Gold as International Reserves: A Barbarous Relic No More?

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ABSTRACT: After moving slowly downward for the better part of four decades, central bank gold holdings have risen since the Global Financial Crisis. We identify 14 "active diversifiers," countries that purchased gold and raised its share in total reserves by at least 5 percentage points over the last two decades. In contrast to the diversification of foreign currency reserves, which has been undertaken by advanced and developing country central banks alike, active diversifiers into gold are exclusively emerging markets. We document two sets of factors contributing to this trend. First, gold appeals to reserve managers as a safe haven in periods of economic, financial and geopolitical volatility, when the return on alternative assets is low. Second, the imposition of financial sanctions by the US, UK, EU and Japan, the main reserve-issuing economies, is associated with an increase in the share of central bank reserves held in the form of gold.

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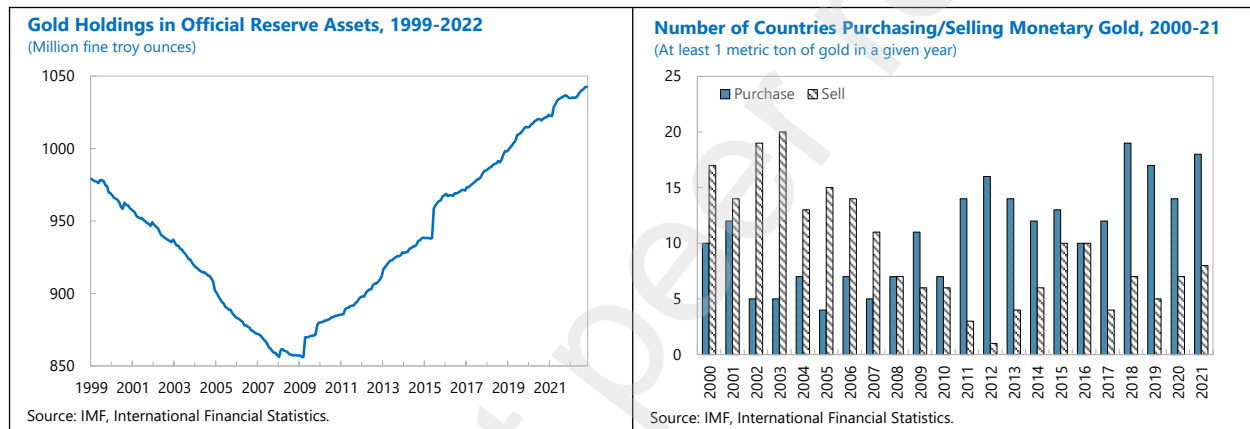[b] University of California, Berkeley, NBER and CEPR

I. Introduction

In the third quarter of 2022, global central banks added US$20 billion of gold to their international reserve portfolios. This was the largest quarterly increase in official gold demand in fully 55 years according to the World Gold Council (2022). This startling increase excited much commentary, taking place as it did against the backdrop of a secular decline in the share of global reserves held in the form of gold stretching over the better part of four decades.

In fact, this increase in official gold demand is not as unprecedented as sometimes portrayed. As Figure 1 (left panel) shows, gold as a share of official foreign reserves had reversed its earlier fall already more than ten years ago, around the time of the 2008-9 Global Financial Crisis. Figure 1 (right panel) shows the swing from more countries selling gold pre-GFC to more countries purchasing post-GFC. In this paper we seek to identify which central banks and underlying economic, financial and political factors account for this shift.

Figure 1. Gold Holdings in Official Reserve Assets, 1999-2022

Gold Holdings in Official Reserve Assets, 1999-2022
(Million fine troy ounces)

Source: IMF, International Financial Statistics.

Number of Countries Purchasing/Selling Monetary Gold, 2000-21
(At least 1 metric ton of gold in a given year)

Source: IMF, International Financial Statistics.

Two hypotheses suggest themselves as potential explanations for this reversal. First, gold is seen as a safe haven and desirable reserve asset in periods of high economic, financial and geopolitical uncertainty, and when returns on reserve currencies are low, two conditions that have been prevalent in recent years. Gold is popularly viewed as an inflation hedge (inflation having reared its head in recent years) and as a portfolio diversifier (portfolio diversification having special value in a volatile environment). In addition, gold is favored by custom and tradition: central banks and governments have long held gold reserves. One might imagine central bank reserve managers investing in a variety of physical commodities when returns on financial assets are unattractive.[1] But investing in gold is regarded, for reasons rooted in history, as more respectable and confidence inspiring than investing in, say, diamonds or lithium.[2] That there exist well-regulated, liquid markets for trading gold in London, New York and Shanghai works in the same direction.[3]

Second, gold is perceived as a safe and desirable reserve asset when countries are subject to financial sanctions and when financial investments are potentially subject to asset freezes and seizure. The decision of G7 countries to freeze the foreign-exchange reserves of the Bank of Russia directed attention to whether reserves might be held in another form better insulated from sanctions. The Bank of Russia accelerated its gold purchases following Russia's annexation of Crimea in 2014. In 2021, it confirmed that its gold was now fully

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[1] For suggestions to this effect, see Pozsar (2022).

[2] An indication of this fact is that gold and not diamonds and lithium are categorized as a form of reserves by the IMF's Balance of Payments Manual (IMF 2013). Some countries also hold gold in Sovereign Wealth Funds, but data on such holdings are limited.

[3] There is also a large over-the-counter market in Switzerland, where there is no centralized exchange.

vaulted at home. While the Russian sanctions imposed by G7 countries—which bar their banks from doing most business with Russian counterparts and deny the Bank of Russia, that country's central bank, access to its reserves at foreign central and commercial banks—are a recent and dramatic case in point, earlier sanctions had already interrupted, or threatened to interrupt, such access for the central banks and governments of other countries. The question is whether this sanctions risk also figures in the recent trend toward gold.

Skeptics will contend that gold also has disadvantages. Financial securities more effectively provide protection against inflation and economic and financial volatility (Economist 2022). Gold is expensive to transport, warehouse and secure. It is costly to use in transactions. It doesn't bear interest. It can, however, be lent out on term deposit, in the same way that currencies in the central bank's reserve portfolio can be lent.[4] It can generate a return when used in swaps (offsetting exchanges of gold for currency on agreed spot and forward dates executed with private counterparties or partner central banks). However, banks acting as counterparties in loan and swap transactions expect gold to be vaulted at the Bank of England, the Federal Reserve Bank of New York, or a recognized depository operated by one of the major gold exchanges, reintroducing sanctions risk. Repatriating gold, as Russia, Venezuela and others have done, thus limits its use.[5]

These issues make it important to understand the role of gold in central bank reserves and how it is affected by transactions costs, relative returns, economic/financial uncertainties, geopolitical events, and sanctions risk.

In this paper we place this question, whether there might be an increased demand for gold by central bank reserve managers in light of recent events, against the backdrop of ongoing trends in the official demand for gold. At the country level, we identify a set of "active diversifiers," defined as countries that purchased gold and raised its share in reserves by at least 5 percentage points in the last two decades. This is the same movement in the direction of portfolio diversification by reserve managers we identified in an earlier paper on foreign exchange reserves (Arslanalp, Eichengreen, and Simpson-Bell 2022), which defined active diversifiers as central banks shifting at least 5 percent of their foreign exchange holdings into nontraditional reserve currencies. But in that earlier paper we identified 46 active diversifiers, including both advanced countries and emerging markets. Here we identify just 14, all emerging markets. Many members of this group are subject to exceptional economic, financial, and geopolitical circumstances, as we show below.

We confirm that the gold share of reserves exhibits considerable inertia, as expected in light of the preceding discussion. But relative returns matter. The gold share is affected positively by the return to stockpiling gold, as captured by the futures/spot price differential, and negatively by the U.S. federal funds rate, where the latter indicates the return to investing in short-term U.S. Treasury securities and their substitutes. Most of these results are driven by the emerging market subsample, consistent with the idea that emerging markets manage their gold reserves more actively than advanced countries.

In addition, the gold share of reserves responds positively to global economic policy uncertainty and U.S. dollar volatility. There is some, albeit more limited, evidence that it responds positively to global geopolitical risk as captured by an index of interstate conflicts and terrorist attacks. Whereas advanced countries respond more to geopolitical risk, emerging markets respond more to economic policy uncertainty.

We then show that fully half of the largest year-over-year increases in central bank holdings of gold reserves since the turn of the century were associated with the risk of sanctions. Using an indicator of financial sanctions imposed by the United States, United Kingdom, European Union, and Japan, traditionally the principal reserve issuing economies, we confirm that sanctions have a positive impact on the share of reserves held in gold. There is some evidence that multilateral sanctions imposed by these countries as a group have a larger impact than unilateral sanctions on the share of reserves held in gold, presumably since the latter leave scope for shifting reserves into the currencies of other non-sanctioning countries, whereas the former render foreign exchange reserves as a class riskier, and gold more attractive.

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[4] In this case, gold bars are lent to a so-called bullion bank (a bank that specializes in gold-related transactions). Interest is paid at the end of the term of the deposit or loan when bars of equivalent weight are returned.

[5] These observations have led some observers to suggest (and others to dispute) that Russia and other countries contemplating the possibility that they might be targeted by G7 sanctions will prefer to substitute Chinese renminbi reserves rather than gold. On this debate, see Arslanalp, Eichengreen and Simpson-Bell (2022) and Eichengreen (2022).

Section II of the paper reviews the related literature, while Section III provides a broad overview of the gold share of international reserves. Section IV then reports an econometric analysis of these global trends using aggregate data. Sections V and VI complement this with analysis of a panel of country-level data: Section V first considers country characteristics affecting the share of reserves held in gold, while Section VI focuses on the effect of sanctions. Section VII concludes with some policy implications.

II. Literature

Our work is related to several literatures. Most obviously, there is a literature on the relative importance of gold and foreign exchange reserves under different monetary regimes, reviewed in Bordo and Eichengreen (2004). Lindert (1969) documented the shares of the two reserve assets under the classical gold standard. Eichengreen (1990) analyzed determinants of the demand for gold relative to foreign exchange under the interwar gold standard. Work on the Triffin Dilemma asked whether the increasing share of foreign exchange relative to gold reserves posed a threat to the Bretton Woods System (see e.g., Triffin 1960, Bordo and McCauley 2019). Monnet and Puy (2020) document continuity between these periods, showing that the longer a country spent on the gold standard, the more important gold was as a reserve asset under Bretton Woods. Analyzing data for 100 central banks in the period 1998-2014, Ghosh (2016) finds that the gold share of reserves responds positively to exchange-rate and inflation volatility. Gopalakrishnan and Mohapatra (2018b) analyze data for 100 central banks in 1990-2015, finding that the share of gold in reserves rises with global risk as proxied by the VIX.[6] However, none of these studies brings the analysis up to the present, as here. Nor do they consider sanctions.

Second, there is literature on the currency composition of foreign exchange reserves. Eichengreen and Frankel (1996), Eichengreen (1998), Chinn and Frankel (2007) and Arslanalp, Eichengreen and Simpson-Bell (2022) use data on global aggregates to analyze the determinants of currency shares in foreign exchange reserves, while Dooley, Lizondo and Mathieson (1989) and Eichengreen and Mathieson use the underlying data to analyze currency shares at the country level. Iancu et al. (2020), Ito and McCauley (2020) and Arslanalp, Eichengreen, and Simpson-Bell (2022) use data from central bank annual reports and related publications to conduct a similar analysis. None of these studies considers gold as an alternative form of reserves. And where these studies utilize quarterly or annual data, we add granularity by analyzing monthly fluctuations.

Then there is work on gold as a financial asset. McCown and Zimmerman (2006) analyze gold as an inflation hedge. Capie, Mills, and Wood (2005) investigate gold as a hedge against fluctuations in the dollar exchange rate, while Cincer, Gurdgiev, and Lucy (2013) do so also for UK exchange rates. Baur and McDermott (2010) and Abid et al. (2020) test whether gold is a hedge and safe haven for equity markets. Burdekin and Tao (2021) analyze periods of high stock market volatility, finding that gold was a more effective hedge during the Global Financial Crisis than the March 2020 COVID episode. Bauer and Smales (2018, 2020) and Beckman, Berger, and Czudai (2019) investigate how gold prices respond to geopolitical and economic uncertainty. Zulaica (2020) looks at the portfolio diversification benefits of gold from the standpoint of central bank reserve managers. He finds that hedging and diversification benefits are minimal for central banks holding short-duration assets and whose exchange rates co-move with the dollar. By implication, it is mainly central banks with long-duration assets and countries with so-called commodity currencies that fluctuate independently of the dollar that benefit from a significant portfolio allocation to gold.[7] We contribute to this literature by examining the impact of returns to gold and other assets on reserve managers' portfolio allocation decisions.

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[6] They also report some evidence that the effect is larger for countries with open capital accounts, and smaller for countries that are more open to trade. Several studies analyze the determinants of the level of gold reserves as opposed to the share of gold in total reserves (e.g., Oktay, Oztunc and Serin (2016) for G7 countries; Oztunc, Hakan and Orhan (2021) for a larger sample).

[7] There is also the interesting question of whether the reserve portfolio or the overall central bank balance sheet is relevant for these allocation decisions, since some central banks have been accumulating substantial sums of longer-duration securities through their asset purchase programs. So far as we know, in most cases the reserve portfolio is managed separately.

Finally, there is a literature on the effects and effectiveness of economic sanctions. One body of work looks at specific country cases. For example, Torbat (2005) and Heydarian, Pahlavani, and Mirjalili (2021) study unilateral U.S. trade and financial sanctions on Iran. Torbat concludes that financial sanctions have had the more powerful negative impact than trade sanctions, while Heydarian et al. (2021) find the opposite.[8] Other studies analyze panel data on sanctions from sources such as Hufbauer, Schott and Elliott (2009) and Felbermayr et. al (2020, 2021).[9] Jing, Kaempfer, and Lowenberg (2003) find that sanctions' likelihood of success is positively correlated with the intensity of prior relations between the sanctioning and sanctioned country and negatively correlated with the economic health and political stability of the target.[10] Eichengreen, Minesso, Mehl, Vansteenkiste, and Vicquery (2022) consider the impact on the exchange rate of the sanctioned country, finding opposite effects for sanctions affecting its imports and exports. None of these studies looks at the impact of sanctions on central bank reserve composition. The one study of which we are aware that does so, McDowell (forthcoming), looks exclusively at U.S. sanctions and focuses on the level of gold holdings rather than their share in reserves.[11]

III. Trends in the Gold Share of International Reserves

Despite termination in 1971 (with a few technical exceptions) of a requirement for official entities to convert their monetary obligations into gold at a fixed price, gold holdings of the official sector (measured in fine troy ounces) have remained relatively stable (Figure 2, left-hand panel).[12] The share of gold in reported foreign exchange reserves trended gently downward after the turn of the century, with the rising share of currencies reflecting foreign exchange reserve accumulation (Cantu and Arslan 2019) and agreement by advanced-country central banks to gradually liquidate some of their gold.[13] Despite this, however, gold still accounts for some 10 percent of total international reserves worldwide and for a slowly rising share in recent years.[14]

Figure 2 displays those ongoing trends. Its left-hand panel shows that, after moving slowly downward for the better part of four decades, the gold holdings of central banks has been rising since the Global Financial Crisis.[15] It also highlights the importance of distinguishing advanced countries and emerging markets. In the advanced economies, which inherited gold reserves for historical reasons, gold holdings fell after the turn of the century. Advanced-country central banks have sought to diversify away of gold, but gradually so as to prevent their sales from depressing the price of residual stocks. In emerging markets, in contrast, gold holdings, after remaining flat in the opening years of the century, have trended strongly upward since the Global Financial

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[8] The difference may be attributable to the fact that Heydarian et al. (2021) look at a much longer and later period.

[9] We utilize the second of these sources below. Peksen (2019) provides a survey of contributions to this literature.

[10] Counterintuitively, they also find that success is negatively correlated with the size of the sanctioner relative to the sanctioned country.

[11] Like us, he finds a positive effect on his dependent variable.

[12] The statement in the text captures the overall state of affairs, but there were exceptions. Until the early 2000s, the Swiss National Bank was prohibited by law from buying or selling gold at any price than the official Bretton Woods parity. To enable it to sell half of its gold reserves (which it set out to do in the subsequent period), it was necessary to change not only the country's Coinage Act but also the Swiss Constitution, which in turn required a national referendum (Hildebrand 2005).

[13] For more on this agreement among advanced economy central banks, see below.

[14] In the IMF's International Financial Statistics (IFS), gold in official reserves is reported at national and market valuation. We use market valuation figures for better comparability across countries.

[15] However, the right-hand panel of Figure 2, which considers gold as a share of official reserves, paints a somewhat different picture. This is at least one reason for the question mark in the title of our paper.

Crisis. This may reflect low interest rates on major reserve currencies in the decade following the crisis, which diminished return differentials between securities and gold (Gopalakrishnan and Mohapatra 2018a). Or it may reflect gold reserves as perceived insurance against economic, financial and geopolitical risk.

Figure 2. Gold Holdings of the Official Sector, 1950-2021

Gold Held by the Official Sector, 1950-2021
(Million fine troy ounces)

Source: IMF, International Financial Statistics.
Note: Advanced economies include the European Monetary Cooperation Fund (EMCF).

Share of Gold in Official Reserve Assets, 1950-2021
(Percent; based on market valuation of gold)

Source: IMF, International Financial Statistics.
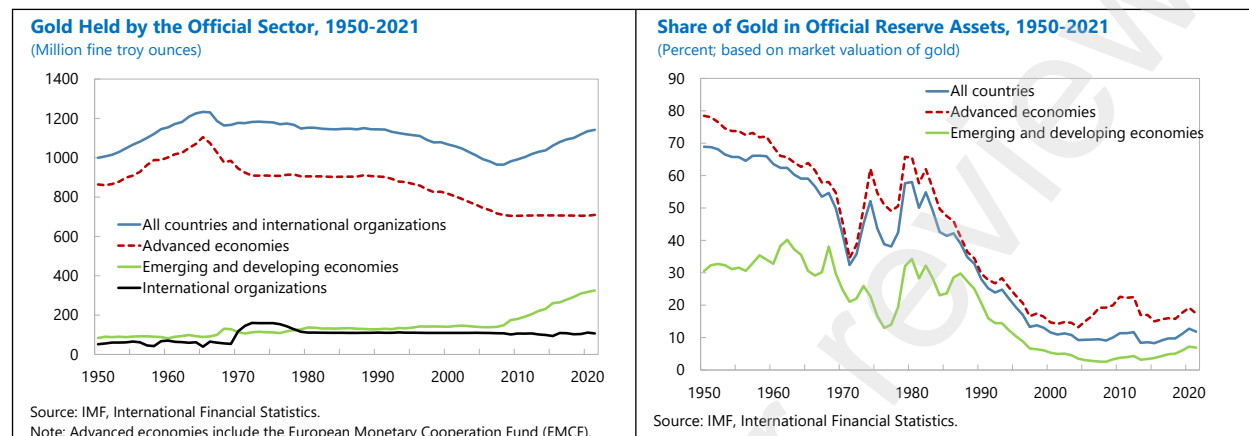
As of end-2021, international organizations (mainly the IMF and Bank for International Settlements) accounted for roughly 10 percent of official gold holdings (Table 1). Of the remainder, two-thirds are held by advanced economies, and one-third by emerging markets and developing economies (EMDEs). The U.S. and members of the Euro Area hold more than half of all official monetary gold. Among emerging markets, Russia, China, India, and Türkiye are the largest holders.

Table 1. Top 20 Reported Official Gold Holdings, end-2021

	million troy ounces	percent of total	percent of reserve assets	reserve assets as percent of GDP
United States	261.5	23%	66%	3%
Germany	108.0	9%	66%	7%
Italy	78.8	7%	63%	11%
France	78.3	7%	58%	8%
Russia	74.0	6%	21%	36%
China	62.6	5%	3%	20%
Switzerland	33.4	3%	5%	137%
Japan	27.2	2%	4%	28%
India	24.2	2%	7%	21%
Türkiye	21.1	2%	35%	14%
Netherlands	19.7	2%	56%	6%
ECB	16.2	1%	33%	1%
Taiwan, Province of China	13.6	1%	4%	73%
Kazakhstan	12.9	1%	68%	18%
Portugal	12.3	1%	69%	13%
Uzbekistan	11.6	1%	60%	51%
Saudi Arabia	10.4	1%	4%	57%
United Kingdom	10.0	1%	9%	6%
Lebanon	9.2	1%	48%	…
Spain	9.1	1%	18%	6%
Memo items:				
Euro Area	346.4	30%	53%	8%
IMF	90.5	8%	…	…
BIS	16.4	1%	…	…

Sources: IMF, International Financial Statistics and World Economic Outlook.

On average, gold represents 17 percent of official reserves for advanced economies (down from 80 percent in 1950) and 7 percent for EMDEs (down from 30 percent in 1950).[16] Some countries hold noticeably higher shares: as of end-2021, gold accounted for more than 60 percent of reserves for Portugal, Kazakhstan, Germany, the United States, Italy, and Uzbekistan, and more than 40 percent for France, Netherlands, Bolivia, Cyprus, Austria, Lebanon, and Greece (Table 2). For the Euro Area (including the ECB), gold represents 53 percent of official reserves as of end-2021.

Since 1999, official gold holdings have increased by 7 percent in volume terms—driven by a 130 percent increase in tons of gold held of EMDEs. The largest buyers were Russia, China, Türkiye, and India, while the largest sellers were Switzerland, France, Netherlands, and the United Kingdom (Table 3). In some case (e.g., Portugal), the share of gold in reserve assets increased despite gold sales either because of changes in total reserves or the six-fold increase in the market price of gold over the last two decades (Table 3, last column).

Table 2. Top 20 Gold Holdings as a Share of Official Reserves, end-2021

	percent of reserve assets	million troy ounces
Portugal	69%	12.3
Kazakhstan	68%	12.9
Germany	66%	108.0
United States	66%	261.5
Italy	63%	78.8
Uzbekistan	60%	11.6
France	58%	78.3
Netherlands	56%	19.7
Bolivia	53%	1.4
Cyprus	51%	0.4
Austria	48%	9.0
Lebanon	48%	9.2
Greece	46%	3.7
Belarus	37%	1.7
Türkiye	35%	21.1
ECB	33%	16.2
Belgium	32%	7.3
Curacao & St Maarten	30%	0.4
Russia	21%	74.0
Kyrgyz Rep	20%	0.3
Memo items:		
Euro Area	53%	346.4
Source: IMF, International Financial Statistics.		

These contrasting trends in advanced economies and emerging markets can be traced to the institutional context in which European central banks decided to diversify out of gold. The framework for these gold sales was the Central Bank Gold Agreements (CBGA). The first of these agreements, also known as the Washington Agreement on Gold, announced in September 1999, covered five years.[17] It was renewed three times subsequently. For the most part, advanced economies stopped selling gold in substantial amounts (more than 1 metric ton a year) after the GFC, and the Agreement on Gold was eventually allowed to expire.[18]

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[16] EMDEs such as former members of the formal and informal British Empire emerged from World War II with large balances of the currency of the now or soon-to-be former metropole, balances that they had accumulated in return for providing commodities, merchandise, and military support during the war (see e.g., Schenk 2011).

[17] The timing in September 1999 is explained by the Swiss referendum the previous April, which signaled the imminent sale of substantial amounts of gold by the Swiss National Bank.

[18] The only exceptions are Germany (which continues to sell gold on a regular basis) and Canada (which sold off its gold in 2015-16). Having been inactive for many years, Ireland bought small amounts of gold during 2021-22 and Singapore in 2021.

Table 3. Top 10 Buyers and Sellers of Gold in the Official Sector from end-1999 to end-2021

	million troy ounces	percent of all buying/selling	change in gold share in official reserves
Largest buyers			
Russia	60.7	28%	-10%
China	49.9	23%	1%
Türkiye	17.4	8%	31%
India	12.7	6%	-2%
Kazakhstan	11.1	5%	42%
Uzbekistan	10.0	5%	21%
Saudi Arabia	5.8	3%	-3%
Thailand	5.4	2%	4%
Poland	4.1	2%	5%
Mexico	3.7	2%	3%
Largest sellers:			
Switzerland	-49.8	34%	-34%
France	-18.9	13%	17%
IMF	-13.0	9%	…
Netherlands	-11.9	8%	7%
United Kingdom	-10.6	7%	-4%
ECB	-7.8	5%	19%
Spain	-7.8	5%	5%
Portugal	-7.2	5%	29%
Austria	-4.1	3%	28%
Germany	-3.5	2%	32%
Memo items:			…
Euro Area	-56.4	38%	21%
Source: IMF, International Financial Statistics.			

Several emerging markets, in contrast hand, started to diversify into gold after the Global Financial Crisis. In some cases (e.g., Russia, Türkiye), that diversification accelerated in recent years. 14 emerging markets have been "active diversifiers," defined here as countries that purchased gold and raised its share in total reserves by at least 5 percentage points over the last two decades. In Table 4, we further distinguish central banks that purchased at least one million troy ounces – Kazakhstan, Belarus, Türkiye, Uzbekistan, Hungary, Iraq, Argentina, and Qatar – from those that purchased less.[19]

This is the same movement in the direction of portfolio diversification we identified in Arslanalp, Eichengreen, and Simpson-Bell (2022), where we focused on foreign exchange holdings and defined active diversifiers as countries that placed at least 5 percent of their foreign exchange reserves in nontraditional reserve currencies. But the current list is shorter: in that earlier paper we identified 46 active diversifiers into nontraditional currencies; here we identify only 14 active diversifiers into gold. Where that earlier list included both advanced countries and EMDEs, there are no advanced countries on the current list. Suggestively, the eight active diversifiers into gold that purchased at least 1 million troy ounces (Kazakhstan, Belarus, Türkiye, Uzbekistan, Hungary, Iraq, Argentina, Qatar) have distinctive international economic or political concerns.[20]

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[19] For the period from 2008 onward, active diversifiers are the same, except Argentina is replaced by Russia.

[20] Kazakhstan, Belarus and Uzbekistan are associated with Russia through the Eurasian Economic Union. Türkiye has experienced sanctions by the European Union and the U.S. Iraq has had disputes with the U.S., as has Hungary with the European Union.

State Street Advisors (2019), writing of the 2008-17 period, observes that Russia and China together accounted for more than two-thirds of gross gold purchases and more than three quarters of net purchases. Over the longer 2000-21 period covered in Table 3, they account for 51 percent. State Street points to "idiosyncratic geopolitical factors" specific to these countries as supportive of gold's role as a reserve asset. Russia has been an active diversifier into gold since 2008, as noted above. China continues to maintain less than five percent of its reserves in gold (Figure 3), despite substantial gold purchases.

Table 4. Active Diversifiers into Gold in Reserve Assets, 1999-2021

	end-1999		end-2021		change in gold share in official reserves
	gold (bil US$)	gold share in official reserves	gold (bil US$)	gold share in official reserves	
Large buyers of gold (> 1 million troy ounces)					
Kazakhstan	0.5	26%	23.5	68%	42%
Belarus	0.0	3%	3.1	37%	34%
Türkiye	1.1	4%	38.5	35%	31%
Uzbekistan	0.5	39%	21.2	60%	21%
Hungary	0.0	0%	5.5	13%	12%
Iraq	0.0	0%	5.6	9%	9%
Argentina	0.1	0%	3.2	8%	8%
Qatar	0.0	0%	3.3	8%	7%
Other buyers of gold (< 1 million troy ounces)					
Bolivia	0.3	22%	2.5	53%	31%
Mongolia	0.0	0%	0.6	13%	13%
Kyrgyz Rep	0.0	10%	0.6	20%	10%
Egypt	0.7	5%	4.7	12%	7%
Serbia 1/	0.1	5%	2.2	12%	7%
Mauritius	0.0	2%	0.7	8%	6%
Sources: IMF, International Financial Statistics; National Bank of Belarus; National Bank of Serbia 1/ The figures for Serbia are as of end-2002 (rather than end-1999) due to data availability.					

Qatar was subject to a travel and economic embargo by Saudi Arabia and neighboring countries in 2017-21. Argentina may have had reason to fear asset seizures by foreign courts as a result of sovereign debt disputes. We return to this below.

Figure 3. BRICs: Share of Gold in Official Reserve Assets, 1950-2021

BRICs: Share of Gold in Official Reserve Assets, 1950-2021
(Percent; based on market valuation of gold)

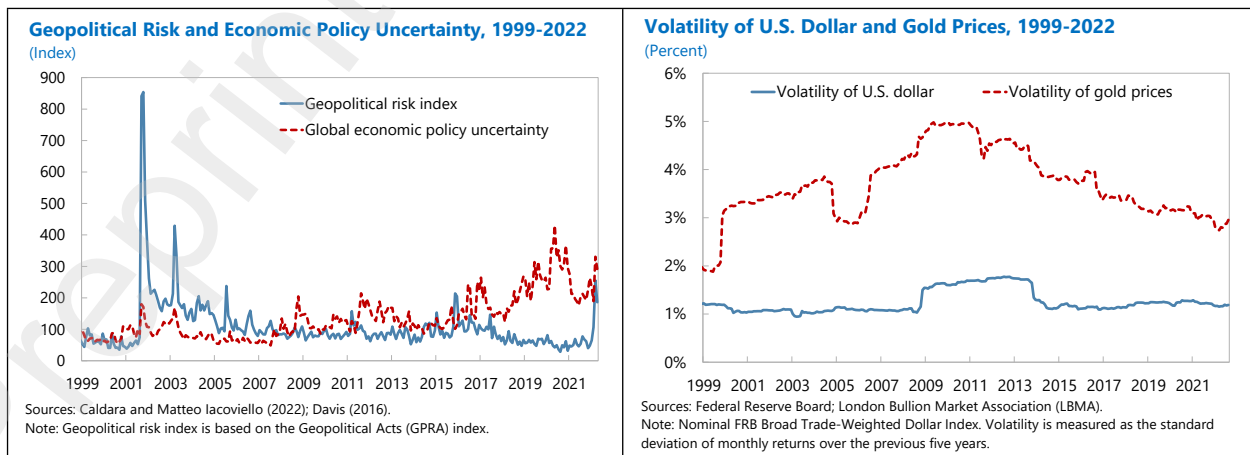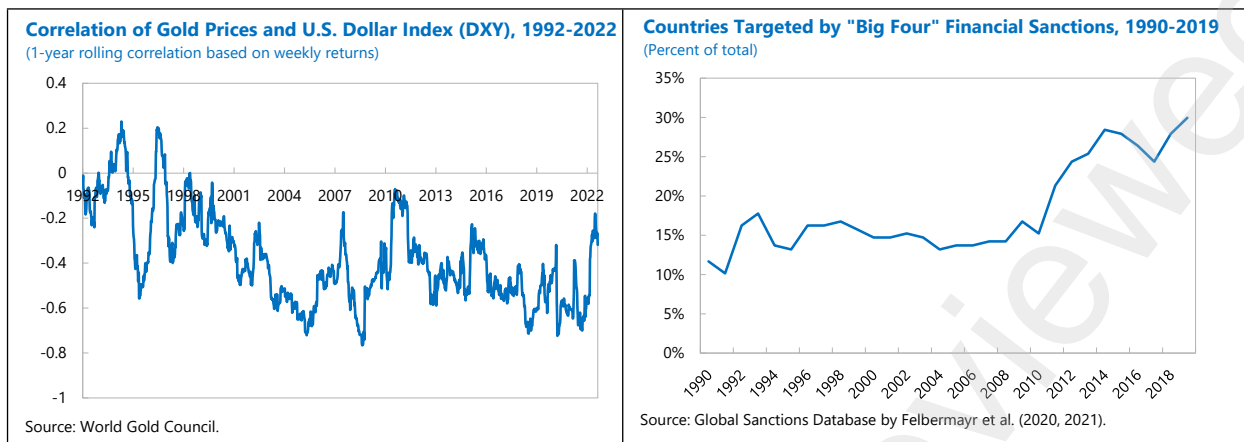Source: IMF, Internatinal Financial Statistics.
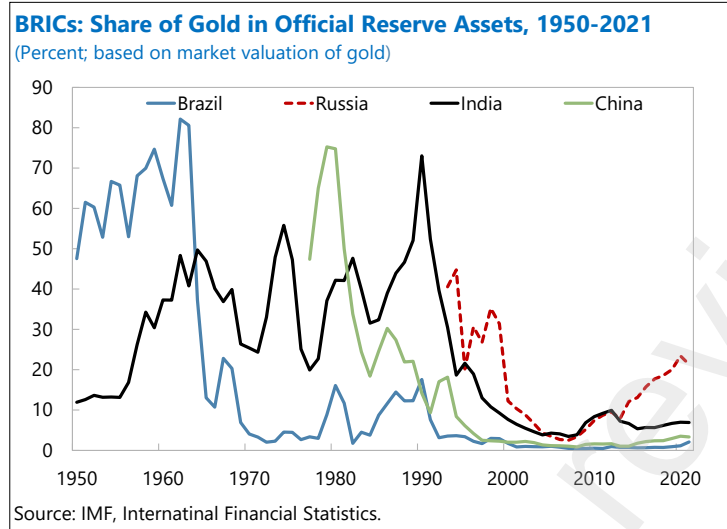
What of the drivers commonly associated with the demand for gold as a reserve asset: political uncertainty, slowdowns in global growth, instability in traditional reserve currencies (especially the dominant currency), and volatility of global gold prices? The top left-hand panel of Figure 4 shows measures of geopolitical risk (in blue) and global economic policy uncertainty (in red). The former is dominated by spikes around 9/11 and the Gulf War but otherwise shows no pronounced trend. There appears to be a positive correlation between the second indicator and gold's share in global reserves.

The top right-hand panel shows the volatility of the U.S. dollar against a basket of currencies and the volatility of gold prices. Dollar volatility is measured by the standard deviation of monthly returns of a broad dollar index over the preceding five years. So measured, there have been no obvious changes in the volatility of the dollar over the two decades. The volatility of gold prices has declined somewhat, which may partly explain diversification into gold by EMDEs (a possibility that we examine more systematically below). The bottom left-hand panel shows that gold returns are negatively correlated with the changes in the U.S. dollar, suggesting that gold can serve as a diversifier in dollar-heavy reserve portfolios.

Finally, the bottom right-panel shows the share of countries targeted by sanctions by the "Big 4" economies (the U.S., UK, European Union, and Japan). There is a modest upward trend and clear up-tick after 2008, coincident with EMDE accumulation of gold.

Figure 4. Potential Determinants of the Share of Gold in Official Reserves, 1999-2022

Geopolitical Risk and Economic Policy Uncertainty, 1999-2022
(Index)

Sources: Caldara and Matteo Iacoviello (2022); Davis (2016).
Note: Geopolitical risk index is based on the Geopolitical Acts (GPRA) index.

Volatility of U.S. Dollar and Gold Prices, 1999-2022
(Percent)

Sources: Federal Reserve Board; London Bullion Market Association (LBMA).
Note: Nominal FRB Broad Trade-Weighted Dollar Index. Volatility is measured as the standard deviation of monthly returns over the previous five years.

Correlation of Gold Prices and U.S. Dollar Index (DXY), 1992-2022
(1-year rolling correlation based on weekly returns)

Source: World Gold Council.

Countries Targeted by "Big Four" Financial Sanctions, 1990-2019
(Percent of total)

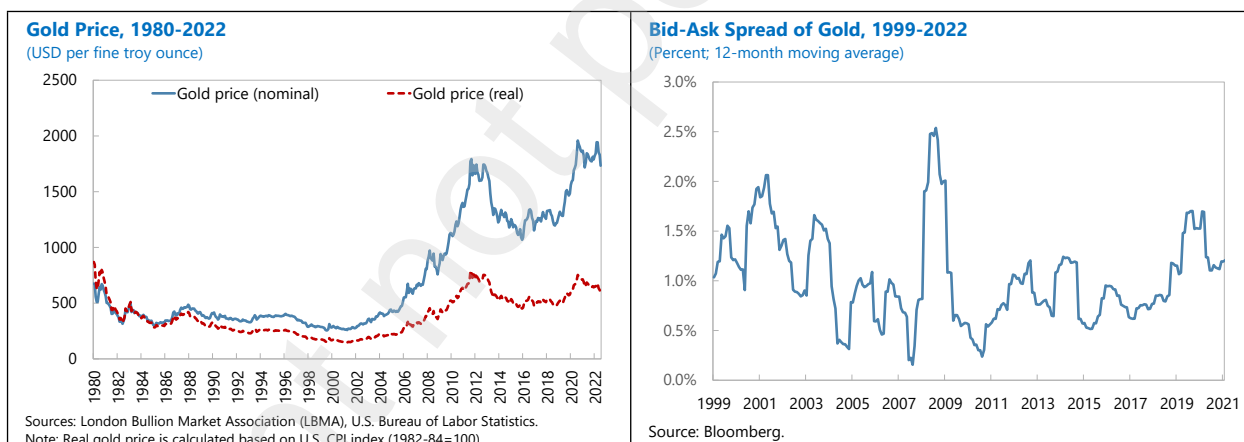Source: Global Sanctions Database by Felbermayr et al. (2020, 2021).

Note: Global geopolitical risk is measured by the Caldara-Iacoviello (2022) subindex for geopolitical acts (conflicts, terrorist attacks). This provides a news-based measure of adverse geopolitical events and associated risks. Global economic uncertainty is measured by Davis (2016) as a nominal GDP-weighted average of national economic policy uncertainty indices.

Figure 5 focuses on gold-market developments. Its left-hand panel shows the price of gold in nominal and real terms, highlighting the rise in gold prices in the first decade of the century, followed by greater volatility in the second. The right-hand panel shows the bid-ask spread in the London gold market. After generally declining through 2008 and then spiking around the time of the Global Financial Crisis, this spread has been on a slowly rising trend and is currently around 1 percent.

Figure 5. Additional Potential Determinants of Share of Gold in Official Reserves, 1999-2022

Gold Price, 1980-2022
(USD per fine troy ounce)

Sources: London Bullion Market Association (LBMA), U.S. Bureau of Labor Statistics.
Note: Real gold price is calculated based on U.S. CPI index (1982-84=100).

Bid-Ask Spread of Gold, 1999-2022
(Percent; 12-month moving average)

Source: Bloomberg.

IV. Analysis of Global Aggregates

In this section we take monthly *International Financial Statistics* (IFS) data for gold's share in global reserves (based on gold's market valuation) for 1980–2021 and regress them on:

- **Inertia.** Captured by the lagged dependent variable.

Return measures

- **Return on gold.** Year-over-year percentage change in the spot price in the London gold market (specifically, in the London Bullion Market Association gold price).

- **Gold basis.** Ratio of 6-month futures gold price and gold spot price. This captures the market compensation for stockpiling gold (including both expected return and risk premium), which in turn reflects the abundance or scarcity of gold in the market.

- **Dollar appreciation against a basket of currencies.** Measured by the 12-month change in the Nominal Broad Trade-Weighted Dollar Index, published by the Federal Reserve Board. For the advanced and emerging economy subsamples, we use the Advanced Foreign Economies Trade-Weight Dollar Index and the Emerging Market Economies Trade-Weighted Dollar Index, respectively.

- **U.S. policy rate.** The Wu-Xia shadow federal funds rate (available from 1990), which adjusts for the zero lower bound on policy rates by incorporating the effects unconventional monetary policies. Before 1990, the effective federal funds rate as provided by the Federal Reserve Board.

- **U.S. CPI inflation.** Measured as the year-over-year change in headline CPI (CPI-U: All Items), as provided by the U.S. Bureau of Labor Statistics.

Volatility measures

- **Volatility of gold prices.** Standard deviation of monthly changes in the spot price of gold over the previous five years*.*

- **Dollar volatility against a basket of currencies.** Measured by the standard deviation of month changes in the Nominal Broad Trade-Weighted Dollar Index over a five-year period. For the advanced and emerging economy subsamples, we use the Advanced Foreign Economies Trade-Weight Dollar Index and the Emerging Market Economies Trade-Weighted Dollar Index, respectively.

Uncertainty measures

- **Global geopolitical risk.** Measured by the Caldara-Iacoviello (2022) subindex for geopolitical acts (conflicts, terrorist attacks), which provides a news-based measure of adverse geopolitical events and associated risks. We use the "historical" version of the index since this allows a longer time series.

- **Global economic uncertainty.** Measured by the Global Economic Policy Uncertainty (GEPU) index constructed by Davis (2016) as a nominal GDP-weighted average of national economic policy uncertainty indices. In alternative specifications, we use the Chicago Board Options Exchange Market Volatility (VIX) Index as another measure of economic uncertainty.

Liquidity measures

- **Gold market liquidity.** Bid-ask spreads in the London market, from Bloomberg.

Summary statistics are presented in Table 5.

The choice of independent variables is informed by the literature on gold reserves and the composition of international reserves more broadly. We expect the demand for gold reserves to be increasing in the return on gold and decreasing in the return on alternative reserve assets such as the US dollar. We also expect gold reserves to increase when the gold basis is high. In this case the gold futures price is above the spot price, indicating that the market is willing to pay compensation for storing gold for sale at a later date. Conversely when the gold basis is low (or negative), gold holders can receive a premium for selling gold immediately, providing a signal for central banks to offload gold. Greater liquidity in gold markets should increase gold's attractiveness, while in the same vein volatility in gold returns should decrease the demand for gold. Volatility in

the returns of other reserve assets should have the opposite effect. Since gold is often considered a safe haven, we would also expect gold shares to increase with measures of uncertainty.[21]

We present results for the full sample and separately for advanced economies and EMDEs. This reflects the different trends in gold holdings for the two groups shown in Section II, as well as earlier empirical work providing evidence of different determinants for the two groupings. Regressions are estimated on monthly data starting in 1980, a period over which all variables are stationary. Month fixed effects capture seasonality, while non-overlapping five-year time dummies capture time effects. Given concern that coefficients on the lagged dependent variable may be picking up serially correlated omitted variables, we report regressions using the Griliches adjustment (instrumenting the lagged dependent variable with the second lag of the dependent variable and first lags of the independent variables).[22] We also apply a logit transformation to the gold shares - $\log \frac{share}{1-share}$ – so that we can work with an unbounded version of the variable.[23]

Table 5: Aggregate Regression Variables, Summary statistics

Variable	N	Mean	S.D.	Min	Max
Gold reserve share	504	0.221	0.16	0.0794	0.652
Gold reserve share (advanced)	504	0.280	0.159	0.126	0.727
Gold reserve share (emerging and developing)	504	0.120	0.103	0.0216	0.373
Gold basis	504	0.019	0.018	-0.0166	0.0903
Gold return	504	0.065	0.237	-0.375	1.98
Global Economic Policy Uncertainty	300	130	67.9	48.9	430
Geopolitical risk	504	72.5	44.1	20.4	470
US Dollar appreciation	504	0.0336	0.069	-0.105	0.230
US Dollar volatility	504	0.0127	0.002	0.0085	0.0177
Shadow FFR	504	0.0414	0.044	-0.0299	0.191
US Dollar volatility	504	0.0437	0.0009	0.0188	0.102
Gold bid-ask spread	313	0.0114	0.017	0	0.130
US CPI inflation	504	0.0322	0.025	-0.021	0.148

Table 6 for all countries shows large values for the lagged dependent variable, confirming inertia in gold shares on a month-to-month basis. Point estimates are comparable to those in our earlier paper for share of reserves held in dollars, euros, sterling, and yen. It is widely presumed that central banks manage their currency portfolios more actively than their gold holdings. This comparison casts some doubt on whether this is the case.[24]

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[21] A caveat here is that certain types of news shocks may affect both volatility/uncertainty and the gold share (through the price of gold). The effect of any relevant (global) news is addressed by our time effects and by the use of the Griliches method to remove the effect of any serially correlated omitted variables.

[22] Results without the Griliches adjustment are broadly the same and are available from the authors on request.

[23] An alternative would be to specify a Tobit model to deal with the bounds at 0 and 1 directly, but inference and specification testing for dynamic Tobit models are not straightforward.

[24] That early paper employed quarterly data on the currency composition of foreign exchange reserves from the IMF's COFER database, whereas the current analysis uses monthly data from the IMF's IFS database. Hence the coefficients measuring persistence in the two studies are not directly comparable. However, the fact that we are looking at persistence over a three-month period there but a one-month period in this paper if anything reinforces the point made in the text.

Consistent with this observation, relative returns matter.[25] The shadow federal funds rate, a measure of global interest rates, shows up negatively for both advanced countries and EMDEs (Tables 7 and 8). Having borrowed abroad in dollars, EMDEs are known to be especially sensitive to fluctuations in the funds rate (Rey 2013, Shousha 2019). But that this may also affect the portfolio-allocation decisions of their reserve managers has not been noted previously. This negative effect is consistent with the view that reserve managers shift toward gold when returns on reserve currencies, notably the dollar, are low (Gopalakrishnan and Mohapatra 2018a). Similarly, market compensation for storing gold, as captured by the futures/spot price differential is positive and significant; this remains true when we include the actual return, suggesting that this is picking up more than just valuation effects. However, the gold bid-ask spread does not have a statistically significant effect.

In addition, the gold share responds positively to U.S. dollar volatility for advanced economies, consistent with previous work finding a positive association of gold prices with economic and financial uncertainty. Our results suggest that central banks contribute significantly to this demand response. To our knowledge, this finding has not appeared in the literature before.[26] In addition, the gold share of reserves also responds positively to global economic policy uncertainty; this response is evident in both advanced economies and emerging markets, although it is more consistently significant for the latter grouping.[27]

Table 6. Aggregate Gold Share Regressions, All Economies

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Gold reserve share							
Inertia	0.95***	0.94***	0.80***	0.81***	0.83***	0.83***	0.82***
Gold basis	0.70***	0.63***	0.42**	0.39**	0.58***	0.58***	0.53***
U.S. Dollar appreciation	-0.02		-0.03	-0.04*	0.01	0.01	0.01
U.S. Policy rate	-0.26*	-0.31***	0.03	0.06	-0.10	-0.09	-0.07
U.S. CPI inflation		0.17*					
Gold return					0.03***	0.03***	0.04***
U.S. Dollar volatility	0.33	1.13	2.45*	2.31*	1.34	1.28	1.96*
Gold volatility							-0.23
Geopolitical Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Global Economic Policy Uncertainty			0.0001***	0.0001***	0.0001**	0.0001**	0.0001*
VIX				0.00			
Gold bid-ask spread						0.02	
Constant	-0.06***	-0.08***	-0.23***	-0.22***	-0.19***	-0.19***	-0.20***
N	504	504	299	299	299	299	299
R^2	1.00	1.00	0.95	0.95	0.96	0.96	0.96

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[25] To test this directly, we also estimated specifications with gold return differentials versus the US policy rate and the US dollar, replacing the gold return and US dollar appreciation variables. The coefficient on the gold-policy rate differential is positive and significant.

[26] Although Beckman, Berger and Czudai (2019) reported a positive impact on gold prices (as distinct from gold reserve shares), as cited above.

[27] Baur and Smales (2018, 2020) similarly find that gold prices are positively related to geopolitical risk, even after controlling for financial market uncertainty. However, they distinguish perceived or anticipated geopolitical risk from realized geopolitical risk, where it is the former that matters for gold prices. We find the opposite.

Note: The table shows regression coefficients after using GMM with Griliches instruments to address potential endogeneity of the lagged dependent variable. All specifications include month dummies to remove seasonal effects and time dummies based on non-overlapping five-year intervals; the coefficients for these are omitted for clarity. Standard errors are robust to heteroskedasticity.

In contrast, geopolitical risk does not show up as having a significant impact on gold shares. But we know that economic policy uncertainty and geopolitical risk are correlated with one another. Dropping economic policy uncertainty raises the significance of geopolitical risk, but not by much. However, when we then disaggregate geopolitical risk into risk associated with acts versus risk associated with threats and control for both, the acts subindex is significantly positive in the majority of specifications in Table 6. It turns out that this significant positive effect is driven by the advanced countries in the sample. Two conclusions follow. First, the effect of economic policy uncertainty is more robust than that of geopolitical risk. Second, whereas advanced countries respond more to geopolitical risk, emerging markets respond more to policy uncertainty (more on this below).

Table 7. Aggregate Gold Share Regressions, Advanced Economies

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Gold reserve share							
Inertia	0.95***	0.95***	0.88***	0.87***	0.88***	0.88***	0.83***
Gold basis	0.72***	0.69***	0.52***	0.46**	0.57***	0.57***	0.56***
US Dollar appreciation	-0.02		-0.01	-0.02	0.03	0.03	0.03
U.S. Policy Rate	-0.26***	-0.35***	-0.16*	-0.09	-0.21**	-0.20**	-0.13
US CPI inflation		0.18**					
Gold return					0.04***	0.04***	0.04***
US Dollar volatility	0.09	0.86	1.91**	1.81**	1.28	1.20	0.68
Gold volatility							0.85*
Geopolitical Risk	0.002	0.002	0.00	-0.0001	-0.0003	-0.0003	-0.0003
Global Economic Policy Uncertainty			0.0001***	0.00	0.00	0.00	0.0001*
VIX				0.0004*			
Gold bid-ask spread						-0.01	
Constant	-0.05***	-0.06***	-0.13***	-0.14***	-0.12***	-0.12***	-0.17***
N	504	504	299	299	299	299	299
R^2	1.00	1.00	0.96	0.95	0.96	0.96	0.96

Note: The table shows regression coefficients after using GMM with Griliches instruments to address potential endogeneity of the lagged dependent variable. All specifications include month dummies to remove seasonal effects time dummies based on non-overlapping five-year intervals; the coefficients for these are omitted for clarity. Standard errors are robust to heteroskedasticity.

Table 8. Aggregate Gold Share Regressions, Emerging Market and Developing Economies

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Gold reserve share							
Inertia	0.96***	0.96***	0.86***	0.86***	0.89***	0.89***	0.86***
Gold basis	0.75***	0.64***	0.38*	0.39**	0.65***	0.65***	0.58***
US Dollar appreciation	0.01		-0.03	-0.03	-0.01	-0.01	-0.01
U.S. Policy Rate	-0.30***	-0.33***	-0.07	-0.07	-0.23**	-0.22*	-0.21*
US CPI inflation		0.16*					
Gold return					0.01	0.01	0.02**
US Dollar volatility	0.15	0.65*	1.31*	1.42	0.26	0.25	0.96
Gold volatility							-0.57*
Geopolitical Risk	0.001	0.0007	-0.0007	-0.0005	-0.0013	-0.0012	-0.0017
Global Economic Policy Uncertainty			0.0001***	0.0001***	0.0001***	0.0001***	0.0001***
VIX				0.00			
Gold bid-ask spread						0.04	
Constant	-0.05***	-0.07***	-0.20***	-0.20***	-0.16***	-0.16***	-0.19***
N	504	504	299	299	299	299	299
R^2	1.00	1.00	0.99	0.99	0.99	0.99	0.99

Note: The table shows regression coefficients after using GMM with Griliches instruments to address potential endogeneity of the lagged dependent variable. All specifications include month dummies to remove seasonal effects and time dummies based on non-overlapping five-year intervals; the coefficients for these are omitted for clarity. Standard errors are robust to heteroskedasticity.

To trace out dynamic impacts, we estimate impulse-response functions from local projections, a la Jordà (2005).[28] We examine the response of gold share to changes in the global economic policy uncertainty (GEPU) index by estimating the cumulative response function over 12-month horizon.

Figure 6 shows the cumulative response of the gold share to a 1-point shock to the GEPU index.[29] This is positive on impact and then rises progressively, peaking after eight months. Observe that the GEPU index rose by 140 points between February and March of 2022 following the outbreak of war in Ukraine. On impact (in the first month), this means a 140*0.15 = 0.21 percent (about a fifth of one percent) increase in the share of gold in central bank portfolios, a relatively small effect. The cumulative impact tops out in 7 months at about three times that increase.

Part of the explanation is that the gold prices rise in periods of heightened uncertainty, increasing the gold share in global reserves. Figure 7 therefore replicates the previous exercise for fine troy ounces, excluding price effects. The figure confirms that gold holdings (in volume terms) do not change on impact, unsurprisingly given that changes in the strategic asset allocation of reserve managers usually require a decision by the board of the central bank, which takes time. But there is evidence of buying subsequently, starting about five months

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[28] This flexible approach does not impose the dynamic restrictions embedded in vector autoregressive specifications. The estimation includes the same control variables as specification 6 of the aggregate regressions (Table 6).

[29] The response functions are consistently higher in magnitude for advanced economies because these countries hold more gold in reserves (twice as high, as shown in Figure 2). Hence, the same shock has a larger impact.

after the uncertainty event. A 140 point shock to the uncertainty variable (again, on the scale caused by the war in Ukraine) would result in a 0.14 percent increase (=140*0.1) in gold holdings (in volume) after 12 months.

Figure 6. Cumulative Response of Gold Share to a 1-point Shock to the Global Economic Policy Uncertainty (GEPU) Index
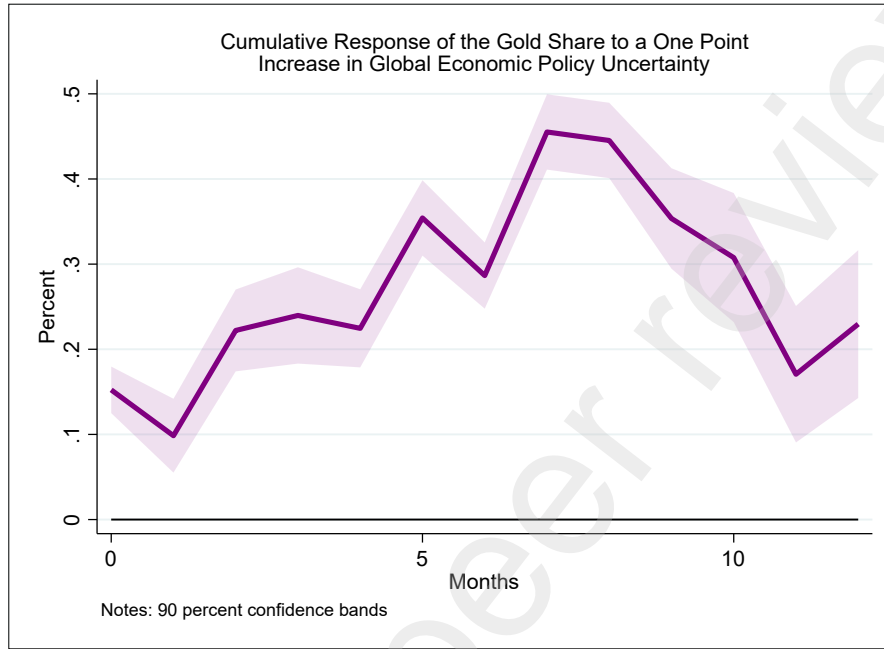

Cumulative Response of the Gold Share to a One Point Increase in Global Economic Policy Uncertainty

Notes: 90 percent confidence bands

Figure 7. Cumulative Response of Gold Volume to a 1-point Shock to the Global Economic Policy Uncertainty (GEPU) Index

Cumulative Response of Gold Volume to a One Point Increase in Global Economic Policy Uncertainty

Notes: 90 percent confidence bands
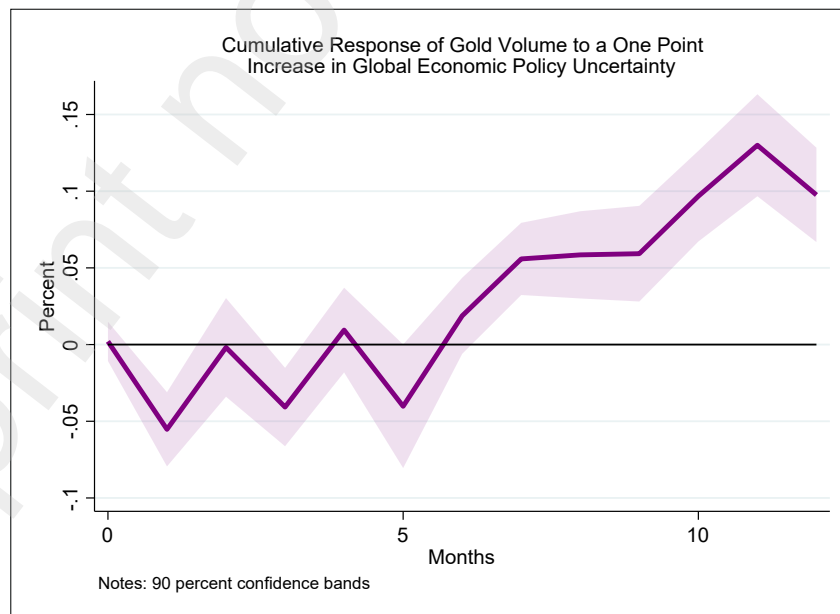
For geopolitical risk, the response peaks after 5-6 months and dissipates after a year (Figure 8). This is in contrast to the response to one-time increase in economic policy uncertainty, where the demand for gold remains elevated after a year. For the federal funds rate, the response continues to grow between 6 and 12 months (Figure 9).

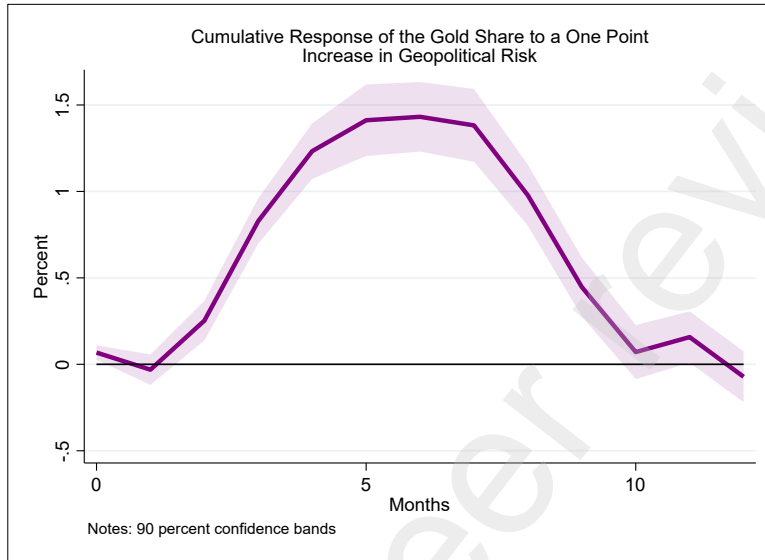**Figure 8. Cumulative Response of Gold Share to a 1-point Shock to the Geopolitical Risk Index**

Cumulative Response of the Gold Share to a One Point
Increase in Geopolitical Risk

Notes: 90 percent confidence bands

Figure 9. Cumulative Response of Gold Share to a 1 percentage point Shock to the U.S. Federal Funds Rate

Cumulative Response of the Gold Share to a One Percentage Point
Increase in U.S. Federal Funds Rate

Notes: 90 percent confidence bands
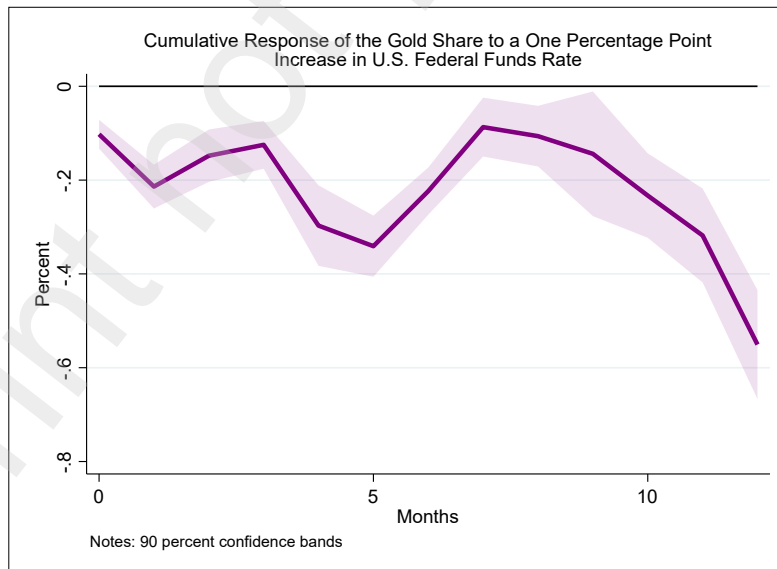
V. Analysis of Country-Level Data

We now analyze the determinants of gold's share in official reserves (again based on market valuation) using annual country-level data from *International Financial Statistics* (IFS). Our unbalanced panel includes 144 economies over the period 1980-2021.

Explanatory variables are as follows:

- *GDP growth.* Year-on-year change in real GDP of each country, based on data from IMF *World Economic Outlook* (WEO).

- *Inflation.* Year-on-year annual change in consumer prices of each country, based on data from WEO.

- *Fiscal balance.* Government net lending/borrowing divided by GDP, based on data from WEO.

- *Public-debt-to-GDP ratio.* General government gross debt divided by GDP, based on data from WEO.

- *Trade openness.* Sum of exports plus imports of goods, based on IFS data, divided by GDP based on WEO.

- *Local currency appreciation.* Current year change of the price of local currency against the U.S. dollar, based on data from the IFS.

- *Domestic gold production.* In metric tons, based on data compiled by the World Gold Council.

- *Exchange rate regime.* Coded as 1 for country with floating rates. Data are from Ilzetzki, Reinhart, and Rogoff (2019).

- *Financial sanctions imposed by traditional reserve currency issuers.* From the Global Sanctions Database, as described by Felbermayr et. al (2020, 2021) and Syropoulos et al. (2022).

- *Growth of reserve assets.* The annual percentage change in the value of total reserve assets, with gold at market value, based on IFS data.

Summary statistics are presented in Table 9.

As in Section III, we present results for the full sample and separately for advanced economies and EMDEs. We control for time effects in all specifications.

As with the aggregate regressions, the choice of explanatory variables is motivated by the literature on gold as an investment and discussions of the role of gold in central bank reserves. Since gold is regarded as a hedge against economic, financial and political shocks, we would expect gold shares to be associated negatively with measures of economic stability, such as high GDP growth, low inflation and low public debt. We would expect countries with higher domestic gold production to be able to secure gold reserves on more favorable terms, and consequently hold a higher share of reserves in gold. Such countries may also view gold purchases as a way of supporting the domestic mining industry. Greater trade openness should increase the need for currency reserves relative to gold reserves, insofar as such countries value a relatively stable exchange rate and currencies are more easily used in foreign exchange market intervention. Of course, the effect of the exchange rate regime is complicated by the history of gold as an anchor of the international monetary system, although in general we would expect economies with an exchange rate pegged to another currency to hold a higher share of foreign exchange reserves and a correspondingly lower share of gold, since the currency in question may be needed for foreign exchange market intervention. By a similar argument, high growth in total reserves may be associated with a lower gold share. In line with arguments presented in the introduction and developed in

Section V, financial sanctions imposed by issuers of major reserve currencies should also encourage central banks to hold a higher gold share.[30]

Table 9: Country-Level Regression Variables, Summary Statistics

Variable	N	Mean	S.D.	Min	Max
Gold reserve share	5463	0.147	0.208	0	0.958
Gold volume	5854	7.99	34.4	0	402.8
Inflation	7351	0.438	8.95	-0.727	653.7
Overall fiscal surplus to GDP	5821	-0.0286	0.143	-5.58	1.25
GDP growth	7369	0.0333	0.0677	-0.667	1.77
Reserves growth	6533	0.196	1.25	-0.986	58.5
Trade openness	5548	0.606	0.442	0.0126	7.06
Currency appreciation	7093	1.87	141.7	-0.993	11800
Public debt to GDP	5140	0.560	0.450	0	6.00
Gold production	2156	0.246	0.580	0	4.54
Flexible exchange rate	8233	0.0949	0.293	0	1
USD financial sanctions	8232	0.0862	0.281	0	1
EUR financial sanctions	8232	0.0448	0.207	0	1
JPY financial sanctions	8232	0.0102	0.101	0	1
GBP financial sanctions	8232	0.0062	0.0785	0	1

Results in Tables 10-12 indicate that the share of gold in reserves is negatively related to GDP growth, although the statistical significance of the relationship varies. The gold share is also negatively related to the fiscal balance, although this effect is larger for advanced countries than emerging markets. An interpretation is that fiscally stronger economies feel less need to hold gold as reserves. The level of public debt, on the other hand, is negatively related to the gold share in emerging markets, whereas there is no relationship in advanced economies.

Countries with floating exchange rates hold more gold, consistent with our priors. Among the advanced countries, this might be dismissed as a legacy effect: advanced countries generally float their currencies and also inherited significant gold reserves from the past. However, the same effect is evident for EMDEs.[31] Evidently, countries with floating rates see less need to intervene in the foreign exchange market and thus attach less importance to the liquidity of foreign exchange reserves (and are therefore more inclined to hold reserves in less liquid metallic form).[32]

Trade openness is associated with a lower gold share, again consistent with our priors, where the effect is larger and more consistently significant for emerging markets. Higher domestic gold production also increases the share of gold in reserves, presumably reflecting gold-buying programs of central banks in countries with significant production. There is also some evidence that reserve growth is associated with a lower gold share, especially for advanced economies.

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[30] Another interesting factor, which we do not present in the main results, concerns the choice of numeraire currency. Because the price of and return on gold may be more variable when expressed in one currency than another, we estimated versions of the regressions which included the Ito-McCauley currency zone weights (Ito and McCauley, 2018), which measure the co-movement of each economy's local currency with the major reserve currencies. We find that higher weights on the US dollar, euro and Japanese yen increase the gold share (relative the weight on the British pound, which is excluded to avoid collinearity issues). Results are available from the authors upon request.

[31] This is in line with the observation in Hentov et al. (2019) that emerging market economies with floating exchange rates tend to have higher gold shares.

[32] Central bank reserve managers typically distinguish the "liquidity tranche" and "investment tranche" of their reserve portfolios (Arslanalp, Eichengreen and Simpson-Bell 2022). Thus, our evidence suggests that the larger the relative weight of the investment tranche, the larger are holdings of gold, ceteris paribus.

Table 10. Country-Level Gold Share Regressions, All Economies

Variable	(1)	(2)	(3)	(4)
Gold reserve share				
CPI inflation	0.003***	0.12**	0.27***	0.21***
Fiscal balance	0.06**	0.16***	-0.46***	-0.47***
Real GDP growth	-0.25***	-0.27***	-0.12	-0.01
Trade openness	-0.02***	-0.02***	-0.03***	-0.03***
Currency appreciation	0.00001***	-0.01	0.00	0.00
Reserves growth (%)	-0.01***	-0.01***	0.00	0.00
Public debt		0.06***	0.01	-0.01
Gold production			0.06***	0.04***
Floating exchange rate				0.07***
Constant	0.33***	0.40***	0.03*	0.04**
Statistics				
N	3095	2750	1291	1291
Pseudo R^2	-0.74	-0.63	-0.28	-0.31

Note: The table reports Tobit model estimates of our baseline specifications for country level gold reserve shares. A lower limit at 0 and an upper limit at 1 for the dependent variable is imposed on all specifications. All specifications also year dummies, for which the coefficients are omitted. Standard errors are robust to heteroskedasticity.

Table 11. Country Level Gold Share Regressions, Advanced Economies

Variable	(1)	(2)	(3)	(4)
Gold reserve share				
CPI inflation	-0.59***	-0.65***	0.95	-0.64***
Fiscal balance	-1.67***	-1.76***	-2.52***	-1.74***
Real GDP growth	-0.35	-0.46*	-0.42	-0.47**
Trade openness	0.00	0.00	-0.04	0.01
Currency appreciation	0.08	0.08	-0.08	0.07
Reserves growth (%)	-0.10***	-0.09***	0.05	-0.08***
Public debt		-0.01	-0.01	-0.02
Gold production			0.08***	
Floating exchange rate				0.05**
Constant	0.43***	0.47***	0.06	0.47***
Statistics				
N	714	676	207	676
Pseudo R^2	-7.67	-5.06	1.79	-5.16

Note: The table reports Tobit model estimates of our baseline specifications for country level gold reserve shares. A lower limit at 0 and an upper limit at 1 for the dependent variable is imposed on all specifications. All specifications include year dummies, for which the coefficients are omitted. Standard errors are robust to heteroskedasticity.

Table 12. Country-Level Gold Share Regressions, Emerging Market and Developing Economies

Variable	(1)	(2)	(3)	(4)
Gold reserve share				
CPI inflation	0.00***	0.26***	0.34***	0.27***
Fiscal balance	0.08***	0.17***	-0.17*	-0.15
Real GDP growth	-0.19***	-0.15**	-0.01	0.04
Trade openness	-0.02***	-0.01	-0.02**	-0.02***
Currency appreciation	0.00001***	0.00	-0.01	0.00
Reserves growth (%)	-0.01**	-0.01***	0.00	0.00
Public debt		0.08***	-0.04**	-0.04**
Gold production			0.02***	0.01*
Floating exchange rate				0.07***
Constant	0.17***	-0.72***	0.07***	0.07***
Statistics				
N	2381	2074	1084	1084
Pseudo R^2	-0.30	-0.24	-0.11	-0.13

Note: The table reports Tobit model estimates of our baseline specifications for country level gold reserve shares. A lower limit at 0 and an upper limit at 1 for the dependent variable is imposed on all specifications. All specifications include year dummies, for which the coefficients are omitted. Standard errors are robust to heteroskedasticity.

VI. Effect of Sanctions

Recent events, including financial sanctions against the government of Russia in response to its invasion of Ukraine, and specifically the decision to freeze foreign exchange reserves of the Russian central bank, have highlighted the possibility that other central banks may respond by shifting a portion of their reserves from foreign exchange into gold, which can be repatriated and vaulted at home.

One indication comes from Table 13, which tabulates the 10 largest annual increases in the gold share of reserves since 1999. In fully half of these cases, the countries in question were subject to sanctions in the same year or the two immediately preceding years. In other cases, increases in the gold share of reserves followed irregular political events, such as bomb blasts, coup attempts, and financial crises, which is not inconsistent with aforementioned observations. Similarly, Table 14 sows that gold purchases by our "active diversifiers" often coincided with political, economic, or financial shocks. This is further consistent with the view that shifts into gold are motivated in part by geopolitical events and may be associated with fear of sanctions.

Table 13. Top 10 Annual Increases in the Share of Gold in Reserves, 2000-21

Country	Year	Increase in gold share (in ppt of reserves)	Increase in gold volume (in percent)	Key events in the concurrent or preceding two years
Türkiye	2020	21%	29%	Sanctions by the US (2018) and EU (2019); COVID-19 pandemic (2020)
Belarus	2010	17%	57%	Sanctions by Russia in 2010
Lao PDR	2001	10%	328%	A series of bomb blasts in 2000 before presidential elections in 2001
Turkey	2017	9%	50%	Coup attempt in 2016; Constitutional referendum in 2017
Sri Lanka	2009	8%	299%	Purchase of gold from IMF following the global financial crisis
Paraguay	2012	8%	1141%	Sanctions by Mercosur and Unasur in 2012
Hungary	2021	8%	200%	COVID-19 pandemic in 2020; Disputes with the EU (ongoing)
Belarus	2006	8%	25%	Sanctions by the EU and US in 2006
Sri Lanka	2000	7%	437%	1997-98 Asian crisis; Assassination attempts before elections in 2000
Belarus	2008	7%	33%	Sanctions by the EU and US in 2006

Sources: IMF, International Financial Statistics; Global Sanctions Database (GSDB).
Note: Excludes countries with central bank gold purchase programs from domestic producers.

Table 14. Key Events Surrounding Periods of Active Gold Diversification

Year	Event
Argentina—Gold accumulation in 2004	
2001	Sovereign default
2001-03	Reserve assets moved from the US (e.g., NY Fed) to protect against potential attachment by creditors: https://caselaw.findlaw.com/us-2nd-circuit/1573075.html#footnote_10
2004	Purchase of gold by central bank
2005	Sovereign debt restructuring
Belarus—Gold accumulation during 2008-11, 2019, 2021	
2006	Sanctions (trade, financial) by EU, US, and Switzerland
2010	Sanctions (trade) by Russia
2020	Sanctions (trade, financial) by EU, US
Iraq—Gold accumulation during 2012-14, 2018	
2010	Sanctions (arms) by the UN
2012	US Congress decides to make Iraq's frozen central bank assets (in 2003) available to settle lawsuits with US families of those who died in attacks in Iraq
2017	Sanctions (travel) by the US
2019	Sanctions (trade, financial) by the US
Hungary—Gold accumulation in 2018 and 2021	
2018	Central bank increases gold holding tenfold, citing the stabilizing role of gold as a "major line of defense under extreme market conditions or in times of structural changes in the international financial system or deep geopolitical crises." https://www.mnb.hu/en/pressroom/press-releases/press-releases-2018/hungary-s-gold-reserves-increase-tenfold-reaching-historical-levels
2021	Central bank triples its gold reserves, citing "risks arising from the coronavirus pandemic, global spikes in government debts, and inflation concerns." https://www.mnb.hu/en/pressroom/press-releases/press-releases-2021/magyar-nemzeti-bank-triples-hungary-s-gold-reserves-to-94-5-tons
Kazakhstan—Gold accumulation since 2012	
2011	Dollar weakness sparks discussion of "US currency wars." Central bank initiates gold buying program, as "the latest emerging economy to favor gold over exposure to the ailing dollar" https://www.reuters.com/article/gold-kazakhstan-idAFLDE77N03620110824
Qatar—Gold Accumulation during 2007, 2015-20, and since Feb 2022	
2007	Global Financial Crisis begins
2017	Beginning of the dispute with Saudi Arabia (marked by severing diplomatic relations and a land/sea/air blockade, but also spoof attacks on Qatar's currency by Banque Havilland)
Feb 2022	War in Ukraine erupts
Russia—Gold Accumulation from 2007 to 2020	
2008	Russia-Georgia War
2014	Russia-Ukraine War (Russia annexes Crimea)
2014	Sanctions (trade, financial, travel) by the US
2014	Sanctions (trade, military, financial, travel) by the EU and Switzerland
Türkiye—Gold accumulation since 2011[33]	
2011	Central bank permits commercial banks to hold physical gold in blocked accounts at the central bank instead of Turkish lira as way of meeting reserve requirements
2016	Coup attempt
2018	Sanctions (trade, financial, travel) by the US
2019	Sanctions (financial) by the EU
Uzbekistan—Gold accumulation at least since 2005	
2003	Sanctions (military) by the US. Central bank granted exclusive right to purchase all locally refined gold: https://www.gold.org/goldhub/gold-focus/2021/10/central-bankers-perspective-role-gold-uzbekistan

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[33] In the case of Türkiye, the increase in reported reserves (gold at the central bank) reflects not only gold purchased by the central bank but also gold owned by commercial banks and deposited at the central bank to meet reserve requirements. This gold is immobilized in a blocked account and can be utilized in transactions by the central bank, and hence, counted as reserves. See: https://www.sbma.org.sg/media-centre/publication/crucible-issue-7/why-do-turkish-banks-hold-gold-at-the-turkish-central-bank/

2005	Sanctions (trade, military, travel) by the EU
2006	Sanctions (trade, military, travel) by Switzerland
2017	Gold reserve deemed secret prior to this date
Bolivia—Gold accumulation during 2010-11	
2010	Creation of a state gold-purchasing company, Empresa Boliviana de Oro (EBO)
2011	Passage of law permitting the central bank to purchase gold from domestic producers
Egypt—Gold accumulation since 2017	
2016	Sanctions (trade) by Saudi Arabia
2017	Sanctions (military) by the US
Kyrgyz Republic—Gold accumulation during 2011-21	
2010	Sanctions (trade) by Uzbekistan
2013	Sanctions (trade) by Uzbekistan
2014	Sanctions (trade) by Uzbekistan
Mauritius—Gold accumulation during 2009 and 2014-16	
2009	Gold purchase from the IMF: https://www.imf.org/en/News/Articles/2015/09/14/01/49/pr09413
2015	Finance Ministers announces plans to buy gold from Australia: https://www.reuters.com/article/ozabs-uk-mauritius-cenbank-gold-idAFKBN0LY0WZ20150302
Mongolia—Gold accumulation during 2018-19	
2018	Launch of the "National Gold to the Fund of Treasures" program to buy gold from domestic producers: https://montsame.mn/en/read/135392
2019	Re-launch of the "National Gold to the Fund of Treasures" program: https://montsame.mn/en/read/185697
Serbia—Gold accumulation since 2002	
2000	Sanctions (financial) by the EU
2001	Sanctions (financial) by Switzerland
2003	Sanctions (financial) by the EU

Source: Global Sanctions Database (GSDB).

In Tables 15-16 we report additional regressions but adding an indicator of financial sanctions against the subject country by the U.S., EU, UK, or Japan. "Big Four sanctions" refers to sanctions imposed by any one or more of these four economies. We further distinguish financial sanctions imposed unilaterally by one of these economies from multilateral sanctions levied by multiple members of the group, since multilateral sanctions may have larger economic and financial effects and thus may elicit a larger reserve-management response. We also include the same sets of variables as in Tables 10-12, though we report here only the coefficients of interest on the sanctions variables.[34]

Sanctions are associated with an increase in the gold share of reserves. This result is evident for the full sample and for EMDE subsample (we do not have cases where the Big Four imposed sanctions on other advanced economies). In the full sample, the presence of financial sanctions from one of the Big Four currency issuers raises the gold share by around 2 percentage points. UK sanctions have the largest effect, but multicollinearity of sanctions imposed by individual members of the Big Four (which not infrequently imposed or removed sanctions at the same time) means that these results for the individual variables should be taken with a grain of salt. Multilateral sanctions have a larger effect than unilateral sanctions, again consistent with intuition. sanctions increase gold shares even when we exclude the active diversifiers, especially for the emerging economy subsample. We again obtain very similar results if we redefine the sanctions dummies to take a value one when sanctions are imposed in the current year or in the preceding two years. Importantly, these patterns hold even after excluding the active diversifier economies from the sample.

In Tables 17-18 we re-run the same regressions but with the volume of gold reserves as the dependent variable. The results confirm that sanctions imposed by Big Four currency issuers have a positive effect on gold

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[34] Results for the other variables are entirely unchanged and are available from the authors on request.

holdings.[35] For example, for the full sample the results indicate that the imposition of Big Four financial sanctions is associated with an increase in gold volumes of 4.2 million fine troy ounces (about 130 metric tons).

In Figures 10-11, we also try to gauge the relative importance of the different determinants by measuring their contribution to the R^2, using the method described in Hüttner and Sunder (2011).[36]This exercise indicates that for the full sample that domestic gold production, the exchange rate and inflation are the most important determinants of the gold share, accounting for 34, 27 and 13 percent of the R^2 respectively. The sanctions variables (those corresponding to the Big Four sanctions in the second regression specification), only account for around 2 percent as a group. However, the balance changes if we only consider emerging and developing economies. In Figure 11, we see that while inflation and currency regime are still important determinants, domestic gold production is much less so. The contribution of the sanctions variables rises to around 6 percent, suggesting that sanctions have a stronger impact on gold reserve allocations for these economies.

Table 15. Effect of Sanctions on Country-Level Gold Reserve Shares, All Economies

Variable	(1)	(2)	(3)
Gold reserve shares			
Big 4 Sanctions	0.02**		
US Sanctions		0.01	
EU Sanctions		0.04***	
Japan Sanctions		-0.04**	
UK Sanctions		0.26***	
Big 4 Sanctions (Unilateral)			0.01
Big 4 Sanctions (Multilateral)			0.04***
Constant	0.04**	0.04**	0.04**
Statistics			
N	1293	1293	1293
Pseudo R^2	-0.31	-0.27	-0.31

Note: The table reports Tobit model estimates of our financial sanctions specifications for country level gold reserve shares. A lower limit at 0 and an upper limit at 1 for the dependent variable is imposed on all specifications. All specifications include year dummies, for which the coefficients are omitted. The regressions also include inflation, fiscal balance, GDP growth, trade openness, currency appreciation, public debt, gold production and FX regime as covariates, but the coefficient for these are omitted for clarity. Standard errors are robust to heteroskedasticity.

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[35] Under these specifications unilateral sanctions have a larger impact than multilateral sanctions.

[36] We estimate the model by OLS for this decomposition so that we can work with a standard R^2 measure.

Table 16. Effect of Sanctions on Country-Level Gold Reserve Shares, Emerging Market and Developing Economies

Variable	(1)	(2)	(3)
Gold reserve shares			
Big 4 Sanctions	0.02***		
US Sanction		0.01	
EU Sanction		0.03***	
Japan Sanction		-0.02	
UK Sanction		0.24***	
Big 4 Sanctions (Unilateral)			0.00
Big 4 Sanctions (Multilateral)			0.05***
Constant	0.07***	0.07***	0.07***
Statistics			
N	1086	1086	1086
Pseudo R^2	-0.14	-0.14	-0.14

Note: The table reports Tobit model estimates of our financial sanctions specifications for country-level gold reserve shares. A lower limit at 0 and an upper limit at 1 for the dependent variable is imposed on all specifications. All specifications include year dummies, for which the coefficients are omitted. The regressions also include inflation, fiscal balance, GDP growth, trade openness, currency appreciation, public debt, gold production and FX regime as covariates, but the coefficient for these are omitted for clarity. Standard errors are robust to heteroskedasticity.

Table 17. Effect of Sanctions on Country-Level Gold Reserve Volume, All Economies

| Variable	(1)	(2)	(3)
Gold reserve volumes (mm troy ounces)			
Big 4 Sanctions	4.17***		
US Sanctions		2.36	
EU Sanctions		2.27	
Japan Sanctions		2.33	
UK Sanctions		-2.11	
Big 4 Sanctions (Unilateral)			4.83***
Big 4 Sanctions (Multilateral)			3.25*
Constant	-10.89***	-10.55***	-10.97**
Statistics			
N	1291	1291	1291
Pseudo R^2	0.04	0.04	0.04

Note: The table reports Tobit model estimates of our financial sanctions specifications for country-level gold volumes. A lower limit at 0 for the dependent variable is imposed on all specifications. All specifications include year dummies, for which the coefficients are omitted. The regressions also include inflation, fiscal balance, GDP growth, trade openness, currency appreciation, public debt, gold production, FX regime and reserves growth as covariates, but the coefficient for these are omitted for clarity. Standard errors are robust to heteroskedasticity.

Table 18. Effect of Sanctions on Country-Level Gold Reserve Volumes, Emerging Market and Developing Economies

Variable	(1)	(2)	(3)
Gold reserve volumes (mm troy ounces)			
Big 4 Sanctions	3.72***		
US Sanctions		2.30***	
EU Sanctions		0.70	
Japan Sanctions		13.35***	
UK Sanctions		-13.59***	
Big 4 Sanctions (Unilateral)			1.55***
Big 4 Sanctions (Multilateral)			6.78**
Constant	1.84	2.28	2.25
Statistics			
N	1084	1084	1084
Pseudo R^2	0.04	0.04	0.04

Note: The table reports Tobit model estimates of our financial sanctions specifications for country-level gold reserve volumes. A lower limit at 0 for the dependent variable is imposed on all specifications. All specifications include year dummies, for which the coefficients are omitted. The regressions also include inflation, fiscal balance, GDP growth, trade openness, currency appreciation, public debt, gold production and FX regime as covariates, but the coefficient for these are omitted for clarity. Standard errors are robust to heteroskedasticity.

Figure 10. Determinants of Gold Shares: All Economies
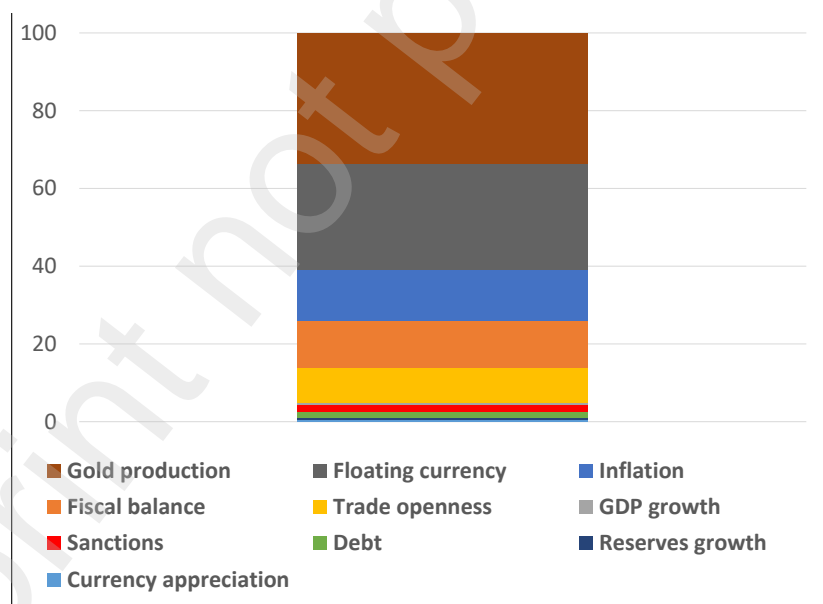
Note: R^2 decomposition using the method from Hüttner and Sunder (2011) .

Figure 11. Determinants of Gold Shares: Emerging Market and Developing Economies
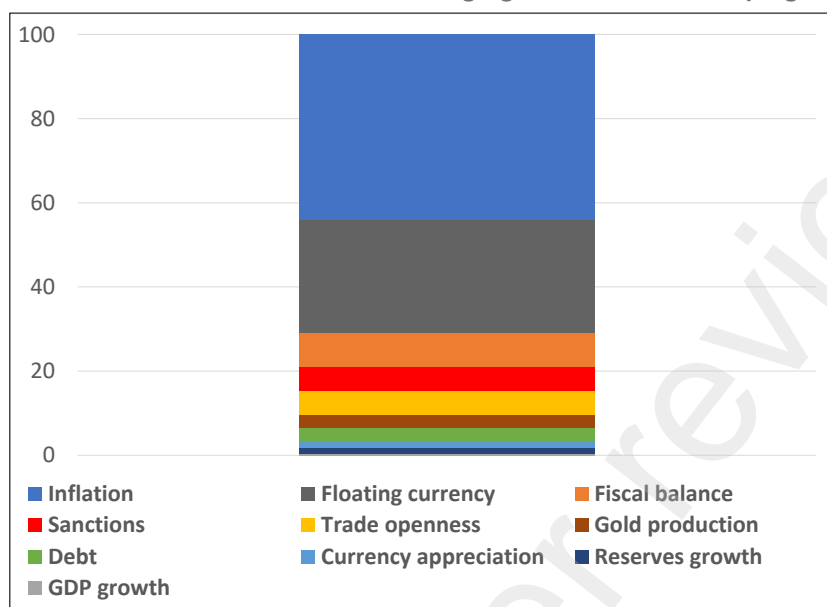
Note: R^2 decomposition using the method from Hüttner and Sunder (2011) .

VII. Conclusions and Policy Implications

Using data for as many as 144 countries, we have analyzed economic conditions and geopolitical factors as potential determinants of the share of central bank reserves held in gold. Aggregate evidence suggests that some reserve managers respond to relative costs and returns: they increase the gold share when the expected return is high while that on financial assets, such as U.S. Treasury securities, is low. They view gold as a hedge against economic and geopolitical risks: gold shares in advanced countries and emerging markets are increasing with a measure of economic uncertainty, and those in advanced economies increase in addition with a measure of geopolitical risk.

In addition, we find that reserve managers in emerging markets increase the share of reserves held in gold in response to sanctions risk. Many of the largest year-on-year increases in individual central banks' gold holdings occur at times when those central banks are or have reason to think that they may be subject to financial sanctions. Our econometric results indicate that both the volume and value of gold reserves increases with the imposition of sanctions from the U.S., UK, Euro Area, and Japan in the current or immediately preceding years.

Whether and to what extent central banks will now increase the share of their reserves held in gold, given recent events, is anyone's guess. The results reported here should in any case allow interested parties to better inform their guesses.

Acknowledgements

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