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Central Bank Balance Sheets and the Interaction between Monetary Policy and Financial Stability

Idris Ademuyiwa, Pierre L. Siklos and
Samantha St. Amand



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About the Global Economy Program

Addressing limitations in the ways nations tackle shared economic challenges, the Global Economy Program at CIGI strives to inform and guide policy debates through world-leading research and sustained stakeholder engagement.

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Through its research, collaboration and publications, the Global Economy Program informs decision makers, fosters dialogue and debate on policy-relevant ideas and strengthens multilateral responses to the most pressing international governance issues.

Acronyms and Abbreviations

BCRA	Central Bank of the Argentine Republic
BIS	Bank for International Settlements
BoE	Bank of England
BoJ	Bank of Japan
ECB	European Central Bank
ELB	effective lower bound
ESCB	European System of Central Banks
ESRB	European Systemic Risk Board
ETFs	exchange-traded funds
GFC	global financial crisis
IFRS	International Financial Reporting Standards
IMF	International Monetary Fund
NCBs	national central banks
OECD	Organisation for Economic Co-operation and Development
PBOC	People's Bank of China
SRC	systemic risk council

Executive Summary

Since the global financial crisis (GFC) of 2008-2009, a balance sheet focus is sometimes the benchmark by which the conduct of monetary policy that relies on non-standard measures is assessed. This paper explores this metric by examining the challenges of interpreting the conduct of monetary policy in recent years. It concludes that while the shift in emphasis toward the balance sheet of a central bank is understandable, it is a hazardous exercise, and this can lead some observers to exaggerate the significance attached to changes in balance sheet composition over time. Accounting standards differ greatly across countries, and the degree of transparency about balance sheet details also varies considerably in the more than 30 economies examined in this study. A global effort to improve the availability, timeliness and quality of central bank balance sheet data remains too much of a work in progress more than 10 years since the financial crisis erupted. Finally, as balance sheet interventions have also been used to address financial system stability concerns, the paper explores whether there is a trade-off between financial stability and the objectives of monetary policy. It finds that balance sheet expansions are associated with higher output volatility, and that central banks' ability to minimize inflation and output variability may have been impaired by the pursuit of global financial stability conditions. These results suggest more, not less, global monetary and financial policy cooperation is needed to improve macroeconomic outcomes.

Introduction

Observers occasionally fall into the conceit of claiming that we live in an era that is fundamentally unique. This is true to some extent when describing the current state of monetary policy. Recent events have shifted the interpretation of the stance of monetary policy from one focused almost exclusively on changes — both observed and anticipated — in a policy interest rate, to one where the size and

composition of central banks' balance sheets is more relevant (see, for example, Patel 2018).¹

By 2007, when what came to be called the GFC began to impact financial markets in advanced economies, monetary policy in many parts of the world was largely governed by the manipulation of a conventional instrument, usually a policy rate.² Since then, central banks in economies directly impacted by the financial crisis entered largely uncharted waters by shifting the focus of policy interventions via changes in the composition of their balance sheets.³ One difficulty in evaluating these policies is that what is regarded as unconventional has evolved over time, ranging from including measures intended to ease financial conditions for select institutions (for example, banks) to virtually all sectors of the economy (see, for example, Bini Smaghi 2009). There was also an attempt to differentiate between monetary and credit easing, but the distinction fell on deaf ears and has since largely been abandoned (see, for example, Lombardi, Siklos and St. Amand, forthcoming 2019). Monetary easing was accomplished by resorting to traditional open market operations on a larger scale than was heretofore the case (i.e., the purchase or sale of government bonds), while credit easing was intended to communicate a policy aimed at easing the growing frictions between borrowers and lenders who were losing trust in the financial system. Finally, what is deemed to be unconventional was broadened to include interventions of the verbal kind (i.e., forward guidance; see Filardo and Hofmann 2014; Morris and Shin 2018), as well as monetary policy easing at the so-called zero lower bound and beyond (now commonly referred to as the effective lower bound [ELB]). While one central bank, namely the US Federal Reserve, is slowly beginning to exit from a reliance on a balance-sheet-based monetary policy strategy, others continue to

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- 1 Central bankers have, of course, always closely monitored movements in their balance sheets in real time, but recent attention to central banks' balance sheets by media and a closer watch by market analysts is novel.
 - 2 A partial reflection of this development is that the Bank for International Settlements (BIS) has, for some time, published policy rates for almost 40 economies around the world. See www.bis.org/statistics/cbpol.htm?m=6%7C382%7C679.
 - 3 Japan, of course, had previously undertaken unconventional policy actions. Masaaki Shirakawa (2010), a former governor, lamented the fact that other central banks had not taken sufficient notice of the Bank of Japan's (BoJ's) interventions. One reason was the belief that Japan's case was idiosyncratic. History, of course, would tell a different story. See, for example, Koo (2015).

hesitate or delay exit, although the time for exiting the unconventional realm is approaching.

This paper explores central bank balance sheet data and examines the challenges of interpreting the conduct of monetary policy in recent years. Central bank balance sheet data was collected for over 30 central banks since at least 1998 at both the annual and quarterly sampling frequencies. In some cases, historical data at the annual frequency was available, going back to the nineteenth century.⁴ The creation of this data set represents an additional contribution of the paper. The paper concludes that while the shift in emphasis toward the balance sheet of a central bank is understandable, it is a hazardous exercise and some observers exaggerate the significance attached to changes in balance sheet composition over time (for example, Tett 2018). The reason, as explained below, is that, at the global level, there are considerable measurement problems with balance sheets and a lack of transparency that does not mirror the significant rise in transparency elsewhere in the realm of central banking (see, for example, Dincer and Eichengreen 2014). Despite this pitfall, the scrutiny of central banks' balance sheets is welcome as it is one area where progress in the transparency and accountability of central banks has lagged behind. Improving policy makers' and the public's understanding of the assets and liabilities of the monetary authorities is a welcome development.

This paper further notes that a distinction must be made according to whether the private sector assets that are held on a central bank's balance sheet are for the conduct of monetary policy as opposed to the maintenance of financial system stability. As concerns over the composition of central bank balance sheets begin to recede from memory, it has been a challenge to construct data going back far enough to help us understand the private sector involvement of the monetary authorities through their holding of private sector assets. While some preliminary evidence linking financial system stability to inflation volatility is presented, there are several challenges that must be overcome before there is adequate data to interpret the motives of central bankers via the analysis of changes in balance sheet composition.

4 The analysis of central bank balance sheet composition over a much longer sample, focusing on the macroeconomic consequences of these developments, is the subject of ongoing work by the second author with Andrew Filardo at the BIS (Filardo and Siklos 2018).

As part of an effort to understand the potential limitations of private sector involvement of central banks, the evolution of central bank legislation is also examined to ascertain the extent to which there are legal restrictions in the ability of the central bank to intervene in private markets. The paper considers whether the lender of last resort function explicitly limits the ability of the monetary authority to intervene in private markets. Relatedly, it asks to what extent explicit indemnification agreements, or what David Archer and Paul Moser-Boehm (2013) call "risk transfer arrangements," are legislated. In principle, these agreements limit losses on the central banks' balance sheets arising from transactions involving private sector assets and the purchase and sale of long-term government bonds.

While observers and analysts shift their attention toward the size and composition of central banks' balance sheets, there remain significant challenges in evaluating this data, largely due to a lack of consistency in accounting standards, frequency of data releases and formatting of data. In the continued effort to improve central bank transparency and accountability around the world, central banks should work together to develop a global standard for balance sheet accounting. While International Financial Reporting Standards (IFRS) have, for the most part, been adopted by private entities around the world, this paper discusses why central bank balance sheets are different than private entities, to the extent that they need to develop their own framework that is tailored to their functions. In addition, because the functions of central banks differ across jurisdictions, accounting standards may need to be flexible. To be effective at increasing transparency and accountability, the accounting standards for central bank balance sheets must include a more detailed breakdown of the types of assets and liabilities and the purpose of their holdings (for example, monetary policy versus financial stability).

Why do these issues matter? The opaqueness of monetary policy as seen through the central bank's balance sheet poses financial stability risks and raises the possibility of a trade-off between being too transparent and unintentionally roiling markets versus providing too little data leading to a loss of reputation in the institution. In particular, there is the risk that, in future, a central bank's balance sheet will suggest either that the monetary authority is underreacting in

Figure 1: Establishing Central Banks – An International Comparison



Data source: Bordo and Siklos (2018).

Notes: Not all central banks in the data set are identified on the vertical axis. The horizontal axis indicates the year when each central bank was established.

the face of a financial crisis or overreacting, in which case there are consequences for perceptions about the resulting financial market distortions.

The rest of the paper is organized as follows. The next section provides a brief history of the role of central bank interventions. This is followed by an overview of the literature arising from issues related to the reporting and measurement of central bank balance sheets. Some stylized facts about the evolution of major balance sheet items are then outlined for a sample of more than 30 countries, then some preliminary evidence is presented that empirically explores the trade-off between standard and non-standard monetary policy in a world where financial stability has become an additional policy objective. The paper concludes with a summary and some policy implications.

A Very Short History of Central Bank Balance Sheet Interventions

Figure 1 highlights the fact that most central banks were created well into the twentieth century, in particular in emerging market and developing economies. During this same period, it is no accident that government intervention in economic affairs was also a feature of economic development. The financial stability function of central banking is the one that gave rise to the creation of many central banks beginning in the middle of the nineteenth century (see, for example, Siklos 2002). However, the number of central banks grew rapidly, especially after World War II when industrial policies of various vintages became common around the globe (see, for example, Bordo

and Siklos 2018). As a result, many newly created central banks became involved more or less directly in assisting with the implementation of policies aimed at promoting economic development. Over time, this form of intervention became less fashionable as the tasks of central banks became more focused — first, on the maintenance of exchange rates, largely the results of the Bretton Woods system of pegged currencies to the US dollar (see, for example, Bordo and Eichengreen 1993), followed by monetary stability and, more recently, policies intended to maintain price stability (see, for example, Siklos 2002; 2017).

The GFC resulted in a return to a state where central banks once again faced the task of becoming more directly involved in maintaining financial system stability. This is now often carried out under the guise of *macroprudential* policies. Some central banks took on the twin responsibilities of monetary and financial stability but, in many other countries and economies, the responsibilities remain spread out over two or more agencies (for example, see Lombardi and Siklos 2016, and references therein). This most recent form of intervention is more subtle than the one that preceded it and is often not separately identified on central bank balance sheets. Moreover, whereas the objective of central bank intervention was once to stimulate economic growth and promote the maturity of the financial system, nowadays the aims are to reduce the likelihood of another financial crisis or at least lessen its future economic costs.

Central Bank Balance Sheets in Theory and Practice

An immediate difficulty confronting a researcher seeking to evaluate the conduct of policies through central bank balance sheets is the heterogeneity and transparency in reporting the relevant data.⁵ These problems stem from at least three sources: international differences in accounting standards; institutional arrangements defining the relationship between central banks and their government; and the residual effect of neglecting the potentially important role central bank balance sheets can play in helping us ascertain the changing stance of monetary policy. While the third point was discussed in the introduction, the other two are briefly discussed in this section. Readers are also asked to consult, for example, Archer and Moser-Boehm (2013) for more details concerning the first two determinants. Other relevant references are also provided below.

It is useful, perhaps, to begin with a stylized central bank balance sheet as shown in Table 1. Note, however, that even if a stylized balance sheet is illuminating there are subtle differences with actual published ones and this has important implications for our understanding of the contribution the central bank makes in dictating the stance of monetary policy and maintaining financial stability. For example, while central banks hold “government bonds” as assets there are potentially profit and loss consequences according to whether any of these are long term in nature. The distinction has become particularly important as central banks that reached the ELB in policy rates moved up the yield curve and began holding longer-term government bonds (see, for example, Lombardi, Siklos and St. Amand, forthcoming 2019).

5 In addition, the balance sheet of a central bank differs from ones published by private firms. For example, a deposit is usually an asset to individuals or firms, but typically a liability for a central bank. Second, whereas intangibles can find their way in a private firm’s balance sheet, the same is not true for the balance sheet of the monetary authority. This has implications because policy makers care, for example, about the credibility of the central bank, an intangible asset. Finally, a central bank cannot easily implement measures to hedge against certain financial risks. To do so may effectively make the monetary authority look like it is taking action against the publicly stated policy position (see, for example, Christensen, Lopez and Rudebusch 2015).

Table 1: Stylized Central Bank Balance Sheet

Assets	Liabilities
Gold and foreign currency	Notes
Monetary policy	Bank deposits
Other	Government deposits
	Monetary policy liabilities
	Other
Total Assets	Total Liabilities

Source: Authors.

Assets are typically made up of two major items — gold and foreign currencies, and monetary policy assets — with the remaining assets listed as “other.” Of course, in some central banks, gold and foreign exchange reserves can serve as an instrument of policy, especially as almost all central banks will display a concern for the exchange rate. Their ability, both legal and effective, to intervene in foreign exchange markets with the potential to influence holdings of foreign currencies and gold can and does vary considerably across countries. In addition, some central banks (for example, the People’s Bank of China [PBOC]) issue their own bonds to deal with unwanted increases in liquidity as opposed to resorting to traditional open market operations to sterilize potential increases in the domestic money supply.

The difficulty with the label “monetary policy assets,” is that it does not permit the easy identification of central banks that intervene in non-standard ways. While the remedy seems straightforward, namely highlighting the difference between standard and non-standard types of assets in monetary policy operations, there are no established accounting or other rules compelling a central bank to do so (see, for example, the discussion in Donnery et al. 2017). An even more difficult distinction might be one that seeks to classify assets according to whether there are fiscal implications from changes in their composition. The *sine qua non* of modern central banking is the autonomy of the central bank from government.⁶ As a result, the monetary authority is keen to avoid policies that

⁶ This is the preferred expression since almost all central banks are government owned and, hence, cannot be deemed independent of, only from, government.

have fiscal consequences. In crisis situations, this cannot, and likely should not, be avoided (see, for example, Orphanides 2017). Nevertheless, as Stanley Fischer (2010, 18) puts it: “Almost every action the central bank undertakes has fiscal consequences.” In any case, it may be useful to identify changes in balance sheet composition that signal large or significant fiscal consequences. Existing balance sheets do not identify the relevant dividing line between purely monetary versus fiscal policy interventions of the central bank.

An additional complication in interpreting central banks’ balance sheets is that, in some cases, in an attempt to protect itself financially from some of the risks associated with non-standard policies, the central bank will arrange to report some of these interventions as effectively off-balance-sheet items. The recent experience of the Bank of England (BoE) comes to mind with the Special Liquidity Scheme and Funding for Lending programs aimed at easing financial conditions (see, for example, Rule 2015).⁷ This issue is returned to in the next section. Alternatively, formal arrangements to indemnify the central bank for losses on transactions considered to be non-standard would leave certain assets on the balance sheet, which belongs to a risk category other than the one that would apply to short-term government bonds but, at least in theory, without the threat of financial losses for the monetary authority. The US Federal Reserve negotiated this kind of arrangement in the aftermath of the GFC (see, for example, Kohn 2010, 6) via a letter of understanding between the Treasury and the Fed.⁸

On the liability side there are notes (i.e., bank notes in circulation), deposits by governments and banks, monetary policy liabilities, other liabilities and, finally, equity. Deposits from governments represent the function of the central bank as the banker for government. Generally, these deposits have no monetary policy and certainly no financial

⁷ The swapping of mortgage-backed securities for more liquid Treasury bonds created by the United Kingdom’s Debt Management Office opens up the possibility of financial losses for the BoE. It is largely for this reason that such financial arrangements are separate from the rest of the BoE’s balance sheet.

⁸ Via the creation of a so-called special purpose vehicle. Details are outlined in www.federalreserve.gov/newsevents/pressreleases/files/monetary20081125a1.pdf. In principle, however, there is nothing preventing a future Secretary of the Treasury from reneging on an earlier agreement. Of course, there may be untold financial consequences in taking such a step.

stability consequences.⁹ Deposits by banks reflect the influence of reserve requirements; in the case where reserve requirements no longer exist, there are day-to-day variations in deposits — often these earn little or no interest — due to frictions in clearing mechanisms. Where reserve requirements exist and remain an important tool of monetary policy (for example, China), there are monetary policy consequences and, potentially, implications for financial stability.¹⁰ In the latter case, the source stems from the desire by the central bank to curtail credit growth. It has long been known that credit growth and financial system stability are intimately linked (see, for example, Borio 2012; Taylor 2015).

The potential role of monetary policy liabilities is of a much more recent vintage. These can represent deposits of credit institutions and governmental organizations (for example, in the case of interventions by the European Central Bank [ECB]). In principle, central banks were always able to take in deposits from the private sector. However, central banking principles long ago dictated that the monetary authority should not mimic some of the core functions of commercial and savings banks in the private sector.¹¹ The potential introduction and spread of digital currencies could increase the significance of these liabilities for monetary policy.¹²

9 Variability in government deposits will stem, for example, from seasonal variations in government revenues. These can be “sterilized,” much as the monetary policy impact of foreign currency transactions can be neutralized.

10 A majority of the economies in the data set still have reserve requirements for the banking system. However, most no longer rely on changes in these requirements to achieve monetary or financial stability objectives.

11 In June 2018, the Swiss rejected a referendum to severely limit commercial banks’ ability to create money via the venerable money multiplier process wherein a certain amount of reserves (these need not be required) can support a multiple of deposits. Since most narrow indicators of the money supply include some bank deposits, commercial banks, in effect, create money. Of course, the central bank, at least in theory, is able to control the money supply. Unfortunately, the degree of control is questionable and poor at best. In the 1980s, at the height of monetarism, many central banks published money growth targets only to see them missed, often by a wide margin (see Bernanke and Mishkin 1992). The Swiss reaction reflected a belief among some that since the GFC was due to “reckless” banking practices, the ability of commercial banks to influence the money supply should be severely curtailed. Martin Wolf (2018) writes largely approvingly of the Swiss proposal, which has echoes of the so-called Chicago 100 percent reserve requirement proposal. See Allen (1993).

12 Indeed, the flurry of discussion about “helicopter money” made famous long ago by Milton Friedman (1969) is made possible at much lower cost in the digital age. At the height of the crisis, helicopter money was sometimes seen as the last resort to stimulate economic activity when an economy was in the throes of a financial crisis. See, for example, Buiter (2004).

Although there are long-standing attempts to reconcile international differences in corporate financial accounting standards, for example through IFRS, these have not had a major impact on the financial reporting by central banks. Accordingly, idiosyncrasies abound in how monetary authorities around the world report financial results (see, for example, Rule 2015). For example, David Bholat and Robin Darbyshire (2016) report in a sample of 19 economies that at least 10 adopt national standards. The fundamental problem does not lie with the absence of a global standard, but with the failure of many central banks to follow even their own national standards. Additionally, there are issues that are specific to the conduct of central banking operations. For example, while market participants may wish to have the value of government or other securities recorded at market value, this may be of limited use, for example, when governments require the monetary authority to hold these assets until they mature.¹³ An illustration is the US Federal Reserve’s policy to hold government securities to maturity as part of their exit strategy from very loose monetary policies in the aftermath of the GFC.

There is also the matter of whether reported balance sheets by central banks can be used to ascertain the financial weakness of the central bank. In the aftermath of the financial crisis, there was a surge of interest in the financial strength or weakness of central banks, in particular ones that undertook large interventions in private financial markets (see, for example, Archer and Moser-Boehm 2013; Bhattarai 2017; ECB 2013). In discussions of private sector balance sheets, equity plays a large role in explaining the strength of the entity as it can be informative about its potential solvency. This interpretation need not hold for central banks, which can receive an injection from government, almost always their sole shareholder. Moreover, there are few indications that central banks with the occasional negative net worth are deemed by markets to be insolvent (see, for example, Archer and Moser-Boehm 2013).

A related issue is whether there exists an “optimal” size for a total balance sheet of the central bank. The question is of interest in view of the large expansion of balance sheets, in particular among the central banks that were most directly implicated in the GFC. Soon after, central banks in these economies responded with

13 The authors are grateful to one of the reviewers for bringing this point to their attention.

extraordinary liquidity and credit-easing measures. Pressure from financial markets, the public and governments began to build out of concern that the resulting expansions were too large and that an exit strategy was required to shrink balance sheets. There is, however, no consensus on the appropriate, let alone optimal, size of the balance sheet as noted by Charles Goodhart (2017). He briefly reviews the state of the debate between those who favour larger balance sheets post-GFC and others, himself included, who advocate for a more modest post-GFC balance sheet expansion. Part of the difficulty is that there is relatively little theoretical guidance that would permit a consensus to develop concerning how large a balance sheet ought to be. Nevertheless, there continues to be a vigorous debate about the merits of both stances (see, for example, Buiter et al. 2017; Greenwood, Hanson and Stein 2016, and references therein).

Data and Stylized Facts

Both annual and quarterly historical data was collected for 31 central banks, primarily from their website or archives.¹⁴ The sample begins, where possible, in 1998 and ends in 2016 (at the time of writing, final data for 2017 was not available for several countries in the sample). Following the International Monetary Fund's (IMF's) definition,¹⁵ 20 of the countries in the sample are considered advanced economies and 11 belong to the emerging market economy group of countries. Five of the economies are in the euro area (Austria, Belgium, France, Germany and Spain). Data for other countries was either too difficult to collect, unavailable or only available for a very short sample; contained definitions for balance sheet items that changed in ways that would not permit us to construct a consistent time series; or included gaps that rendered the resulting series not very useful for statistical analysis.¹⁶ In the

case of countries with a formal inflation target, some of the samples are adjusted to exclude the period before the policy strategy regime shift.¹⁷

Challenges experienced in constructing the data set include the availability of the data in a format that makes subsequent statistical analysis easier (for example, in spreadsheet form) as opposed to other electronic formats, and differences in balance sheet presentation formats and terminology used to classify various asset and liability categories.¹⁸ Typically, balance sheet data is published in the financial statements sections of central banks' annual reports, on their online database or in other frequently published documents (such as quarterly reports). Other than for a handful of countries in the data set (see Filardo and Siklos 2018), the available data is limited to the past three decades or less. Central banks have different balance sheet reporting formats and rely on different terminologies. This is the direct result of the heterogeneity in accounting standards used around the world noted in the preceding section, as well as historical legacies from a time when outside observers paid scant attention to central bank balance sheets. Consequently, it can be time consuming to verify the definition of the components through the notes to the accounts and consolidate them across countries.

As noted above, most central banks' balance sheets do not clearly identify private sector asset holdings, in part because central banks in the last few decades were not designed to do so on a regular basis. There are, however, a few exceptions. Some important examples are central banks that have or continue to conduct some form of unconventional or non-standard monetary policy, including the ECB and the euro-area national central banks (NCBs), the BoJ, the BoE, the Federal Reserve and the Swiss National Bank.¹⁹ Table 2 shows how the type of assets and the form in which they are held differ across these institutions.

14 A link to all the central bank websites covered by this study can be found at: www.bis.org/cbanks.htm?m=2%7C9.

15 The list of countries in different groups can be found at: www.imf.org/external/pubs/ft/weo/2018/01/weodata/weoselagr.aspx.

16 The initial sample included over 40 central banks. The countries in the sample where the data was unavailable include: Czech Republic, Estonia, Hong Kong, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Malaysia, Peru, Portugal, Saudi Arabia, Slovenia and Slovakia.

17 The countries in question are: Brazil, Colombia, Indonesia, Mexico, Norway, the Philippines, South Africa, Thailand and Turkey.

18 Quite often balance sheet data was available in PDF format, separately for each month, quarter or financial year. Hence, extracting the data can be laborious and time consuming.

19 It is important to exercise caution when comparing the ECB to the euro-area NCBs, in particular because the latter do not have monetary policy autonomy. Also, as a multinational central bank, the ECB has a different capacity to act in the event of a crisis than other central banks.

Table 2: Private Sector Assets Holdings for a Selection of Central Banks

Central Bank	Private Sector Assets Held	Additional Notes
BoJ	Commercial papers, corporate bonds, stocks, exchange-traded funds (ETFs), investment equities	The bank purchases commercial papers and corporate bonds in the conduct of its unconventional monetary policy. Furthermore, it acquires other financial assets such as stocks, ETFs and investment equities of real estate investment corporations in Japan through trust banks.
ECB and euro-area NCBs	Private sector bonds and other financial assets	As part of the ECB and NCBs unconventional monetary policy, different interventions have been adopted since 2008, including the Asset-backed Securities Purchase Program, Security Market Program and, more recently, the Corporate Sector Purchase Program. These programs, among others, involve direct purchases of private sector assets, in particular corporate bonds. The balance sheet currently reflects the total value of the assets held by the bank under these programs without providing specific information about their compositions.
Swiss National Bank	Distressed assets of UBS Bank — the asset types were not explicitly stated in the balance sheet	Between 2008 and 2013, the bank established the special purpose vehicle (the SNB Stabilization Fund), which held distressed assets of the then insolvent UBS Bank.
BoE	Corporate bonds	The bank's holding of the private sector assets is rather indirect and arguably costless. The bank holds shares in the Bank of England Assets Purchase Facility Fund, which it uses to conduct unconventional monetary policy purchases of corporate bonds and gilts. However, because the Fund is fully indemnified by HM Treasury and only managed by the bank, the transactions are only mentioned in the bank's balance sheet with zero value.
Federal Reserve	Commercial papers, asset-backed securities, shares, preferred stocks	In response to the 2008 financial crisis, the Fed (specifically the Federal Reserve Bank of New York) engaged in different interventions, which resulted in its holding of different private sector assets. This includes the setting up of Maiden Lane LLC (I, II and III), Commercial Paper Funding Facility LLC, TALF LLC, etc. The roles of the limited liability companies range from purchasing assets of troubled private corporations such as AIG (and its subsidiaries) and Bear Stearns to the purchase of US-dollar denominated commercial papers and granting loans to holders of asset-backed securities. Currently, the Fed's consolidated balance sheet reflects the value of the assets purchased by Maiden Lane LLC.

Data sources: Central bank websites accessed through the BIS Central Bank Hub (www.bis.org/cbanks.htm?m=2%7C9).

Table 3 summarizes, where the information is explicitly available, central bank legislation concerning the lender of last resort function, as well as any rules or regulations concerning the holding of private sector assets. Existing and past legislation, where available, are generally silent about the disposition of private sector assets. Instead, as in the case of the US Federal Reserve, an exit strategy is outlined — or what is more commonly known today as a process for

the “normalization of monetary policy.”²⁰ Explicit mention and definition of the lender of last resort function is also spotty, at least for the 40-plus central banks surveyed. Of course, as the large literature dealing with central bank independence suggests, legislation can provide an indication of the scope of intervention available to the various monetary authorities considered, but *de facto* behaviour when it comes to intervention can often

20 Even as the GFC was, in retrospect, ongoing, the Fed in 2010 outlined an exit strategy (see www.federalreserve.gov/newsevents/testimony/bernanke20100210a.htm). Some elements were delayed for some time until the Fed began to raise its policy rate (at the end of 2015). The process of policy normalization began soon after and an outline of the strategy was published in 2017. See www.federalreserve.gov/monetarypolicy/bst_policynormalization.htm.

Table 3: Central Banks – Lender of Last Resort and Limitations on Private Sector Asset Holdings

Country/ Issues	Year of Latest Amendment	Lender of Last Resort Definition and Restrictions	Rules and Limitations on Acquiring Private Sector Assets
Australia	1959		Section 8 of the act grants the bank power to buy and sell securities issued by the Commonwealth and other securities. <i>The definition of other securities is, however, not provided.</i>
	2011		Section 8 of the act is the same as the 1959 version.
Austria	1955	No mention of lender of last resort role.	
	2013	Article 2 identifies the bank as an integral part of the European System of Central Banks (ESCB) and thus it is aligned with the ESCB's primary objectives. Article 4 further stresses that the bank is empowered to effect only transactions not covered by the remits of the ESCB. The lender of last resort function seems to be the ESCB's.	Article 47; para. 1 and 2 suggest that the bank can operate and trade in the financial markets and conduct credit operations based on adequate collateral.
Belgium	1959		Article 12 permits the bank to acquire equities of financial institutions if they are governed by special legal provisions or they are under the guarantee of the state.
	1998		Articles 5 and 6 permit financial market activities and credit operations in line with the ECB.
Brazil			Article 11 permits the bank to purchase and sell obligations of mixed capital entities and state companies.
Canada	1953-1954		Similar provisions as below (in the 2012 version) are in sections 18 and 19 of this version.
	2012	Subsection 18h permits the bank to grant loans not exceeding six months to members of the Canadian Payment Association based on securities that such banks are authorized to hold. Section 23 prohibits the bank from lending or making advances without security.	Subsection 18g (i and ii) permits transacting in securities and any other financial instruments with any person for the purpose of conducting monetary policy or promoting the stability of the financial system — as determined by the governor. Section 23 prohibits the bank from engaging or having direct interest in any trade or business whatsoever and prohibits the bank from purchasing shares in any other banks except the BIS.
Chile		Section 36, para. 1 permits the bank to concede credits to banking entities and financial institutions, for a period of 90 days, in the event of emergencies due to illiquidity. Para. 2 permits the extension of credits and acquisition of their assets pursuant to the Banking Act while para. 3 further permits the forgiveness of part of their debts.	Section 34, para. 6 permits the bank to buy and sell securities of banking entities and financial institutions, but not their shares of stocks, except in the case stipulated in section 36 (which is the emergency situation as in lender of last resort function).

Country/ Issues	Year of Latest Amendment	Lender of Last Resort Definition and Restrictions	Rules and Limitations on Acquiring Private Sector Assets
China	2003	Article 23(4) permits the bank to lend as part of its monetary policy while article 30 permits this lending to non-banking financial institutions only in exceptional cases. No explicit mention of the last resort function though.	Article 23(5) permits the bank to trade treasury bonds, other government securities, financial bonds and foreign exchange on the open market. It also grants the bank the discretion to formulate detailed conditions and procedures.
Czech Republic	2013	Article 29(2) permits the bank to provide exceptional short-term credit for a period of three months to banks in the interest of maintaining banks' liquidity and adequate collateral is required.	Article 32 permits the bank to purchase and sell securities in order to regulate the money market. Article 36(a) permits the bank to carry out all types of banking transactions in the financial markets.
Denmark	1936	No mention of lender of last resort role.	No specifics on private sector assets.
	2010	Section 15 permits the bank to grant advances in exchange for satisfactory security, normally for one to three months, but not beyond six months. Such advances can, however, be renewed.	
Estonia	2011	Section 14. ss(1) permits the bank to grant loans against adequate collaterals ss(3) permits it to trade in securities, all in line with the ESCB/ECB Act.	
European Union/ECB	2003	Article 18.1 permits the ECB and NCBs to conduct credit operations with both credit institutions and other financial market participants based on adequate collateral.	Article 18.1 permits the ECB and national central banks to operate in financial markets in terms of trading instruments and by lending and borrowing claims and marketable instruments. Article 20 permits the Governing Council, having received a majority of two-thirds votes, to decide on other operational methods of monetary controls as it sees fit.
Finland	1925		Article 12 prohibits the bank from investing its assets in shares, except for reasons that are of special importance to the bank.
	2011	Section 5 empowers the bank to grant and obtain loans. Section 7 requires the bank to request adequate collateral in granting loans. Section 10 of the act on certain conditions of securities and currency trading requires the bank to request collateral in connection with its operations, notwithstanding an insolvency or other corresponding proceedings against the provider.	Section 5 grants the bank the power to trade in securities.
Germany	1966	No mention of emergency assistance or lender of last resort roles	
	2011	Section 19(1) grants the bank the right to grant loans backed by collateral and the right to auction or dispose of such collateral at market price in the event of a default.	Section 19(1) also grants the bank the right to trade in open markets: buying and selling claims, marketable securities and precious metals both outright and under repurchase agreements.

Country/ Issues	Year of Latest Amendment	Lender of Last Resort Definition and Restrictions	Rules and Limitations on Acquiring Private Sector Assets
Hong Kong SAR	1997		Section 2 allows the fund, with the permission of the financial secretary and its advisory committee, to invest in securities and other assets and to buy and sell other securities accordingly.
Hungary	2013	Article 36 permits the bank to extend extraordinary credit to credit institutions if there are circumstances owing to which the operation of such institution jeopardizes the stability of the financial system.	Article 18b permits the bank to buy and sell securities and act as intermediary of securities in the spot and derivatives markets within the framework of open market operation and repurchase agreements. Article 165 prohibits the bank from owning shares of any domestic and foreign organization, except an organization that has been established in relation to the bank's activity, or it performs activities for the operation of the payment system or performs stock exchange, clearing house or central depository activities. The article noted an exemption in the case where this is done to achieve the objective of financial stability, and even in such case, the bank may not acquire securities incorporating membership rights directly from the issuer.
Iceland	2011	Under exceptional circumstances, article 7, para. 2 permits the bank to issue guarantees and grant loans to credit institutions on special terms and collaterals or subject to other conditions when it is deemed necessary in order to maintain confidence in the domestic financial system.	In order to achieve its primary objectives, article 8 permits the bank to buy and sell government-backed securities and other sound domestic securities on a securities market or through direct transactions with credit institutions. However, article 17 permits the bank to conduct banking and securities transactions only with entities that are consistent with its role and functions. It may <i>not</i> undertake such transactions with individuals or companies that by law, custom or their nature are considered the function of others.
India	1934		
	2009	Section 18 permits the bank to make loans and advances to state cooperative banks and any other person and purchase, sell or discount any bill of exchange or promissory notes, when a special occasion makes it necessary that actions should be taken for the purpose of regulating credit in the interest of India. Such are repayable on conditions set by the bank, on demand or expiry of a fixed period not exceeding 90 days.	Section 17(6A) permits the bank to deal in derivatives, and with approval of the Central Board, in any financial instrument. Also, section 17(11b) permits the bank to transact in securities of any company on behalf of government and other institutions as approved by its Central Board. Section 19 prohibits the bank from engaging in trade or direct interest in any commercial, industrial or any undertaken except acquired in the course of satisfaction of any of its claims. Also, the bank is not permitted to purchase the shares of any banking or other company or grant loans upon the security of any such shares.

Country/ Issues	Year of Latest Amendment	Lender of Last Resort Definition and Restrictions	Rules and Limitations on Acquiring Private Sector Assets
Indonesia	1953	No mention of emergency liquidity assistance role.	
	1999	Article 11(1) permits the bank to extend credit based on Syariah principle to a bank for a maximum of 90 days to overcome its short-term financial or liquidity difficulty (or mismatch). Article 11(2) stipulates that such credit must be backed by adequate collateral.	Article 64(1) permits the bank to conduct an equity participation in a legal entity or other entities deemed necessary only in the implementation of the tasks of the bank and with the approval of the House of Representatives. Article 64(2) stipulates that the funds required for such investment may only be obtained from the Special Purpose Reserve.
	2010		
Italy	1963	No mention of lender of last resort role.	
	2006		Article 35 permits the bank to negotiate and administer financial instruments.
Japan	1957	No mention of uncollateralized loans or lender of last resort role.	
	2007	Article 37 permits the bank to grant uncollateralized loans to banks and deposit-taking institutions for a period prescribed by a Cabinet Order when such institutions experience unexpected temporary shortage of funds that can seriously hamper their business operations if not swiftly recovered.	
Korea	2012	Article 65 permits the bank to conduct emergency credit operations with banking institutions in cases of liquidity mismatch or illiquidity due to breakdown of electronic information processing system or other accidents. This should be done with the approval of at least four monetary committee members. In this instance, the bank may temporarily accept any assets of the banking institution as collateral. However, the bank is also mandated to hear the opinion of the government before making the emergency credit decisions. Article 66 permits the bank to refuse to grant loans in cases where the monetary policy committee deems the institution as relying excessively on the bank's credit relative to others or the institution has been involved in unsafe credit and loan practices.	Article 68 permits the bank to transact in securities (government and other types) in accordance with the provisions of the monetary policy committee and provided the securities are freely negotiable and their terms of issuance are completely fulfilled.

Country/ Issues	Year of Latest Amendment	Lender of Last Resort Definition and Restrictions	Rules and Limitations on Acquiring Private Sector Assets
Malaysia	2009	Section 49 permits the bank to, with the approval of the minister and on recommendation of the bank's board, establish fund to provide financing to financial institutions on terms and conditions deemed necessary in the event of exigent circumstances or force majeure.	Section 26 permits the bank to transact in non-government securities with approval from the Monetary Policy Committee. Section 75 also contains similar stipulations. Section 76 prohibits the bBank from having direct interest in any undertaken except to satisfy debts due to it. It also prohibits the purchase of shares of any corporation, among others.
Mexico	1948	No mention of lender of last resort role.	
	2014	Article 3 states that one of the functions of the bank is to act as lender of last resort to credit institutions. Article 15 permits the bank to grant credit to financial institutions without an auction system in order to prevent disruption to the payment system or in the course of the bank's role as lender of last resort.	Article 63(III) forbids the bank from purchasing ownership interests in the capital of corporations, except companies providing appropriate services for the performance of the bank's functions.
New Zealand	2013	Section 31 stipulates that one of the functions of the bank is to act as lender of last resort to the financial system if the bank considers it necessary to maintain the soundness of the system.	
Norway	1966	No mention of the lender of last resort or emergency lending role.	
	2010	Section 19 permits the bank to grant loans to commercial banks on special terms when warranted by special circumstances.	
Peru			Article 84 prohibits the bank from buying shares nor participate directly or indirectly in the capital of commercial, industrial or any kind of enterprises.
Philippines	1948	Section 90 permits emergency credit operations in the case of imminent financial panic. Similar conditions are attached as in the 1993 version.	Similar provisions as below are in section 133.
	1993	Section 84 permits the bank to grant extraordinary credit to banking institutions secured by assets during periods of national emergencies of financial panics, which directly threatens monetary and financial stability, provided at least five members of its Monetary Board approve. During normal times, such extraordinary credits can be granted to a bank in precarious financial conditions but is solvent. Other conditions for emergency lending are highlighted.	Section 128 prohibits the bank from buying shares of any kind or accepting them as collateral nor participate in the ownership or management of any enterprise directly or indirectly.

Country/ Issues	Year of Latest Amendment	Lender of Last Resort Definition and Restrictions	Rules and Limitations on Acquiring Private Sector Assets
Portugal	1962		Article 34 prohibits the bank from promoting or participating in the creation of a commercial enterprise or others, except in cases specially provided for.
	2013	Article 12 mandates the bank to ensure the stability of the national financial system through its role as lender of last resort.	
Russia	2013	Article 4 identifies one of the functions of the bank as being the last resort creditor for credit institutions and organizing the system to re-finance them.	Article 8 forbids the bank from participating in the capital or becoming a member of a commercial or non-commercial organization that does not provide support to the activities of the bank. Article 46 permits the bank to trade securities on the open market and sell securities accepted as collateral for its loans. However, article 49 prohibits the bank from acquiring shares of credit institutions and other organizations, except if it is of an international organization, it is permitted by federal law or the bank's board.
Saudi Arabia			Article 6 prohibits the bank from having any interest in commercial, industrial and agricultural enterprise.
Singapore	1999	Section 26 permits the bank to grant special loans and advances to financial institutions, class of financial institutions or persons when necessary, in order to safeguard the stability of the financial system or public confidence in the financial system, based on terms and conditions that the bank thinks befitting.	Section 24 permits the bank to invest in non-government securities, financial instruments and investments as may be approved by its Board.
Slovak Republic	2010	Article 24 permits the bank to grant exceptional short-term loans to financial institutions as a temporary liquidity support, provided it is in compliance with provisions of monetary financing, backed by sufficient collateral, it is non-discriminatory, and its repayment must be prioritized over other liabilities.	Article 22 permits the bank to trade in securities and other assets in accordance with the European System of Central Bank Statutes. Article 27 stipulates the same.
Slovenia	2006	Article 61 transferred the lending and advances role of the bank to the ECB from the date of the adoption of the euro as the country's currency.	Article 17 permits the bank to operate in the open market with the purpose of fulfilling its monetary policy objective, although article 16 transferred all monetary policy operations of the bank to the ECB.

Country/ Issues	Year of Latest Amendment	Lender of Last Resort Definition and Restrictions	Rules and Limitations on Acquiring Private Sector Assets
South Africa	1944		Contains similar restrictions as in the 2003 amendments in its section 9.
	2003		Subsection 10(1D) permits the bank to acquire shares in a registered limited company if the board thinks such acquisition will be conducive for the attainment of any of the bank's objectives. Section 13 prohibits the bank from purchasing the shares of commercial banks or granting loans and advances backed by such securities without the authorization of the finance minister.
	1994		Article 9 permits the bank to operate in the financial markets in line with the objectives of the ESCB.
	1966	Article 18 permits the bank to grant loans from special funds under its administration in conformity with special regulations issued thereon.	
Sweden	2012	Chapter 6, article 8 permits the bank to grant credits or provide guarantees on special terms to banking institutions in exceptional circumstances with the aim of supporting liquidity.	Chapter 8, article 2 permits the bank to purchase equity and shares in economic associations and assume the obligations linked to such rights. However, it further states that when such acquisitions are done to fulfil other tasks apart from the bank's central banking objectives, authorization must be sought from the Riksdag (the parliament). Otherwise, the bank is prohibited from such activity.
Switzerland	1953	No mention of lender of last resort role.	
		Article 5 mandates the bank to provide the Swiss franc money market with liquidity.	Article 12 permits the bank to participate in the capital of companies and other legal entities only to the extent necessary for performing its tasks.
Thailand		Section 42 permits the bank to provide loans and other financial assistance to a financial institution that is experiencing liquidity problems and the bank is convinced the effect of such problem can endanger the economic and monetary system as a whole. In such instance, the approval of the Financial Institution Policy Board and the Cabinet is required and shares of other financial institutions can be accepted as collateral by the bank.	Section 9 prohibits the bank from having direct interest in any commercial or industrial or other beneficial undertaking. It also prohibits it from purchasing or holding shares of any other financial institution or company, except the BIS, or when shares are held as a result of debt settlements.

Country/ Issues	Year of Latest Amendment	Lender of Last Resort Definition and Restrictions	Rules and Limitations on Acquiring Private Sector Assets
Turkey	2001	Article 4(II[e]) designates the bank as the lender of last resort responsible for extending credits to banks. Article 40 (I[a&c]) permit the bank to act as lender of last resort by providing daily credit facilities to the financial system to eliminate obstructive technical payment problems and to extend credit to banks that are subject of uncertainty or lack of confidence in the banking system, based on terms to be determined by the bank.	
United States	2010	Section 4(8) permits each Reserve Bank to extend discounts, advancements and accommodation to member banks safely and reasonably for the maintenance of sound credit condition and in line with prescribed regulations. Section 10A permits a Reserve Bank to make emergency advances to a group of five or more member banks in its district provided: they do not have adequate assets or collateral to access the Federal Reserve's normal rediscount and advances channels; not less than five members of the Board of Governors of the Fed System consents, among other conditions. Section 10B provides similar conditions for single banks and limits the advances to not more than 60 days in any 120-day period.	

Sources: See Table 2.

be a different matter entirely (see, for example, Dincer and Eichengreen 2010; Masciandaro and Romelli 2015). The reluctance to at least broadly define the rules of engagement according to which central banks acquire and dispose of assets may enhance the flexibility of their response in the event of a crisis, but it is also a potential avenue for the fiscal authorities to limit their autonomy.

Figure 2 shows a bar chart of the ratio of total central bank assets to GDP. Changes over time can be taken as a rough indicator of the size of central bank interventions over time. As noted earlier, the substantial heterogeneity in reporting requirements must be kept in mind, not to mention the precise types of assets that are recorded on the balance sheets of the monetary authorities. There are large and clearly visible increases in the size of the balance sheets in the four economies most directly implicated by the GFC, that is, the United States,

the United Kingdom, the euro zone and Japan. Nevertheless, there is collateral damage elsewhere, as seen in the sharp increases in total assets to GDP for the Swiss National Bank in response to the decision, later abandoned in 2015, to put a floor on the value of the Swiss franc, which was introduced due to the strong appreciation of the currency vis-à-vis the euro.²¹ A few central banks show temporary surges in central bank assets (for example, Sweden and a few individual euro-zone

21 As a consequence (see also Figure 2) the Swiss National Bank's balance sheet grew very quickly relative to the size of the Swiss economy. However, much depends on the treatment of foreign exchange reserves. For example, the series entitled "Central Bank Assets to GDP for Switzerland" in the St. Louis Federal Reserve's Economic Data database shows a decline whereas most observers would expect a rise. See <https://fred.stlouisfed.org/series/DDDI06CHA156NWDB>.

Figure 2: Central Bank Assets to GDP Ratio



Data source: Data is from individual country central banks and the IMF and authors' calculations.

Notes: Country codes (three letters; see the appendix), TA_G is the ratio of total central bank assets to GDP, in percent. Annual data (1998–2016) was used to construct the bar charts.

member central banks).²² While there is no obvious impact from the GFC on many emerging market economies' central banks, it is generally the case that total assets to GDP ratios are higher post-GFC than at almost any time prior to 2007. This is clearly the case for all four systemically important economies shown in Figure 2, while increases are mostly modest elsewhere in the world.²³

Figure 3 turns to the available data showing the share of loans and assets to the private sector as a percent of GDP. Unfortunately, it is difficult to separate the two components. Loans to the private sector are usually the result of the lender of last resort function, while private sector assets might represent interventions by the central bank to promote industrialization or as a consequence of interventions stemming from the financial crisis.

Overall, there is little evidence of a permanent surge post-GFC, although there are a few examples of temporary surges around 2008, which leaves little doubt that this is due in one way or another to the fallout from the GFC. Indeed, in most cases, the share of private loans and assets to total assets is modest, often less than 10 percent. In a few cases, most notably the countries in the euro zone, the share is higher than elsewhere, but this is due to the division of responsibilities between the ECB and NCBs. The latter are closer to the banking sector in individual countries than is typical elsewhere.²⁴ Even in Japan — where the central bank has likely intervened most heavily and for longer than the other central banks in the data set — the shift away from the holding of private sector assets is noticeable.

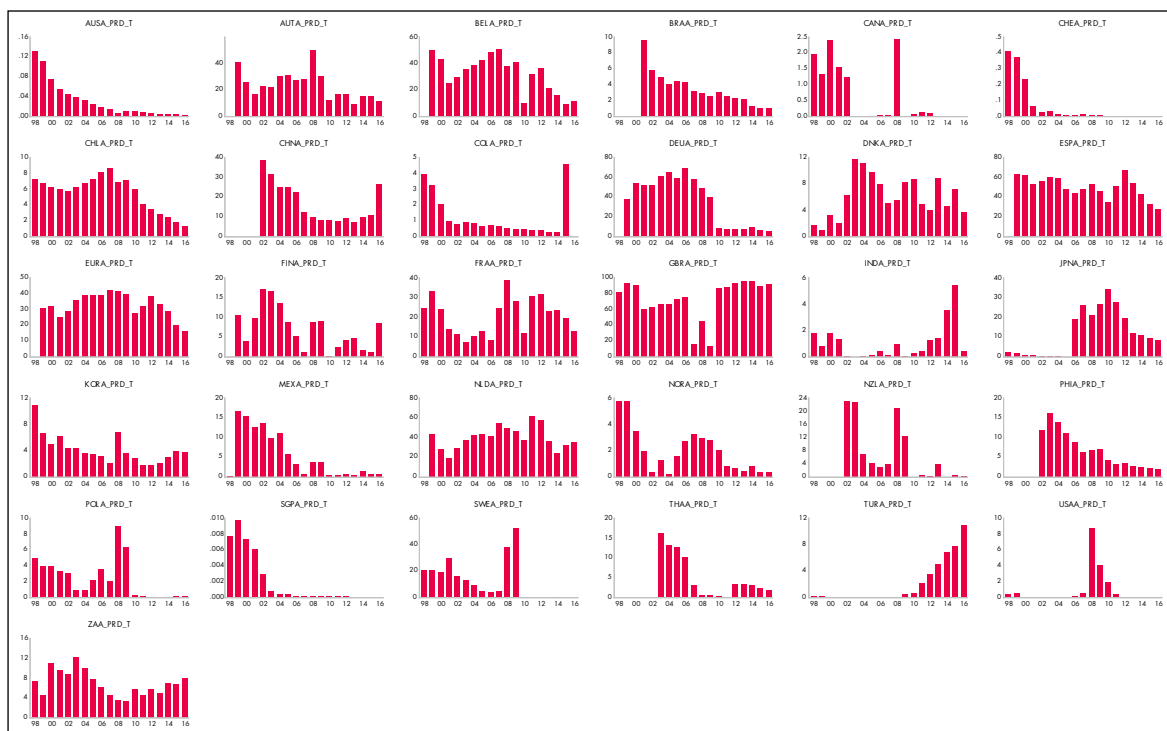
From the perspective of portfolio allocation it is conceivable that, as needs change, central banks

22 In some cases (for example, Norway) the significant increases shown stem from increases in the government investment fund (i.e., Norway's sovereign wealth fund). Whether this can be partly attributed to the effects of the GFC is unclear.

23 In a few cases the average ratio is unchanged or declines modestly. This is the case for Australia, Chile, Singapore and Turkey.

24 In part for this reason, there has been a push to create a banking union in order to limit these links and reduce the future possibility of the sovereign-bank doom loop reasserting itself.

Figure 3: Private Sector Assets to Total Assets at Central Banks



Data source: Data is from individual country central banks and the IMF and authors' calculations.

Notes: PRD_T is the ratio of private sector assets on central bank balance sheets to total assets of the central bank, in percent. Annual data. Private sector assets exclude currency, foreign exchange reserves and government securities. They are essentially loans and other forms of advances made to banks and other private entities as recorded by central banks.

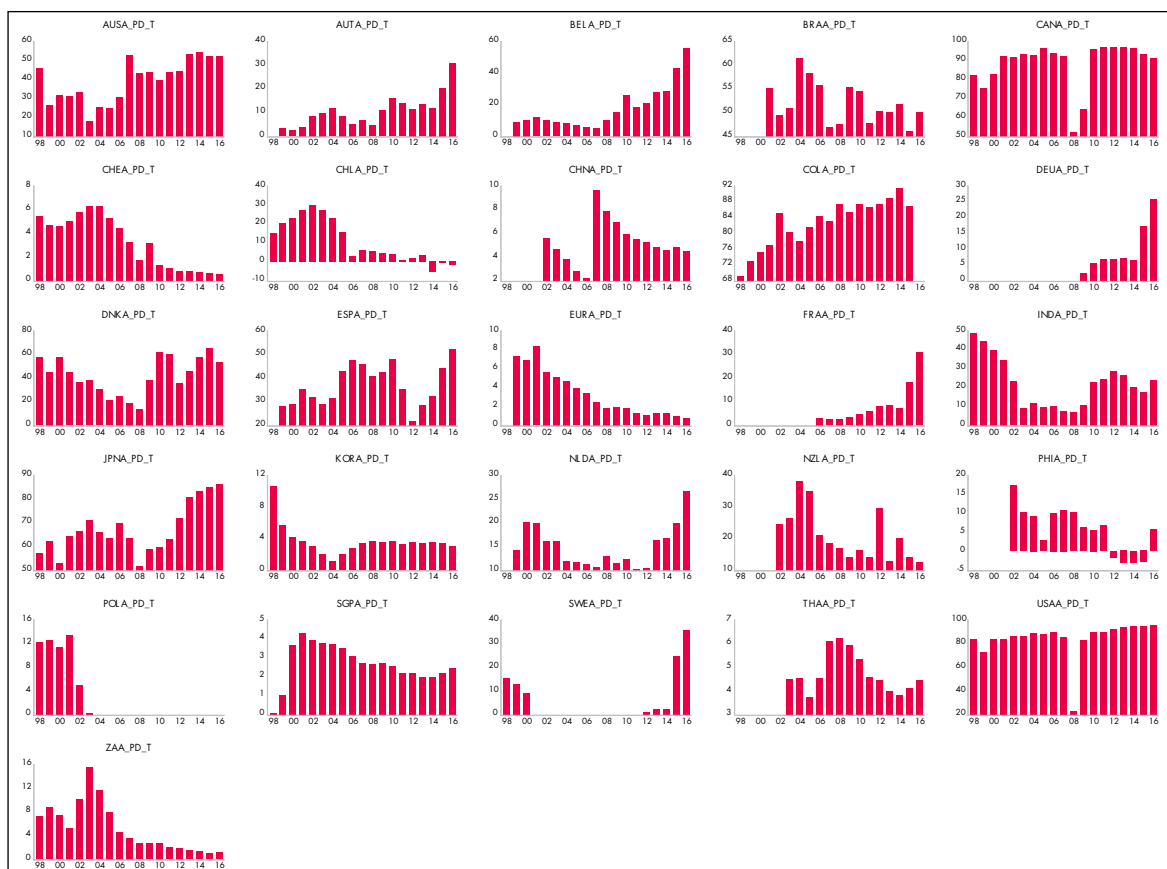
shift emphasis away from the holding of private sector assets to holding government assets, typically short term, but as the financial crisis of 2008-2009 progressed, longer-term government bonds.²⁵ For example, this shift means that concerns can emerge when central banks hold assets whose value can change and there is the possibility, perhaps via political pressure, to sell them at a loss. Alternatively, the possibility of a financial loss can stem from a decision that intervention in private financial markets is required, say, to maintain financial stability. Figure 4 plots the share of total assets held in the form of government financial instruments as a percent of total assets. In a few cases (for example, Canada and the United States) the temporary shift in portfolio holdings away from private to public assets is clear. The same effect is evident for some of the euro-zone central banks

but, as in the case for Japan, the post-GFC increase reflects the twin effects of the sovereign debt crisis and the BoJ's return to resorting to UMP with the launch of quantitative and qualitative monetary easing in 2013 under Governor Shirakawa.

Some have also argued that changes in gold and foreign exchange holdings signal interventions that are akin to some of the unconventional monetary policy actions referred to above. However, to the extent that these reflect a reaction to spillovers from advanced economies' unconventional policies, it is unclear that the resulting impact on central bank balance sheets reflects anything other than a response to external shocks. To be sure, the external shock that the GFC represents is a large one, but changes in the holdings of foreign exchange long predate the GFC. Indeed, when the gold and foreign exchange holdings of the central banks are examined in the sample (not shown), it is clear that changes predate the GFC and are likely due to the fallout from the Asian financial crisis of 1997-1998 (see, for example, Filardo and Siklos 2016, and

25 Regrettably, as with private-sector assets, we have little ability to distinguish between short- and long-term government bond holdings for the vast majority of the economies shown in Figure 3. This raises the issue of indemnification in the event of losses on the sale of longer-term government bonds, which is returned to below.

Figure 4: Central Bank Public Sector Assets to Total Assets



Data source: World Bank, www.worldbank.org/en/publication/gfdr/data/global-financial-development-database.

Notes: PD_T is central bank public sector assets to total assets ratio, in percent. Annual data.

references therein). A clear rising trend in holdings as a percent of total assets is evident for almost all the emerging market economies in the sample.²⁶

Finally, as noted earlier, questions have been raised about the potential insolvency of a central bank. Figure 5 displays a bar chart of the net worth to total assets for 31 central banks.²⁷ As is true for other major categories of central bank balance sheets, there is considerable heterogeneity across countries. Nevertheless, in at least 25 of the 31 cases shown, net worth by the end of the sample is at least 20 percent and, in several cases, much higher. Among the countries with low net worth to total assets are the BoE and the PBOC. It is highly doubtful that injections of capital, should

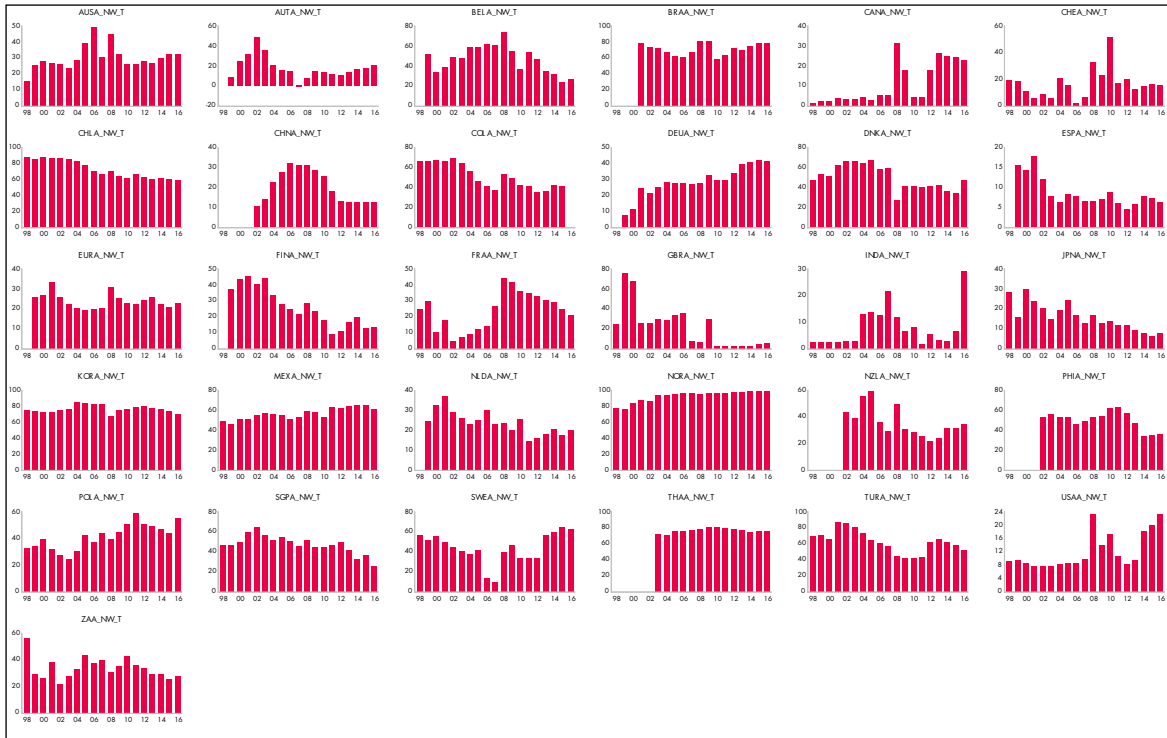
they prove necessary, represent a constraint in China, while in the case of the United Kingdom, the current state reflects the large-scale purchases of various government instruments. If there is a return to pre-crisis-like conditions, then the BoE no longer stands out from the other central banks shown. Indeed, the United States offers an illustration of a fall in the net worth ratio post-2008 that begins to be reversed in 2014 as the Fed starts to unwind its various interventions in private and government bond markets.

Despite the foregoing developments, there is little in the way of a stylized fact that can be gleaned from even simple correlations between the main central bank balance sheet components and credit-to-GDP figures or government-debt-to-GDP ratios, whether or not the period that includes and follows the GFC (results not shown) is excluded. Whether this reflects the difficulties inherent in interpreting central bank balance sheet developments is, of course, unclear. Unlike changes

26 For example, the case of China is one that has attracted considerable attention but is not unique.

27 In private firms, the relative size of net worth provides an indication of the available financial buffer in case of losses on the value or sale of assets.

Figure 5: Net Worth to Total Assets in Central Banks



Data source: Data is from individual country central banks and the IMF and authors' calculations.

Notes: Country code (three letters), NW_T is the net worth to total assets, in percent. Annual data.

in a policy interest rate, which, other things equal, can signal a tightening or loosening in monetary policy,²⁸ the clarity of signals from quantitative analysis of central bank balance sheets remain unclear (with some exceptions noted above).

The Interaction between Inflation-Output Variability and Financial Stability

A principal aim of the shift away from using a policy rate that gets into “all the cracks” of the financial system (Stein 2013) toward balance sheet composition was to restore and maintain financial system stability. Of interest, then, is

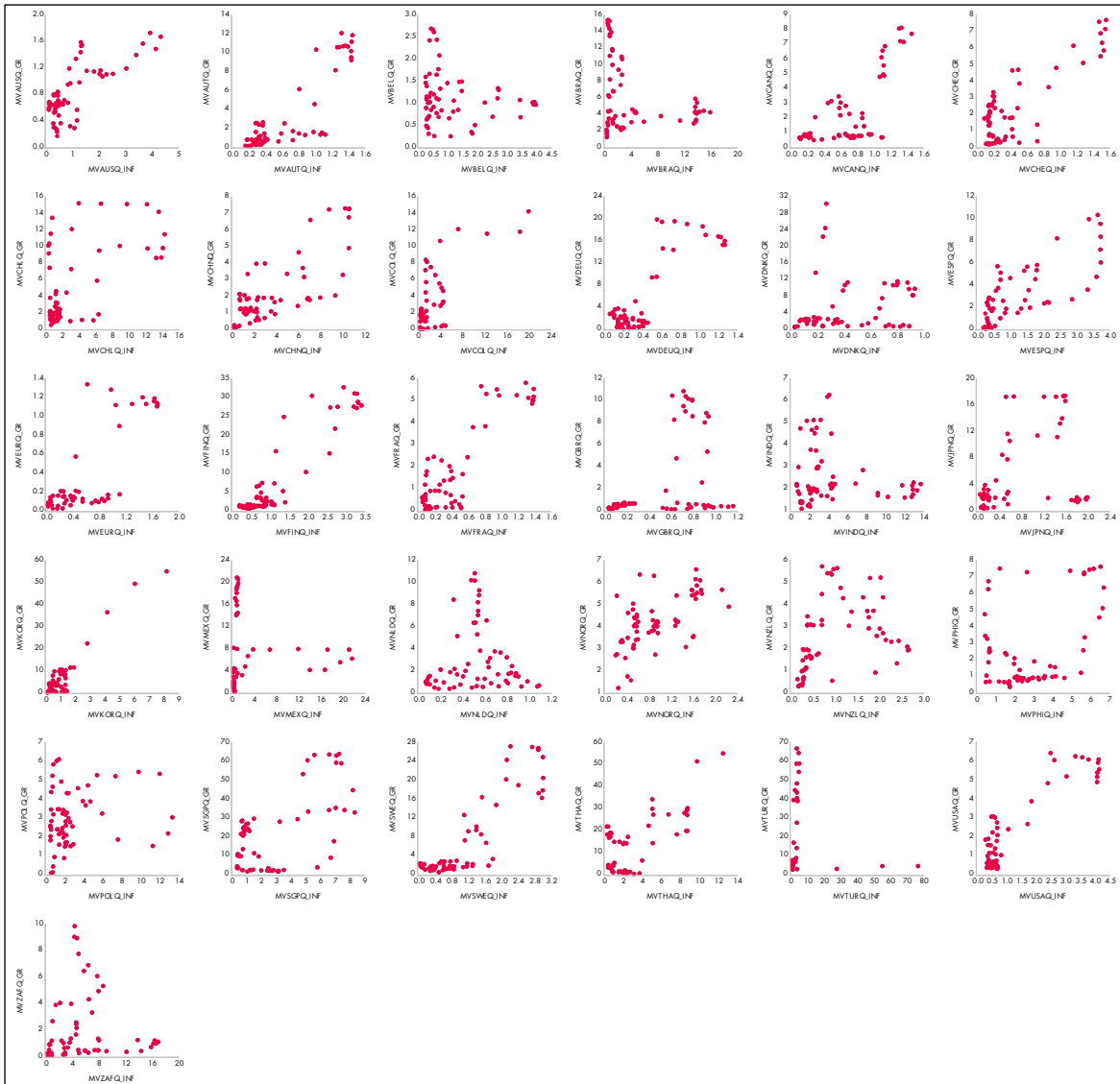
whether there is a trade-off in using balance sheet interventions to address financial stability concerns versus achieving monetary policy objectives. The effectiveness of monetary policy has long been framed as a trade-off between inflation and output volatility (Taylor 1979; 1994).²⁹ The “optimal” choice is for policy makers to set monetary policy such that the variabilities of both inflation and output are minimized.

Figure 6 shows a scatter plot of the variance of inflation against the variance of real GDP growth for 31 economies in the data set for the sample of quarterly data since 1998. The dots reflect one-year moving variance calculations over a

28 The tightness and looseness of monetary policy over time is signalled by the real interest rate (i.e., nominal rates less expected inflation), as well as interest rate spreads and lending conditions more generally.

29 In Taylor’s setup, the policy maker is concerned with both inflation and output outcomes. Hence, it is easy to see how the trade-off referred to eventually produced the specification of what has come to be called the Taylor rule where policy makers must decide how much weight to place on inflation versus output outcomes.

Figure 6: The Inflation-Output Growth Variability Trade-Off



Data source: Data is from individual country central banks and the IMF and authors' calculations.

Notes: MV stands for moving variance (three-year rolling), next are the country codes followed by INF (inflation) and GR (real GDP growth). Generated from quarterly data.

three-year horizon.³⁰ In jurisdictions where the monetary policy objective is to control inflation, the central bank aims to move in the direction of the origin, that is, simultaneously minimize inflation and output volatility. Broadly speaking, higher inflation and real GDP volatilities are positively related to each other in 21 of the 31 cases

shown. For the United Kingdom, the Netherlands, Turkey and Poland, there appears to be no obvious trade-off that emerges. In a few cases, such as Brazil, Mexico and South Africa, the trade-off is sensitive according to whether the overlapping samples exclude the period since the GFC.

Financial stability is more challenging to measure. Table 4 shows that there is no clear consensus of what financial system stability consists of and that only a few central banks have legislation that explicitly deals with the

30 That is, the variance is evaluated for a period of three years and then the calculation is repeated by advancing the sample one year at a time. Hence, there is a two-year overlap of the samples. Specifying a slightly longer horizon such as four or five years does not fundamentally change the results.

Figure 7: Financial Stability Factors



Data source: Data is from individual country central banks and the IMF and authors' calculations.

Notes: Factor scores are estimated as explained in the main body of the paper. "Housing" is the rate of change in (real) housing prices, "credit" is the change in total credit to GDP, "realeffer" is the rate of change in the real effective exchange rate, "equity" is the rate of change in a national stock market index, "spread" is the change in the difference between long-term and short-term government bond yields, "econpolunc" is the indicator of economic policy uncertainty, "forexres1" is the rate of change in foreign exchange reserves, "monpolunc2" is the indicator of monetary policy uncertainty explained in the main body of the paper and "VIX" is the options price indicator also defined in the paper. Generated from quarterly data .

question of financial system stability. As a result, it is not surprising for observers to claim that, when it comes to financial system stability, it is often a case of "we know it when we see it" (Hoenig 2016). There is now an extensive literature that attempts to evaluate financial conditions (see, for example, Gadanecz and Jayaram 2009; Hatzius et al. 2010, and references therein). James D. Hamilton et al. (2016), for example, list 45 potential indicators of financial conditions. Nevertheless, subsequent statistical testing reduces the number of variables that can signal instability to only a few. A challenge is that there is plentiful data if the focus is only on the United States. Once the researcher goes beyond advanced economies, data availability becomes spottier.

For this paper, nine potential indicators of financial stability are used based on the extant literature (see Figure 7). The growth in housing prices and

credit are two variables that have, for example, been emphasized by research at the BIS. Next, changes in real effective exchange rates have a long history, and there is a well-developed theory and empirical evidence, linking financial conditions to economic performance.³¹ The same is true of the related variable that represents changes in holdings of foreign exchange reserves. Similarly, the evolution of equity prices is viewed as a harbinger for sudden changes in financial conditions. Central banks have long relied on the spread between short- and long-term yields as a signal of the future outlook for inflation and real economic activity, even if the link is not always a reliable one (see, for example, Owyang and Shell 2016; Tett and Rennison 2018). Moreover, changes

³¹ The experience of Greece through the euro zone's sovereign debt crisis is, arguably, the best known example that illustrates the potential for such a link to operate.

Table 4: The Responsibility and Meaning of Financial System Stability

Country	Responsibility and Definition of Financial Stability	
	From Central Bank Legislation	From Other Sources (including Central Bank Websites)
Argentina		<p>a. Law 26, 739, which amends the Central Bank of the Argentine Republic (BCRA) Charter (Act 24, 144) in 2012 has established that the promotion of financial stability is one the goals of the bank. While the BCRA has ample power to gather information and take actions against systemic risks, the macroprudential mandate is shared with other regulatory authorities (i.e., the Comision National de Valores [National Security Commission] and Superintendencia de Seguros de La Nación [Superintendency of Insurance]).</p> <p>b. No explicit definition of financial stability on the website (at least the English version).</p>
Australia		<p>a. The bank has an implicit responsibility to ensure financial stability by virtue of its legislative mandate of “ensuring that the monetary and banking policy of the Bank is to the best advantage of the people.” However, the explicit responsibility for financial stability is shared with other agencies (especially the Australian Prudential Regulatory Authority, the major prudential regulator). Also, there is an interagency body (the Council of Financial Regulators) for coordinating the activities of all regulators. b. On the website, financial stability is defined as follows: “a stable financial system is one in which financial institutions, markets and market infrastructures facilitate the smooth flow of funds between savers and investors. This helps to promote growth in economic activity.”</p>
Austria	No explicit definition of financial stability. Articles 44a and 44b suggest the bank’s role in monitoring and contributing to maintenance of financial stability through information gathering and sharing, collaboration with other institutions and publishing of the financial stability reports.	<p>a. The bank’s primary role in financial stability involves monitoring and risk identification. The bank (as a member) shares information with the Financial Market Stability Board, which is the interagency body established to strengthen cooperation in macroprudential policy and promote financial stability. b. On the bank’s website, financial stability is defined as follows: “Financial stability means that the financial system — financial intermediaries, financial markets and financial infrastructures — is capable of ensuring the efficient allocation of financial resources and fulfilling its key macroeconomic functions even if financial imbalances and shocks occur.”</p>
Belgium	Article 12 states the bank shall contribute to financial stability in an independent way as the ECB. Article 36 (2 and 3) establishes the bank as the prudential authority required to act in line with the ECB and identifies some steps to be taken in ensuring and sustaining financial stability.	<p>a. The legislation explicitly gives the bank as the financial stability mandate and spells out its roles including the deployment of instruments under its purview and recommendations to other regulators when it does not control the required instrument. b. In the bank’s Financial Stability Report 2015, financial stability is defined as “a condition in which the financial system — consisting of financial intermediaries, markets and market infrastructures — can withstand shocks without major disruption in financial intermediation and in the effective allocation of savings to productive investment.”</p>

Country	Responsibility and Definition of Financial Stability	
	From Central Bank Legislation	From Other Sources (including Central Bank Websites)
Brazil		a. By legislation, the bank does not have an explicit financial stability mandate, but it controls most of the macroprudential instruments. The bank has a Financial Stability Committee for assessing systemic risk and proposing risk mitigation policies while it coordinates with other regulators through its role as a commissioner for the National Monetary Council, which is in charge of issuing regulations including on financial stability issues. b. No explicit definition of financial stability on the website (at least the English version).
Canada		a. The bank has no explicit financial stability mandate based on its legislation. Rather, it performs financial stability-related roles through its functions in the Financial Institutions Supervisory Committee, which is the comprehensive regulatory and supervisory framework for coordination and information sharing. While the bank collaborates extensively with the Office of the Superintendent of Financial Institutions on risk assessment and identification, the latter, arguably, controls most of the macroprudential instruments available in Canada. b. No explicit definition of financial stability on the website.
Chile	The bank's financial stability mandate is stipulated in sub-title 5, section 36 (1 to 3) in terms of the bank's power for emergency lending, asset acquisitions and forgiveness of part of the debts of banking entities and financial institutions.	a. The bank plays a major role in financial stability, both through its control over some macroprudential instruments and its role as the permanent adviser in the Financial Stability Council. b. No explicit definition of financial stability on the website.
China	Article 2 mandates the bank to prevent and mitigate financial risks and maintain financial stability in addition to its monetary policy function. Article 33 permits the bank to request the banking regulatory authority for conduct of supervisory examination on banks and respond within 30 days, when deemed necessary. Article 34 permits the bank to conduct examination and supervision so as to maintain financial stability when banking financial institutions have payment difficulties that may trigger financial risks. Article 35 permits the establishment of a supervisory information-sharing system between the bank and other supervising regulators.	a. The bank shares the financial stability mandate: power to deploy most instruments is within the purview of both the bank and the financial regulator China Banking Regulatory Commission. Also, there exists a committee for coordination at the state council level (i.e., the Joint Ministerial Conference of Financial Regulatory Coordination), in addition to different MOUs for information sharing. b. No explicit definition of financial stability on the website.

Country	Responsibility and Definition of Financial Stability	
	From Central Bank Legislation	From Other Sources (including Central Bank Websites)
Colombia		a. The bank has the responsibility to deploy macroprudential instruments to maintain financial stability. The responsibility is jointly assigned to the Ministry of Finance, the bank and Financial Superintendence of Colombia, while there is also a coordinating body known as the Financial System Coordinating Committee, which oversees the integrity and stability of the financial system through information sharing and risk assessment.
Czech Republic	Article 2(1) identifies ensuring financial stability and safe operation of the Czech financial system as one of the bank's objectives. Article 2(2e) sets out the specific tasks of setting macroprudential policy for the bank.	a. The bank is the financial stability and macroprudential authority. b On its website, financial stability is defined as "a situation where the financial system operates with no serious failures or undesirable impacts on the present and future development of the economy as a whole, while showing a high degree of resilience to shocks."
Denmark		a. While it is not explicitly stated in the bank's legislation, the website states that one of its responsibilities is to contribute to the stability of the financial system. The bank also plays a key role in the activities of the nation's national systemic risk council (the SRC, which was formed upon the recommendation of the European Systemic Risk Board [ESRB]). The SRC is composed of various regulators, headed by the bank's governor and has the responsibility of monitoring, identifying and providing recommendations on systemic risks. b. On its website, the bank defines financial stability as "a condition with an overall financial system that is robust enough for any potential problems in the sector not to spread and prevent the financial system from functioning as an efficient provider of capital and financial services."
Estonia	Section 2(2) mandates the bank to promote the smooth operation of the payment system and ensure the stability of the financial system.	a. The bank has power over most non-ESCB macroprudential tools and works together with two other domestic authorities that have discretion over other tools (i.e., the Ministry of Finance and Estonian Financial Supervisory Authority) in a joint committee for macroprudential supervision. b. On its website, the bank defines financial stability as "the smooth functioning of financial intermediation under both normal and unexpectedly adverse circumstances."
European Union/ECB	Article 3.3 mandates the ESCB to contribute to smooth conduct of policies by relevant institutions relating to the stability of the financial system. Article 25 also permits the ECB to offer advice and consultancy to other institutions toward this objective and perform specific tasks on policies related to prudential supervision except insurance undertaken.	a. The bank and those of member countries, through the ESRB, oversee the financial sector and prevent and mitigate systemic risk in the European Union. b. On its website, the bank defines financial stability as "a state whereby the build-up of systemic risk is prevented" and further defines systemic risks as "the risk that the provision of necessary financial products and services by the financial system will be impaired to a point where economic growth and welfare may be materially affected."

Country	Responsibility and Definition of Financial Stability	
	From Central Bank Legislation	From Other Sources (including Central Bank Websites)
Finland	Section 3(2) mandates the bank to participate in maintaining the reliability and efficiency of the payment system and the overall financial system and participate in their development.	a. Apart from its individual mandate, the bank also fulfils its financial stability objective through its participation as a member of the board of the Finnish Financial Supervisory Authority, which is the country's macroprudential authority. b. No explicit definition of financial stability on the website.
France		a. The website states that one of the three main missions of the bank is ensuring financial stability in the economy. The bank does this by both ensuring the safety of savers' deposits and regularly accessing the risks and weaknesses in the financial system. The bank's governor also provides recommendations to the High Council for Financial Stability, which is the national macroprudential authority and has the binding power to deploy appropriate instruments. b. No explicit definition of financial stability on the website.
Germany		a. While the bank's primary mandate is monetary stability, the 2013 German Financial Stability Act mandates it to identify and assess risk to the stability of the financial system as part of its macroprudential function. Furthermore, the bank is an active member of the high-level Financial Stability Committee, which provides recommendations on deployment of macroprudential instruments to the government (and its members, Ministry of Finance, the bank and the Federal Financial Supervisory Authority). b. On its website, the bank defines financial stability as "a state in which the financial system can perform its key economic function smoothly at all times, particularly in times of stress and structural upheaval."
Hong Kong SAR	Subsection 1(A) grants the financial secretary the power to use the Exchange Fund as he sees fit to maintain the stability and integrity of the financial system in Hong Kong.	a. The bank has the mandate for ensuring financial stability and, together with other domestic authorities (especially the Insurance Authority), has power to deploy some macroprudential instruments. Similarly, the bank is a member of the Council of Financial Regulators and Financial Stability Committee, which serves as a coordinating body for the relevant agencies. b. No explicit definition of financial stability on the website.
Hungary	Article 3(2) mandates the bank to maintain the stability of the financial system, enhance its resilience and sustainable contribution to economic growth. Article 4(7) further gives the bank the macroprudential policy mandate while article 8 puts the Financial Stability Council under the authority of the bank's Monetary Council. Articles 31 to 37 provide detailed information on the basic tasks of the bank in terms of identification and management of systemic risks, deployment and administration of different macroprudential measures, all without prejudice to the bank's role as a member of the ESCB.	b. On its website, the bank defines financial stability as "a state in which the financial system, i.e., the key financial markets and the financial institutional system is resistant to economic shocks and is fit to smoothly fulfil its basic functions: the intermediation of financial funds, management of risks and the arrangement of payments."

Country	Responsibility and Definition of Financial Stability	
	From Central Bank Legislation	From Other Sources (including Central Bank Websites)
Iceland	Article 4 grants the bank the mandate of promoting financial stability — and undertaking tasks consistent with promoting a sound and efficient financial system. Article 12 permits the bank to set rules on a credit institution's minimum liquid assets and minimum stable funding for both domestic and foreign currencies. Article 13 also permits the bank to set rules of institutions' foreign exchange balance. Article 35 permits the bank to share information with the Financial Supervisory Authority and conclude a cooperation agreement aimed at this purpose.	a. The bank's financial stability mandate includes both its core responsibilities in terms of power over macroprudential instruments and its role in the country's Financial Stability Council, which provides recommendation on when to deploy the instruments. b. On its website, the bank defines financial stability to mean "the financial system is equipped to withstand shocks to the economy and financial markets, ensure the availability of capital, mediate credit and payments, and redistribute risks appropriately."
India		a. The bank does not have an explicit legislative mandate in terms of financial stability. However, it has control over macroprudential instruments and is a member of the Financial Stability and Development Council, whose mandate covers coordination, ensuring financial stability and promoting financial market development. b. No explicit definition of financial stability on the website.
Indonesia		a. The bank is implicitly responsible for financial stability and the assumed authority for macroprudential policy and deployment of instruments. It also shares information and coordinates with relevant agencies through the Financial System Stability Coordination Forum. b. On its website, the bank acknowledges that there is no standard definition of financial stability. However, three related definitions were quoted. One of them is that "financial stability means that the financial system has the capability to allocate funds efficiently and absorb shocks as they arise, thus preventing disruption of real sector activities and the financial system."
Ireland	Section 6A(2) mandates the bank to ensure the stability of the financial system overall.	a. The bank is responsible for ensuring financial stability and it exerts control over macroprudential policy. b. No explicit definition of financial stability on the website.
Israel	Section 3a(3) mandates the bank to support the stability and orderly activities of the financial system. Section 38 empowers the bank to set liquid assets requirements for banks and issue liquidity directives. It also highlights the administration of this requirement.	b. No explicit definition of financial stability on the website.
Italy		a. The bank's responsibility includes safeguarding the stability of the financial system. Also, the bank is the designated national macroprudential authority. b. No explicit definition of financial stability on the website.

Country	Responsibility and Definition of Financial Stability	
	From Central Bank Legislation	From Other Sources (including Central Bank Websites)
Japan	Article 1(2) mandates the bank to contribute to the maintenance of the stability of the financial system. Article 38 permits the bank, at the request of the prime minister and finance minister and after due diligence, to conduct business necessary to maintain the stability of the financial system such as provide loans under special conditions.	a. Apart from its statutory financial stability and macroprudential function, the bank also contributes through its cooperation with the Financial Service Authority in the Council for Cooperation for Financial Stability. b. On its website, the bank defines financial system stability as “a state in which the financial system functions properly, and participants, such as firms and individuals, have confidence in the system.”
Korea	Article 1(2) mandates the bank to pay attention to financial stability in carrying out its monetary and credit policy.	b. On its website, the bank defines financial stability as “a condition in which the financial system is not unstable.” It can also mean “a condition in which the three components of the financial system — financial institutions, financial markets and financial infrastructure — are stable.”
Malaysia	The law grants the bank tremendous power in terms of financial stability. Section 5(1) stipulates that promoting financial stability conducive to the sustainable growth of the economy as one of the principal objects of the bank. Section 28 confers the bank the power to promote financial stability. Section 29 defines risks to the financial system as any risks that, in the bank’s opinion, disrupts or is likely to disrupt financial intermediation or one that affects or is likely to affect the confidence of the public in the financial system or stability of the financial system. Sections 30 and 40 permit the bank to request information and enter into cooperation with agencies and supervisory institutions, and section 31 grants the bank the power to order any person to take action to avert or reduce risk to financial stability. Section 37 establishes a Financial Stability Executive Committee within the bank.	b. On its website, the bank defines financial stability as “a condition where the financial intermediation process functions smoothly and there is confidence in the operation of key financial institutions and markets within the economy.”
Mexico	No mention of financial stability role. Article 2 states that one of the bank’s responsibilities is promoting the sound development of the financial system.	a. The bank is also a member of the Financial System Stability Council and the macroprudential mandate is shared with other regulators. b. No explicit definition of financial stability on the website.
Netherlands		a. The bank’s website states that its mission is to ensure a stable financial system. It also has control over the non-ESCB macroprudential instruments. b. A stable financial system is described as one that “continues to operate as required during economic slowdowns, if banks or pension funds run into trouble, or amid bearish stock markets.”
New Zealand	Section 1(A) stipulates one of the responsibilities of the bank as promoting the maintenance of a sound and efficient financial system.	a. The bank is the primary financial stability/ macroprudential authority. b. No explicit definition of financial stability on the website.

Country	Responsibility and Definition of Financial Stability	
	From Central Bank Legislation	From Other Sources (including Central Bank Websites)
Norway		a. Although it is not explicitly stated in its legislation, the bank's website notes that it has the responsibility for ensuring a stable financial system. The responsibility is shared with the Ministry of Finance and Financial Supervisory Authority b. No explicit definition of financial stability on the website.
Peru		a. The financial stability mandates are not explicitly stated. However, the bank has control and sometimes deploys some macroprudential instruments; so does the Superintendency of Banks. b. No explicit definition of financial stability on the website.
Philippines		b. No explicit definition of financial stability on the website.
Poland	Article 3(2-6a) stipulates that one of the tasks of the bank is acting to sustain the stability of Poland's financial system.	a. In addition to its functions relating to sustaining financial stability, the bank also contributes by heading the four-agency Financial Stability Committee. b. On its website, the bank defines financial system stability as "a situation when the system performs all its functions in a continuous and effective way, even when unexpected and adverse disturbances occur on a significant scale."
Portugal	Article 12 mandates the bank to ensure the stability of the national financial system by functioning as the national macroprudential authority and participating in the European system to prevent and mitigate systemic risks.	b. No explicit definition of financial stability on the website.
Russia	Article 3 mandates the bank to ensure the stability of the financial markets of the Russian Federation. Article 45 empowers the bank, together with the government, to monitor the financial system and implement measures to mitigate threats to financial stability. Article 62 and subsequent articles (in chapters 9 and 10) grant the bank the power to regulate the bank's liquidity ratio, capital adequacy ratio and credit risk, among others, for the purpose of ensuring their stability.	b. No explicit definition of financial stability on the website.
Saudi Arabia		a. The bank is responsible for maintaining financial stability and implementing available macroprudential policy. It also coordinates its activities with three other national bodies through the Financial Stability Board. b. No explicit definition of financial stability on the website.
Singapore	Section 4 identifies one of the principal objectives of the bank as promoting financial stability	a. The bank has the responsibility for both macroprudential policy and deployment of instruments, based on decisions by its chairman's meeting with support from its in-house Financial Stability Committee b. No explicit definition of financial stability on the website.

Country	Responsibility and Definition of Financial Stability	
	From Central Bank Legislation	From Other Sources (including Central Bank Websites)
Slovak Republic	Article 2(3) mandates the bank to contribute to the stability of the financial system as a whole and the secure and sound functioning of the financial markets, especially through supervision and other activities.	b. No explicit definition of financial stability on the website.
Slovenia	Article 4(3) mandates the bank to strive for financial stability	a. The bank is the national macroprudential authority. b. On its website, the bank defines financial stability as “a situation in which the components of the financial system (financial markets, financial institutions and the financial infrastructure) function without systemic disruptions, and in which each component of the system provides the greatest possible degree of flexibility in responding to any shocks that occur.”
South Africa		a. The bank implicitly has a financial stability mandate and is delegated by the Ministry of Finance to deploy macroprudential instruments. Also, it is a member of the Financial Stability Oversight Committee. b. On its website, the bank acknowledges and mentions some different definitions of financial stability. However, in broad terms, it defines financial stability as “the joint stability of the key financial institutions and the financial markets in which they operate.”
Spain	Article 16 establishes a Central Risk Information Department, which collects data and monitors the activities of banks, savings banks and credit institutions. Article 7(5b) mandates the bank to promote the smooth operation and ensure the stability of the financial system, without prejudice to the ESCB statute. Article 7(6) further mandates the bank to supervise the solvency activities and compliance with specific regulations related to credit institutions without prejudice to the responsibilities of their prudential supervisor.	b. On the website, the function of financial stability is explained as one that involves ensuring “the soundness and efficiency of the financial system as a whole and, thereby, smooth the transfer of resources among agents, from savers to demanders of funds.”
Sweden	Although not part of the bank’s legislation, by the order of the king and based on the Liquidity and Cash Ratio Act, 1962 and the Investment Ratio Act 1962, the bank may issue regulations with respect to these ratios in extraordinary conditions or if deemed indispensably necessary. (These necessary conditions are translated to mean maintaining some equivalence of financial system stability.)	a. Stemming from its major mandate of promoting a safe and efficient payment system, the bank posits that it is consequently (albeit indirectly) responsible for ensuring financial stability. While the financial stability responsibility is shared and, arguably, lies mainly with the Financial Supervisory Authority, the bank contributes through its emergency lending and last resort function. b. The bank provides a detailed video presentation on its website explaining what financial stability means. Emphasis is placed on the proper functioning of the financial markets and institutions and their resilience to shocks if and when they occur.

Country	Responsibility and Definition of Financial Stability	
	From Central Bank Legislation	From Other Sources (including Central Bank Websites)
Switzerland	Article 5 highlights one of the tasks of the bank as contributing to the stability of the financial system.	a. The bank also cooperates with the Swiss Financial Market Supervisory Authority in terms of sharing the responsibility for oversight over financial institutions of different sizes (or importance). b. On its website, the bank defines a stable financial system as “a system whose individual components — financial intermediaries and the financial market infrastructure — fulfil their respective functions and prove resistant to potential shocks.”
Thailand	Section 7 defines one of the bank’s objectives as carrying out tasks that pertain to financial system stability. Section 8 also grants the bank the powers for supervision and examination of financial institutions.	b. No explicit definition of financial stability on the website.
Turkey	Article 4(Ig) states that one of the fundamental duties of the bank is to take precautions for ensuring the stability of the financial system.	a. The bank is a member of the Financial Stability Committee, which monitors and identifies systemic risks and recommends to members to deploy necessary instruments. b. No explicit definition of financial stability on the website.
United Kingdom	Subsection 2A of the Financial Regulation and Services Act 2012 confers on the bank the power to act as the prudential regulation authority.	a. The bank is responsible for financial stability and macroprudential policy making in the United Kingdom. Both the Financial Policy Committee and Prudential Regulation Committee are in-house and are responsible for both policy making and deployment of tools to this end.
United States	Section 23 includes provisions aimed at limiting the exposure of other depository institutions to the risk of failure of large depository institutions. Also, the section highlights detailed regulations, guidelines and restrictions on the transactions (especially covered transactions) between a member bank and affiliates.	a. In addition to its specific financial stability role, the Fed also contributes as a member of the Financial Stability Oversight Council, which is statutorily responsible for checking systemic risk and taking macroprudential measures.

Note: * a — responsibility for financial stability; b — definition of financial stability provided.

in bond spreads can also reflect stresses in the financial system due to a shortage or liquidity, confidence among lenders and borrowers, or both.

The final three indicators reflect more recent concerns expressed by policy makers and academics connecting uncertainty more generally and future financial conditions. There is the increasingly popular measure of economic policy uncertainty (Baker, Bloom and Davis 2016) applied first to US data, but which has now been extended to a large number of countries.³² A narrower focus, and one arguably more germane to the analysis in this paper, asks about the amount of monetary

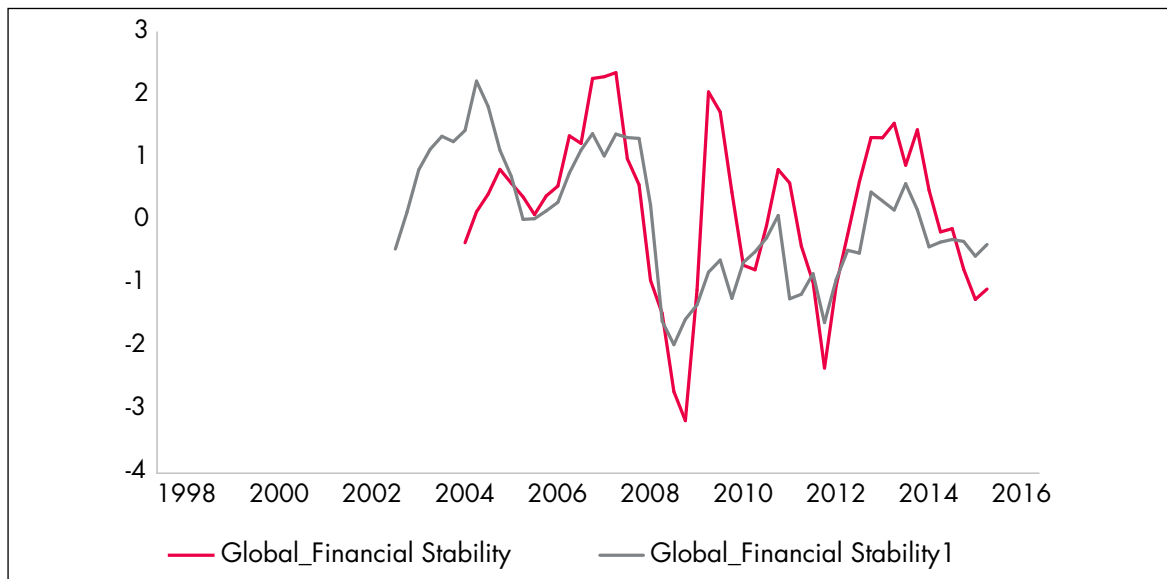
policy uncertainty that is based on an aggregate of differences between forecasters about inflation and real GDP growth one year ahead (see Siklos 2018).³³ Lastly, the VIX, related to equity price developments, is sometimes known as the “fear” index, since rising volatility of stock prices appears to move in concert with rising financial instability.

To obtain the values plotted in Figure 6, what essentially amounts to a linear combination of

³³ The sensitivity of the monetary policy uncertainty variable was tested, with the key results showing that when China is omitted from the group, monetary policy uncertainty rises by less during the height of the GFC — likely a reflection of the aggressive actions taken by the PBOC soon after its start — and the measure is considerably higher in 2010, 2012 and 2016.

³² See www.policyuncertainty.com/index.html.

Figure 8: Global Financial Stability Estimates



Data source: Data is from individual country central banks and the IMF and authors' calculations.

Notes: Global_Financial Stability1 excludes the spread and housing prices; Global_Financial Stability includes all factors shown in Figure 5. Quarterly data. The methodology is described in the main body of the text.

the series for individual countries, where data is available, was estimated, with the exception of the VIX, which describes volatility in US prices.³⁴ For most series, the plots in Figure 6 can be interpreted such that a declining value signals more financial instability; two exceptions where an increase in the variable signals more financial instability are for the policy uncertainty variables and the VIX. Two indicators appear to be forward looking, housing and credit, while none appear to be lagging indicators of financial instability.

Under the assumption that some combination of the variables shown can foretell a future deterioration in financial conditions leading to a financial crisis, Figure 8 considers what financial system stability conditions might look like worldwide under two scenarios.³⁵ The red line indicates global financial conditions when all nine variables in Figure 6 are used. The grey line repeats the exercise, but excludes housing and bond spreads for two reasons: excluding these two variables lengthens the available sample; and

these data are unavailable for several countries. Although both versions of global financial stability conditions move broadly in parallel with each other, there are clear differences in amplitude in the two series at crucial moments. For example, the deterioration in financial conditions is muted when the spread and housing prices are excluded as an indirect indication of their importance. Similarly, most improvements in financial conditions (for example, 2010 and 2013-2014) are understated when the same two variables are excluded. How one constructs a financial stability indicator can therefore influence the interpretation of the degree of financial system stability at any given moment. Perhaps the foregoing also illustrates the difficulty policy makers face in defining conditions that are consistent with financial stability.

Finally, Table 5 presents some regression evidence about the potential role played by financial stability and central bank balance sheet composition in explaining the variability of inflation over time. The various estimated regressions consider many of the indicators of central bank balance sheet composition examined above, as well as the proxy for global and domestic financial system stability previously discussed. The relatively small number of available observations, together with the many challenges surrounding the

³⁴ This approach is frequently used in studies of this kind (see, for example, Hamilton et al. 2016) and is called principal component analysis. It has the advantage of reducing the effective number of variables considered when estimating relationships econometrically.

³⁵ Estimation follows the same procedure outlined in note 36.

Table 5: Empirical Determinants of Inflation and Output Volatility across Countries

A. Inflation Volatility

	Variance of Inflation				
Treasury debts/assets	0.000 (0.007)				
EME dummy	2.090 (0.428)**	2.295 (0.452)**	2.142 (0.422)**	2.095 (0.423)**	2.082 (0.430)**
G_FINSTAB	1.606 (0.405)**	1.370 (0.428)**	1.641 (0.399)**	1.602 (0.398)**	1.600 (0.402)**
C_FINSTAB	-0.092 (0.098)	-0.073 (0.093)	-0.087 (0.092)	-0.090 (0.092)	-0.090 (0.093)
Non-monetary liab./assets		0.023 (0.016)			
Total assets/GDP			0.005 (0.006)		
Total assets/net worth				-0.000 (0.000)	
(Treasury + private debts)/net worth					-0.000 (0.000)
Constant	-0.044 (0.387)	-0.264 (0.390)	-0.227 (0.397)	-0.021 (0.354)	-0.023 (0.349)
R ²	0.26	0.27	0.27	0.26	0.26
N	116	103	118	118	116

B. Output Growth Volatility

	Variance of Real GDP Growth						
Gold/total assets	0.024 (0.009)**						
EME dummy	0.617 (0.699)	1.077 (0.670)	1.396 (0.772)	0.678 (0.726)	1.443 (0.667)*	1.124 (0.689)	1.040 (0.701)
V. G_FINSTAB	1.393 (0.631)*	1.488 (0.619)*	1.300 (0.731)	1.387 (0.642)*	1.681 (0.631)**	1.432 (0.649)*	1.396 (0.654)*
V. C_FINSTAB	0.162 (0.149)	0.171 (0.159)	0.099 (0.159)	0.097 (0.149)	0.093 (0.146)	0.076 (0.150)	0.080 (0.152)
Treasury debts/assets		-0.018 (0.011)					
Non-monetary liab./assets			0.060 (0.028)*				
Net worth/assets				0.025 (0.012)*			
Total assets/GDP					0.030 (0.010)**		
Total assets/net worth						-0.000 (0.000)	
(Treasury + private debts)/net worth							-0.000 (0.000)
Constant	0.125 (0.634)	1.679 (0.612)**	0.602 (0.667)	0.334 (0.662)	0.055 (0.628)	1.408 (0.577)*	1.393 (0.569)*
R ²	0.14	0.10	0.11	0.11	0.15	0.09	0.09
N	118	117	103	118	118	118	116

Notes: EME dummy = 1 for emerging economies; G_FINSTAB and C_FINSTAB are global and individual country financial stability factors, respectively. See Figure 7. “Globalfinancialstability1” is used in the estimation. The number of observations vary because data for central bank balance sheet items are not available for all countries. Standard errors are in parenthesis below coefficients. * $p < 0.05$; ** $p < 0.01$.

interpretation of central bank balance sheets as currently published, argues against attempting to estimate, let alone specify, a fully articulated model. Instead, the aim is to generate some preliminary evidence that asks whether there is an empirical link between inflation-output variability and indicators of financial stability developed above.

Although theory suggests that inflation and output variability are jointly determined, in practice the preferences of central bankers are not observed.³⁶ Moreover, it is unclear whether there are all of the necessary variables to adequately “identify” separately the forces influencing inflation versus output variability. Accordingly, the results should be viewed as preliminary at best. Nevertheless, the results are informative in the sense that it is asked whether inflation or output volatility are linked to a financial stability proxy, conditional on variables that capture the composition of central bank balance sheets.

Despite the foregoing limitations, there are at least three striking features about the results worth highlighting. First, global financial stability is much more successful in explaining inflation than output variability. Second, recalling from Figure 7 that a higher value for the financial stability proxy signifies *more* stability, greater financial stability may be associated with more inflation and output variability. Additionally, inflation variability is shown to be higher, on average, in the emerging market economies in the sample, but this is only statistically significant for one case of output volatility. Finally, none of the central bank balance sheet indicators significantly explain inflation variability. It is unclear whether this means that the use of balance sheet policies to ease (or tighten) monetary policy is neutral for inflation variability. Alternatively, the cross-country measurement problems identified earlier may render balance-sheet-based variables noisy enough to understate the potential impact of central bank interventions since the GFC and the portion that is intended to maintain financial system stability. On the other hand, four of the seven balance sheet items have a statistically significant and positive impact on output variability, although the coefficients appear economically small.

³⁶ Because these variables are jointly determined, there is no stand taken here concerning the direction of causality between them. In any event, the arguments below do not rest on a particular direction of causation. Indeed, a fully developed model would allow for lead and lagged relationships between the variables of interest.

Therefore, central bank interventions via their balance sheets may have increased the variability of output. Other things equal, this implies a potential worsening of the trade-off that is implied by standard macroeconomic models.

Conclusions and Policy Implications

The focus of this study was three-fold. First, despite growing public discussion about the shift away from reliance on interest rates in setting the stance of monetary policy toward changes in the composition of the balance sheets of central banks, the study posits that there are many reasons to be cautious about the data on which some inferences about the stance of monetary policy continue to be based. Accounting standards differ greatly across countries, and the degree of transparency about balance sheet details also varies considerably, in the more than 30 economies examined in this study. A global effort to improve the availability, timeliness and quality of central bank balance sheet data remains too much of a work in progress, more than 10 years since the financial crisis erupted. Equipped with the lessons learned from the GFC and taking advantage of relatively stable conditions in the global economy and financial system, policy makers should work together toward establishing common accounting standards for central bank balance sheets.

Next, policy makers are fond of emphasizing that the GFC taught them to place much greater priority on attaining financial system stability. However, what has been underemphasized is that greater financial stability is not a “free lunch.” In terms of the trade-off that economists rely on to ascertain how well monetary policy is practised, central bank interventions appear to worsen output variability. The difficulty, of course, is that we are working with noisy data when it comes to understanding the import and impact of changes in the composition of central bank balance sheets. More informative data is indeed needed to better understand the connection between monetary policy actions and its consequences for the inflation-output variability trade-off needs.

The study also found that central banks' ability to deliver improved macroeconomic outcomes, as seen through the inflation-output variability trade-off, may have been impaired by the aim of maintaining global financial stability. While there was insufficient data to determine with any degree of precision whether this finding is directly the result of the GFC or its aftermath, the strength of the impact on both inflation and output volatility suggests more, not less, effort at global cooperation on this score. Otherwise, critics may well mistake the size and sign of spillovers from large-scale interventions by central banks in future should these prove necessary.

Authors' Note

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Appendix

Country Codes

Country/Economy	Code	Country/Economy	Code
Argentina	ARG	India	IND
Australia	AUS	Japan	JPN
Austria	AUT	Korea	KOR
Belgium	BEL	Mexico	MEX
Brazil	BRA	Netherlands	NLD
Canada	CAN	Norway	NOR
Switzerland	CHE	New Zealand	NZL
Chile	CHL	Philippines	PHI
China	CHN	Poland	POL
Colombia	COL	Russia	RUS
Germany	DEU	Singapore	SGP
Denmark	DNK	Sweden	SWE
Spain	ESP	Thailand	THA
Euro zone	EUR	Turkey	TUR
Finland	FIN	United States	USA
France	FRA	South Africa	ZAF
United Kingdom	GBR		

Balance Sheet Data Source

Country	Period Available	Source
Argentina	1999 to 2017	www.bcra.gov.ar/PublicacionesEstadisticas/balances_anuales_i.asp www.bcra.gov.ar/PublicacionesEstadisticas/balances_semanales_i.asp
Australia	1969 to 2017	www.rba.gov.au/statistics/historical-data.html
Austria	1995 to 2017	www.oenb.at/en/Statistics/Standardized-Tables/OeNB--Eurosystem-and-Monetary-Indicators-/Balance-Sheet-Items-of-the-OeNB- www.oenb.at/en/Statistics/Standardized-Tables/OeNB--Eurosystem-and-Monetary-Indicators-/Financial-Statement-of-the-OeNB-.html
Belgium	1999 to 2017	stat.nbb.be/Index.aspx
Brazil	2001 to 2017	www.bcb.gov.br/?BALANCE
Canada	1935 to 2017	www.bankofcanada.ca/rates/banking-and-financial-statistics/bank-of-canada-assets-and-liabilities-month-end-formerly-b1/
Chile	1998 to 2017	https://si3.bcentral.cl/Siete/secure/cuadros/arboles.aspx?idCuadro=EM_NOMINALES_01
China	2002 to 2017	www.pbc.gov.cn/diaochatongjisi/116219/index.html
Colombia	1996 to 2015	https://stats.oecd.org/
Czech Republic	2004 to 2017	www.cnb.cz/cnb/STAT.ARADY_PKG.STROM_DRILL?p_strid=A&p_lang=EN ; www.cnb.cz/en/about_cnb/performance/finvykazy.html
Denmark	1994 to 2017	http://nationalbanken.statbank.dk/nbf/182890

Country	Period Available	Source
Estonia (different reporting formats across periods and different currencies)	1995 to 2017	http://statistika.eestipank.ee/#/en/p/EP_ARUANDED
Finland	1999 to 2017	https://helda.helsinki.fi/bof/handle/123456789/71 www.suomenpankki.fi/en/Statistics/mfi-balance-sheet/tables/rati-taulukot-en/SP_tase_en/
France	1998 to 2017	http://webstat.banque-france.fr/en/browse.do?node=5384926
Germany	1999 to 2017	www.bundesbank.de/Navigation/EN/Publications/Reports_and_studies/reports_and_studies.html / www.bundesbank.de/Navigation/EN/Statistics/Time_series_databases/Euro_area_and_euro_area_countries/euro_area_and_euro_area_countries_node.html
Hong Kong	1993 to 2017	www.hkma.gov.hk/eng/key-information/press-release-category/exchange-fund.shtml ___ www.hkma.gov.hk/eng/publications-and-research/annual-report/
Hungary (Organisation for Economic Co-operation and Development [OECD] format is completely different from central bank's format; not comparable)	1989 to 2017	www.mnb.hu/en/statistics/statistical-data-and-information/statistical-releases-and-notes/preliminary-statistical-balance-sheet-of-the-mnb
Iceland	1994 to 2017	http://statistics.cb.is/en/data/set/28s8/#!ds=28s8!2s1q=1.ce.3.4v&display=line
India	1998 to 2017	https://rbi.org.in/Scripts/WSSViewDetail.aspx?TYPE=Section&PARAM1=1
Indonesia	2002 to 2017	www.bi.go.id/en/publikasi/laporan-tahunan/bi/Default.aspx
Ireland	1999 to 2017	www.centralbank.ie/publication/corporate-reports/annual-reports
Israel	2000 to 2017	www.boi.org.il/en/NewsAndPublications/RegularPublications/Pages/maazan.aspx
Japan	1998 to 2017	www.stat-search.boj.or.jp/index_en.html
Korea	1970 to 2017	http://ecos.bok.or.kr/flex/EasySearch_e.jsp
Malaysia	1996 to 2017	www.bnm.gov.my/index.php?ch=statistic&pg=statistic_bnmstatement
Mexico	1985 to 2017	www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=4&accion=consultarCuadro&idCuadro=CF1&locale=en
Netherlands	1983 to 2017	https://statistiek.dnb.nl/en/downloads/index.aspx#/?fq=%7Ctags%3Aabalans&page=2
New Zealand	2001 to 2017	www.rbnz.govt.nz/statistics/r2
Norway	1817 to 2017	www.norges-bank.no/en/Published/Balance-sheets/Norges-Banks-balance-sheets-from-1817-to-the-present/
Peru (hard to interpret the items)	1979 to 2016	https://estadisticas.bcrp.gob.pe/estadisticas/series/cuadros/historicosanual/ACuadro_37

Country	Period Available	Source
Philippines	2001 to 2017	www.bsp.gov.ph/statistics/statsearch0.asp?descm eta=BSP+Balance+Sheet &descfield=All&submit=Search&do=yes
Poland	1996 to 2017	www.nbp.pl/homen.aspx?f=/en/statystyka/bilans_nbp_mon/bilans_nbp.html
Portugal (OECD format is different from central bank's format; the data is largely non-comparable)	1995 to 2017	www.bportugal.pt/PAS/sem/src/(S(hfddo255nskeqsapgabuvqb4))/selecAnalise.aspx?Token=E2AC707B-E1AA-4500-8646-05AC9E5B8547
Russia	1998 to 2017	www.cbr.ru/Eng/publ/?PrtId=bbs&pid=dkfs&sid=ITM_36907
Saudi Arabia	2000 to 2017	www.sama.gov.sa/en-US/EconomicReports/Pages/MonthlyStatistics.aspx
Singapore	1989 to 2017	https://secure.mas.gov.sg/msb-xml/Report.aspx?tableSetID=I&tableID=I.2C
Slovakia	2004 to 2017	www.nbs.sk/en/statistics/financial-institutions/banks/statistical-and-analytical-overview/monetary-statistics-of-monetary-financial-institutions
Slovenia	1996 to 2016	www.bsi.si/en/publications/annual-report
South Africa	1946 to 2017	www.resbank.co.za/Publications/QuarterlyBulletins/Pages/Quarterly-Bulletin.aspx
Spain	1980 to 2017	www.bde.es/webbde/en/estadis/infoest/bolest7.html
Sweden	1668 to 2017	www.riksbank.se/en-gb/statistics/
Switzerland	1907 to 2017	https://data.snb.ch/en/topics/snb#!/cube/snbbipo
Thailand	2003 to 2017	www2.bot.or.th/statistics/ReportPage.aspx?reportID=11&language=eng
Turkey	1980 to 2017	https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket
United Kingdom	1696 to 2016	www.bankofengland.co.uk/statistics/research-datasets
United States	1998 to 2017	www.federalreserve.gov/releases/h41/
European Union	1999 to 2017	www.ecb.europa.eu/pub/annual/balance/html/index.en.html // www.ecb.europa.eu/stats/policy_and_exchange_rates/eurosystem_balance_sheet/html/index.en.html

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