3M)	ST Debt	ST Debt	ST Debt
Estimation method	OLS	OLS	OLS	OLS	OLS

t statistics in parentheses

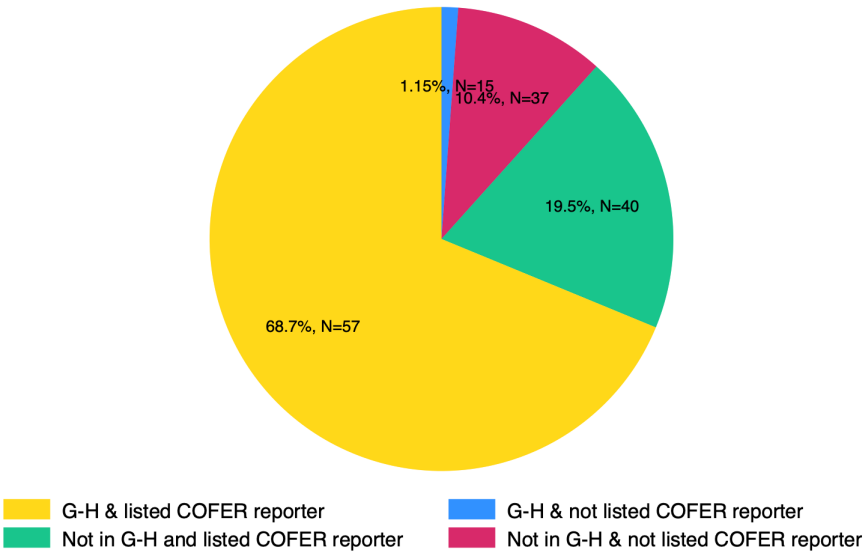
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

B Limitations of a Basic Decomposition

The application provided in Section 2 is intended to decompose the observed changes in a reserve portfolios, aggregated across countries, into components associated with shifts in shares of dollars in each country's reserve portfolio or with changes in levels of reserve portfolios. It also provides a way of bounding the contribution to the aggregated portfolio share of the countries for which there are information gaps on portfolio allocations.

This approach has a few limitations when used for explaining the published COFER series. One limitation stems from the country coverage of the full empirical application, as the complete composition of countries in the COFER is not published: 52 of the 149 participating countries/economies included in the COFER aggregates are not identified, representing on the order of 11.7% percent of allocated reserves as of 2021. Another 40 countries have names published, representing approximately 20 percent of the COFER allocated reserve aggregate as of 2021, but are not within the sample of countries for which the Ito and McCauley 2020; Chinn, Ito, and McCauley 2022 database has estimates of portfolio share decomposition database for the 2015/2016 dates that are the starting period of our application. The distribution of aggregated reserves across these different country groups is shown below.

Figure B1: FX Reserve share of Allocated Reserves in 2021, by sample



Source: Author's construction using data from the IMF COFER. *G-H* (Goldberg-Hannaoui) refers to countries included in this paper's analytics and the illustrative decomposition section described in section 2, COFER reporter refers to countries who volunteer to report their participation in COFER, not listed COFER reporter refers to countries who participate in COFER but do not publicly dispose their participation. Within the exhibit, N refers to the number of countries included in the corresponding group, and the percentage values within the exhibit slices refer to the respective countries' total share of total allocated reserves in 2021.

As the names of this latter group of countries representing the majority of the data gap are known, we can provide some insights into which countries dominate reserves for this group and introduce considerations for whether those countries are likely to have shifted away from dollar share in the period examined (2015 to 2021).

Shown in Table B1, presenting the top reserve portfolio countries in this group, Japan, Singapore, Mexico and the United Arab Emirates have the largest reserve stocks, with other countries holding substantially smaller volumes. Among these Japan, Singapore and Mexico have above median shares of trade with the US, and the UAE has commodity exports that are mainly invoiced in USD. The USD is considered the anchor currency for most of the countries presented in the table, with some of the larger countries having a dollar peg or band de facto in place. External debt shares in USD are high, with the exception of France and Hungary (where euro shares are high). These characteristics weigh against these countries being likely contributors to shifting preferences away from USD. Using the insights of our regression analysis and conjectures, the combination of low UN voting alignment with the US for Singapore and Kuwait with a high investment tranche could push in the opposite direction. Between 2015 and 2021, the overall accumulation of reserve balances by this group was 358 billion dollars, compared with 1501 billion dollars by the 72 country group in our empirical example. It may be that this full group, if anything, is pulling up the dollar share of COFER reserves - not reducing it.

	JPN	SGP	MEX	UAE	FRA	KWT	ARG	HUN
GDP (Bil USD)	5006	424	1273	415	2958	137	487	182
FX Reserves (Bil USD)	1283	408	181	124	54	40	35	35
Investment tranche with 3-months imports (%)	81.64	61.32	22.69	0.3	0	69.16	48.87	0
Share of Trade with US (%)	14.32	8.73	61.42	3.69	5.63	2.58	7.66	2.07
Share of External Debt in USD (%)	79.6	N/A	85.55	99.7	1.58	100	90.77	48.88
US UN vote agreement	Middle	Low	Low	Low	High	Low	Low	High
Peg or band?	No	Yes	No	Yes	No	Yes	No	Yes
Anchor currency	USD	USD-EUR	USD	USD	USD	USD	USD	EUR

Table B1: Indicators of propensity toward dollar reserves, 2021 end of period.

Source: Author construction using data from the World Bank World Development Indicators, World Bank International Debt Statistics, IMF International Financial Statistics, IMF Direction of Trade Statistics, BIS Joint External Debt Hub, (Voeten, Strezhnev, and Bailey, 2009), and Ilzetzki, Reinhart, and Rogoff (2019).

Beyond these considerations, measurement bias can be a feature of application to the full COFER change of dollar asset share using data exclusively tied to the 72 countries available in the Ito and McCauley 2020; Chinn, Ito, and McCauley 2022 portfolio share decomposition database for 2015/2016 and representing about 70 percent of world allocated reserves (in 2021). One source

of measurement bias arises because the denominator of the terms in the decomposition could be about 40 percent higher, reflecting the aggregated allocated reserves across all 149 countries - at 12 trillion USD - in place of only the 72 countries in our empirical example - at 8.5 trillion USD. This larger denominator reduces the magnitude of each of the identified aggregated components of our application. In addition, potential contributions to both preference change and reserve balance shifts can come from the countries included in the COFER sample, representing about 11.7 percent of the aggregate allocated reserve total, but whose identities are not published.

Below we provide the modified decomposition equation that would include the full group of COFER reporters:

$$d(USRSH_{2021,2015}) = \frac{\sum_{c=1}^{54} d\sigma^c R^c_{2015}}{\sum_{c=1}^{149} R^c_{2015}} + \frac{\sum_{c=55}^{72} d\sigma^c R^c_{2015}}{\sum_{c=1}^{149} R^c_{2015}} + \frac{\sum_{c=1}^{72} (\sigma^c_{2015} - USRSH_{2015}) dR^c}{\sum_{c=1}^{149} R^c_{2015}} + \frac{\sum_{149}^{c=73} d\sigma^c R^c_{2015}}{\sum_{c=1}^{149} R^c_{2015}} + \frac{\sum_{c=73}^{149} (\sigma^c_{2015} - USRSH_{2015}) dR^c}{\sum_{c=1}^{149} R^c_{2015}}$$

To fully align our decomposition to the COFER aggregate requires details on the 77 countries outside of our 72 country sample for the 2015 to 2021 period, and the results would be refined if data were available to bridge this significant information gap. The two missing terms are presented on the lower line of this equation.