The Global Reach of US Monetary Policy: Suggestive Evidence from the Global Financial Crisis and the COVID-19 Pandemic

by

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Abstract:

This paper assesses the global reach of US monetary policy over the 2007-2022 period in a sample of 78 countries and currency unions. Our findings show that the zero-lower-bound (ZLB) problem was restricted to advanced economies or those with currencies tied to the US dollar during the Global Financial Crisis (GFC) but became more widespread following the outbreak of COVID-19. The enormous and rapid expansion of the Fed's balance sheet was not common elsewhere in the GFC period. Only three central banks expanded the size of their real balance sheet by more in relative terms than the Fed during the GFC and its aftermath. In contrast, six central banks did so after hitting the ZLB bound during the COVID-19 pandemic. The strongest support for a leading global role of Fed policy action comes from a pairwise assessment of central bank balance sheet changes during the two crises. Positive co-movements, both contemporaneous and lagged, between US balance sheet changes and changes in other countries were common, with correlations being considerably more widespread and higher during the pandemic than the GFC.

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1. Introduction

Only 12 years apart, the Global Financial Crisis (GFC) of 2008 and the COVID-19 pandemic of 2020 were responsible for the two deepest global recessions since the Great Depression of the 1930s. The two crises were similar in that they brought about unprecedented hardship around the world in terms of lost output, high unemployment, and financial losses. At the same time, the two crises differed fundamentally with respect to their origin. Arguably, the GFC originated in the United States and was the result of financial excesses. From the start, the crisis bore the hallmarks of a dangerous cocktail. Its ingredients consisted of excessively low interest rates, a lack of financial oversight and regulation, financial imbalances, and, in hindsight, questionable policy initiatives to support home ownership.[1] In consequence, the GFC was due to systemic failure of market and policy mechanisms, i.e. the crisis was generated from within. By contrast, the COVID-19 pandemic was a pure public health related phenomenon and, as such, exogenous. Due to its contagious nature, the virus spread rapidly around the globe, putting enormous pressure on all types of health and care facilities. The ensuing pandemic led to an economic standstill in all continents. Lockdowns of production facilities and closures of companies in the service sector were the inevitable consequences. No economy was spared. By all accounts, the economic losses suffered during the pandemic exceeded those during the GFC. The World Bank reports that real global output contracted by 1.34 percent in 2009 while in 2020 it decreased by 2.8 percent.[2]

The seeds of the Global Financial Crisis (GFC) were planted well before the outbreak of the crisis. Financial markets were first rattled in 2007 by the shutdown of a closed investment fund operated by BNP Paribas. With the insolvency of Bear Stearns in March 2008, market sentiment deteriorated before crashing after the outright bankruptcy of Lehman Brothers in late September of the same year. Risk premia on financial assets reached abnormal heights. The panic that engulfed financial markets, first in the United States and then elsewhere, presented a unique challenge for central banks. In an effort to restore calm and confidence in the banking and insurance sector as well as the commercial paper market, the Federal Reserve (Fed) of the United States established unprecedented emergency loan facilities and special liquidity-enhancing programs. By December 2008 it had also lowered the Federal Funds Rate target, its

[1] Davies (2010) provides a detailed account of the origin and potential causes of the GFC. A savings glut in Asia and the oil-rich countries of the Middle East as well as the US current account imbalance are also frequently mentioned as contributing factors to the outbreak of the GFC. NINJA (No income, no jobs or assets) loans were a major driving force behind the surge in house prices before the GFC.

[2] Growth rate of world GDP (constant 2015 US$) taken from World Bank database.

conventional monetary policy tool, in a series of cuts ranging from 25 to 100 basis points to virtually zero. At the zero lower bound (ZLB), the Fed had run out of room to lower the federal funds rate target further.

Seeking further economic stimulus, the Fed therefore turned to unconventional monetary policy in November 2008, adding balance sheet management and announcements on the future course of monetary policy to its toolkit. The GFC marked the beginning of a large-scale expansion of the Fed's balance sheet by US$ 3.6 trillion to 4.5 trillion by October 2015 (Board of Governors of the Federal Reserve System, 2024). Four large-scale asset purchase programs (LSAPs) involved buying long-term assets, including mortgage-backed securities, Treasury bonds and agency debt, with the objective of lowering long-term interest rates and thus flattening the yield curve.[3]

However, the threat of an economic collapse was not unique to the United States. The effects of the GFC sent an economic shockwave across the world, resulting in deep recessionary conditions elsewhere. Stagnating domestic economies and an extremely easy monetary policy by the Fed put pressure on many central banks to cut their policy rates too. While interest rates decreased in many advanced countries in the wake of the GFC, central banks in some emerging countries maintained relatively high interest rates. As a result, these countries experienced sizeable capital inflows that were perceived as threats to domestic financial stability.[4] The central banks in the affected countries thus had to think of appropriate ways to respond to stimulatory policies pursued by the Fed, as well as by other major central banks such as the European Central Bank and the Bank of Japan.

Concerted policy action was once again required after the outbreak of the COVID-19 pandemic in early 2020. Its rapid spread was a global phenomenon that disrupted supply-chains and dealt a massive blow to international trade. Consumer confidence plummeted to extreme lows in the United States, the Euro area, Japan, the UK, and other countries during the COVID-19 pandemic, surpassing the lows of the GFC. Economies contracted sharply everywhere. Fortunately, the GFC had persuaded policymakers in many countries to develop and install safety measures to improve regulation and oversight of financial markets and thus prevent a

[3] For an overview of the Fed's approach to unconventional monetary policy during the GFC and its aftermath, see Kuttner (2018) and Federal Reserve Bank of New York (2018).

[4]For example, starting in 2009, Brazil slapped a tax on capital inflows that varied from 2 to 6 per cent to counter the record low interest rates in the United States and elsewhere. "Brazil threatened on Friday a further clampdown on speculative foreign capital, firing a warning shot in a 'currency war' its finance minister blamed on money-printing by Western central banks. *If necessary….we have the option of short-term capital taxes…"*(Reuters, 22 September 2012).

financial meltdown.[5] In addition, fiscal authorities played a more prominent role in the attempt to restore calm and confidence in the public domain. From the very start of the pandemic, they initiated special rescue programs and coordinated their activities with the central bank to forestall a collapse of aggregate demand and to shore up the supply side of their economies.

In the United States, the policy space of the Fed was more constrained at the time than during the GFC because the target for the Federal Funds rate had edged up during the recovery phase to only the 2.25 to 2.5 percent range by 2018. When the pandemic broke out, the Fed called two emergency meetings to lower the target for its conventional policy instrument to the 0 to 0.25 percent range. After reaching the ZLB once more, the Fed again resorted to its supplementary tools, special credit facilities, forward guidance and LSAPs, to stabilize the economy. The purchases of additional long-term Treasury Bonds, agency debt securities, and corporate bonds expanded the Fed's balance sheet by approximately US$ 4.8 trillion to a staggering 8.95 trillion in May 2022 (Board of Governors of the Federal Reserve System, 2024).

This study explores the global reach of US unconventional monetary policy in both the GFC and the COVID-19 period. Its central aim is to determine how the rest of the world adapted to the radical changes in US monetary policy that were implemented during both crises and their immediate aftermath.[6] Most of our attention and effort is geared towards scrutinizing one form of unconventional monetary policy: balance sheet management by central banks. We begin our analysis, however, by posing a few simple questions about the ZLB. How widespread was the ZLB problem during both crises? Was it exclusive to central banks in advanced industrialized countries or did it also occur in emerging or lesser developed countries? Was it more prevalent in the COVID-19 period compared to the GFC period? After parsing the global evidence for the ZLB, we take a close look at the way central banks managed their balance sheets in both crisis periods. Specifically, we investigate the degree to which central banks in the rest of the world adjusted their balance sheets in response to the easy monetary conditions set by the Fed. How widespread was the reliance on purchases of assets to bring down long-term interest rates and restore calm and confidence in financial markets in other parts of the world? Were there

[5] Macroprudential policy tools such as countercyclical capital buffers, liquidity coverage, loan to value, debt to income ratios, etc. were put in place to make the financial sector more resilient to adverse shocks.
[6] The alleged existence of a global financial cycle driven by US monetary policy changes has gained some currency since the GFC. See Miranda-Agrippino and Rey (2020) and the literature cited therein.

material differences in the way balance sheets of central banks were managed during the GFC compared to the COVID-19 period?

Three features characterize our empirical study of the spillover effects of US monetary policy decisions on policy action abroad in the wake of the two crises. First, the scope of our analysis is very comprehensive. It extends to a large sample of up to 78 countries and currency unions that includes advanced, emerging, and developing economies. Second, our empirical investigation places a distinct focus on the experience of each individual country vis-à-vis the United States whose central bank played a leading role to contain both crises. We relate movements in the size of the central bank's balance sheet in a country over time to changes in the size of the Fed's balance sheet, determine the maximum expansion of central bank balance sheets, and assess the degree of co-movement of monthly percentage changes in central bank balance sheets in relation to the Fed's. A third distinguishing feature of our study is that it compares the global response to unconventional US monetary policy during the Global Financial Crisis with the response during the COVID-19 pandemic. Much of the existing research on the topic focuses on the spillovers from the US response to the GFC only, while some newer studies also investigate the spillovers during the COVID-19 pandemic.[7]

The two crises were triggered by different events, but both crises led to global downturns. What is left unexplored is the extent and speed of the response of individual central banks to the Fed's expansionary monetary stance in both crisis periods. In this context, our comparative analysis of balance sheet adjustment by central banks worldwide shines a light on the global reach of US monetary policy changes and their effects on policymaking in other countries.

Our findings reveal that during and in the aftermath of the GFC, only a small group of central banks resorted to balance sheet management as a policy tool. These central banks were mostly in advanced countries with important financial centres or had their monetary policy tied to either the Fed or the European Central Bank. Unsurprisingly, in these advanced economies, the central bank's primary policy instrument, a short-term interest rate, had approached the zero lower bound. Yet, marked differences exist even between advanced countries in the way their central banks confronted the challenges posed by the GFC. Central banks in Oceania (Australia and New Zealand) escaped the zero lower bound problem altogether with policy rates staying

[7] Fischer (2021) limits his detailed comparison of central bank response to both crises to the Fed, the ECB, and the Bank of England. Kuttner (2018) and Dell'Ariccia et al. (2018) review the experience of the Fed and the ECB, Bank of England, and the Bank of Japan, respectively, during the GFC. Delgado and Gravelle (2023) examine the scale of asset purchases by central banks in 19 countries during the COVID-19 crisis.

well above zero. In a similar vein, many emerging and developing countries' central banks did not encounter the zero lower bound at all during or in the wake of the GFC. While a handful of central banks in these countries did experience substantial balance sheet expansion even in real terms, most of them did not. Conventional monetary policy via interest rate management remained the norm there.

During the COVID-19 pandemic, more central banks in advanced economies encountered the zero lower bound. They turned to balance sheet management after exhausting the potency of the policy rate. These central banks were in countries firmly embedded in the global financial network. A few of these countries are home to important financial centres. During the GFC only the Bank of England purchased long-term securities on a relative scale comparable to the Fed's, whereas multiple central banks did so during the COVID-19 period. In fact, six central banks (Australia, Canada, Chile, Hungary, New Zealand, and Turkey) expanded their asset holdings by more in relative price-adjusted terms and at times faster than the Fed. However, the reason for the growth of asset holdings varied among central banks. While purchases of domestic long-term government (and in some cases also corporate) bonds were largely responsible for the increase in asset holdings in most cases, a few central banks also increased their foreign exchange reserves by enormous amounts. The experience of COVID-19 illustrates that balance sheet management as an unconventional policy tool was no longer the exclusive domain of central banks in advanced economies. Over this period alone, month-to-month increases in the size of central bank balance sheets in over 30 countries were positively correlated with increases in the Fed's balance sheet, with the correlation coefficient exceeding 0.5 in the majority of countries.

The rest of the paper is structured as follows. Section 2 focuses on the way monetary policy was implemented in 78 central banks worldwide during and in the aftermath of the GFC. We first investigate the prevalence of the zero lower bound problem in the countries included in this study. Then we compare the balance sheet response of each central bank to the massive balance sheet expansion by the Fed during the GFC and its aftermath. Section 3 repeats the exercise for the period covering the COVID-19 pandemic. The final section presents a summary of our findings and explains in what sense they add to the existing literature.

2. Data and Ancillary Information

This study uses observations on up to 78 central banks in 76 countries and two monetary unions. Of these countries, 21 are OECD members, three are classified as "Other Advanced," (Singapore, Hong Kong, and Croatia), five are part of BRICS,[8] 35 are "Emerging," and twelve are "Developing." The classification of "Other Advanced," "Emerging" and 'Developing" countries corresponds to the IMF (2024)'s list of "Advanced Economies," "Emerging Markets and Middle-Income Economies" and "Low-Income Developing Countries" respectively. The two currency unions are the Euro Area and the West African Economic and Monetary Union (UEMOA). When adding OECD countries, "Other Advanced" countries and the Euro Area together, we obtain a group of 25 "Advanced" economies. The remaining countries make up the group of "Emerging and Developing" economies.

Data was collected for each central bank's policy interest rate, total assets on its balance sheet, and the country's CPI at the end of each month from January 2006 to August 2022. The whole sample period is divided into two subsample periods: the first running from January 2006 to December 2015 (pre-GFC plus GFC and its aftermath), and the second running from January 2018 to August 2022 (lead-up to and COVID-19 pandemic).

Where available, data was sourced from the International Monetary Fund (IMF)'s International Financial Statistics database, and otherwise from the Bank of International Settlements, the St. Louis Fed's FRED database, or the country's own central bank website or national statistical database.

Policy interest rate data was unavailable for Suriname and Uruguay in the second subsample period, reducing the country sample size to 76 for policy interest rate analysis. Data was unavailable for the total assets of the central bank of Jordan in the first subsample period. CPI data was not available for D.R. Congo in the second subsample period, and for Belize, Papua New Guinea, and UEMOA in both periods. This reduces the country sample size for analysis involving calculated real balance sheets to 72 in each subsample period.

3. Global Evidence on the Use of Standard and Alternative Policy Instruments

3.1 The Toolkit of Central Banks: Standard and Alternative Monetary Policy Tools

[8]BRICS is a bloc of large emerging economies that originally included Brazil, Russia, India, China and South Africa). Its membership increased in 2024 and now includes other emerging economies such as Egypt.

The Global Financial Crisis and the COVID-19 pandemic shook up financial markets, led to heightened uncertainty in factor and product markets, and caused economies to stagnate or dip into a recession. In many advanced countries, intervention by central banks was seen as necessary to sustain the economy and to prevent a deflationary spiral.

Against the backdrop of a sluggish economy, in normal times, a central bank lowers the target for its main policy instrument, a nominal interest rate which sets a benchmark for short-term market interest rates, to stimulate the economy. In crisis situations when financial stability is under threat, a central bank also provides additional liquidity and sets up special credit programs to shore up the banking sector, insurance companies, mutual funds, and even systemically important private non-financial companies. Once the ZLB is reached, its main policy tool ceases to be the standard policy instrument unless a central bank is prepared to introduce negative interest rates.[9] If the latter is not an option, a central bank needs to turn to alternative monetary policy tools to sustain and stabilize money, capital, and foreign exchange markets. The Fed turned to balance sheet management via quantitative easing (QE) and forward guidance for the main policy instrument as alternative monetary policy tools. The former involves the purchase of mainly long-term assets. Both large scale asset purchases (LSAPs) and a commitment to keep the policy rate at low levels for an extended period are meant to lower long-term interest rates, which in turn should stimulate spending on consumer durables and investment. In open economies, central banks can also manage the exchange rate by intervening in the foreign exchange market. The Swiss National Bank did so with great effect in the aftermath of the GFC to prevent the Swiss Franc from appreciating too much against the Euro.[10]

In the next section, we look at how central banks adjusted their policy interest rate in response to the respective crisis. Initially, we explore the prevalence of the ZLB problem among the countries in the sample, both in the lead-up to and during the crises. We then go on to examine the expansion of the balance sheet of more than 70 central banks. The objective here is to see whether the massive expansion of the Fed's balance sheet unleashed a global expansion of central banks' balance sheets, first during the GFC and then again during the COVID-19 pandemic.

[9] Many central banks, but not all, resisted the move into negative territory. For instance, the Bank of Japan, the Swiss National Bank, the central banks of Denmark and Sweden, and the European Central Bank charged interest on deposits by commercial banks at various stages during the sample period.
[10] Interest on reserves deposited by commercial banks at the central bank and required reserves ratios are other monetary policy instruments. Macroprudential policy tools are used primarily to safeguard financial stability.

3.2. Empirical Results[11]

3.2.1. Global Prevalence of the Zero Lower Bound Problem

As discussed, the Federal Reserve faced the ZLB problem during both the GFC and the COVID-19 pandemic. This section reports the findings of our investigation into the extent to which the rest of the world had to grapple with the same problem.

3.2.1.a. Global Financial Crisis

Table 1 shows that before the GFC only two central banks, those of Japan (≤0.25%) and Singapore (≤ 0.5% but > 0.25%, had their benchmark interest rates below 1%.

Table 1: Minimum Policy Interest Rates Before and After the GFC

Countries	1.00% and less but greater than 0.5%		0.5% and less but greater than 0.25%		0.25% and less	
	2006M1-2008M8	2008M9-2015M12	2006M1-2008M8	2008M9-2015M12	2006M1-2008M8	2008M9-2015M12
OECD (21 countries)	0	1	0	2	1	8
Other Advanced (3)	0	0	1	1	0	1
BRICS (5)	0	0	0	0	0	0
Emerging (35)	0	0	0	2	0	2
Developing (12)	0	1	0	0	0	0
Euro Area (1)	-	-	-	-	-	1
UEMOA (1)	-	-	-	-	-	-
Total (78)	**0**	**2**	**1**	**5**	**1**	**12**

Notes: Lead-up to crisis: 2006M1-2008M8. GFC Crisis and its aftermath: 2008M9-2015M12.
Table A1 in the appendix displays the same findings but groups countries by continent.

In the wake of the ensuing crisis, 19 of the 78 central banks lowered interest rates to 1% or below. Apart from the Fed, ten central banks were those of OECD[12] member countries, two of them were in "Other Advanced" countries (Hong Kong and Singapore), one was the central bank of a common currency area (ECB), and four were in "Emerging"[13] countries. The central bank of Kyrgyzstan was the sole policy-making institution from the set of "Developing" economies.

[11] The appendix provides further details about the methods we used to describe the incidence of the ZLB and the scale of balance sheet expansion by central banks.
[12] Canada, Switzerland, Chile, Czechia, Denmark, United Kingdom, Israel, Japan, Norway, and Sweden.
[13] Bahrain, Bulgaria, Fiji, and Saudi Arabia.

Of these 19 central banks, twelve lowered policy interest rates to 0.25% or lower: the Fed, the ECB, and central banks in six OECD countries[14], the central bank of Singapore ("Other Advanced"), and two central banks in "Emerging" countries (Bulgaria and Saudi Arabia).

This short assessment of how central banks responded to the imminent crisis leaves very little doubt that the ZLB was primarily a problem for advanced countries and those countries that anchored their monetary policy to the Fed's or the ECB's monetary policy. Hong Kong, Saudi Arabia, and Bahrain's low policy interest rates are therefore not surprising considering those countries' currencies are pegged to the United States dollar. The same is true for Bulgaria and Denmark, whose currencies are either pegged to the euro or fluctuate within a narrow band.[15]

What is perhaps more surprising is that the Bahamas, Belize, Jordan and Qatar, whose currencies are tied to the US dollar, did not have the same low policy interest rates. Nor did North Macedonia or the West African Economic and Monetary Union (UEMOA), whose currencies are pegged to the euro. However, a range of factors specific to those economies may be behind the higher interest rates in these countries, for example, a high inflation rate or a high risk premium. Of the Persian Gulf countries, Saudi Arabia and Bahrain had already been roughly following US monetary policy in the lead-up to the crisis, whereas Qatar had raised its policy rate in response to high inflation and high growth driven by exports of natural gas (IMF, 2009).

It must be borne in mind, however, that minimum policy rates do not give the full picture of monetary policy settings over the whole period. Of the 19 countries with minimum policy interest rates below 1%, 14 maintained average policy rates below 1% between September 2008 and December 2015.[16] All of these 14 countries are either "Advanced" economies or maintain a currency peg with the US dollar or euro. Figure 1 illustrates average policy interest rates before and during/after the GFC. It shows that average rates for most countries fell after September 2008 given that they lie below the diagonal line. The lower portion of Figure 1 shows the 14 countries with average policy rates below 1% appear below the red dotted line.

[14] Canada, Switzerland, Czechia, Denmark, Israel, Japan, and Sweden.
[15] Bulgaria operates a currency board, while the Danish krone is maintained within a 2.25% band from the euro.
[16] The same 19 countries with a minimum policy rate below 1%, minus Chile, Fiji, Israel, Kyrgyzstan and Norway.

3.3.1.b. COVID-19 Crisis

Table 2 presents a different story in the lead-up to the COVID-19 pandemic. 17[17] central banks out of 76[18] had policy interest rates at 1% or lower in the immediate interval preceding the outbreak of the pandemic, including seven[19] at or below 0.25%. Several countries were still dealing with the ZLB problem a decade after the occurrence of the GFC. The policy space of these central banks was thus extremely constrained. In fact, central banks such as the Swedish Riksbank, the Swiss National Bank, the ECB, and the Bank of Japan had already experimented with negative policy interest rates in the period between the two crises.

Table 2: Minimum Policy Interest Rates Before and After COVID-19

Countries	1.00% and less but greater than 0.5%		0.5% and less but greater than 0.25%		0.25% and less	
	2018M1-2019M12	2020M1-2022M8	2018M1-2019M12	2020M1-2022M8	2018M1-2019M12	2020M1-2022M8
OECD (21 countries)	3	3	3	2	5	13
Other Advanced (3)	1	0	0	1	0	1
BRICS (5)	0	0	0	0	0	0
Emerging (35)	1	2	2	4	1	4
Developing (12)	0	0	0	0	0	0
Euro Area (1)	-	-	-	-	1	1
UEMOA (1)	-	-	-	-	-	-
Total (76)	**5**	**5**	**5**	**7**	**7**	**19**

Notes: Lead-up: 2018M1-2019M12 Crisis Period: 2020M1-2022M8. Policy interest rate data was unavailable for Suriname and Uruguay

After the eruption of the COVID-19 pandemic and during the ensuing recession, the number of central banks with policy rates of 1% or lower reached 31. This included all 21 OECD members except Colombia, Mexico, and Turkey, which despite being OECD members are categorized as "Emerging Market and Middle-Income Economies" as per the IMF's classification. In addition, the 31 central banks included the ECB as well as the central banks of two "Other Advanced" economies (Hong Kong and Singapore). It is interesting to note though that ten "Emerging" economies [20] also lowered their policy rates below 1% during the COVID-19 period, a number much larger than during the GFC. None of the 31 countries were

[17] Albania, Australia, Bulgaria, Czechia, Denmark, Euro Area, Fiji, Hungary, Israel, Jamaica, Japan, New Zealand, Norway, Singapore, Sweden, Switzerland, and the United Kingdom.
[18] Policy interest rate data was unavailable for Suriname and Uruguay in the second subsample period.
[19] Bulgaria, Denmark, Euro Area, Israel, Japan, Sweden and Switzerland.
[20] Albania, Bahrain, Bulgaria, Cape Verde, Fiji, Jamaica, Peru, Saudi Arabia, Serbia and Thailand.

"Developing," highlighting that developing countries were not effectively constrained by the ZLB.

19 of the 31 central banks reached the effective zero lower bound of 0.25% or lower: the Fed, the ECB, central banks in twelve OECD countries, one "Other Advanced" country (Singapore), and four "Emerging" countries (Bulgaria, Cape Verde, Fiji and Peru).

Again, Hong Kong, Saudi Arabia and Bahrain, whose currencies are tied to the US dollar, are among the countries where the policy rate approached the ZLB during the COVID-19 period. The same is true for currencies pegged to the euro: Bulgaria and Denmark again approached the ZLB, while North Macedonia and the UEMOA did not. Again country-specific factors play an important role in explaining higher policy interest rates in those other countries.[21]

An inspection of average policy rates during the COVID-19 period is also illuminating. Bahrain, Chile, Costa Rica, Czechia, Hungary, Iceland, Jamaica, Peru, Poland, and Serbia had average policy rates above 1% in the period from February 2020 to August 2022 despite cutting rates to below 1% at some point during this same period. In marked contrast to the GFC period, policy interest rates rose in quite a few countries in 2021 and 2022 due to a sudden surge in inflation. Given this, there are two reasons why average policy rates for the aforementioned countries were above 1%: First, the specific central bank's response to rising inflation later in the subsample period may have been particularly aggressive, or earlier than other central banks. This appears to be the case with Czechia, Peru, and Poland. Second, the central bank may have lowered the policy interest rate to or not far below 1% early on but reversed interest rate decreases later in the subsample period. This appears to be the case for Bahrain and Serbia. For the others, it is a combination of the two. Even if these countries are excluded, there were 21 countries with average policy rates below 1% over the COVID-19 period. Of these, 15 are OECD or "Other Advanced" economies and six are "Emerging," with two of those "Emerging" economies maintaining a currency peg with the US dollar (Saudi Arabia) or the euro (Bulgaria). The remaining four "Emerging" economies were Albania, Cape Verde, Fiji, and Thailand.

Figure 2 illustrates average policy interest rates before and during COVID-19, showing that average rates for most countries fell after January 2020 given that they appear below the diagonal line. The 21 countries with average policy rates below 1% are shown below the red dotted line. Noticeably, countries are clustered more closely towards zero when compared to

[21] This includes the use of multiple instruments in the implementation of monetary policy.

Figure 1, even pre-crisis. This accentuates the severity of the ZLB problem for a number of countries in the COVID-19 period.

Clearly, the ZLB problem was more prevalent during the more recent COVID-19 pandemic period than during the GFC. In the next sub-section, we explore whether this seeming lack of adequate policy space induced central banks worldwide to follow the lead of the Fed and turn to unconventional monetary policy to stimulate economic activity.

3.3.2. The Fed's Balance Sheet Expansion and its Global Response

Constrained by the ZLB during both the GFC and the COVID-19 pandemic, the Fed undertook a large expansion of its balance sheet through the provision of temporary emergency liquidity for systemically important institutions and the purchase of long-term assets.

In response to the Global Financial Crisis and its aftermath, the Fed implemented three rounds of large-scale asset purchases (LSAPs): the first round from November 2008 to March 2010 in the wake of the Lehman Brothers collapse, the second round from November 2010 to June 2011, and the third round from September 2012 through to October 2014. Additionally, from September 2011 through 2012 the Fed carried out "Operation Twist" in which it purchased long-term Treasury bonds and offset this with sales of short-term Treasuries (Federal Reserve Bank of New York, 2018). As the GFC unfolded, financial and economic turmoil spread from the United States to other corners of the globe. Central banks in advanced economies that also encountered the ZLB then faced the same problem as the Fed, prompting a turn to the same or similar unconventional monetary policy tools.

The ZLB posed a policy problem again for the Fed in March 2020 after it had lowered the funds rate target to the 0 – 0.25 % range in response to the spread of the COVID-19 virus in the United States. Again, the Fed resorted to using its balance sheet as a monetary tool. It did so in two ways. First, it reinstated temporary emergency liquidity programs and designed new support facilities. Combined, the scale and scope of these unconventional support measures dwarfed those that were in place during the GFC. In addition to propping up financial markets, the Fed provided relief for private enterprise, consumers, state and local governments through an array of special assistance programs. Second, it resumed purchases of Treasury bonds and mortgage-backed securities on a massive scale.[22] These actions by the Fed led to a balance

[22] For further details on these operations, see Brookings (2024).

sheet expansion that in absolute, nominal terms was larger than all three rounds of LSAPs in the wake of the GFC combined. Asset purchases occurred over a two-year period, from March 2020 until March 2022. In June 2022 the Fed began to reduce its balance sheet by allowing securities to mature (Sablik, 2022).

This subsection analyzes the degree to which other central banks followed the US in significantly expanding their balance sheet following each of the two global crises. We investigate whether central bank balance sheet growth was confined to the predominantly advanced economies that also encountered the ZLB, or whether it was a global phenomenon occurring in emerging and developing economies alike. In addition, we scrutinize the data for evidence whether there were marked differences in the way central banks managed their balance sheets during the period following the GFC and the period following the outbreak of COVID-19.

Taking a country-by-country approach, we identify which central banks engineered an unusually large balance sheet expansion in the wake of both crises and explore the reasons for this expansion. This gives insight into whether central banks followed the Fed in adopting large scale asset purchases and emergency liquidity provision or expanded their balance sheet for other reasons, for example, to accumulate foreign currency reserves or to finance fiscal deficits.

3.3.2.a. Global Financial Crisis

By December 2015, the size of the Fed's balance sheet had increased to more than 500% of its size in July 2007. Table 3 summarizes the experience of other central banks in countries around the world that also substantially expanded their nominal balance sheet during the GFC period. More specifically, it groups countries / currency areas by category into different bins. Each bin defines a balance sheet expansion of 100%. In total there are four bins. The lowest band marks maximum expansions to at least 200% but less than 300% (from its base period value of 100% in July 2007) during the GFC period. The highest band marks maximum expansions to more than 500%. Central banks assigned to the latter bin thus increased the relative size of their balance sheet roughly in line with the Fed's.

Table 3: Nominal Balance Sheet Ratio Relative to the Base Period (2007M7=100%)

Countries	Over 200% but less than 300 % of BS in 2007M7	Over 300% but less than 400% of BS in 2007M7	Over 400% but less than 500% of BS in 2007M7	Over 500% of BS in 2007M7
OECD (21 countries)	8	3	2	3
Other Advanced (3)	1	0	0	0
BRICS (5)	0	3	1	0
Emerging (33)	14	4	1	5
Developing (12)	3	5	0	2
Euro Area (1)	1	-	-	-
UEMOA (1)	1	-	-	-
Total (76)	**28**	**15**	**4**	**10**

Note: The balance sheet data refer to central banks' asset holdings. They comprise public claims, private claims, foreign exchange holdings, gold reserves, and other assets. Balance sheet data were not available for Jordan and Vietnam.
Quarterly observations apply for the UK from 2014M10 onwards.
19 central banks increased their respective balance sheet to less than 200 percent of its size in 2007M7 (base value = 100 percent). Hence only 57 countries appear in the table.

Table 3 shows that 57 central banks out of 76, 75 percent of all central banks included in the sample, at least doubled the size of their nominal balance sheet in the GFC period. Of these, 16 are central banks in OECD countries and one is in an "Other Advanced" country. Another four are in BRICS countries, 24 are in "Emerging" countries, and ten are in "Developing" countries. The latter three groups of countries account for 67 percent of the central banks that expanded their balance sheet beyond the 200 percent mark. The central banks of both currency unions are among those 57 central banks too.

With reference to nominal balance sheet expansion, countries at all levels of development experienced a substantial expansion of their central banks' balance sheet. More than half of the central banks kept the increase in the size of their balance sheet to less than 400 %. Ten of the 57 countries' central banks appear in the top band. Thus, during the GFC period nine other central banks more or less matched the Fed's accumulation of assets in relative terms.

Naturally, examining nominal balance sheet expansion across countries does not tell the whole story. It ignores the effect of rising price levels, a problem that is more prevalent in emerging and developing economies.[23] The results in Table 4 are based on nominal balance sheet changes adjusted for changes in the CPI.

[23] The opposite, a falling price level, if sustained, is deflationary and cannot be ruled out either. Several advanced countries, e.g. Japan, Switzerland and others, experienced episodes of mild deflation during the GFC period (in Japan's case from the 1990s onward).

Table 4: Real Balance Sheet Ratio Relative to the Base Period (2007M7 = 100%)

Countries	Over 200% but less than 300 % of BS in 2007M7	Over 300% but less than 400% of BS in 2007M7	Over 400% but less than 500% of BS in 2007M7	Over 500% of BS in 2007M7
OECD (21 countries)	7	3	2	1
Other Advanced (3)	0	0	0	0
BRICS (5)	2	0	0	0
Emerging (32)	5	2	0	2
Developing (11)	4	0	0	0
Euro Area (1)	1	-	-	-
Total (73)	**19**	**5**	**2**	**3**

Note: CPI data were not available for Belize, Papua New Guinea, and UEMOA.
For Australia and New Zealand quarterly only quarterly observations of the CPI are available. The real asset holdings in 2007M7 values are calculated using the 2007q2 CPI.
Quarterly observations apply for the UK from 2014M10 onwards.
The 2007M7 value for Bahrain is calculated using the 2007M8 CPI due to data unavailability up to this point.

The findings presented in Table 4 are revealing. The number of central banks that expanded their balance sheets in real terms is markedly lower than when measured in nominal terms. Of the 73 central banks for which CPI data was obtainable, 29 (40 percent) at least doubled their real asset holdings. Only 15 of the 29 central banks (52 percent) are those of BRICS, "Emerging," or "Developing" countries. Adjusting for varying price levels over time thus changes the picture somewhat for non-advanced countries. At the same time, the remaining 14 countries/currency area (48 percent), comprising 13 OECD countries and the Euro Area, had their central banks increase their balance sheets beyond the 200 % mark. The price-adjustment evidently matters less for capturing the balance sheet expansion by central banks in advanced economies and the European Central Bank.

By comparison, the Fed's price-adjusted balance sheet expanded from its reference value of 100 % in July 2007 to 464 % in the GFC. Thus, the Fed falls into the "Over 400 % but less than 500 % of BS in 2007M7" band. Overall, four central banks matched or exceeded the Fed's level of real balance sheet expansion during the GFC period.

Although these tables provide a general overview of central bank balance sheet expansion, they do not provide precise information on the balance sheet management of individual central banks. To identify the central banks that undertook a substantial balance sheet expansion after approaching the ZLB, we compiled information on both central bank policy rates and balance sheet expansion specific to each country. The first column of Table 5 lists countries in alphabetical order and their classification in parentheses. A checkmark appears in the second column if a country's central bank had a minimum policy interest rate at or below 1 % from September 2008 to December 2015. A checkmark also appears in the third column if the

average policy rate fell below 1 % over the same period. The maximum indexed nominal and real expansion of the balance sheet appears in columns four and five, respectively.

Let us now propose a simple and workable definition of unconventional monetary policy during the GFC period. A central bank is said to have resorted to unconventional monetary policy if it encountered the ZLB (both the minimum and average of the policy rate were less than 1 percent) *and* at least doubled the size of its real balance sheet. By this measure, seven of the 70-odd central banks did so. These central banks are those of the countries shaded in blue in Table 5: Switzerland, Denmark, the Euro Area, the UK, Japan, Sweden, and the United States. Notably, all of these countries are advanced economies. Moreover, Switzerland, the Euro Area, the UK and Japan are major financial centres and home to major international banks, insurance companies, and investment funds.[24] Sweden and Denmark are EU member states with close ties to the Euro Area. In the case of Denmark, a currency band arrangement with the euro means that Danish monetary policy is closely coordinated with the European Central Bank's policy stance.

To gain further insight into the balance sheet management of central banks during the GFC period, we explore the evolution of each central bank's real balance sheet vis-à-vis the Fed's. The aim here is to identify the central banks that followed the Fed most closely in expanding their balance sheets over the July 2007 to December 2015 period. Figure 3 tracks the CPI-adjusted changes in balance sheets for central banks in 71 countries and relates them to those observed for the Fed. Data points in blue apply to the GFC period while red data points refer to the COVID-19 period.

Before scrutinizing the extent and speed of global balance sheet expansion, we first turn the spotlight on the events that triggered the expansion of the Fed's balance sheet over time. Here we focus on the three rounds of LSAPs. The first round of LSAPs began in November 2008 and ended in March 2009.[25] The acquisitions of mortgage-backed securities, Treasuries, and agency debt brought the Fed's total assets to around 269 percent of their nominal value in July 2007. The size of the balance sheet did not increase markedly further until November 2010 when the second round of LSAPs began. At the conclusion of the second round in June 2011, the Fed's total assets sat at around 330 percent of their July 2007 value and remained roughly at this level until December 2012, at which time the third round of asset purchases was

[24] The currencies of the Euro Area, Japan, and Switzerland are also reserve and vehicle currencies next to the US dollar.
[25] Kuttner (2018). Here we refer to nominal changes in the size of the Fed's balance sheet.

underway. The Fed's balance sheet peaked at roughly 520 percent of its July 2007 value at the end of the third round of LSAPs in late 2014. From this point to the end of 2015 the Fed's asset holdings remained fairly stable.

One noticeable feature of the graphs of Figure 3 that measure real balance sheet adjustment vis-à-vis the US over the GFC period (blue dots) is the appearance of two vertical spikes.[26] The first spike sits near the center of the graphs and occurred in most instances over the 2011-2012 period when the Fed held its balance sheet at slightly above 300 percent of the July 2007 reference value. The second vertical spike sits at the rightward end of the graph and occurred during 2015 after the Fed had ended its third round of LSAPs. These spikes mark episodes when other central banks continued to expand their balance sheet while the Fed had paused its balance sheet expansion.[27]

In general, Figure 3 shows that many central banks followed the Fed in expanding their real balance sheet between July 2007 and December 2015, albeit at a slower pace. In most cases the blue dots lie below the 45-degree line. Only the central banks of Belarus (D9), Qatar (D57), and Switzerland (D67) experienced a maximum balance sheet expansion greater than the Fed in real terms.

Inflation in Belarus reached as high as 59 percent in 2012, which explains a large proportion of the nominal balance sheet expansion. However, in real terms the balance sheet of the Belarusian central bank still expanded faster than the Fed's, peaking in November 2011. The real expansion is associated with the loose macroeconomic policies pursued by the Belarus National Bank in coordination with the government in 2009-2010 in the face of inertial price adjustment. As a result, a large real balance sheet expansion occurred initially but slowed down over time.

There was a brief episode of rapid expansion of the central bank of Qatar's balance sheet from July 2007 to April 2008, before the Fed began its first round of asset purchases, followed by a decline in asset holdings. Over most of the sample period, the Qatar Central Bank expanded its balance sheet significantly, outpacing the Fed in both nominal and real terms. Indeed, by the end of the period the size of its real balance sheet was roughly eight times its size in the base period. Qatar's increasing exports of natural gas seem to coincide with this balance sheet expansion, pointing to balance sheet movements being driven by the accumulation of foreign

[26] Graphs tracking nominal balance sheet adjustment are available upon request from the authors.
[27] Blue dots inside an oval mark out these episodes in the most obvious cases.

reserves by the central bank (IMF, 2009). Qatar's central bank maintained a currency peg with the US dollar over this period even though its policy interest rate was considerably higher than the Fed's.

The Swiss National Bank (SNB) roughly matched the pace of the Fed's balance sheet expansion through mid-2010. Around this time the SNB ended its first asset purchase program, while the Fed commenced its second round of LSAPs a few months later in November 2010. A large proportion of the SNB's balance sheet expansion can be explained by the Swiss franc's status as a safe haven currency, particularly during the European Sovereign Debt Crisis. Investors flocked to the Swiss franc, causing a rapid appreciation (Christensen and Krogstrup 2016). At the time Switzerland faced exceptionally low levels of inflation (in August 2011 CPI inflation was a meagre 0.19 percent) or outright deflationary pressure, in part attributable to the franc's appreciation. To avoid further appreciation of its currency, the SNB enforced a temporary rigid exchange rate peg vis-a-vis the euro. Continual purchases of euros added substantially to its foreign currency reserves between August 2011 and September 2012. This expansion of the balance sheet was out of sync with the Fed's moves because it took place between the second and third rounds of LSAPs by the Fed. The SNB then halted its balance sheet expansion through to May 2014 when it resumed purchasing assets. By the end of 2015, the real balance sheet of the SNB stood at around 600 percent of its July 2007 reference value.

The experience of other central banks' relative expansion is summarized below. This summary is limited to the experiences of other major central banks and/or observed interesting patterns evident in some countries.

Starting in March 2009, the Bank of England (D70) began its first round of LSAPs, primarily purchasing UK government bonds (gilts). The Bank of England kept pace with the Fed's balance sheet expansion through mid-2010, after which it paused until October 2011. Against the backdrop of the European Sovereign Debt Crisis, the Bank of England commenced its second round of asset purchases, still mainly in gilts (Smith, 2020). These purchases continued until October 2012, at which point the Bank of England put further asset purchases on hold. Overall, real assets holdings by the Bank of England increased to about 440 percent of the July 2007 reference value. They grew at a slower pace than the Fed's, though not by much.

Growth in the European Central Bank's real balance sheet (D24) was considerably slower compared to the Fed's, aside from an expansionary phase between May 2011 and June 2012.

This episode coincides with the European Sovereign Debt Crisis. The ECB also began asset purchases only in 2015, after the Fed had halted its third round of asset purchases.

Sweden's (D66) experience also tells an interesting story; During the initial round of asset purchases from late-2008 onward, the Swedish Riksbank expanded its real balance sheet at a faster pace than the Fed. However, the Riksbank's unconventional policy was more modest in that it offered fixed, low-interest loans with a 1-year maturity to banks from July to November 2009 (Elmér et al., 2012).[28] As these loans matured, assets on the Riksbank's balance sheet declined rapidly from their peak index value of 353 percent in May 2010 and did not increase again until March 2011. Overall, the Riksbank expanded its real balance sheet by less in relative terms than the Fed, even though it accelerated its asset purchases after the Fed had completed its third round of asset purchases in late 2014.

The Central Bank of Iceland's real balance sheet (D33) grew rapidly from the start of the period as the highly leveraged Icelandic financial system encountered liquidity problems. It expanded further amid the collapse of Icelandic banks during the Icelandic financial crisis. In addition to lending to the ailing banking sector, the central bank accumulated foreign exchange reserves through an assistance programme set up by the IMF (Central Bank of Iceland, 2010). Up to August 2008, this expansion in assets outpaced that of the Fed. The Central Bank of Iceland would significantly expand its assets further again during the European debt crisis in 2011 and 2012 when CPI-adjusted assets held relative to the July 2007 reference value peaked at 330 percent. From June to September 2012, the Bank scaled back its real asset holdings considerably and held the balance sheet at around 180 percent throughout the remainder of the GFC period.

In Australia (D4) and New Zealand (D51), the balance sheet of the respective central bank did not grow very much at all, peaking at around 130 percent of its base period value of 100 percent. Neither country approached the ZLB during the GFC. There was no obvious need for the Reserve Banks of Australia and New Zealand to turn to unconventional monetary policy because the main policy rate (OCR) never fell below 3 and 2.5 percent, respectively. Likewise, the real balance sheet of the central banks of Cabo Verde (D12), Egypt (D23), Guatemala (D29), Honduras (D31), Iraq (D36), Jamaica (D38), South Korea (D42), Malaysia (D45),

[28] The Fed had also set up emergency loan facilities but by February 2010 these had been unwound.

Nigeria (D52), São Tomé and Príncipe (D60), Serbia (D62), and Singapore (G63) did not expand by more than 33 percent of the value recorded in the base period.

From a geographic perspective, there were observable patterns during the GFC period. The economic upheaval associated with the European Sovereign Debt crisis coincided with substantial real balance sheet expansions in Europe except for Norway, Croatia, and Serbia. By contrast, in Oceania and a few Central American countries (except for Mexico), balance sheet expansion was minimal or modest.

To sum up, the enormous expansion of the central bank's real balance sheet during the GFC period was not limited to the United States. Central banks in many other countries followed suit. The reasons for doing so varied across countries. While provisions were made for emergency liquidity and special asset purchase programs, other factors such as the outright bail-out of systemically important domestic banks, foreign exchange market intervention to prevent appreciation of the domestic currency, and inflationary finance in "Emerging" and "Developing" countries accounted for the increase of asset holdings by central banks. Most central banks expanded their real balance sheets at a slower pace than the Fed. The only central bank that undertook an asset purchase program similar in type and scale to the Fed's was the Bank of England. In view of the importance of the financial services industry to the UK economy and the sheer weight of London as a global financial centre, the strong reaction during the crisis period by the Bank of England relative to other countries is perhaps not surprising.

3.3.2.b. COVID-19 Crisis

The nominal value of the Fed's total assets peaked at US$ 8.9 trillion in March 2022, 217 percent of its base period (January 2020) value of US$ 4.1 trillion. The pace of balance sheet expansion was fastest during the Fed's initial reaction to COVID-19 in March and April of 2020. The Fed then continued to expand the balance sheet at a steady pace until November 2021, when it decided to slow the pace of asset purchases. From June 2022 onward, the Fed did not replace maturing securities. As a result, asset holdings fell back to around 200 percent of the base period value by August of the same year.

In absolute nominal terms, the increase in the value of the Fed's assets was larger during the COVID-19 period than during the GFC period. Because of the size of the balance sheet being much larger in January 2020 than in July 2007, however, the maximum size of the balance

sheet, calculated as a ratio relative to the base period, is smaller in the COVID-19 period than in the GFC period.

Table 6 presents a comprehensive overview of the number of central banks that substantially expanded their nominal balance sheet in the "COVID-19 period" from January 2020 to August 2022. Again, there are four bands to consider but now the width of each band is only 50 percent because asset holdings by central banks were higher at the beginning of the COVID-19 pandemic compared to the GFC. The lowest band extends from 150 to 200 percent while the top band records expansions to more than 300 percent, measured relative to the reference value of 100 percent in January 2020. For each country, we identify the maximum relative size of its central bank balance sheet during the COVID-19 period and assign the percentage value to one of the four bins.

31 of the 77 central banks brought the nominal size of their balance sheet to over 150 percent. Among these are central banks in 14 OECD and "Other Advanced" countries, nine in "Emerging" countries, seven in "Developing" countries, and the ECB. No central bank of a BRICS country is included among these 31 central banks. There is no clear evidence that balance sheet expansion was tied to a country's level of economic development. It occurred in developing as well as advanced countries.

Table 5: Nominal Balance Sheet Ratio Relative to the Base Period (2020M1=100%)

Countries	Over 150% but less than 200 % of BS in 2020M1	Over 200% but less than 250% of BS in 2020M1	Over 250% but less than 300% of BS in 2020M1	Over 300% of BS in 2020M1
OECD (21 countries)	5	2	1	4
Other Advanced (3)	2	0	0	0
BRICS (5)	0	0	0	0
Emerging (34)	7	0	1	1
Developing (12)	5	1	0	1
Euro Area (1)	1	-	-	-
UEMOA (1)	-	-	-	-
Total (77)	**20**	**3**	**2**	**6**

Note: Balance sheet data were unavailable for Vietnam.
Data ends 2022M6 for Belarus, 2022M3 for Iraq, and 2022M1 for Russia.
Quarterly observations apply for the UK, and the 2019M12 balance sheet is used as the base period.
46 central banks increased their respective balance sheet to less than 150 percent of its size in 2020M1. Hence only 31 countries appear in the table.

Given the shorter timeframe and larger initial asset holdings, maximum balance sheet sizes for central banks are not directly comparable to the GFC period. However, the number of central banks that matched or exceeded the Fed's maximum balance sheet expansion is still telling. As mentioned above, the Fed's balance sheet peaked in March 2022 at 217 percent of its nominal

value in January 2020. In nominal terms, eleven of the 77 central banks matched or exceeded the Fed's rate of balance sheet expansion.

To control for the influence of inflation on the size of central banks' balance sheets during the COVID-19 period, we deflate nominal asset holdings by the country-specific CPI. Table 7 shows the CPI-adjusted maximum balance sheet ratios.

Table 6: Real Balance Sheet Ratio Relative to the Base Period (2020M1=100%)

Countries	Over 150% but less than 200 % of BS in 2020M1	Over 200% but less than 250% of BS in 2020M1	Over 250% but less than 300% of BS in 2020M1	Over 300% of BS in 2020M1
OECD (21 countries)	6	3	1	2
Other Advanced (3)	1	0	0	0
BRICS (5)	0	0	0	0
Emerging (33)	4	0	0	0
Developing (10)	2	0	0	0
Euro Area (1)	1	-	-	-
Total (73)	**14**	**3**	**1**	**2**

Note: CPI data were not available for Belize, D.R.Congo, Papua New Guinea, and UEMOA.
For Australia and New Zealand quarterly observations apply, and 2020M1 values are calculated using the 2019M12 CPI.
For the UK, quarterly observations also apply, and 2019M12 balance sheet data is used for the base period.

Adjustment for changes in the level of prices matters. In real terms, a much lower number of central banks, 20 of 73, expanded their balance sheet to over 150 percent of the January 2020 base value. This includes central banks in 13 OECD or "Other Advanced" countries, six in "Emerging" or "Developing" countries, and the ECB. Two observations are worth mentioning here. Six central banks, all of them in OECD countries, exceeded the Fed's maximum real balance sheet expansion of 196%. Although elevated inflation was behind the increase in the size of central bank balance sheets in the majority of "Emerging" and "Developing" economies, six of them expanded their balance sheet in real terms during the COVID-19 period.

Table 8 displays the countries individually and checks whether the balance sheet expansion of their central banks can be tied to the ZLB problem for the COVID-19 period. This table brings out a few interesting facts. In 31 countries the policy rate was at or fell below 1 percent. But in only 21 countries did the average policy rate remain at 1 percent or less over the January 2020 to August 2022 period. Again, we settle on a simple, workable definition of unconventional monetary policy. In the current context, a central bank engages in unconventional monetary policy if the average policy rate is at 1 percent or lower and the balance sheet expansion exceeds 150 percent of the base period value in real terms.

Given this definition, there were eleven central banks that resorted to real balance sheet expansion after encountering the ZLB during the COVID-19 period. The countries/currency unions where these central banks are located are highlighted in blue. They are Australia, Canada, the Euro Area, Fiji, the UK, Israel, Norway, New Zealand, Singapore, Sweden, and the United States. All countries but Fiji are advanced economies. Chile, Hungary and Poland, highlighted in green, deserve further comment. All three countries meet the balance sheet criterion of an increase of at least 150 percent in real terms and experienced minimum policy rates of 1 percent or less. However, the average policy rates in these three countries over the COVID-19 period exceeded the 1 percent mark because their central banks raised policy rates earlier and faster in 2021 than other central banks.

Closer inspection of the percentage values in the rightmost column of Table 8 reveals that only six central banks, those of Australia, Canada, Chile, Hungary, New Zealand, and Turkey, expanded their balance sheet faster than the US in real terms ($\geq$ 196 percent). The red dots in Figure 3 illustrate in some detail how the size of the real balance sheets of central banks evolved vis-a-vis the Fed's during the COVID-19 period. Parsing the statistical and graphical evidence produces a string of noteworthy observations.

Australia, Canada, and New Zealand's central banks pursued LSAP programs of a similar nature to the Fed's during the COVID-19 pandemic.

Relative to the size of the balance sheet in January 2020, the Reserve Bank of Australia (RBA) expanded its assets at roughly the same pace as the Fed in 2020 and outpaced the Fed in 2021. The RBA's assets reached their peak in February 2022 at 359 percent of their inflation-adjusted total in the base period.

The Bank of Canada expanded its real balance sheet relative to the base period at a rapid pace, too, outpacing the Fed through to February 2021, when its total real assets reached 478 percent of the January 2020 value. In March and April of 2021, the Bank of Canada's total assets decreased as it allowed some of its assets to mature following an improvement in market conditions (Bank of Canada, 2022). Despite this, the Bank of Canada continued to purchase assets, albeit at a slower pace, until late 2021, and then began reducing its balance sheet in April 2022.

The real balance sheet of the Reserve Bank of New Zealand (RBNZ) also grew faster in relative terms than the Fed's in late 2020 and in 2021. Unlike the RBA, the Bank of Canada, and the

Fed, the RBNZ continued to increase its asset holdings through and beyond August 2022, resulting in the RBNZ's balance sheet reaching 279 percent of its real value in the base period.[29]

The Hungarian National Bank increased its balance sheet initially at a slower pace than the Fed. From July 2020 onwards, however, the Hungarian National Bank began to expand its balance sheet faster in relative terms than the Fed. Similarly to the Fed, it purchased government securities to bring down long-term yields and was successful in doing so (Committee on the Global Financial System, 2023, Babos et al., 2021). In addition, the Bank acquired substantial foreign reserves over the subsample period, largely in the form of transfers from the EU and the issuance of euro-denominated government debt (Magyar Nemzeti Bank, 2022). This combined effect brought the size of the balance sheet to 207 percent of its CPI-adjusted value in the base period.

In Chile, the central bank undertook a range of measures, including purchases of bank bonds, as well as opening lending facilities to provide low-interest loans to financial institutions (Banco Central de Chile, n.d.). The programs were mainly set up to provide banks with liquidity and to avoid a credit crunch (International Monetary Fund, 2022). This resulted in a substantial expansion in the Central Bank of Chile's balance sheet, outpacing that of the Fed over the subsample period. The size of its balance sheet peaked in November 2021 at just over 230 percent of its CPI-adjusted value in the base period.

The European Central Bank (ECB) purchased both private and public securities through the Pandemic Emergency Purchase Program (European Central Bank, n.d.). As a result, from June 2020, the ECB maintained a real balance sheet expansion at a similar pace to the Fed until March 2022, when asset purchases were discontinued. The ECB's real balance sheet peaked at around 174 percent of its value in the base period, but, unlike the Fed's balance sheet, did not begin to contract before August 2022.

The Bank of England expanded its existing Asset Purchase Facility in response to COVID-19, allowing it to increase its asset purchases. The Bank of England also maintained a similar pace of balance sheet expansion compared to the Fed and had not started systematically reducing the size of the balance sheet by August 2022. Rather, from the end of 2021, the Bank of

[29] Interestingly, when measuring central bank assets as a percentage of GDP, Australia, Canada, and New Zealand's asset holdings were much lower pre-pandemic than the Fed's. After the three central banks ran out of room to lower the policy instrument further in early 2020, they began to expand rapidly their balance sheets. Because nominal central bank asset holdings were still fairly low in January 2020, the speed of balance sheet expansion in the three countries relative to the United States during the COVID-19 period was extraordinary.

England's balance sheet sat at around 180 percent of its CPI-adjusted value in the base period. Among the countries investigated, the Bank of England is unique given that they matched the pace of the Fed's expansion in both the GFC and COVID-19 periods.

The Reserve Bank of Fiji was the only central bank of an "Emerging" economy whose policy rate approached the ZLB. The Bank substantially increased its asset holdings in 2021 and 2022, with total real assets reaching 184 percent of the base period in July 2022.[30] As such it came very close to matching the Fed's relative speed of asset accumulation. Before the surge, the Bank's asset holdings were relatively stable around the base value.

The central banks of Israel, Norway, Singapore, and Sweden were also among the eleven institutions that, by our definition, turned to unorthodox monetary policies during the COVID-19 period. Inspection of the final column of Table 8 yields the same basic insight: after reaching the ZLB, these central banks increased their real asset holdings substantially, albeit at a slower pace relative to the Fed's.

Not surprisingly, a sustained high rate of inflation lay behind the Turkish central bank's expansion of its nominal balance sheet. In August 2022 year-on-year CPI inflation was 80 percent. Despite this runaway inflation, real assets held by the Central Bank of Turkey grew to 2.25 times their size in January 2020.[31] The policy rate in Turkey never fell below 6.25 percent during the COVID-19 period.

3.4 Correlation of Percentage Changes in Central Bank Real Balance Sheets

As a final exercise, we relate the monthly percentage change in the size of the real balance sheet of the central bank in a country to the percentage change in the Fed's real balance sheet over each of the two crisis periods. That is, we calculate $\frac{BS_t - BS_{t-1}}{BS_{t-1}}$ for the central bank of each country, do likewise for the Fed, and then compute the pairwise correlation coefficient for the percentage changes over the respective period. Doing so yields two correlation coefficients, one that measures the extent of co-movement of balance sheet changes in country *i* relative to

[30] The Reserve Bank of Fiji introduced a number of facilities aimed at providing low-interest loans for ailing businesses and purchased FJD$300 million in government bonds with the purpose of financing the government rather than bringing down bond yields (Reserve Bank of Fiji, 2020). In addition, the Reserve Bank of Fiji significantly increased its foreign exchange reserves in 2021 and 2022 (Reserve Bank of Fiji 2022).

[31] The rate of inflation in Turkey was already excessive at the start of the COVID-19 period. The expansion of the central bank's balance sheet was partially the result of loans provided to banks and changes in reserve requirements to improve liquidity, as well as accumulation of foreign reserves, including through incentives for FX deposit holders to convert foreign currency to Turkish Lira (Central Bank of the Republic of Turkey, 2021). Turkish monetary policy during this period was often unorthodox, including multiple policy rate cuts despite surging inflation in 2021 (Central Bank of the Republic of Turkey, 2022).

the United States in the GFC period and the other for the same during the COVID-19 pandemic period.[32] The correlation coefficients for each country are plotted in Figure 4.

There are four shaded rectangles. The north-east rectangle, shaded red, contains the correlation coefficients that are positive and significantly different from zero (5 percent level or below) in both the GFC and the COVID-19 period. The label on each dot shows the acronym of the country. The south-eastern rectangle, shaded yellow, shows the countries for which the correlation coefficient is positive and significant only during the GFC period. The north-western rectangle, shaded green, shows positive and statistically significant correlation coefficients for only the COVID-19 period. Blue dots in the south-western rectangle represent pairs of correlation coefficients that are not statistically significant in either period and therefore bear no country label. A positive trend line implies that for the sample of 70 odd countries a high (low) correlation coefficient in the GFC period tends to be paired with a high (low) correlation coefficient in the COVID-19 period.

In total, 13 central banks expanded the size of their real balance sheet month-by-month in concert with the Fed during both crisis periods. All but three of these central banks are in OECD countries. Turkey is the only OECD country of the five countries where monthly changes in the central bank's real balance sheet were positively correlated with changes in the Fed's balance sheet only during the GFC period. By comparison a far greater number of central banks, 15 in all, had changes that were positively correlated with changes in the Fed's real balance sheet only during the COVID-19 period.[33] Of note here is the variety of countries that adopted balance sheet management alongside the United States: one BRICS country (India), one "Developing" country (Ghana), one "Other Advanced" country (Singapore), six "Emerging" countries, and six OECD countries.[34]

Roughly half of the central banks included in our study did not engage in systematic balance sheet management in concert with the Fed. Changes in the monthly real balance sheet of 32

[32] The correlation coefficients reported are based on changes in the real balance sheet. The nominal value in a month is divided by the CPI for the same month for all countries except Australia and New Zealand. The correlation coefficients for both countries are based on quarterly observations. Using nominal balance sheet data to compute the correlation coefficients yielded very similar results.
[33] This number increases to 16 if Malaysia is included. Its correlation coefficient for the COVID-19 period is positive and very large during the COVID-19 period but substantially negative during the GFC period. Korea is a similar case. Other "outliers" are Egypt, Croatia, and Saudi Arabia.
[34] Emerging: Argentina, Georgia, Guatemala, Jamaica, Qatar, Philippines. OECD: Colombia, Czechia, Denmark, Japan, Poland.

central banks (blue dots with no country label) exhibited no systematic co-movement with changes in the Fed's balance sheet.

These observations are based on contemporaneous movements in real balance sheet assets of central banks vis-à-vis those of the Fed's. Further analysis shows, however, that changes in the size of the CPI-adjusted balance sheet of a few central banks varied systematically with the Fed's changing real asset holdings but only with a lag. Inspection of the period-specific correlation coefficients based on lagged real balance sheet changes in Tables 9 and 10 reveals that during the GFC period, the central banks of Bahrain, the Czech Republic, Hong Kong, Indonesia, Iraq, Korea, the Russian Federation, and Singapore increased their real asset holdings too, but only with a one- or two-month lag. Even more central banks responded with a one- or two-month delay during the COVID-19 period. In all, nine central banks did so. They were the central banks of Albania, Bangladesh, Croatia, Honduras, Kenya, Korea, Nepal, Peru and Serbia. Another three countries followed suit with a three-month lag (Jordan, Kyrgyzstan, and Mauritius). Two noteworthy observations concerning the COVID-19 period are that, first, the correlation coefficient (based on contemporaneous changes) exceeds 0.5 for 17 countries, and, second, the correlation coefficients (based on contemporaneous or lagged changes) exceeds 0.4 for 40 countries. By comparison, over the 2008-2015 interval, correlation coefficients exceeding 0.5 (contemporaneous) are observed only for 5 countries and correlation coefficients exceeding 0.4 (contemporaneous and lagged changes) are logged only for 8 countries.

4. Conclusion

The Federal Reserve encountered the zero lower bound in the wake of two major crises in the past twenty years, the Global Financial Crisis and the COVID-19 pandemic. On both occasions the Fed turned to unconventional monetary policy levers to stabilize the US economy. Arguably, the most potent lever that the Fed engaged repeatedly to reduce long-term interest rates consisted of enormous purchases of diverse, predominantly long-term assets. The accumulation of assets over time led the balance sheet of the Fed to reach unprecedented heights. This paper turns the spotlight on the experience of 78 central banks around the world to examine their response to the Fed's unconventional policy action during both crises from several angles.

Our examination of central bank policy action began by identifying the central banks that approached or hit the zero lower bound before and during either crisis. We found that 19 central

banks, including the Fed, had lowered interest rates sufficiently to be effectively at the zero lower bound during the GFC. In fact, 14 of these central banks held rates near zero on average over the entire crisis period. These central banks were mostly in "Advanced" economies. Four of the 14 central banks were in small open economies whose monetary policy was geared to maintaining a currency peg with the US dollar or the euro. During the COVID-19 pandemic, the number of central banks encountering the zero lower bound rose to 31, with 21 of them holding interest rates near zero on average. While most of these countries were "Advanced" economies, there were also six "Emerging" economies, only two of which maintained a currency peg with the US dollar or the Euro.

Next, we examined from three slightly different angles the extent to which central banks followed the path of the Fed in significantly expanding their balance sheet in response to both crises. We first identified the maximum expansion of a central bank's nominal and real balance sheet over the respective crisis period relative to a base period. The second angle considered real balance sheet management by an individual central bank vis-à-vis the Fed over both crisis periods. The final angle measured the degree of positive correlation of movements in a central bank's real balance sheet, both concurrent and lagged, with those observed on the Fed's balance sheet.

A substantial expansion of a central bank's CPI-adjusted balance sheet generally reflected either an accumulation of foreign reserves, often for purposes of exchange rate management, or asset purchases aimed at stimulating the economy, or both. At times, growth in central bank balance sheets was asynchronous. Of the four central banks that expanded real asset holdings at a similar or faster pace than the Fed during the Global Financial Crisis, only the UK did so with similar motivations. The central banks of Switzerland, Qatar and Belarus expanded their real assets faster than the Fed but under unique circumstances for each country. Central banks in a few additional countries / common currency areas also expanded the size of their real balance sheet, although to a lesser extent than the Fed, after encountering the ZLB in the wake of the GFC. The European Central Bank, the Bank of Japan, the Swedish Riksbank, and Denmark's central bank fall into this category. Most central banks, however, saw very little real expansion in their balance sheet, among them "Advanced" economies like Australia and New Zealand, during the Global Financial Crisis and the time thereafter.

Central banks reacted somewhat differently to the COVID19 pandemic. In many countries, expansionary monetary policy to prop up the economy and safeguard financial stability was

more aggressive but of shorter duration compared to the GFC period. An added complication for a few central banks in advanced countries was that their balance sheets were already unusually large because of the enormous asset purchases during the GFC and its aftermath. As a result, the proportional size of balance sheet expansion was generally smaller during the COVID-19 period. In inflation-adjusted terms, 20 central banks expanded their balance sheet to more than 1.5 times the value at the start of 2020, with six of them exceeding the Fed's relative scale of expansion. They were the central banks of Australia, Canada, Chile, Hungary, New Zealand and Turkey. The European Central Bank and the Bank of England were also not far behind. While Turkey's economic and political circumstances were unique during this period, the other central banks turned to large-scale asset purchase programs after encountering the ZLB. For the Reserve Bank of Australia and New Zealand, respectively, the COVID-19 pandemic proved a unique challenge as neither had to grapple with the ZLB problem during the GFC period.

There is some evidence that contemporaneous and lagged increases in the size of real balances of central banks around the globe were positively correlated with those on the Fed's balance sheet. However, there is a profound difference between the tightness of systematic co-movements in real balance sheet changes and their occurrence during the GFC period compared to the COVID-19 period. Co-movements between real asset holdings of individual central banks and the Fed were much tighter and more common during the COVID-19 pandemic.

Taken altogether, interpreting the statistical evidence leaves little doubt that the Fed blazed a trail for many other central banks to follow during the COVID-19 pandemic. As the Fed expanded its balance sheet after the outbreak of the pandemic, so did many other central banks. By comparison, evidence that a similar phenomenon occurred during the GFC period is much scarcer. Only central banks in a few advanced economies, some of whom are home to important financial centers, partook in the enormous expansion of their real balance sheets.

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Appendix

Methods of Visualizing Policy Rate and Balance Sheet Data of Central Banks: A Roadmap

Global Prevalence of the Zero Lower Bound Problem

As stated in Section 2, we carve up the whole sample period (January 2006 - August 2022) into two subsample periods, the GFC subperiod (January 2006 to December 2015) and the COVID-19 pandemic period (January 2018 to August 2022). To explore the global prevalence of the ZLB, we divide each subsample period into "before" and "during/after" periods. The first subsample period is split into "before the GFC" interval (January 2006 to August 2008) and "during/after the GFC" interval (September 2008 to December 2015) that began with the collapse of Lehman Brothers[35] and ended with the Fed raising the Federal Funds Rate for the first time since the 2005-2006 rate hike cycle. Similarly, we divide the COVID-19 subsample period into "before the pandemic" (January 2018 to December 2019) and "during the pandemic" (January 2020 to August 2022) with the latter crisis interval time beginning with the declaration of COVID-19 as a Public Health Emergency by the World Health Organization and witnessing the February 2020 stock market crash.

To measure policy rate adjustments and the severity of the ZLB problem, we classify countries into three bands according to their minimum policy interest rate "before" and "during/after" each respective crisis: 1% or less (but greater than 0.5%), 0.5% or less (but greater than 0.25%), and 0.25% or less. A country thus appears in a table if its lowest policy interest rate in each pre- and post-crisis sub-period meets these criteria.

To gain further insight into monetary policy settings over the whole period, we also measure average policy interest rates "during/after" both crisis periods.

Balance Sheet Expansion of Central Banks Worldwide

For the next part of the empirical analysis, we track the size of central banks' balance sheets over time. We create an index that expresses the value of total assets held by each central bank in each month relative to total assets held at a reference point shortly before the Fed began its easing cycles. For the first subsample period, the reference point is July 2007,

[35] There is no clear consensus on the beginning of the GFC and many consider it to have started earlier than this, however the collapse of Lehman Brothers was a pivotal moment that marked the beginning of severe financial disruptions worldwide and prompted global central banks to react.

shortly before the Fed began its systematic easing of monetary policy in the early stages of the GFC. Likewise, the reference point for the second subsample period is January 2020, shortly before the Fed began its large-scale asset purchases in response to the COVID-19 outbreak. Indexed values can therefore be expressed as:

$$\frac{BS_{t+j}^{i}}{BS_{t}^{i}} * 100$$

where BS_t^i is the reference date (July 2007) for total assets held by the central bank of country *i* during the first subperiod, and BS_{t+j}^i gives the size of total assets in subsequent months of the GFC subperiod: $t+1$ = 2007m8,……$t+n$ = 2015m12. For the COVID-19 subperiod, the relevant time subscripts are $t+1$ = 2020m2…… $t+n$ = 2022m8.

We take the maximum value of the ratio of balance sheet values as a measure of the extent of unconventional monetary policy in a country. Because inflation overstates the true extent of changes in the nominal assets, we also divide the nominal balance sheet values of a given country by the CPI index for the same month. The calculated maximum expansions fall within bands that vary in size depending on the sample period. For the first subsample period, the bands are 100-200%, 200-300%, et cetera, and for the second subsample period, the bands are 100-150%, 150-200%, et cetera. The bands are narrower for the second subsample period due to generally smaller percentage changes, partially because of a shorter timeframe, and partially because of larger initial balance sheet sizes resulting in the same absolute change translating to a smaller proportional change. We display the number of countries of a given group (i.e. "OECD," "Emerging," "Developing," etc.) that fall into each of the bands, during the GFC and its aftermath, according to nominal and real balance sheet changes respectively. To paint a more precise picture, we then list all countries individually, noting whether their minimum and average policy rate fell below 1% in the aftermath of the collapse of Lehman Brothers. We also report their maximum indexed nominal and real balance sheet expansion. For countries which had both minimum and average policy rates below 1% and a real balance sheet expansion to more than 200% of the base period value of 100%, the row is shaded blue. We carry out a similar analysis for the second subsample period covering the COVID-19 pandemic, with a real balance sheet expansion of over 150% being the benchmark.

The next step of our empirical analysis consists of a more granular approach. It boils down to a comparison of monthly observations on balance sheet adjustment in a country relative to the

Fed's during a crisis period. We graph the indexed values for each individual country on a scatter plot against the indexed values of the United States, with the US on the x-axis and country *i* on the y-axis. If the expansion of the balance sheet in country *i* occurred at the same speed as in the United States, then all observations would lie along the forty-five-degree line. If the Federal Reserve's balance sheet grew at a faster (slower) pace than elsewhere, then the observations would lie below (above) the forty-five-degree line. The two subsample periods are laid on top of each other, with the GFC period observations in blue and the COVID-19 observations in red. All in all, there are 75 graphs to consider.

Table A 1: Minimum Policy Interest Rates Before and After the GFC (By Continent)

Continent	1.00% and less but greater than 0.5%		0.5% and less but greater than 0.25%		0.25% and less	
	2006M1-2008M8	2008M9-2015M12	2006M1-2008M8	2008M9-2015M12	2006M1-2008M8	2008M9-2015M12
North America (2)	0	0	0	0	0	2
South/Cent Am. (17)	0	0	0	1	0	0
Europe (19)	0	1	0	1	0	6
Africa (11)	0	0	0	0	0	0
Asia (25)	0	1	1	2	1	4
Oceania (4)	0	0	0	1	0	0
Total (78)	**0**	**2**	**1**	**5**	**1**	**12**

Table A 2: Minimum Policy Interest Rates Before and After COVID-19 (By Continent)

Continent	1.00% and less but greater than 0.5%		0.5% and less but greater than 0.25%		0.25% and less	
	2018M1-2019M12	2020M1-2022M8	2018M1-2019M12	2020M1-2022M8	2018M1-2019M12	2020M1-2022M8
North America (2)	0	0	0	0	0	2
South/Cent Am. (15)	0	1	1	2	0	1
Europe (19)	2	3	3	1	5	9
Africa (11)	0	0	0	0	0	1
Asia (25)	1	1	0	4	2	3
Oceania (4)	2	0	1	0	0	3
Total (76)	**5**	**5**	**5**	**7**	**7**	**19**

Note: Policy interest rate data was unavailable for Suriname and Uruguay

Table A 3: Country Acronyms (according to the ISO 3166-1 alpha-3 standard)

OECD (21):

AUS	Australia
CAN	Canada
CHE	Switzerland
CHL	Chile
COL	Colombia
CRI	Costa Rica
CZE	Czech Republic
DNK	Denmark
GBR	Great Britain (UK)
HUN	Hungary
ISL	Iceland
ISR	Israel
JPN	Japan
KOR	South Korea
MEX	Mexico
NOR	Norway
NZL	New Zealand
POL	Poland
SWE	Sweden
TUR	Turkey
US	United States of America

Other advanced (3):

HKG	Hong Kong
HRV	Croatia
SGP	Singapore

Emerging (35):

ALB	Albania
ARG	Argentina
ARM	Armenia
AZE	Azerbaijan
BGR	Bulgaria
BHR	Bahrain
BHS	Bahamas
BLR	Belarus
BLZ	Belize
CPV	Cabo Verde
DOM	Dominican Republic
EGY	Egypt
FJI	Fiji
GEO	Georgia
GTM	Guatemala
GUY	Guyana
IDN	Indonesia
IRQ	Iraq
JAM	Jamaica
JOR	Jordan
KAZ	Kazakhstan
MKD	North Macedonia
MNG	Mongolia
MUS	Mauritius
MYS	Malaysia
PER	Peru
PHL	Philippines
QAT	Qatar
ROU	Romania
SAU	Saudi Arabia
SRB	Serbia
SUR	Suriname
THA	Thailand
URY	Uruguay
VNM	Vietnam

BRICS (5):

BRA	Brazil
CHN	China
IND	India
RUS	Russia
ZAF	South Africa

Developing (12):

BGD	Bangladesh
COD	Democratic Republic of the Congo
GHA	Ghana
GMB	Gambia
HND	Honduras
KEN	Kenya
KGZ	Kyrgyz Republic
MDA	Moldova
NGA	Nigeria
NPL	Nepal
PNG	Papua New Guinea
STP	São Tomé and Príncipe

Monetary unions (2):

EUR	Euro Area
UEMOA	West African Economic and Monetary Union

Other Abbreviations:

ECB	European Central Bank
Fed	Federal Reserve System
GFC	Global Financial Crisis
IMF	International Monetary Fund
LSAP	Large-scale asset purchase
ZLB	Zero lower bound

Figure 1: Average Policy Interest Rates Before and After the GFC

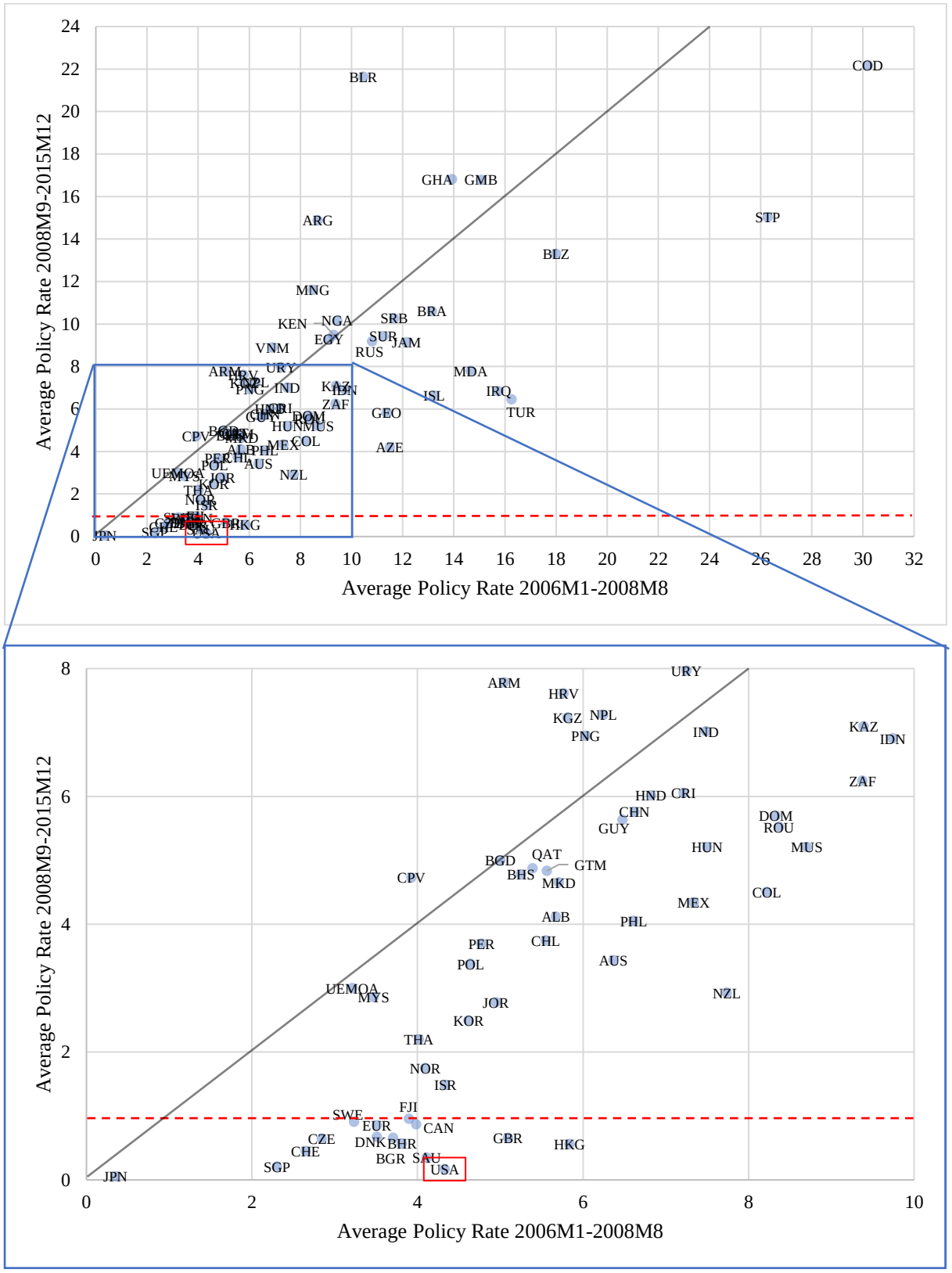


Figure 2: Average Policy Interest Rates Before and During the COVID-19 Pandemic

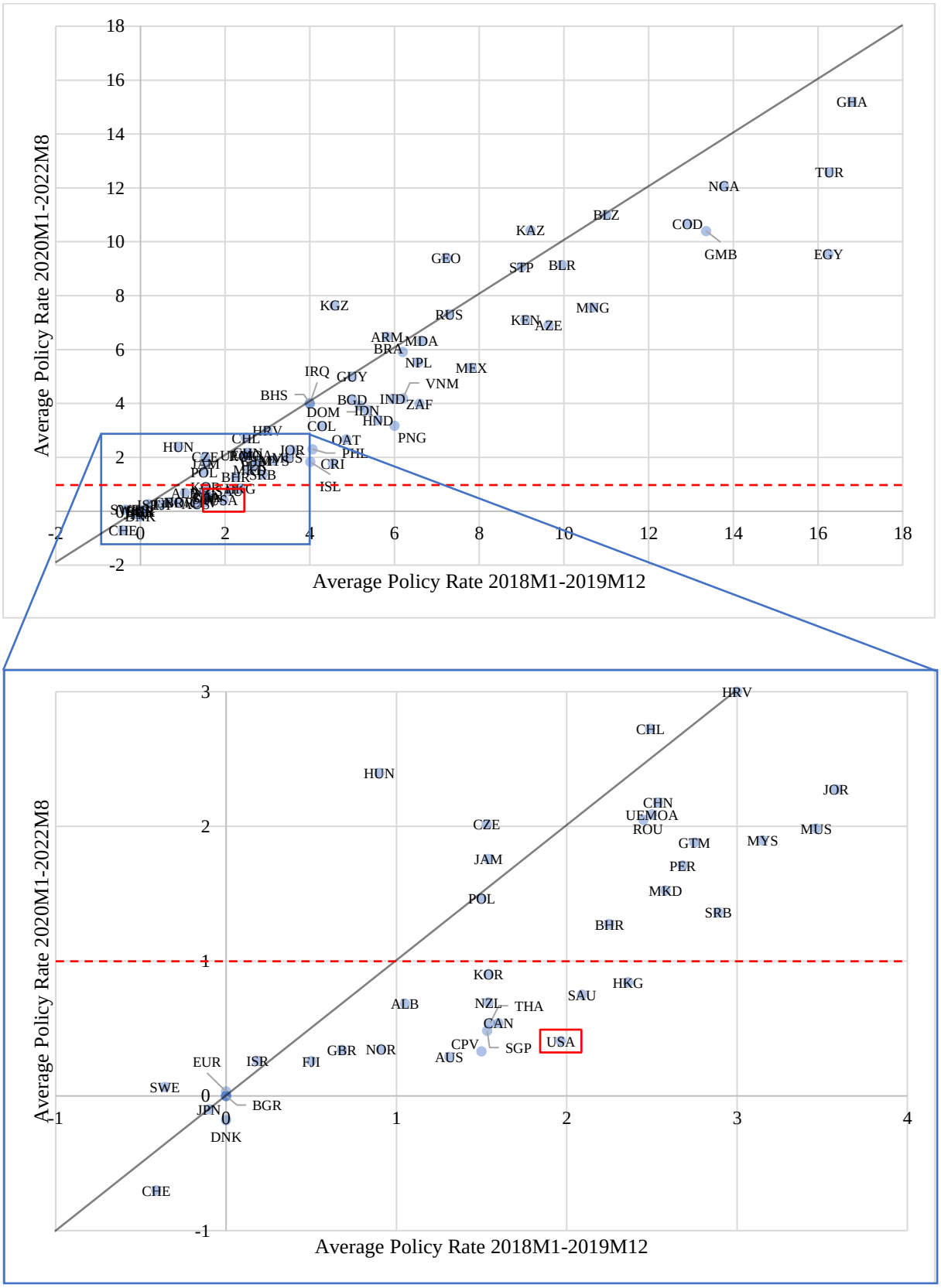
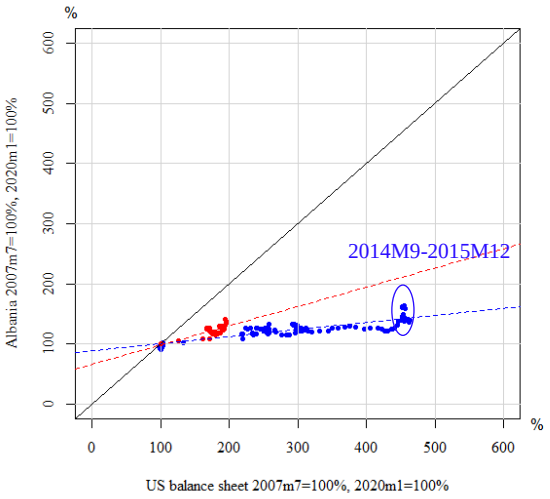


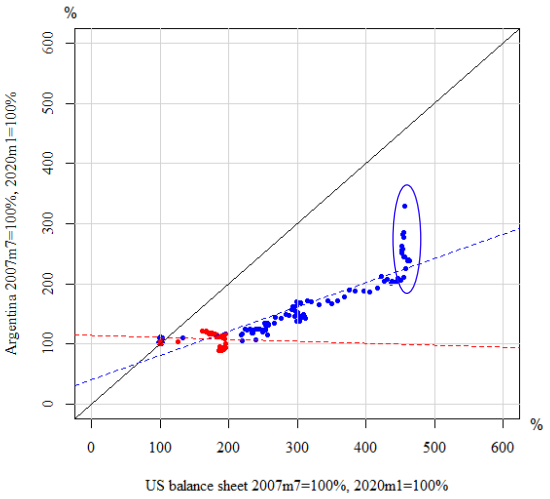
Figure 3: A Country-By-Country Analysis of CPI-Adjusted Balance Sheet Changes

Blue = 2007m7-2015m12, Red = 2020m1-2022m8

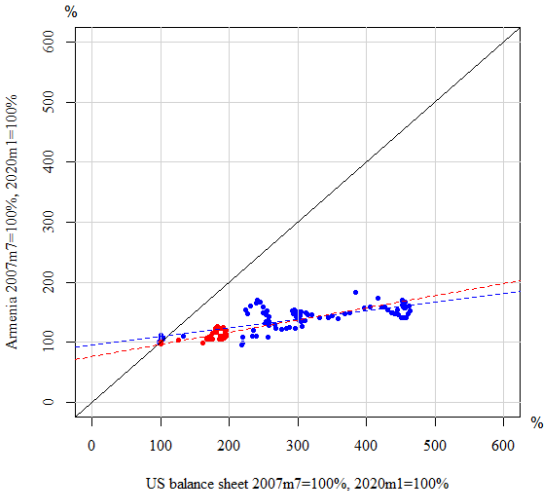
D1 Index of BS: ALB to US



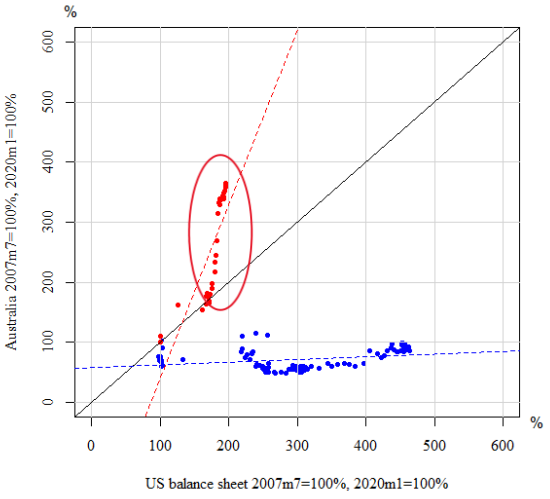
D2 Index of BS: ARG to US



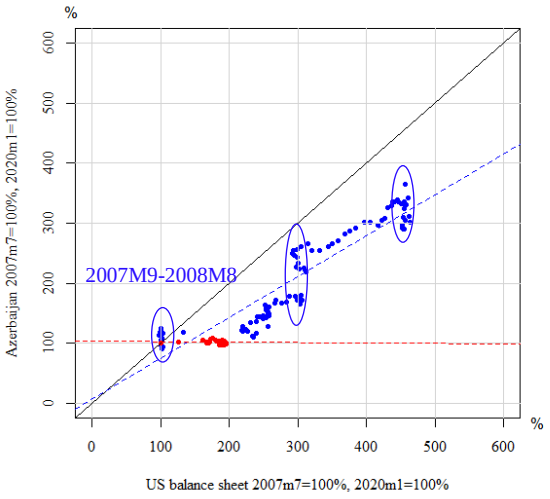
D3 Index of BS: ARM to US



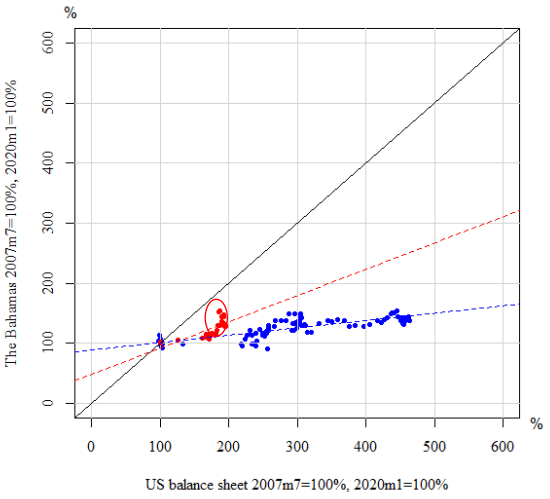
D4 Index of BS: AUS to US



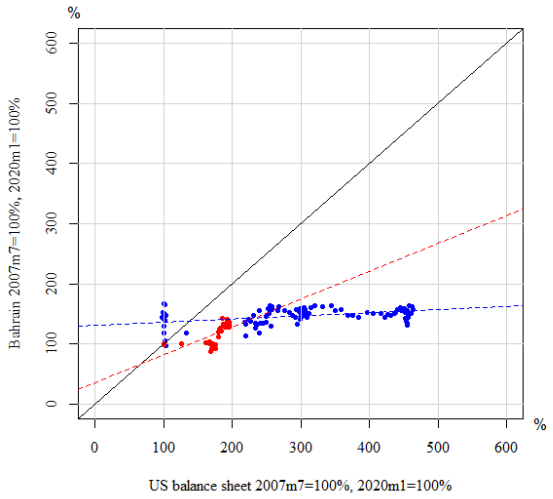
D5 Index of BS: AZE to US



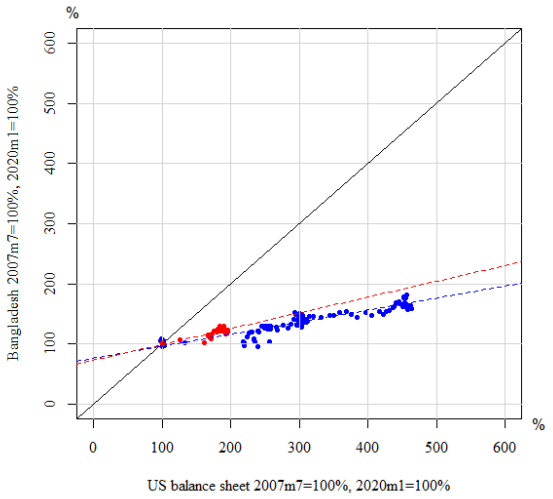
D6 Index of BS: BHS to US



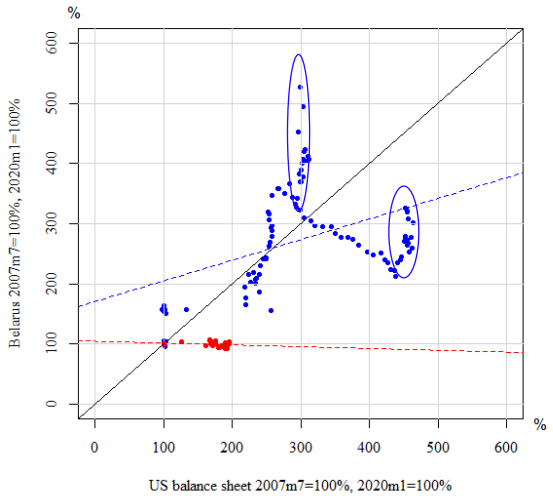
D7 Index of BS: BHR to US



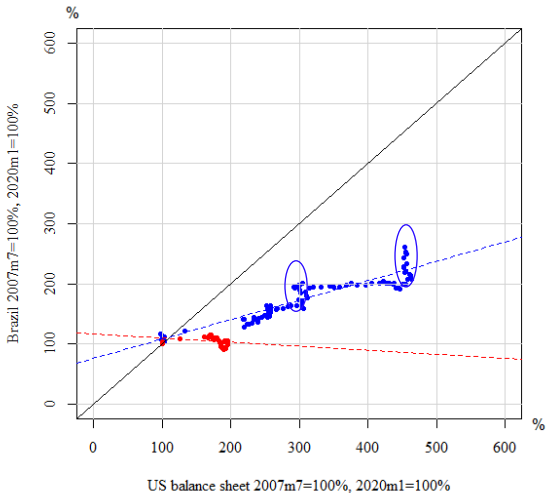
D8 Index of BS: BGD to US



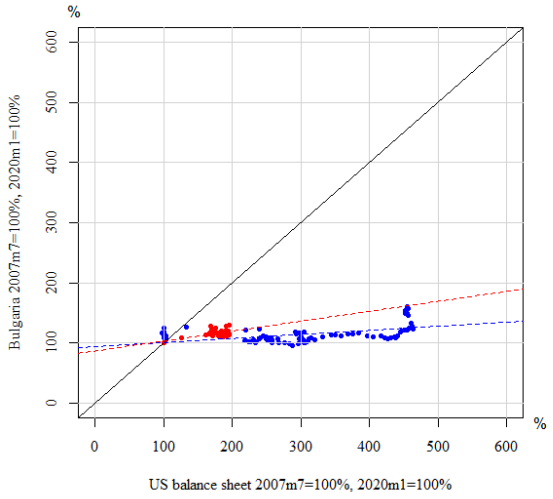
D9 Index of BS: BLR to US



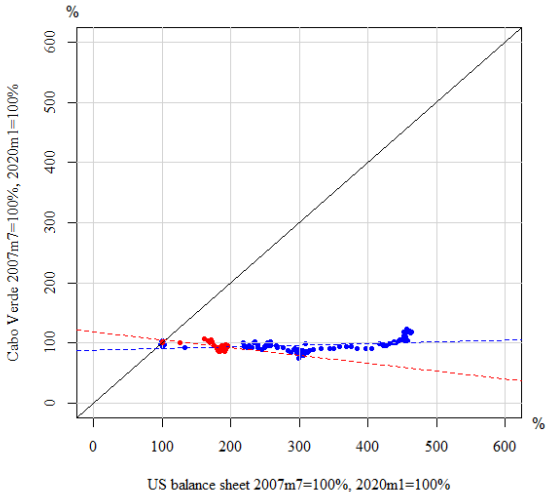
D10 Index of BS: BRA to US



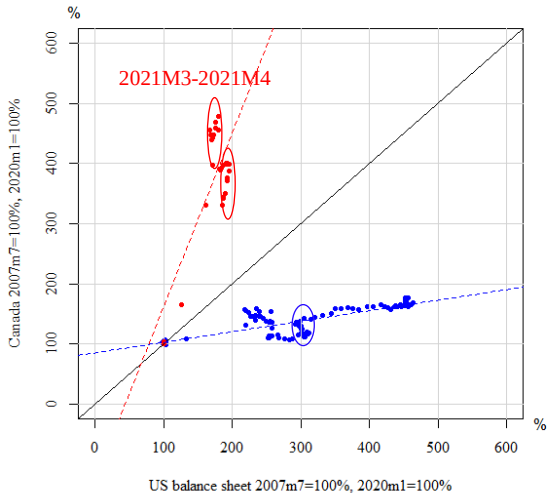
D11 Index of BS: BGR to US



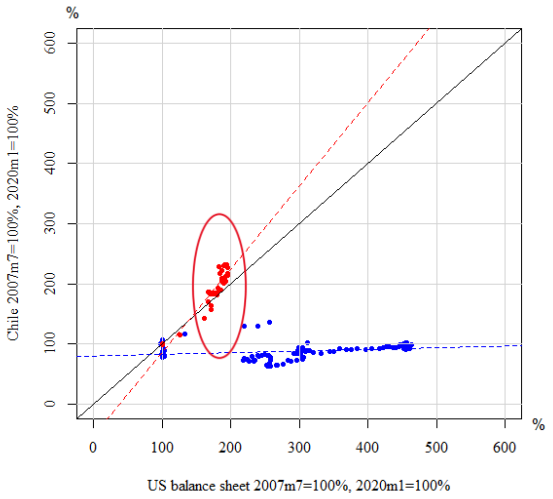
D12 Index of BS: CPV to US



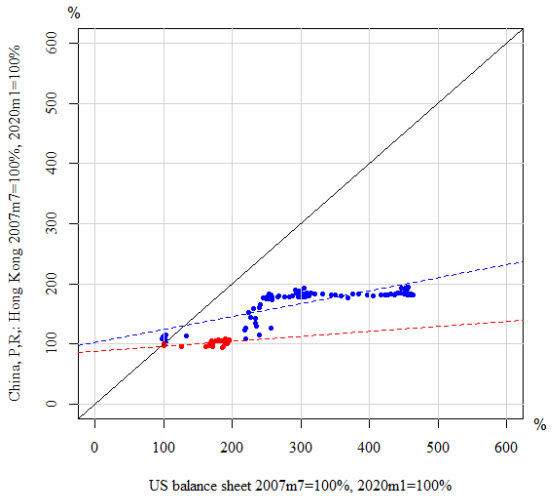
D13 Index of BS: CAN to US



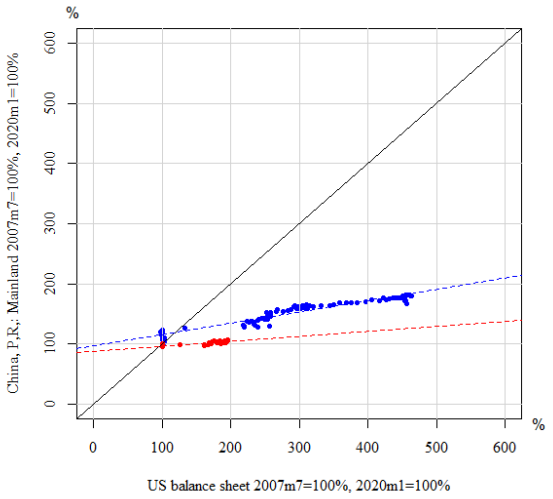
D14 Index of BS: CHL to US



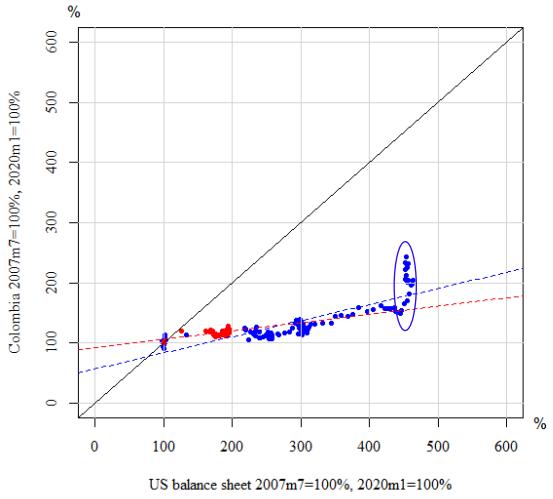
D15 Index of BS: HKG to US



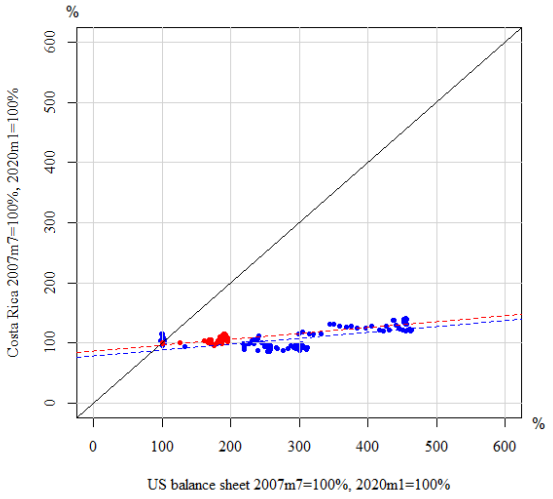
D16 Index of BS: CHN to US



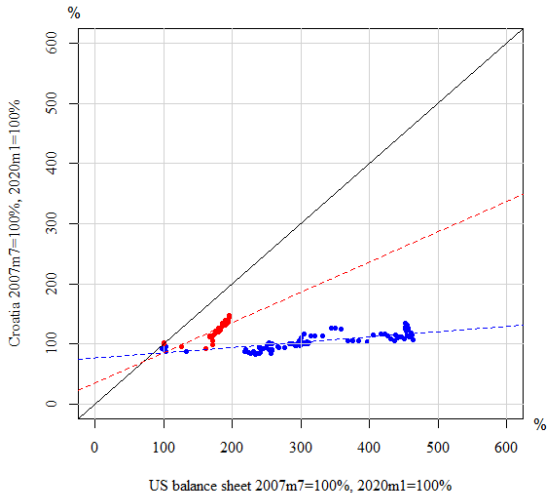
D17 Index of BS: COL to US



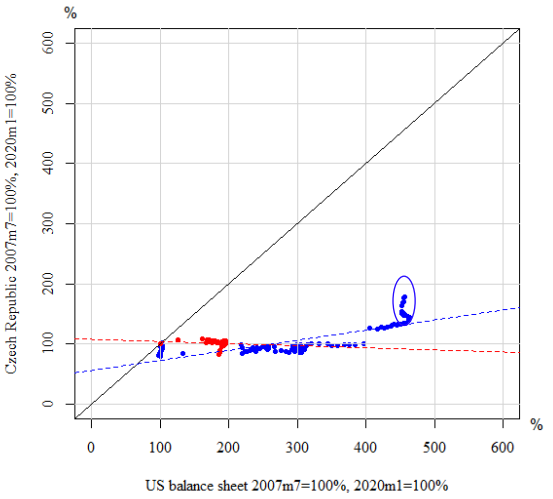
D18 Index of BS: CRI to US



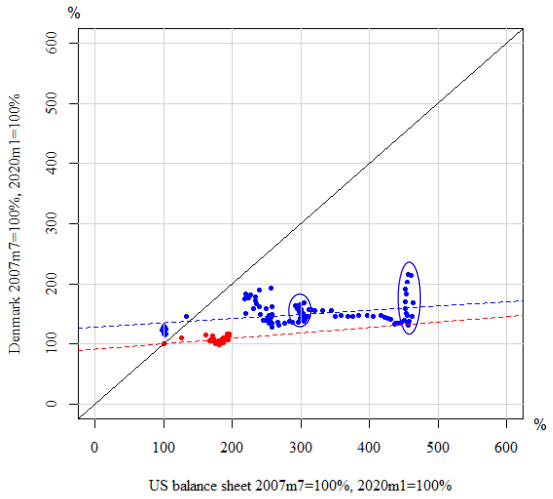
D19 Index of BS: HRV to US



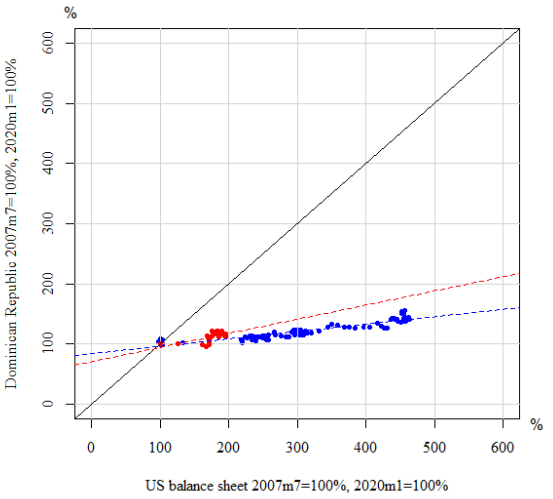
D20 Index of BS: CZE to US



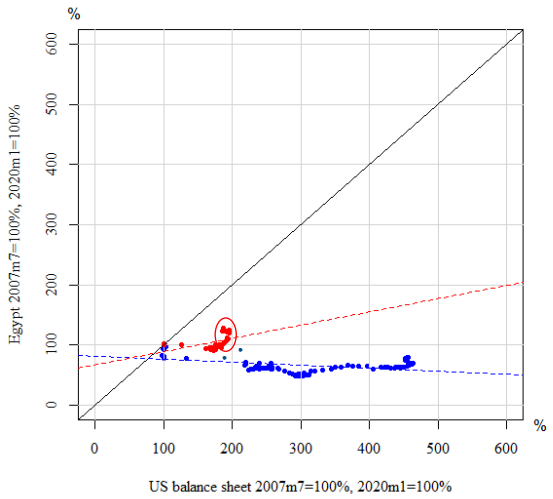
D21 Index of BS: DNK to US



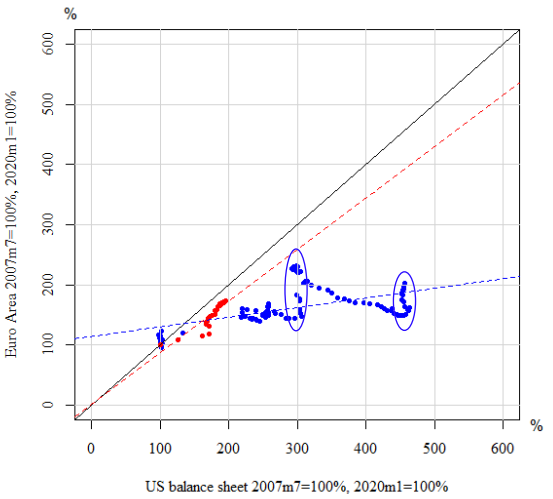
D22 Index of BS: DOM to US



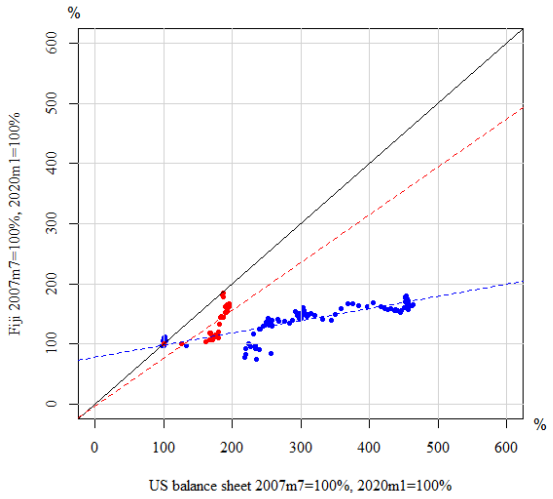
D23 Index of BS: EGY to US



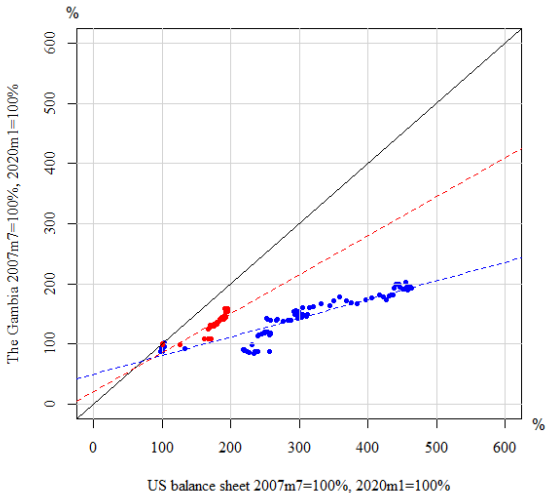
D24 Index of BS: EUR to US



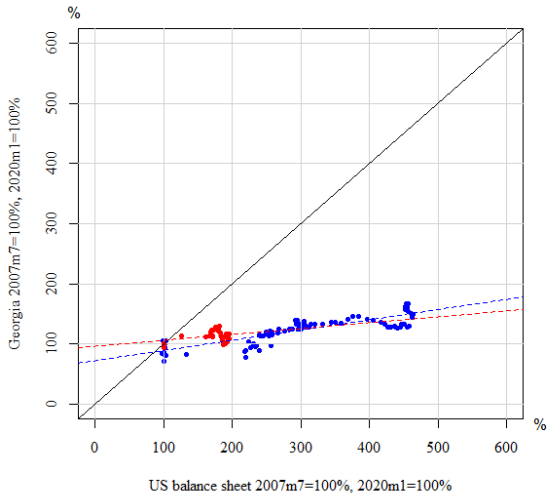
D25 Index of BS: FJI to US



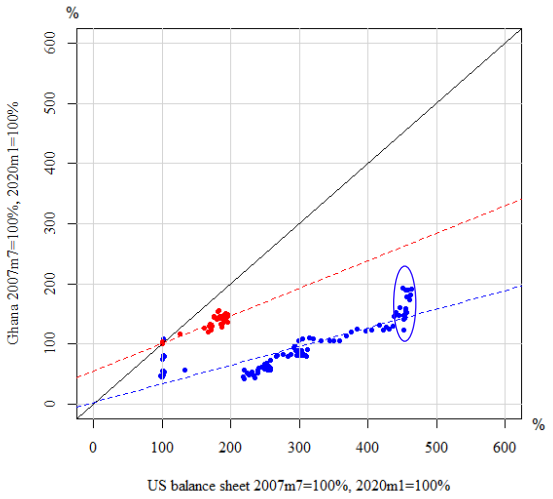
D26 Index of BS: GMB to US



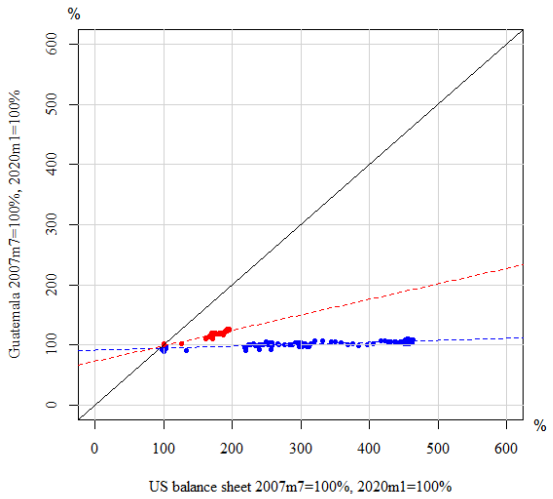
D27 Index of BS: GEO to US



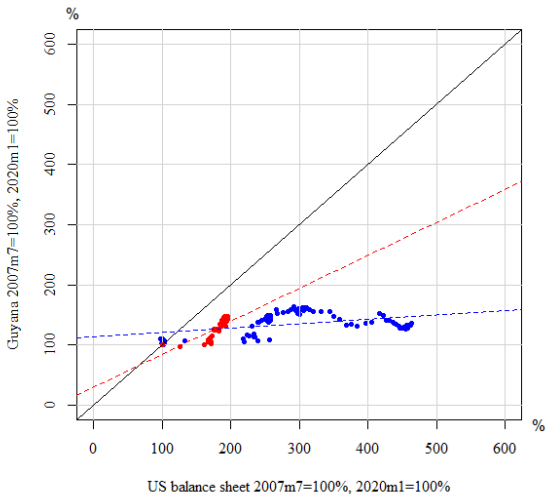
D28 Index of BS: GHA to US



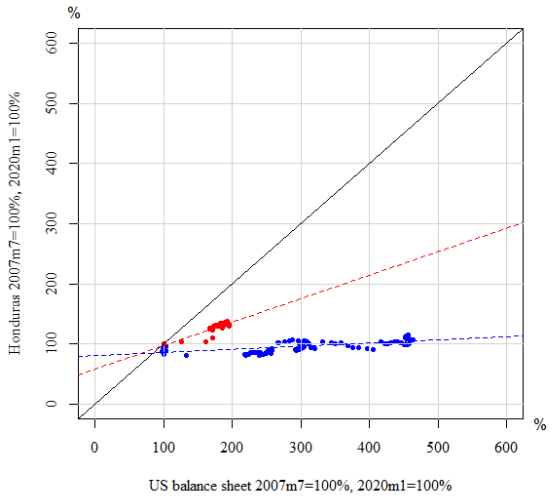
D29 Index of BS: GTM to US



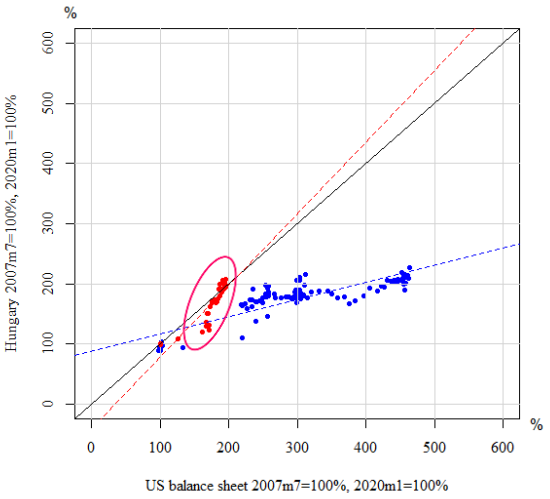
D30 Index of BS: GUY to US



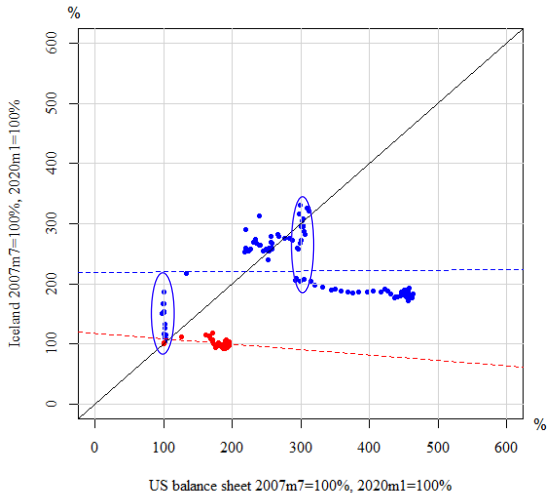
D31 Index of BS: HND to US



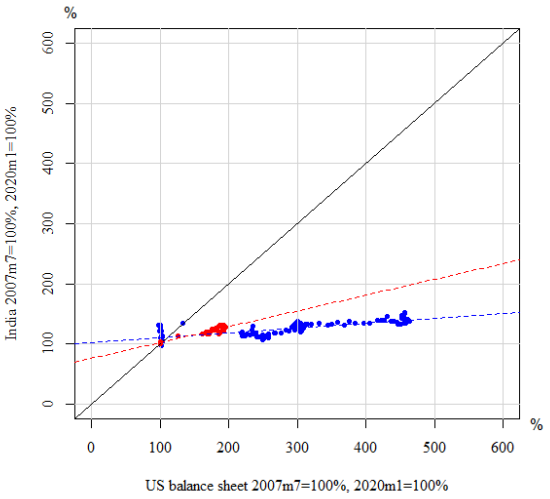
D32 Index of BS: HUN to US



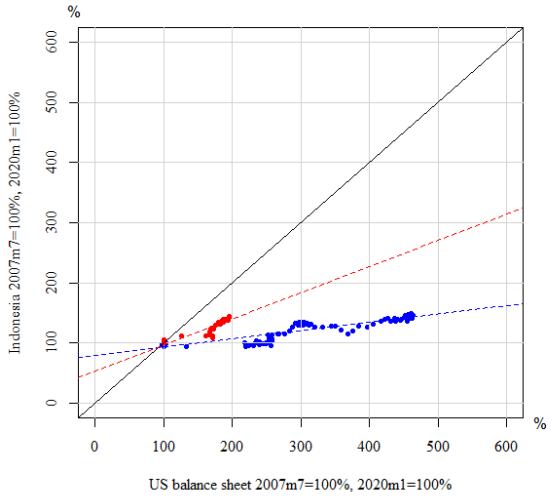
D33 Index of BS: ISL to US



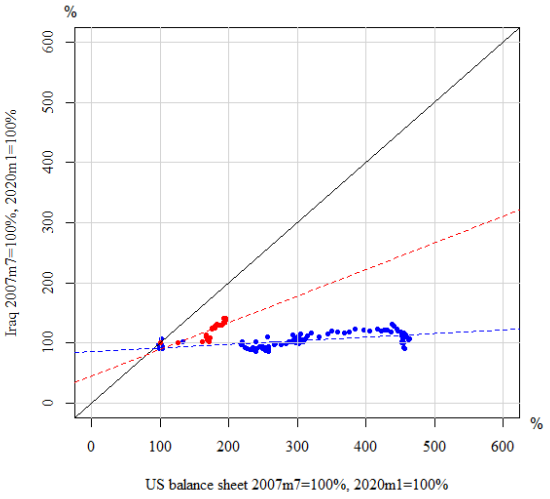
D34 Index of BS: IND to US



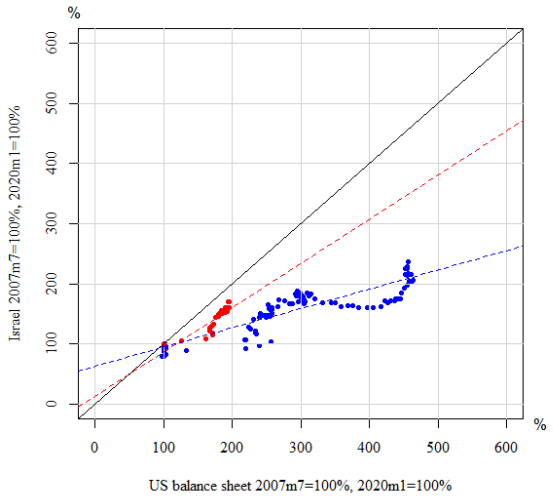
D35 Index of BS: IDN to US



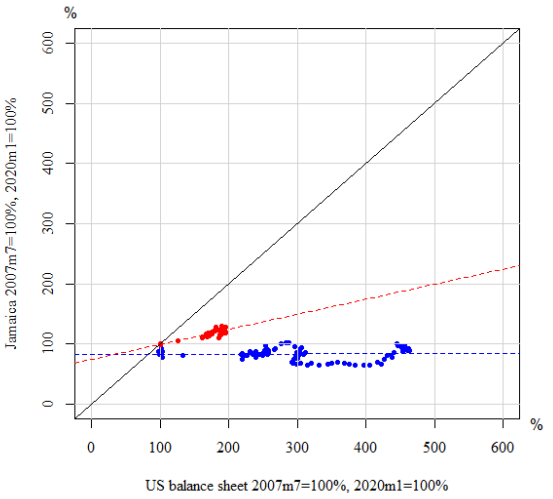
D36 Index of BS: IRQ to US



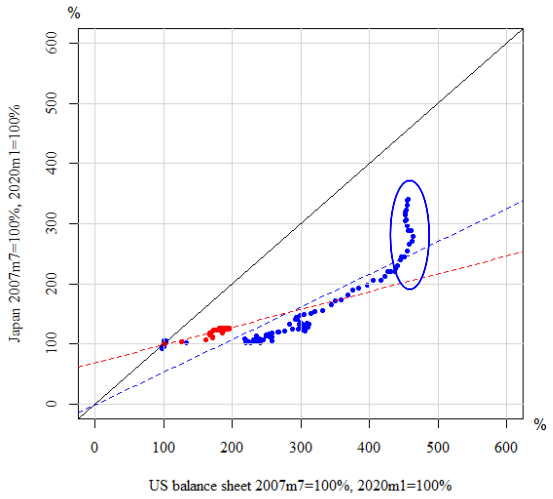
D37 Index of BS: ISR to US



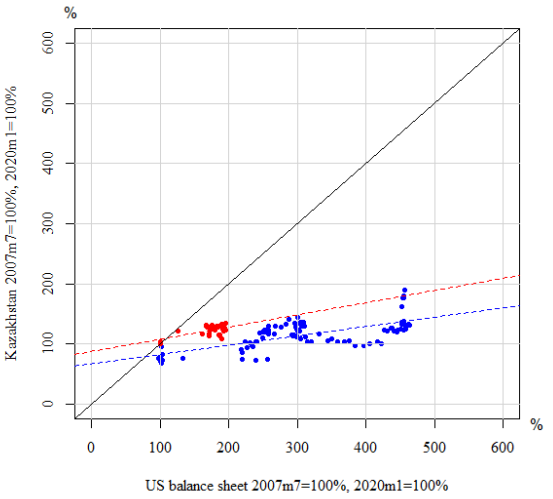
D38 Index of BS: JAM to US



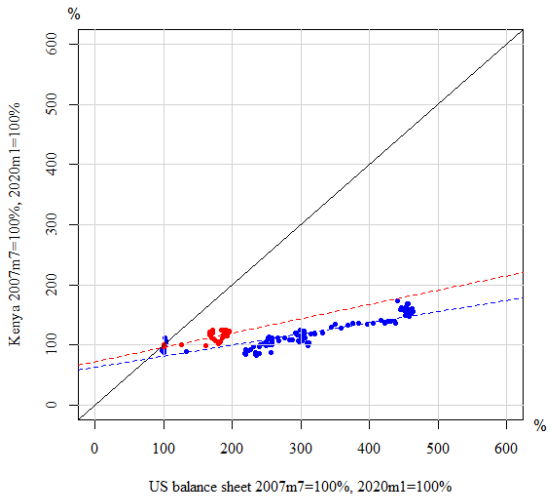
D39 Index of BS: JPN to US



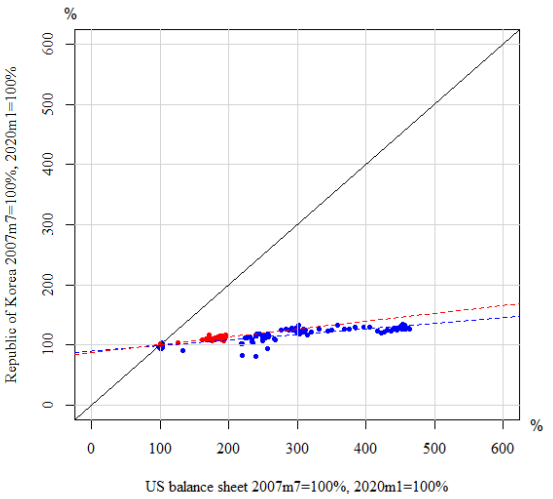
D40 Index of BS: KAZ to US



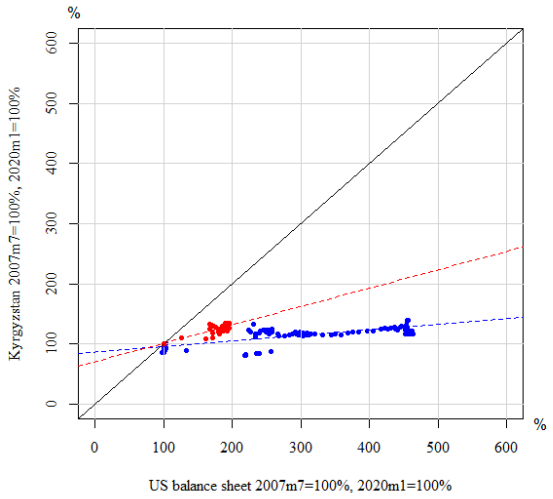
D41 Index of BS: KEN to US



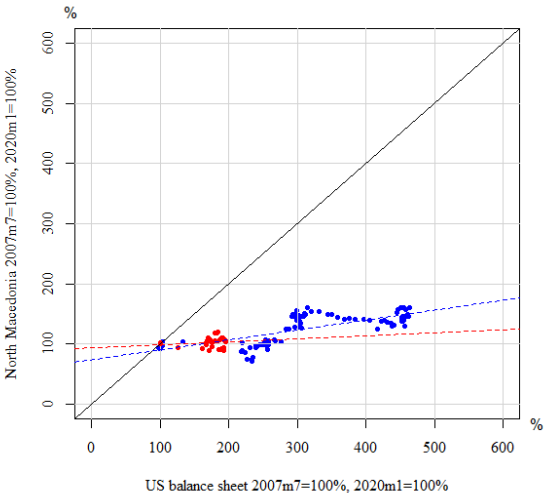
D42 Index of BS: KOR to US



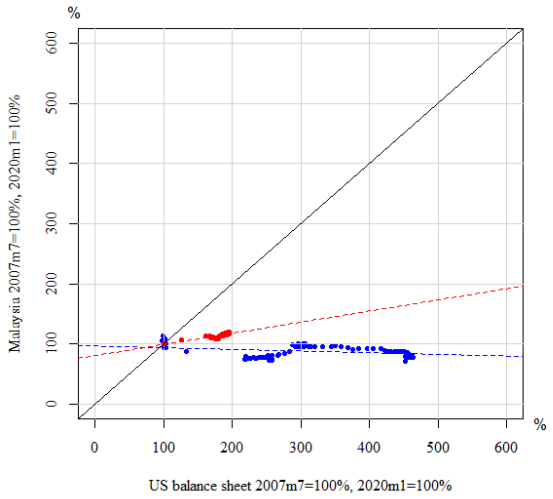
D43 Index of BS: KGZ to US



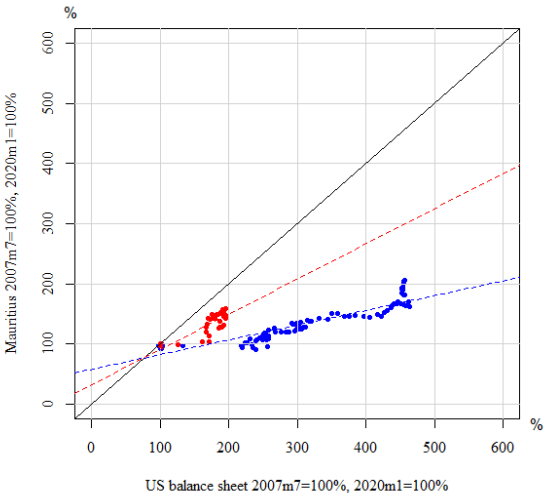
D44 Index of BS: MKD to US



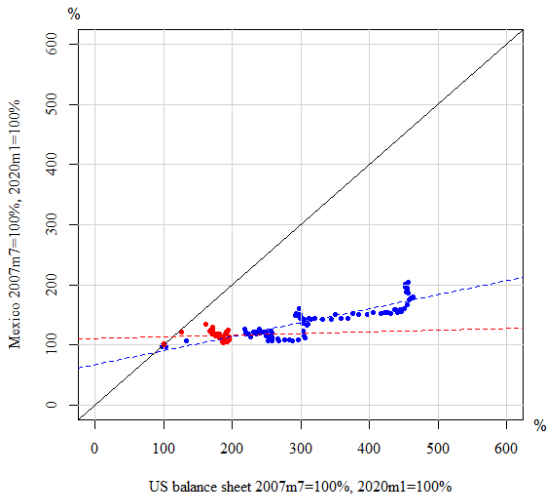
D45 Index of BS: MYS to US



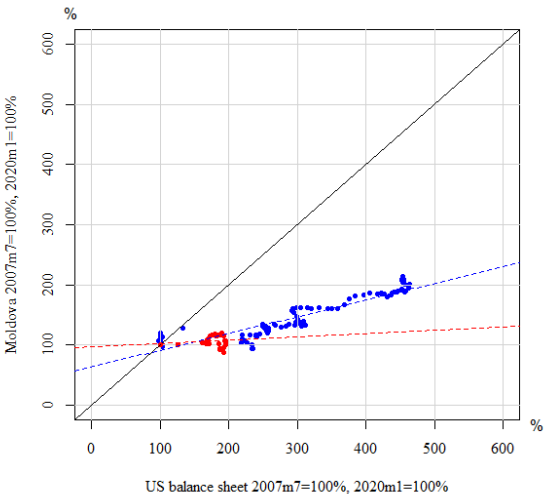
D46 Index of BS: MUS to US



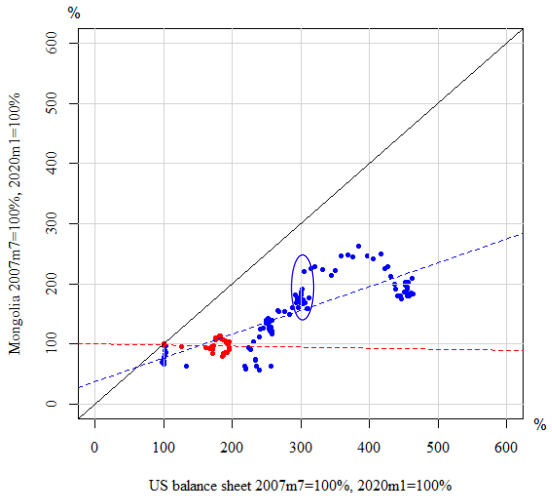
D47 Index of BS: MEX to US



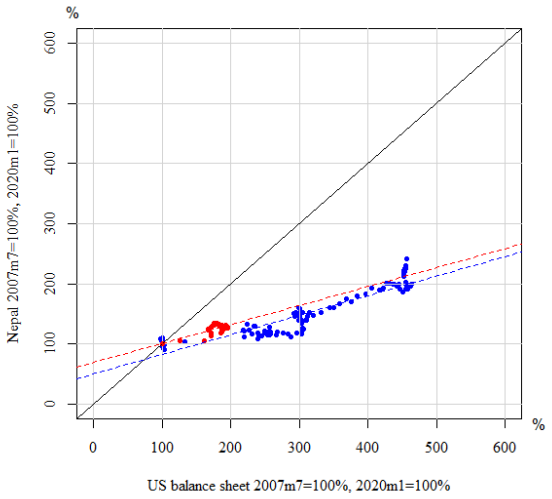
D48 Index of BS: MDA to US



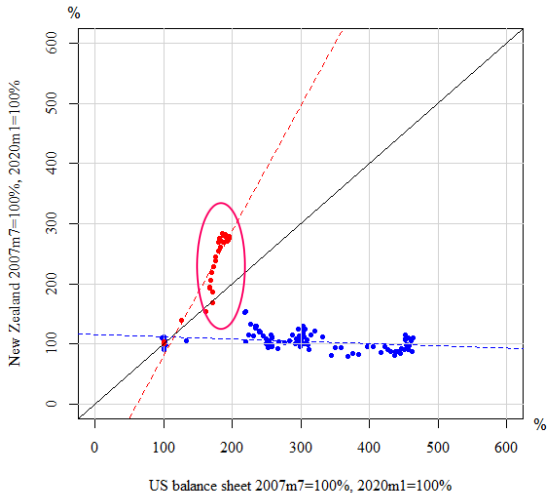
D49 Index of BS: MNG to US



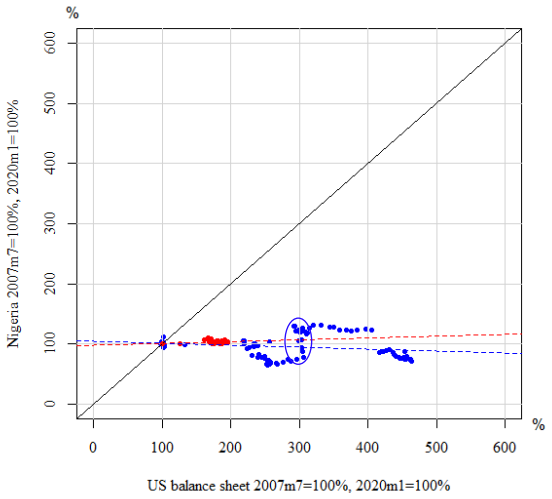
D50 Index of BS: NPL to US



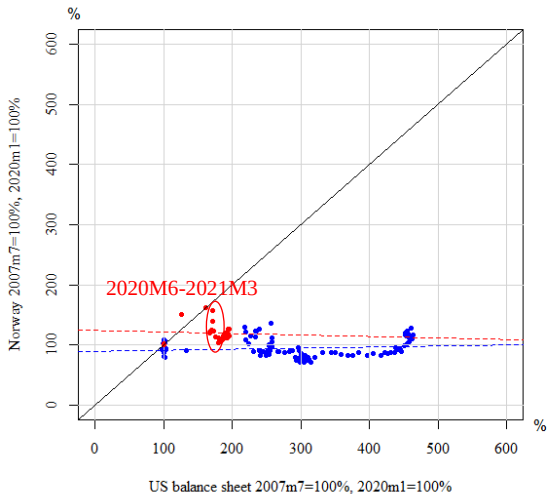
D51 Index of BS: NZL to US



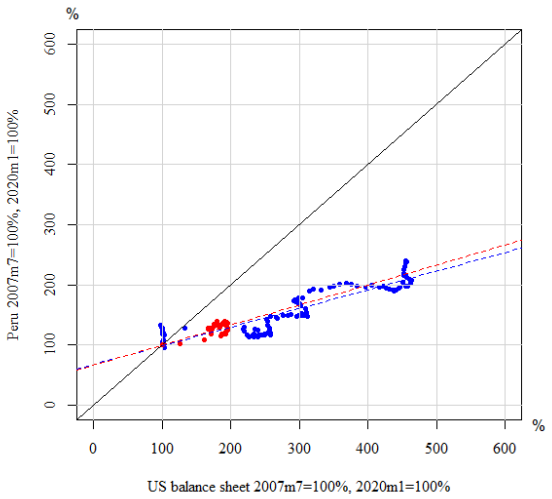
D52 Index of BS: NGA to US



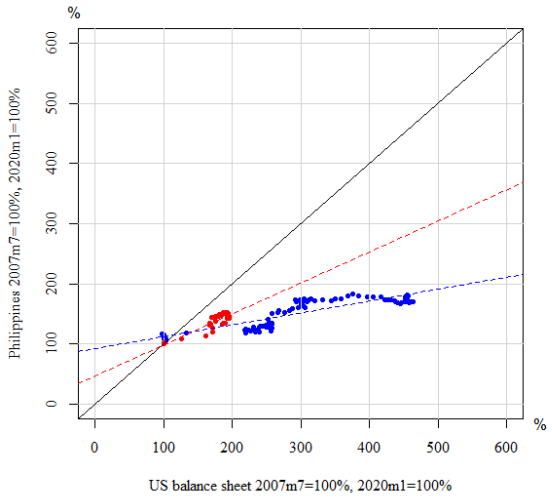
D53 Index of BS: NOR to US



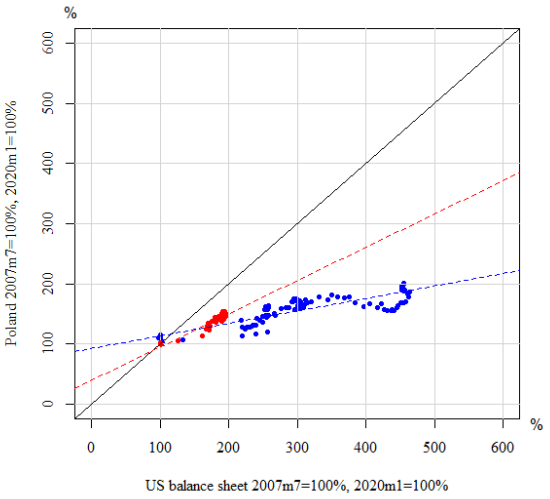
D54 Index of BS: PER to US



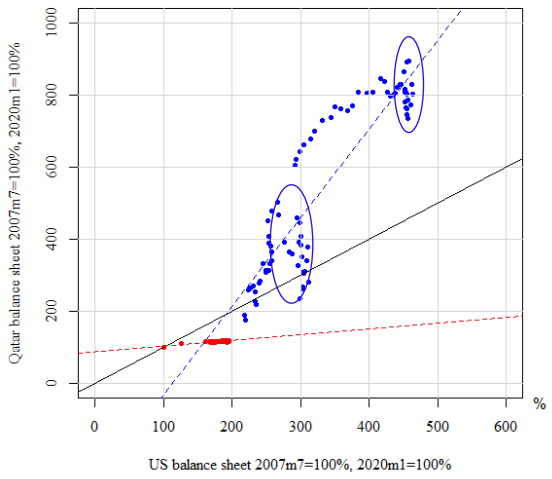
D55 Index of BS: PHL to US



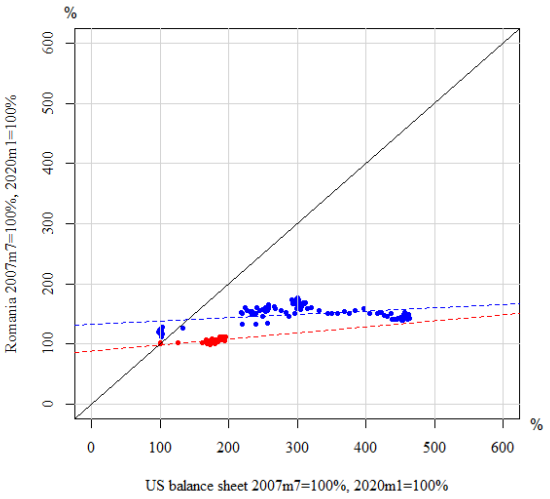
D56 Index of BS: POL to US



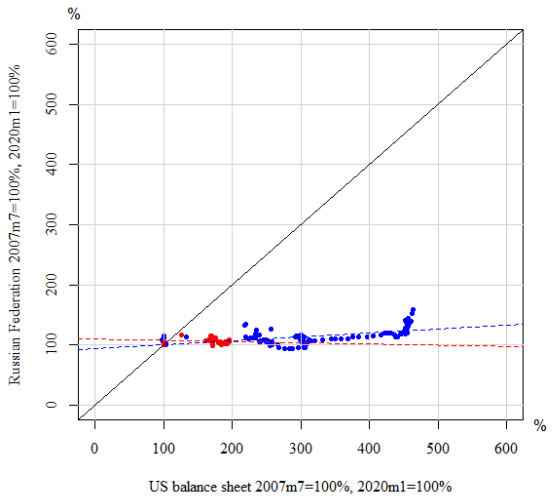
D57 Index of BS: QAT to US



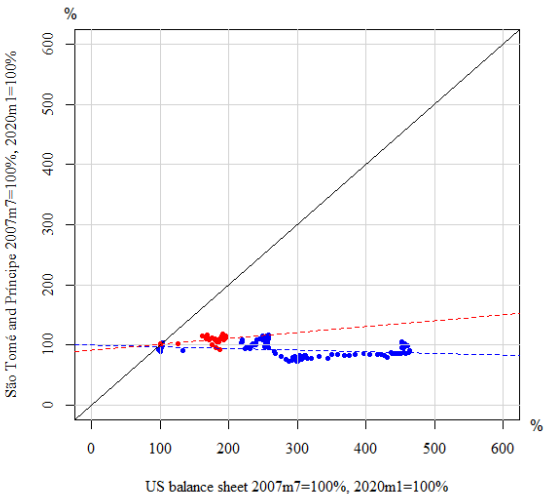
D58 Index of BS: ROU to US



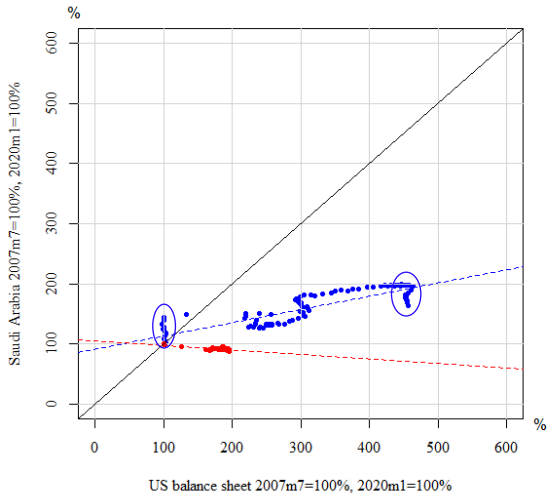
D59 Index of BS: RUS to US



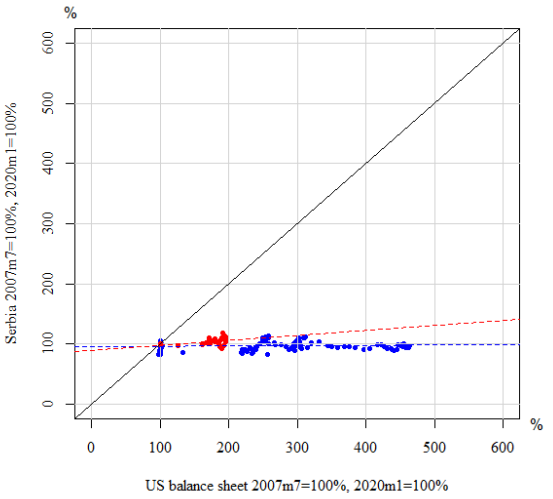
D60 Index of BS: STP to US



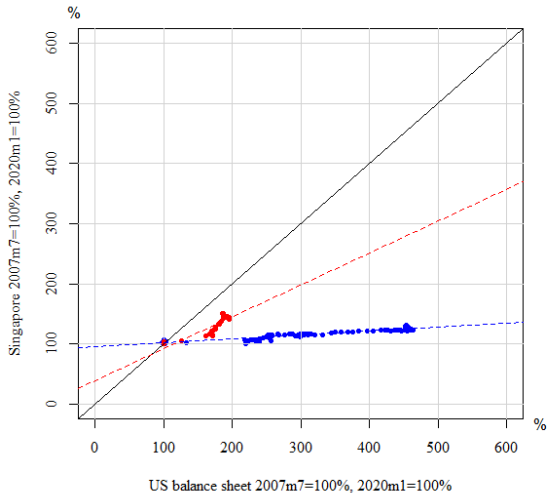
D61 Index of BS: SAU to US



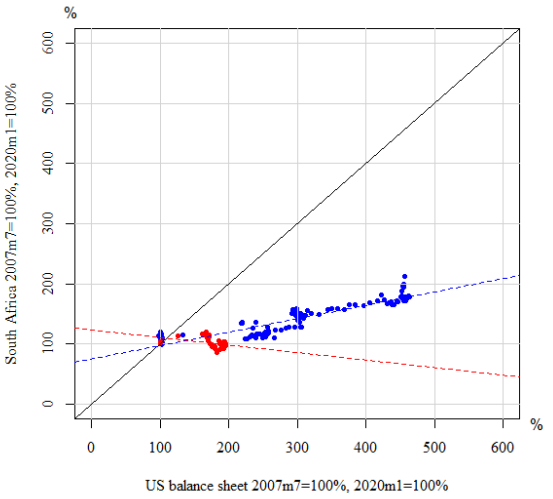
D62 Index of BS: SRB to US



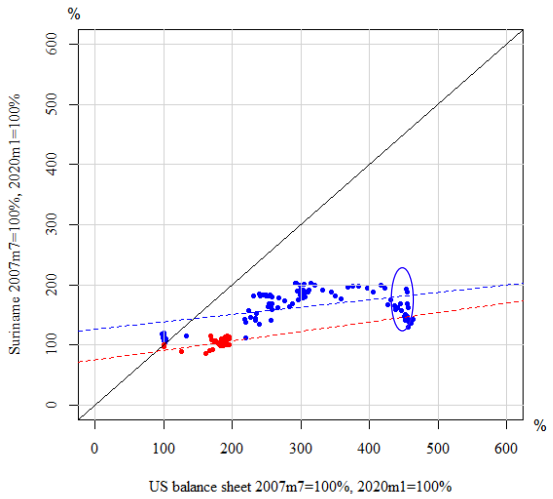
D63 Index of BS: SGP to US



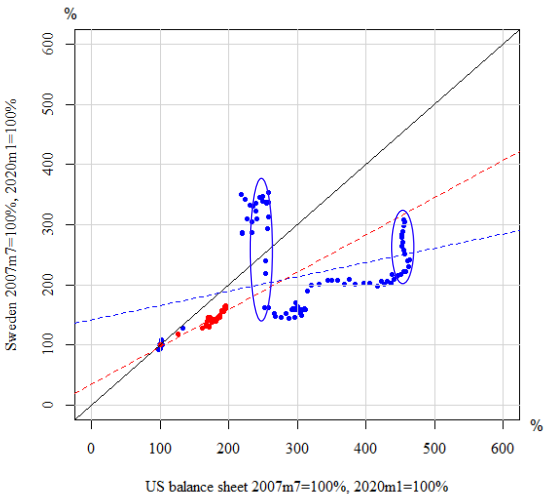
D64 Index of BS: ZAF to US



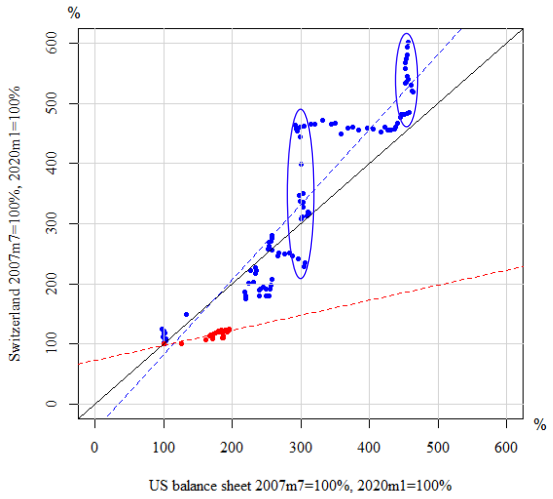
D65 Index of BS: SUR to US



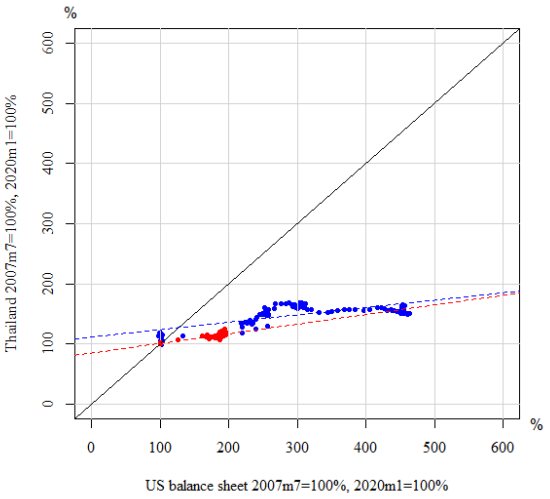
D66 Index of BS: SWE to US



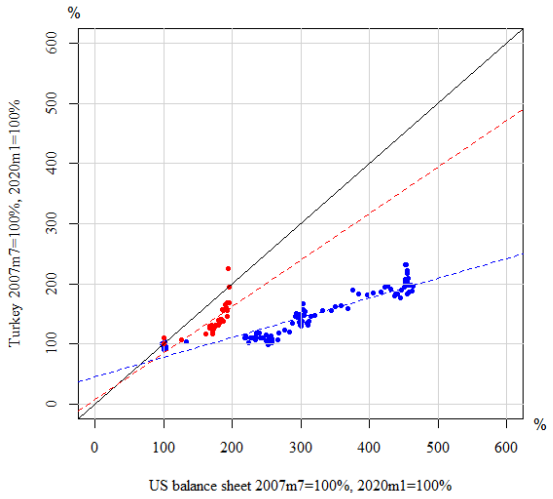
D67 Index of BS: CHE to US



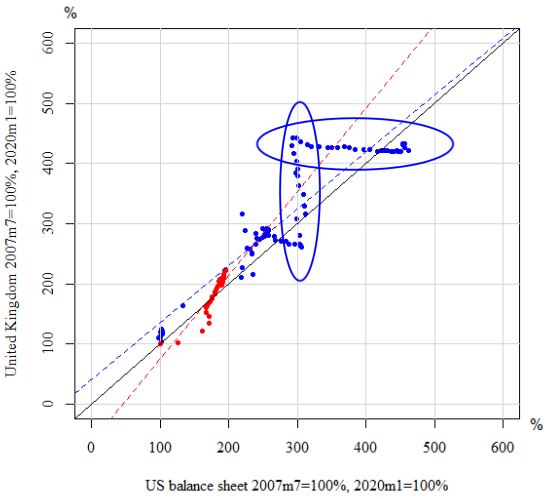
D68 Index of BS: THA to US



D69 Index of BS: TUR to US

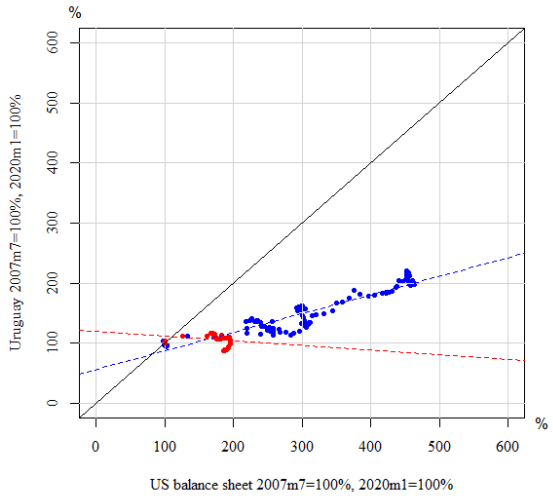


D70 Index of BS: GBR to US



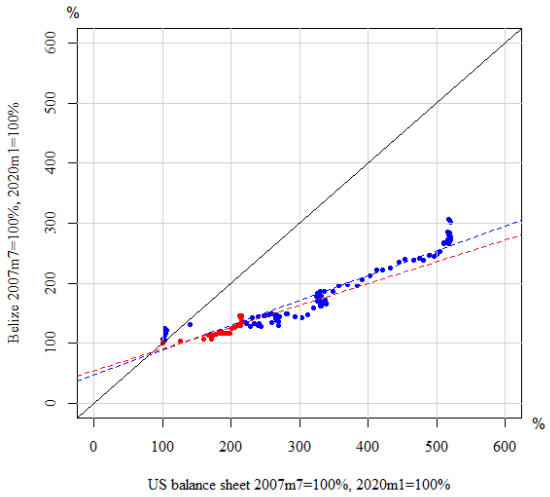
Note: 2020M1-2022M8 data uses a different dataset to Tables 6, 7, and 8. It is derived from weekly BoE statements containing ~ 90% of balance sheet.

D71 Index of BS: URY to US

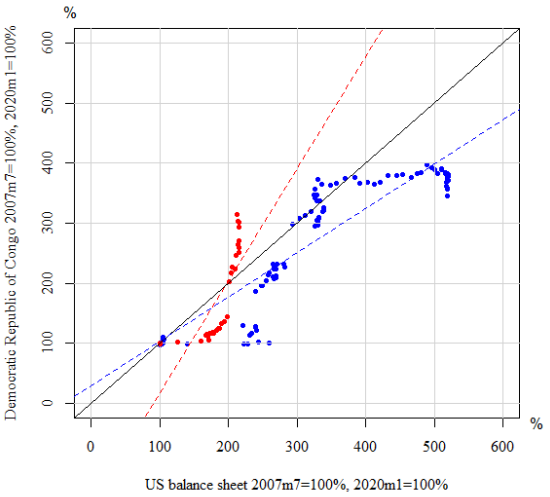


Part B: Nominal Balance Sheet Changes Only (Due to Lack of CPI Data)

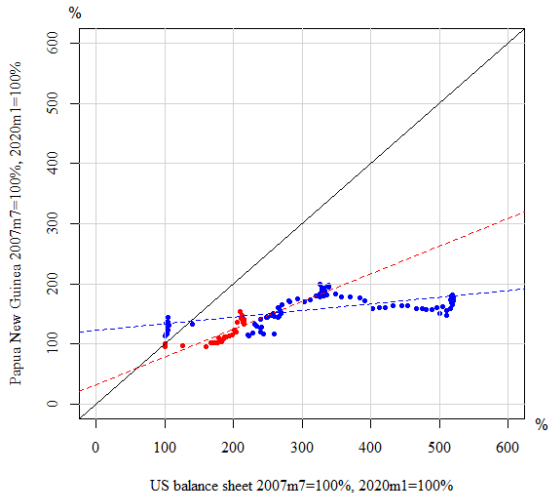
G1 Index of BS: BLZ to US



G2 Index of BS: COD to US



G3 Index of BS: PNG to US



G4 Index of BS: UEMOA to US

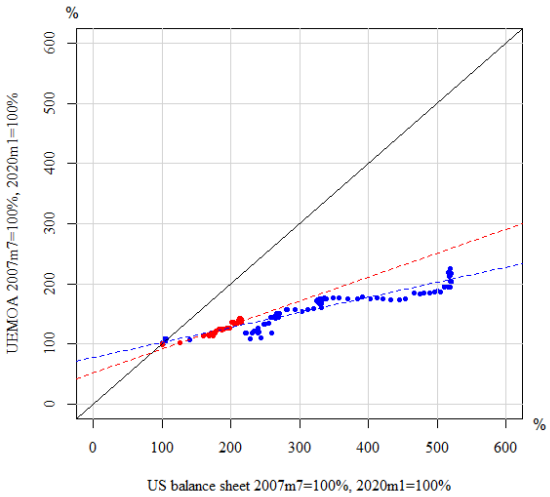


Figure 4: Correlation Coefficients for GFC and COVID-19 Periods: Real Balance Sheet Changes

Table 7: The Experience of Central Banks Before, During, and After the GFC

Country	Minimal policy rate ≤ 1% 2008M9:2015M12	Average policy rate ≤ 1% 2008M9:2015M12	Max size of BS (% of 2007m7 value) 2007m7:2015m12	Max BS/CPI ratio (% of 2007m7 value) 2007m7:2015m12
ALB (E)			200-300%	100-200%
ARG (E)			>500%	300-400%
ARM (E)			200-300%	100-200%
AUS (O)			100-200%	100-200%[1]
AZE (E)			>500%	300-400%
BGD (D)			300-400%	100-200%
BGR (E)	✓	✓	200-300%	100-200%
BHR (E)	✓	✓	100-200%	100-200%[2]
BHS (E)			100-200%	100-200%
BLR (E)			>500%	>500%
BLZ (E)			300-400%	-[3]
BRA (B)			400-500%	200-300%
CAN (O)	✓	✓	200-300%	100-200%
CHE (O)	✓	✓	>500%	>500%
CHL (O)	✓		100-200%	100-200%
CHN (B)			200-300%	100-200%
COD (D)			300-400%	200-300%
COL (O)			300-400%	200-300%
CPV (E)			100-200%	100-200%
CRI (O)			200-300%	100-200%
CZE (O)	✓	✓	200-300%	100-200%
DNK (O)	✓	✓	200-300%	200-300%
DOM (E)			200-300%	100-200%
EGY (E)			100-200%	100-200%
EUR	✓	✓	200-300%	200-300%
FJI (E)	✓	-[4]	200-300%	100-200%
GBR (O)	✓	✓	>500%[5]	400-500%[5]
GEO (E)			200-300%	100-200%
GHA (D)			>500%	100-200%
GMB (D)			200-300%	200-300%
GTM (E)			100-200%	100-200%
GUY (E)			200-300%	100-200%
HKG (OA)	✓	✓	200-300%	100-200%
HND (D)			100-200%	100-200%
HRV (OA)			100-200%	100-200%
HUN (O)			200-300%	200-300%
IDN (E)			200-300%	100-200%
IND (B)			300-400%	100-200%
IRQ (E)			100-200%	100-200%
ISL (O)			400-500%	300-400%
ISR (O)	✓		200-300%	200-300%
JAM (E)			200-300%	100-200%
JPN (O)	✓	✓	300-400%	300-400%
KAZ (E)			300-400%	100-200%
KEN (D)			300-400%	100-200%
KGZ (D)	✓		300-400%	100-200%
KOR (O)			100-200%	100-200%
MDA (D)			300-400%	200-300%
MEX (O)			200-300%	200-300%
MKD (E)			100-200%	100-200%
MNG (E)			>500%	200-300%
MUS (E)			200-300%	200-300%
MYS (E)			100-200%	100-200%
NGA (D)			200-300%	100-200%
NOR (O)	✓		100-200%	100-200%
NPL (D)			>500%	200-300%
NZL (O)			100-200%	100-200%[1]
PER (E)			300-400%	200-300%
PHL(E)			200-300%	100-200%
PNG (D)			100-200%	-[3]
POL (O)			200-300%	200-300%
QAT (E)			>500%	>500%
ROU (E)			200-300%	100-200%
RUS (B)			300-400%	100-200%
SAU (E)	✓	✓	200-300%	100-200%
SGP (OA)	✓	✓	100-200%	100-200%
SRB (E)			100-200%	100-200%

STP (D)			200-300%	100-200%
SUR (E)			300-400%	200-300%
SWE (O)	✓	✓	300-400%	300-400%
THA (E)			100-200%	100-200%
TUR (O)			400-500%	200-300%
UEMOA			200-300%	-[3]
URY (E)			400-500%	200-300%
US (O)	✓	✓	>500%	400-500%
ZAF (B)			300-400%	200-300%
Total (76)[5]	**19/76**	**14/76**	**76**	**73**

Note: O = OECD, OA = Other Advanced, B = BRICS, E = Emerging, D = Developing. Country abbreviations can be found in the appendix table A3.

1. For Australia and New Zealand quarterly observations apply, and 2007M7 values are calculated using the 2007M6 CPI.
2. CPI for 2007M8 was used for Bahrain's base period (2007M7) CPI adjustment
3. CPI data was not available for Belize, Papua New Guinea, and UEMOA.
4. Insufficient data to determine average rate for Fiji (2007M6 to 2010M4 data unavailable)
5. Quarterly observations apply for the UK from 2014M10 onwards. CPI for 2007M8 was used for Bahrain's base period (2007M7) CPI adjustment
6. Balance sheet data was not available for Jordan and Vietnam.

Table 8: The Experience of Central Banks Before, During, and After COVID

Country	Minimal policy rate ≤ 1% 2020M1:2022M8	Average policy rate ≤ 1% 2020M1:2022M8	Max size of BS (% of 2020M1 value) 2020M1:2022M8	Max BS/CPI ratio (% of 2020M1 value) 2020M1:2022M8
ALB (E)	✓	✓	100-150%	100-150%
ARG (E)			250-300%	100-150%
ARM (E)			100-150%	100-150%
AUS (O)	✓	✓	350-400%	300-350%[1]
AZE (E)			100-150%	100-150%
BGD (D)			100-150%	100-150%
BGR (E)	✓	✓	100-150%	100-150%
BHR (E)	✓		100-150%	100-150%
BHS (E)			150-200%	150-200%
BLR (E)			100-150%[2]	100-150%[2]
BLZ (E)			100-150%	-[3]
BRA (B)			100-150%	100-150%
CAN (O)	✓	✓	450-500%	400-450%
CHE (O)	✓	✓	100-150%	100-150%
CHL (O)	✓		250-300%	200-250%
CHN (B)			100-150%	100-150%
COD (D)			300-350%	-[3]
COL (O)			100-150%	100-150%
CPV (E)	✓	✓	100-150%	100-150%
CRI (O)	✓		100-150%	100-150%
CZE (O)	✓		100-150%	100-150%
DNK (O)	✓	✓	100-150%	100-150%
DOM (E)			100-500%	100-150%
EGY (E)			150-200%	100-150%
EUR	✓	✓	150-200%	150-200%
FJI (E)	✓	✓	150-200%	150-200%
GBR (O)	✓	✓	150-200%[4]	150-200%[4]
GEO (E)			100-150%	100-150%
GHA (D)			200-250%	150-200%
GMB (D)			150-200%	150-200%
GTM (E)			100-150%	100-150%
GUY (E)			100-150%	100-150%
HKG (OA)	✓	✓	100-150%	100-150%
HND (D)			150-200%	100-150%
HRV (OA)			150-200%	100-150%
HUN (O)	✓		200-250%	200-250%
IDN (E)			100-150%	100-150%
IND (B)			100-150%	100-150%
IRQ (E)			150-200%[2]	100-150%[2]
ISL (O)	✓		100-150%	100-150%
ISR (O)	✓	✓	150-200%	150-200%
JAM (E)	✓		100-150%	100-150%
JOR (E)[5]			100-150%	100-150%
JPN (O)	✓	✓	100-150%	100-150%
KAZ (E)			150-200%	100-150%
KEN (D)			100-150%	100-150%
KGZ (D)			150-200%	100-150%
KOR (O)	✓	✓	100-150%	100-150%
MDA (D)			100-150%	100-150%
MEX (O)			100-150%	100-150%
MKD (E)			100-150%	100-150%
MNG (E)			100-150%	100-150%
MUS (E)			150-200%	150-200%
MYS (E)			100-150%	100-150%
NGA (D)			150-200%	100-150%
NOR (O)	✓	✓	150-200%	150-200%
NPL (D)			100-150%	100-150%
NZL (O)	✓	✓	300-350%	250-300%[1]
PER (E)	✓		100-150%	100-150%
PHL(E)			150-200%	150-200%
PNG (D)			150-200%	-[3]
POL (O)	✓		150-200%	150-200%
QAT (E)			100-150%	100-150%
ROU (E)			100-150%	100-150%
RUS (B)			100-150%[2]	100-150%[2]

SAU (E)	✓	✓	100-150%	100%
SGP (OA)	✓	✓	150-200%	150-200%
SRB (E)	✓		100-150%	100-150%
STP (D)			100-150%	100-150%
SUR (E)	-[6]	-[6]	300-350%	100-150%
SWE (O)	✓	✓	150-200%	150-200%
THA (E)	✓	✓	100-150%	100-150%
TUR (O)			300-350%	200-250%
UEMOA			100-150%	-[3]
URY (E)	-[6]	-[6]	100-150%	100-150%
US (O)	✓	✓	200-250%	150-200%
ZAF (B)			100-150%	100-150%
Total (77)[7]	**31/77**	**21/77**	**77**	**73**

Note: O = OECD, OA = Other Advanced, B = BRICS, E = Emerging, D = Developing. Country abbreviations can be found in the appendix table A3.

1. For Australia and New Zealand quarterly observations apply, and 2020M1 values are calculated using the 2019M12 CPI.
2. Data ends 2022M6 for Belarus, 2022M3 for Iraq, and 2022M1 for Russia.
3. CPI data was not available for Belize, D.R.Congo, Papua New Guinea, and UEMOA.
4. For the UK quarterly observations apply, and 2019M12 balance sheet data is used for the base period.
5. Data for Jordan was unavailable in the original period.
6. Policy interest rate data was unavailable for Suriname and Uruguay
7. Balance sheet data is unavailable for Vietnam.

Table 9: Correlation of CPI-Adjusted Balance Sheet Changes during the GFC Period

Real 2007-2015	Correlation	Correlation 1 lag	Correlation 2 lag	Correlation 3 lag
Albania	0.236134**	0.327585***	0.101342	-0.0634
Argentina	-0.10698	-0.03126	0.16596*	0.066188
Armenia, Republic of	-0.00608	-0.05096	-0.12386	-0.03509
Australia	0.644781***	-	-	-0.00751
Azerbaijan, Republic of	-0.03575	-0.0352	0.084982	-0.00911
Bahamas, The	-0.11721	-0.05791	-0.04624	0.088926
Bahrain, Kingdom of	-0.14702	0.019723	0.202049**	0.125399
Bangladesh	-0.03475	-0.08184	0.149696	0.025154
Belarus	-0.03437	0.074706	-0.13405	0.062754
Brazil	0.254431***	0.223204**	0.247054**	-0.04721
Bulgaria	-0.12546	-0.12032	-0.33222***	-0.30471***
Cabo Verde	0.05355	0.05868	0.032355	-0.02767
Canada	0.530016***	0.54533***	0.160111	0.059894
Chile	0.368224***	0.016377	-0.04338	-0.54964***
China, P,R,: Hong Kong	-0.0523	0.137503	0.406751***	0.074071
China, P,R,: Mainland	0.100017	0.080785	0.047878	-0.04183
Colombia	0.173714*	-5.6E-05	-0.09459	0.129058
Costa Rica	-0.15002	-0.12187	0.043896	0.060351
Croatia	-0.0595	0.084337	-0.09676	0.0296
Czech Republic	0.057247	0.073578	0.241454**	0.102472
Denmark	0.168336*	0.346949***	0.176056*	-0.07019
Dominican Republic	0.032274	0.078282	0.155756	-0.01803
Egypt	-0.1603	-0.20638**	-0.06412	-0.06016
Euro Area	0.560432***	0.208954**	-0.03679	-0.0593
Fiji	-0.13971	-0.07275	-0.20806**	-0.271***
Georgia	0.116298	0.13823	0.186832*	-0.06358
Ghana	0.021707	-0.08692	-0.00952	-0.14839
Guatemala	0.075099	0.086677	0.032457	0.166675*
Guyana	0.045171	-0.03706	-0.01184	-0.10242
Honduras	0.049208	0.027134	0.072568	0.011726
Hungary	0.356187***	0.554348***	0.249463**	0.319717**
Iceland	0.525503***	0.261042***	-0.14501	-0.18063*
India	-0.16192	-0.27868***	-0.15351	-0.01354
Indonesia	0.038134	0.202417**	-0.05032	-0.02555
Iraq	0.045512	0.038958	0.225788**	-0.07005
Israel	-0.00422	0.169169*	0.14397	0.139766
Jamaica	-0.13187	0.059607	0.162041	0.098071
Japan	0.144505	0.015894	0.121188	-0.03654
Kazakhstan	-0.1005	-0.05168	0.069467	0.177563*

Kenya	0.077845	-0.13585	-0.01416	-0.05587
Korea, Republic of	-0.29692***	-0.1076	0.423626***	0.381609***
Kyrgyz Republic	-0.05556	-0.0123	0.052255	-0.22789**
North Macedonia	-0.00016	-0.13041	-0.16441*	-0.10875
Malaysia	-0.34483***	-0.16193	-0.10913	-0.03725
Mauritius	-0.04081	-0.23957**	0.058253	-0.02217
Mexico	0.320859***	0.159706	-0.03236	-0.12608
Moldova	-0.12345	-0.17355*	0.071641	-0.21533**
Mongolia	-0.1243	-0.07118	0.095783	-0.03355
Nepal	0.163172	0.013169	0.069873	0.174355*
New Zealand	0.063802	-	-	0.241071
Nigeria	-0.00144	-0.02538	0.086357	0.066911
Norway	0.347989***	0.303567***	0.186577*	-0.0408
Peru	-0.04592	-0.1942**	-0.09971	-0.04385
Philippines	-0.01979	0.046698	0.006305	0.050817
Poland	-0.03771	0.068269	0.12812	0.186415*
Qatar	0.012044	-0.103	-0.21977**	-0.01293
Romania	0.125087	0.046822	0.082059	0.27788***
Russian Federation	-0.06517	0.065639	0.264451***	0.245837**
São Tomé and Príncipe	0.300735***	0.180476*	-0.02539	0.088318
Saudi Arabia	0.116346	0.005454	-0.08973	-0.16908*
Serbia, Republic of	0.129537	0.073465	-0.14464	-0.04841
Singapore	-0.05564	0.233084**	0.165957*	0.081072
South Africa	0.307195***	0.169477	-0.0865	0.077893
Suriname	0.015322	0.209981	0.164586*	0.00508
Sweden	0.848316**	0.397751***	0.052043	-0.04384
Switzerland	0.310398**	0.060861	0.030549	-0.0405
Thailand	0.214203**	0.228382**	0.259127***	0.030497
Turkey	0.258779***	0.102111	-0.03638	-0.05156
United Kingdom	0.882774***	0.252502**	-0.10759	-0.21967**
United States	1	0.448382***	0.071937	-0.13654
Uruguay	0.2347**	-0.02598	0.37167***	0.065012

Note: For country *i*, correlation *j* lag is defined as: $Corr(\Delta BS_t^i, \Delta BS_{t-j}^{US})$.

1st and 2nd lag correlations are unavailable for Australia and New Zealand due to only quarterly CPI data being available

Table 10: Correlation of CPI-Adjusted Balance Sheet Changes during the COVID-19 Period

Real 2020-2022	Correlation	Correlation 1 lag	Correlation 2 lag	Correlation 3 lag
Albania	0.177732	0.133686	0.444857**	0.428862**
Argentina	0.477643***	0.389908**	-0.01345	0.074991
Armenia, Rep. of	0.123187	-0.00044	0.163964	0.035277
Australia	0.357515**	-	-	0.011957
Azerbaijan, Rep. of	0.296491*	0.163088	-0.18213	-0.19325
Bahamas, The	0.064158	-0.04564	-0.10855	0.000238
Bahrain, Kingdom of	0.002141	-0.06626	-0.00105	0.091733
Bangladesh	-0.00572	0.054793	0.460551***	0.206789
Belarus, Rep. of	-0.05152	-0.16134	0.275827	0.331676*
Brazil	0.418956**	0.241113	0.065166	-0.1065
Bulgaria	0.261798	0.076616	-0.01555	0.041395
Cabo Verde	0.188165	0.205203	-0.17755	-0.0459
Canada	0.947835***	0.669588***	0.102496	0.018152
Chile	0.707253***	0.544079***	0.181011	0.125235
China, P.R.: Hong Kong	-0.06085	0.12061	0.251449	0.29785*
Mainland China	0.217208	0.185475	0.062189	-0.15368
Colombia	0.446162**	-0.09812	-0.06191	0.01387
Costa Rica	0.177585	0.145912	0.023845	-0.06873
Croatia	-0.36901**	0.119799	0.461613***	0.386278**
Czech Rep.	0.500192***	0.082852	-0.0871	-0.11609
Denmark	0.534538***	0.096672	-0.27294	-0.2581
Dominican Rep.	0.012046	0.041026	-0.15042	-0.21633
Egypt	-0.31252	-0.18966	0.067042	-0.05842
Euro Area	0.542724***	0.46266***	0.570998***	0.504757***
Fiji, Rep. of	-0.0318	0.034822	-0.03797	-0.06722
Gambia, The	0.277938	0.226135	-0.10673	0.023216
Georgia	0.448849***	-0.00615	-0.04836	-0.01735
Ghana	0.528672***	0.151459	-0.12119	-0.20651
Guatemala	0.463515***	0.445236**	0.00844	0.117454
Guyana	-0.04464	0.147125	0.110247	0.038464
Honduras	0.115341	0.333547*	0.750535***	0.544134***
Hungary	0.539143***	0.245958	0.056529	0.035845
Iceland	0.325705	-0.08231	0.103597	0.226684
India	0.586977***	0.194599	0.124686	0.108316
Indonesia	0.257412	-0.21055	-0.20908	0.060923
Iraq	-0.02494	-0.04752	0.036075	0.28189
Israel	0.305305*	0.300016*	0.321501*	0.167245
Jamaica	0.506785***	0.390531**	0.135557	-0.11748
Japan	0.498402***	0.509525***	0.427523**	0.329958*
Jordan	0.268861	-0.00603	0.123381	0.597475***

Kazakhstan, Rep. of	0.231435	-0.17302	0.073898	0.326287*
Kenya	0.175786	0.437318**	0.480098***	-0.04436
Korea, Rep. of	0.303343*	0.407603**	0.201878	-0.2371
Kyrgyz Rep.	0.249617	-0.00909	0.226075	0.406206**
Macedonia	-0.22155	0.018171	0.302532*	0.285872
Malaysia	0.727748***	0.213284	-0.11942	0.026857
Mauritius	0.080483	0.162623	0.24945	0.390665**
Mexico	0.712603***	0.117373	-0.18597	-0.08149
Moldova, Rep. of	0.081482	0.052504	-0.11513	-0.03492
Mongolia	-0.17528	-0.2538	0.00445	0.317455
Nepal	0.274054	0.453374***	0.624939***	0.394992**
New Zealand	0.747708***	-	-	0.299224
Nigeria	0.333723*	0.293554	0.146385	0.217936
Norway	0.668231***	-0.0006	-0.27178	-0.28855
Peru	0.344228	0.559617***	0.366903**	0.21572
Philippines	0.374775**	0.312464*	0.364676**	0.274636
Poland, Rep. of	0.439304**	0.558388***	0.219477	-0.14778
Qatar	0.703655***	0.197469	-0.16232	-0.02828
Romania	-0.00425	0.113211	0.084624	0.063938
Russian Federation	-0.03077	-0.51646***	-0.22624	0.22819
São Tomé and Príncipe, Dem. Rep. of	0.225354	0.115793	-0.12419	0.004759
Saudi Arabia	-0.43274**	-0.11688	0.178972	-0.12944
Serbia, Rep. of	0.155768	0.453921***	0.204469	-0.2617
Singapore	0.453444***	0.371609**	-0.01362	0.020327
South Africa	0.289796	-0.0376	-0.09835	0.100587
Suriname	-0.19824	0.09221	0.068402	-0.09164
Sweden	0.736807***	0.218202	-0.04762	-0.01897
Switzerland	0.388529**	0.471278***	0.271713	0.16086
Thailand	0.438352**	0.153106	-0.18086	0.030904
Türkiye, Rep of	0.06699	0.130539	-0.01538	0.030354
United Kingdom	0.805006***	-	-	0.669419***
United States	1	0.554584***	-0.01354	-0.13174
Uruguay	0.352229**	0.039868	0.053041	0.193317

Note: 1st and 2nd lag correlations are unavailable for Australia, New Zealand and the UK due to only quarterly CPI data being available for the former two, and only quarterly full balance sheet data being available for the UK.