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# RETHINKING EXCHANGE RATE REGIMES

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## Abstract

This paper employs an updated algorithm and database for classifying exchange rate and anchor currency choice, to explore the evolution of the global exchange rate system, including parallel rates, capital controls and reserves. In line with a large recent literature, we find that the dollar has become ever-more central as the de facto anchor or reference currencies for much of the world. Our discussion encompasses the history of anchor currency choice, methods for classifying exchange rate regimes, a detailed discussion of the evolution of regimes, the growing substitution of reserves for capital controls as a tool for exchange rate stabilization, the modern Triffin dilemma, and the surprising recent trend decline in volatility of exchange rates at the core of the system. It concludes with issues surrounding the rise of China.

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# I. Introduction

A large literature has emerged in recent years showing the remarkable dominance of the United States dollar in the international financial system, despite the rapid ascent of Asia and the ever-shrinking US share of the global economy. In this chapter, we explore the post-war evolution of the global exchange rate system, both with respect to individual countries' choice of exchange rate regime, and the resulting international system emerging. To do so, we necessarily draw on insights from several other chapters in this handbook, re-evaluate perspectives from past handbooks, and in our conclusions try to imagine what topics might evolve in the next edition.

In the 1990s, when the second edition of the *Handbook if International Economics* Series was being written, researchers were still coming to terms with the end of the Bretton Woods system of fixed exchange rates. The new order was viewed as a "non-system" (Williamson 1976, Black 1985), with enormous volatility among major currencies. In hindsight, this period was a transition period between two international monetary regimes: an interim era of instability, which we have dubbed the "great de-anchoring" (Ilzetzki, Reinhart, and Rogoff 2020).[1] Certainly, there was already enormous volatility among the G3 currencies (dollar, Deutschmark, and yen), but at the same time several countries were in fixed or near-fixed regional exchange rate blocs, most notably in Europe. Among emerging markets and developing countries, some were officially moving towards more flexible arrangements, while others towards rigid pegs. True, in a great many cases, reality did not reflect rhetoric. Some of the "floaters" were intervening heavily to stabilize their exchange rates, as documented in Calvo and Reinhart (2002), while many of the purported "fixers" had active and usually highly volatile parallel market exchange rates that typically reflected far more accurately underlying monetary conditions. Very often, the inconsistencies came to the surface, with speculative attacks taking down one fixed exchange rate after another (Reinhart and Rogoff 2004). Overall, the system was characterized by high and variable inflation rates, with investors seeking inflation hedges.

As the 21st century unfolded, most commentators recognized that a new order was emerging. At its core were two major currency blocs, with the euro providing a counterbalance to the US dollar. The idea of a third Asian-centric currency block remained remote. While the yen was a highly traded currency in international markets, the Japanese central bank was at best ambivalent about foreign circulation, and China was still a far smaller economy. Instead, the dollar remained the dominant anchor in East Asia, an

[1] To be clear, the de-anchoring was primarily an advanced economy phenomenon.

arrangement Dooley et al. (2003), in a highly prescient paper, referred to as "Bretton Woods II". Following the Asian financial crisis, smaller countries were advised to choose one of two polar regimes: a hard anchor to a major currency (e.g., a currency board or joining a currency union) or allow their currency to float freely. For the countries choosing the latter option, the rising popularity of inflation targeting seemed to provide an alternative monetary framework. The apparent remaining questions were the extent to which the euro would truly compete with the dollar for prominence and the degree of monetary coordination–or competition—needed among these major currencies (Rogoff 2001).

The hindsight of two additional decades of data, and research have led to a new consensus, which we explore in this chapter. This new view can be summarized as follows. First, the US dollar is even more central to the international financial system than was previously understood and its reach has increased in the 21st century (see also Gopinath and Itskhoki 2021 in this volume). We summarize the multiple dimensions of dollar dominance in international trade and finance, placing particular emphasis on individual countries' de facto choice of exchange rate anchor/reference currency, which we argue implicitly incorporates a broad range of factors. The rise of the euro as an international currency has been far more muted than most economists anticipated two decades ago. Outside Europe, it plays no greater role than the national currencies it replaced, by some metrics. It is true that the renminbi, still in the shadow of the yen in 2000, has emerged as a contender. But although the renminbi may well be the global currency in the year 2100, to date it has still made limited headways as an international currency. In fact, Chinese overseas lending practices have reinforced rather than diminished the role of the dollar, as Chinese official lending has been overwhelmingly denominated in US dollars to date (Horn, Reinhart, and Trebesch 2019).

Second, de facto exchange rate flexibility has not increased as many had expected, nor have hard fixes with the very important exception Eurozone countries. Intermediate regimes, that range from crawling pegs to managed floating with varying degrees of "management," dominate. However, despite the scope for floating, exchange rates in general have become notably more stable than in the "non-system" era of the late 20th century. The enormous rise in reserve holdings in large emerging market economies has surely played a role, but the general collapse in inflation rates and inflation volatility is likely even more important. While there has been a move towards "inflation targeting," the fact is that most central banks take great pains, often involving intervention and/or interest rate adjustments, to stabilize their exchange rate against an anchor currency, most often the dollar. However, despite the clear policy prerogative of maintaining a relatively stable dollar exchange rate, the frequent and spectacular exchange collapses of the 1990s and early 2000s have become much less common. Indeed, there has been a transition from

dramatic devaluation to large scale depreciation without much drama. This is in stark contrast with the conventional wisdom at the turn of the century that intermediate regimes were recipes for exchange rate disasters and central banks should either irrevocably commit to an exchange rate target or not do so at all. In fact, one of the most dramatic crises of the 21st century occurred in the Eurozone, where the hard peg prescription was followed.

Third, perhaps most surprisingly, these trends in exchange rate stability have extended to the core of the international monetary system, where G3 currency volatility has declined, precipitously so since 2014. This has occurred with some international coordination, such as swap lines during the global financial crisis and the Covid-19 crisis. But the main drivers have likely been a benign environment for exchange rate fluctuations, including low inflation and low interest rate volatility.

Fourth, most currencies are now convertible and capital controls have been removed gradually both in high income and subsequently in developing countries (albeit the pandemic, especially, led to uptick).[2] This is despite mounting evidence that capital controls may be useful as macroprudential tools and that capital flow bonanzas and sudden stops can lead to violent boom-bust cycles. (See Bianchi and Lorenzoni 2021 in the volume.)

Finally, massive accumulation of safe (primarily dollar-denominated) assets is in part due to central banks' attempts to manage their exchange rate while allowing capital to flow freely. This rising reserve accumulation may pose a risk to the system like the one observed by Triffin (1960) in the context of the dollar-gold standard of the Bretton Woods system. The modern equivalent asks whether US will be able to persuade investors that its fiscal capacity is sufficient to support the enormous outstanding liabilities it is creating, currently supported by seemingly insatiable demand for safe assets (see Maggiori 2021 in this volume).

Throughout the paper and in our concluding remarks we cautiously speculate whether the current system is stable and what alternative might come in its place. As we show in the following section, changes in the dominant anchor currency are rare and often associated with not only major geopolitical shifts, but also major armed conflicts. Financial innovation also plays a role in determining the epicenter of the international monetary system, so that rapid changes in payment and financial technology may play a role going forward.

Before turning to the discussion of this new consensus, the following section gives a brief history of the role of a dominant currency at the center of the international monetary system. Section III then

[2] This observation is tempered by the fact that the currency of the second largest economy in the world (China) is not convertible.

provides an overview of the variety of methods that have been used to classify exchange rate regimes and anchor currencies that have been developed in the past two decades. Sections IV to XIII of this chapter detail the evidence that has accumulated over the past decade in support of the new consensus. Chapter IX concludes.

## II. A Brief History of the Dominant Currency

In understanding the 21st century global exchange rate system, there is perhaps no more fundamental question than the outsized role of dollar. In this section, we first present a brief overview of the history of the dominant currency, and then a similarly brief tour of debates over the workings of the system. Simply put, the fact that the current system is increasingly stabilizing around the dollar, as we will see in our formal analysis of exchange rate regimes, does not necessarily imply that the system is optimal. In particular, there are important arguments in the recent literature that the potential gains to greater cooperation might be significant.

History tells us that once a currency has established itself atop the global financial pyramid, it tends to remain there for a very long time, typically a century or more. Changes in the dominant currency are few and far between. When they do occur, there is typically a long transition. Since the 1500s only Spain, the Netherlands, Great Britain, and the United States have seen their currencies reaching dominant status.[3] Of course this is the view from Europe, with separate monetary systems having evolved in China and other parts of the world. Even the European system was far more fragmented than it is today and featured multiple currencies. And even when a currency was dominant, there were often several prominent alternatives alongside the leading currency.

Through most of the 1500s, Spain was the most important economic and military power, thanks to a huge inflow of precious metals from the New World. Although Spain's military success was mixed, the Spanish monarchy's willingness to freely spend and borrow to finance wars flooded Europe with Spanish silver coins, giving them familiarity and critical mass. Even as Spain's hegemony faded with the sinking of "Invincible Armada" in 1588 and ultimately the dissolution of the Iberian Union in 1640, the Spanish silver dollar (and later the Mexican silver dollar) retained a central role in global commerce persisting into the 19th century. This owed in part to the quality of Spain's coinage, but also to the fact her colonies accounted for four fifths of global silver production between 1493 and 1850. (See Ilzetzki, Reinhart and

[3] Pick and Sédillot (1971) provide a quirky, but incredibly comprehensive historical evolution of currencies: dominant and minor.

Rogoff, 2019, and references therein.) It is noteworthy that the rise of the northern European currencies that usurped Spanish silver at the center of the international monetary system coincided with, and was facilitated by, the rise of British naval supremacy. Eichengreen et al. (2019) document the importance of military power and geopolitical alliances in buttressing the role of anchor currencies.

Although Spain's coins remained important long after its empire was surpassed, by the 1600s, the Netherlands became the most important commercial power (Denzel, 2010). Bills of exchange drawn on the Bank of Amsterdam became a reference unit of account in much of Europe and bills payable by the Bank became a store of value. In this respect, some historians argue that the Bank of Amsterdam effectively issued the first global fiat currency. This is a prime example of the role of financial innovation in determining the global anchor currency. However, the florin's era as a reserve currency came to an end with the fourth Anglo-Dutch war (1780-84) that led to the bank's effective insolvency (Quinn and Roberds 2014): a further example of the role of military conflict in anchor currency determination. Although England had been a major power for centuries, the mantle of global hegemon only passed unambiguously to the United Kingdom after the Napoleonic War. The UK had emerged almost unchallenged as the global economic superpower, with its empire eventually encompassing 25% of global GDP. The gold-backed British pound became the world's reserve currency. (For a discussion of the transition from silver to bimetallism to gold-backed currency, see Eichengreen 2019, who argues that global coordination on gold was a history-dependent outcome connected to choices the UK hegemon made.) The years 1870 to 1913 are regarded as the halcyon days of the gold standard, when there were relatively few government-imposed impediments to the movement of goods, capital, or people, at least in the core of the system. Meissner (2005) studies countries' decision to adopt the gold standard, and concludes that trade considerations were quite important. See also Meissner and Oomes (2009).

The British pound remained the dominant currency throughout the classical gold standard era even though its economy had been clearly eclipsed by the United States economy by end of the 19th century. Indeed, at the outset of World War I, the United States economy was roughly the size of Britain, France and Germany combined. True, the British empire in total still encompassed almost a quarter of the world's population, and the United States only got around to forming a central bank in 1913. One factor that allowed the pound to remain dominant was American bankers' relative lack of interest in international lending, viewing their comparative advantage as tapping into booming United States growth.

It was only after the devastation of World War I, when the relative size of the US economy was further magnified, that the dollar emerged, and then only as a co-equal, at least as measured by share of international reserves. Eichengreen and Flandreau (2009) emphasize that the dollar had pulled even with

the pound in international reserve holdings by the mid-1920s and by the late 1920s had already begun to surpass it.[4] The dollar's late arrival on the scene was partly due to deliberate policy decisions. The US was consciously isolationist during most of the 19th century and restrictions on bank branching made the US a less attractive location for international funding. The Fed-supported creation of banker acceptances was a reversal of these trends and certainly accelerated the role of the dollar in international trade in the interwar period (Eichengreen, 1991; Eichengreen and Flandreau, 2010). World War II brought a decisive end to the dual (or multiple) global currency regime. With the UK having taken on huge wartime debts, its economy suffering widespread destruction and dislocation, and its empire visibly unravelling, (not to mention 11 IMF programs during the post war decades), that the dollar emerged alone at the center of the post-war fixed exchange rate Bretton Woods system.

The durability of the pound and its ability to withstand the continual diminution of Britain's economic size and empire, reinforces the point that even if the dollar were pushed off its perch this century, the process could be a very long one. Moreover, any transition is likely to involve an intermediate period of multi-polar anchors, much as the case of the US and Great Britain during the interwar period, or Germany and the United States after the demise of Bretton Woods. Finally, there are parallels between the limited US role in international finance in the late-19 century due to policy restrictions and the limited reach of the renminbi today due to lack of convertibility.

Why is there such a gravitational pull towards a single currency, and what forces might lead to having the multi-polar world envisioned by Frankel (2008) and Eichengreen (2011)? Going back at least to Swoboda (1969), economists have long noted the convenience factor of having all trade denominated in a common currency. Bacchetta and Van Wincoop (2005) and Goldberg and Tille (2008) suggest that strategic complementarities in pricing and highly competitive markets lead firms to price in a dominant currency. The findings of Maggiori, Neiman and Schreger (2020) on the remarkable dominance of the US dollar in corporate bond markets indicates that such complementarities are also true in choice of denomination for financial assets. Further, currency choice in trade and finance may be reinforcing, as Gopinath and Stein (2020) show. The more a firm's exports are priced in dollars, the lower the premium they are required to pay on bonds. Market liquidity is also a critical factor, as He, Krishnamurhty and Milbradt (2019) show. Market size increases liquidity, with lower premia creating a feedback loop to larger market size. Importantly, especially in a world of massive post-pandemic debt, He et al. caution

[4] Eichengreen and Flandreau (2009) also document that a large share of cross-border financing was conducted in German Deutschemark and French francs in this period, so that the British pound was not alone at the pinnacle of the international monetary system.

that the feedback loop from size to liquidity premia is positive only as long as there is a sufficiently strong demand for safe assets. Otherwise, risk premia may rise due to concerns about sustainability.

Outside of strategic complementarities in the pricing of goods and assets, risk considerations can also play a strong consideration for countries to gravitate towards the dollar as a safe asset. Hassan, Mertens and Zhang (2020) argue that to the extent the dominant currency provides the premier global safe asset, it will tend to appreciate in times of severe adverse global shocks. This implies that countries that are able to credibly stabilize exchange rates against the safe asset (the dollar) can lower their borrowing rates. (Credibility is an important caveat since it assumes the peg will be kept precisely in situations where it might be most painful to do so.) The importance of the risk premium as a factor in exchange rate dynamics has been explored recently in work by Lilley and Rinaldo (2020) and Stavrakeva and Tang (2021).

More generally, there is a broad host of reasons why central banks may want to stabilize exchange rates against the dominant currency, including borrowing mismatch, inflation pass-through, trade, and impact on competitiveness (Calvo and Reinhart, 2002). This is why Ilzetzki, Reinhart and Rogoff (2019) suggest that an individual country's exchange rate regime may be regarded as a portmanteau measure of the multiple channels through which exchange rate fluctuations can impact the economy.

Schmelzing (2020) proposes a timeline of the global safe asset (as opposed to the global dominant currency), shown in the second column of Table 1.[5] In Schmelzing's classification, the Italian city states including Genoa, Florence, and Venice, issued the (relatively) safe global asset. Over parts of this early period, Portugal also issued a relatively safe asset. (Just as there can be more than one reserve currency, there can more than one safe asset.) Schmelzing's timeline lists Spain as the global safe asset from 1509-1598, ending as Philip ceded the throne of the Netherlands following the Treaty of Vervins with France. From 1599-1702, the Dutch province of Holland issued the most reliable global safe asset, with British long-term consols constituting the global safe asset from 1703-1907. Interestingly, German Imperial bonds were the safe(est) asset from 1908-1913, we return to this interpretation momentarily. In any event, if Germany did issue the safe asset briefly, it quickly lost the franchise back to Britain during the period of the Great War. From 1919 until 1961, the United States issues the most reliable global safe asset. But

[5] For the purposes of this paper, we define a safe asset as one that best preserves purchasing power, that is not only is it unlikely to default, but also it is the one that provides a reliable store of value and is readily acceptable as a medium of exchange, It should be noted that although the dominant currency tends to be a global safe asset, it is by no means always the *safest* asset among internationally issued bonds, at least not in the sense of being consistently the lowest yielding. In recent years, the Japanese yen provided lower yields than the US dollar, for example. .

from 1962-1980, one can reasonably argue that it was Germany. It worth recalling that as the Bretton Woods system collapsed and inflation raged throughout the world, and even as UK and Japanese inflation peaked at over 20% and the US's over 13%, German inflation never approached double digits. After 1980, the US is again the safe asset. Importantly, the third column in Table 1 contains an annotated overview of exchange rate arrangements during these different epochs, including the role of gold which at times also played a fundamental role both in the exchange rate system and as a safe asset.

One can argue with the judgement embodied in the timeline, but it makes the point that the asset which appears safest on ex-ante grounds does not always turn out to be so ex-post. The post-war German hyperinflation could hardly have been anticipated a few years prior to World War I. Indeed, World War I itself was not fully anticipated. Political scientist Graham Allison (2017) refers to the historical challenges of avoiding war between the old economic/military power and the rising one as "Thuycides trap." (The name refers to the Greek general and historian who posited the inevitability of the Peloponnesian war between incumbent power Athens and rising power Sparta.) War is a frequent outcome but not inevitable; in four of the sixteen historical cases Allison studies, three in the 20th century, war was averted through imaginative statecraft. Arguably, World War I may have been avoidable as well. The safe asset history in Table 1 should be read through that lens of uncertainty, not what we know happened historically ex-post.

Figure 1 shows the 800-year history of the real return on the global safe asset from Schmelzing (2020). As Schmelzing emphasizes, there is a downward trend of 1.67 basis points per annum over the full sample, and 2.29 basis points in the subsample after 1820.

How soon, if ever, will the Chinese RMB become the dominant currency? Obviously, given China's sheer size and growth, its emergence as the dominant currency is a distinct possibility. If China avoids the middle-income trap and continues it inexorable growth, its economic size—which already passed the United States in purchasing power terms by 2014—will have surpassed that of the United States in dollar terms by 2040 if not much sooner. Already, the emerging world as a whole accounts for 61% of global GDP compared to 42% in 1980 at purchasing power parity (PPP) exchange rates. Over the same period, the United States' share of global GDP has fallen from 22% to 17%. Although China's banking and financial system still lag—in part because its legal system does not protect property rights sufficiently well yet—both are evolving, albeit not necessarily towards a Western model. We note in this regard that, for at least the past two centuries, the main anchor currency has been issued by relatively democratic countries with strong commitment to the rule of law. On the other hand, as the new entrant, China may benefit from a shift to new digital infrastructures, having less to lose to from disruptive technologies that undermine the existing regime. Although in principle, the dollar could remain dominant indefinitely even

as the US share of global GDP continues to fall, the home market advantage the US now enjoys will inevitably become less meaningful and the position of the dollar more fragile.

Another key question, in addition to economic size is military power, as Eichengreen et al. (2019) and Ilzetzki, Reinhart and Rogoff (2019) emphasize. At present, the US far outstrips China in conventional military capacity, but that advantage is gradually eroding and will likely change dramatically over the next two decades; China already appears to be at least on par with the United States in most areas of emerging military technology, including cyber and biological warfare, not to mention drones. (Europe badly lags the US in military capabilities and this may be a piece of the explanation for the internationalization of the euro has advanced so slowly.)

The falling size of the US economy could also be aggravated by rising debt, especially short-term debt. Farhi, Gourinchas and Rey (2011) and Obstfeld (2011) point to this "Modern Triffin Dilemma." In an important paper, Farhi and Maggiori (2018) argue that the hegemon is likely to be tempted to overextend borrowing because the costs of crisis (which could be a sharp rise in inflation rather than default) extends to the entire world and not just to the hegemon. We revisit the modern Triffin Dilemma in Section VIII.

The global appetite for safe assets is also a consideration, as we have already noted. Although the appetite for advanced economy debt has seemed insatiable in recent years, with real interest rates on global safe assets at record lows, no country has embraced this opportunity as fully as the United States. As we shall see in Section IV, US public debt in global markets already rivals that of all other advanced economies combined, and the same is true of corporate debt. There are strong intellectual arguments—mainly that the interest rate is less than the growth rate—that public debts could be expanded far more, particularly if the funds are used on enhanced infrastructure or decarbonizing the economy. (See Blanchard 2019, for example.) The political imperative to urgently address within-country inequality is also likely to lead to much faster debt accumulation. Thus far, the appetite for safe assets has seemed to outstrip supply by far, particularly in the face of two massive shocks (the pandemic and the financial crisis), barely a decade apart. But there is no guarantee this will continue to be the case going forward. As Reis (2020) shows, when one considers the rate of return on capital (which is greater than the growth rate of the economy), not only government borrowing rates (lower than the growth rate of the economy), the US may have already be on track to exhausting its fiscal space.

Finally, a major factor that has coincided with ever-growing dollar dominance has been the remarkable fall in global inflation, which has made the purchasing power of the US dollar extraordinarily predictable. Further, as we will see in Section VI, exchange rates among major advanced currencies have been

extremely stable in recent years, so that the dollar's purchasing power has also been stable in non-dollarized economies. Although the success of lowering inflation owes much to central bank independence and more predictable central bank policy, there is a strong case to be made that it was greatly facilitated by globalization and the rise of China (Rogoff, 2004). Central bankers had the wind at their backs as Chinese imports pushed down prices in highly visible fashion, helping to bring down inflation expectations. Going forward, the dynamic could turn. Even without a trade war, demographic pressures are likely to raise change the shape of globalization over the next two decades (when China's labor force is projected to fall by 200 million, and dependency ratios are set to become far more challenging across advanced economies). Goodhart and Pradhan (2020) argue that the next phase of the global demographic decline is very likely to lead to strong inflationary pressures unless India and/or Africa develop at a speed far faster than currently forecast. They also raise the possibility, albeit more cautiously, that the same pressures could reverse the real interest rate trends of the past three decades.

Last but not least, it is difficult to forecast with certainty how changes in digital transactions technologies might lead to significant changes in finance and ultimately currency dominance, particularly given that many countries are concerned that the current system gives the United States government excessive control over the flow of transactions information, and too much power to use regulation of dollar clearing as vehicle for achieving political ends.

Benigno, Schilling and Uhlig (2019) argue that, regardless of government incentives, the impact of cryptocurrencies on the global exchange rate system could also upend the status quo. True, central to their analysis is the assumption that in the long run, governments cannot interfere with a significant migration from fiat to cryptocurrencies in transactions. This assumption is strong indeed, given that governments control all elements of the legal economy, and have the capacity to make it extremely difficult to launder crypto into the legal economy once banned. As Rogoff (2016) argues, given the imperative of collecting taxes, enforcing laws and regulations, and dealing with financial crises, governments have an overriding incentive to ensure they can control the flow of information and the unit of account. Governments may suffer temporary setbacks in controlling cryptocurrencies but have enormous capacity to achieve this end once they make it a priority. In less developed countries, restrictions on crypto currency may be imposed to avoid capital flight. Governments are unlikely to indefinitely lose at a game whose rules they make. Nevertheless, one should not underestimate the potential for the coming shift to digitalization, along with new rails to the international payments that might not be US-centric, to have a significant impact on currency choice and the exchange rate system. Central banks have begun contemplating digital versions of their currencies and upgrading their payment systems to the new digital age. These new technologies

may well determine the epi-center of the international monetary system in the second half of this century, if not before.

***Cooperation***

Our discussion of the history of anchor currencies would be incomplete without at least some discussion of the related literature on international monetary policy cooperation. The fact that the world has coalesced around a dollar-dominant regime does not necessarily mean the system is in any sense optimal. The subject of international monetary cooperation remains an active literature where there have indeed been some developments since the last handbook in 2013. We do not have space here to give it justice but will make mention of a few recent developments, though as one expands the notion of monetary control to encompass information flows embedded in payments, and the ability of the dominant country to enforce financial sanctions, it is clear that there is much to be done.

Theories of international policy coordination stem from early work by Cooper (1969) and Hamada (1976), identifying how demand spillovers across countries can create incentives for cooperation. Of course, Nurske (1944) already highlighted the benefits of policy coordination in the interwar period. For example, an expansionary monetary policy in the home country increases overall global demand which benefits both home and foreign, but the concomitant depreciation of home exchange rate that generally arises creates an expenditure-switching effect that can make the spillover smaller or even negative. The first-generation of analyses is surveyed in Richard Cooper's (1985) contribution to the first set of volumes in the *Handbook on International Economics*. Engel (2016) has assessed the literature much more recently.

A major topic of debate in the modern literature is whether there is still significant scope for international monetary cooperation if countries follow optimal domestically-oriented monetary policies. Obstfeld and Rogoff (2002) develop conditions under which the gains from cooperation are small, provided all countries are following optimal domestically oriented monetary policies. Incomplete markets for international risk sharing create scope for gains from cooperation, but these are not necessarily large in their framework. Since then, a substantial literature has developed, emphasizing a number of cases where cooperation can yield first-order gains. An important example is Engel (2011), who shows that the gains from cooperation are potentially much larger when prices are rigid in local currency terms (the currency of the importer) rather than producer currency terms (the currency of the exporter). Bodenstein, Corsetti and Guerrieri (2020) extend Obstfeld and Rogoff's framework to allow for a richer pricing dynamic using Calvo contracts. In their model, large imbalances can accumulate over time and create a significant wedge; the debtor benefits from a global monetary policy that brings down the path of real

interest rates and the creditor similarly loses.) Egorov and Mukhin (2020) show that international coordination is desirable for non-US economies when prices are sticky in US dollars, but such cooperation may not be sustainable because it isn't in the self-interest of the US. The problem of international coordination can become especially acute at the zero bound, as Cabellero, Farhi and Gourinchas (2021) show, in part because at the zero bound demand shortfalls spill directly into output declines.

In an ambitious paper, Korinek (2017) develops a very general framework to identify cases where international spillovers create significant gains for cooperation. He finds that even in the face of a wide range of domestic market imperfections and distortions, non-cooperative domestically- oriented macroeconomic policies can still yield a globally efficient outcome provided (1) policymakers have sufficient external instruments and (2) international markets are free of imperfections.

Most of the cooperation literature employs New Keynesian models that focus on classical productivity or government spending shocks; there has been much less research exploring the risk premia and liquidity shocks that play an increasingly central role in applied exchange rate models, for example Gabaix and Maggiori (2015), Itskhoki and Mukhin (2020), Lilley and Rinaldi (2020). It is also clear that in extreme events such as the pandemic and the global financial crisis, there are very direct mechanisms for cooperation outside the usual interest rate channels. Federal Reserve Swap lines, for example, appear to have played a critical role in stabilizing dollar funding markets globally in both instances (see Bahaj and Reis, 2020). Further, several countries have swap lines with the ECB and more than 40 central banks have signed for swap lines with the People's Bank of China. This has been an important development that needs to be explored in much greater detail. Arguably the expectation that such swap lines will be available in future emergencies helps remove tail risk and affects exchange rate stability even during quieter periods, although the empirical importance of this effect relative to other factors such as reduced monetary policy uncertainty is unclear (see Ilzetzki, Reinhart and Rogoff, 2020b and Stavrakeva and Tang, 2020).

There is, of course, an important parallel between dollar swap lines and cooperation under the gold standard, when major central banks with strong gold positions would, on rare occasion, step in to help major central banks whose gold peg was under duress; see Ahamed (2009) or Eichengreen (2019) for discussion of cooperation under the gold standard. Harris (2021) shows that the Tripartite Agreement of the late 1930s between the United States, the United Kingdom and France, formed an early example of more routine central bank cooperation; that framework is in some ways was a precursor to the post-war Bretton Woods system. Indeed, as Horn, Reinhart, and Trebesch (2020) document, during the 19th

century, there were repeated episodes with sizeable central bank lending, including the Panic of 1861, the Baring Crisis in 1890 and the Panic of 1907. In the 20th century, international central bank lending intensified during the interwar years. In the 1920s, for example, consortia of central banks agreed to extend reciprocal credits to help each other return to gold. In 1931, central bank lending reached a historic peak, with total credits exceeding 3% of US GDP. That a financial crisis in a major financial center could lead to long-lasting impacts on the global economy is shown by Xu (2020).

Another quite practical issue is whether small developing economies might have an incentive to try to use monetary policy to behave non-cooperatively and temporarily maintain an undervalued exchange rate. Bergin and Corsetti (2020) develop a two-sector model with two tradeable sectors, one perfectly competitive, and the other with monopolistic competition, nominal rigidities, and sunk entry costs. Monetary policy can affect the competitiveness of the differentiated goods firms, and thereby affect the composition of output and exports. The theme is reminiscent of Rajan and Subramanian (2011), who show that aid can having last effects on the composition of production.

In a world of rapidly rising "safe" global debts, the issue of how safe currency debt issuance policies affects other countries is likely to be an increasingly important one. Farhi and Maggiori (2018) show that having more than one reserve currency can sometimes help to put a check on a hegemon's incentive to issue debt to the point of fragility (to reach a zone where multiple equilibria become more of a concern). Their argument is somewhat analogous to Rogoff (1985), who shows that in the presence of distortions in domestic policy (he uses the example of inflation bias), international policy cooperation can actually be counterproductive. The fact that unilateral inflation depreciates the exchange rate actually worsens the tradeoff between higher output and higher inflation and leads to a lower equilibrium inflation bias.

In a similar vein, we note the interesting observation of Canzoneri and Henderson (1991), who show that in a system where the hegemon has the dominant monetary authority, the choice of exchange rate regime by the rest of the world can have significant strategic implications on the lead country. In some cases, the rest of world can actually be better off it is collectively committed to a fixed exchange rate regime. Despite the loss flexibility in responding to asymmetric shocks, the fixed rate commitment has a strategic tempering effect on the hegemon's monetary policy that can, with symmetric shocks, leave the rest of the world better off overall than under a flexible rate system.

We note in concluding this section that beyond continuing to explore Keynesian themes that dominate the existing international cooperation literature, there is also great potential and need for future research on the broader implications of the international payments system. Topics would include control of information flows embedded in transactions data, the ability to impose financial sanctions, standardization

of digital transfer protocols, and central bank swap lines. Indeed, economic cooperation is likely to be one area of international relations where it is important to look at strategic interactions across issues (fiscal and monetary policy) in an integrated framework, for example where reputation for cooperative behavior in one area affects a county's credibility in other area. (This point is, of course, familiar from the sovereign debt literature, see Bulow and Rogoff, 1989).

## III. Rethinking Exchange Rate Regimes

Post-World War II debates on the nature and ideal structure on the international monetary system date back at least to Keynes' (collected 1978) writings in the interwar period and Nurske (1944). Their period of focus was the volatile inter-war period, which also saw the first modern effort to track exchange rate arrangements in the League of Nations' Annual Yearbooks. Keynes was of course one of the eventual architects of the Bretton Woods gold-dollar system, although much of its details were devised by Harry Dexter White and the US Treasury. During the Bretton Woods years, several authors, including Friedman (1953) and Johnson (1967) called for a move away from the "adjustable peg" system to a (non-)system of flexible exchange arrangements. On the other side of the debate stood Mundell's (1961) analysis of optimal currency areas. The arguments on both sides were theoretical or historical rather than empirical. With the end of Bretton Woods in the early 1970s, countries diverged in their approaches to exchange rate management ranging from continued adjustable pegs to freely floating exchange rates. This provided variation that allowed an empirical assessment of the pros and cons of different exchange rate arrangements. The literature on this topic is too large to summarize here, but Ghosh, Gulde, and Wolf (2003) provide a useful overview. This first generation of empirical analysis on exchange rate regimes relied on the IMF's classifications, summarized in the Fund's *Annual Report on Exchange Arrangements and Exchange Restrictions* (AREAER). The regime classifications in this annual report were based on countries' self-reported exchange rate practices at the time. (The Fund has revised its methodology several times since.) In its early years, the report focused on whether central banks were meeting their commitments under Bretton Woods' rules of the game. The report also contained information on capital controls, which we discuss further in Section VII. In the post Bretton Woods period, the report expanded its taxonomy of exchange rate arrangements to reflect the heterogeneity of practices that emerged but continued to be based on countries' self-reported regimes. Evidence on differences in economic performance across regimes was inconclusive on many dimensions, possibly because actual practice diverged from official exchange rate policy.

Starting in the mid-1990s, several articles pointed out this divergence between policy and practice. Obstfeld and Rogoff (1995) noted that countries claiming to peg their currency often succeeded for a number of years, but in an era of more open capital markets, almost invariably succumbed to severe exchange rate crises at some point.. Calvo and Reinhart (2002) argued that many developing countries suffer from "fear of floating", i.e. they tend to manage their exchange rate more than their official policy would imply. These observations led to new generation of classification methods based not on *de jure* exchange rate arrangements but based on *de facto* practices towards exchange rate management, most notably Levy-Yeyati and Sturzenegger (2003, 2005), Reinhart and Rogoff (2004), and Shambaugh (2004). In addition, the IMF's AREAR revised its classification methodology to combine countries' de jure policies and their de facto practice, based on IMF staff assessment. The new classification schemes differed in methodology, but importantly departed from the previous practice of accepting self-reported policies at face value. They relied instead on statistical and historical evaluation of actual exchange rate practices. Klein and Shambaugh (2010) compare the classification methodologies in detail and we describe them briefly here.

Not surprisingly, all classification methodologies include exchange rate movements as an input to their classifications. Levy-Yeyati and Sturzenegger (2003, 2005), henceforth LYS, look at the change and volatility of exchange rates and combine this information with variation in central bank reserves to determine whether a give country has a peg, a flexible exchange rate, or an intermediate regime. The idea behind their classification is that accumulation or sale of reserves is a common policy tool in exchange rate management, so that a pegged exchange rate will be associated with low exchange rate variability and high reserve variability; the opposite should be true for a flexible exchange rate. The authors then use cluster analysis to classify countries into these categories. The use of reserves has the potential advantage of making the distinction between low exchange rate variability due to more benign external conditions as opposed to active policy to achieve low exchange rate variability. Of course, if exchange rate pressures are subdued or if a peg is highly credible, the central bank may not need to intervene heavily in the market for foreign exchange. Further, central banks may use other policies such as interest rate policies and capital controls to control the value of their currency.

Reinhart and Rogoff (2004) and Shambaugh (2004) both use month-on-month variation in exchange rates as their main input to classification. An important contribution of Reinhart and Rogoff (2004) was to show that parallel markets were very common during the Bretton Woods period. Indeed, unifying exchange rates was a major preoccupation of the early International Monetary Fund (see De Vries, 1969). Parallel exchange rates meant that the market exchange rate used for many transactions showed far

greater variation than the official exchange rate. Shambaugh (2004), in contrast, uses the official exchange rate. Both methodologies classify exchange arrangements based on whether a currency varies within a (+/- 2% or +/-5%) band of their anchor currency. Shambaugh (2004), like LYS, classifies countries in very broad categories, while Reinhart and Rogoff (2004) have both a coarse (6-category) and fine (15-cateogry) taxonomy of exchange rate practices. A novelty of Reinhart and Rogoff's (2004) classification was the inclusion of a category for "freely falling" currencies whose currency fluctuated wildly during high-inflation episodes. They argue that it is important to distinguish these cases from freely floating currencies, but where the central bank still maintains monetary control. This is of particular importance when assessing the economic merits of different monetary frameworks.

Shambaugh and Klein (2010) show that the three academic classifications are highly correlated with each other (but less so with the IMF's classification). Their imperfect correlation is to some extent by design, with each classification attempting to capture a different aspect of exchange rate flexibility. Put differently, there is no single "correct" way to classify exchange arrangements that is suitable in all empirical settings. Shambaugh and Klein (2010) discuss the categories of empirical questions each of the classifications is best suited to answer.

All three classifications have difficulties in classifying currencies that are pegged to an exchange rate basket de facto, as many countries with a de jure basket peg don't publicize their basket weights, and even floating currencies will coincidentally appear to be within a narrow band of *some* currency basket. A separate literature attempts to classify central banks' implicit currency baskets, without necessarily taking a position on whether these baskets are by design. Frankel and Wei (1994), Frankel (2008), and Frankel and Xie (2010) are examples of this research agenda.

The second-generation exchange rate regime classifications have all been updated since, with Levy-Yeyati and Sturzenegger (2016) updating LYS; Ilzetzki, Reinhart, and Rogoff (2019) updating Reinhart and Rogoff's classification; and Klein and Shambaugh (2010) and Obstfeld, Shambaugh and Taylor (2010) updating Shambaugh's (2004) classification. Ilzetzki, Reinhart and Rogoff (2019), henceforth IRR19, attempts to grapple with some of the challenges in the second-generation classification methodologies, synthesize some of their approaches, and addresses new realities in the international monetary system of the past 20 years.

Most pertinent for the discussion that follows is that IRR19 propose an algorithm that jointly classifies exchange rate arrangements and the anchor currency to which each currency is tied. Of course, previous classifications necessarily had to classify anchor currencies in determining whether an exchange rate was pegged, and in the cases of hard pegs, this classification is straightforward. But in intermediate cases,

anchor currency classification was ad hoc and at times arbitrary. Further, the advent of the euro as a major anchor currency increased the plausible set of candidate anchor currencies. IRR19 classify anchor currencies algorithmically. In the case of managed floating currencies, the term "anchor" is less appropriate and IRR19 use a variety of statistics to classify the "reference currency" that each country follows most closely.

Classifying anchor currencies required IRR19 to re-examine the question of how to address countries who are anchored (de jure or de facto) to a basket of currencies. In the few cases where the basket is publicized, IRR19 verify whether this basket does reflect the country's anchor. They also provide an algorithm to assess whether other countries are better categorized as anchored to a single currency or to a basket of several. In this respect, IRR19 built on the earlier literature that estimated currency basket weights.

Changes in the international monetary environment, discussed in detail in Section VII required a rethinking of the appropriate bands to classify countries as having a hard peg or a looser band. Namely, exchange rate volatility *among* anchor currencies reached an all-time low during this period. A naïve use of earlier algorithms risks understating the degree of exchange rate flexibility, due to a benign external environment for exchange rate fluctuations. IRR19 outline the algorithmic changes introduced to address this challenge. Most importantly, IRR19 no longer draw the line between managed floats and freely floating currencies based on an algorithm alone. Instead, they use narrative evidence from central banks, the IMF, and other reports to classify managed floating currencies as those whose central bank frequently used foreign currency reserves or capital controls as instruments to affect the level or volatility of the exchange rate. In this regard, the IRR19 methodology incorporates and expands on the view expounded in LYS that central bank reserves can be used to classify exchange arrangements.

***Do Exchange Rate Regimes Matter?***

The new exchange rate classification methods facilitated a burgeoning literature on the effects of exchange rate practices on a large variety of economic outcomes. We cannot do justice to this vast literature, but rather sample a few important areas where the importance of exchange rate regimes has been studied. Shambaugh and Klein (2010) summarize this literature in more detail. One of the earliest arguments for a system of fixed exchange rates was that exchange rate volatility harms trade. Rose (2000) and the literature that followed showed that currency unions do have a positive effect on trade. While currency unions are easy to detect, the classification methodologies developed in the past two decades allowed a broader study of the effects of exchange rate practices and trade. Klein and Shambagh (2006) show that Rose's (2000) findings extend to fixed exchange rates more broadly.

The debates on the post-war international monetary system were framed in the context of the "Trillema" or "Impossible Trinity", which posited that a country with fixed exchange rates loses monetary autonomy. Shambaugh (2004) and Obstfeld, Shambaugh and Taylor (2010) show that countries with fixed exchange rates do indeed inherit the monetary policy stance of the central bank to which they anchor. We discuss the impossible trinity further in Section VIII. Though the lens of the Mundell-Flemming model and its modern variants, this same loss of monetary autonomy implies that fiscal policy will have a larger impact in countries with fixed exchange rates. Ilzetzki, Mendoza, and Végh (2013) show that this is indeed the case.

Further studies have shown that developing countries attain lower inflation rates when operating under a fixed exchange rate, but that exchange rate flexibility is associated with faster economic growth (Levy-Yeyati and Sturzenegger 2003; Hussain, Mody, and Rogoff, 2005; Klein and Shambaugh 2010). Subsequent studies showed more mixed results on exchange rate flexibility on economic growth and in fact Aghion et al. (2009) show that exchange rate flexibility is associated with lower productivity growth for countries with lower degrees of financial development.

Exchange rate regimes have been used in the study of reserve accumulation (Aizenman and Lee, 2007 and Jeanne and Ranciere, 2006); current account adjustment (Chinn and Wei, 2013 and Ghosh et al., 2013); capital flows and equity prices (Hau and Rey, 2006); credit flows (Mendoza and Terrones, 2008); the effect of remittances on the macroeconomy (Ball, Lopez and Reyes, 2013); the effect of oil shocks (Habib et al., 2016), and the transmission of credit cycles to economic activity (Mian, Sufi, and Verner, 2017; Obstfeld, Ostry, and Qureshi, 2019). Jordà, Schularick, and Taylor (2015) have shown how to use exchange rate classifications to identify the effects of monetary policy shocks. Countries with fixed exchange rates will tend to inherit the monetary policy of the anchor central bank, even when it is responding to shocks orthogonal to domestic conditions, giving plausibly exogenous variation in interest rate policy.

## IV. Dollar Dominance in the 21st Century

As we have already emphasized, perhaps the most salient feature of the international monetary system today is the outsized role of the US dollar as an international unit of account, a medium of exchange, and a store of value. This is evident from the role of the dollar in trade invoicing and bond denomination, as well as the demand for of dollar-denominated bonds as safe assets arising from the private sector, central banks, and sovereign wealth funds.

We begin by documenting the role of the dollar as an anchor currency: the international currency to which central banks gravitate in setting their own monetary policy decisions. Figure 2 shows the share of currencies that have the US dollar, the euro (previously the German Deutchemark and French franc), or the UK pound as their de facto anchor/reference currency. The share of countries in the bottom panel is weighted by each country's GDP, so that this panel reflects the share of world GDP anchored to each currency. The figure employs and updates the anchor classification methodology of Ilzetzki, Reinhart and Rogoff (2019) to the year 2019. IRR19 argue that this metric provides a summary measure of the role of each candidate anchor currency along the multiple dimensions that we investigate below. This in no way implies a causal chain beginning with central bank's anchor currency and leading to private sector demand for a currency or its choice of currency denomination. Instead, central banks' choices reflect a revealed-preference indicator of the importance domestic policymakers attribute to an international currency due to economic, political, and geopolitical considerations.

Figure 2 shows the currency to which the 194 countries and territories in the IRR19 sample were anchored from 1946 to today. The 3 to 4 anchor currencies shown in the figure constitute a nearly comprehensive list, omitting the small number of countries anchored to regional currencies, such as the Australian dollar (New Zealand) and the South African rand (Namibia). The most significant omission is the ruble in the Eastern bloc during the Soviet era, excluded due to data limitations. The figure includes a handful of countries who are anchored to a de-facto basket of currencies; in the figure they are allocated to anchor currencies in proportion to the basket weights. The classification algorithm identifies China, Singapore, and Malaysia as moving from dollar anchors to an anchor that equally weights the dollar and the euro.[6] This explains the increase in the share of countries anchored to the euro at the end of the time series. No currency (other than the yen itself) is anchored to the Japanese yen.

It is difficult to ascertain whether any currency is anchored de facto to the Chinese renminbi, itself tightly anchored to the US dollar. The three currencies anchored to a dollar-euro basket may reflect a nascent Asian bloc, but it is too soon to tell and for the time being a dollar-euro anchor appears to fit the data better than a renminbi anchor, given the small fluctuations among these currencies.

The figure indicates that some of the historical trends discussed in Section II continued into the 20th century. The persistence of a dominant currency and the slow transition between regimes is evident from the first two decades following the Second World War. The UK pound remained the de facto anchor currency for a large share of the globe (mainly former colonies) despite the dollar's official role as the

[6] An equally weighted dollar-euro basket fits the data better than People's Bank of China's official currency basket.

anchor currency in the Bretton Woods system, the British empire's unravelling, and the fact the UK itself was a frequent borrower from the IMF throughout this period. The UK did eventually lose its centrality in the international monetary system by the 1970s, mostly in favor of the US dollar, although it is worth noting that the pound still has a weight in both central bank reserve holdings and international transactions well above the UK's share of the world economy.

By the 1970s, the dollar's de facto dominance matched its de jure role as the anchor currency at the center of the system of fixed exchange rates. 50 percent of countries, representing 70 percent of world GDP were anchored to the dollar. As the dollar de-linked from gold and the rest of the world was no longer obliged to anchor to the dollar, an alternative formidable anchor emerged. The German Deutschemark became the de facto anchor for countries in Europe, including the UK, an arrangement formalized in the European Exchange Rate Mechanism (ERM). (Recall that in Schmelzing's classification of safe assets discussed earlier, the DM had been the safe(st) asset from 1962-1980.) Former colonies, already anchored to the French franc, became a part of this proto-euro bloc. It is on this backdrop that some commentators at the turn of the century imagined a multipolar exchange rate system with the dollar, Deutschemark/euro, and possibly the Japanese yen at its center. A major policy question was whether monetary coordination among these blocs was desirable: The Plaza and Louvre accords of the 1980s provided practical examples that such coordination was feasible.

By this point, however, the number of countries and currencies anchored to the dollar was steadily rising, eventually reaching a similar share (of both countries and world GDP) to that previously seen at the height of the Bretton Woods system. How did the dollar's role in a laisez faire international non-system come to match the prominence it had when it was formally at its center? Three main factors account for the dollar's expanded international reach. First, the collapse of the Soviet Union brought over twenty former Eastern bloc countries into the international monetary system. The Soviet republics and their satellites were never part of the Bretton Woods system and are unshaded in Figure 2. These countries almost uniformly anchored their currencies to the dollar after the Cold War, although several have since joined the euro or anchored to the euro; and Russia itself now anchors to a dollar-euro basket. Second, the first two decades of the non-system era following Bretton Woods was a period of frequent high (and hyper) inflationary bouts and currency crashes, primarily in developing countries. In the early 1990s, more than forty countries had inflation over 40% (Rogoff, 2004) and therefore were de-facto unanchored. Of course, the dollar continued to play an important role in goods and assets pricing, and in some cases domestic transactions, in these high-inflation, high-volatility countries. As inflationary pressures subsided in the 21st century, many of these countries re-anchored their currencies to the US

dollar. We note and will discuss below the re-emergence of multiple currency practices, parallel markets, and high inflation in recent years. Third, the remarkable growth rates of several large dollar bloc developing countries, particularly in Asia, substantially increased the share of world GDP anchored to the dollar.

Turning to the private sector's international currency choice, Figure 3 shows the share of international trade denominated in dollars (left-hand panel) and local currency (right-hand panel) for several major economies. The figures from 1976 come from Black (1985) in the first edition this handbook and the 2016 figures are from Gopinath (2016). (Gopinath has compiled a far more comprehensive dataset than shown here.) The selection of large economies in Figure 3 biases the absolute shares against finding an important role for the dollar, as larger countries are more likely to invoice in their own currencies. For comparison, around 40% of the median country's trade in Gopinath's (2016) sample and its expanded and updated version in Boz et al. (2021) is denominated in dollars.

Rather than giving a representative estimate of the share of trade denominated in dollars, Figure 3 instead shows how currency choice in trade invoicing has evolved over time in major economies. Nearly all trade with the US is denominated in dollars and that share has slightly increased over the 30 years considered here. The more surprising fact, perhaps, is that the share of trade denominated in dollars has increased for Germany, the median European country, and for the UK. This has occurred despite increased European monetary integration, the advent of the euro, a large increase in the volume of intra-European trade, and that the volume of UK trade with Europe now 4 to 5 times greater than its trade with the US. The dramatic increase in the UK's share of dollar-invoiced trade is elucidated by the panel on the right-hand side. Nearly 70% of UK's international trade was invoiced in UK pounds in the 70s: a remanent of its past global stature; but this share dropped to below half today, converging to the world median. Japan bucks the trend towards greater trade in dollars, invoicing ten percentage points more of its trade in yen and ten percentage points less in US dollars today than in the 70s. This, too, reflects a convergence to the world median; the yen's share of dollar trade, at over 50%, remains strikingly high for a large economy. The US is a source or destination of only 15% of Japan's international trade.

Virtually all the modern literature on trade invoicing focuses on the very recent period, post 1990 and mostly the 21st century, where better data has been available (see Gopinath and Itskhoki in this volume for an excellent survey of the literature.) We briefly digress here to discuss the earlier post-war period. Our main point is that what is new in the 21st century is not wide prevalence of dollar invoicing, but sweeping relaxation of exchange rate controls, first in Europe and Japan and later in emerging markets, including China and India. (See the extensive discussion and documentation in Reinhart and Rogoff,

2004, and the significantly extended and updated database linked to Ilzetzki, Reinhart and Rogoff, 2019, including the multi-year update done in conjunction with the present paper).

For example, after World War II and well into the 1950s, many countries in Europe had a menu of exchange rates that might differ according to the type of good or transactions. Effectively, these constituted a differential tax on different kinds of imports and exports. Naturally, this gave rise to extensive efforts to evade the controls, resulting in capital flight often exceeding 10% of the value of trade. With the major currencies fixed against the dollar under the Bretton Woods system, effectively all goods were priced in dollars, but the pass-through to consumers and businesses depended on the implicit taxes and the degree of evasion. Whereas Europe gradually removed its controls during the 1950s and 1960s, multiple exchange rate practices continued in emerging markets for several more decades, with China only removing its dual exchange rate system in 1994.

Dominant currency pricing—particularly in dollars—remained common in emerging markets long after the advent of floating exchange rates. With domestic inflation still high and official exchange rates often subject to devaluation, there were very strong incentives for trade to be denominated in hard currencies.

Developments in Europe were quite different than elsewhere where pricing shifted away from dollars, especially in intra-European trade, and coalesced around the German Deutsche Mark. Of course, the former Soviet bloc priced trade in roubles within the bloc, but even here trade outside the block was effectively in dollars (albeit at a very unrealistic rouble/dollar exchange rate.)

In this sense, the expansion of dollar invoicing (and dominant currency pricing in general) cannot be separated from exchange rate unification, which has been the truly dramatic change in the system. Relatively recent efforts to understand the issue of whether dominant currency invoice pricing translates in consumer prices and goods demanded is discussed in Gopinath and Itskoki (2021, in this volume).

Dollar dominance is similarly large and persistent in the pricing of financial assets. Maggiori, Neiman, and Schreger (2020) assemble a dataset of corporate bond holdings in mutual funds and classify them by the currency in which they are denominated. Figure 4 uses their data to show the share of corporate bonds denominated in dollars and in euros and held internationally over the past decade and a half. The shares of dollar-denominated and euro-denominated corporate bonds is strikingly similar to the share of countries anchored to the dollar and the euro, respectively, shown in Figure 2. Roughly 50% of bonds are

denominated in dollars and 30% in euros.[7] Most of the remainder is bonds issued in the local currency of the issuer. Much of the high frequency movement in the shares of these currencies—and thus part of the seeming trend towards dollar bonds—is due to valuation effects, with the euro depreciating during the Eurozone crisis.

Dollar dominance in the currency composition of corporate bonds in part reflects the fact that US corporations are dominant in the corporate bond market. Ilzetzki, Reinhart, and Rogoff (2020a) document that US corporate bond issuance dwarfs that of Eurozone corporations: the stock of US corporate bonds outstanding is five times of that issued by Eurozone firms. This stems from a historical reliance of bank finance, with 80 percent of Eurozone corporate debt held as unmarketable assets on bank balance sheets, compared to less than 30 percent in the US.

The dollar also dominates in safe (government-issued) assets. Figure 5 shows the stock of sovereign bonds outstanding by country at the end of 2020. The US accounts for roughly half of the outstanding stock of high-income country debt. Japan is a distant second and most Japanese sovereign bonds are held domestically. The Eurozone is an outlier in the small volume of safe assets it generates. Euro area GDP is three times that of Japan and roughly two thirds of US GDP. Yet Eurozone sovereigns have less than half the outstanding debt of Japan and roughly a quarter that of the US. This is in part because the figure excludes debt issued by countries in southern Europe, most notably Italy, though including these would not change the basic point. In any event, a discussion of truly "safe assets" appropriately omits countries who faced wide sovereign spreads during the Eurozone crisis. When it comes to safe (sovereign) assets, the dollar is once again the main show in town.

The various dimensions of anchor currency choice documented here are mutually reinforcing. The central bank's choice of a dollar anchor introduces stability in the relative value of contracts and prices denominated in dollars and local currency, reducing the risk entailed in pricing goods and bonds in dollar terms.[8] Conversely, Rey and Miranda-Agripino (2020) and Hassan, Mertens and Zhang (2020) argue that the importance of the dollar in the global financial cycle and as a global safe asset makes anchoring to the dollar more attractive. As Rey (2013) puts it, the traditional trilemma is really a dilemma, whereby any country open to capital flows will be hugely affected by US Federal Reserve monetary policy, regardless

[7] The ten countries/areas in this study are Australia, Canada, Denmark, the Eurozone, Norway, New Zealand, Switzerland, Sweden, the UK, and the US. Half of the countries in the sample have close ties and are anchored to the euro. Only one country, Canada, was anchored to the dollar during the period of interest and even it has move to a freely floating currency. If anything, the figure overstates the share of countries issuing euro-denominated bonds and understates the dollar share.

[8] Partial or full indexation to the dollar in the pricing of domestic goods and services is another dimension and one that has typically shown to be difficult to reverse (Reinhart, Rogoff, and Savastano, 2003).

of its exchange rate regime. As cited previously, Gopinath and Stein (2020) show that currency choice in trade invoicing and the denomination of financial assets are mutually reinforcing.

The implications of dollar dominance are far reaching. Rey and Miranda-Agripino (2020) argue that the global financial cycle can be attributed to a single factor that is likely associated with US monetary policy. (See also their chapter in this volume.) Anchor currency status may confer on the US an exorbitant privilege, allowing the US government and possibly the private sector to issue assets at lower rates (cf. Eichengreen 2011). It may also mean that the US is more insulated from exchange rate fluctuations than are other countries, as demonstrated by Gopinath et al. (2020). Maggiori, Neiman and Schreger (2020) suggest that in fact, dollar dominance allows small and medium corporates to borrow from abroad in way no other country can match, and that this funding vehicle in fact might be considered the most important feature of US "exorbitant privilege."

As already noted in our discussion of international cooperation, there are also important geopolitical benefits to dominant currency status. One is that a disproportionate share of global transactions is intermediated, or cleared, one way or another through the United States. (A central reason for this is that any large dollar clearing entity outside the United States is potentially vulnerable to runs if its regulator does not have the capacity to print dollars.) In a world where power and information flows are intimately intertwined, the ability of the United States to have such extensive access to data is a concern not just to US adversaries, but to allies as well, with Europe making efforts to build its own dollar clearing system. Relatedly, US control over dollar clearing has also been used by US administrations to enforce other countries to comply with US-imposed financial sanctions, for example on Iran.

In his then-somewhat-radical book, Ronald McKinnon (2013) characterized the emerging global exchange rate regime as "The unloved dollar standard." An important theoretical and practical challenge to economists going forward is finding approaches to developing a better loved system that is still stable.

## V. Exchange Rate Practices in Extended Bretton Woods II

The previous section shows that the dollar is the currency of choice for the denomination of trade and assets. We have also seen that the dollar is the anchor currency of choice. Exchange rate classifications, described in Section III, give a picture of how closely countries orbit around their anchor currency of choice. Figure 6 depicts the share of countries with each category of exchange rate arrangement from 1940 to 2019. The taxonomy is based on Ilzetzki, Reinhart, and Rogoff's (2019) coarse classification, so that each broad category includes a range of exchange rate practices. Other classifications would certainly

give a similar evolution over time. The top panel of the figure shows the share of countries in each category and the bottom panel shows the share of countries weighted by each country's share of world GDP.

The three main periods of the post-war international monetary system can be seen in the figure. These are the Bretton Woods system of fixed exchange rates from 1945 to the early 1970s; the non-system era from the mid-1970s to the mid-1990s; and the Extended Bretton Woods II system from the turn of the 21st century to the time of writing. Bretton Woods was a system de jure pegs to the US dollar, so that it is hardly surprising that most countries had exchange rate pegs during this period. If anything, the share is surprisingly low when weighing countries by their share of world GDP. This is because several large European countries (including France, Germany, and the UK) had active parallel exchange markets and de facto managed floating arrangements, as pointed out by Reinhart and Rogoff (2004).

The "non-system" period shows more diversity in exchange rate practices, with de facto crawling pegs, exchange rate bands, and managed floating becoming more common. Freely floating becomes the most common arrangement as a share of world GDP, but this is mostly attributable to the largest economies: The G3 countries (the US, Japan, and Germany) alone comprised more a third of world GDP at the time. Hard pegs were most common monetary regime among developing countries, so that although 40% of countries had exchange rate pegs, they comprised less than 10% of world GDP. A category of exchange rate arrangements that is omitted from the figure became increasingly important during this period. These are freely falling currencies with high rates of inflation, currency crashes, and loss of monetary control. These cases account for the widening missing share of countries (the white area completing the chart to 100%) in the 1980s and 1990s.

With lower rates of inflation at the turn of the 21st century, new developments in monetary economics, and theories promoting benign neglect of the exchange rate, it might have been expected that exchange rate management was a thing of the past, at least for those countries with low exchange rate pass-through. Instead, Figure 6 shows that tight exchange rate management remains the most common practice today, with roughly two thirds of countries representing 40% of world GDP either in a fixed exchange rate or a narrow band regime. A portion of this phenomenon is due to the introduction of the euro, and China certainly plays an outsized role in the GDP-weighted share of countries with fixed exchange rates. Only 3% of countries allow their currency to float freely. The GDP-weighted panel shows that these are some of the largest economies, reflecting 30% of world GDP, a figure that would be even larger if one considers that the euro itself is a freely floating currency (the figure is for countries, not currencies and

Eurozone countries are classified as having no legal tender).[9] We will see in the following section that volatility among these major advanced-economy currencies has been extremely muted in the past decades, so in this respect, Figure 6 may overstate the degree of exchange rate flexibility in the system today.

As noted in the introduction, a common presumption entering the 21st century was that countries would opt for one of two polar extremes: either a freely floating currency or a hard peg such as a currency union or currency board. The figure shows no such trend. 40% of countries, representing 50% of GDP fall into intermediate categories where most countries have no pre-announced exchange rate target, but where exchange rate management remains central to the monetary regime. The popularity of, and the apparent macroeconomic stability in many countries opting for, intermediate regimes is an open question for future research. It is possible that constructive ambiguity with regards to exchange rate targets helps fend off speculative attacks. It is also possible that political-economy considerations, for example fear of being branded as a "currency manipulator" by the US Treasury, plays a role in this decision.

Some central banks have taken dramatic actions to defend their exchange rate from depreciating (The most notable recent case was the central bank of Turkey in 2020.) Exchange rate interventions in the 21st century are more commonly employed for the opposite purpose, a phenomenon Levy-Yeyati, Sturzenegger, and Gluzmann (2013) refer to as "fear of appreciation" (building on Calvo and Reinhart's 2002 "fear of floating"). Levy-Yeyati et al. describe this phenomenon as a neo-mercantilist attempt to keep the exchange rate "competitive." They document that countries following this practice have indeed grown at faster rates, although mainly due to capital accumulation rather than expenditure switching. (As noted earlier, Bergin and Corsetti's (2020) model suggests such an approach might be rationalized as a way to disproportionately raise growth in sectors where firms produce differentiated goods, thereby influencing both exports and domestic production.)

One-sided interventions to avoid appreciation naturally lead to central bank reserve accumulation and indeed the massive stockpiles of reserves is one of the most notable features of the 21st century international monetary system. Emerging markets engaging in these practices are now large enough to have a systemic effect as the numbers in Figure 7 indicate. The dark line in this figure shows (on the right-hand side scale) the total stock of central bank reserves. This has increased six-fold in the past two decades from less than $2 trillion at the turn of the century to close to $12 trillion today. The figure also shows in the shaded areas (and left-hand side scale) the currency composition of central bank reserves.

[9] The IMF inexplicably classifies all Eurozone countries as having a flexible exchange rate.

This is yet another indicator showing dollar dominance with shares very similar to those shown in Figures 2 and 4. Roughly 60% of central bank foreign exchange reserves are held in dollar assets and 20% are held in euros. (The high frequency fluctuations mainly reflect valuation effects due to changes in the dollar-euro exchange rate.) The figure also shows the new reserve currency entrant: the Chinese renminbi, shown in the red sliver at the top of Figure 7. The renminbi comprised merely 2% percent of central bank reserves in 2020, but this share has risen rapidly from essentially zero in 2015 to 1% in 2016 and 2% by 2020. The share is large considering that the renminbi still provides little portfolio diversification for central banks holding dollars and euros in their coffers.

***Inflation Targeting***

The trends documented here may seem at odds with the proliferation of inflation targeting regimes not only in high income countries but also in the developing world. In fact, inflation targeting regimes are far from homogenous and reflect very diverse monetary practices, as shown in Ilzetzki, Reinhart and Rogoff (2017). Furthermore, Eichengreen and Taylor (2004) show that inflation targeting regimes generally lead to greater exchange rate stability, rather than increased volatility. This is consistent with our discussion in the following section, where exchange rate stability is found even among core anchor currencies.

Table 2 lists the countries that have adopted this policy framework de jure, the data of adoption, and the de facto exchange rate regime classification according to IRR19. Nearly 30 countries have adopted inflation targeting since New Zealand adopted an inflation target in 1989. But the table shows that that there is considerable variation in exchange rate practices among countries who have officially adopted an inflation target. This ranges from freely floating currencies such as Australia, Canada, and the UK to Romania's de facto peg to the euro, and Guatemala's de facto crawling peg against the dollar. Nearly half of the countries with formal inflation targets have exchange arrangements with limited flexibility (coarse category 2 in IRR2019).

Formalizing this distinction, Table 3 shows the regression results from Ilzetzki, Reinhart and Rogoff's (2017) estimate of exchange-rate augmented Taylor rules for inflation targeting countries. This is done through an admittedly simple OLS estimator, but nevertheless sheds some light on differential attention paid to exchange rates among inflation targeters. The coefficients are from the regression:

$$i_{n,t} = \alpha_n + \beta\pi_{n,t-1} + \beta^F\pi_{n,t-1}Fixed_{n,t} + \gamma s_{n,t-1} + \gamma^F s_{n,t-1}Fixed_{n,t} + \delta E_t u_{n,t-1} + \varepsilon_{t,n}, \quad (1)$$

where $i_{n,t}$ is the policy interest rate in country n in month t, $\pi_{n,t}$ is the inflation rate, $s_{n,t}$ is the logarithm of the spot exchange rate vis a vis the country's anchor currency, $u_{n,t}$ is the unemployment rate—used here as a proxy for the output gap—and $Fixed_{n,t}$ is a dummy variable taking on the value of one if the country is classified as having a peg, crawling peg, or narrow band according to IRR19 (coarse classifications 1 and 2). The specification includes country fixed effects so that the Taylor rule is estimated using within country variation. The specification is as in Taylor (1993) but allowing for the possibility that monetary policy responds to the exchange rate in addition to inflation and the output gap. The specification excludes the lagged interest rate, but results are very similar when allowing for interest rate persistence. For simplicity, the specification has a common reaction to unemployment across exchange rate regimes, but results are nearly identical when unemployment is interacted with the exchange rate regime.

$\beta$ and $\gamma$ in (1) give the coefficients on inflation and the exchange rate in the excluded category—countries with a flexible exchange rate. The coefficients reported in Table 3 show that inflation targeting central banks with flexible exchange rates increase the monetary policy interest rate when inflation is high, but also increase interest rates when the exchange rate is stronger. $\beta^F$ and $\gamma^F$ are the coefficients of interest, showing the differential correlation between the policy interest rate and inflation and the exchange rate, respectively, in countries and months identified as having a fixed exchange rate in IRR19. The coefficients show a smaller correlation with inflation and a greater correlation with the exchange rate. The coefficients are statistically significant at the 99% confidence level. These results provide suggestive evidence that the "inflation targeting" label is too vague and too broad to characterize most real-world monetary regimes, certainly from an open-economy perspective. De facto exchange rate classifications add crucial information and may give a more accurate description of the monetary regime of many inflation targeters—particularly in the developing world.

## VI. Striking Stability at the Center of the System

The exchange rate stability we documented in the previous section primarily refers to smaller and lower-income countries. Inflation targeting in several key economies does appear to have replaced exchange rate management as a monetary strategy. Australia, Canada, South Africa, and the United Kingdom, and—for brief periods—Brazil, Mexico, and Turkey have allowed their exchange rates to float freely. Others, such as South Korea and Israel have continued to intervene actively but have allowed large swings in the international price of their currencies.

Despite these trends towards greater flexibility among some larger economies, the international exchange rate stability documented in the previous section has extended even to the core of the system: the G3 currencies of the US dollar, the euro, and the Japanese yen. This stability at the center has sharpened dramatically in the past decade to the point that by some metrics exchange rate volatility is now as low as it was during the Bretton Woods system of fixed exchange rates. This has been associated with a decline and convergence in inflation rates across the world. This breadth of this stability is even more extensive when one considers that China, now comprising a sixth of the world economy, has had a near peg to the US dollar and more recently a de facto equally weighted euro/dollar basket, as we have discussed.

This stability at the core can be seen in Figure 8, which shows the (four year moving average of) the absolute value of the monthly change in the Japanese yen (top panel) and euro (bottom panel) against the US dollar from 1975 to the end of 2020. This extends the sample of Ilzetzki, Reinhart and Rogoff (2020b) who first documented this finding. Large exchange rate swings are evident from the high exchange rate variability during the non-system era of the 1970-80s. But as we enter the 1990s—and even more strikingly in the following decades—a secular decline in exchange rate variability began to emerge. This decline appears to accelerate around 2014 and Ilzetzki et al. show through formal breakpoint analysis that the trend-decline in exchange rate volatility saw a break in the summer of that year.

Particularly striking is the lack of volatility at the end of the sample during the Covid-19 pandemic. NBER recession dates are shaded in Figure 8 and exchange rate volatility spikes are clearly visible in past US recessions. Covid-19, despite being one of the sharpest recessions on record, saw no commensurate increase in exchange rate volatility. Ilzetzki, Reinhart, and Rogoff (2020b) show that when compared to the price volatility of the stock market, commodities, or other assets, the euro-dollar and dollar-yen exchange rates saw lower variability in recent years than did the Deustchemark-dollar or dollar-yen exchange rate at any point during the Bretton Woods system of fixed exchange rates. Further, the paper documents that since 2014, this stability has extended to other bilateral exchange rates, even those that have seen a trend toward greater exchange rate flexibility in the first decade and a half of the century (e.g. the UK pound and Australian and Canadian dollars). This widespread declining exchange rate volatility must be considered another major feature of the current system.

What has driven this decline in exchange rate variability? Figure 9 shows (in a solid line) the standard deviation across four major economies of changes in the policy interest rates in each month from 1960 to today. These countries represent major economies that have been core of the international monetary system over this timespan (Germany, Japan, the US, and the UK). Larger values indicate greater

differences among central banks in these countries in the magnitude (and sign) of monetary policy changes. Perfect monetary coordination—a perfect correlation of policy interest rates—would lead to a standard zero reading in this chart.

Maintaining fixed exchange rates limits countries' ability to autonomously change interest rates if capital is mobile. The heyday of the Bretton Woods system of fixed exchange rates to the dollar in the 1960s does indeed show moderate differences in interest rate changes across these countries. The differences increase dramatically in the 1970s, with the breakdown of Bretton Woods. As we enter the 1990s, dispersion in interest rate changes becomes more muted. By the 2000s, monetary policy divergence at the core of the international monetary system is at historical lows—below even that of the Bretton Woods system, where policy coordination was part of the rules of the game. Months with zero dispersion in interest rate changes, never seen in the second half of the 20$^{th}$ century, have become frequent in the 21$^{st}$.

Of course, the decline in the variability of interest rate changes is due in large part to the steady decline in the *level* of interest rates in all these countries. This is seen in the dotted line in Figure 9, which gives the average policy interest rate across these four economies. However, open economy macro theories, e.g. the Dornbusch (1976) model and its modern variants (e.g, Obstfeld and Rogoff, 1995, 1996) link relative *changes* in interest rates to exchange rate volatility, regardless of the *level* of interest rates. (It is the basis point change rather than the percent change in interest rates that matters.) Moreover, these theories focus on long-run interest rate differentials rather than merely policy changes on the short end of the yield curve. Indeed, Ilzetzki, Reinhart, and Rogoff (2020b) show a similar decline in dispersion in interest rates on 10-year government bonds across high income countries.

A comparison of Figures 8 and 9 shows that the timing of the decline in exchange rate variability is similar to the time path of lower interest rate volatility. Ilzetzki, Reinhart and Rogoff (2020b) show further that this decline occurs on the backdrop of lower inflation rates and lower inflation variability across countries. While this doesn't necessarily imply a causal relationship between monetary factors and lower exchange rate volatility, it gives a plausible mechanism that might explain this decline. A more benign inflation environment has led to worldwide lower inflation (see Goodhart and Pradhan 2020 for potential underlying factors leading to deflationary pressures) and similar factors may have contributed to lower world real interest rates. This has led to lower nominal interest rates, lower interest rate variation across countries, and less monetary pressures on the exchange rate. The further decline in exchange rate variability in 2014 is also consistent with this mechanism. This was the year when the Eurozone and

Japan not only began to experiment with negative interest rates, but also saw their 10-year bonds hit negative yields.

The inter-war period was characterized with both real and nominal volatility; both real and nominal volatility were subdued in the Bretton Woods period. The divergence occurred in recent years. The decline in exchange rate volatility coincided with enormous volatility in the real and financial sectors, most notably the global financial crisis and the Covid-19 pandemic. In contrast, this has been a period of low interest rate variability and nearly comatose interest rate policy in the past decade. Ilzetzki et al. refer to the likely dominance of monetary factors in determining exchange rate volatility as the "revenge of Dornbusch". This refers to theories following Dornbusch (1976) that emphasize the role of monetary policy in exchange rate determination.

Although there is a strong case to be made that the paralysis of monetary policy at the zero bound is the leading candidate for the collapse of exchange rate volatility, it is also possible that institutional changes have helped reduce the financial frictions highlighted in the recent exchange rate literature, for example Gabaix and Maggiori (2015), Itzhoki and Mukhin (2020), and Maggiori (2021 in this volume). In particular, the swap lines extended by the Federal Reserve to central banks worldwide (and to a lesser extent similar facilities offered by the ECB and the Reserve Bank of China) have taken on unprecedented scope and scale during the two recent global crises, in 2008 and again 2020. Figure 10 shows the outstanding volume of Fed liquidity swap lines over the past two decades. These facilities were introduced in December 2007, when central banks began actively responding to the first fissures in the banking system that led to the global financial crisis. Swaps increased again following the failure of Bear Stearns in March of 2008. After the collapse Lehman Brothers in September, central bank swap line holdings skyrocketed to $600 billion. Support in smaller amounts was provided during the Eurozone crisis. Swap lines were again extended in massive volumes during the financial market collapses as Covid-19 spread around the globe in March 2020.

These facilities were primarily viewed as temporary injections to avoid US dollar liquidity shortages around the world during tight financial market conditions. The importance of dollar liquidity should be apparent from the discussion of the dollar's outsized role in international trade and finance, discussed in Section IV.

Swap lines do not go as far as earlier advocates of monetary policy coordination envisioned—or those undertaken in the Plaza and Louvre accords of the 1980s—like explicit devaluations to restore external balance. Their ambitions were more modest temporary liquidity injections to avoid financial market disruptions. Nevertheless, Bahaj and Reis (2018) show that swap lines during the global financial crisis

did limit deviations from covered interest parity and thus will have influenced exchange rates. Further, the expectation among market participants that swap lines will be extended may have further muted exchange rate volatility.

## VII. Capital Flows and Capital Controls

Another trend in the international monetary system has been countries' increased openness, both de jure and de facto, to capital flows. The volume of flows can be seen in Figure 11, using the gross capital flow data assembled by Broner et al. (2013) and Reinhart, Reinhart and Trebesch (2016). The Broner et al. series are slightly more comprehensive in coverage, including 103 countries, using IMF balance of payments data. The Reinhart et al. series give a longer time series for a smaller sample of 68 countries. The former is reported as a percent of world GDP and the later as a percent of US GDP.

Post-war capital flows were very muted at below 5% of US GDP. These increased in the 1970s, consistently around 10% of world GDP up to the 1990s. Starting in the mid-1990s, however, capital flow volumes intensify, peaking first at 25% of GDP in 2000 and then again at 45% of GDP in 2007. These surges dwarf other capital flow episodes in the post-World War II era. Reinhart et al.'s longer historical sample suggest that the capital flow surges of recent decades may not have reached the magnitudes (relative to GDP) of the previous golden era of free capital movement in the late 19$^{th}$ and early 20$^{th}$ century, or even those seen in the inter-war period, prior to the Great Depression.

The collapse in cross-border financial flows during the global financial crisis is evident at the end of the period. Indeed, a major message of the Broner et al. (2013) and Reinhart, Reinhart, and Trebesch (2016) studies is that the global business cycle is very much associated with the global cycle of capital flows. The samples end in 2009 and 2015, respectively, but simple calculations from IMF balance of payments data indicate that cross-border capital flows have remained subdued since the global financial crisis.[10]

The increases in capital flows in the 1990s and 2000s were facilitated by dramatic declines in restrictions on capital flows across countries. Figure 12 shows how capital controls evolved in this period using two indexes. Chinn and Ito (2006) measure de jure capital mobility based on the number of legal restrictions a government has in place on the flow of capital, according to the IMF's Annual Report on

10Prior to the GFC, large and surging capital flows to periphery Europe financed record double-digit current account deficits, a trend that was abruptly reversed around 2009.

Exchange Arrangements and Exchange Restrictions (AREAER). We convert this index into a measure of capital controls (as opposed to mobility) equal to one minus the capital mobility measure and normalize it to range between 0% and 100%. Figure 12 shows in dashed lines the average capital control index for all countries in the Chinn and Ito sample in the top panel, and for high-income countries in the bottom panel. The index is based on the 2020 update of the Chinn and Ito (2006) series.

The second measure is taken from Ilzetzki, Reinhart and Rogoff (2019), which is more closely related to exchange rate arrangements and their classification. The IRR19 index also draws on the IMF's AREAER and assigns a value of 1 to a country in each year where any one of three criteria is met. First, the country has an official (de jure) dual market for foreign exchange. Second, the country has a de jure system of multiple exchange rates. Third, there is an informal parallel market (whether tolerated or illegal) and the parallel market has a premium of 10 percent or more within a 12-month moving window. The first two of these criteria are de jure, but the third is de facto and based on a price signal that indicates capital controls are in place. (A premium of this magnitude in a parallel market would not be possible otherwise.) The index takes a value of zero in any year when none of these three criteria is met. Figure 12 shows in solid lines the share of countries with capital controls (a value of one in the IRR19 index) in place.

The IRR19 index reflects a lower bound on the actual incidence of capital controls, given the plethora of other controls a government could impose on the flow of capital. Unlike prior studies, it incorporates a de facto, not only de jure, component into its classification. It also has the advantage of a longer time series and its direct relevance to exchange rate management—the topic of this chapter. Other indexes of capital controls, including Chinn and Ito, suffer from the opposite bias of overstating the incidence of capital controls[11] given that he private sector may in many cases be able to circumvent the legal restrictions to capital mobility captured by de jure indexes.[12]

Figure 12 shows a dramatic decline in restrictions on capital flows over time, based on either measure: the two are highly correlated over time. In the case of high-income countries, seen in the bottom panel of

[11] A recent study by Fernandez et al. (2016), which derives from the AREARS similarly relies on de jure measures and suffers from a similar bias.

[12] As we noted in the introduction, the recent literature has increasingly attempted to separate out the use of capital controls for macroprudential purposes (say to prevent excess short-term "hot money" inflows) as opposed to using capital controls as say, an implicit tax on the savings of domestic residents.) Sometimes the distinction is difficult to make. Advanced economy regulators would certainly argue that stricter post-financial crisis regulation, that has effectively forced domestic banks to hold much more local government debt, is intended to reduce the odds of financial crisis, although the regulations have likely also had the effect of reducing the servicing cost of government debt. See Bianchi and Lorenzoni in this volume for a discussion of some of these issues, particularly with respect to developing economies.

the figure, there were two major waves of capital control loosening. First, the IRR19 index shows that nearly all high-income countries had capital account restrictions in place at the end of the Second World War. During the 1950s, the majority of high-income countries unified their foreign exchange rate markets and removed de jure restrictions on foreign exchange. The post-Bretton Woods period from 1970 to 1990 saw another wave of financial integration, with all remaining high income countries removing controls based on the IRR19 index. Chinn and Ito's index tells a similar story where nearly all restrictions on capital flows were removed by the 1990s, according to their index.

Exchange rate convertibility was a major topic in earlier volumes of this handbook (e.g. Black 1985).With the notable exception of China, convertibility is now almost a non-issue in most economies. Alongside the decline in capital controls, there has been a major march towards exchange rate convertibility. Even in China, recent currency swap arrangements, greater openness of domestic bond markets to non-residents, and the importance of Hong Kong as an offshore center have gradually tilted the renminbi towards greater de facto convertibility.

The top panel shows the same chart for all countries. It indicates a third wave of looser capital controls in the 1990s, now spreading to lower income countries. By the end of the decade, merely 12% of countries had capital controls based on the IRR19 index, and the average country had capital controls comparable to that of the average *high-income* country in the 1970s.

There has been a modest resurgence in capital controls at the end of the sample (and a further one during Covid-19, which is beyond these series' coverage that ends in 2019), but capital restrictions remain minimal compared to earlier decades. Relatively free capital mobility has (so far) survived a major financial crisis and a financial panic in 2020 associated with the onset of the Covid-19 pandemic. Further, despite the well-publicized "trade wars" of recent years, there hasn't been a political about-face of similar magnitude on capital mobility. It is important to note that capital controls are often introduced in the context of an acute shortage of foreign exchange, which, in turn, is often connected to a country's loss of capital market access during crises. In developing countries, the debt problems of the 1980s importantly delayed liberalization and often reversed previous policies. It remains to be seen whether debt crises proliferate post COVID-19. At present, at least 28 countries have active parallel markets and multiple exchange rates; all of these are already in debt distress or rated as high risk.

The relative political consensus on capital mobility is particularly interesting given mixed evidence on the gains to financial openness and further evidence on risks of fully mobile capital across borders. Prassad et al. (2003) find little correlation between an open capital account and economic growth. They qualify in Kose et al. (2006) that the gains to financial openness are likely due to collateral benefits, such

as increased domestic financial development. In the shorter term, Reinhart and Reinhart (2008) show that capital flow surges, which they term "bonanzas", are associated with procyclical fiscal policies and exchange rate appreciations (often leading to interventions to avoid them as discussed in Section V) and greater economic vulnerability in developing countries. This vulnerability manifests itself in a greater probability of debt, banking, and currency crises, or all these crises jointly (Reinhart and Rogoff, 2009). These often take the form of sudden stops in capital flows (cf, Calvo, Izquierdo, and Loo-Kung, 2006 and Calvo, Izquierdo, and Talvi 2006). Ghosh, Ostry, and Qureshi (2016, 2018) argue that these crises are less likely when restrictions to capital movement are in place. (See also Reinhart and Rogoff 2009, for a long view on the nexus between global capital mobility and banking crises). Figure 13 is drawn from their historical study, showing a very strong association between capital mobility and banking crises.

## VIII. The Impossible Trinity and the New Triffin Dilemma

The prevalence of exchange rate management documented in Section V and the trend towards greater capital mobility shown in Section VII, confronts policymakers directly with the impossible trinity of open economy macroeconomics. The trinity posits that a country cannot retain monetary sovereignty while managing its exchange rate and remaining open to capital flows. Shambaugh (2004); Obstfeld, Shambaugh and Taylor (2010); Jordà, Schularick and Taylor (2015); and Obstfeld, Ostry and Qureshi (2019) study the impossible trinity (or trilemma) and demonstrate that countries with fixed exchange rate do indeed inherit the monetary policy stance of the anchor-currency central bank. Rey (2013) suggests an even more dominant role for the anchor currency, whereby even countries with flexible exchange rates follow the lead of the Federal Reserve, when open to capital mobility (a dilemma, not a trilemma).

Figure 6 shows that arrangements with limited flexibility still dominate the international landscape and that the period since 1990 has shown an uptick in the share of countries (and world GDP) with less flexible exchange rate arrangements. Figure 12, in turn, shows that this period coincided with a dramatic reduction in capital controls, particularly in developing countries. These facts and the impossible trinity suggest a substantial loss in monetary autonomy. However, countries have been able to circumvent this limitation through sterilized interventions in foreign exchange markets. Bussière et al. (2015), Heathcote and Perri (2016), and Korinek (2017) have shown how sterilized intervention can substitute for capital controls in attempts to stabilize the exchange rate while maintaining monetary independence.

Interventions of this sort require large war-chests of foreign exchange reserves. With the massive increases in cross-border capital flows documented in Figure 11, the stock of reserves required to stabilize

an exchange rate has likely increased substantially. Ito and Yabu (2007) show that looser capital market restrictions do in fact require larger reserves to achieve the same degree of exchange rate stabilization. Further, interventions in recent decades have often been one-sided to avoid appreciation, as discussed in Section V, and this would lead to increasing stocks of international reserves over time. Indeed, Figure 7 shows an unprecedented increase in central bank reserve holdings in the past two decades. Gourinchas and Obstfeld (2012) and Caballero, Farhi and Gourinchas (2017) attribute these reserve holdings to a precautionary savings motive. Dooley, Folkerts-Landau and Garber (2003), Aizenman and Lee (2007), Obstfeld, Shambaugh and Taylor (2010), Aizenman, Chin and Ito (2013, 2016), and Ilzetzki, Reinhart and Rogoff (2019) emphasize the role exchange rate management in driving reserve accumulation.

Figure 14 shows how countries responded to the trilemma depending on their exchange arrangement. The top panel of the figure repeats the exercise of Figure 12 and shows the share of countries with capital controls according to IRR19, but now split into four categories of countries. The lines represent different exchange rate arrangements, based on the coarse classification of IRR19: fixed, crawling peg, managed floating, and freely floating (shown in lines decreasingly dark). The composition of the categories changes as countries shift across exchange rate regimes.

The trend towards capital openness is apparent across all exchange arrangements. We documented earlier that high income countries eventually adhered to the rules of the Bretton Woods game and opened up to capital flows during this period. This explains the relatively small share of countries with capital controls during the Bretton Woods years. That this share is even smaller, less than 10%, today, is explained by the large representation of Eurozone countries in this category and the decline in restrictions on capital flows in developing countries in the 1990s, shown earlier in Figure 12.

In three of the four categories, a negligible share of countries have capital controls today. Nearly all capital restrictions appear in (usually lower income) countries with crawling pegs. Even in these countries, the prevalence of capital controls has declined dramatically from nearly 100% during Bretton Woods to 30% around 2010.The bottom panel in the figure shows the average ratio of central bank reserves to GDP in the same four categories of countries. Except for freely floating currencies, central banks in all other categories, ranging from hard pegs to managed floats, have contributed to the dramatic rise in central bank reserves in the past few decades. This is consistent with our narrative of central banks using reserve management as a substitute for capital controls in the past few decades.

The large reserve stockpiles may appear puzzling in large emerging market economies that have opted for intermediate regimes. However, the experience of the past two decades suggests that countries with intermediate regimes have contributed substantially to the demand for foreign exchange reserves. As of

the end of 2020, China remains the largest reserve accumulator, with more than a quarter of all central bank foreign exchange reserves held by Reserve Bank of China. But Japan, which IRR19 classify as having a freely-floating currency is second.[13] While there some are central banks with hard pegs are among those with large reserve holdings (Hong Kong and Saudi Arabia are 7th and 8th with roughly $500 million each), most countries on the list have intermediate regimes (Switzerland is 3rd with $1 billion, Russia and India are 4th and 5th, with roughly $600 million each).

Whatever its cause, the large accumulation of reserves has contributed to the global demand for safe assets. These assets are primarily denominated in dollars, as Figure 7 shows. Figure 5, in turn, shows the necessary implication that roughly half of the world's safe assets are backed by the fiscal capacity of a single sovereign: the US federal government. But while demand for dollar-denominated safe assets has exploded, the tax base backing these assets has diminished. This is a modern-day version of the Triffin (1960) dilemma, which posited that the first Bretton Woods system was unsustainable, because demand for dollars would outstrip US gold reserves, meant to back the dollar at a constant price. The modern equivalent is discussed in Farhi, Gourinchas and Rey (2011), Obstfeld (2013), Farhi and Maggiori (2018), and Ilzetzki, Reinhart, and Rogoff (2019). Now it is the demand for safe dollar assets that risks eventually overwhelming the US government's fiscal capacity to back them.

The modern dilemma is illustrated in Figure 15, which combines the stock of central bank reserves as a proportion of world GDP and US GDP's share of world GDP (in nominal terms). The trend towards greater central bank reserves comes at a time when the US's share of world economic output is declining. While demand for foreign exchange reserves may flatten out, the latter trend is unlikely to reverse, given the steady rise of China and other emerging market economies. Indeed, with the Japanese government already heavily indebted and the Eurozone still unable to provide an asset backed by the full fiscal capacity of the entire EU, China is the most likely candidate to eventually produce a large stock of safe assets that would add to (or replace) dollar safe assets. These would be backed by the largest economy in the world in purchasing power terms, already comprising 15% world GDP even nominal terms. But this scenario is still far from reality, with Chinese bonds not actively traded internationally, the renminbi not fully convertible, and China currently the largest *buyer* of safe assets. China's controls on capital flows and convertibility are far from complete and de facto barriers have been gradually removed as evidenced

[13] The appendix to Ilzetzki, Reinhart, and Rogoff (2019) documents substantial foreign exchange interventions by the Bank of Japan but classify the yen as freely floating because they are unable to show conclusively that the motivation for these interventions were for exchange rate management rather than liquidity provision.

by the proliferation of dim sum bonds, expansion of the Qualified Foreign Institutional Investor quotas, and increased integration between the Shanghai and Hong Kong stock exchanges.[14]

In the near term, the rapacious demand for dollar-denominated assets is likely to persist and in itself prop up the US government's ability to borrow at ultra-low rates. But referring again to Farhi and Maggiori (2018), this good equilibrium cannot be taken for granted indefinitely. Low interest rates may tempt US policymakers to test the limits of US capacity to issue debt, which could ultimately lead to a loss of confidence like the one that ended the Bretton Woods system half a century ago.

## IX. Conclusions

Although events as dramatic as the collapse of the Bretton Woods fixed exchange rate system in the early 1970s are the exception, the global exchange rate system has experienced considerable evolution over the past half century, as reflected in countries' choice of exchange rate arrangements, the return of dollar dominance, and the marked decline in the volatility of inflation and interest rates that has now extended to exchange rates, particularly since 2014. What Dooley, Folkerts-Landau and Garber (2003) aptly characterized as "Bretton Woods II" (referring to the choice of East Asia to coalesce around dollar exchange rate stabilization) has now morphed into the much broader global exchange rate stability of "Extended Bretton Woods II." Although virtually every central bank has embraced inflation targeting *de jure*, *de facto* is that there is a broad array of considerations, ranging from currency mismatch in borrowing to geopolitical pull, that have made implicitly giving considerable weight to exchange rate stabilization. This is reinforced now by the fact that exchange rates among the G3 currencies themselves (and G4 including China) have become more stable.

Going forward, a major challenge will be to be better understand the costs and benefits of what Ron McKinnon (2013) described as "the unloved dollar standard," and how these might relate to both its stability and desirability. In particular, a richer understanding of models with imperfect financial markets may help to understand why monetary policymakers often seem to disproportionately weight exchange rate stability compared to what one finds in canonical Keynesian models that tend to be much stronger on articulating goods market than financial market imperfections. Unloved as it may be, changes in global anchor currencies are very rare, measured in decades and centuries rather than years. Many transitions

[14] See also Coppola et al. 2020 who show that offshore markets have been used to circumvent capital controls and list Chinese corporations on US stock exchanges.

have been associated with wars, indicating that they occur in concurrence with large geopolitical shocks. Financial innovation is another important determinant of the anchor currency, as indicated in the role of bankers' acceptances in the transition from the British pound to the US dollar. Financial innovation has accelerated in the past decade, spurred by technological advances and the increasing popularity of crypto currencies. Leadership in this arena will be crucial in determining anchor currencies in this century.

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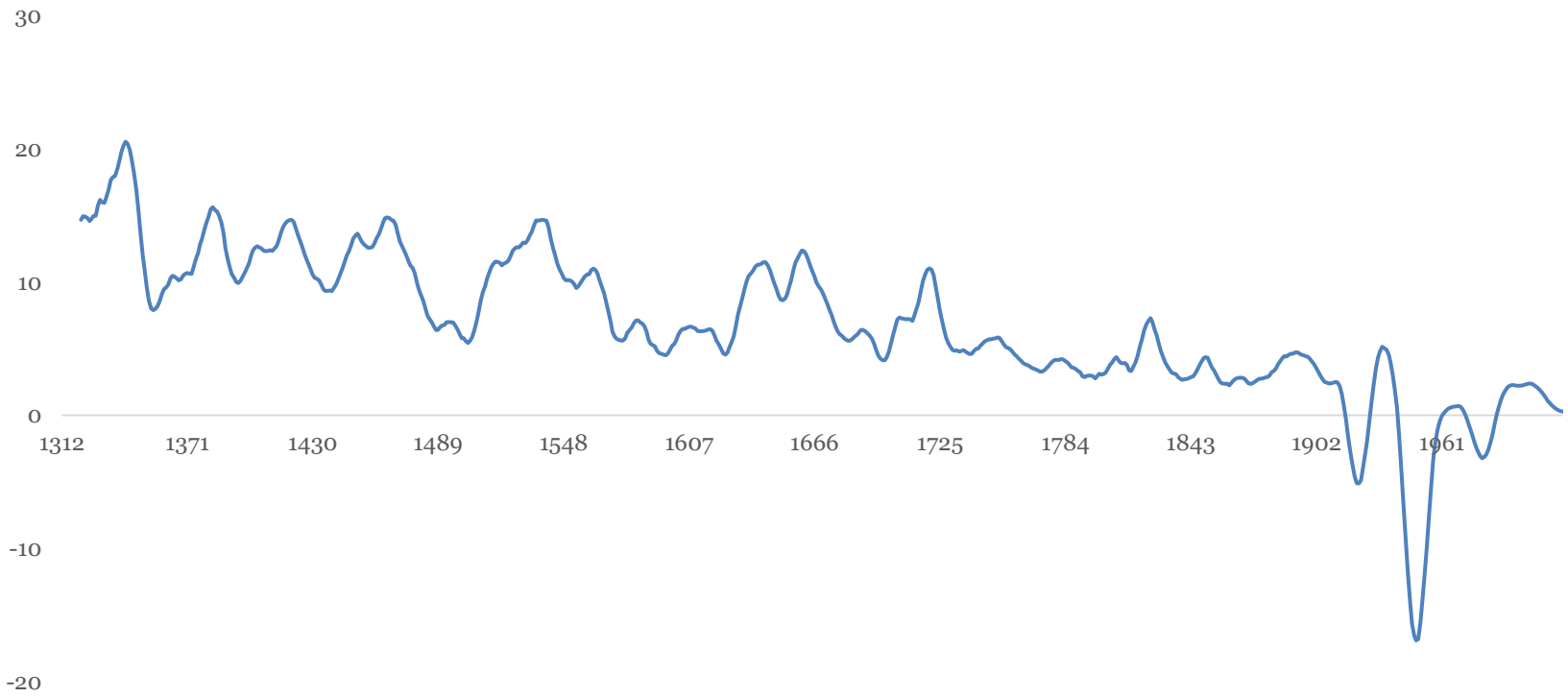
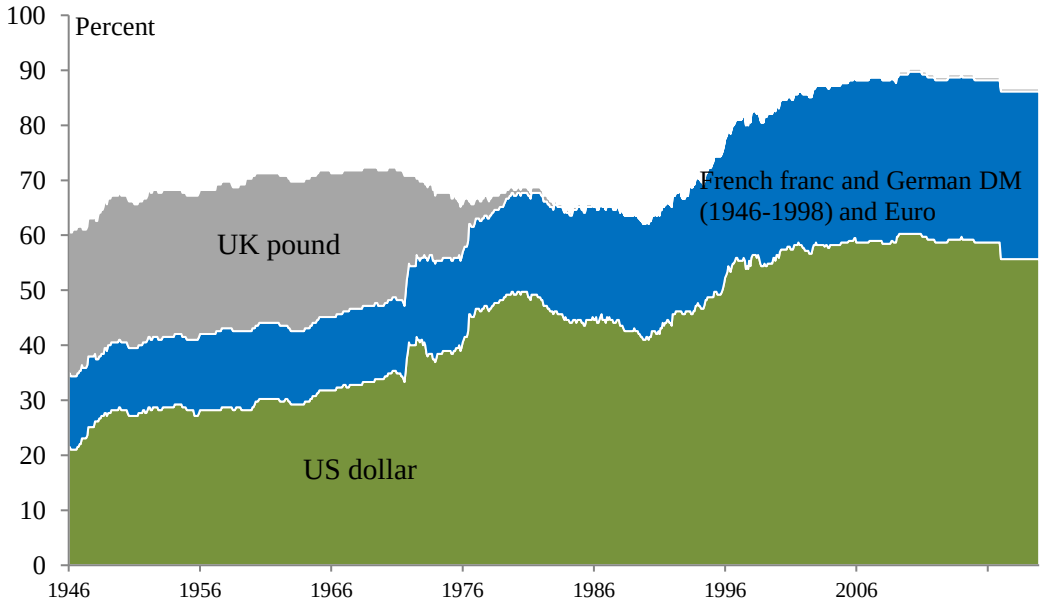
FIGURE 1: THE REAL RATE OF RETURN ON THE GLOBAL SAFE ASSET (1310-2018)



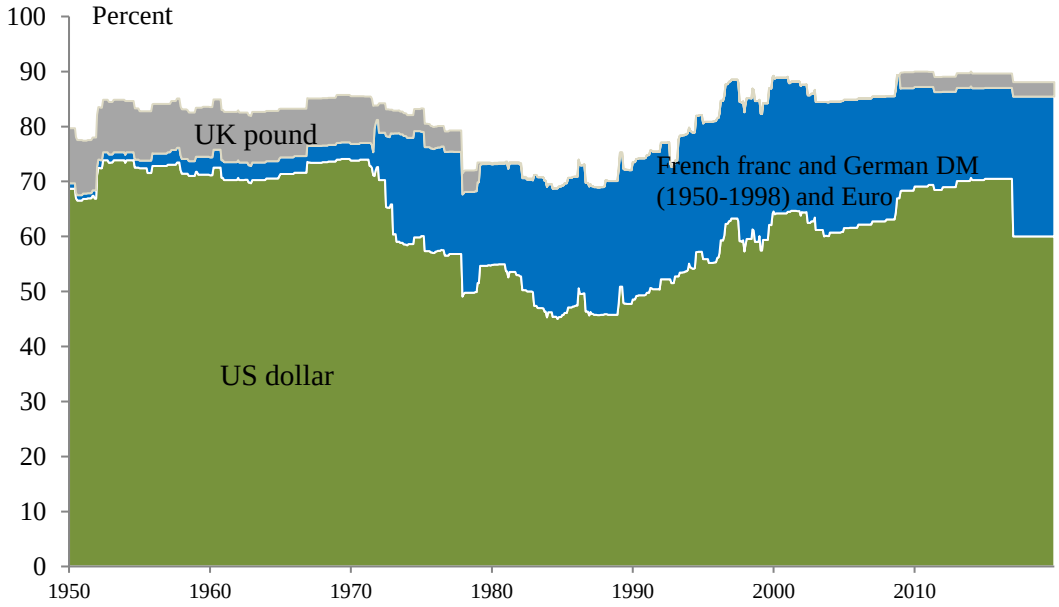

The figure gives the real rate of return on the global safe asset of the time. Table 1 gives a classification of the global safe asset in each period. Source: Schmelzing (2020).

FIGURE 2: ANCHOR CURRENCY CLASSIFICATIONS (IRR, 2019, 2021 UPDATE )

*Panel A: Share of countries 1946-2019*

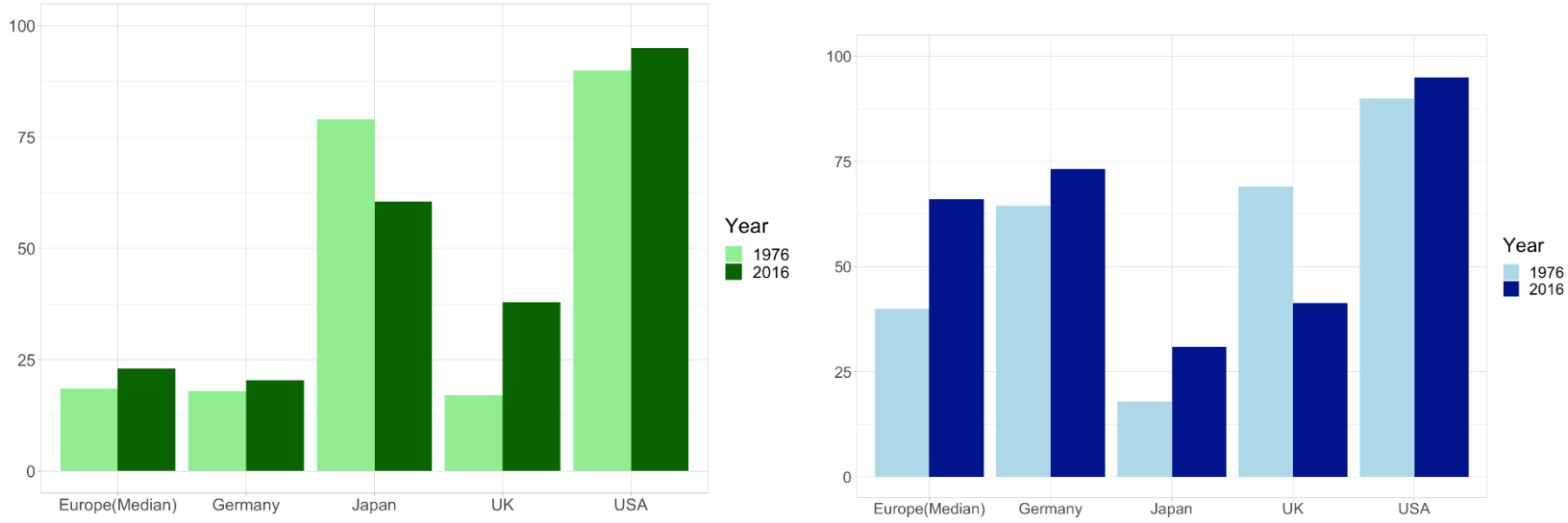



*Panel B: Number of countries weighted by their share of world GDP, 1950-2019*



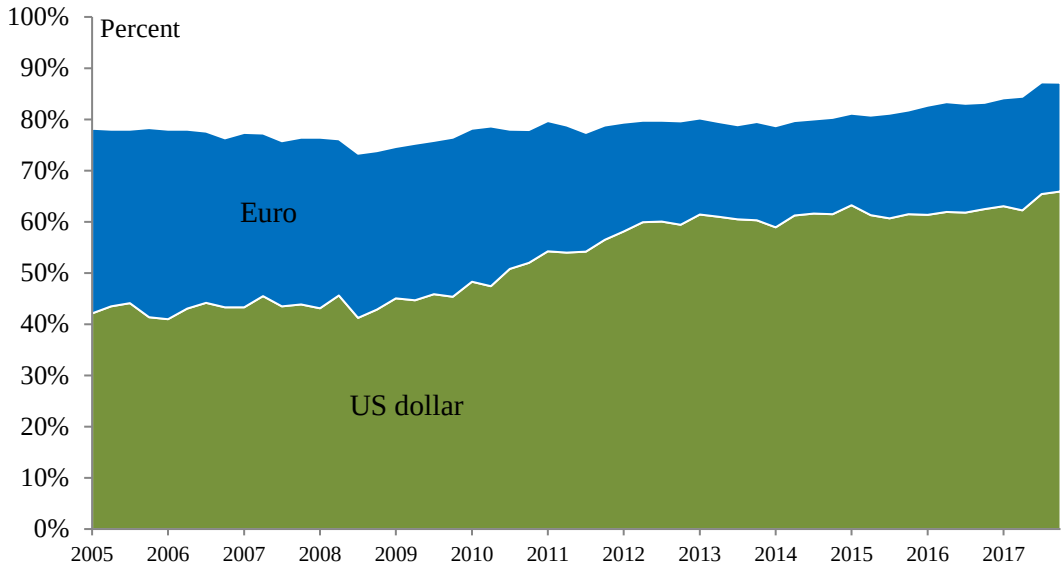

The panels show the share of countries anchored to the US dollar, the euro, and the UK pound. The euro is replaced with the sum of the French franc and German Deutschemark pre-1999. The top panel gives the share of countries. The bottom panel gives the number of countries weighted by each country's share of world GDP. Currency baskets are allocated to anchors proportionally to basket weights. Sources: The Conference Board Total Economy Database, International Monetary Fund International Financial Statistics, Reinhart and Rogoff (2004), Ilzetzki, Reinhart and Rogoff (2019), sources cited therein, and authors' calculations.

FIGURE 3: TRADE INVOICING



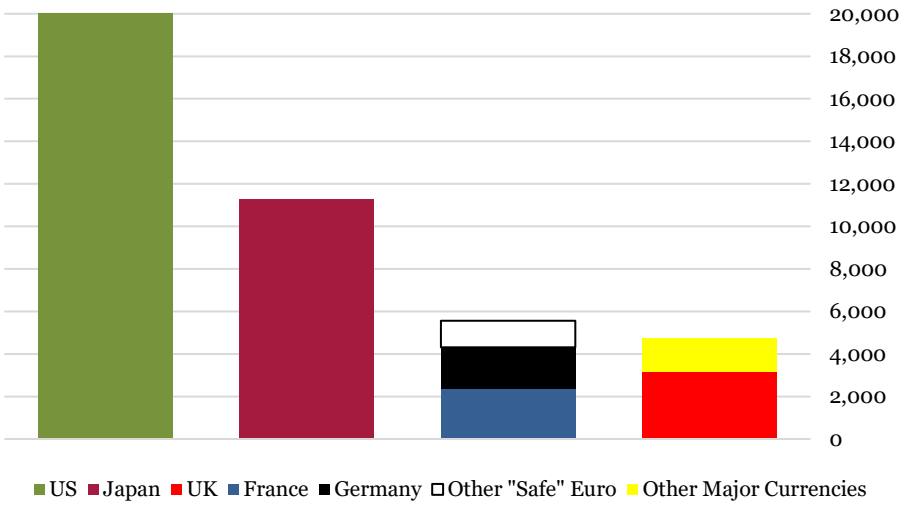

The figure shows the share of trade (imports plus exports) denominated in US dollars (left-hand side) or local currency (right-hand side) for several countries and areas in 1976 and 2016. Sources: Black (1985), Gopinath (2015) and the authors' calculations.

FIGURE 4: CURRENCY DENOMINATION OF CORPORATE BONDS




The figure shows the share of corporate bonds issued in 10 major economies and held internationally denominated in dollars (bottom) and euros (top). Most of the remainder is denominated in local currency. Sources: Maggiori, Neiman and Schreger (2020).

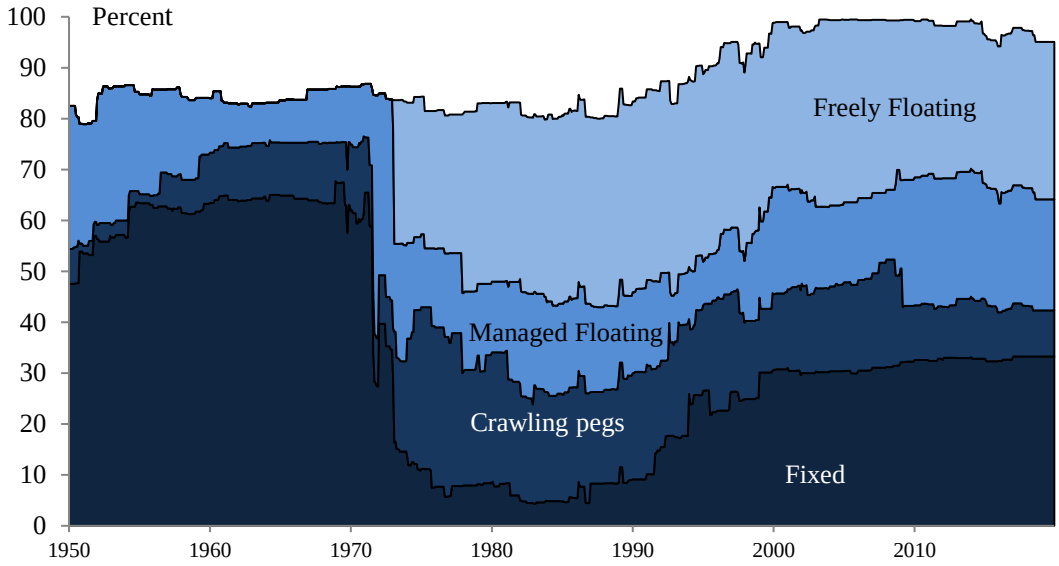
FIGURE 5: SOVEREIGN BONDS OUTSTANDING END-2020 (MILLIONS US DOLLARS)



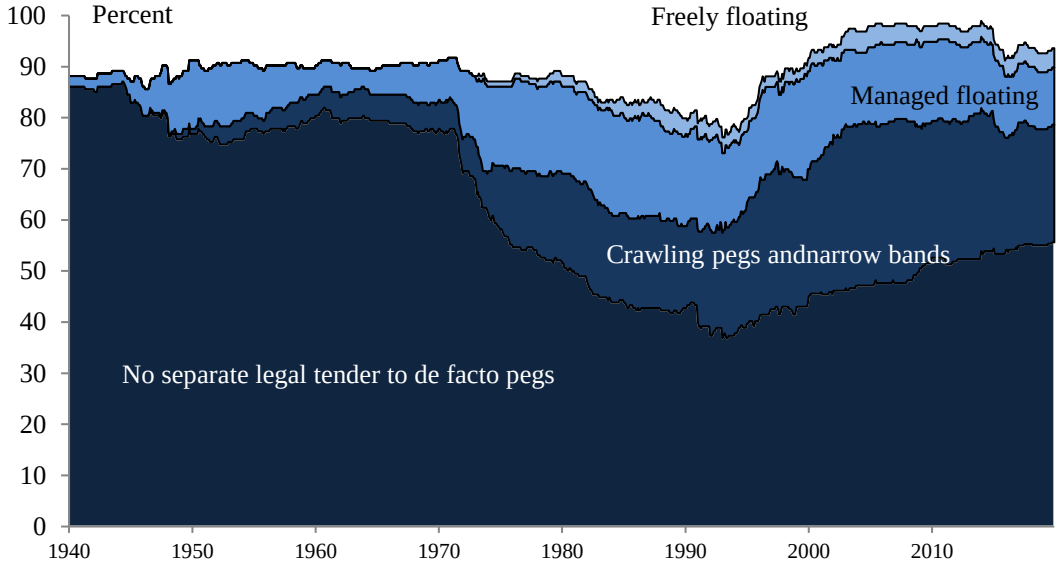

The figure shows stock of government issued bonds outstanding by country in millions of US dollars. The numbers are the most recently available figures as of January 2021. Sources: Bank of International Settlements, national finance ministries, and the authors.

FIGURE 6: EXCHANGE RATE CLASSIFICATIONS (IRR 2019)

Panel A: Share of countries 1940-2015

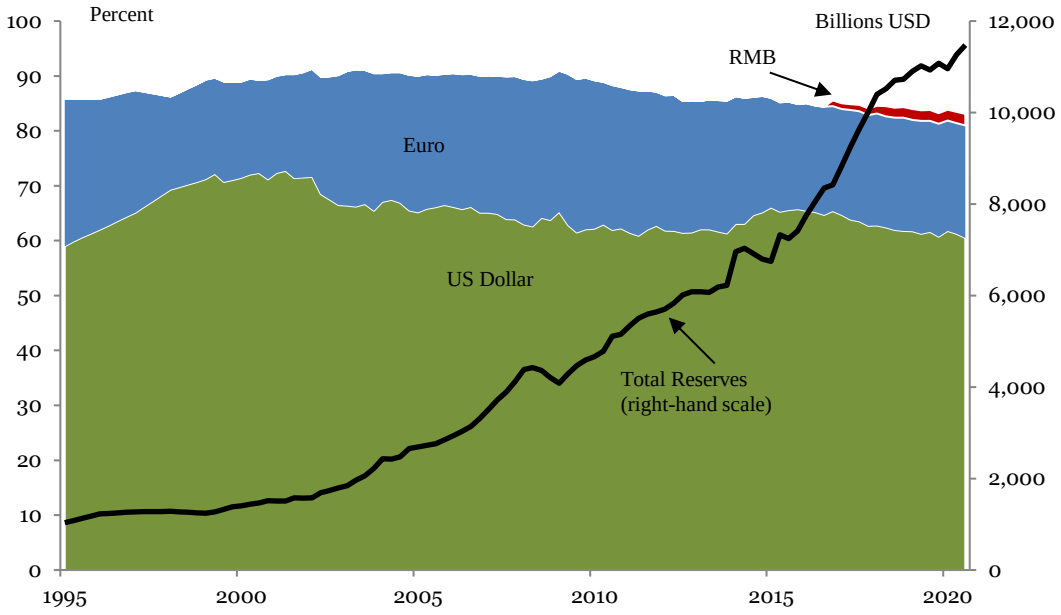



Panel B: Number of countries weighted by their share of world GDP, 1950-2015




The panels show the share of countries in four coarse categories of exchange rate regimes. Finer classifications can be found in Ilzetzki, Reinhart and Rogoff (2019) and its data updates. The "fixed" category combines countries with no legal tender, de facto hard pegs and pre-announced narrow bands of less than or equal to +/-2%. The "crawling peg" category includes de facto and de jure crawling pegs and de facto narrow bands. "Managed floating" includes countries with wider bands of up to +/-5% and countries who have actively intervened to affect the level or volatility of their exchange rate. Freely floating includes countries outside these narrow bands, but who didn't experience currency crashes or high rates of inflation. The excluded categories are freely falling currencies and countries with parallel exchange rates but with no data on the parallel rate. The top panel gives the share of countries. The bottom panel gives the number of countries weighted by each country's share of world GDP. Sources: The Conference Board Total Economy Database, International Monetary Fund International Financial Statistics, Reinhart and Rogoff (2004), Ilzetzki, Reinhart and Rogoff (2019), sources cited therein, and authors' calculations.

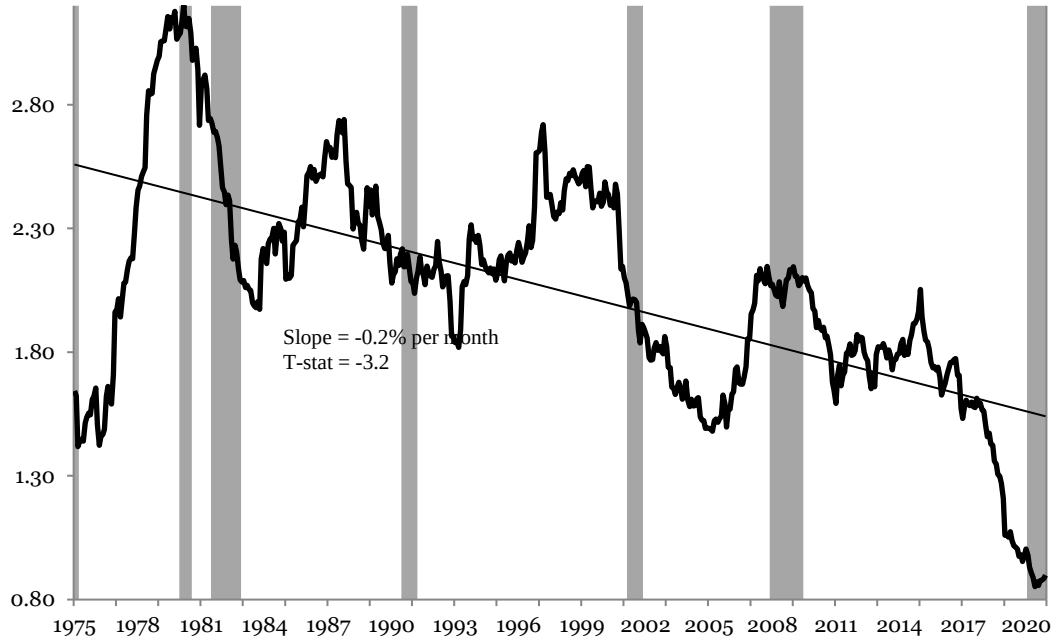
FIGURE 7: CENTRAL BANK FOREIGN CURRENCY RESERVES



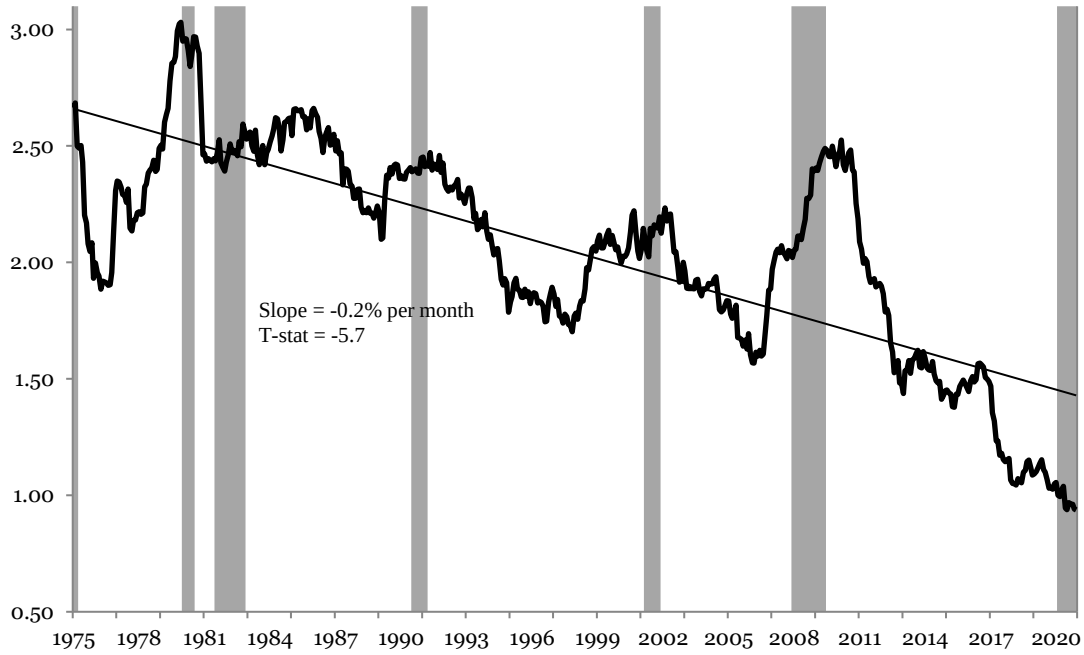

Note: The solid line shows the total stock of world central bank reserves in billions of US dollars (right-hand scale). The shaded areas show the share of central bank reserves by currency denomination in percent of total (left-hand scale). Sources: Ilzetzki, Reinhart and Rogoff (2020a), IMF Cofer and the authors.

FIGURE 8: DECLINING G3 EXCHANGE RATE VOLATILITY

*Panel A: Yen-Dollar*

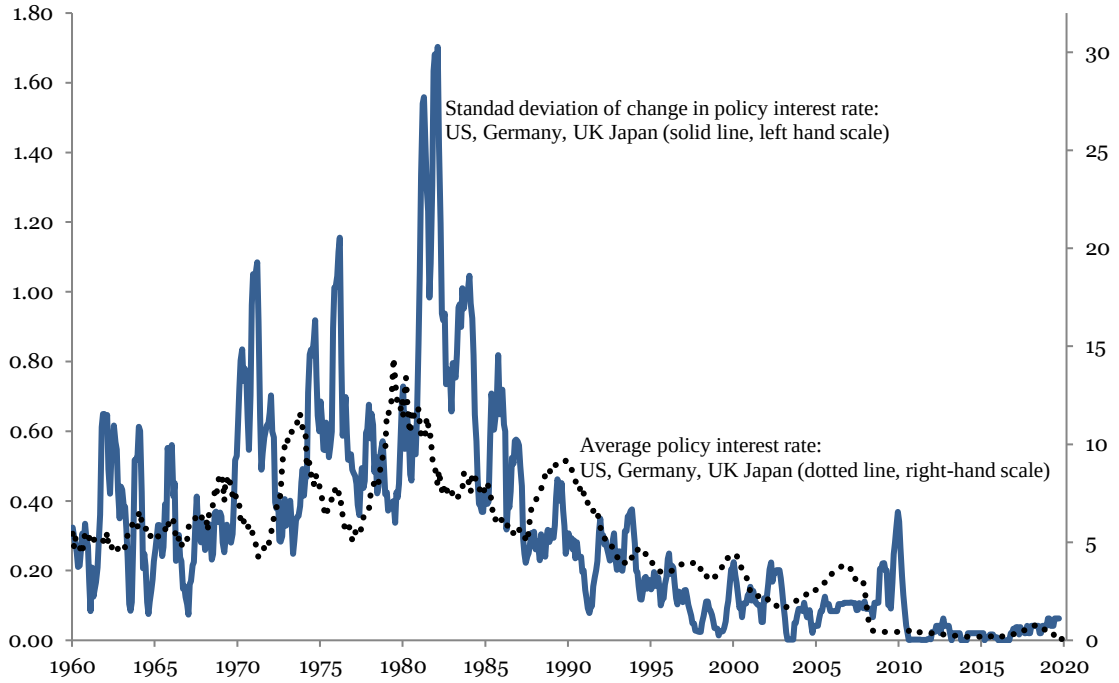



*Panel B: Dollar-Euro/Deustchemark*



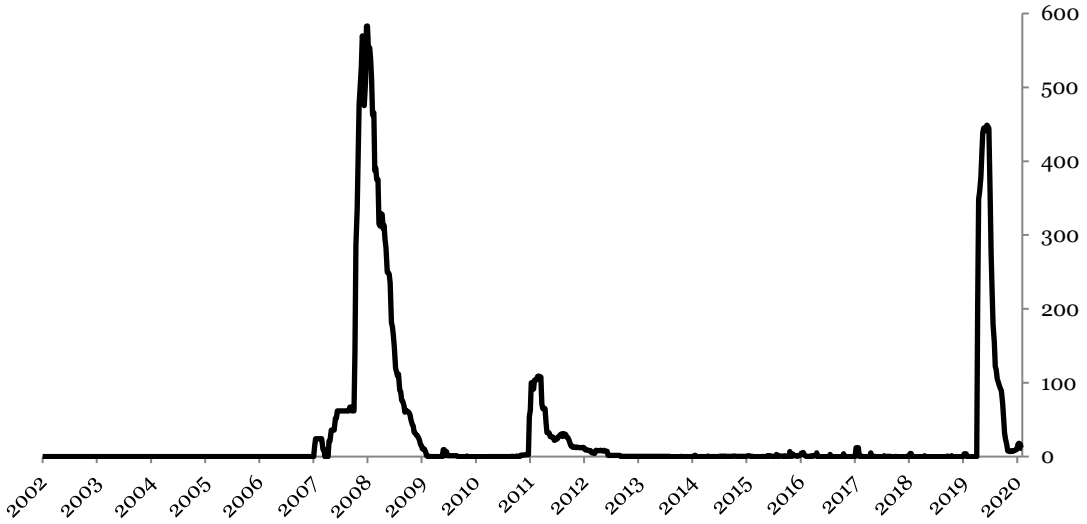

The figure shows the four-year moving average of the absolute value of month on month exchange rate change. Top panel: yen-dollar. Bottom panel: euro-dollar. The euro is replaced with the German Deutschemark before 1999. Shaded areas show US NBER recession dates. Sources: Ilzetzki, Reinhart and Rogoff (2020b), International Finance Statistics, NBER, and the authors.

FIGURE 9: POLICY INTEREST RATE VARIABILITY ACROSS 4 COUNTRIES



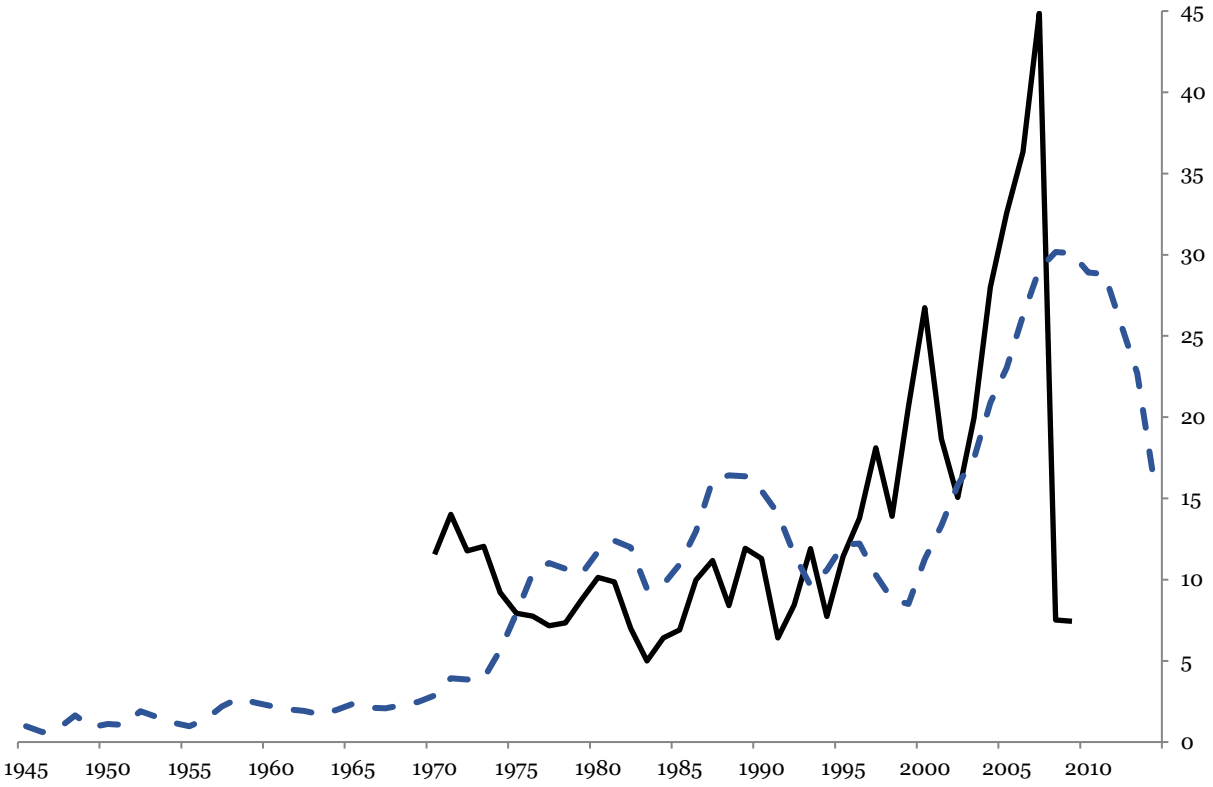

Note: The solid blue line shows the standard deviation in the monetary policy interest rate across four countries in each month. The countries are: Germany, Japan, the US, and the UK (left-hand scale). The dotted line shows the average policy interest rate across these countries in each month (right-hand scale). The decline in interest rates since the 1990s has been associated with lower interest rate variability across countries. Source: Ilzetzki, Reinhart, Rogoff (2020b), IMF International Finance Statistics, national central banks, and the authors.

FIGURE 10: FEDERAL RESERVE INTERNATIONAL SWAP LINES OUTSTANDING (BILLIONS US$)




The figure shows the outstanding volume of Federal Reserve swap lines to other major central banks in billions of dollars. Source: Federal Reserve Board.

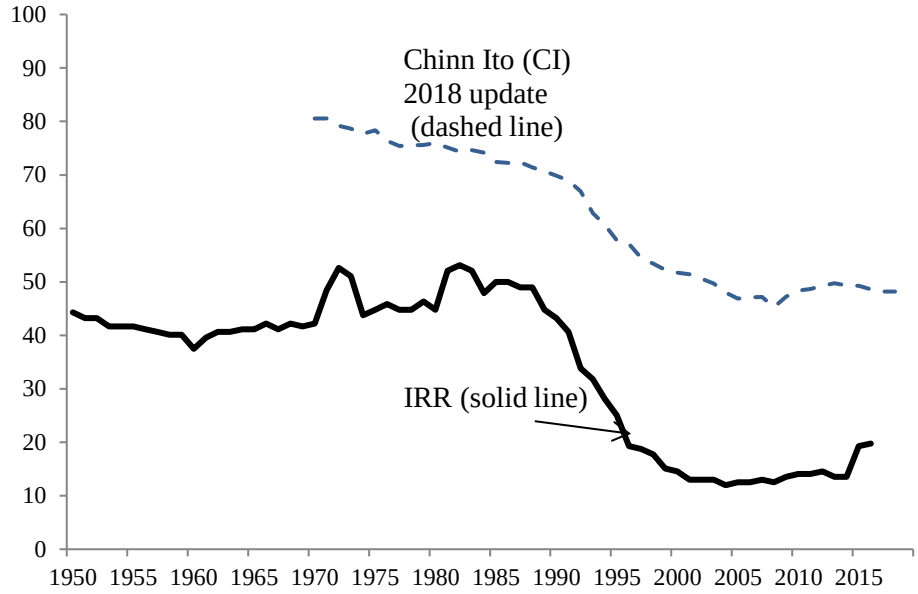
FIGURE 11: WORLD GROSS CAPITAL FLOWS (% OF WORLD GDP)



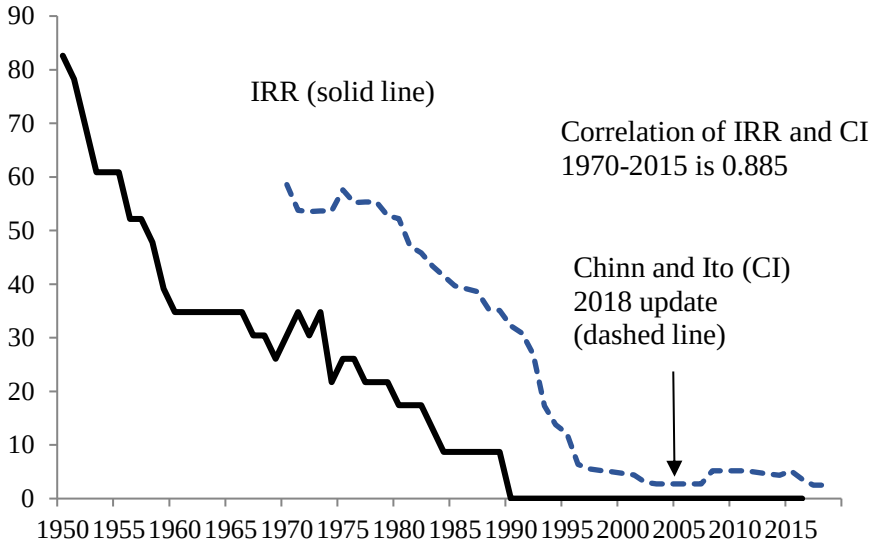

Note: The solid line shows gross international capital flows for 103 countries as a percent of world GDP. Sources: Broner et al. (2013) and the authors. The dashed line shows capital flows into 68 countries as a percent of US GDP. Sources: Reinhart, Reinhart, and Trebesch (2016).

FIGURE 12: CAPITAL CONTROL INDEXES

*Panel A: All Countries*

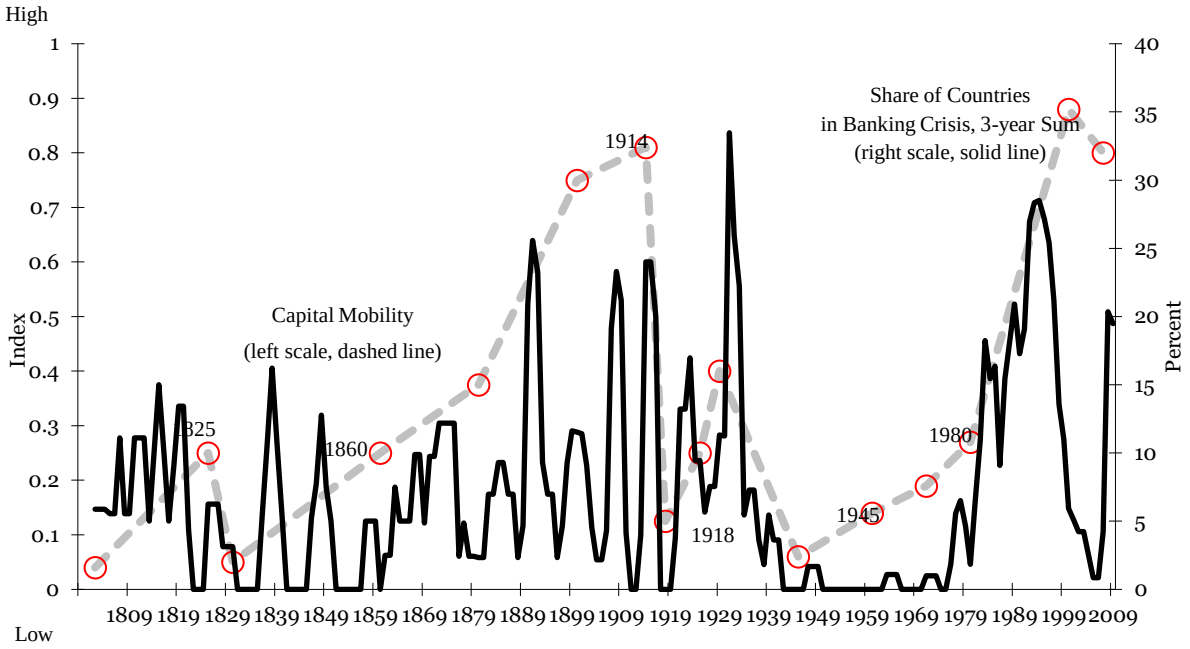



*Panel B: High-Income Countries*




Note: The solid line shows the share of countries with capital controls based on the Ilzetzki, Reinhart and Rogoff (2019) capital controls index. The dashed line shows the average value of the Chinn and Ito (2006, 2020 update) index of capital controls, normalized to be between 0 and 100. The index of capital controls is one minus the Chinn and Ito capital mobility measure. Sources: Chinn and Ito (2006/2020), Ilzetzki, Reinhart and Rogoff (2019), and the authors.

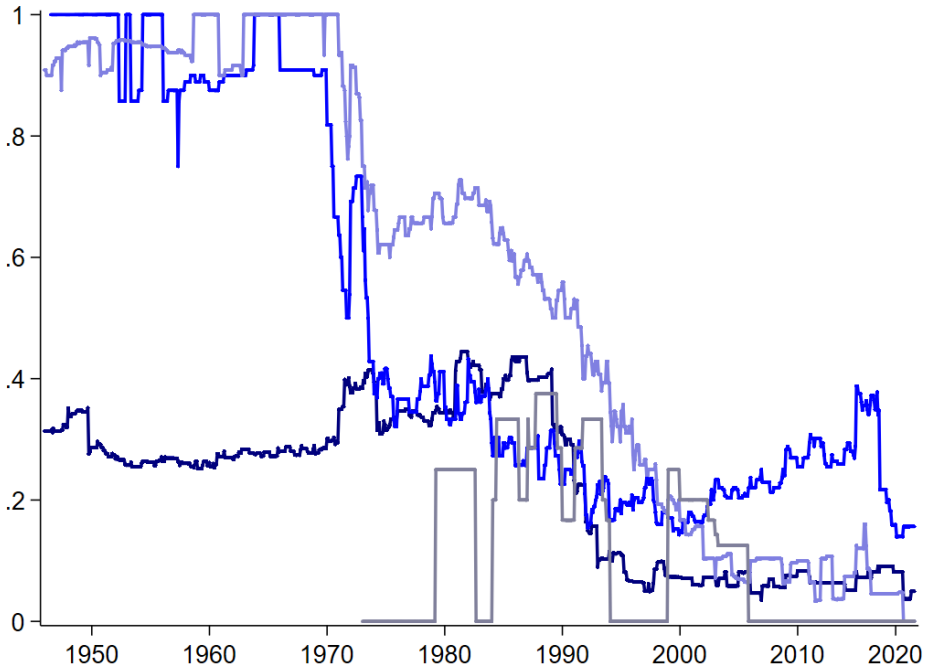
FIGURE 13: CAPITAL MOBILITY AND BANKING CRISES: A TWO CENTURY VIEW



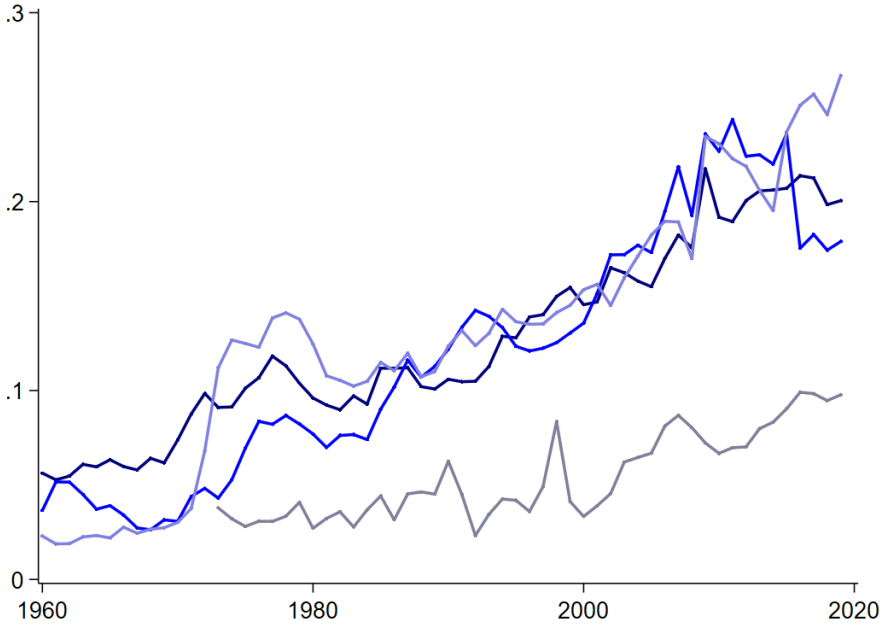

Note: The solid line shows the share of countries with a banking crisis. The dotted line shows an index of capital mobility based on Obstfeld and Taylor (2004), extended by Reinhart and Rogoff (2009). Sources: Kaminsky and Reinhart (1999), Bordo et al. (2001), Caprio et al. (2005), Obstfeld and Taylor (2004), Reinhart and Rogoff (2009) and the authors.

FIGURE 14: CAPITAL CONTROLS AND RESERVES BY EXCHANGE RATE ARRANGEMENT

*Panel A: Share of Countries with IRR (2019) Capital Controls*

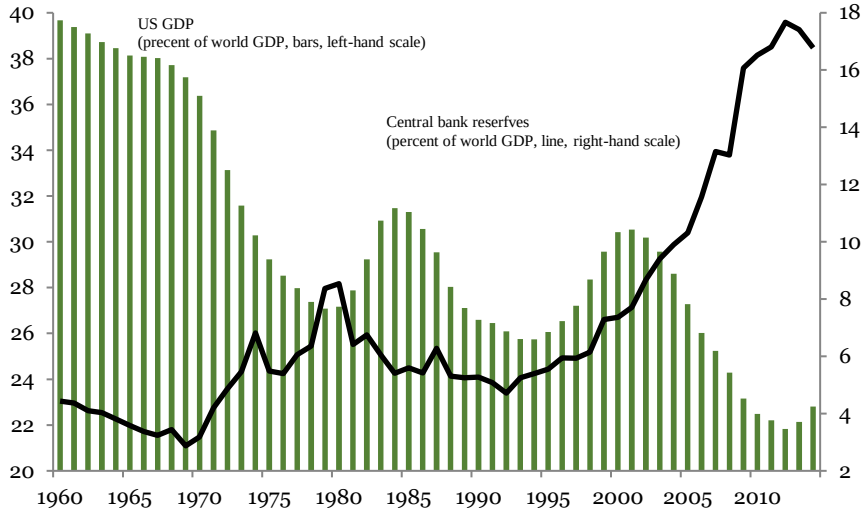



*Panel B: Average Central Bank Reserves to GDP*




Note: The top panel shows the share of countries with capital controls according to Ilzetzki, Reinhart, and Rogoff (2019) in four coarse categories of exchange rate arrangements, according to the authors. The lines represent (from darkest to lightest): fixed, crawling pegs, managed floating, and freely floating. The bottom panel shows the ratio of central bank reserves to GDP in countries in the four categories mentioned above. Sources: Ilzetzki, Reinhart and Rogoff (2019), IMF IFS, and the authors.

FIGURE 15: US GDP AND CENTRAL BANK RESERVES (% OF WORLD GDP)




Note: The solid line shows world central bank foreign exchange reserves as a precent of GDP (right hand scale). The bars show US GDP as a precent of world GDP (left hand scale, 5-year moving average, all values in US dollars). Sources: World Bank, U.S. Bureau of Economic Analysis, and the authors.

TABLE 1: A TIMELINE OF THE GLOBAL SAFE ASSET

| Period | Asset Used | Exchange rate practices and arrangements in major financial centers |
|---|---|---|
| 1311 – 1508 | Venice: *Monte Vecchio* (1311 – 1481)<br>Venice: *Monte Nuovo* (1482 – 1508)<br>Genoa: *Compere*, San Giorgi Bank<br>Florence: *Monte Comune* | A variety of local coins (ducati, florins, Byzantine hyperions) with differing gold and silver content trading at market exchange rates. The gold-silver price is relatively stable throughout this period. |
| 1509 – 1598 | Spain: *Juros* | Spanish dollar, or piece of eight, with fixed silver content, circulates internationally and is the primary anchor of the time. Complemented with the gold escudo in 1537. |
| 1599 – 1702 | Dutch Province of Holland *Renten* | Mainly silver standard.<br>Dutch florin/guilder with fixed silver content circulate as international medium of exchange. Dutch bills of exchange (backed by florins) also circulate as medium of exchange. Spanish dollars still circulate widely internationally. |
| 1717 – 1815 | British consol | Silver standard.<br>As Master of the Mint, Issac Newton fixes the gold guinea in value to the (sliver) pound sterling. Silver standard reigns internationally. As predicted by Gresham's law, silver flight put England itself effectively on a gold standard. |
| 1816 - 1907 | | Pound-gold standard<br>Britain officially adopts the gold standard, with pound fixed in price to gold. Sterling notes circulate and are widely accepted outside of Britain. Latin Monetary Union formed in 1865 by France, Belgium, Italy, and Switzerland, with a bimetal (gold-silver) standard, survives only for a decade. |
| 1908 – 1913 | German Imperial 3% bond | |

| | | |
|---|---|---|
| 1914 – 1918 | British consol | |
| 1919 – 1939 | | Frequent instability with competitive devaluations and hyperinflations. Gold standard the most common *de jure* arrangement. |
| 1943 - 1947 | U.S. long-term bonds (11.5 year maturity, 1943-1947) | |
| 1948 – 1973 | U.S. 10-year bond. | Gold-dollar standard. Bretton Woods. |
| 1973 –2018 | U.S. 10-year bond. | Dollar standard.<br>Great de-anchoring, high and hyperinflations in 1970s-1990s.<br>("The non-system" era.)<br>Euro launched in 1999.<br>Extended Bretton Woods II in 21st century. |

Sources: Schmelzing (2020) and the authors.

TABLE 2: LIST OF COUNTRIES WITH DE JURE INFLATION TARGETS

| Country | Date of Adoption |
|---|---|
| Argentina | Sep – 2016 |
| Armenia | Jan – 2006 |
| Australia | Jun – 1993 |
| Brazil | Jun – 1999 |
| Canada | Feb – 1991 |
| Chile | Sep – 1999 |
| Colombia | Oct – 1999 |
| Czech Republic | Dec – 1997 |
| Dominican Republic | Dec – 2011 |
| Georgia | Jan – 2009 |
| Ghana | May – 2007 |
| Guatemala | Dec – 2005 |
| Hungary | Jun – 2001 |
| Iceland | Mar – 2001 |
| India | Aug – 2016 |
| Indonesia | Jul – 2005 |
| Israel | Jun – 1997 |
| Japan | Jan – 2013 |
| Kazakhstan | Aug – 2015 |
| Mexico | Dec – 2001 |
| Moldova | Jan – 2010 |
| New Zealand | Dec – 1989 |
| Norway | Mar – 2001 |
| Paraguay | May – 2011 |
| Peru | Jan – 2002 |
| Philippines | Jan – 2002 |
| Poland | Dec – 1998 |
| Romania | Aug – 2005 |

| | |
|---|---|
| Russia | Jan – 2014 |
| Serbia | Jan – 2009 |
| South Africa | Feb – 2000 |
| South Korea | Apr – 1998 |
| Sweden | Dec – 1995 |
| Thailand | May – 2000 |
| Turkey | Jan – 2006 |
| United Kingdom | Oct – 1992 |
| Uganda | Aug – 2015 |
| Ukraine | Dec – 2016 |

*Sources*: Bank of England (2012), Niedźwiedzińska (2018) and national central banks.

TABLE 3: TAYLOR RULE COEFFICIENTS FOR INFLATION TARGETING CENTRAL BANKS

| Dependent Variable = Nominal Interest Rate | | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Inflation (β) | .68*** | .67*** | .71*** | .71*** |
| | (.015) | (.014) | (.017) | (.017) |
| Log(Exchange Rate) (γ) | | 2.24*** | 2.14*** | 2.08*** |
| | | (.144) | (.145) | (.148) |
| Unemployment | | | | .09*** |
| | | | | (.017) |
| Inflation*"Fixed" ($\beta^F$) | | | -.13*** | -.12*** |
| | | | (.026) | (.026) |
| Log(Exchange Rate)*"Fixed" ($\gamma^F$) | | | .15*** | .13*** |
| | | | (.038) | (.039) |
| $R^2$ | 0.32 | 0.35 | 0.35 | 0.36 |
| n | 4717 | 4666 | 4665 | 4574 |

Note: The table shows Taylor rule coefficients for country-months when a country had a fixed exchange rate (IRR19 categories 1 or 2) or a flexible exchange rate (IRR categories 3 and 4). The coefficients are from the specification shown in (1) and following Ilzetzki, Reinhart and Rogoff (2017). The coefficient on inflation is higher and on the exchange rate lower for countries with a flexible exchange rate. The specification includes country fixed effects. All coefficients are statistically 95% confidence level. Source: Ilzetzki, Reinhart and Rogoff (2017) and the authors.