

Can Central Bank Balance Sheets Be Used as a Macro-Prudential Policy Tool?

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Can central bank balance sheets be used as a macro-prudential policy tool?¹

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Abstract: By 2018, economic cycles in the advanced economies had reached a stage when policy-determined interest rates were on the rise in the US and UK and prospectively Europe, and the question arises whether, when and how far monetary policy should be 'normalized'. That includes how past balance sheet expansions should be unwound. However monetary and financial conditions have also changed; it may no longer be appropriate to take central bank balance sheets back to their pre-crisis position. This paper sets out how the regulatory changes, most notably new prudential regulations on liquidity, mean that central bank balance sheets, even if reduced, are likely to remain significantly larger than pre-crisis and the experience of crisis operations has led to new opportunities for underwriting financial stability.

This question is important because while central banks retain their traditional monetary objectives (low inflation and stable outcome growth) as a priority, most are now required (or expected) to work to preserve financial stability as well. We focus mostly on the balance sheets of the Bank of England, the ECB and the US Federal Reserve as exemplars but the results are generally applicable. Our main conclusions are that:

- i) central bank balance sheets can be used, not only to set interest rates and the narrow money supply, but also to affect financial stability directly;
- ii) that this can be done without impacting on monetary policy objectives;
- iii) that what matters is the ability to improve liquidity in a financial crisis (normal operations can be more restrained);
- iv) such financial stability impacts would be more difficult to achieve if a central bank does not have a statutory responsibility, or at least an explicit remit for financial stability.

An especially important case is the euro zone, where lead responsibility for financial stability remains with national authorities, even though monetary policy and banking supervision are centred at the ECB and for large bank failures with the Single Resolution Board (IMF, 2018).

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² We are grateful to Diarmuid Murphy for comments.

³ Paul Fisher was Executive Director of Markets at the Bank of England from 2009 until 2014. However, the views expressed in this paper should not be attributed to the Bank of England now or then.

1 *Introduction*

A central bank is defined by its balance sheet⁴: it is the monopoly supplier of base money in the national currency. By use of its balance sheet a central bank can:

- a. set an interest rate for monetary policy, and/or control the money supply (and hence credit conditions);
- b. operate as the lender of last resort (LOLR);
- c. be the public issuer of bank notes.

Most modern central banks therefore have price stability (suitably defined) as a key objective, and bank note issuance and LOLR as key functions. This paper argues that the balance sheet can also be used as a tool to meet financial stability objectives, without prejudice to monetary objectives.

Although the main purpose of the paper is to establish that proposition, we need also to consider how efficient balance sheet instruments are as a means to create financial stability, whether they create counterproductive side effects or are otherwise limited in scope. At the same time, the financial crisis of 2008 has introduced a new set of unconventional monetary instruments. In what follows, we consider each in turn – starting with quantitative easing – in order to provide some guidance as to which balance sheet operations are best suited to the task of preserving financial stability.

To rationalise our proposition, we note that prudential regulation⁵ does not require the use of the central bank's balance sheet (as opposed to balance sheets of the commercial banks). Consequently, prudential regulators are not always located in the central bank. In fact, they are quite often located elsewhere, or at arm's-length to the central bank. However, the synergies between regulation and central bank operations mean that there are significant gains to be had from having them work closely together. Most central banks now have at least some degree of responsibility for financial stability and hence a strong interest in prudential regulation. That makes them well placed to carry out the kind of balance sheet policy operations we describe.

As a by-product, we detail how and why linkages between central banks and financial stability have recently grown. Even when a central bank does not have an explicit financial stability remit, it still has the ability to affect financial stability conditions by making particular choices about how it manages its balance sheet. We note that this does not require a trade-off with desired monetary policy positions for the range of instruments considered. Hence, being unencumbered in that respect, central bank balance sheet policies become a powerful tool for macro-prudential policy and preserving financial stability.

That said, central bank balance sheets have as yet not been recognised in the literature as a possible macro-prudential tool. For example, Claessens (2014), writing from the IMF, offers a categorisation of policy tools which would not easily accommodate central bank balance

⁴ Various references are given throughout this paper but a good overall source for understanding the scope of a central bank balance sheet is Rule (2015).

⁵ We differentiate between prudential regulation – principally of capital and liquidity – and conduct regulation, which is almost always undertaken by a regulator that is independent of the central bank, as it requires different skill sets and resources, and follows orthogonal objectives.

sheet operations. A word search on a recent, near 400-page BIS volume on the topic (BIS 2017) does not reveal any mention of central bank balance sheets. And a recent Bank of England (2018) consultation paper on the future of its balance sheet does not talk about either financial stability or macro-prudential policy - although it does touch on many other issues covered in this paper. Instead, across these various publications, the discussion has been about how liquidity regulations affect the central bank balance sheet and monetary policy operations, instead of the objective here which is to turn the causality around and ask how the balance sheet could be used as an instrument macro-prudential policy. That distinction has become more salient as a result of quantitative easing.

Greenwood et al (2016) argue that central banks could issue credit-risk free short-term paper in large scale to fund themselves, and thereby squeeze out short-term wholesale market funding by commercial banks. That is an interesting example of the general propositions in this paper, but is not considered further. Instead we focus on the other (neglected) side of the story in this paper: the impact of other prudential policy choices in this context.

1.1 Quantitative Easing as an example:

Starting with the Great Financial Crisis (GFC) in 2008/09, many central bank balance sheets have expanded by orders-of-magnitude (Charts 1 and 2). This is most easily explained away as a consequence of short-term nominal interest rates having approached zero and central banks then deciding to loosen monetary policy further by expanding the narrow monetary base directly⁶. This process is usually called 'Quantitative Easing' (QE), although in its purest form it was simply a text book expansion of the money supply.

Initially, QE was seen as a means to stem the financial crisis of 2008-09 which had severely damaged the real side of the economy, as well as financial stability, in many countries. But, after stemming the initial crisis, the aim was to try to prevent deflation and simultaneously support the recovery. Subsequently there were knock-on effects of the financial crisis, for example the Greek financial collapse and euro-zone debt. In this paper we do not address the efficacy of those expansions in terms of reaching their objectives, but address instead the use of central bank balance sheets in the future given recent developments in prudential regulation and financial stability.

In 2018, the economic cycle has reached a stage when policy-determined interest rates are rising in the US and the UK, and balance sheet considerations – in the US, UK and in the euro area – relate to whether, when and how they should be 'normalized'. That includes how the QE expansions should be unwound. However monetary and financial conditions have changed since 2006 and it may no longer be appropriate to take central bank balance sheets back to where they were pre-crisis. This paper therefore sets out how the regulatory changes – most notably prudential regulations on liquidity – may mean that central bank balance sheets, even if they are unwound somewhat, could remain substantially larger than pre-crisis levels. That would provide new opportunities for influencing financial stability.

It is likely that the primary consideration for any QE unwinding will be monetary, that being the paramount objective in the mandate of most advanced economy central banks. But the monetary question can be expressed as the optimal size of balance sheet; that is the level of

⁶ Jeanne and Svensson (2007) is an example of possible tactics for how to avoid deflation when at the zero bound.

money supply consistent with the desired level of policy interest rates. However, even for a balance sheet of a particular size there are many attendant options, including how to maintain that level, which do not primarily have monetary objectives. We find that the distribution of assets or liabilities in the balance sheet may be as important as its size. Hence there are also decisions to be made which do not affect the price or quantity of base money, but are nonetheless important for financial stability.

This paper operates as follows. In Section 2 we look at the component parts of the central bank's balance sheet, and how they interact with the new prudential requirements for liquidity and capital, in order to show how central bank operations can affect financial stability. We start with the liabilities side, as that best explains the impact a central bank can have. In Section 3 we look at the asset side where most of the operational choices are made. We begin by defining the optimal size of the balance sheet; then move on to asset-side operations which deliver the required scale. Section 4 then turns to market functioning issues, including the 'Market Maker of Last Resort' function that proved so important in some jurisdictions in the recent crisis. Section 5 shows how operational decisions can usefully be varied when moving between financial stability (normal times) and instability (crisis times). Section 6 concludes with the overall policy lessons learned.

2 Central bank liabilities

Central bank balance sheets are typically similar across countries in certain key features, but often with important and substantial variations between them in other aspects.

The liability side of the central bank balance sheet is the focus for monetary policy. The two main components are bank notes and 'reserve accounts' held by commercial banks. Reserve accounts are simply a commercial bank's deposits held at the central bank in domestic currency. These two components make up base or 'central bank money'.⁷

Commercial banks are the main counterparties of the central bank. While commercial banks can bank with each other, ultimately some must hold accounts with the central bank in order to obtain supplies of bank notes and to clear payments between themselves. The clearing takes place across the reserve accounts. So it would be unusual for a large deposit-taking bank not to have its own central bank account. Other financial institutions may also have deposit facilities at the central bank: The Bank of England recently opened up facilities for central clearing counterparties and for major investment firms (commonly known as investment banks although, since they do not take deposits, they are not authorised banks)

2.1 Notes and Coins

Coins are not normally issued by the central bank. In the UK they are issued by the Royal Mint and must be bought by the commercial banks from the Mint. Although they perform the same economic functions as notes, their stock is small in value terms. In this paper we refer to both notes and coins as 'cash' but otherwise ignore coins.

⁷ A good description of central bank operations in the euro zone may be found in Mercier and Papadia (2011) and for the UK in Bank of England (2015) and associated publications on the Bank's web site. For the US, see the Federal Reserve System website at: <https://www.federalreserve.gov/monetarypolicy/policytools.htm>.

Deposit-taking commercial banks need cash to supply to their customers, whether individuals or corporates (retailers). Banknotes ('notes') are usually supplied by the central bank to those commercial banks on demand in exchange for payment taken from their reserve accounts. Because the stock of notes is determined in a relatively predictable way by the demand for them in private sector transactions, this paper takes the stock of notes as given – but notes that the future demand for physical cash may be uncertain in the light of competing electronic payments systems (Judson, 2017).

2.2 Commercial Bank Reserves

This paper mostly concerns itself with the other liability of a central bank – commercial bank reserve balances. The demand for such reserves used to be small, predictable and relatively uninteresting except insofar as it was the primary mechanism used by most central banks to set a policy interest rate. But, for reasons explained below, the demand for reserve balances has increased dramatically since then. The question now is whether and how a central bank should meet that increased demand.

In many central bank operating models, one can formally distinguish between 'required' and 'excess' reserve balances depending on the particular framework. That distinction is unimportant in this paper *unless* the rate of remuneration on excess reserves differs from that on required reserves – which it does in some jurisdictions [such as the euro area today, or in the US before 2007]. Such a split introduces an unnecessary extra degree of monetary policy complication. But in principle the original justification for minimum reserves as a prudential requirement has now been supplanted by new liquidity regulations to which we now turn.

2.3 The interaction of central bank liabilities with the new prudential regime

Since the GFC, the international Basel III regime for prudential supervision has set much higher liquidity requirements for banks⁸ than previously. The Liquidity Coverage Ratio (LCR) is almost entirely in place, while the Net Stable Funding Ratio (NSFR) is still in a transition phase internationally. Detailed descriptions can be found in documentation from the Basel Committee on Banking Supervision (BCBS)⁹. The point to note is that both the LCR and NSFR link the assets and liability sides of the balance sheet – but set minimum requirements for the opposite sides. Broadly speaking, the LCR specifies a minimum level of liquid assets that must be held in order to meet potential outflows of liabilities, given how a bank has funded itself. These must be High Quality Liquid Assets (HQLA), as officially defined. In contrast, the NSFR specifies a minimum level of stable term funding for any illiquid assets held in case the latter cannot be sold. For the NSFR to be calculated, assets are weighted by duration and/or liquidity characteristics. The NSFR is being implemented for European entities, but it is not yet clear whether or when it might be implemented for US entities.

In this paper we argue that both LCR and NSFR have created upwards pressure on central bank balance sheets and that that has created new policy opportunities.

Another key prudential development is the leverage ratio. In the Basel regime, capital requirements have generally been set by referencing a risk-weighted evaluation of a bank's

⁸ Liquidity requirements for other institutions have also been tightened e.g. Solvency II for European insurance companies.

⁹ See for example BCBS (2018a, 2018b) for calculating the LCR and NSFR respectively, and (2017) for the Leverage Ratio.

assets. In contrast, the leverage ratio takes an unweighted value of those assets relative to capital held. In general, risk-weighted requirements discourage large holdings of risky assets whereas the leverage ratio discourages the holding of very large volumes of relatively safe assets such as repo and other short-term expansions of a bank's balance sheet.

The market consequences of these changes, together with the new risk-weighted capital requirements, are still being played out (see CGFS¹⁰, 2016 for a detailed discussion). On the one hand, banks are now safer because they hold more capital and liquidity. On the other, credit risk charges mean that the unsecured inter-bank lending markets have shrunk in importance, while secured markets are steady but have not expanded sufficiently to fill the gap (in part because of the leverage ratio constraint). Market making for securities has therefore diminished (especially for illiquid securities) as it is no longer cost-effective for banks to use their balance sheets to support clients in that way. These market changes are important for the issues discussed in this paper, in part because they mean that banks have become less able to manage their reserve accounts by lending to, or borrowing from, another bank. That creates a need and scope for policy interventions.

The effect of regulatory changes on banks implies that their role as intermediaries has become more limited compared to before the GFC. That, in turn, means that other firms are growing in importance to fill the gap. Just a few examples: tech companies which are becoming involved in payments; hedge funds which sometimes engage in market making; and peer-to-peer lenders.

In time, this change in market structure may mean that central banks will try to widen their choice of counterparties and the scope of regulation on systemic grounds. Some extensions in that direction have already been made. Access to the central bank balance sheet is one of the operational choices that we consider in this paper. But we start by concentrating on the commercial banks, defined here as authorised deposit takers (so that it includes UK building societies for example).

Reserve accounts at the central bank are the highest quality and most liquid asset a commercial bank can hold. Pre-GFC, the main use of such accounts was to meet fluctuations in routine payments between banks - which were cleared and then settled across their reserve accounts. In developed economies, settlement is usually via a Real-Time Gross Settlement System (RTGS). That use of central bank accounts remains important. In the UK, the pre-GFC payments system operated in a tiered fashion – only larger commercial banks were allowed to hold reserve accounts, with smaller banks operating their banking via the 'clearers'. And some medium-sized banks chose not have a reserve account. But where small banks bank with larger banks, financial stability concerns arise because this system increases interconnectedness. As a result, the Bank of England's rules were relaxed in 2010 so that smaller banks could hold reserve accounts. The number of reserve account holders has risen from around 50 to just under 200 since (Chart 3).

Minimum reserve requirements can also be used as a potential tool to make a bank hold a specified level of liquidity. But implementation of the LCR rule has probably made any such

¹⁰ Committee on the Global Financial System (CGFS) is one of the various BIS-hosted committees reporting to central bank governors. Fisher was a member of CGFS from 2009-2014.

considerations redundant. A case for retaining required reserves can also be made since the HQLA definitions have been relaxed somewhat since their original conception (see BIS 2013). But it would be awkward for a central bank to maintain its own liquidity regime in competition with that decided by the Basel Committee and implemented by national laws and regulations.

On the other hand, reserve account balances do count as HQLA¹¹. But we do not yet know empirically what proportion of their requirements commercial banks will wish to hold in that form, in part because that choice has been obscured by QE which makes teasing out what scope there is for possible macro-prudential policy instruments difficult.

2.4 Quantitative Easing

QE takes the form of a direct injection of base money into the system by a central bank that buys other financial assets outright and on a large scale. Pre-GFC, relatively small-scale purchases of securities in this way were a routine part of central bank open market operations, alongside reverse repo transactions, and used to control the monetary base.

The impact of QE, by contrast, depends crucially on what assets are bought. In the UK the vast majority of QE was purchases of UK government debt (gilts). Gilts are also HQLA but had not previously been held in large quantities by commercial banks. QE was therefore an effective change because it allowed the Bank of England to maximise the ‘Portfolio Balance Effect’ (Joyce et al 2017).

In fact, expanding the money supply by outright purchases of assets affects the economy through many channels. These include downward pressure on longer term interest rates which affects investment spending and “big ticket” consumption; a wealth effect caused by rising asset prices which also affects consumption; and the stimulus from an (induced) lower exchange rate. The Portfolio Balance Effect is an additional channel in which QE removes some investment assets from the hands of the private sector, replacing them with money balances (extra liquidity). This drives a ‘search for yield’ as investors try to maintain rates of return by buying other riskier assets.

The portfolio balance effect is most powerful when the central bank buys low-risk assets that are, or would have been, held by the non-bank private sector, forcing the latter to hold other assets. Typically, the non-banks would hold riskier assets such as corporate bonds or equities (since money deposits would not generate a sufficient return, especially at a time of near-zero short-term interest rates). Thus QE can be effective because it helps drive down risk premia [by country, region or sector] as well as average market rates (see Gagnon et al 2011 for example).

But QE should not be expected to stimulate bank lending much if the banks are already struggling to meet capital and liquidity ratios and hence deleveraging. If a central bank were to buy assets that are only held directly by commercial banks it may not have any effect on the real economy at all in that context¹². The banks – unlike investment managers – may be happy to hold base money instead of the purchased assets, especially in a time of liquidity

¹¹ See BCBS 2018a, paras 49-54, for definitions of HQLA.

¹² It is possible that Japanese QE did not have much impact, in part because the Bank of Japan bought Japanese Government Bonds which were being held in large scale by the Japanese banks.

stress. At best, QE may stem any underlying contraction of lending whilst stabilising markets by supplying liquidity.

It is important to note however, that whether the portfolio balance effect is significant or not, the arithmetic consequence of increasing the supply of base money is that commercial banks are forced, collectively, to hold exactly that extra supply in their reserve accounts. In other words, if a central bank expands its balance sheet by buying assets, that necessarily creates an increase in its liabilities.

In practice the actual mechanism is that, when a central bank buys assets, it supplies base money in exchange by crediting someone's reserve account. That extra base money must then be held by the private sector – and ultimately in the form of commercial bank reserve balances (unless it is converted into notes). This mechanism is just an automatic consequence of expanding the money supply; it does not depend on any behavioural decisions. So the behavioural dimension is important in terms of the distribution, not the level. Any individual commercial bank could choose to reduce its own level of reserves by lending them on; that would normally be expected to boost the impact of QE. But the banking system collectively cannot shed its excess reserves - except insofar as they decide to switch between reserves and bank notes, which is unlikely.

One indicator that reserve balances are held in excess is when there is no demand at all to borrow in the central bank's normal (routine) reserve supplying operations and competing to lend the reserves they have. Interestingly, and sadly from the point of view of supporting a recovery, apart from a few isolated end-period frictions¹³, we do not appear to have observed banks trying to shed their expanded reserves balances by actively attempting to lend them on.

But there is a largely unremarked positive consequence for the banks from this process. By massively expanding reserve balances which count as HQLA - it has almost certainly become much easier for commercial banks to collectively meet their LCR requirements and possibly their NSFRs. Individually they would have needed to compete to get 'their' share of deposits created by QE; but there have been plenty of deposits to go around.

The reason why this effect is only 'almost' certain is that it depends on the precise channel through which banks receive their reserves from their customers or other funders. That is because potential outflows could also rise, offsetting the benefit to the LCR. For example, retail deposits are treated by the LCR as 'sticky' and hence do not require matching HQLA. Similarly, if banks were able to issue more term debt, that would count as term funding until it neared maturity. Both would also count as stable funding for their NSFR. But if the consequence of QE were to be a rise in corporate deposits or deposits by non-bank financial firms, that would then leave the net effect on the LCR as zero. Equally, the effect on the NSFR also depends on the nature and term of the funding obtained.

¹³ Balance sheets are reported at quarter and year ends. The leverage ratio and some taxes are also calculated on such reporting dates. That has led to market consequences – such as highly negative overnight rates - as some banks reduce their balance sheets at end-periods.

The fact that QE occurred just before liquidity regulations were starting to tighten is not a coincidence in the sense that both reflect the consequences of the GFC. But the policy choices were in some cases made by different bodies and, at least when the regulations were initially being developed, independently. Once the full implications of the original regulatory design became clear, central bank governors and national legislators started to make corrective changes to offset some of the more extreme implications – for example allowing proportions of undeniably less liquid assets to count towards HQLA.

In summary, the new liquidity regulations increased the demand for HQLA and hence central bank reserve balances. Alongside the increase in requirements, the supply of reserves was independently increased so that the extra demand was more than met although part of the impact of QE on regulatory metrics would have been offset by short-term deposits arriving at commercial banks through wholesale or corporate channels.

2.5 QE in the future

In the UK, US, Japan and Europe, QE was undertaken when policy interest rates had fallen to near-zero, or in some cases below zero. Looking forward to the situation where interest rates have risen significantly (as they have done in the US), the yield curve is likely to have a stronger upward slope. It is then possible that banks will decide they would prefer to hold assets with higher rates of return than reserve balances. And the obvious way to earn higher rates of return is to take the credit risk, liquidity risk or interest-rate risks associated with longer-dated assets. But given the balance of risks, commercial banks may well decide that they would prefer to continue to hold their HQLA, as much as possible, in the form of reserve accounts at the central bank. Ultimately, this will be something that we can observe directly. In the US, the Fed Funds rate has already reached 2%, but as yet there is little evidence of banks individually trying to shed their reserves.

Hence, given the LCR, the demand for reserve accounts is likely to remain very much higher than pre-crisis levels, which were principally determined by the necessary payments buffers. As an example, the level of reserves created by, and held at, the Bank of England has risen from under £20bn in 2006, to nearly £40bn in late 2008, and to £300bn in 2014; and, further boosted by the Term Funding Scheme (TFS) in 2018, to just under £500bn¹⁴: Chart 1. For most of the crisis period, this clearly exceeded demand since the commercial banks stopped borrowing from routine sterling liquidity supply operations. But not so now. Commercial banks are currently¹⁵ borrowing around £6bn from the Bank; a small quantity, but not zero. That amount had reached around £25bn in 2016 before being effectively displaced by the TFS (of which more later).

So either there has been a problem for some banks attracting a sufficient share of funding in the market; or collectively, at current interest rates, the commercial banks are content to hold an order of magnitude more in their reserve accounts than 10 years earlier. We cannot be sure, from the outside, which of the two applies. We suggest probably both, on the basis of

¹⁴ £487bn as at 12 September 2018. But these numbers are subject to fluctuation as assets mature and are replaced.

Source: Bank of England Weekly Report.

¹⁵ Source: Bank of England Weekly Report, 12 September 2018.

another piece of evidence for that arises from the fact that large non-banks do not have access to the central bank's balance sheet. If banks had excess reserve balances, then short-term market rates would dip well below the policy rate. That happened for a while during the first few years of QE. But it is much less prevalent now, in any major jurisdiction.

Finally, to the extent that central banks do supply more reserves than they did previously, they have a number of choices to make about how to do so. We turn to those choices next.

3 *Central bank assets and their use in supplying liquidity*

Central banks can increase (decrease) the money supply, and hence reserve balances, by acquiring (shedding) assets. This process creates (destroys) central bank money by expanding (shrinking) both sides of their balance sheets. The obvious policy questions are then exactly how big the balance sheet should be, and which assets should be held. Different operational parameters and choices about the assets can yield the same level of monetary supply and/or interest rates, but may have quite different impacts on regulatory metrics and hence financial stability. We argue that those effects need to be recognised and the choices made proactively, preferably under a transparent financial stability remit currently missing from the statutes of some of the world's leading central banks: for example the ECB (see Mersch 2018).

3.1 *The optimal size of balance sheet*

The choice of the optimal size of the balance sheet is not a purely hypothetical issue: as of mid-2018, the US Federal Reserve, the ECB, the Bank of England (BoE) and even the Bank of Japan (BoJ) are all contemplating how much, and how quickly, to reduce the size of their asset holdings (BoE, 2018). Their public announcements suggest that it should be monetary policy that determines how much QE is unwound. That is certainly a requirement in the sense that reserves need to be at a level consistent with policy rates of interest: in theory, the money supply should be kept precisely in line with the demand for reserves at a given level of interest rates.

Pre-crisis the optimal size of the central bank balance sheet was seldom debated. Interest rates were set to target the price level and, at that rate, the level of notes that would be demanded and supplied. And given both those outcomes, then a level of reserves would be supplied to be consistent with the policy rate. In practice, that level of reserves was often forced by the use of reserve targets and penalty interest rates.

In principle, the optimal size of a central bank balance sheet could be calculated formally by adding the demand for cash and the demand for reserves (together with a number of other autonomous factors which are generally small). But that is likely to be difficult in practice because the interest elasticities of the demand for both cash and reserves have never been very well determined¹⁶. Econometric estimates for money demand equations have an unfortunate habit of breaking down as soon as one tries to rely on them for policy making (Goodhart's Law). But estimating such demand equations in this new era would be even harder than usual for the following reasons:

¹⁶ See, for one example, Grant et al (2004) and note the low elasticities and the broad confidence intervals. The discussion therein explains more about why such estimates are problematic.

- i. structural trends in the demand for cash, reflecting technology developments,
- ii. structural trends in the demand for reserves, reflecting prudential regulations and
- iii. the changing trends in the reserves data as a result of QE.

It is unlikely that empirical research will be able to generate estimates of the optimal balance sheet size until central banks return to more normal operations for a while and we have a consistent set of data at that level – which is unfortunate because it means we will only know the empirical answer once it is no longer a pressing question. Nevertheless, it is most likely, for the reasons given, that the level of reserve balances and the optimal balance sheet size will remain significantly higher than pre-GFC, even if the demand for cash by the public falls somewhat.

Second, it is also possible that the *precise* quantity of narrow money now no longer matters so much for setting monetary policy. In principle, any excess money balances ought to be inflationary. But very large expansions of the narrow money supply over the past 10 years, in many of the larger developed economies simultaneously, did not result in high inflation (although they may have warded off deflation). We have already partly explained why that would be the case – the extent to which the bank lending channel of QE was offset first via the GFC and then higher liquidity requirements. But there are two other considerations.

QE puts base money into circulation in place of the purchased assets. That is likely to be particularly powerful in a liquidity crisis when markets are dysfunctional and liquidity is precious. In such circumstances it may not be possible, easy or cheap to obtain base money in the market itself, even when offering to repo out the most liquid securities such as United States Treasury bills (USTs). The sustained peaks of dysfunction were in 2008-9 after the collapse of Lehman Brothers and AIG, and then again in 2011-12 as the Euro-zone crisis unfolded (Fisher 2012). It is not a coincidence that these were exactly the periods when the BoE was undertaking most of its QE – and also consistent with their undertaking a bit more QE after the Brexit referendum, as an insurance policy. In the US, some markets also had to adapt to the negative impact on market-making liquidity of the Dodd-Frank regulations so QE may have had a more prolonged effect.

As market conditions have settled down since the worst of the crisis, it is likely that the effect of UK QE on financial markets has diminished considerably – although no reliable or precise quantification is available to prove it. It is also possible that the continuing stretches of QE in the US and euro area have become increasingly ineffective as market functioning has improved¹⁷. The improvement in market functioning, albeit not back to unsustainable pre-GFC conditions, gives a *prima facie* reason to suggest that the sale/maturity of QE assets will not have an equal and opposite effect to their purchase during a crisis period.

A second reason for the weakening of monetary imperatives is the assertion that monetary policy should only have a short run or second-order effect on real outcomes. It is quite likely that real interest rates today are being driven mostly by real factors, in particular by sluggish productivity growth in the developed world, not by monetary policy. If QE unwinds slowly,

¹⁷ See the QE fatigue argument in Hughes Hallett (2017). There are a number of reasons to expect QE fatigue to set in.

perhaps by allowing assets to roll off as they mature¹⁸, then that is unlikely to have a big independent impact on real interest rates.

Overall, the monetary case for tightening by reducing balance sheet size may not be strong. And at this stage, one might reasonably think that a wide range of reserves balances is consistent with any particular policy rate of interest. In consequence, the financial stability implications of balance sheet size could be relatively more important: the supply of narrow money will affect the ease with which banks acquire their HQLA quotas needed to meet their LCR requirements.

Thus the actual size of central bank balance sheets will probably need to be determined by trial (and possibly error). If QE is unwound and banks see their HQLA shrinking too far, one can expect some strong signals back from the market as the price of liquidity starts to rise – bidding up for deposits for example. To the extent that this is consistent with the intentions of monetary policy, it would not cause a problem. But if the monetary base is reduced too far then it could lead to volatile and/or excessive changes in market interest rates as banks struggle to meet their regulatory metrics.

3.2 Excess cash or shortage, and the ability to influence market rates

A framework decision for a central bank, in normal times or crisis, is whether to operate with an ex ante excess of liquidity, or a shortage. At the margin, moving from one to the other simply requires a slightly larger or smaller balance sheet. The main consequence is whether the central bank ends up supplying or draining liquidity in order to adjust to the ‘right’ level.

Direct asset purchases have long been a normal part of the tool kit to adjust the underlying size of the central bank balance sheet: Open market operations (OMOs) can conventionally take the form either of outright purchases/sales or collateralised lending/deposit facilities. Most common, at least pre-GFC, was for the major central banks to operate their balance sheets in such a way as to maintain a general but small ex ante shortage of base money on a regular basis – which they would then offset by routine lending operations to meet the demand for reserves exactly¹⁹. The shortest-term operations were generally undertaken at the policy rate so that market interest rates are set, or at least strongly influenced, by the policy rate. Any longer-term loans or deposits would usually be conducted via an auction so that the price for term liquidity is market-determined and no signals are sent about future policy decisions.

Under this shortage approach, in order to force a precise, known quantity for reserves, commercial banks might be required to meet targets for the level of their reserve accounts, at least during a ‘reserve maintenance period’, typically between rate-setting meetings. Once the target level of reserves is known, any shortage can be estimated and supplied by routine lending operations, subject to a few small ‘autonomous factors’ – defined as other, usually banking flows across the central bank balance sheet.

¹⁸ That is the publicly stated policy for a number of the purchase operations undertaken by the ECB for example. One reason being that selling large quantities of less liquid assets would likely cause severe disruption to those markets.

¹⁹ Alternatively, one could operate by buying short-term bills at close to the policy rate, rather than making short-term loans. This distinction is not significant for this paper.

More generally, a wide variety of related operating procedures is possible. For example, some central banks operate in the markets every day (e.g. Sweden) and others once a week (e.g. Bank of England, ECB).

It is also possible to operate routinely with a general level of excess liquidity. For example, Botswana is a country where this has been appropriate, and although a small economy, it is worth explaining why. Botswana has a high level of foreign exchange earnings, largely from the government's share of the proceeds from the diamond industry, and it targets a composite²⁰ exchange rate as its nominal anchor. A proportion of those foreign currency earnings are converted into domestic currency to help meet government expenditure needs and that process leads to an excess supply of domestic liquidity. To prevent the risk that excess liquidity becomes inflationary, the central bank drains liquidity through a deposit facility which also enables the central bank to set a base interest rate. This is a perfectly reasonable way of operating, for both government and central bank. It also illustrates the fact that monetary and fiscal regimes can naturally interact with each other to affect the amount of liquidity in the system (if allowed to²¹).

A hybrid, interim approach combining an ex ante excess supply, within a system designed for a shortage, is also possible. When operating with a shortage, it is normal for the central bank to offer only as much liquidity as is needed for the system as a whole and for banks to bid for their share. If necessary, the banks must then trade between themselves so that each and every firm's requirements are met. But in a crisis, when the inter-bank market may not be functioning, this approach is problematic. An unlimited amount can then be offered in a central bank's normal operations with 'full allotment' (i.e. every bidder gets exactly the cash they need at the pre-determined rate). This was the approach of the ECB in 2007 when the first signs of crisis appeared.

The choice of shortage or excess becomes important especially when combined with other operational choices, which we take in turn.

3.3 Corridor or floor system for interest rates

Although central banks can set a policy rate to influence market interest rates, in a market-based economy they can never be sure that market rates will follow the policy rate precisely, even for very short-term rates. So arrangements are made to try to guide market interest rates to stay close to the policy rate (Fisher, 2011). Maximum and minimum rates can then be set to define a 'corridor' around the policy rate to limit volatility. These rates can be set by offering special facilities for commercial banks to borrow or deposit overnight, such that there is never an incentive for commercial banks to operate overnight at market rates above or below the corridor.

When conducting QE, with very substantial excess base money being created by the authorities, most central banks elected to switch to a 'floor' system for rates, rather than a corridor. There was so much excess base money that rates were quite likely to fall below the

²⁰ That is, it targets a weighted average of the currency values of its main trading and investment partners.

²¹ Under the Lisbon Treaty, monetary financing of government expenditure is illegal in the EU. And this has meant that government decisions are not allowed to have a big influence on the central bank balance sheet. In practice, in the UK, cash management is undertaken by the Debt Management Office and only small balances are held directly at the BoE.

policy rate and were very unlikely to rise above it. In such a world, a minimum rate on all deposits at the intended policy rate can help ensure market rates behave in line with policy intentions²². At the ECB, this had the effect that the marginal deposit rate became the *de facto* policy rate, displacing the higher main weekly refinancing rate at which the ECB offered to lend reserves. At the Bank of England, its reserve targets were suspended. At the FOMC, they asked for the law to be changed so that they could pay interest on ‘excess’ reserves and help retain some degree of control.

In normal times, central banks can decide which of these operating systems they prefer to use. If the demand for reserves remains high because of liquidity requirements, then short rates should stay close to the policy rate. That is because the requirements set a minimum not a maximum or an optimum: for tactical reasons most firms would hold plenty of excess HQLA over their LCR in order to avoid the regulatory consequences of falling below it. These internal buffers mean that banks would not be constrained to go into the market to borrow immediately when faced with an unanticipated outflow – as was required when reserve balances were targeted exactly. Nor would commercial banks lend in the market at less than the policy rate, if they can earn the policy rate without limit on their reserve balances.

This situation has been reinforced by an apparent shrinkage of the unsecured inter-bank market²³ relative to pre-GFC, in which commercial banks used to trade in order to shuffle reserve balances between themselves.

This choice of corridor or floor system ties in neatly with that of operating with a shortage or excess demand for reserves. Central banks creating an excess will naturally find that the floor system is a more appropriate choice, in which draining could be automated by paying interest on any level of reserves.

3.4 Access to the central bank balance sheet

If central banks allow LCRs to be met principally by reserves, possibly with a default ex ante excess, then their balance sheets will remain expanded; in which case complicated rate-setting systems would neither be necessary, nor would they appear very attractive. A continuation of operating with excess base money and a simple floor system for interest rates would probably work well to guide market rates closely to the policy rate.

Such a simple floor system does raise other challenges however. If procedures are chosen that require a central bank to be precise about the quantity of reserves, then it has to take account of any autonomous factors which wash over its balance sheet on a daily basis e.g. deposits by non-banks such as government entities. Under a shortage system, any source of fluctuation in domestic currency needs to be tightly monitored and controlled so that the shortage is precisely known. Access to the central bank balance sheet – including by

²² Technically, if there are large holders of cash who do not have central bank accounts or cannot receive interest on those accounts, then market rates can fall below the floor whatever the system. This was an issue in the US, where some important market players, such as the Federal Home Loan banks, have reserve accounts at the Fed, but were and are banned from receiving interest on them. It was a particular problem with their new deposit facilities for draining excess cash, and arrangements had to be introduced to work around this.

²³ Formal reporting of volumes in the unsecured money markets for sterling and euro only commenced in the past few years and insufficient data are available as yet to confirm this trend. The comment is based on anecdotal evidence from market participants.

government accounts for example - is a potential disturbance (autonomous factor) and such access is strictly curtailed.

A simple floor system relaxes the technical necessity for the central bank to choose a target value for the precise aggregate amount of reserves they wish to see held by the banks. Instead the market can be left to decide. The central bank can discover whether it has supplied approximately the right amount of reserves by observing the market rates that emerge. If it wishes, it could even vary its balance sheet to see how sensitive demand really was – this being a ‘repeat game’ in real time.

A corollary of this arrangement, and possibly an unwelcome one, is that central banks may find themselves under pressure to take deposits from, or lend to, a wider variety of institutions. Given a context in which non-banks have become more influential in providing intermediary services and/or become a systemic risk, this could become an important consideration. No longer would a simple cry of ‘monetary policy’ allow a central bank to deny such proposals, and the pressure for change could become uncomfortable. A new policy approach could be needed to determine exactly what systemic risks the central bank balance sheet could and should be asked to mitigate, or what economic benefits an active use of the balance sheet could bring. Answering such questions would then determine what size the balance sheet should be.

3.5 The optimal composition of balance sheet assets

We have argued that, even if monetary policy remains the principal determinant of the size of the balance sheet,²⁴ that choice will affect financial stability. A large balance sheet would facilitate HQLA requirements being met by reserves. A smaller balance sheet might force commercial banks to buy more HQLA in the market. But the size of the balance sheet is not the only parameter affecting the outcome for liquid asset holdings and funding ratios. *Asset composition* is perhaps even more important.

To illustrate this point, we take the BoE as an example. As of now, it could continue to hold a large portfolio of gilts to maintain reserves at a high level²⁵. Gilts are HQLA. If the BoE sold some of its gilt portfolio, reducing reserves supplied and hence its balance sheet, the total quantity of HQLA in the market would be unchanged. But if commercial banks then ended up holding large portfolios of gilts or other long-dated liquid assets instead of reserve balances, that would increase the market risk on their balance sheets. And that, in turn, could add to the risk of financial instability in the system. This is unlikely to be a desirable outcome for either the central bank or the firms. Alternatively, commercial banks could optimise risk vs return across all the HQLA available which would likely make them want to hold credit assets (loans), or other short-term liquid securities, rather than gilts. So simply swapping gilts for cash is unlikely to have much effect in practice. But other choices could.

²⁴ A central bank may provide services to a range of customers, including other central banks, and the size of such activities can clearly affect the balance sheet.

²⁵ Technically the BoE’s QE gilts are held off balance sheet in a special purpose vehicle (SPV). On the balance sheet is a loan to the SPV to finance those purchases. This is done for accounting and risk purposes, but it does not affect the economic outcomes.

One alternative for the BoE is to keep the size of its balance sheet unchanged, but alter the composition of the assets purchased. Suppose that the BoE replaced its gilt portfolio with a portfolio of purchased illiquid assets which were all non-HQLA: leading to portfolios of loans (**credit easing** rather than just monetary easing). That would be equivalent to an injection of HQLA – hence liquidity - into the system. This could potentially be a powerful policy tool.

There are other options. Suppose the BoE sold all its QE assets and carried out large scale lending operations instead. That would maintain its balance sheet/reserve balances in place and hence HQLA at a similar level. But the impact on the commercial banks would depend on what parameters are set in or by those lending operations (price, term, collateral). In general, relying on short-term funding from the central bank, on a large scale, could represent a significant replacement risk to the individual institutions that would have to continually re-bid for their needs even while market conditions were changing. The funding that commercial banks receive indirectly as a result of sustained central bank asset purchases is in practice likely to change slowly and hence be more predictable for them, than funds supplied by large scale lending operations.

From the central bank's perspective, it is also unlikely to want to have routine short-term lending operations on very large scale since that would be resource intensive and give them operational risk. Maintaining an expanded balance sheet mostly through outright purchases would appear to be a more comfortable outcome operationally for both sides.

There are, however, also risk issues associated with purchases of large quantities of assets. Buying government bonds can be thought of as a (private sector) credit risk-free strategy for a central bank; but it does not leave the central bank completely free of risk. First it ties the central bank to uncertain fiscal outcomes which may affect future borrowing conditions. And if a serious possibility of government default does emerge then wider considerations apply which would include risks to central bank independence. Buying government bonds also implies a once-off monetary financing of government expenditure. There is also the interest rate risk on any portfolio of longer-term securities: that led the BoE to get a government indemnity for its QE portfolio, given that it holds a relatively small amount of free capital and reserves itself²⁶.

Next, if private sector securities are bought, there is, in addition, credit risk. A government indemnity or other form of capital support could help with that too; but one can also expect the government to (quite reasonably) think it should have some influence over what is bought, if it is bearing the risk. Then there will be pressures by different interest groups for the central bank to buy 'their' preferred assets. Buying some assets and not others will have an impact on relative spreads and the allocation of capital in the economy. That could be useful as a form of industrial or sectoral policy. But it also carries the risk of re-politicising the central bank's monetary policy: to support "Zombie" firms, create distortions and the danger of being stuck with an inappropriate portfolio as circumstances change.

²⁶ During 2018 it was announced that agreement had been reached on a mechanism to automatically supply the BoE with extra capital if necessary (HMT 2018) so this particular constraint on its operations may have been mitigated somewhat. Nevertheless the BoE will always be reluctant to risk losing public money.

In response to these various pressures, a central bank's defence might be to 'buy the market' in an attempt to avoid distortionary allocations of capital.

In sum, buying large quantities of private sector assets outright in normal times is not a very attractive proposition. The one obvious exception is the ECB, where political constraints and the absence of a fiscal union in the EU make it harder to buy sovereign debt, especially given the varying credit risk across different EU member states. The ECB might therefore have a preference to buy private assets, especially in disadvantaged areas or sectors (but it chooses instead to buy the private market in a neutral way).

3.5 Collateral policy

To the extent that the central bank chooses to use lending (or draining) operations, then the policy question becomes what collateral it should accept or place. By changing eligibility of less liquid collateral, a central bank can influence commercial banks' liquidity metrics. Such a policy of 'Eligibility Easing', seen by some as a variant of credit easing, has been suggested by Huertas (2018). It reflects what some central banks actually did in the crisis.

If the central bank takes non-HQLA as collateral as the ECB does at the margin, then it offers a very powerful liquidity transformation that would directly impact the LCR measures. Most central banks would be wary of doing that in any size for at least two reasons: First because of the increased contingent credit risk and interest rate risk. The use of appropriate haircuts could equalize the risk to the central bank to a large degree, although the haircuts can become both large and difficult to calculate correctly given the uncertainty of future financial events.

A downside of high haircuts for very illiquid collateral is that the larger the haircut, the more conservative it needs to be to ensure protection and so less support is offered. Against that, collateral which is completely illiquid in the market has virtually no opportunity cost for the commercial bank. So haircuts will not deter commercial banks from trying to utilise as much illiquid but eligible collateral as they can in order to get more HQLA in return.

A second consequence of a very broad definition of collateral eligibility (in normal times) is that commercial banks would then be less independently liquid and less resilient than they appeared. It would also be likely to distort markets by reducing illiquidity premia and hence price differentials between those assets that were both eligible and traded, whilst increasing demand for and supply of them. The central bank would then be encouraging growth in markets that only exist on account of their own collateral policy. Some might argue that this would be a positive outcome. But unless done to offset some other externality, it becomes a market distortion.

The BoE at least, saw this coming. It introduced unique operations for lending against illiquid collateral, in which it defines three different collateral sets with varying liquidity characteristics against which different prices and quantities can be lent. Index-Linked Term Repo operations (Fisher, 2011) are conducted in which any of the three collateral sets can be used, with different bid prices allowed. Greater quantities are offered by the BoE automatically for less liquid collateral, as commercial banks bid up the price to use it. This was based on a design by Klemperer (2008, 2016). It is technically complex to implement but has

functioned reasonably well in the period since it was established in 2010 (albeit that the demand for extra reserves has been low because of QE).

In contrast, the ECB is currently offering to lend in full allotment operations against a very broad collateral set, including some non-HQLA (with the risks being born by the National Central Banks). The ECB's collateral policy was originally determined by the need to treat all the euro area countries equally (Mercier and Papadia 2011). That resulted in a very broad eligibility regime, much which was relatively illiquid – or would have been if it were not eligible (a degree of liquidity being endogenous to central bank acceptability). Emergency measures have expanded the eligibility definition even further.

Now that more normal conditions have returned, the ECB needs to consider whether it wishes to retain such a broad collateral set as part of the “new normal”. The pressure to use the least liquid collateral in ECB operations will intensify if and when the ECB reduces its supply of reserves.

3.6 Term structures

A further dimension of balance sheet choice is the maturity or term of the central bank operations. First, consider outright purchases. These are neither permanent since assets are generally fixed maturity and can be sold at any point; nor is the stock held time-limited since maturing assets can always be replaced/refinanced. But, in general, swapping cash for term securities shortens the maturity of the portfolio of assets in the system and flattens the yield curve. Thus the longer the maturity, the bigger the impact.

Second, consider the central bank's lending operations. To the extent that central banks choose to lend or drain, they can do so at a range of maturities. The target interest rate for monetary policy is usually short-term; that is, until the next policy meeting.²⁷ To facilitate that, at least some portion of operations will need to be offered at very short maturities – daily and/or weekly. But short-term operations (unless fully allotted at the policy rate) are an unpredictable source of liquidity (draining) for commercial banks. Relying on short-term auctions in large scale would therefore create liquidity risk. And very large operations may increase operational risk for both central banks and their counterparties. So, typically, a portion of longer-term operations – maybe up to 12 months - are used in part to reduce the turnover in the short-term operations in order to make the latter more manageable and the supply of reserves more predictable for individual banks.

As an example to make the point, both the ECB and the BoE have engaged in multi-year loans as a crisis measure and help support their real economies. The BoE's latest Term Funding Scheme (TFS) lent over £125bn for up to 4 years²⁸. Unlike its predecessor, the Funding for Lending Scheme (FLS), the TFS lends cash (FLS lent 9-month Treasury Bills²⁹). So the TFS scheme directly increased the level of reserve balances. But the FLS did not.

²⁷ Technically any point on the yield curve, or the slope of the yield curve, could be the policy target. The Swiss National Bank targets 3-month Swiss Franc Libor rates.

²⁸ £126.4bn as at 12 September 2018. Source: Bank of England website.

²⁹ The FLS was essentially a collateral swap and therefore off balance sheet. TFS is a collateralised loan and therefore on balance sheet.

Liabilities of over 12 months' maturity are very useful to the banking system in that they represent stable funding which helps meet NSFR requirements whilst supplying cash which can be held to help meet HQLA. But by making cheap funding available to all banks at the same fixed price, these schemes also depress competition in the banking market. That is to say, prices can become determined by, or consistent with, the central bank's desired policy rate, rather than at a price determined ex-post (and endogenously) after banks have competed for the loans they want or need.

Within the banking sector, it is clear from published statistics that the FLS boosted the smaller, growing challenger banks, whereas the TFS appears to have been used more by the larger banks. Be that as it may, as those measures mature, all banks will have to replace their term funding in the market. That could help push up longer-term rates, albeit at a time when the authorities are likely to tighten anyway.

Will central banks be tempted to lend at longer than 12 months to help meet NSFR needs? That seems unlikely, absent a crisis. There are political economy arguments which arise if the central bank ended up providing extensive term funding directly to commercial banks. For example, it can have unpredictable effects on competition as some inevitably benefit more than others (as seen in FLS vs. TFS). If the banks end up over-lending – e.g. to the housing market – then the central bank may take the blame. And if a bank over-extends itself using central bank funds, will the central bank be under more pressure to bail it out? There is more credit (and possibly thereby fiscal) risk associated with longer-term funding. Arguably, providing more extensive funding is akin to part-nationalising the banking system.

The Bank of England has already announced the prospective closure of the TFS and the ECB has closed its version, the TLTROs, to new operations. But, given the political economy arguments that could be levelled at outright QE purchases, one cannot exclude term funding operations entirely, at least as a crisis measure.

3.7 Leverage ratio considerations

Central bank operations can also affect a commercial bank's capital requirements. Reserve balances are generally zero-weighted on a risk basis, so changes in reserves have no impact on risk-weighted capital ratios. But they can have an impact on other unweighted measures that could be used for policy purposes, such as leverage ratios, unless that is explicitly ruled out. The reason for doing so is what happens dynamically over the credit cycle.

Suppose that there is a liquidity crisis, or even just a straightforward economic downturn, and the central bank decides that it needs to expand the money supply for conventional monetary policy purposes. Supplying more reserves – by any of the methods described in this paper – would then add liquidity. But if those extra reserves were counted as assets for the leverage ratio, improving liquidity metrics would increase capital requirements whenever the leverage ratio was binding. To that extent, such a policy would be pro-cyclical and limit the central bank's ability to mitigate whatever negative shock had occurred.

By contrast, leaving reserves out of the leverage ratio calculation gives the central bank a potential macro-prudential policy instrument through its balance sheet size. Whether this is an independent tool from interest rates depends on whether the central bank can separately influence both the price and quantity of money. In principle that should not be possible, but

in practice, at least when interest rates are close to zero, there does seem to be at least some ability to do both. On the other hand, excluding reserve accounts is probably a sensible policy for the reasons given by the BoE (PRA, 2016).

4 Market Considerations

Central banks can have a big impact even when operating in relatively small scale. Pre-GFC, interest rates were usually set by relatively small-scale operations that had an impact on the whole of the economy. But when a central bank operates in large scale other issues come to the fore.

So far we have focussed on the financial stability implications via the effect on regulatory metrics. But those are not the only implications of balance sheet choices which can be quite political – for example changes to asset prices can affect the distribution of wealth and income quite substantially (Bunn et al, 2014). The income and substitution effects on consumption arising from interest rate changes would be regarded as the normal channels through which monetary policy has effects on the real economy in unstressed conditions. Indeed, that is how monetary policy is intended to work. But the effects become more visible and politically important when there are large-scale asset purchases. In addition, we have noted that large-scale asset purchases and other central bank operations can be distortionary to the allocation of capital. Central banks would prefer to be as neutral as possible on that. Similarly, price differentials aside, central bank operations can also be large enough to create a market which is existentially dependent on those operations. This is not ideal. A central bank would like to be able to expand or contract its balance sheet for monetary policy reasons. If a contraction could undermine the real economy by closing a market completely, that is an unfortunate and difficult to deal with non-linearity in policy even if a monetary tightening is intended to reduce aggregate demand.

Again, if a central bank has bought credit assets in large size, it usually will not be able to sell them back to the market in large size at any speed. Such securities are intended by their issuers to raise capital. Selling large quantities quickly would depress those asset prices, increasing the cost of capital sharply and could create unpredictable distributional consequences across different sectors. For example, large scale sales of corporate bonds could push up interest rates for corporate finance in an unpredictable fashion. That could impact the supply-side of the economy, not just demand, which would be undesirable. So in this section we examine the case for smaller scale purchases and sales.

4.1 Market Maker of Last Resort

Acknowledging that the central bank balance sheet can be used to alter more than just base interest rates or narrow money supply, opens up the possibility of 'Market Maker of Last Resort' operations (MMLR)³⁰. The idea is that if an event causes particular markets to cease to function, that is likely to lead to financial instability. For central banks the most important markets may be those which are part of the monetary transmission mechanism, but other markets will affect the real economy directly. Various options exist for operations designed

³⁰ These are examined by the IMF in King et al 2017.

to address such circumstances – should the authorities deem that there is market failure to warrant intervention: the precise response depends on the nature of the market failure.

If demand has simply collapsed for an important market, one option is for the official sector to start buying those assets. The Fed's purchase of housing-related assets as part of the QE programme would be an example of such credit easing. But large scale purchases do not address market functioning – the buyer subsequently has to hold the assets to maturity, since the reversing of the process - large scale sales - could have a negative and potentially dramatic impact on the market.

In the case where credit risk spreads are deemed to be excessive, one option is to offer to attach an official guarantee to the affected assets. The UK Government did this for commercial bank bonds (for a risk-related fee) under the UK's Credit Guarantee Scheme during the GFC. That can work, but only by changing the nature of the financial instrument. It does not improve market functioning directly for the unguaranteed security.

MMLR operations are where the official sector steps in directly to improve market functioning. This might be necessary because the normal process of market making has failed. An example, during the GFC, traders stepped back from market making in some Over-the-Counter (OTC) markets. The central bank could step in here offering to both buy and sell assets in such a market at spreads which, whilst maybe wider than normal, are not so distressed.

The concept of MMLR is still in its infancy as a policy and has not been widely adopted. Tucker (2009) set out some principles that one might want to observe, based on the UK experience of buying corporate bonds and commercial paper in 2009-10. These were markets key to corporate finance and needed to operate to support the real economy. But spreads in the UK had ballooned out – in large part because the assets were relatively long-dated and illiquid. Banks, at the time, could not afford to hold the assets on their own balance sheets to make markets. Small scale purchases and eventually sales of corporate bonds by the BoE enabled its balance sheet to act as a substitute for those of commercial banks. These operations and how they worked are described in detail in Fisher (2012).

The advantage of MMLR is that central bank policy can be effective in promoting monetary and financial stability without large expansions in the balance sheet and without affecting the overall level of interest rates. Hence it does not interfere with monetary policy settings directly, even though the macroeconomic outcome is improved. Rather, small purchases could be used to target particular assets and interest rate spreads. But MMLR needs to be implemented carefully: it can be easier to initiate such operations than to get out of them. So the exit strategy needs to be planned carefully in advance (a point relevant to all operations in this section).

Based on Tucker (2009) and Fisher (2010), some of the principles for MMLR are as follows:

- Purchases of assets should be made in small scale packets, so as not to limit any expansion in the money supply.

- Purchase prices should be at spreads wider than they would be in normal trading conditions, but inside crisis levels. The operation should then be self-liquidating when markets return to normality.
- Relative spreads for individual assets can be set to minimise risk to the central bank: credit risk, concentration risk etc. But when buying private sector assets, credit risk does require constant vigilance so as not to lose public money.
- Assets should only be bought if they can be priced and risk-managed by the purchaser. In the UK case, corporate bonds containing options were excluded from purchase by the BoE on these grounds.
- The central bank should not make subjective, political judgements about which assets within a market to buy as that would cause distortions and call into question central bank independence. So, subject to normal risk management, the whole of the market in question must be deemed eligible.
- MMLR can start in a crisis with just purchases; but as demand improves, sales should take place to help re-establish private markets.

5 Crisis Considerations

Ideally, a central bank needs to be able to loosen and tighten liquidity counter-cyclically to reflect both macroeconomic and macro-prudential conditions. One might argue that it is more important that their operations should work effectively in a crisis than that they work optimally in normal times. Let us consider the case of moving from ‘normal’ conditions to a crisis that justifies a loosening.

We have described how a central bank can loosen policy by changing selected parameters of either lending or outright purchase operations. The size of the operation is one parameter that can be used for that purpose, but not the only one. The full range of choices will include all those outlined above when thinking about the steady state. Table 1 shows those choices and the possible impacts, each isolated as far as possible from the others, although in practice they would be combined.

Taking the table as a whole, and other reflections in this paper, some of the principles for crisis operations can be extracted:

- Central bank operations can affect both monetary and financial stability. Sometimes these interact. But some financial stability operations can be carried out without affecting the price or quantity of base money e.g. collateral widening.
- Regulatory changes have increased the financial stability impact of central bank operations, making them a more potent tool in a crisis; in particular through the impact that the central bank can have on LCRs and NSFRs.
- Those regulatory changes may also affect the monetary transmission mechanism, especially in a crisis. For example, the impact of the leverage ratio in combination with QE could become pro-cyclical unless reserves are excluded.
- Crisis-related operations may need to be introduced quickly. This can be difficult if it requires substantial operational changes by the central bank in terms of collateral acceptability, mandates or legislation. So operations which may be used in crisis times

are best not just designed, but operated in small scale in normal times. They should also be tested regularly.

- If crisis operations are to be easily reversible, exit strategies need to be considered as part of the original design.
- Different policy choices may be needed depending on the source of the disturbance to the economy. Flexibility should be kept to deal with unforeseen shocks.
- There are many operational policy choices and some of them work in combination – for example, large scale purchases with ex ante excess supply of base money, draining and a floor system.
- Operations should always be designed bearing in mind potential crisis conditions. An example: collateral haircuts need to be set for a 'jump-to-default' scenario, in a way that is not the market norm.
- In general, one needs some capacity for loosening liquidity in a crisis. So it is probably best to set non-crisis parameters to be relatively tight.

6 Conclusions

The first major conclusion of this paper is that a central bank can use its balance sheet, not just to set interest rates and the stock of base money, but to affect financial conditions and financial stability generally. That ability arises from the choices of a range of parameters in their operations – both routine and crisis – and defines a set of unconventional monetary and macro-prudential policies, based in part (but not always) on the regulatory metrics that emerged after the 2008 financial crisis. This impact of balance sheet choices on financial stability – market conditions and regulatory metrics - can happen even as a result of normal operational choices made as to how monetary policy is conducted. So they cannot just be ignored.

Second, it turns out that many of these new macro-prudential instruments could be operated independently of (without impact on) monetary policy objectives such as the interest rate or supply of narrow money. This is important because it means they can be operated alongside conventional monetary policies without either diminishing or interfering with the impact of either. This is what will enable central banks to achieve their traditional objectives of monetary policy (inflation control and output stabilisation), while also pursuing the aims of their new financial stability objectives.

Third, the most important consideration is to be able to supply more liquidity in a crisis. This means that in normal times, balance sheets should be more restrained so as to allow scope for expansion. But it also implies that preparatory work can be done in normal times, and operations could be conducted in small scale, to make sure that effective operations are available when needed.

Fourth the financial stability impact can be difficult to take into account properly if a central bank does not have an explicit legal remit and statutory powers for financial stability. One especially important case is the euro area. The ECB's remit (see Mersch, 2018) under the various EU Treaties is specific about its monetary policy and banking supervisory responsibilities, but vague on financial stability responsibilities, for which national authorities

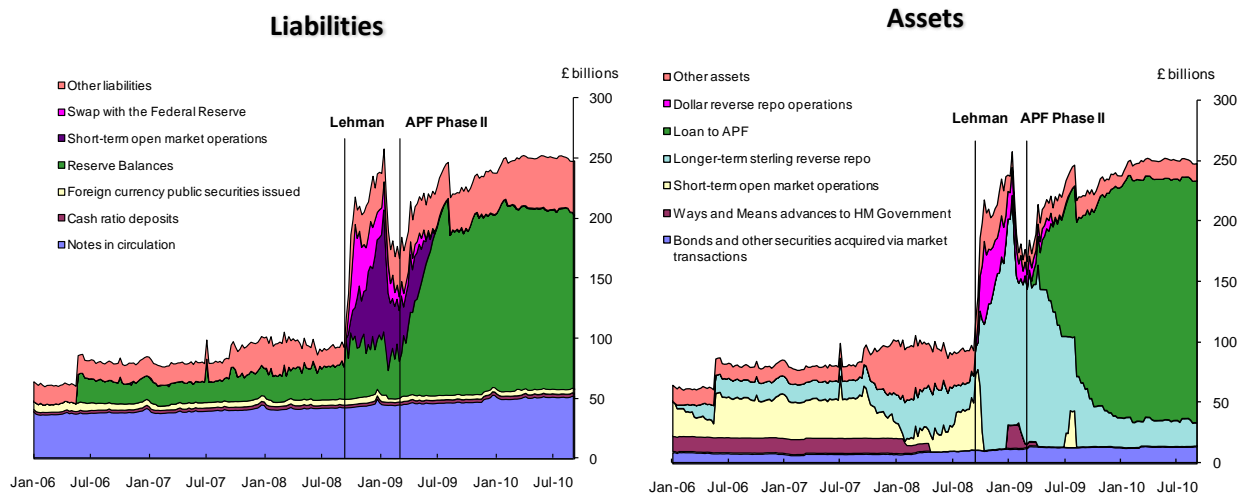
remain in the lead (except where the Single Resolution Board comes into play for larger banks). This mixture of responsibilities raises complex issues of coordination and capabilities (see IMF, 2018).

Overall, this paper shows how choices made when implementing both normal and crisis monetary operations will have an impact on macro-prudential conditions and regulatory metrics, whether the central bank has an appropriate legal remit or not. Those impacts are not just unfortunate spillovers, but potentially powerful policy tools. An imaginative use of the balance sheet could give a central bank at least some of the weapons it needs in order to act counter-cyclically *and* support of financial stability. Given that macro-prudential instruments are otherwise in short supply or unproven, it is crucial that central banks are able to properly use those that they have. If that requires a re-think of central banks' global financial stability remits, then that would be no bad thing.

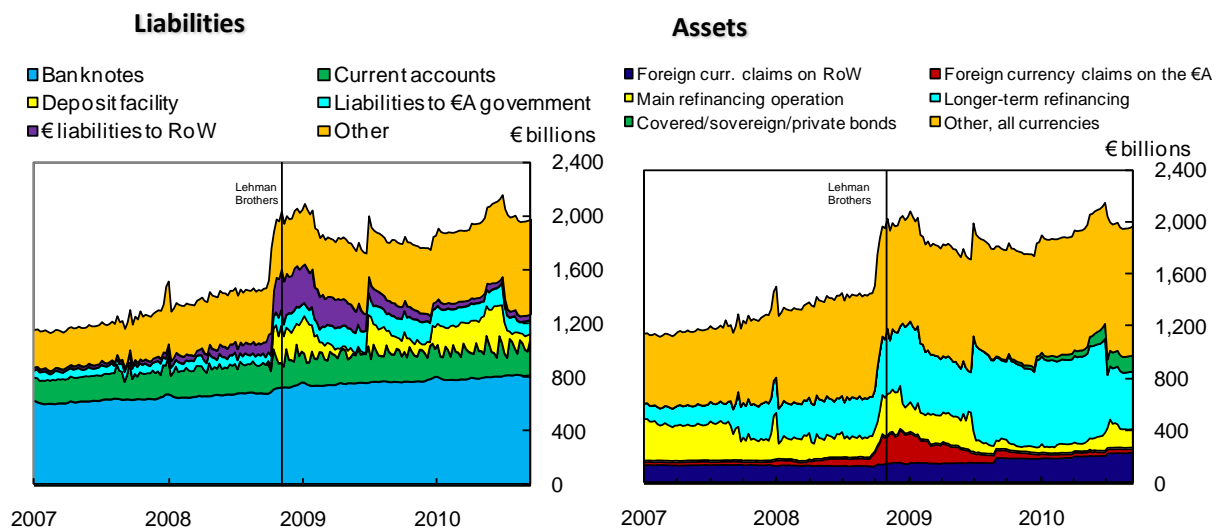
Table 1: Balance sheet policy choices and their impact.			
Policy Choice	Possible counter-cyclical response	General impact on economic and market conditions of that response	Impact on regulatory ratios of that response
Size of balance sheet.	Expand.	Expands money supply, adds liquid assets to the market.	Potentially helpful for LCRs and NSFRs depending on how done. Neutral on leverage ratio if reserves are excluded, negative impact otherwise.
Excess liquidity vs shortage.	Move to excess.	Enabling change for other policy options such as large, quick expansions.	Makes liquidity more certain for individual firms and hence less pressure on LCR, NSFR.
Breadth of collateral.	Expand eligibility of collateral set. Possibly to include non-HQLA.	Improves liquidity. Reduces market spreads between eligible assets.	Could help meet LCR if non-HQLA accepted.
Pricing for different collateral sets.	Keep at market spreads in non-crisis, but reduce price differentials in a crisis.	Keeps market functioning neutral in non-crisis times, but then improves liquidity in a crisis by making it cheaper than otherwise to change less liquid assets into fully liquid.	Could help meet LCR.
Outright purchases of liquid assets vs lending.	Switch to outright purchases instead of lending.	Puts downward pressure on a range of interest rates depending on the term of what is purchased. Outright purchases enable a relatively quick, large and sustained expansion of the money supply/injection of liquidity.	Has potential to make LCRs and NSFRs more certain. Depends on which assets are purchased and what collateral is taken. Improve valuation of bank balance sheets by boosting asset prices.
Outright purchases of illiquid assets.	Switch from liquid to illiquid purchases.	Improves financing for the broader economy.	Helps meet LCR.
Full allotment vs limited supply of reserves.	Move to full allotment.	Makes liquidity more certain.	Helps meet LCRs if less liquid collateral allowed.
Term of lending.	Extend (a) up to 12 months (b) beyond 12 months.	(a) Makes liquidity more certain. (b) Can incentivise lending to the real economy, if access is linked to that objective.	(a) Helps meet LCR, depending on collateral taken (b) Helps meet NSFRs

Chart 1: Central Bank Balance Sheets in Crisis: BoE, ECB and Federal Reserve

The Bank of England's Balance Sheet



ECB Balance Sheet



US Federal Reserve Balance Sheet

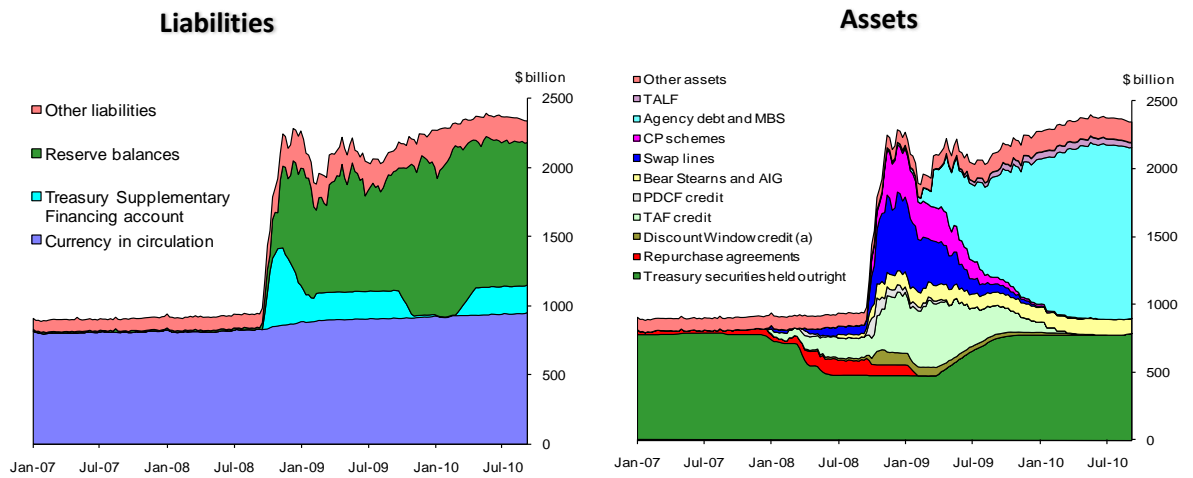
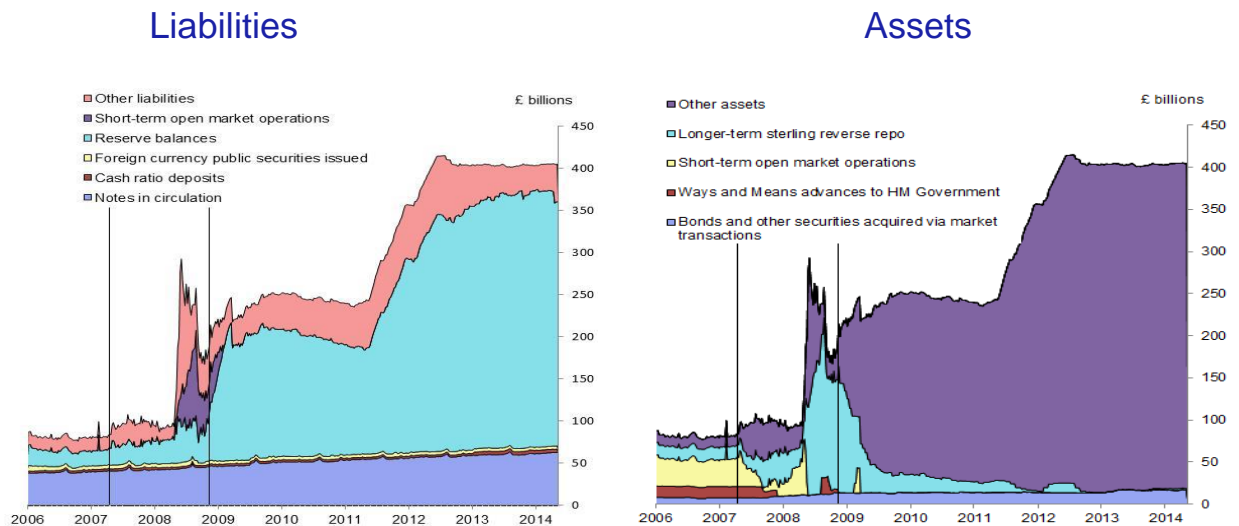


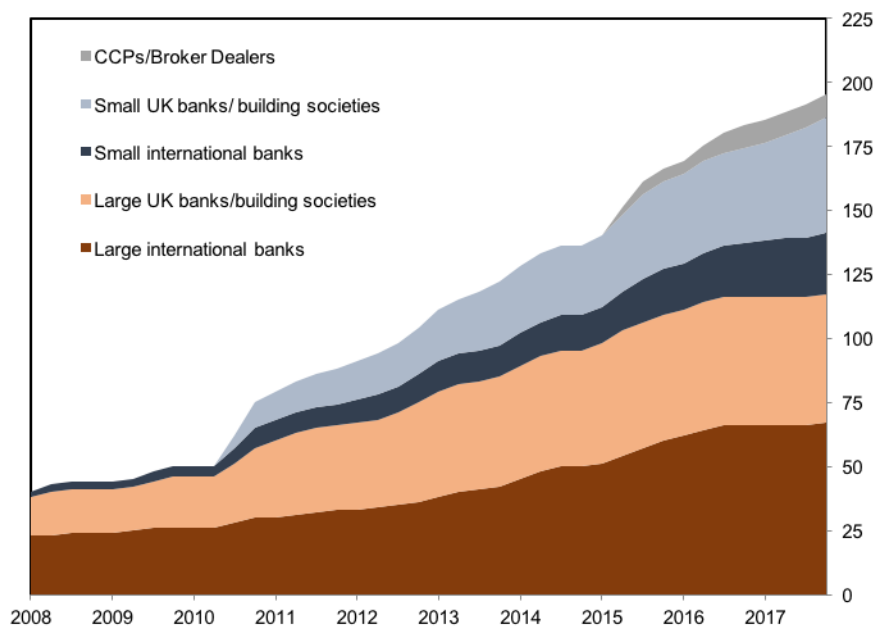
Chart 2: The Bank of England Balance Sheet in the longer run

The Bank of England's Balance Sheet



Sources Charts 1&2: Central bank websites.

Chart 3: Access to the Bank of England's balance sheet: reserve accounts.



Source: Bank of England (2018)

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