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Will the Secular Decline in Exchange Rate and Inflation Volatility Survive COVID-19?

ABSTRACT Over the twenty-first century, and especially since 2014, global exchange rate volatility has been trending downward, notably among the core G3 currencies (dollar, euro, and the yen), and to some extent the G4 (including China). This stability continued through the COVID-19 recession to date—unusual, as exchange volatility generally rises in US recessions. Compared with measures of stock price volatility, exchange rate volatility rivals the lows reached in the heyday of the Bretton Woods system of fixed exchange rates. This paper argues that the core driver is convergence in monetary policy, reflected in a sharp reduction of inflation and short- and especially long-term interest rate differentials. This unprecedented stability, which partially extends to emerging markets, is strongly reinforced by expectations that the zero bound will be significantly binding for advanced economies for years to come. We consider various hypotheses and suggest that the shutdown of monetary volatility is the leading explanation. The concluding part of the paper cautions that systemic economic crises often produce major turning points, so a collapse of this new and extended Bretton Woods II regime cannot be ruled out.

One of the most surprising features of the COVID-19 shock has been the stunning stability in exchange rates, despite an epic global recession. Although the yen-dollar rate has barely moved, the exchange rate between

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the euro and dollar has appreciated 6 percent (as of this writing). But to put this in perspective, over the course of the 2008 financial crisis, the euro-dollar rate gyrated between 1.58 and 1.08 and the yen-dollar rate between 90 and 123. In this paper, we show that increasing G3 global exchange rate stability during the COVID-19 pandemic (so far) is an acceleration of a barely studied longer-term trend.[1] Incorporating China into a G4 that encompasses half of global GDP only strengthens the point. Figure 1 illustrates this fact, showing the decline in yen-dollar (top panel) and euro-dollar or Deutschemark-dollar (bottom panel) exchange rate variability since the mid-1970s.

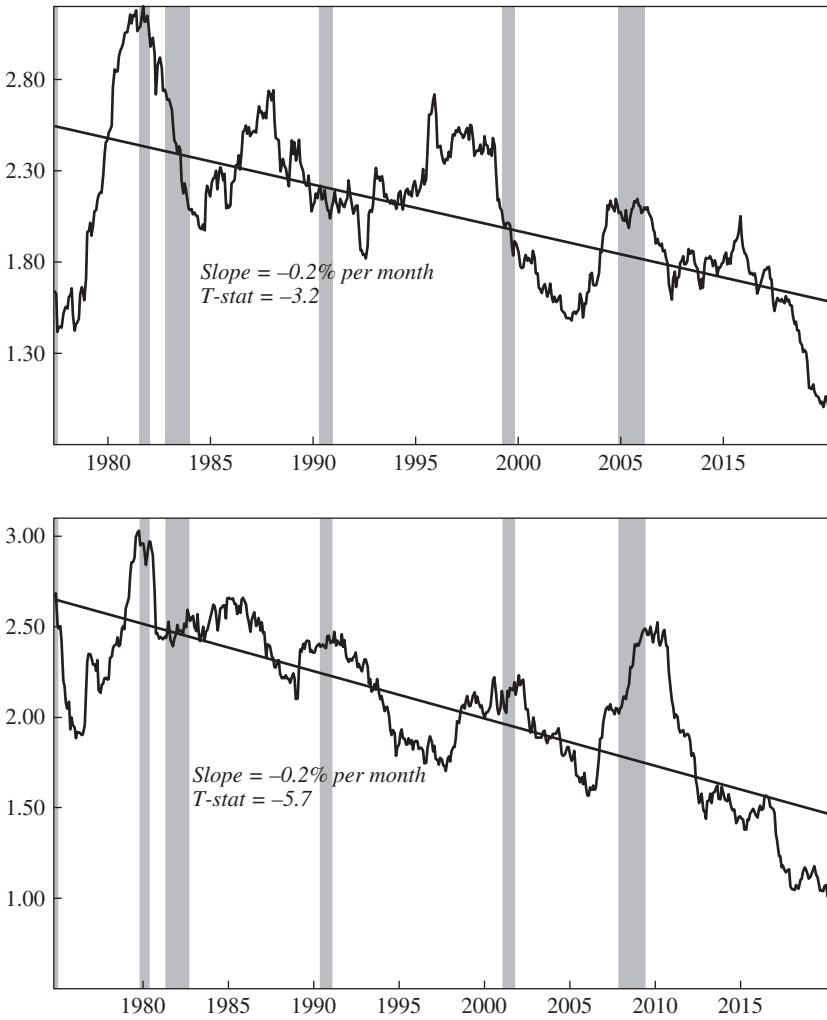
For the moment, the world is in an extended Bretton Woods II exchange regime, where not only are developing Asian currencies stable against the dollar but also much of the OECD, including Europe and Japan. Indeed, we will show that in some respects extended Bretton Woods II has now lasted as long as the open capital markets period of Bretton Woods I and has been more encompassing in terms of global GDP. Recent stability in the core global exchange rate system does not yet match the best years of the postwar Bretton Woods I system, but it is even more stable when compared to stock price volatility (see figure 2).

What is going on and what might the missing volatility portend for the future of the global exchange rate system, not just at the center but for emerging markets and the periphery? We will argue that a central driving force has been a collapse in international short-term and long-term interest differentials combined with an assumption in markets that the effective lower bound on interest rates is here to stay for a very long time. Relative volatility in conventional monetary policy has apparently been taken off the table for an extended period. The collapse of interest differentials not only reflects the global nature of the pandemic but also the stunning decline in long-term global inflation differentials. Even the gentle decline in the dollar against the euro that did occur over the latter part of 2020 may be largely attributed to a growing market expectation that liftoff from the zero interest bound for the US Federal Reserve would likely be years in the future, draining the last vestige of G3 (conventional) monetary policy uncertainty.

We will, of course, consider other possible explanations, including a fall in real or financial risk, massive post-COVID-19 fiscal interventions, and rising dollar dominance including enhanced Federal Reserve central

1. Rising stability in the core of the global exchange rate system is noted by Ilzetzki, Reinhart, and Rogoff (2019), but we did not explore the issue in detail.

Figure 1. Declining G3 Exchange Rate Volatility



Sources: International Finance Statistics, NBER, and authors' calculations.

Note: 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.

bank swap lines. Greater synchronicity of real shocks is also possible. The pandemic has hit the entire world, albeit some countries have been affected much more than others through policy choices and vulnerabilities, with the epicenters moving across time.

For international economists, the "natural experiment" of the COVID-19 shock and its impact on exchange rates has produced interesting and perhaps surprising results. Dornbusch (1976) famously argued that monetary policy uncertainty can, in principle, be a major driver of exchange rate volatility. However, several decades of empirical research, following Meese and Rogoff (1983), have found that supporting this conjecture empirically is difficult. Instead, the literature of the past decade, particularly following the influential work of Gabaix and Maggiori (2015), has argued that risk factors and financial frictions likely play a dominant role; Itskhoki and Mukhin (2017, 2019) argue that there is no other plausible way to explain the major puzzles in international macroeconomics. Nevertheless, we argue here that the natural experiment of the COVID-19 shock, which has effectively shut down conventional interest rate policy while exacerbating uncertainty in other dimensions, suggests that monetary factors might be more important than previously recognized, not just in the hours following central bank policy announcements but over much longer horizons as well.

Although emerging market exchange rate volatility is slightly elevated, it remains well below 2008–2009 levels, despite the avalanche of challenges and relentless credit agency downgrades. The International Monetary Fund (IMF) has moved proactively to extend credit lines, but its funds are limited, and rallying cries for more aid are largely being lost on advanced countries mired in their own problems. No one believes that emerging markets are going to have access to the bailout resources that, for example, the eurozone has extended to southern Europe. After two decades of steady improvements, the risks of macroeconomic distress and a return to much higher inflation and exchange rate volatility seem greater than at any time since the 1980s.

In section III, we explore some stark differences between the COVID-19 pandemic and the 2008 financial crisis. The surfeit of liquidity today is certainly one striking feature: in 2008 massive central bank quantitative easing did not have a leveraged effect on broader monetary measures; banks largely held on to reserves without expanding lending. This time is different: within just a few months, the M2 money supply has spiked by 25 percent in the United States; monetary aggregates have seen a rapid rise globally; corporations have called on lines of credit and borrowing

as insurance against a credit squeeze; and in the United States, mortgage refinancing is also playing a significant role. There is a liquidity glut.

Lastly, we consider the role of the dollar at the center of the system, a status that most informed observers still view likely to remain extremely durable. However, as Farhi and Maggiori (2018) emphasize, a hegemon's natural temptation to expand debt to very high levels (because it does not fully internalize the risks to the rest of the world) can lead to a situation where the "safe" asset is no longer safe and becomes vulnerable to a loss of confidence. We note that the United States now has as much outstanding public debt in world markets as all of Europe and Japan combined, with plans to issue much more, even as the US share of global GDP continues its long-term declining trend. Again, the marginal risk/benefit trade-off may be entirely reasonable from the United States' perspective, but not necessarily from a global one.

I. The Secular Decline in G4 Exchange Rate Volatility

Our tour of the international monetary system in 2020 begins at its core, with the currencies of the largest economic areas by economic activity: the dollar, renminbi, euro, and yen, which we label the G4. Together these economies reflect approximately half of world GDP (in purchasing power terms). At their center is the dollar, by far the most traded currency, the currency of choice for central bank reserves, and the top invoicing currency in trade and financial contracts (Rey 2013; Gopinath 2015; Ilzetzki, Reinhart, and Rogoff 2017, 2019, 2020; Maggiori, Nieman, and Schreger 2020). In this section, we document our central finding: the long-term secular decline in the volatility of core exchange rates, enhanced when long-term interest rates essentially hit zero in late 2014 and early 2015, and continuing through the COVID-19 shock.[2] To put this recent decline in perspective, note that even during the period of Great Moderation (before 2008), exchange rate volatility remained relatively stable even as many real variables became notably less volatile (Rogoff 2006).

Figure 1 documents the declining volatility of G3 currencies: the dollar, euro, and yen. The top panel of the figure shows the volatility (four-year moving average of the absolute value of the month-on-month change) of the bilateral yen-dollar exchange rate from 1975 (shortly after the end of

2. Japanese bond yields declined below 50 basis points in October 2014. German and French ten-year bond yields hit 50 basis points in March 2015. They have all since declined to negative territory, in 2016 in Japan and in 2019 in the core euro countries.

the Bretton Woods system of fixed exchange rates) to August 2020. The bottom panel shows the same figure for the euro-dollar exchange rate, replacing the euro with the German Deutschemark before 1999. Both figures show similar dynamics. While exchange rate volatility has seen ebbs and flows, a (statistically significant) downward trend is clearly visible in both bilateral exchange rates. The euro-yen cross rate (not shown) has also declined in volatility.

Very recent trends are perhaps even more striking. G3 exchange rate variability has declined sharply and has been well below trend since around 2014. This decline includes the months of March–June 2020 amidst the global uncertainty surrounding the COVID-19 pandemic. The low exchange rate volatility during the COVID-19 recession or depression is a remarkable outlier given that exchange rate volatility has been procyclical historically, tending to increase in US recessions. This is evident in figure 1, where US NBER recession dates are shaded.[3]

Figure 2 shows that exchange rate stability isn't merely a manifestation of low asset price volatility more broadly. It shows the difference between the absolute value of the monthly change in the euro-dollar (or earlier Deutschemark-dollar) exchange rate to the same metric for several other asset prices.[4] Panel A gives the difference between exchange rate and oil price volatility. Panel B compares exchange rate and commodity price index volatility. Panel C compares exchange rate volatility to (US) stock market volatility, using the S&P 500 as a stock market index. Indeed, all three panels show that the declining trend in exchange rate volatility is even more pronounced when compared with other assets.

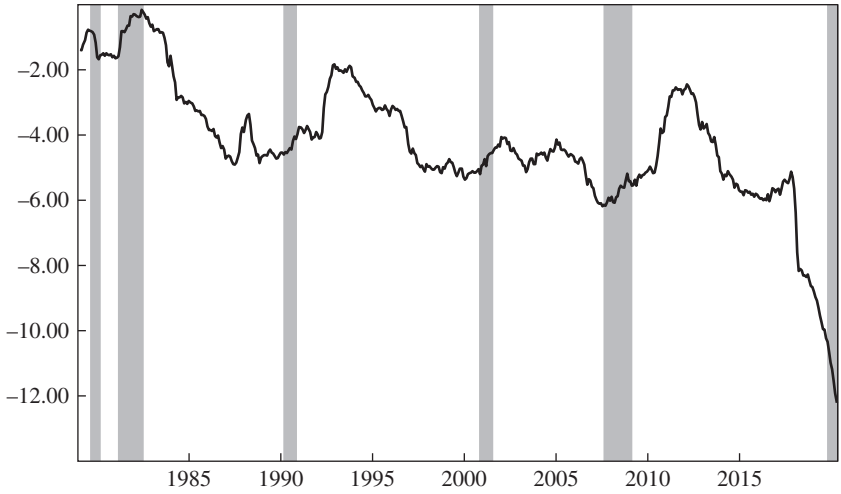
Panel D of figure 2 puts the recent exchange rate volatility decline into a longer historical context. The first two decades shown in panel D, the 1950s and 1960s, are the years of the Bretton Woods system of fixed exchange rates. Not surprisingly, these are years of low exchange rate volatility both in absolute and relative terms. However, the panel highlights that in the past several years, the volatility of exchange rates relative to that of other assets is now low even compared to Bretton Woods. Relative to the stock market, March 2020 was the month with the lowest exchange rate volatility on record.

3. The question of volatility is separate from what has happened to the level of the exchange rate. There has been some discussion as to whether there was an atypical decline in the dollar during "flight to safety" episodes throughout 2020. Whatever the value of the dollar relative to other major currencies, its variability has been nearly null relative to previous—and far smaller—recessions.

4. We use difference rather than ratio as our relative metric due to occasional zero and near zero observations.

Figure 2. Declining Euro-Dollar Exchange Rate Volatility Relative to Asset Prices

Panel A: EUR/USD versus oil price volatility



Panel B: EUR/USD versus commodity price volatility

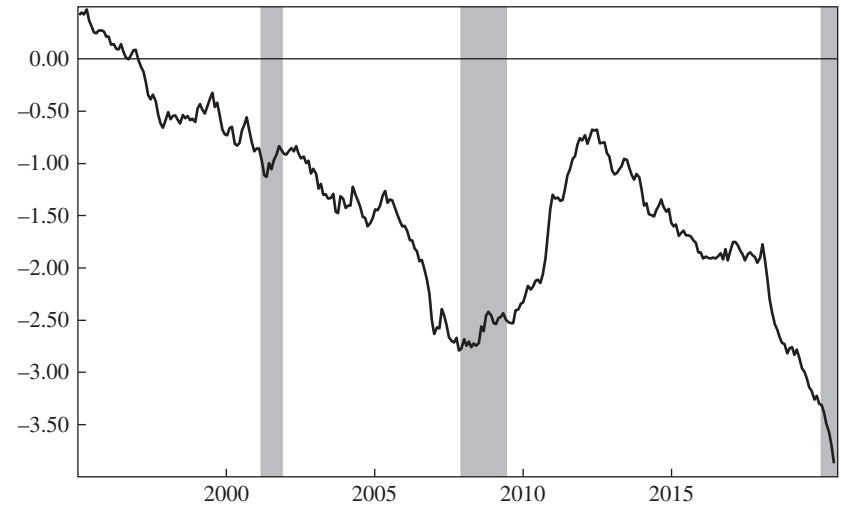


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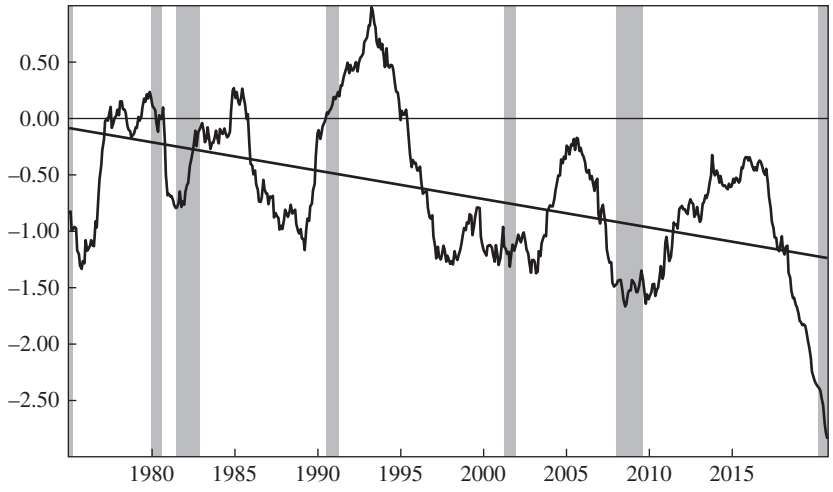
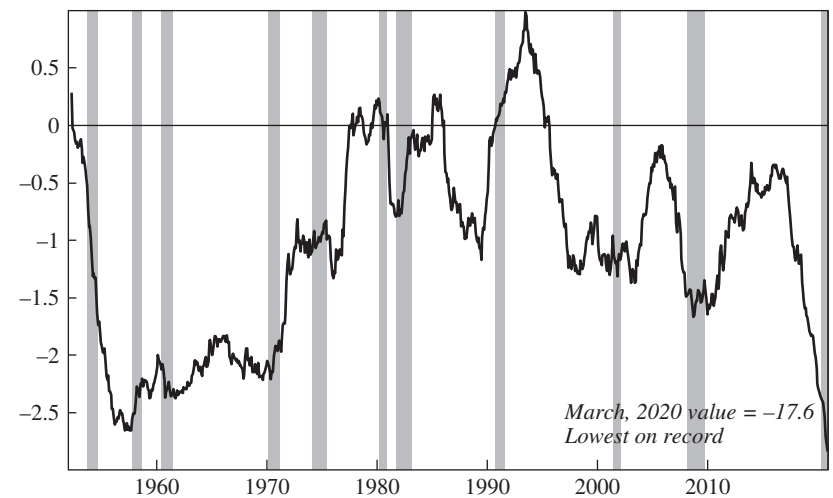
Figure 2. Declining Euro-Dollar Exchange Rate Volatility Relative to Asset Prices (*Continued*)

Panel C: EUR/USD versus stock market volatility, 1975–2020



Panel D: EUR/USD versus stock market volatility, 1950–2020



Sources: Federal Reserve Bank of St. Louis, International Finance Statistics, IMF primary commodities database, Shiller (2005), and authors' calculations.

Note: The figure shows the four-year moving average of the difference between the monthly change in the euro-dollar exchange rate (spliced with the German Deutschemark at 1999) and the absolute value of the monthly change in asset prices. The assets in the four panels are (A) oil—spot price of crude West Texas Intermediate (WTI), dollars per barrel; (B) all-commodity price index; (C) S&P 500, 1975–2020; and (D) S&P 500, 1950–2020.

While the Chinese renminbi still plays a far less important role in international commerce and finance compared to G3 currencies, China is already the largest economy in the world at PPP exchange rates, the world's largest exporter, and the renminbi is gradually expanding its international role.[5] Thus, in comparing the international system under extended Bretton Woods II to earlier episodes, it makes sense to consider the renminbi in a basket of the main G4 currencies.

Figure A1 in the online appendix shows the renminbi's volatility vis-à-vis the dollar and the euro. Over the past two decades, China has fixed its exchange rate, first against the dollar and starting in 2015, to a basket. Hence the stability of the renminbi-dollar exchange rate is hardly news. However, the figure demonstrates two less obvious facts. First, as the People's Bank of China moved toward pegging the renminbi to a basket of currencies, the greater volatility in its dollar exchange rate has been replaced roughly one-to-one with declining volatility relative to the euro. Whereas the renminbi has shown slightly more volatility relative to the dollar since 2015, its flexibility relative to the euro and the yen has declined. Second, even prior to 2015, renminbi-euro exchange rate variability was on a downward trend because of the declining euro-dollar volatility documented in figure 1.

Figure A2 in the online appendix compares G4 currency volatility during the two decades of extended Bretton Woods II with the volatility of the top four currencies (the dollar, Deutschemark, UK pound, and French franc) during the original Bretton Woods system from 1950 to 1970. The figure shows that in its prime Bretton Woods saw far lower (nearly zero) exchange rate variability than core rates during the past two decades. However, the figure also illustrates the relative durability of the current international monetary arrangement. With inflation in Western Europe hitting double digits in the 1950s, and active parallel markets for the exchange of these currencies, the shadow exchange rate among the core countries was still volatile. Indeed, with the United Kingdom devaluing the pound and serving as the largest borrower from the IMF during the 1950s, it took a full decade before Bretton Woods brought about the exchange rate stability originally promised. This success was also short lived. The figure shows that only a decade later the system was coming apart at the seams. Bretton Woods II has already outlived its namesake.

5. As a currency, the renminbi is gradually making inroads as an international currency and some predict that it may have equal status to the dollar within decades (Eichengreen 2011).

Further, the modern G4 comprises 50 percent of world GDP (in purchasing power terms, even more at market rates) compared to 40 percent for the previous G4 in 1960, according to the Conference Board and International Finance Statistics. It is also useful to recall that the Soviet Union was the second-largest economy in the world and was not part of the Bretton Woods arrangement. The current arrangement is thus far more global in its reach than Bretton Woods I. Finally, note the increased exchange rate stability *within* blocs, as the modern period is characterized by the advent of the euro and the elimination of nineteen national currencies in Europe.

Turning to other high-income economies outside the G4, the trends look different in some respects but similar in others. Figure A3 in the online appendix shows the exchange rate volatility of the next three main currencies in terms of trading volumes. In contrast to G4 currencies, the Australian and Canadian dollars have gradually moved toward greater exchange rate flexibility. However, similarly to the G4, the past five years have shown a dramatic decline in exchange rate variability, with exchange rate volatility well below trend, including during the COVID-19 crisis.[6] This points to common factors, particularly in the past half decade, leading to universally low exchange rate variability.

Table 1 shows that the changes that are visually apparent are also statistically significant. It reports results of regressions of all pairs of G3 currencies' weekly absolute change in value against several trends and break points. In most specifications we find a small secular downward trend in exchange rate volatility from 1999 to 2020. In all specifications, we find that this downward trend accelerated more than fivefold since 2014. The 2014 break point corresponds almost precisely to the date when the European Central Bank (ECB) set negative interest rates for the first time and many European long-term bonds started trading at negative yields.[7] This began the period

6. The exception is the UK pound, where the large depreciation following Brexit and the volatility due to Brexit uncertainty have led to a small increase in exchange rate volatility.

7. The break point is located in August 2014, where the test by Bai and Perron (1998) identifies a statistically significant break point in the trend of the absolute value of change of the dollar exchange rate against a GDP-weighted euro-yen basket. This date shortly follows the adoption of negative interest rates by the ECB in June 2014. An additional break point is in August 2008, corresponding to the global financial crisis. This break point is due to an *increase* in trend volatility and most likely reflects a temporary increase in the level of volatility in that period, rather than its trend, an impression visually reinforced in figure 1. Accordingly, we control for the crisis itself, not a change in trend volatility in the crisis. Results are identical when controlling for a break in trend exchange rate volatility in August 2008. COVID-19 wasn't identified as a formal break point. One is unlikely to capture break points with so few observations at the end of the sample.

Table 1. Trends and Break Points in G3 and G4 Currency Volatility

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Trend	−.03***	−.02***	−.01	−.02***	−.02***		
Trend after August 2014		−.12***	−.17***	−.14***	−.15***	−.15***	−.10***
Abs(Δ%S&P 500)			.07***	.05***	.05***	.05***	.04***
Abs(Δ%Oil Price)			.02***	.01***	.01***	.01***	.01***
Global financial crisis				.74***	.74***	.74***	.56***
Currency pair fixed effects	No	No	No	No	Yes	Yes	Yes
Currency pair specific trends	No	No	No	No	No	Yes	Yes
Including China	No	No	No	No	No	No	Yes

Source: Authors' calculations.

Note: The table shows results from a panel OLS regression where the dependent variable is the absolute value of the week-on-week change in G3 exchange rate pairs. "Trend" is a linear time trend. "Trend after August 2014" is an interaction between a linear time trend and a dummy equaling one for weeks after August 2014. This is the date identified as a trend break point in a stability test by Bai and Perron (1998). Coefficients on these two variables are multiplied by 100 to ease reading and reflect the monthly change in the absolute value of exchange rate change in basis points. The regressions show more than a fivefold acceleration in the decline in volatility starting in 2014, with exchange rate volatility declining at a rate of close to 10 basis points per year from an average of 75 basis points. A constant and a dummy for weeks after August 2014 were included but not reported. Abs(Δ%S&P 500) and Abs(Δ%Oil Price) are the absolute values of the weekly percentage growth in the S&P 500 stock market index and crude West Texas Intermediate (WTI) oil prices. Columns 1–6 are regressions for G3 currency pairs. Column 7 also includes cross rates with the renminbi. Columns 5–7 include currency pair fixed effects. Columns 6–7 also include separate time trends for each currency pair.

of unprecedentedly low long-run interest rate volatility and differentials across countries, as we discuss in the following section. The table also shows that the trend since 2014 is even more pronounced when controlling for volatility in other asset prices, confirming the visual impression from figure 2. Allowing for an additional break in exchange rate volatility during the COVID-19 pandemic generally shows a further acceleration in the decline in exchange rate volatility, but the result is not yet statistically significant in most specifications, as could be expected due to the short time frame.

II. Exchange Rate Stability and Monetary Developments

What explains the declining G4 exchange rate variances and their surprisingly muted responses to the massive shocks of COVID-19? Only a single country (China) we analyzed in the previous section has an explicit policy of targeting its exchange rate. While others may have less-flexible exchange rate regimes de facto (Ilzetzki, Reinhart, and Rogoff 2019), there is no sign of a conscious move to greater exchange rate management among the central banks in question, certainly not from central bank statements. Instead, we conjecture that inflation, growth, and interest rate trends, culminating in the low inflation environment and the zero lower bound on monetary policy of the past decade, have led to low exchange rate volatility.[8] In this section, we provide suggestive evidence that monetary convergence to the zero bound has been especially important. We then turn to other, less likely (in our view), explanations for the volatility decline.

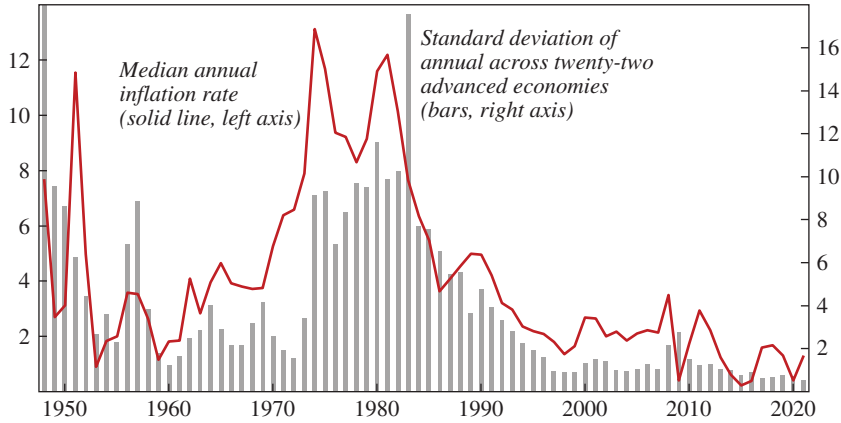
II.A Inflation and Interest Rate Dynamics

Over the past decade, global inflation has been remarkably muted. Several major economies have flirted with deflation; inflation-targeting central banks faced the unusual challenge of attempting to hit their targets from below. With inflation in single digits virtually everywhere in the world, inflation differentials across countries have also declined. Purchasing power parity requires that exchange rates adjust to cross-country price differences in the long run. Hence low inflation differentials may lead to smaller contemporaneous and expected trend exchange rate adjustments.

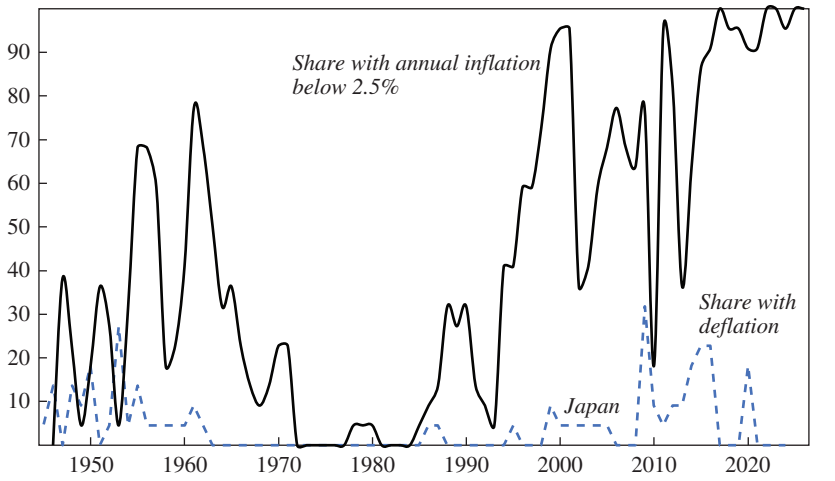
8. In an important related paper, Stavrakeva and Tang (2018) use surveys and data on macro news to decompose factors driving exchange rates. Their decomposition supports the view that the effects of monetary policy factors on exchange rate volatility have been diminishing over time for most exchange rate pairs.

Figure 3. Declining Inflation Volatility

Panel A: Median and standard deviation of annual inflation



Panel B: Share of countries with low (< 2.5 percent) and negative inflation



Sources: IMF World Economic Outlook (including projections) and authors' calculations.

Panel A of figure 3 shows the standard deviation of annual inflation rates across twenty-two advanced economies (in bars) and the median inflation rate (in a line) from World War II to today. More pertinent for exchange rate determination is that cross-country inflation differentials have also declined. The past two decades have witnessed the lowest differentials in inflation across countries on record in the postwar period. The figure extends

to the year 2030, replacing actual inflation variation with variation in inflation projections across countries, using the April 2020 IMF *World Economic Outlook*. The differentials are projected to continue to shrink.

Panel B of figure 3 shows that the share of high-income countries with annual inflation below 2.5 percent (solid line) is now hovering near 100 percent, a feat never achieved in the Bretton Woods years. The dashed line shows the share of countries in deflation. The deflationary episodes experienced by many countries following the global financial crisis have subsided, so that today nearly all high-income economies have inflation rates in the narrow 0 to 2.5 percent band. Of course, purchasing power parity holds only weakly in the data and often requires many years to unfold (Rogoff 1996; Gopinath and others 2020). As such, inflation differentials can only be part of the story in explaining the decline in exchange rate variability, particularly at higher frequencies. Even more important, albeit related, is the convergence of short-term and long-term interest rates.

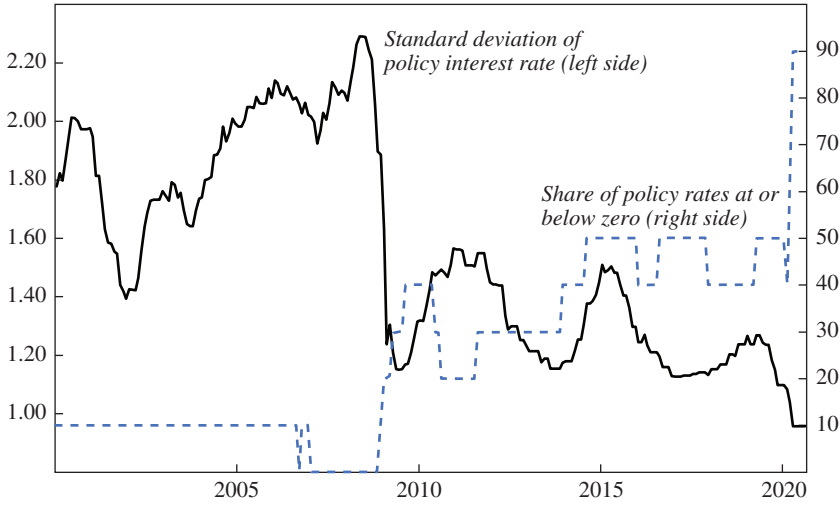
Panel A of figure 4 shows the standard deviation of the monetary policy interest rate of the central banks issuing the ten most traded currencies in 2020 (solid line), going back to 2000. The secular decline in the level of global interest rates is well documented, but as the figure emphasizes, this has been associated with smaller variation in policy rates across countries as well. The dashed line in the figure shows the percent of countries with zero or negative interest rates (defined as 25 basis points or below, as some central banks were reluctant to set rates exactly at zero).[9]

At the beginning of the sample only Japan had zero interest rates. By 2020, all but one of the central banks considered here (the People's Bank of China) had interest rates at zero or below. With policy interest rates stuck at zero, and shadow policy rates (estimated by, say, a Taylor rule) expected to remain well below zero for years to come, the scope for short-term interest rate differentials is minimal. (We recognize that we are abstracting from risk premia that can create a wedge between interest differentials and expected exchange rate movements, but these are small compared to the generalized collapse in interest rates.)

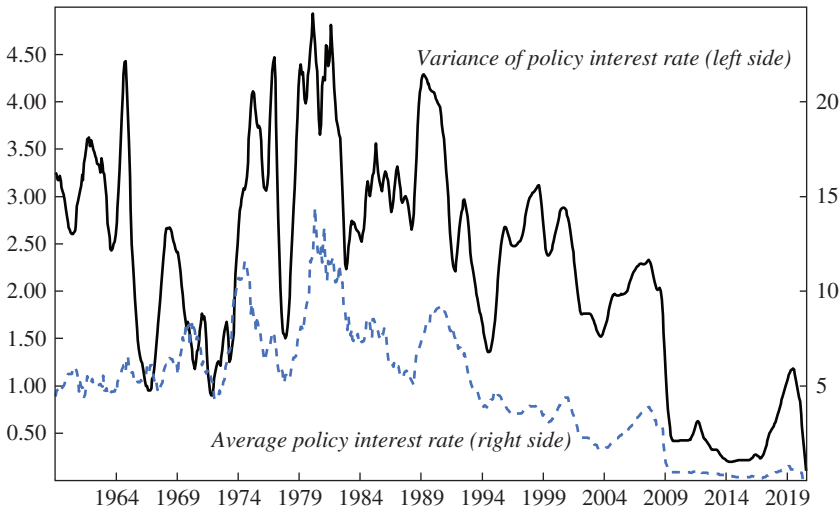
9. Interestingly, Lilley and Rinaldi (2020) find that, after the financial crisis, exchange rates for riskier advanced economy currencies (which would have included the euro during the euro crisis) became more correlated with measures of global market risk (e.g., the VIX), possibly because the zero bound constraint implied that central banks had less room to allow policy rates to move to offset changes in global risk, so exchange rates absorbed more of the adjustment.

Figure 4. Declining Policy Interest Rate Volatility

Panel A: Standard deviation of monetary policy rate and share at the zero lower bound—Ten major currencies, 2000–2020



Panel B: Average and standard deviation of monetary policy rate—US, Germany, UK, and Japan, 1959–2020



Sources: IMF, International Finance Statistics, national central banks, and authors' calculations.

Panel B of figure 4 puts recent trends in a longer historical perspective going back to 1959, restricting attention to four major central banks (the Federal Reserve, Bundesbank/ECB, Bank of Japan, and the Bank of England). The figure shows that as average monetary policy rates have declined (dashed line), the variance among them has also declined. What little variance remains is mainly because some central banks have opted for negative rates while others have so far treated zero as the lower bound on the nominal policy rate. Interestingly, variation in policy rates across countries has been more stable in the second decade of the twenty-first century than it was under Bretton Woods I, when monetary policy coordination should have been a consequence of the fixed exchange rate system, at least once controls on international capital movements were lifted. With central banks setting policy interest rates to zero and expected to pursue these policies for years to come (because of economic conditions regardless of the credibility of forward guidance), the degree of de facto monetary coordination has never been greater.

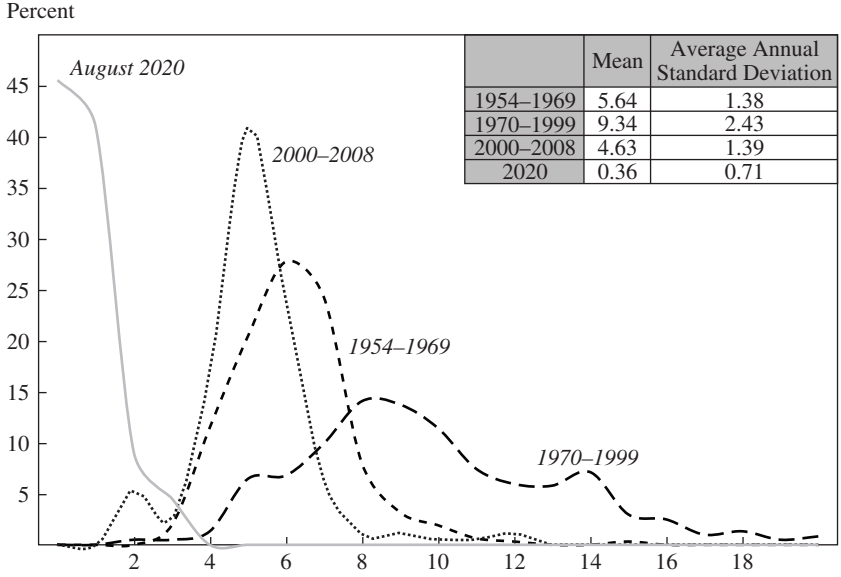
Indeed, the collapse of long-term interest rate differentials, illustrated in figure 5, is a key element of the story; standard monetary models of exchange rates suggest that the entire term structure of interest differentials matters.[10] Figure 5 illustrates how the distribution of the annual interest rate on ten-year bond yields for twenty-one high-income economies has evolved throughout the postwar period (panel A: nominal; panel B: real). The stable years of the Bretton Woods period (1954–1969) are shown in a solid black line, with ten-year bond yields averaging 5.6 percent and an average annual cross-country standard deviation of 1.4 percent.[11] The demise of Bretton Woods and the high inflation of the 1970s brought a period of higher yields (averaging 9.3 percent) and a dramatic increase in interest rate variability (an average annual standard deviation of 2.4 percent) in 1970–1999 (shown in a dashed black line). Long-term interest rate differentials across countries declined in the twenty-first century, returning to the standard deviation of the Bretton Woods period (averaging 4.6 percent and with an average annual standard deviation of 1.3 percent, shown in a

10. In addition, uncovered interest parity (UIP), relating interest rate differentials to exchange rate dynamics, holds better empirically with longer term rates. The decline in interest rate variance is in part a mechanical implication of the decline in the level of interest rates. However, according to UIP theory, exchange rate volatility is determined by the volatility of interest rates *differentials*, even if the latter declined due to this mechanical artifact.

11. We exclude Greece from the sample as its high bond yields dominate the mean and variance in the 1950s and 2000s.

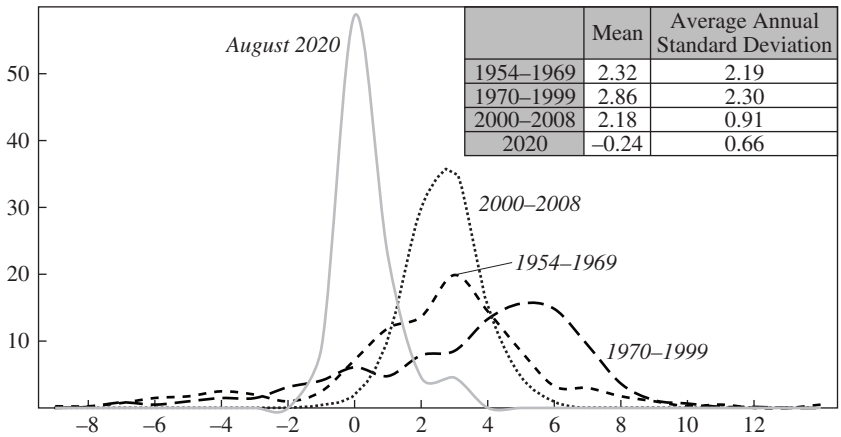
Figure 5. Ten-Year Bond Yields for Twenty-One High Income Economies

Panel A: Nominal yields



	Mean	Average Annual Standard Deviation
1954–1969	5.64	1.38
1970–1999	9.34	2.43
2000–2008	4.63	1.39
2020	0.36	0.71

Panel B: (Ex post) real yields



	Mean	Average Annual Standard Deviation
1954–1969	2.32	2.19
1970–1999	2.86	2.30
2000–2008	2.18	0.91
2020	–0.24	0.66

Sources: IMF, International Finance Statistics, *World Economic Outlook*, and authors' calculations.
Note: Ex post yields calculated based on inflation in the preceding year.

dashed gray line).[12] Finally, the solid gray line shows the distribution of long-term interest rates in early August 2020.[13] The decline in long-term interest rates is unprecedented in the modern era; nearly half of the high-income economies are borrowing at *negative* nominal rates at ten-year horizons. The standard deviation across countries is also at historical lows (0.8 percent). The bottom panel of the figure shows a similar decline in real long-term rates.

Although nonmonetary explanations are possible—and we will consider them—the collapse of exchange rate variability is certainly consistent with the exchange rate overshooting model of Dornbusch (1976), which placed monetary policy volatility front and center. Some might point to the mild decline in the dollar post April 2020 against the euro as evidence against stability, but this decline is moderate by historical standards and so far reflects only a minor blip in the trend toward lower volatility. Indeed, the weakening dollar can be interpreted as a firming of beliefs that the US Federal Reserve may not raise interest rates for years to come, removing most residual (conventional) monetary policy uncertainty for two to three years.

II.B Alternative Explanations for Exchange Rate Volatility

If not convergence of monetary policy, what other factors might explain the fall in exchange rate volatility?

THE DOLLAR'S RISE AS AN ANCHOR CURRENCY One plausible argument for greater exchange rate stability is that the dollar has cemented its role as the dominant currency, providing greater incentives for foreign central banks to stabilize their dollar exchange rates, leading to a decline in volatility across the system. Rey (2013) and Gopinath (2015) have emphasized the dominant role of the dollar; we review the evidence in Ilzetzki, Reinhart, and Rogoff (2019) and discuss why the euro has fallen so far short as a challenger in Ilzetzki, Reinhart, and Rogoff (2020).

12. The figures are for the years 2000–2008 to avoid overstating the variance due to the global financial crisis. However, the standard deviation is similarly low for the period 2000–2020 at 1.4 percent and even lower at 1.3 percent when excluding the single year of 2011, with a high variance because of rising yields in southern Europe during the eurozone crisis.

13. Each line in figure 5 shows a distribution of interest rates over time windows of different lengths. The distributions in the longer time periods are mechanically fatter because each reflects variation both over time and across countries. The tables in the figure show the *average annual* variance in each period, which is more comparable as it only includes variation across countries.

Dollar dominance is a plausible explanation, but by most measures it has been relatively stable for the past decade and cannot easily explain the sharp drop in volatility after COVID-19.[14] If anything, thanks to a dramatic introduction of Eurobonds to cushion the most hard-hit European countries, the pandemic has given renewed strength to the euro as an alternative to the dollar over the next decade. We acknowledge that starting in 2008 and again in 2020, the Federal Reserve engaged in very proactive measures to stabilize international markets by offering dollar swap lines to advanced economy central banks and some emerging markets. Had the Fed not acted, there would almost certainly have been a crisis in overseas dollar funding markets, and the potential effects on exchange rate volatility could have been immense. In the future development of the global financial system, historians may regard the two crises as marking the evolution of the Fed toward taking a more international role.

The Federal Reserve's extension of swap lines is an intriguing alternative hypothesis, but on balance we are skeptical that it can explain the collapse of exchange rate volatility, going far beyond what might be expected if the Fed were simply offsetting a liquidity crunch. Nearly 90 percent of outstanding Fed swap lines were indeed to the ECB and the Bank of Japan, and it is certainly possible that they cushioned exchange rate volatility. However, COVID-19 central bank swap lines never reached the magnitudes of those in the global financial crisis. Further, by now the ECB has almost entirely drawn down its swap line balances, and the Bank of Japan has unwound three-quarters of its holdings. Finally, the decline in exchange rate volatility began accelerating in 2014, well after the previous round of swap arrangements ended and well before the COVID-19 swap lines were in place.[15]

A GENERALIZED DECLINE IN FINANCIAL RISKS As we have noted, the academic literature of the past decade has placed an increased emphasis on shifting risk premia and financial frictions as the major driver of short-term exchange rate volatility. Itskhoki and Mukhin (2019) argue that only shifting risk premia can simultaneously explain the Meese-Rogoff disconnect puzzle, the PPP puzzle, the terms-of-trade puzzle, the Backus-Smith puzzle, and the UIP puzzle. It is plausible that the paralysis caused by the zero lower bound actually reduces financial risk; Miranda-Agrippino and Rey (2020) argue

14. See Ilzetzki, Reinhart, and Rogoff (2019, 2020) for details.

15. See the Federal Reserve Bank of New York, https://apps.newyorkfed.org/markets/autorates/fxswap.

that shocks to US monetary policy are major drivers of global risk cycles. More work is necessary to discriminate the risk hypothesis from the Dornbusch model and from new open economy descendants, as in Obstfeld and Rogoff (1996).

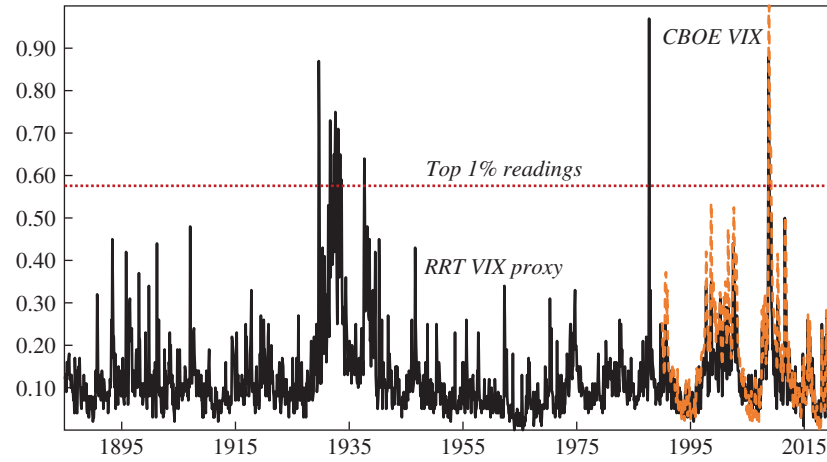
Nevertheless, the notion that the secular stabilization in twenty-first-century exchange rates came about because the world has become a safer place flies against casual observation. The brief Pax Americana of the 1990s was shattered with a major terrorist attack on US soil in 2001 and led the United States to two major international conflicts in a single decade. The past twelve years have seen the greatest global financial crisis since the Great Depression and the most consequential pandemic in a century at least. The two crises combined have produced enormous political ferment and uncertainty about the role of the state and the uses of government debt. In the second quarter of 2020, the US economy saw its greatest quarterly GDP decline since modern national accounts data have been collected. Measures of financial uncertainty (such as the VIX) remain elevated, even if they have fallen since their huge rise in March 2020. At the same time, exchange rate volatility has declined. The top panel of figure 6 expands the analysis of figure 2, illustrating the decline in exchange rate volatility relative to other assets. It shows the VIX index, extended back over a century. The actual VIX index measures "implied volatility," that is, private sector perceptions of risk implied from thirty-day futures options. We extend the series historically using realized volatility, but the two series are highly correlated (89 percent) for overlapping months.

The figure shows that the twenty-first century has been a volatile period for financial markets in historical comparison. The dashed horizontal line in panel A demarks observations that were in the top 1 percent of observations in the 135-year time series. Outside the Great Depression, only three other events have shown volatility of these magnitudes: Black Monday in 1987, the global financial crisis in 2008, and the COVID-19 shock of March 2020. Thus, the two decades of declining exchange rate volatility have occurred against the backdrop of two of the greatest episodes of implied stock market volatility in over a century.

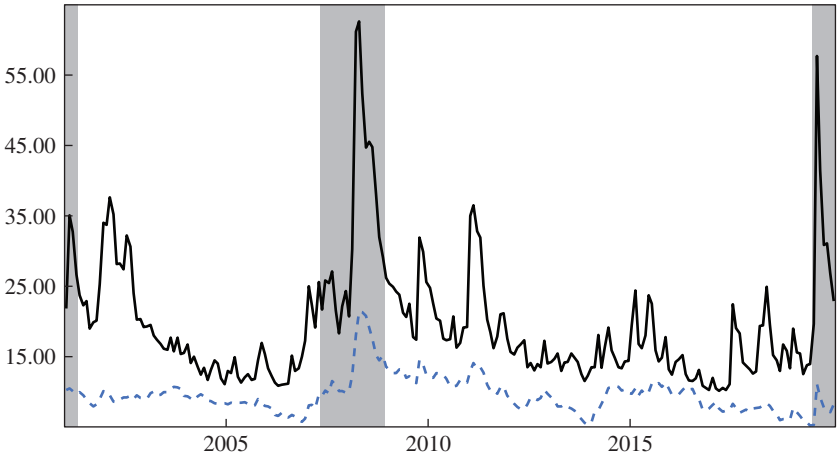
Panel B of figure 6 focuses on recent years and shows the VIX (top line) alongside a currency equivalent of the VIX, the Currency VIX (CVIX, bottom line), constructed by Deutsche Bank. The CVIX averages the implied volatility of the top nine currency cross pairs in terms of trade volume. The CVIX has trended slightly downward: it hit its lowest reading on record in January 2020. The downward trend in the CVIX is moderated compared to our core currency comparisons because it includes not only the G3 currencies

Figure 6. Implied Volatility: VIX and the Deutsche Bank Currency VIX

Panel A: VIX, 1885–2020



Panel B: VIX (top line) and Currency VIX (bottom line), 2001–2020



Sources: Schwert (1990), Thompson Reuters, Deutsche Bank, Chicago Board Options Exchange, and authors' calculations.

of the dollar, euro, and yen (and excludes the renminbi), but also the British pound, Swiss franc, and Australian and Canadian dollars.

While the two series are certainly correlated, the CVIX has shown very different dynamics than the VIX during the COVID-19 pandemic. While the VIX hit near historic highs in 2020, the CVIX was below its historical average for all but the single month of March. In March, it hit a value of 11, a figure only half a standard deviation above the index's historical mean, and a value previously exceeded in the unremarkable month of February 2016. The VIX, on the other hand, has come down precipitously since March but remained well above its historical median through early 2021.

The evidence compiled in figures 2 and 6 show a decline in currency volatility relative to other assets, indicating that a benign risk environment is an unlikely explanation for the phenomenon.

THE REAL ECONOMY AND FISCAL POLICY We have already made the point that the trend decline in global exchange rate volatility, particularly at the core, has survived the worst global financial crisis in eight decades and the worst pandemic in a century. Although one can speak of a great moderation in the run-up to the 2008 global financial crisis, and a second moderation in the run-up to the COVID-19 shock, any measure that takes into account the two crises will show extremely high volatility in output, unemployment, global trade, and so on. The argument that exchange rate volatility has fallen because the real economy has become more stable seems highly dubious.

Similarly, it is difficult to reconcile the collapse in exchange rate volatility with recent fiscal activism, either in the run-up to COVID-19 or during the pandemic. For example, although the general direction of travel was similar across countries in the pandemic, the timing and magnitudes of fiscal announcements were quite varied across countries, and the exchange rate effects apparently minimal.

Having said this, the global nature of the crisis has itself led to a very coordinated response in central banks across the world. The nature of the shock may therefore have an indirect role in explaining the muted exchange rate volatility that followed. Further, there is far greater coherence across central banks in their expected responses to real shocks and inflation, which may have led to clearer market expectations on monetary policy going forward.

EMERGING MARKETS So far, we have mainly focused on advanced economies; we next turn to emerging markets. The greater exchange rate and inflation stability of the twenty-first century didn't bypass emerging markets. With some notable recent exceptions (Argentina, Ukraine, Venezuela),

emerging markets have seen low and stable inflation rates and the longest period in the postwar era without a single case of hyperinflation (2003–2013; Zimbabwe had a notable case of hyperinflation in 2008, but it isn't typically classified as an emerging market). In terms of exchange rates, many emerging markets have bucked the G4's trend and moved to greater exchange rate flexibility and eschewing formal exchange rate targets.[16]

Panel A of figure 7 shows that the global financial crisis and the monetary developments that followed revived the currency crash, with 6 percent of all currencies crashing in 2008–2009, and an additional 4 percent during the proverbial "taper tantrum" of 2013, when the Federal Reserve slowed its asset purchases. The figure shows the share of all countries experiencing a currency crash, defined in this case as a decline of 12.5 percent in their bilateral exchange rate with their anchor currency.[17] COVID-19 saw only a handful (2 percent) of currencies crashing. Compared with previous shocks, this is a pittance—roughly half a taper tantrum and nowhere close to the global financial crisis. Panel B shows the generalized decline in hyperinflations, which is associated with much lower trend inflation in emerging markets overall. We will return to the risk to the apparent resilience of emerging markets in the next section.[18]

III. Risks to Extended Bretton Woods II

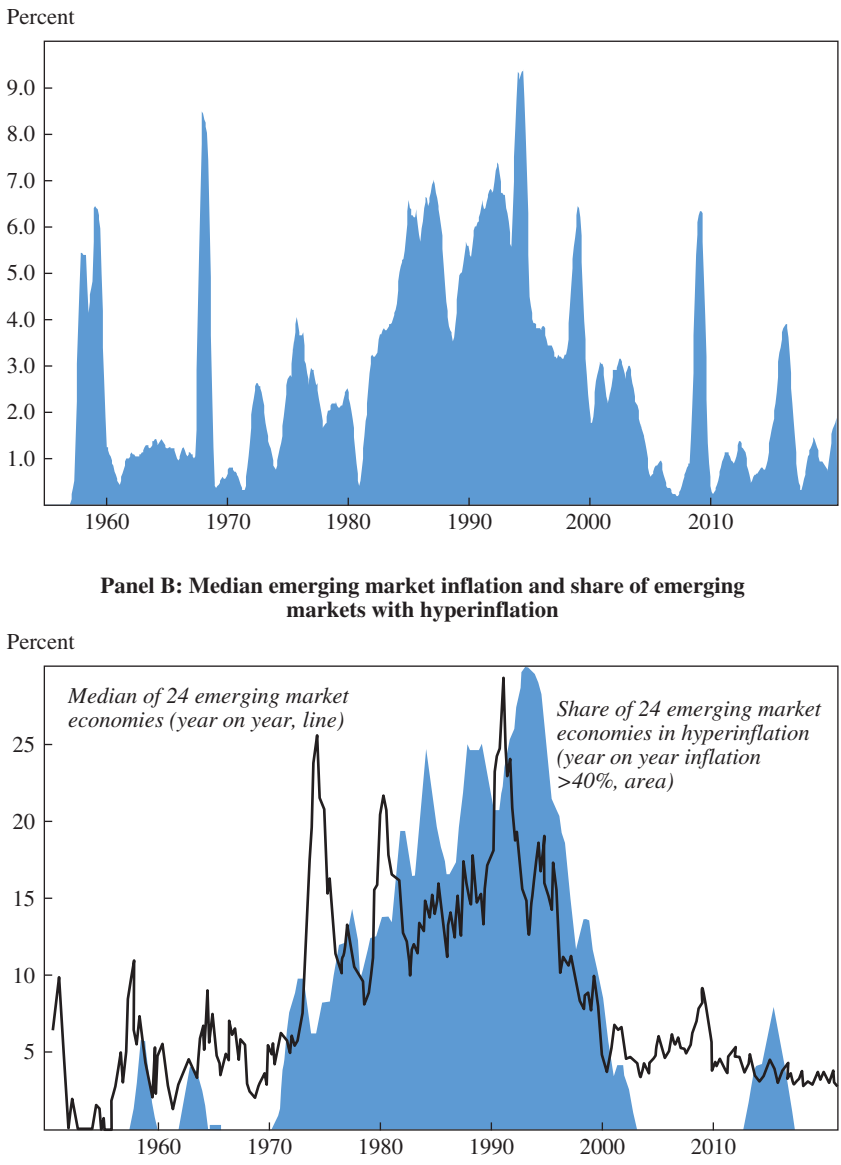
At the time of this writing, exchange rate stability among advanced economies has persisted and other financial assets have stabilized as well. However, the pandemic is still unfolding, cases and death tolls continue to accumulate worldwide, and a second acute round of the pandemic remains a distinct possibility. What risks does the continued pandemic—or its aftermath—pose to the downward trend in exchange rate volatility and to the international monetary system more broadly? Of course, in addition to macroeconomic and especially monetary policy, outcomes depend on success in dealing

16. See Ilzetzki, Reinhart, and Rogoff (2019) for evidence in this regard.

17. See Ilzetzki, Reinhart, and Rogoff (2019) on anchor classifications.

18. Exchange rate variability in some emerging markets has remained high during this period as many emerging market have opted for more flexible exchange arrangements. Kalemli-Özcan (2019) shows that variability in emerging market policy interest rates has declined in the twenty-first century, but unlike high-income countries, this decline has somewhat faltered since 2014 and rates have been well above zero. Further, the comparison with high-income countries is complicated due to risk premia, whose importance for emerging markets Kalemli-Özcan (2019) highlights.

Figure 7. Currency Crashes, Global Liquidity, and Emerging Market Inflation



Source: International Finance Statistics, the Conference Board, Federal Reserve Bank of St. Louis, and authors' calculations.

with the virus and on how well the public is reassured that further extreme risks do not lie around the corner.[19]

Determining whether the current period of exchange rate stability will continue is highly speculative, so in this section we can only highlight some considerations. But we certainly don't want to leave the reader with the impression that one can be highly confident in extrapolating extended Bretton Woods II indefinitely into the future. For example, some notable differences between the current pandemic recession and the 2008 financial crisis suggest a distinct chance that the inflation, interest, and exchange rate aftermath will eventually become much more volatile, even if markets presently heavily discount the possibility.[20]

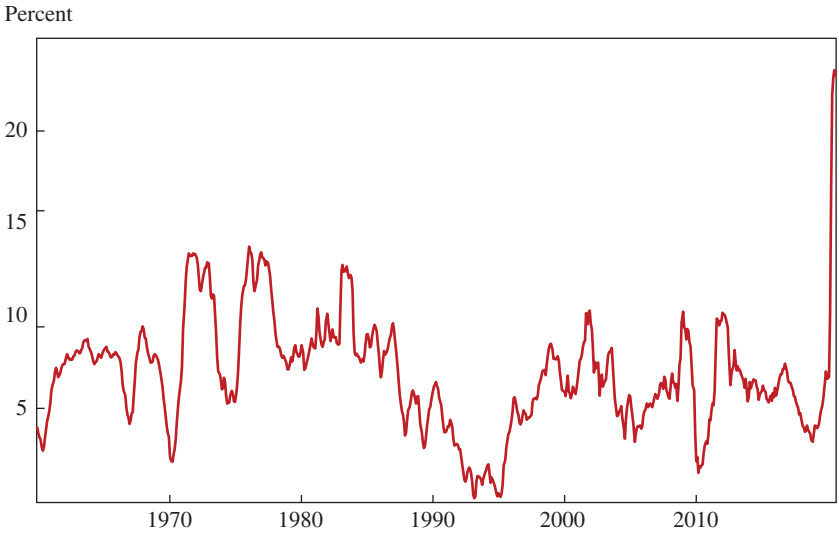
One factor, to which we alluded earlier, is that aggressive central bank intervention has produced far more market liquidity this time around. In 2008, massive increases in bank reserves largely sat at the central bank and did not have a leveraged effect on broader monetary aggregates. This time, many markets are experiencing significantly higher liquidity, notably the dramatic rise in monetary aggregates in the United States, Europe, Japan, and the United Kingdom, seen in figure 8. The top panel shows that M2 has grown at an unprecedented rate since the start of the COVID-19 pandemic, while the bottom panel shows that this monetary expansion has reflected in broader measures of liquidity (M3) and more globally. This is partially due to firms calling on lines of credit to have a war chest for the next spike of the pandemic, but in the United States, mortgage refinancing has also been important. It is an open question whether, as the economy heals, this higher liquidity will eventually bleed over into inflation, particularly if central banks remain concerned with low growth and high public and private sector debts. The Federal Reserve's new policy framework, which many other central banks are likely to follow, underscores that policymakers are now (rightly) willing to take more risks on inflation to promote growth.

19. Kozlowski, Veldkamp, and Venkateswaran (2020) argue that even if the pandemic ends by December 2020, the long-term effects of higher perceived tail risk will have a significant impact on investment and consumption for many years to come.

20. Inflation expectations collapsed at the onset of the COVID-19 crisis but have since recovered to prepandemic rates. Expectations remain below the Federal Reserve's 2 percent target (see top panel of figure A4 in the online appendix). At the same time, there are some indications of underlying inflationary pressures. Using scanner data in the United Kingdom, Jaravel and O'Connell (2020) show that *monthly* inflation spiked to 2.4 percent in the first month of the lockdown. Cavallo (2020) argues that official figures understate inflation in seventeen emerging and high-income economies, as they fail to consider shifting consumption patterns during the pandemic. The bottom panel of figure A4 in the online appendix shows an atypical divergence between food price inflation and CPI inflation, highlighting the current uncertainty in the effective inflation rate.

Figure 8. Growth in Monetary Aggregates

Panel A: US M2



Panel B: Aggregate M3 for the United States, eurozone, Japan, and the United Kingdom

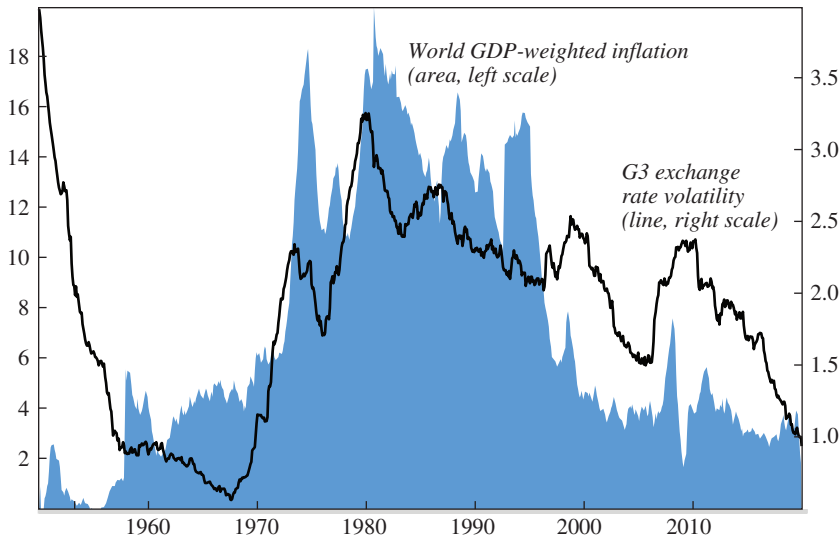
Sources: Federal Reserve Board, European Central Bank, Bank of Japan, Bank of England, and authors' calculations.

A second key difference is that the COVID-19 crisis is a significant supply shock; whereas it has likely accelerated some important positive productivity shifts (more telecommuting and teleconferencing), the medium-term effect could turn out to be quite negative. This is apparent in the stress on global supply chains and the fall in trade, which had already been growing at a slower rate since the 2008 financial crisis than in the previous several decades. A considerable body of evidence has accumulated indicating that global factors have been a major reason for downside surprises in trend interest rates and inflation the past two decades, as suggested in Rogoff (2004) and Kose and others (2020). Deglobalization, should it happen, could put the dynamic into reverse. Indeed, the massive effective growth in the global labor force over the past four decades, particularly due to the integration of China and Eastern Europe, as well as an expansion of women into the labor force, was likely a major force in pushing down labor shares and prices. Even without deglobalization, demographics point to a declining effective global labor force unless India and Africa pick up the slack as China ages (Goodhart and Pradhan 2020).

The COVID-19 crisis is also likely to lead to major domestic restructuring, away from consumer-facing businesses, which in turn could reverse the four-decade shift toward greater urbanization. Greater population density produces production efficiencies but at the cost of heightened pandemic risks. Financial stress can also take a toll. Even with very generous federal loans, many small businesses will not survive, and there is likely to be huge damage in commercial real estate. Thus, it is important to be careful in making analogies to the deflationary 2008 financial crisis; the lasting supply effects here could be much more adverse.

Turning to history as a guide, we have already seen (in figure A2 in the online appendix) that the international monetary system of the twenty-first century has by now outlived Bretton Woods. This may seem surprising since the Bretton Woods era is sometimes viewed as running from after World War II until its collapse in the early 1970s, but in fact one can divide the regime into two distinct phases. The first, from the end of the war to the mid-1950s was characterized by high volatility of market exchange rates (as measured by active parallel markets across Western Europe) in the face of high and volatile inflation. So although formally a period of fixed exchange rates, it was a very different regime than one with integrated capital markets, a unified exchange rate regime, and low inflation. The true heyday of Bretton Woods—the second phase from the mid-1950s to the late 1960s—was relatively short and only arrived when inflation declined to low single digits, exchange markets were unified, and as the eurocurrency market began to develop.

Figure 9. World Inflation and Exchange Rate Variability



Sources: International Finance Statistics, the Conference Board, and authors' calculations.

Note: World inflation is calculated as the average GDP-weighted year-on-year inflation. GDP weights are at 1990 Geary-Khamis purchasing power parity. Individual country inflation rates capped at 100 percent to avoid excessive influence of outliers. G3 exchange rate volatility is given as the four-year moving average of the monthly absolute value of exchange rate change averaged among the three cross rates of the US dollar, euro (or Deutschemark pre-1999), and yen.

Figure 9 shows the evolution of the international monetary system and of global inflation from 1950 to 2020. It combines world inflation (average inflation weighted by each country's share of world GDP, for over one hundred countries) with the average variation in G3 (United States, Germany, and Japan) bilateral exchange rates (a synthesis of the two panels of figure 1). The strong correlation between the level of global inflation and the variability of exchange rates is immediately apparent, much as we highlighted for advanced economies alone. Note that the mid-1950s saw the nadir of global inflation although inflation differentials were higher.[21]

21. In figure 9, global inflation is calculated as a GDP-weighted average of those countries for which data were available in each month. Inflation rates in the 1950s and 1960s should therefore be compared to recent inflation rates with caution: the sample in the 1960s contains far fewer developing countries and developing countries comprised a far smaller share of world GDP at the time. Nevertheless, it is interesting that exchange rates only began stabilizing in Bretton Woods in the deflationary years and years with low interest rates following the Korean War.

The Bretton Woods halcyon era formally ended when the United States de-linked the dollar from gold in 1971, but as the figure shows, the system was already in decline by the late 1960s. The inflation surge in the early 1970s was the straw that broke the camel's back. It is not coincidental that the departure from the gold standard was part of a package of policies all announced in tandem on August 15, 1971. The package included price controls in an attempt to limit already rising inflation and 10 percent tariffs on imported goods—another relevant parallel to today's world of heightened trade tensions.[22]

This ushered in a third phase of the global exchange rate system, a great de-anchoring, with world inflation consistently in double digits and peaking at 20 percent. We have seen that inflation was also very variable across high-income countries and even more so when including developing countries, many of which experienced hyperinflation.[23] This was also a period of high exchange rate volatility and multiple currency crashes (see figure 7). It was only in the mid- to late 1990s that world inflation stabilized at moderate rates and inflation differences across countries diminished. This ecosystem supported the emergence of the Bretton Woods II system, which has now morphed into the extended Bretton Woods II system, thanks to the decline in G4 exchange rate variability documented in this paper.

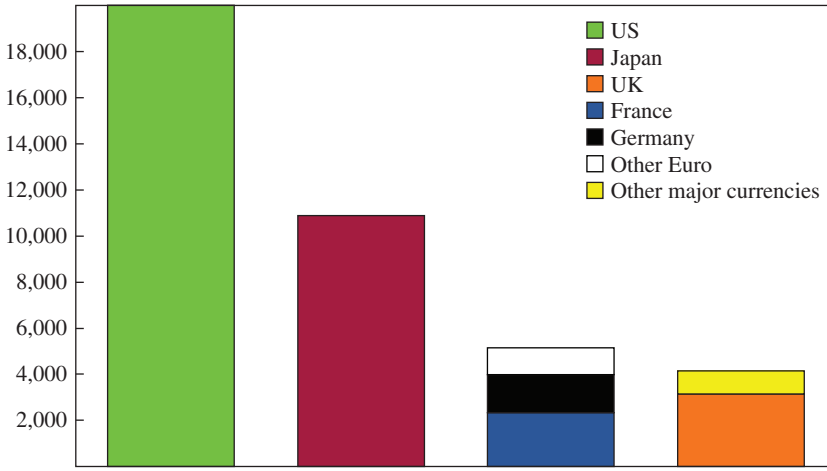
Clearly, a surge in global inflation could pose a threat to the current international monetary order. Inflation targeting has been the de jure monetary framework of choice in the twenty-first century. The proliferation of independent central banks and inflation targeting regimes may well have anchored inflation expectations and contributed to the benign inflationary environment of the past two decades. However, inflation targeting has not yet faced a test commensurate with the challenges that led to the great de-anchoring of the 1970s. It may yet face one after the COVID-19 crisis.

Another potential source of risk is the dramatic rise in global debt, both public and private. Sharply rising debt may well be perfectly benign given very low interest rates, but at the same time it can increase vulnerability to a loss of confidence. Theory suggests that an optimizing hegemon may be tempted to take advantage of global demand for its debt by sharply expanding issuance, taking the world from a safe zone to a risky multiple

22. See Richard Nixon's "Address to the Nation Outlining a New Economic Policy: 'The Challenge of Peace,'" American Presidency Project, https://www.presidency.ucsb.edu/documents/address-the-nation-outlining-new-economic-policy-the-challenge-peace.

23. Our world inflation index caps countries' inflation at 100 percent to avoid disproportionate weight on extreme hyperinflations.

Figure 10. Marketable Debt Securities, August 2020



Sources: National finance ministries and authors' calculations.

Note: Marketable debt securities in billions of US dollars, August 2020 (June or July for some countries depending on data availability, converted at market rates of August 2018). "Other euro" are highly rated eurozone securities (Austria, Belgium, Finland, and the Netherlands) other than France and Germany; other major currencies are Australia, Canada, Sweden, Switzerland, and the United Kingdom. China omitted due to lack of concurrent data.

equilibrium zone. This can happen if the hegemon only takes into account risks to its own welfare and does not internalize the global costs of systemic breakdown. It is worth recalling that in the run-up to the 2008 financial crisis, policymakers in the United States and United Kingdom (whose financial firms were big beneficiaries of financial globalization) downplayed concerns expressed by other countries that their lax financial regulation could become a global problem.

Presumably, near-term risks to significantly higher US debt issuance remain low, but nevertheless consider figure 10, which compares US borrowing in global markets to other major currency issuers. Remarkably, although the combined economic size of the other major advanced economies issuers considerably exceeds the size of the United States, the United States government has placed roughly as much public debt in global markets as all the others combined. Moreover, near term, even with Europe now issuing Eurobonds, US borrowing is likely to continue to outstrip the world.

Even if rising US debt levels eventually push it into a zone of greater fragility—that is, entering a multiple equilibria zone in a model such as that of Farhi and Maggiori (2018)—economic theory tells us little about the

timing of a loss of confidence, which could take a year or a century. Our own strong prior is that the near-term risks are likely very small and should remain so over the next several years. However, if US public debt continues to increasingly dominate global public debt markets—which are rapidly growing overall—the situation can change quickly and unexpectedly. It bears noting that Yale economist Robert Triffin famously warned the US Congress in 1960 that there was a fundamental inconsistency between the growing size of foreign reserves of US dollars and the shrinking backing in terms of gold reserves and US GDP (Triffin 1964). Yet, the Bretton Woods system lived on for more than a decade.

The collapse of the interwar gold standard in the 1930s and the breakup of Bretton Woods in the early 1970s were times of great macroeconomic duress. The same need not be true next time, if there is a breakup of extended Bretton Woods II, but the risks should not be underestimated.

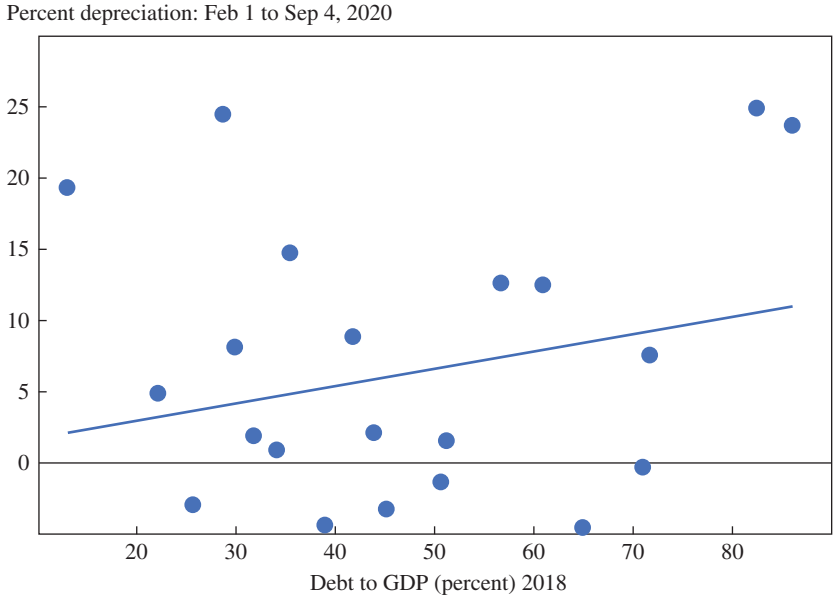
Even without a breakdown at the core, the risks to emerging markets are immense, and unlike in the 1980s and 1990s, the spillovers to advanced economies, including the United States, could be much greater this time. At purchasing power parity weights, emerging markets now account for roughly 60 percent of global GDP compared to just over 40 percent in the 1980s and 1990s. Moreover, advanced economies and emerging markets today are linked by complex global supply chains that almost certainly have a big impact on productivity and prices in advanced economies, at least in the medium run. It would be hyperbole to say that emerging markets are the canary in the coal mine for global inflation and exchange rate stability, but it would be complacent to dismiss the transmission risks.

Spreads on emerging market sovereign bonds spiked in March, currencies from the Brazilian real (down 25 percent in 2020) to the Turkish lira (down 60 percent from 2016 to the end of 2020) collapsed, and several central banks expended as much as a quarter of their reserves to prop up their currencies. The Institute of International Finance's daily capital flows showed capital flowing out of emerging markets from February to April 2020 in quantities five times greater than in the similar time frame following the collapse of Lehman Brothers in 2008. Outflows have since abated and capital flows have resumed into some markets. Emerging market exchange rates have moved, but in most cases by less, so far, than in the 2008 crisis. But this could change.

Indeed, the crisis is still unfolding; even if a vaccine is found, emerging markets may not benefit for years. In the meantime, they face many of the same fiscal, social, and political stresses as advanced economies. The long period of macroeconomic stability in emerging markets is at risk. Figure 11

Figure 11. Preexisting Conditions and COVID-19 Devaluation: Emerging Markets

Panel A: Public debt to GDP



Panel B: Deficit to GDP

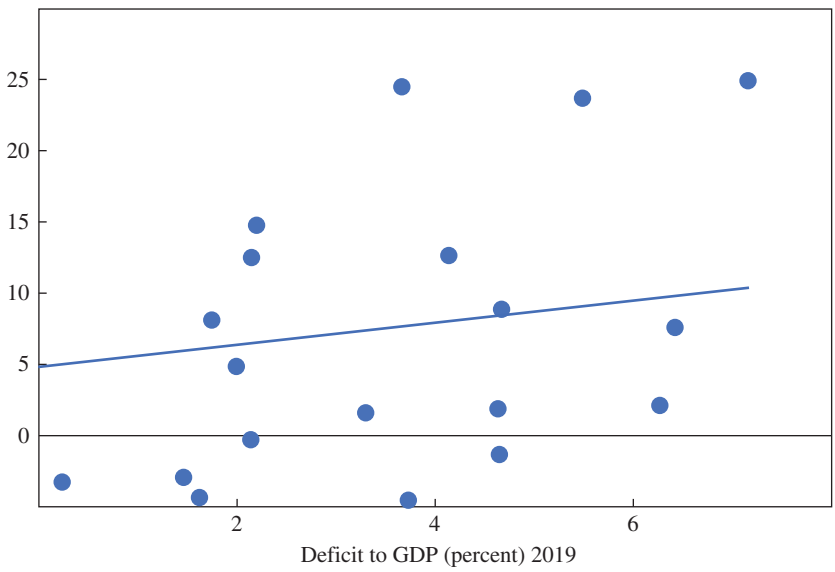
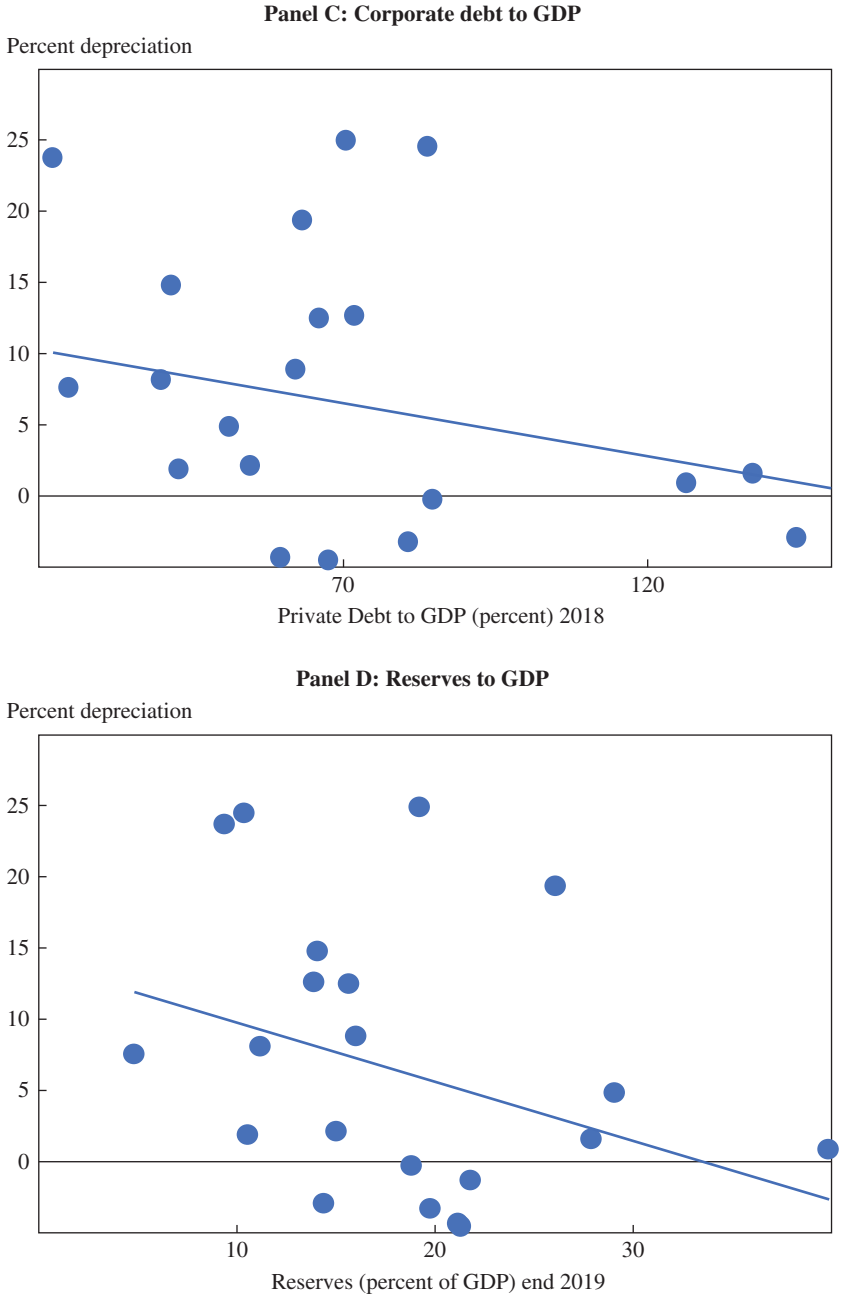


Figure 11. Preexisting Conditions and COVID-19 Devaluation: Emerging Markets (*Continued*)



Sources: IMF Global Debt Database, Bloomberg, and authors' calculations.

assesses some of the risk factors hovering in the background of the relatively benign outcomes in emerging markets to date. It shows a scatter plot across countries categorized as emerging markets by the IMF, comparing the exchange rate decline from February 1 to date with a number of preexisting conditions prior to the COVID-19 crisis. Much has been written on the importance of private sector debt as a predictor of financial crisis, but interestingly we find no correlation between the ratio of private sector debt to GDP and the currency sell-off during the COVID-19 pandemic (panel C of the figure). This is separately true for corporate debt and household debt and the growth of private sector debt in recent years (not shown in the figure).

In contrast, panels A and B of figure 11 show that fiscal conditions are correlated with the emerging market exchange rate decline in 2020. Countries with higher ratios of debt to GDP and higher deficits to GDP (both measured in 2019) saw greater exchange rate declines since February 2020. While the sample size is small and there is much variation in the data, the correlations are at least suggestive that markets are more sensitive to emerging markets' fiscal positions than they are to private sector balance sheets, at least so far.

The twenty-first century saw the greatest accumulations of central bank foreign exchange reserves on record. Central bank foreign exchange reserves have increased nearly eightfold this century from $1.4 trillion in 2000 to $11 trillion today. Panel D of figure 11 shows that the relative stability of emerging market exchange rates should be viewed in the context of a large deployment of these reserve holdings to prop them up. Countries entering the crisis with larger reserve holdings relative to GDP saw lower exchange rate declines, suggesting that reserves served as a buffer against exchange rate volatility. Most dramatic is the case of Turkey, whose central bank has already expended 40 percent of its foreign exchange reserves since the beginning of the year. But the reserve sell-off has been widespread with countries ranging from Egypt to Ecuador (showing foreign exchange reserves declining by 20 percent and 30 percent, respectively) to support their currency.[24]

IV. Conclusions

This paper highlights a significant but not well-known fact about the global exchange rate system: the increasing stability at its core. The Bretton Woods II regime, first highlighted in an insightful series of papers by Dooley,

24. Figure A4 in the online appendix shows the same figure comparing emerging market sovereign spreads (over ten-year US Treasuries) and shows similar patterns.

Folkerts-Landau, and Garber (2004), stressed stability between the dollar and the rapidly growing countries of Asia. Bretton Woods II has now morphed into extended Bretton Woods II, including the United States, Europe, and Japan. By some measures, extended Bretton Woods II has surpassed Bretton Woods I in stability, durability, and breadth. One only has to recall that during Bretton Woods I, the second-largest economic region in the world, the Soviet Bloc, did not participate and was not pegged to the dollar. By contrast, not only has the euro-dollar rate become relatively stable, but exchange rate instability among the nineteen countries of the eurozone has been completely eliminated.

Just as Bretton Woods I came to a crashing end, there are risks to extended Bretton Woods II. The risks are most apparent in emerging markets, whose share of global GDP has risen dramatically since 1980 and are linked to advanced economies both through demand and through increasingly important global supply chains. External debt levels (public and private) in emerging markets were already rising to risky levels in the years prior to the pandemic and are a significant source of risk now with uncertain output and falling global trade. Although many are able to tap today's extremely liquid markets, the interest costs are high, and new borrowing has not been enough to refinance loans coming due and to replace portfolio outflows. Arguably, several debtor countries are effectively liquid (thanks especially to extraordinary actions by the Federal Reserve and the ECB) but insolvent.

Moreover, even after the full-blown health crisis is tamed, the COVID-19 crisis could well have a lasting negative effect on the supply side of the economy. Globalization could be dramatically rolled back, with some travel restrictions likely to remain in place for years, global supply chains consolidated to strengthen resilience, and political ferment threatening to amplify these effects, regardless of election outcomes. As the virus lingers, the explosion of small business bankruptcies could strengthen monopolies and reduce pressures for innovation. Although central banks have extended broad guarantees, financial fissures could start expanding. Even if the current low inflation dynamic persists for many more years, there is non-trivial risk that eventually the mix of highly expansive monetary and fiscal policy in the face of a long-term adverse supply shock could upend the inflation calm of recent decades. Massive shocks to the global economy can produce turning points. Needless to say, the risks are difficult to assess, but we have argued that despite the preternatural calm in exchange rate markets, this too can come to an end, just as the Great Moderation did in 2008 and the second great moderation did in 2020.

Enhanced stability of the global exchange rate system is hardly a problem. Indeed, the longer-term trend decline in core exchange rate volatility likely reflects the global shift to having independent, technocratic central banks. But the more recent decline in volatility since 2014 and even more so in the face of the COVID-19 pandemic still needs to be diagnosed. We have argued that the recent trend more likely reflects the paralysis of monetary policy at the zero bound and there are reasons to be concerned that today's stability might mask fragilities, not strengths. The exchange rate is a portmanteau measure of relative national macroeconomic and financial shocks, and the current low pressure reading needs to be studied further before being declared an unalloyed triumph of modern independent central banks.

ACKNOWLEDGMENTS We thank Clemens Graf von Luckner for his outstanding research assistance and Andrew Lilly for his comments and sharing the CVIX data. The editors Janice Eberly and James Stock, our discussant Silvia Miranda-Agrippino, participants at the Brookings Papers on Economic Activity conference, Fall 2020, and Barbara Rossi provided useful suggestions.

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Comment and Discussion

COMMENT BY

SILVIA MIRANDA-AGRIPPINO[1] This paper by Ethan Ilzetzki, Carmen M. Reinhart, and Kenneth S. Rogoff analyzes the drivers and latent risks associated with the recent trends in exchange rate volatility among major currencies. The paper is developed along three main lines. First, using data since the end of Bretton Woods, the authors document a slow but persistent decline in average volatility among the core G3 currencies—the US dollar, the euro, and the yen. The decline is shown to have accelerated after the first half of 2014, when European interest rates moved into negative territory, and persisted throughout the first half of 2020, notwithstanding the global health crisis. Second, the authors argue that the fundamental driver of this increased exchange rate stability at the core is to be found in the "paralysis" of monetary policy. The convergence of inflation rates, and of short and long rates in particular, is singled out as the driving force behind this downward trend. Other explanations—including the rising status of the dollar as a global reserve currency, global risk cycles, and the global nature of recent real shocks—are briefly examined but ultimately dismissed. Third, the paper weighs some of the risks around this extended Bretton Woods II regime. On the one end, the supply nature of the COVID-19 shock and some of the unprecedented liquidity injections implemented in response to it may put advanced economies on a trajectory of rising inflation. On the other, large and increasing levels of private and public debt, manageable in a low interest rate environment, may generate vulnerabilities

1. I thank Hélène Rey and colleagues at the Bank of England for useful comments and discussions. The views expressed are those of the author and do not represent those of the Bank of England or any of its committees.

and potentially lead to a loss of confidence if monetary policy divergence arises due to inflation risk. Realization of such risks could lead to a Triffin event (Farhi and Maggiori 2018; Gourinchas, Rey, and Sauzet 2019) and have dramatic consequences for the stability of the international monetary system as we know it.

This is a very important paper and addresses one of the main outstanding challenges in international macroeconomics and finance, with fundamental policy implications. I will organize my comments around two main points. First, I will propose a complementary view of the drivers of foreign exchange (FX) volatility among major currencies. My conclusions will be that it would be unwise to discount global risk cycles altogether and that monetary policy broadly intended may have in fact played an active role as a global stabilizer over the recent months. Second, I will zoom in on the latest data and note that—differently from previous recession episodes—following the COVID-19 shock, the dollar is depreciating while other currencies are in high demand. We may already be experiencing a loss of confidence to some degree. And despite relatively benign inflation projections and guidance that monetary policy will likely remain accommodative for years to come.

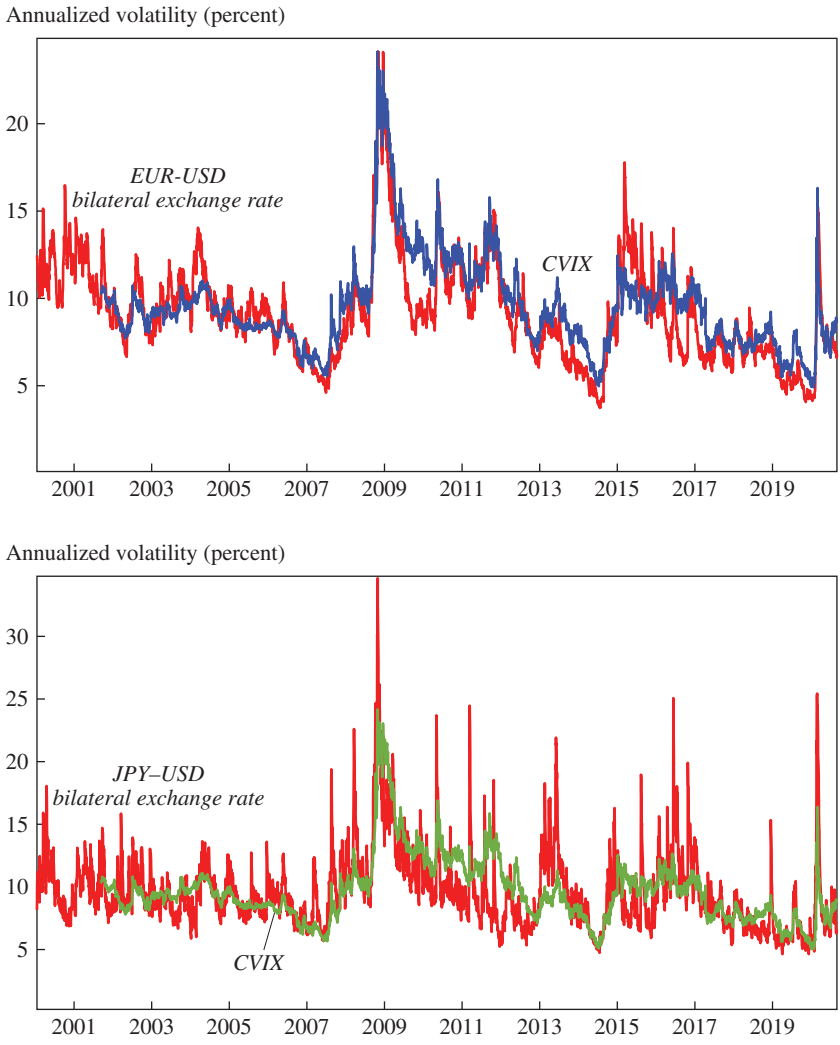
FX VOLATILITY DYNAMICS AT THE CORE I will start with looking at the time evolution of FX volatility among major currency pairs over the last two decades. In order to bring forward the dynamics relative to longer-term averages as used in the paper, for my analysis I will use the estimates provided by the NYU Stern Volatility Lab.[2] Figure 1 plots the estimated annualized volatility of the bilateral exchange rates for the euro (top panel) and the yen (bottom panel) against the dollar.[3] In both subplots, the Deutsche Bank's Currency Volatility Index (CVIX) is also shown. The CVIX is a synthetic measure of the historical volatility of the major G7 currencies. Similar to the VIX, it can be used to assess stress levels in currency markets. Data are daily and cover the period January 1, 2000 to September 18, 2020.

There are a number of elements that are worth noting. First, across currency pairs, the years immediately following the turn of the century are indeed characterized by a certain degree of stability. This pattern, however,

2. NYU Stern Volatility Lab; https://vlab.stern.nyu.edu/. By construction, applying a moving average filter increases the persistence of the original data, the more so the higher the moving average order. This can have the effect of introducing trends in place of one-off peaks of different intensity and renders the interpretation of the timing of events more challenging. See online appendix A.

3. For the purpose of this discussion, the specific model used to estimate the volatility of FX currency pairs is inconsequential.

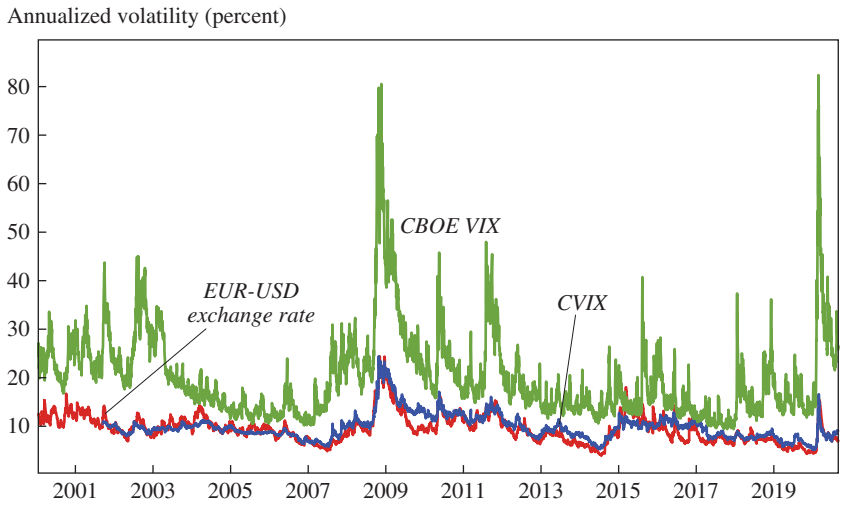
Figure 1. Estimated Volatility of Bilateral Exchange Rates against the US Dollar



Source: NYU Stern Volatility Lab.

Notes: Top panel shows the volatility of the EUR-USD bilateral exchange rate and Deutsche Bank's Currency Volatility Index (CVIX). Bottom panel shows the volatility of the JPY-USD bilateral exchange rate and Deutsche Bank's CVIX.

Figure 2. FX Volatility and Global Risk Measures



Source: NYU Stern Volatility Lab.

Notes: Estimated volatility for the bilateral EUR-USD exchange rate, Deutsche Bank's CVIX, and CBOE VIX.

was dramatically interrupted with the global financial crisis, and again in 2015. This latter period corresponding roughly to the end of the Federal Reserve's quantitative easing (QE), and to expectations of interest rates moving away from the zero lower bound. While short-lived, the COVID-19-induced volatility spike that occurred in the earlier months of 2020 also stands out as a significant and quite dramatic shift in volatility dynamics. Second, and importantly, the volatility dynamics seem to share a large common component. Abstracting from country-specific idiosyncrasies, the CVIX tracks the lower frequency movements remarkably well irrespective of the specific pair. Hence, while the existence of a clear downward trajectory over this sample is somewhat unclear, the notion that common causes may be responsible for the bulk of the movements in the volatility of the G3 currencies seems to find significant traction.

Figure 2 adds to the comparison the VIX index. Nominally a measure of the implied volatility of S&P 500 options, the index is customarily used as a barometer for market uncertainty and overall risk levels in financial markets by practitioners and academics alike. Despite the different scales and the noise embedded in daily data, the similarity of the time profiles is immediately apparent.

This correlation should not be surprising. As the authors also note, "the literature of the past decade, particularly following the influential work of Gabaix and Maggiori (2015), has argued that risk factors and financial frictions likely play a dominant role; Itskhoki and Mukhin (2017, 2019) argue that there is no other plausible way to explain the major puzzles in international macroeconomics." Kalemli-Özcan (2019) shows how risk factors are particularly important for emerging market economies. This exercise is purely illustrative and can hardly provide a formal quantitative account. But it does indicate that dismissing the role played by risk cycles may potentially omit an important part of the story.

Of course, this should not be interpreted as indicating that macroeconomic fundamentals do not matter, or indeed that monetary policy is altogether irrelevant. On the contrary, I would argue that the fact that following the COVID-19 shock currency volatility did not reach the levels seen during the global financial crisis, and that the recent COVID-19-associated volatility episode (albeit not completely reabsorbed) was overall short-lived, may in large part be attributed to the prompt, large, and synchronized intervention of the major central banks.

In March 2020, COVID-19-related news triggered what has been dubbed a "dash for cash" (Hauser 2020). Financial markets, and particularly bond markets, showed signs of worrying dysfunction as market participants were forced to unwind some of their existing positions and sell US Treasuries to generate cash. The disorderly conditions under which bond markets were operating quickly spread to all other corners of the global financial system, quickly raising alert levels worldwide. As the threats to the global economy—and to financial stability (exacerbated by the markets' dysfunctions)—grew, the major central banks intervened with vigorous response packages. The Federal Reserve, the European Central Bank (ECB), and the Bank of England (BoE) launched bond purchase programs on the order of 10–15 percent of national GDP.[4] Also, large programs specifically directed at reducing stress levels in corporate financing were implemented. There is evidence that these interventions were successful in restoring confidence in bond markets and addressing the demand for liquidity.[5] More

4. Bond purchase programs amounted to 14.9 percent of GDP in the United States ($3.2 trillion), 11.9 percent of GDP in the eurozone (€1.35 trillion), and 13.6 percent of GDP in the United Kingdom (£300 billion).

5. Gilchrist and others (2020) show that the Secondary Market Corporate Credit Facility (SMCCF) was effective in stabilizing the corporate bond market following the COVID-19 shock. Altavilla and others (2020) show how ECB policies implemented in response to the COVID-19 crisis were crucial in guaranteeing continued bank lending and favoring the supply of credit.

important from the perspective of this comment, however, was the activation of central bank swap lines in order to address the large and rising demand for US dollars that international banks were increasingly unable to meet.

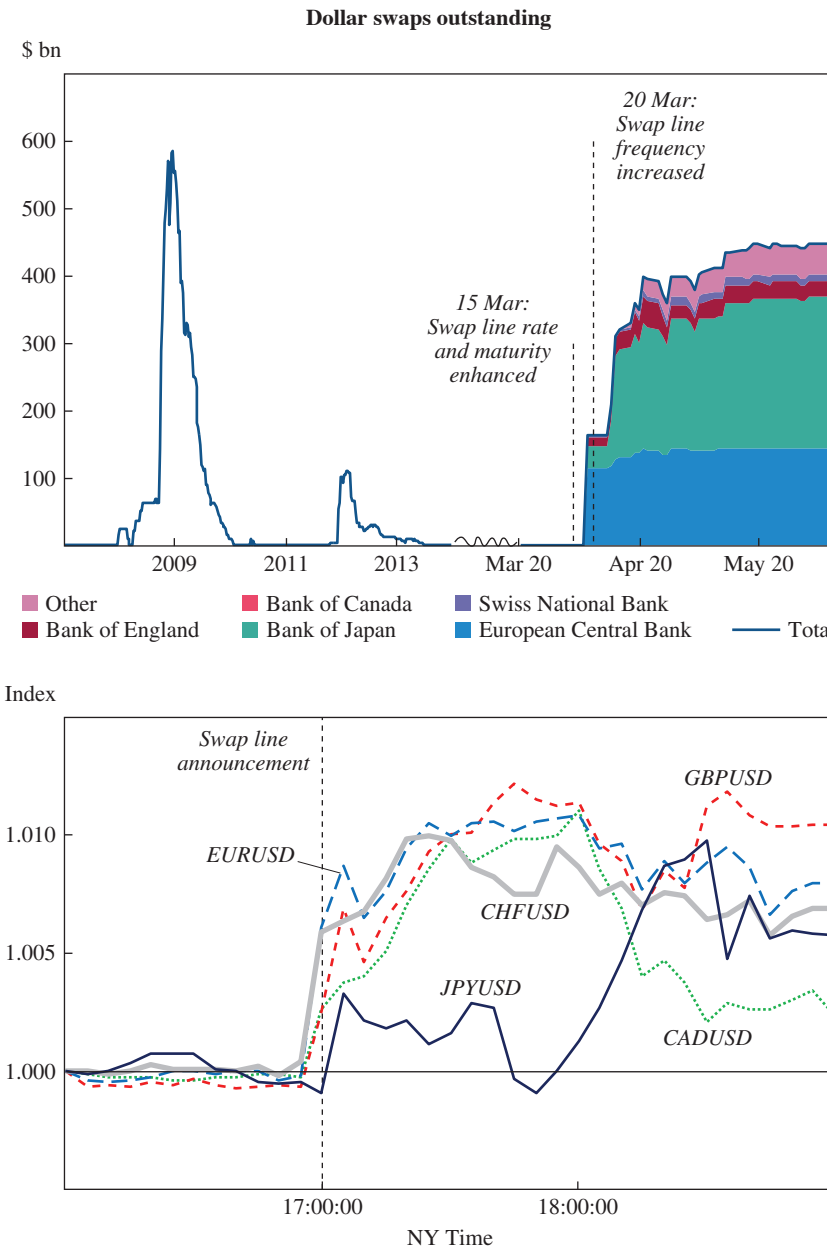
Swap lines were introduced after the global financial crisis to facilitate offshore US dollar funding in times of market disruption.[6] Since their reintroduction in March 2020, dollar swap lines have been heavily used (figure 3, top panel).

The swap lines are an effective tool for monetary policy (Bahaj and Reis 2018). While not designed with the explicit aim of intervening in currency markets, it can be argued that by facilitating the circulation of US dollars at times when demand for them cannot be met due to other types of friction, swap lines can have second-order effects on exchange rates too. While only illustrative, the bottom panel of figure 3 shows that bilateral FX rates against the dollar reacted significantly to the reintroduction of swap lines. At least visually, movements in major bilateral exchange rates are compatible with the announcement date. Eguren-Martin (2020) shows that, if large enough, central bank swap lines are effective in attenuating the adverse effects of dollar shortage shocks, by also acting on the exchange rate channel that functions as an amplifier of such shocks. More research on the effects of swap lines on exchange rates is certainly needed. But the evidence discussed so far is at least indicative that this time around central banks were alert and reacted in a vigorous way that helped to compress the heightened volatility in financial markets. At least to some extent, monetary policy is likely to have accounted also for the quick reversals in FX volatility.

HOW IS THIS TIME DIFFERENT? Since the onset of the pandemic, commentators and scholars have debated the nature of the COVID-19 shock. While a textbook supply shock at its origin, its large second-round demand effects have become increasingly more apparent. Guerrieri and others (2020) rationalize these effects by introducing Keynesian supply shocks: supply shocks that can trigger demand shortages that lead to contractions in output and employment larger than the supply shock itself. They argue that the COVID-19 shock may be a negative Keynesian supply shock.

6. The standing swap lines allow five major central banks (BoE, Bank of Japan, ECB, Swiss National Bank, and Bank of Canada) to lend dollars to their local banks, confident in the knowledge that they can back those loans with dollars secured from the Federal Reserve, short-circuiting any market dysfunction.

Figure 3. Central Bank Swap Lines and FX Market Reactions



Sources: Hauser (2020); Eguren-Martin (2020).

Notes: Top panel shows dollar swaps outstanding. Bottom panel shows high-frequency reactions of bilateral exchange rates against the US dollar at announcement.

The data are consistent with this interpretation. Against the backdrop of sharp increases in unemployment figures, inflation in the United States has so far remained relatively subdued. And the propagation of the COVID-19 shock does not appear to differ in material ways from previous recessions, which Del Negro and others (2020a) argue have been largely the result of negative demand shocks (figure 4).

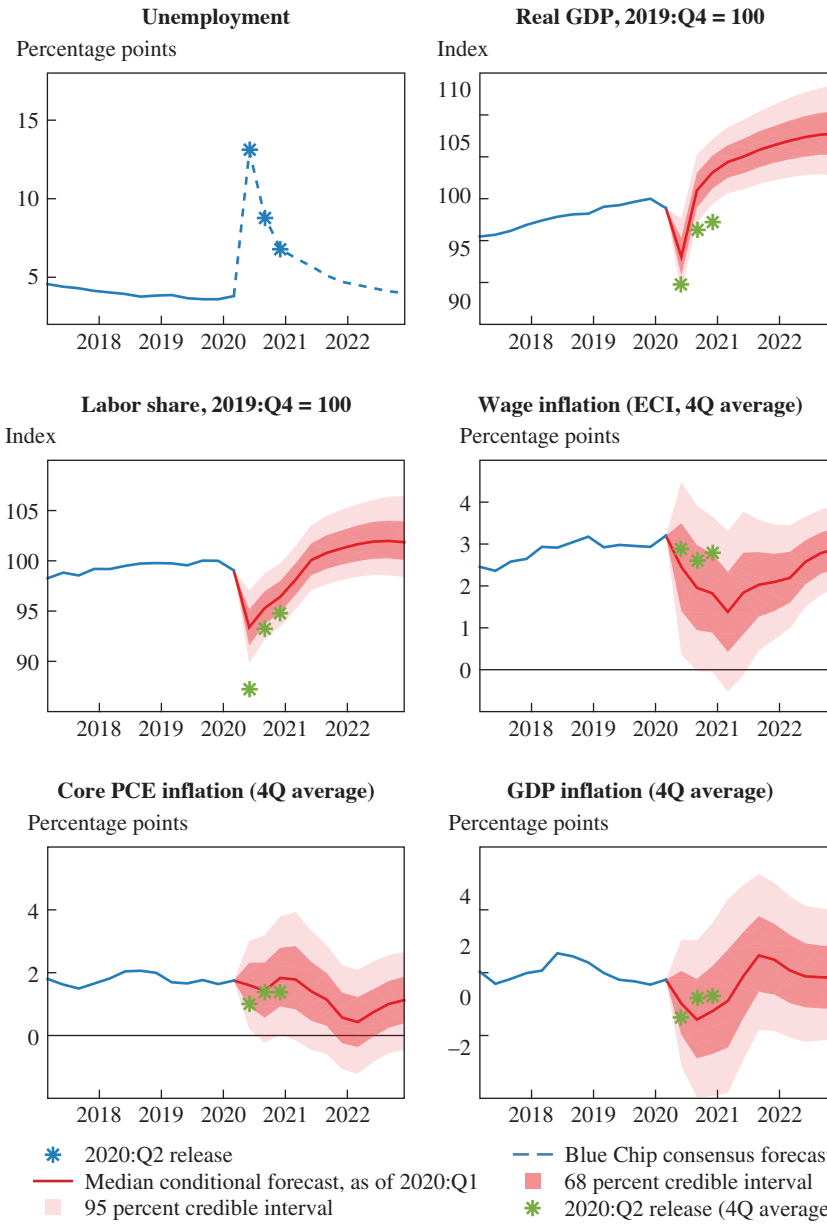
Consistently, professional forecasters attach higher probability to low inflation states for 2021 (figure 5, top panel) and over the long term (figure 5, bottom panel). Taken together, figures 4 and 5 suggest that inflation risk does not seem to be an immediate cause for concern.

At his Jackson Hole appearance last August, Chairman Powell announced the implementation of a revised operating framework for the Federal Reserve. Under the new mandate, the Federal Open Market Committee (FOMC) will "seek to achieve inflation that averages 2 percent over time" (Powell 2020). As a consequence, were they to materialize, inflation overshoots would arguably be less likely to induce expectations of immediate monetary policy tightening. In the most recent FOMC minutes at the time of writing, the guidance was reinforced by projecting no interest rate increases until at least the end of 2023. From this standpoint, it is unlikely that in the immediate future material divergence in the monetary policy stance of the major central banks would arise due to COVID-19-induced inflation risk, and that exchange rate pressures may ensue for this reason.

The current health crisis, however, differs from other major recession episodes, including the global financial crisis, in at least one important way: the continued depreciation of the US dollar against other major currencies. The US dollar is the safe currency par excellence, and it is the primary reserve currency and the currency of choice for invoicing and international financial transactions (Rey 2013; Gopinath 2015; Ilzetzki, Reinhart, and Rogoff 2017, 2019, 2020a, 2020b; Maggiori, Neiman, and Schreger 2020). One feature this status comes with is the fact that the dollar typically appreciates during recessions. Instead, after the initial rally in March, the dollar depreciated considerably (figure 6).

The depreciation is notable in the bilateral exchange against the euro (figure 7, left panel). The euro is the second-largest currency in global exchanges, therefore its appreciation is perhaps not entirely surprising. But the dollar depreciated also against the British pound (figure 7, right panel). It is unlikely that international markets are not keeping track of the developments around negotiations with the EU, and that the arguably higher risks of a no-deal Brexit have not been priced in. Therefore, the dollar is losing ground relative to the pound despite these significant

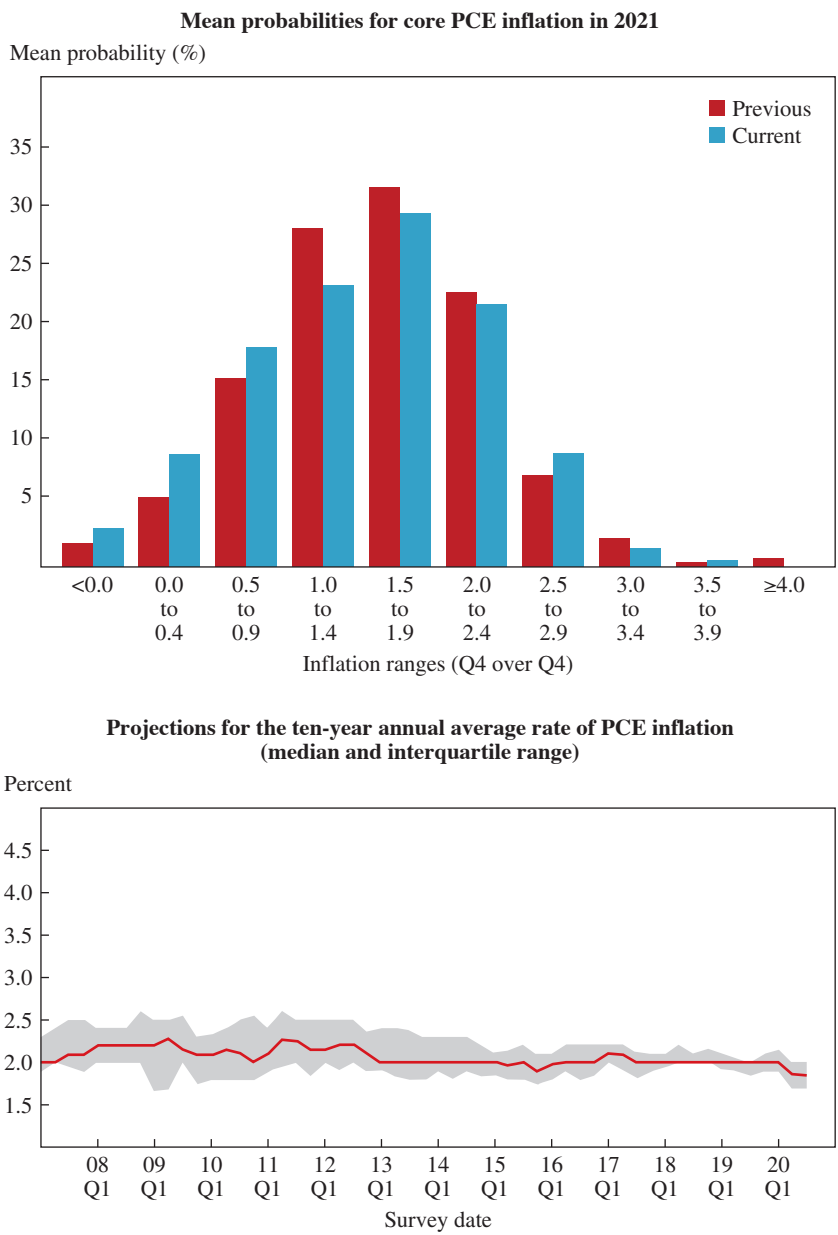
Figure 4. Responses of US Macro Aggregates to COVID-19 Shock



Source: Del Negro and others (2020b).

Notes: Response of GDP; unit labor costs; and wage, core PCE, and GDP deflator inflation, conditional on unemployment following the path in the first subplot, which represents the median blue chip projection; US data.

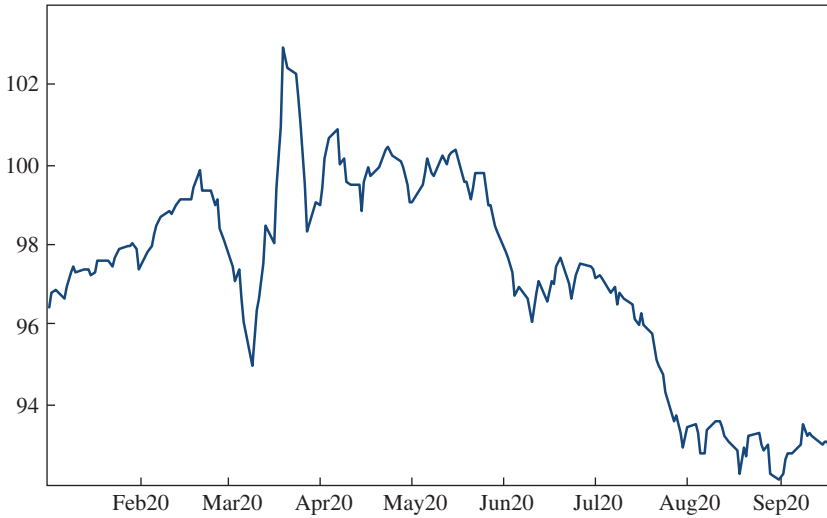
Figure 5. SPF Inflation Projections



Source: Third Quarter 2020 Survey of Professional Forecasters.

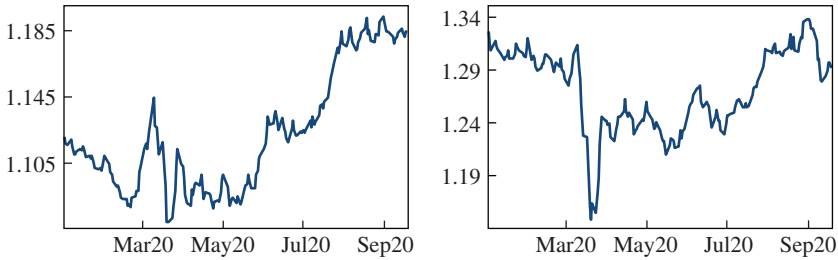
Notes: Top panel shows mean probabilities for US core PCE inflation in 2021, current SPF vintage (August 2020) versus previous quarter vintage. Bottom panel shows projections for the ten-year annual average rate of US PCE inflation.

Figure 6. US Dollar Exchange Rate Index



Source: Refinitiv.

Figure 7. Bilateral Exchange Rates against USD



Source: Refinitiv.
Notes: Left panel shows the bilateral EUR-USD exchange rate. Right panel shows the bilateral GBP-USD exchange rate.

UK-specific risks. This suggests that the motives behind this broad-based dollar depreciation may be specific to the United States.

The United States typically behaves as a world banker (Gourinchas and Rey 2007b). Issuing the international currency confers to the hegemon excess returns on its net foreign asset position in normal times ("exorbitant privilege"; Gourinchas and Rey 2007a). During global crises, however, it has typically been the case that this was associated with net wealth transfers to the rest of the world, due to the joint action of dollar appreciations and

stock market devaluations ("exorbitant duty"; Gourinchas, Rey, and Govillot 2010). In the current conjuncture, and despite the global recession, stock markets are trading at record highs, while the dollar is depreciating. As noted in Gourinchas, Rey, and Sauzet (2019), one of the key underpinnings of the international monetary and financial system is that the hegemon provides safe assets to the rest of the world. But safety is a relative concept and ultimately rests on confidence. It is entirely possible that the recent swings in FX markets may be the result of temporary speculative positioning motivated by a search for yield. However, the dollar depreciation may also signal a shift in investors' appetite away from US assets. As the world battles its way out of the global pandemic, the United States faces the extra burden of maintaining its status as the provider of a stable and safe global currency in times of crisis. The combination of high levels of debt (public and external) and weak fundamentals resulting from the COVID-19-induced disruption may prove unsustainable. Political and global geopolitical factors could become first order. Risks to the stability of the international monetary system may be closer than they appear even in times of extremely low interest rates and subdued inflation for years to come.

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GENERAL DISCUSSION Alan Blinder started the discussion by acknowledging that the authors' explanation that exchange rate volatilities are lower than in the past due to the decline in the volatility of inflation and interest rates made intuitive sense. However, Blinder wondered whether this trend has been mainly driven by the fact that whenever the mean of a series decreases over time—as has been true of inflation and nominal interest rates—its standard deviation is also very likely to decrease. Therefore, Blinder suggested, it would be more illuminating to consider the coefficient of variation (the ratio of the standard deviation to the mean). During the presentation, he did some rough calculations which indicated that the coefficient of variation for the series hadn't changed much, as both the mean and the standard deviation decreased at the roughly same rate.

Finally, Blinder agreed with Silvia Miranda-Agrippino in finding it puzzling that, unlike during prior crises, there hadn't been a flight to quality directed at the United States and asked if anyone knew why.

In response to Miranda-Agrippino's discussion, Ethan Ilzetzki showed the audience a graph, featured in their presentation, of the exchange rate levels of the euro and yen from 1999 to 2020 in order to illustrate the markedly visible decline in exchange rate volatility after 2014. In particular, Ilzetzki contrasted the gyrations of both exchange rates following the 2008 global financial crisis with a very muted response to the COVID-19 crisis. This observation, he argued, put the decline in volatility into a broader perspective. Moreover, he emphasized that the facts discussed in the paper weren't solely about the COVID-19 crisis. The flatlining of the exchange rate levels occurred well after the swap lines of the global financial crisis were gone and before the swap lines of the COVID-19 crisis came into play. Therefore, he reasoned that the swap lines alone can't explain the break after 2014.

Next, Ilzetzki revisited Miranda-Agrippino's point that the implied volatility of currencies is highly correlated with the implied volatility of stocks.

He pointed out that while the stock market in 2020 showed the highest readings of volatility in 150 years, the increase in exchange rate volatility had been modest. In particular, he suggested the blip in volatility was comparable to the unmemorable month of February 2016. Therefore, he argued that the volatility decline was related to currency risk and not generalized risk. While admitting the swap lines explanation met that criteria, he countered that it failed to explain why January 2020, prior to the COVID-19 crisis and the resultant swap lines, was the lowest period of implied volatility on record.

Kenneth Rogoff thanked Miranda-Agrippino for her comments. Rogoff clarified that while the authors didn't believe that central bank policy had been ineffective, they drew a distinction between conventional policy—such as interest rate policy—in which central banks have independence with other policies in which central banks essentially operate as extensions of the treasury. Since exchange rates depend on both past interest rates and expectations of future interest rates he emphasized that one crucial aspect of the COVID-19 crisis was that, on top of central banks hitting the zero lower bound, markets viewed the neutral or equilibrium policy rate to be significantly negative for years to come.

Carmen Reinhart turned to Blinder's question on the depreciation of the dollar by saying she did not claim to know the answer and explaining that currency cycles are notoriously difficult to predict. On the larger question of whether the COVID-19 crisis would undermine the dollar's dominance, Reinhart argued that major alternatives to the dollar were difficult to contemplate. However, she suggested that the large outstanding debt of the United States paired with the decline in the United States' share of global GDP—largely due to the increasing share of China's GDP—could ultimately undermine the Bretton Woods II system.

Finally, Reinhart highlighted the role played by the synchronicity of policy responses in major economies during the global financial crisis and the COVID-19 crisis to the decline in currency exchange rate volatility.

Şebnem Kalemli-Özcan stated that emerging markets' interest differentials and their inflation rates have also been going down for some time—albeit not to the same extent as those of high-income countries.[1] Kalemli-Özcan then asked the authors whether, based on these trends, one

1. Şebnem Kalemli-Özcan, "US Monetary Policy and International Risk Spillovers," in *Economic Policy Symposium Proceedings: Challenges for Monetary Policy* (Jackson Hole, Wyo.: Federal Reserve Bank of Kansas City, 2019). https://www.kansascityfed.org/~/media/files/publicat/sympos/2019/2019ozcan.pdf?la=en.

should expect emerging markets' exchange rate volatility to go down as well. If so, she wondered whether the authors thought that the reason this hadn't happened yet had to do with emerging markets, unlike high-income countries, responding to exchange rate volatility as part of their monetary policy.

Reinhart stated that the conduct of monetary policy in emerging markets was new territory. The COVID-19 crisis was the first time in which emerging markets adopted countercyclical monetary policy across the board. In prior crises, emerging markets typically raised interest rates in order to protect their currencies. Nevertheless, Reinhart cautioned that she was leery of what to expect on the inflation front due to the lasting effects of supply shocks—which she expected to play out most imminently in emerging markets.