

Centre for Central Banking Studies

Handbook – No. 32 Understanding the central bank balance sheet

Garreth Rule



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BANK OF ENGLAND

CCBS Handbook No. 32

Understanding the central bank balance sheet

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The central bank's balance sheet plays a critical role in the functioning of the economy. The main liabilities of the central bank (banknotes and commercial bank reserves) form the ultimate means of settlement for all transactions in the economy. Despite this critical role the central bank's balance sheet remains an arcane concept to many observers. Recently, the huge increases in many central bank's balance sheets, as a result of responses to the global financial crisis and the implementation of unconventional monetary policy, has led to renewed interest, although misconceptions remain regarding their structure and many of their main components.

Although most central banks have moved from quantitative targets for monetary policy operations to price targets, where the domestic interest rate and/or the exchange rate are the operational target for monetary policy, the central bank's balance sheet remains the best place to understand policy implementation. Central banks control the price of money by adjusting the terms and availability of their liabilities. The availability of liabilities is influenced both by changes in the remaining components on the balance sheet and by how the central bank chooses to respond through its operations. Therefore an understanding of the whole balance sheet is required to fully understand central bank policy actions.

An understanding of the structure of the central bank's balance sheet can provide significant insights into the goals that the central bank is attempting to achieve, be it as an inflation targeter, an exchange rate targeter or if the central bank is responding to a financial crisis. Changes in the balance sheet through time can also reveal how successful the central bank has been in achieving its goals and how sustainable its current policy objectives are.

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The views expressed in this *Handbook* are those of the author, and are not necessarily those of the Bank of England.

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Understanding the central bank balance sheet

Introduction

As noted by Bindseil (2004a), 'whenever a central bank transacts with the rest of the world — that is when it issues currency, conducts foreign exchange operations, invests its own funds, engages in emergency liquidity assistance, and, last but not least conducts monetary policy operations — all of these operations affect its balance sheet'. Therefore the balance sheet of the central bank is critical to everything the central bank does. Despite this, as many central banks moved away from pursuing quantitative targets of monetary policy towards price targets, interest in the central bank's balance sheet waned in many economies and the literature too. Despite some renewed interest in the central bank's balance sheet during the global financial crisis, the format and evolution of the central bank balance sheet is still unappreciated by many observers. The differences between the form and the frequency of publication of balance sheets by central banks around the world do little to dispel this mystique. Nonetheless, the structure and evolution of a central bank's balance sheet remains a crucial tool in understanding the policy goals that the central bank is aiming to achieve and its effectiveness in doing so.

The primary purpose of this handbook is to provide a framework for understanding a central bank's balance sheet. Section 1 introduces the critical role that the central bank plays in the wider economy, in particular how its liabilities provide the ultimate means of settlement for transactions. Section 2 looks at how the central bank's balance sheet became an arcane concept in many economies and how the financial crisis revived interest. Section 3 reviews the main components of the central bank's balance sheet. Section 4 examines how the components evolve over time and how the evolution of the central bank's balance sheet can provide insights into the effectiveness of the central bank in achieving its goals. Finally Section 5 looks at how the structure of the central bank's balance sheet affects its income flow and discusses how important a positive capital level is for a central bank to achieve its policy goals.

1 Role of the central bank balance sheet

Ultimate means of settlement

To understand the role that the central bank's balance sheet plays in an economy it is important to understand the role of money. The central bank's balance sheet is important as its

main liabilities — banknotes and commercial bank reserves — are both a form of money in a modern economy and in fact underpin nearly all other forms of money. As noted by McLeay, Radia and Thomas (2014a) money is a form of IOU which allows agents to settle transactions. Ultimately anything can be used as a means of transaction between two agents in an economy if both are willing and able to agree to the transaction. Money, however, is special as it a means of transaction between agents that does not require them to necessarily trust each other. Agents should always be willing to accept money, as both a store of value and a unit of account, as long as they trust the issuer of such money. The central bank's balance sheet plays a vital role in providing the trust that underpins most forms of money in an economy.

For those transactions that settle in banknotes it is fairly easy to see the role of the central bank. In many countries, by law the central bank is the only issuer of banknotes.⁽¹⁾ Hence all transactions that settle using banknotes are done so because agents trust the value of banknotes. That is they trust the central bank to maintain and honour the value of banknotes.

While banknotes play an important transactional role, in most economies they do not make up the majority of money by value. Instead commercial bank deposits form the majority of money by value. These are balances held by economic agents at commercial banks. These balances can be transferred electronically between agents as means of settlement. While this may suggest that people's confidence in this form of money depends on their trust in the commercial bank where they hold the deposit, the central bank balance sheet is still vital in underpinning such money for reasons explained later.

In most cases balances held in commercial banks are exchangeable on demand for banknotes; this guarantee of direct convertibility into a form of central bank liability provides some degree of trust in the value of such money. More pertinently commercial banks will often need to settle

(1) In some countries private banks retain the right to issue banknotes; however, in the majority of cases the ability to do so requires backing with central bank banknotes or other liabilities. For example in the United Kingdom a number of Scottish and Northern Irish banks issue their own banknotes, however, such issuance is only possible due to such banknotes being backed by Bank of England banknotes. In Hong Kong private banks are responsible for the majority of banknote issuance; however such notes are backed by the holding of HKMA securities. In addition some smaller entities, such as towns and companies, may also issue a form of banknotes; again the value of these is derived from backing and convertibility into central bank notes.

transactions between economic agents by transferring balances between themselves and other commercial banks and there is a role here for the central bank. While some transactions that move money between agents that hold bank accounts at the same bank do not require central bank intervention, merely the credit and debit of different accounts at that commercial bank,⁽¹⁾ most will need the transfer of money between two institutions typically by a combination of real-time or deferred settlement payment systems. A common currency is needed to transfer these balances and in most cases this is commercial bank reserves held on account at the central bank.⁽²⁾ These reserves will be discussed in depth below, but can be thought of as the equivalent of commercial bank's current accounts at the central bank. When money needs to be transferred between two commercial banks, reserves move across the balance sheet of the central bank with one commercial bank's reserve account being debited and another being credited. This payment flow between commercial banks is often offset by interbank transactions to ensure that commercial banks avoid being overdrawn at the central bank.

Therefore the central bank provides a transactional means that underpins confidence in commercial bank deposits as a means of settlement. In normal times the confidence provided by the central bank in facilitating transactions ensures that commercial banks are free to intermediate between agents in the economy and to create money through credit creation.⁽³⁾

2 Recent changes in central bank balance sheets

Despite the obvious importance of the central bank's balance sheet in the functioning of an economy, in the years leading up to the beginning of the financial crisis, interest had diminished almost to the point that it was seen as an arcane concept.

Price versus quantity targets

One of the main reasons for the decrease in attention paid to the central bank's balance sheet was the move by many central banks away from quantitative doctrines of monetary policy towards price targets. As detailed by Bindseil (2004b), in the late 1970s and early 1980s academic ideas of having the central bank target specific narrow measures of money as an operational target led to much greater interest in the central bank's balance sheet. The reserves position doctrine, although not enthusiastically embraced by many central banks, led to the quantities on the central bank's balance sheet, in particular various measures of commercial bank reserves, becoming of great interest to both practitioners and observers. The relatively poor performance of such operational frameworks through the 1980s led to many central banks abandoning such quantitative targets.

Bindseil notes that in hindsight such doctrines were doomed to fail for two reasons. The first is that the central bank can do little to control precisely the quantity of its liabilities in the short run. Demand for both banknotes and reserves is exogenous in the very short run and central bank attempts to ration either form of liability will only lead to significant market instability. The second is that there is no clear reason why the central bank should try to control with precision the quantity of its liabilities. Most explanations are based on the idea of a money multiplier concept. This both significantly oversimplifies the role of commercial banks in money creation and confuses the causality between narrow and broad monetary aggregates. Absent of this concept, there is little theoretical justification for a central bank directly targeting the quantity of money.⁽⁴⁾

Having abandoned such quantitative targets in the late 1980s and early 1990s, central banks moved instead to targeting the price of money. Many central banks embraced either an explicit inflation target as their monetary policy framework⁽⁵⁾ or a closely related framework.⁽⁶⁾ The hallmarks of such a framework involve using a short-term interbank interest rate as the operational target of monetary policy. That is central banks target the domestic price of money, which through a broad transmission mechanism influences the ultimate goal: inflation. Many central banks, particularly those in small open economies or large commodity exporters, chose instead to target their exchange rate as their monetary policy target, believing it provided a better nominal anchor. Under such a system money market operations are designed to support the exchange rate or the external price of money. Critically under both frameworks the quantity of money is largely independent of its price in the short run. It is the terms on which commercial banks access central bank liabilities that are vital to achieving the desired price.⁽⁷⁾

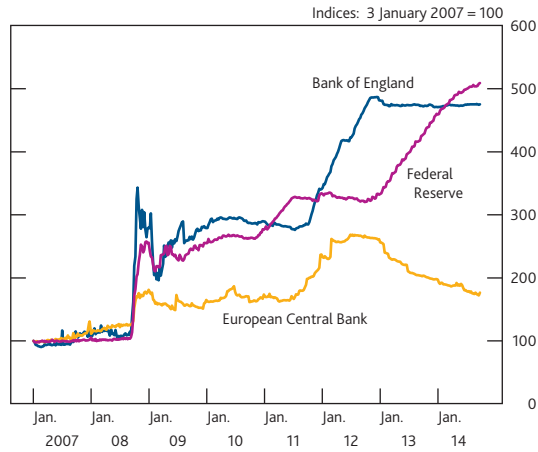
Crisis response and unconventional monetary policy

The onset of the global financial crisis in 2007 has led to renewed interest in the central bank's balance sheet. For

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- (1) This includes transactions that may appear to move money between two different banks, but where one of the commercial banks in question holds a correspondent account at the other. This is often the case for smaller or foreign banks looking to avoid the costs of holding settlement accounts at the central bank.
 - (2) It is possible for commercial banks to perform such transactions outside of the central bank, but this would require all commercial banks to hold correspondent accounts at every other commercial bank. A combination of the complexity plus the credit risk this exposes commercial banks to ensures centralised payments systems are the preferred mechanism for settlement between commercial banks in the majority of economies.
 - (3) To understand commercial banks' role in money and credit creations see McLeay, Radia and Thomas (2014b).
 - (4) This is not to say there is no role for looking at broader measures of money as intermediate targets. There is significant informational content for central banks in monetary measures and many central banks still retain monetary aggregates as a means of tracking the transmission of monetary policy from operational target to ultimate target.
 - (5) Hammond (2012) provides an overview of which central banks are currently inflation targeters and details of their frameworks.
 - (6) For example the Federal Reserve in the United States has a dual mandate focussed on both employment and inflation, while the European Central Bank (ECB) in the euro area targets inflation close to, but below its inflation target.
 - (7) For background on operational frameworks to support both policies see Disyatat (2008).

many central banks, both the initial crisis response and the subsequent implementation of unconventional monetary policy led to significant increases in the size of their balance sheets (**Chart 1**).

Chart 1 Recent growth in central bank balance sheets



Sources: Bank of England, ECB and US Federal Reserve.

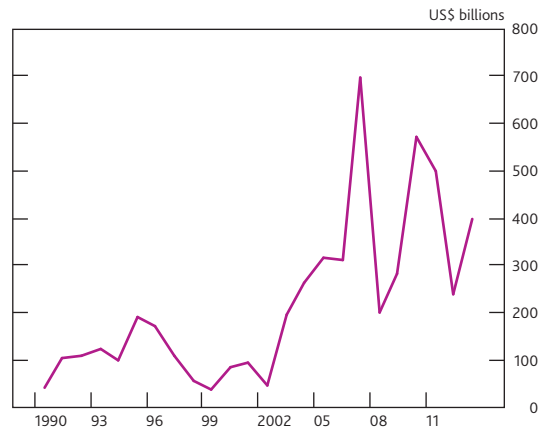
The initial stages of the crisis saw significant impairment to financial markets around the globe. In particular, interbank markets in many countries stopped ensuring the smooth dissemination of reserve balances among commercial banks. Many commercial banks started to hoard reserves instead of lending in interbank markets, partly to self-insure against potential adverse shocks to themselves and partly out of heightened credit risk fears with regards to potential counterparties. Without the dissemination of funds through interbank markets the ability of commercial banks to settle transactions in commercial bank deposits was threatened. Central banks responded by increasing the supply of reserves through various methods⁽¹⁾ to ensure smooth settlement of transactions. In the early stages of the crisis the increase in central bank balance sheets could be seen as **liability driven**, ie demand for central bank liabilities had increased.

Once price targets had reached their effective lower bounds central banks shifted from supporting the functioning of interbank markets, to wider policies designed to stimulate economic growth. Many central banks implemented policies of asset purchases aimed at reducing longer-term interest rates (both reducing risk-free rates and the spread between risk-free rates and other rates) and affecting the portfolio composition of agents in the economy. As these asset purchases were financed by the creation of reserves, central bank balance sheets continued to increase, however, in this instance growth was **asset driven**.

For central banks that targeted the exchange rate, the impact of the global financial crisis manifested itself through additional channels. In particular, volatility in global capital flows had a significant impact on the exchange rates of many

countries (**Chart 2**). At the peak of the crisis there was a sharp retrenchment of capital from emerging markets back to developed countries. This led to depreciation pressure for many emerging market economies forcing intervention to support the value of the currency. As conditions in financial markets eased and liquidity became abundant, as a side effect of unconventional policy in many developed economies, capital flows resumed forcing central banks to respond to appreciation pressure.

Chart 2 Private financial flows to developing and emerging economies



Source: IMF.

In all cases attention once again became focussed on the size and composition of the central bank's balance sheet.

3 Components of the balance sheet

Publication

While central banks publish their balance sheets in a wide range of publications on a regular basis, there is no agreed standard format or frequency.

The most common place for a central bank to publish its balance sheet is in its annual report; however, such reports by their very nature appear only on an annual basis and often at a significant lag. In addition many central banks separately publish their balance sheets on their websites and in other publications at a higher frequency. Some central banks, such as the Bank of England, ECB and the Federal Reserve, publish their balance sheets (or parts of their balance sheet) on a weekly basis with minimal lag. Others, such as the national central banks within the euro system and the Hong Kong Monetary Authority publish their balance sheet monthly, again with a minimal lag. **Table A** summarises the publication practices of G20 central banks.

(1) See Borio and Disyatat (2009) for an overview of policies undertaken at major central banks.

Table A Publication of G20 central banks' balance sheets

Country	Frequency	Country	Frequency
Argentina	Weekly	Italy	Monthly
Australia	Weekly	Japan	Ten days
Brazil	Monthly	Mexico	Weekly
Canada	Weekly	Russia	Monthly
China	Monthly	Saudi Arabia	Monthly
European Union	Weekly	South Africa	Monthly
France	Monthly	South Korea	Monthly
Germany	Monthly	Turkey	Weekly
India	Weekly	United Kingdom	Weekly ^(a)
Indonesia	Annual	United States	Weekly

(a) To improve its ability to provide covert liquidity assistance the Bank of England ceased weekly publication of its full balance sheet on 25 September 2014. From 2 October 2014 the Bank began publishing a weekly report providing data on all assets and liabilities generated through the Bank's monetary policy operations. Such publication typically covers 90% of the Bank's balance sheet by value. Data on the remaining elements of the Bank's balance sheet will be published on a lagged basis.

The format and breakdown of the central bank balance sheet also varies across countries. Often these variations are down to accounting practices and local idiosyncrasies. In particular, as we will see, the importance of certain balance sheet items varies across countries. For example, for central banks that permit a fully floating exchange rate, the breakdown of foreign exchange reserves may be more concise than for central banks that fix their exchange rate, as they are likely to hold a smaller amount of such assets.

In addition historical practices may see arcane names retained for certain balance sheet items. For example, on the Bank of England's balance sheet the historical advance to the UK government was named the Ways and Means Advance, even following the suspension of advances to the government under European law and the transfer of cash management to the UK Debt Management in 2000, the item remains entitled as such on the Bank of England's balance sheet to this day.

Despite these variations nearly all central bank balance sheets can be generalised to the form presented in **Table B**.

Table B Stylised central bank balance sheet

Liabilities	Assets
Banknotes	Foreign assets (net)
Commercial bank reserves	Government balances (net)
	Central bank operations (net)
Capital and reserves	Other items (net)

In this stylised balance sheet the elements on the liabilities side of the balance sheet represent central bank money and as such can only be liabilities. The elements on the asset side of

the balance sheet are netted in the above representation but can be both assets and liabilities when they appear on a real world central bank balance sheet. Each of the components plays a significant role in the operation of both the central bank and the wider economy, if only because their variation will naturally impact on the availability of reserves to the banking system. Therefore understanding the nature and changes in the components of the central bank's balance sheet is important for understanding the economy as a whole.

Liabilities

Banknotes

This element covers banknotes issued by the central bank that are 'in circulation', either being held by commercial bank in vaults or automatic teller machines (ATMs) or by the wider population.⁽¹⁾ In most economies banknotes enter circulation through commercial banks. The process involves commercial banks drawing down banknotes in exchange for reserve balances held at the central bank. The wider population then obtains banknotes either through direct withdrawals from commercial banks or from other agents. Most central banks targeting price targets will supply banknotes on demand to commercial banks.

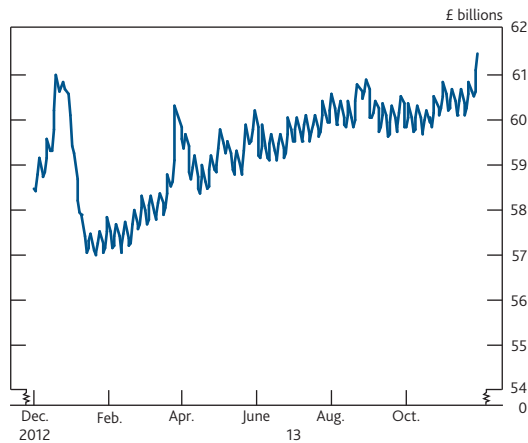
Short-term demand for banknotes is often volatile and linked to seasonal factors. In particular weekly, monthly and annual factors (**Chart 3**):

- **Within the week**, demand for banknotes typically increases ahead of the weekend, when a large amount of cash transactions take place, and decreases at the start of the week, when cash is returned by businesses. As banknotes enter the economy through commercial banks the increase and decrease in banknotes often takes place over the days preceding and following the weekend as commercial banks ready themselves for the outflow and inflow of notes around the weekend.
- The degree to which banknote demand fluctuates **within a month** will often depend on how large a proportion of the country's population has access to banking facilities. If access to banking is near universal, and the majority of the population receive their salaries in the form of commercial bank deposits, then the intra-month variation in banknote demand may be minimal. However, if a large proportion of the population does not have access to banking facilities, and instead receive their salaries in cash, then the intra-month variation may be more pronounced. In such a situation note demand will spike around common payment dates, before decreasing as people spend their wages and banknotes return to the central bank via business and subsequently commercial banks.

(1) Notes that have been printed but are still held by the central bank, or those returned to the central banks are not counted as in circulation.

- Demand for banknotes also increases around **public holidays**. Major holidays such as Christmas or Eid al-Fitr, which also involve gift giving usually lead to an increase in demand for banknotes in the days leading up to them. Other seasonal factors can influence banknote demand, for example countries with specific tourism seasons can see increases in demand around the peak tourist season.

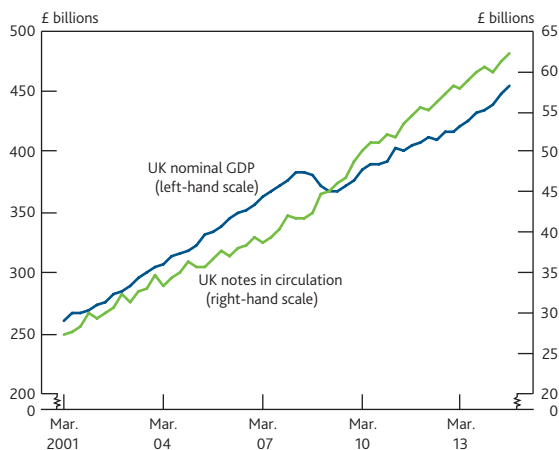
Chart 3 UK banknotes in circulation



Source: Bank of England.

In the long run banknote demand has historically been linked to growth in nominal GDP (**Chart 4**). Over time as both the value and volume of payments in the economy increase, demand for banknotes increases in line. Other factors influence the long-run demand for banknotes, namely the opportunity cost of holding cash and payment technology.

Chart 4 UK banknotes in circulation to nominal GDP



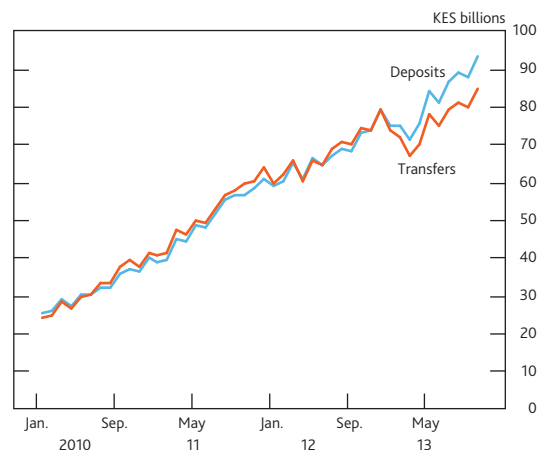
Sources: Bank of England and Datastream.

There are opportunity costs that limit the demand for cash. In particular banknotes are a zero interest paying asset. The size of this opportunity cost will vary over time depending on the central bank's interest rate. In periods of low interest rate the opportunity cost of holding banknotes will be lower. In addition banknotes are generally a less safe method for holding value; if the holder of a banknote is robbed then it is

often difficult and costly to be compensated. Making arrangements to protect banknotes may also involve costs, ie buying a safe. In contrast money held in electronic form at commercial banks cannot be physically stolen. Even in the case of bank robberies, neither electronic fraud nor the loss of physical banknotes is assigned to particular accounts. In addition centrally administrated deposit insurance insures against loss in the case of the failure of a commercial bank in many countries. However, if trust in commercial banks is low then agents may prefer to bear the risks of cash. A combination of both of these factors, as well as growth in the informal economy, could explain an increase in demand for cash in many economies through the global financial crisis despite reduced growth in nominal GDP.

Payment technology can also influence demand for banknotes. Many advances in payment technology such as debit cards, contactless payments and mobile phone technology have through time altered individuals' options for settling transactions that previously may have been settled in cash. Woodford (2001) notes that while the death of cash has been predicted on many occasions demand for banknotes has continued to increase. However, interestingly it is in developing economies where the impact of payment technology is having the greatest impact. For example in Kenya, M-Pesa, a mobile phone based payment service, has made significant progress in capturing a significant proportion of payments especially in rural areas (**Chart 5**).

Chart 5 M-Pesa Kenya deposits and transfers



Source: Safaricom.

The wider confidence in the central bank will also influence the demand for banknotes. If the general public has limited confidence in the central bank to maintain the value of the currency, ie due to fears of inflation or devaluation, they may look to use other means to settle transactions. The most common manifestation of this is dollarisation,⁽¹⁾ where another country's currency circulates either unofficially or

(1) Named such because the US dollar is often the most common currency employed, but could potentially be any foreign currency employed.

Table C Commercial bank securities purchases

Bank A		Bank B	
Liabilities	Assets	Liabilities	Assets
Deposits	Reserves	Deposits	Reserves
Interbank	Loans	Interbank	Loans
Capital	Securities	Capital	Securities

Bank A		Bank B	
Liabilities	Assets	Liabilities	Assets
Deposits	Reserves	Deposits	Reserves
Interbank	Loans	Interbank	Loans
Capital	Securities	Capital	Securities

From the initial starting point, Bank A buys an asset from Bank B. Bank A's holding of reserves are reduced and its holding of securities increased, however, Bank B's holding of reserves are increased and its holding of securities reduced. The total reserves held by commercial banks are unchanged.

semi-officially alongside the domestic currency. Changes in the level of dollarisation over time will obviously have a significant impact on demand for domestic banknotes.

Commercial bank reserves

As eloquently stated by Clews, Salmon and Weeken (2010), 'reserves are overnight balances that banks hold in an account at the central bank. As such, they are a claim on the central bank. Together with banknotes, reserves are the most liquid, risk-free asset in the economy. And they are the ultimate asset for settling payments; banking transactions between customers of different banks are either directly or indirectly settled through transfers between reserves accounts at the central bank'. As discussed above reserves can be thought of as current account balances held by commercial banks at the central bank in the same way that individuals hold such accounts at commercial banks. Despite their critical role in the functioning of the economy there are a number of widely held misconceptions regarding reserves.

Misconceptions regarding reserves

Misconception 1 — reserves and other assets

One of the biggest misconceptions is the idea that commercial banks in aggregate can choose between reserves and other assets. This supposes that the total amount of reserves being held at the central bank at any point is directly controlled by commercial bank decisions. While it is true that an individual commercial bank is free to choose between reserves and other

assets, at the system-wide level the quantity of reserves is determined by accounting identities on the central bank's balance sheet.⁽¹⁾

To understand this idea, consider what happens when an individual commercial bank attempts to reduce its reserve balance (Table C).⁽²⁾ If the commercial bank buys an asset, then while the purchasing bank's reserve balance has been reduced, the selling bank's account has been credited by the same amount. If the institution selling the asset does not hold a reserve account at the central bank then its correspondent account at its clearing bank is credited with the balance and that clearing bank's reserve account is credited with the reserves. Even if the commercial bank attempts to reduce its reserve balance by purchasing an asset in a foreign currency then the reserves will remain in the system. To purchase the foreign asset the commercial bank must obtain the foreign currency: to do this it must exchange its domestic currency (the reserves) for this foreign currency with another bank. The bank providing the foreign currency then receives the reserves.

(1) Such a misunderstanding was apparent in much of the coverage surrounding increased use of the ECB's deposit facility following the three-year Long Term Repo Operations in late 2010 and early 2011. Increased use of the deposit facility reflected increased central bank provision of reserves, not directly hoarding by commercial banks.

(2) Keister and McAndrews (2009) use a simple example to sketch out how the quantity of reserves being held by commercial banks is a function of central bank policies alone.

Table D Lending by commercial banks

Bank A		Bank B	
Liabilities	Assets	Liabilities	Assets
Deposits	Reserves	Deposits	Reserves
Interbank	Loans	Interbank	Loans
Capital	Securities	Capital	Securities

Bank A		Bank B	
Liabilities	Assets	Liabilities	Assets
Deposits	Reserves	Deposits	Reserves
Interbank	Loans	Interbank	Loans
Capital	Securities	Capital	Securities

Bank A		Bank B	
Liabilities	Assets	Liabilities	Assets
Deposits	Reserves	Deposits	Reserves
Interbank	Loans	Interbank	Loans
Capital	Securities	Capital	Securities

From the initial starting point, Bank A makes a new loan, the impact of which is to lengthen its balance sheet by increasing loans as assets and deposits as liabilities. There is no impact on reserves. If the borrower subsequently spends the loan at a business that holds its account at Bank B, the deposit transfers from Bank A to Bank B and in return reserves move from Bank A to Bank B. There is no impact on the total quantity of reserves.

Even when commercial banks increase their lending they cannot reduce the total amount of reserves in the system (Table D). The initial process of lending involves only the extension of an individual commercial bank's balance sheet, an increase in assets from the freshly created loan and a matching increase in liabilities from the accompanying deposit created for the recipient of the loan. At this point there is no impact on the quantity or distribution of reserves across commercial banks; it is only when the recipient of the loans spends their new deposit then reserves may move between commercial banks in the manner discussed above for settling transactions. If there is a distinction between required and free reserves, the process of lending can lead to a reclassification of reserves, but not a change in the total quantity.

From the initial starting point, Bank A makes a new loan, the impact of which is to lengthen its balance sheet by increasing loans as assets and deposits as liabilities. There is no impact on reserves. If the borrower subsequently spends the loan at a business that holds its account at Bank B, the deposit transfers from Bank A to Bank B and in return reserves move from Bank A to Bank B. There is no impact on the total quantity of reserves.

The only feasible means by which commercial banks can independently reduce the total quantity of reserves in the system is by exchanging reserves for banknotes. However, similar opportunity costs exist for commercial banks in holding banknotes as for individuals. In particular bank vaults are

expensive to maintain. Moreover this does not reduce the monetary base, merely alters its composition.

Misconception 2 — reserves to lend

A further misconception surrounding reserves is that commercial banks require reserves to lend. As noted above the process of creating a new loan by a commercial bank does not immediately impact on the reserve quantity or distribution of reserves in the system. When the freshly created deposit is transferred between commercial banks then reserves need to move in return, again however, this simply reflects a credit and debit of different commercial bank reserve accounts.⁽¹⁾

However, if for any of the reasons discussed below the central bank imposes reserve requirements, and there are no free reserves in the system, then the additional lending by commercial banks requires a higher level of reserves to be held at the system wide level.

This creates the impression that the central bank can influence the level of lending in the economy by rationing the provision of reserves, ie commercial banks must obtain reserves from the central bank before lending. This explanation supports the traditional money multiplier explanation of monetary policy, where the central bank implements monetary policy by varying the quantity of money. In reality as discussed above such an idea both significantly oversimplifies the role of commercial banks in money creation and confuses the causality between narrow and broad monetary aggregates.

As noted by Gray (2011), of the central banks around the world that impose reserve requirements, 80% of them impose them in a lagged manner. This means that current reserve requirements are imposed on lending measured in a previous period. Were the money multiplier process discussed above to hold then under a lagged reserve system new credit creation appears impossible. In addition the frameworks used by many central banks, to achieve their policy goals require that their supply of reserves must meet the exogenous short-term demand. Therefore commercial banks can assume that the central bank will ensure sufficient reserves are available to ensure that in aggregate they can meet reserve requirements. Any observation of a stable money multiplier relationship between narrow and broad money actually reflects the reverse causality. Broad money adjusts in line with economic activity while narrow money is subsequently adjusted by the central bank to meet imposed requirements.

More fundamentally the money multiplier treats the banking system as a black box through which loans are made in a mechanical way constrained only by central bank provision of reserves. In reality commercial banks and their role in credit creation is far more complex than this. While many things determine commercial bank lending, availability of reserves is unlikely to be one of them. In fact as shown by Martin, McAndrews and Skeie (2013) if the central bank is able to

control conditions in the interbank market then commercial banks' lending decisions are independent of the quantity of reserves they are holding. Commercial banks ultimately will lend if it is profitable for them to do so. In the Martin, McAndrews and Skeie model this is when the return on the loan is greater than the cost of funding (ie the market interest rate controlled by the central bank). Increased reserve levels impact lending only to the extent that if the central bank is unable to control conditions in the interbank market, then excess reserves push market rates lower and hence make more lending profitable to commercial banks.

Beau, Hill, Hussain and Nixon (2014) note that the market interest rate is just one element to the cost of funding for an individual commercial bank and this cost will vary from bank to bank. In addition to the risk free rate the interest rate a commercial bank faces in the market will include both credit and liquidity risk premia. The size of such premia will be influenced by both macro factors, which will affect all commercial bank, and idiosyncratic factors, affecting only individual commercial banks.

In addition to the cost of funding, Carney (2012) notes there are significant additional costs and considerations for a commercial bank making a lending decision, meaning that loan rates are often higher than the cost of funding:

- Regulatory and capital requirements. Commercial banks need to hold both capital against risky lending and liquid assets against the illiquid asset created by the loan. Both involve additional costs to the commercial bank.
- Administrative and hedging costs. The process of making a loan entails a number of administrative costs. Traditionally there is the cost of running the branch and employing the member of staff who makes the loan. Additionally there is the cost of drawing up the loan agreement and any checks that must be run on the borrower prior to the loan agreement. Finally many loans, particularly personal loans, are made on fixed interest rate terms. This means that commercial banks are bearing interest rate risk over the life of the loan. Therefore many banks will enter into swap agreements to hedge their interest rate risk, such arrangements add additional costs.
- Credit worthiness and credit hungriness of borrowers. Perceptions of credit risk will also feed into loan prices: if commercial banks perceive that borrowers are less likely to repay their loans they may charge more to compensate for these risks. Increasing the cost of loans may limit the supply. Separately the quantity of lending that a

(1) Commercial banks need to fund their lending for this reason, should the borrower wish to transfer the balance the commercial bank requires reserves to enact this payment.

commercial bank can make is bounded by finding agents in the economy to enter into such agreements, the desire of agents in the economy to enter into loan agreements will be influenced by their perception on the returns from taking such loans.

The final element above is particularly pertinent. Commercial banks through history have shown that they are more than capable of expanding lending at times of high interest rates and contracting lending even when rates are low.

Required versus free reserves

Many central banks impose reserve requirements on commercial banks that hold reserve accounts with them. This requires commercial banks to hold a certain balance on their reserve account, either at all times, at a specific point in time or on average over a period. Through time as detailed by Bindseil (2004a) the justification for imposing such requirements has changed. Today there are five potential roles for reserve requirements: monetary policy purposes, liquidity management purposes, structural liquidity purposes, central bank revenue purposes and sectorial behaviour purposes.

Required reserves for monetary policy purposes

Required reserves can be employed for monetary policy if the reserves are unremunerated or remunerated at a rate of interest that is below the prevailing market rate. The traditional view was that forcing commercial banks to hold reserves that pay a return below the prevailing market rate creates a deadweight loss on commercial bank lending. Varying the size of this deadweight loss will affect both lending and deposit rates offered by commercial banks. For example an increase in reserve requirements increases the deadweight loss borne by commercial banks. To compensate a commercial bank will either raise lending rates or lower deposit rates (discouraging deposits and hence increasing bank funding costs), which in turn will likely reduce new lending. The opposite is the case for a reduction in reserve requirements. The impact of a change in reserve requirements in this framework has an economic effect equivalent to a change in interest rates.

For many years reserve requirements fell out of favour as a monetary policy tool because the effect of varying reserve requirements was equivalent to altering interest rates and central banks wished to avoid confusion by using a single instrument. However, in recent years some central banks began again to use reserve requirements as a monetary policy tool, in particular in countries facing inflationary pressure as a result of capital inflows. Central banks in such circumstances find their ability to tighten interest rates compromised by the fact that this would exacerbate capital flows, by increasing the interest rate differential between themselves and the source of the capital flows. Instead, by tightening policy through

reserve requirements, central banks can ease domestic inflationary pressure without attracting a greater amount of capital inflow.

The resurgence in reserve requirements has also led to a greater examination of the mechanism through which they impact on bank lending. In addition to the traditional cost channel discussed above additional channels such as the liquidity channel have also been identified. The liquidity channel proposes that in situations where commercial banks need to borrow reserves to meet reserve requirements then the encumbrance of collateral taken in return for such reserves reduces commercial bank's liquidity buffers. Commercial banks will potentially limit expansion of lending as they adjust their balance sheets to rebuild liquidity buffers.

Required reserves for liquidity management

Reserve requirements can also be applied for liquidity management purposes if commercial banks are free to meet such requirements on average over a period. The ability to vary reserve balances each day reduces pressure on commercial banks to fine-tune their reserve balance and trade in the market late in the day and hence potentially reduces money market volatility. To provide a liquidity management role reserves can be either remunerated or unremunerated. If reserves are remunerated at a rate in line with prevailing market interest rates then the size of the requirements does not play a direct monetary policy role. Varying the size of the reserve requirements does however, impact on the availability of collateral to the market if the central bank is providing such reserves to the market through collateralised operations.

Required reserves for structural liquidity purposes

The imposition or variation of reserve requirements can be used by the central bank to change or enhance the desired liquidity shortage. As discussed below, central banks will generally prefer to operate with a liquidity shortage, and by using reserve requirements to increase the liabilities side of the asset sheet, they can create or enhance such a shortage.

Required reserves for revenue purposes

Reserve requirements can also be used for central bank revenue purposes. In the United Kingdom commercial banks over a certain size are required to hold a small unremunerated balance at the Bank of England, known as Cash Ratio Deposits. These balances are then invested by the Bank of England in other assets to earn a return that is used to finance the policy functions of the Bank.

Required reserves for sectorial behaviour purposes

Finally reserve requirements can be used by central banks to try to influence commercial bank behaviour towards different sectors of the economy. For example a central bank could try to encourage either domestic lending over foreign lending or

lending to particular sectors by imposing lower reserve requirements on the desired form of lending.

Voluntary versus excess free reserves

In addition to required reserves commercial banks may also hold free reserves at the central bank. Free reserves are any reserves that do not contribute to the fulfilment of reserve requirements. It must be stressed that the presence of free reserves at a system-wide level is the result of central bank actions. While an individual commercial bank may look to hold free reserves, if the central bank does not provide or allow the extra reserves in the system then these holdings must come at the expense of another commercial bank being unable to meet their reserve requirement. Free reserves can be further broken down into two separate categories: voluntary free reserves, which commercial banks are happy to hold and excess free reserves, which commercial banks do not wish to hold and will look to trade away.

In many developed economies with a shortage of liquidity, holdings of free reserves are nearly always small, voluntary and reflect an asymmetry in the costs of using central bank standing facilities. As commercial banks generally want to avoid being overdrawn at the central bank and there is a degree of uncertainty around managing cash flows they may wish to self-insure against the possibility of being overdrawn at the end of the day by holding free reserves. As free reserves generally pay no remuneration, the commercial bank will wish to trade off the chance of overdraft with the opportunity cost of holding unremunerated reserves. Despite varying opportunity costs of holding free reserves as the central bank's policy rate changes, Disyatat (2008) shows that free reserves in developed economies are relatively time invariant. In addition central banks are able to design their monetary policy frameworks such that holdings of free reserves have little impact on their ability to meet their policy target.

In many developing economies free reserves may be potentially significant and reflect consequences of other actions undertaken by the central bank. The phenomenon of surplus liquidity is discussed in Section 4, but one of the main characteristics is an abundance of excess free reserves. This abundance of excess free reserves may limit the central bank's ability to implement monetary policy as commercial banks will look to trade free reserves among themselves for any potential positive return. This will bear down on market interest rates, pushing towards the floor of the central bank's framework (the deposit rate if such a facility is offered or zero otherwise). This potentially could lead to looser than intended monetary policy being transmitted into the economy.

In addition to a greater likelihood of excess free reserves, holdings of voluntary free reserves could also be larger in developing economies. The uncertainty around payment flows may be larger due to underdeveloped financial markets

and payment systems, leading to larger balances being held by commercial banks for self-insurance purposes. In addition while free reserves generally don't pay a positive return, they do have other appealing properties; in particular they are by definition the most liquid asset in an economy (as they are the ultimate means of settlement) and as a claim on the central bank they also entail very little credit risk. Therefore in the absence of other assets that have similar qualities (due to underdeveloped financial markets) commercial banks may choose to hold significant quantities of free reserves despite the lack of return.

Capital

In many ways central banks are structured like private corporations. As Cukierman (2010) noted they 'are incorporated within similar legal structures and utilise similar accounting principles'. Like private sector institutions central banks carry capital on their balance sheets and like private institutions the capital buffer (or net worth calculated as the difference between the value of total assets and total liabilities) becomes the channel through which the central bank absorbs losses.

Unlike private financial institutions central banks are not subject to regulatory capital requirements. Commercial banks and other financial institutions are mandated by international and domestic regulations to hold capital buffers directly proportional to the size and riskiness of their lending activities. No such regulations exist for central banks. In addition, if a private institution wishes to increase the amount of capital it wishes to hold then it can either retain earnings or go to financial markets to raise additional funds. The ability of the central bank to do this is limited; more often than not the central bank is wholly owned by the government and such choices have wider fiscal implications.

Optimal level of capital in central banks

Many authors have attempted to quantify the optimal level of capital for a central bank, Cukierman (2010) and Derbyshire (2010) both conclude that there is no simple correct answer. Stella (2010) finds that 'poorly capitalised central banks are often constrained in their policy choices, or, even when not constrained, sometimes loosen policy to avoid large losses for reputational or political economy reasons'. Ultimately the correct level of capital for a specific central bank will be determined by a number of unique factors related to the situation it faces. These include its institutional structure and the types of operations it undertakes.

A further point pertaining to central bank capital levels is that while in an accounting and legal sense central banks are structured in a similar way to private sector companies, their ultimate goals vary significantly. While private sector companies are focussed on profits and maximising shareholder value, central banks are focussed on achieving policy goals.

Table E Appreciation

Liabilities		Assets	
Notes	FX	Notes	FX
Required reserves		Required reserves	
Free reserves		Free reserves	
Government		Government	
Capital and reserves		Other	

Table F Depreciation

Liabilities		Assets	
Notes	FX	Notes	FX
Required reserves		Required reserves	
Free reserves		Free reserves	
Government		Government	
Capital and reserves		Other	

These policy goals will often create situations where it may be socially optimal for a central bank to lose money or to take greater risks. For example if a central bank were to undertake a programme of quantitative easing it would be buying government debt at what will likely be low yields (high prices) as investors seek safety over risky assets. Such a situation would likely occur in a period of depressed growth in the economy with inflation either undershooting or being forecast to undershoot its target. A mark of success for such a programme would be economic recovery and inflation back closer to target. When the economy recovers, the yields on government debt will tend to increase (prices fall) as investors once again choose to purchase riskier assets and policy rates are raised. When the central bank comes to sell its bond holdings it will likely do this at a loss. Despite the financial loss it has been socially optimal for the central bank to undertake this programme as it has achieved its policy goal of encouraging growth and/or meeting its inflation target. This point was raised by the former Deputy Governor of the Bank of England, Charlie Bean,⁽¹⁾ when discussing the potential closing accounts of Bank's Asset Purchase Facility when it is run down at some future date: 'the aim of quantitative easing and the Asset Purchase Facility is to help the Monetary Policy Committee achieve its macroeconomic objective, namely hitting the Government's inflation target without generating undue volatility in output. The accounts of the Asset Purchase Facility are not designed to address these overall macroeconomic costs or benefits, which instead requires an assessment of the impact of Quantitative Easing on demand and inflation'.

Assets

Foreign assets

Foreign assets (and liabilities) are those denominated in a non-domestic currency. The main form of foreign assets held by central banks is foreign exchange reserves. Central banks hold foreign exchange reserves for a variety of purposes including intervention, the need to meet external obligations on foreign currency debt (public and/or private) and to cover trade balances.

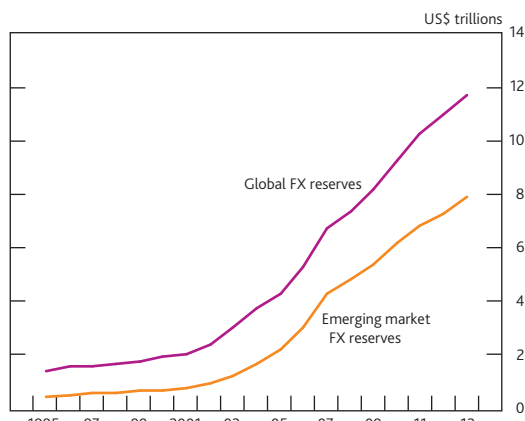
When a central bank intervenes to counter appreciation in the domestic currency all other things being equal it will increase its holding of foreign exchange reserves (**Table E**). The central bank will intervene by selling domestic assets (likely reserves) in exchange for foreign currency denominated assets. This has the joint impact of increasing supply of domestic currency assets and increasing the demand for foreign currency assets, which should offset the appreciation pressure. The impact of such intervention will lead to a lengthening of the central bank's balance sheet.

Foreign exchange reserves are also a prerequisite for a central bank being able to intervene to offset depreciation in the domestic currency (**Table F**). The central bank will intervene by selling foreign assets in exchange for domestic currency denominated assets. This has the joint impact of increasing the supply of foreign assets and reducing the supply of domestic assets, which should offset depreciation pressure. The impact of such intervention will often lead to a shortening of the central bank's balance sheet.

(1) Bean (2009).

The scale of foreign exchange reserves held by central banks will likely be proportionate to the scale of the foreign exchange intervention. For central banks that permit their currencies to float freely reserves may be relatively small.⁽¹⁾ For others, especially countries that have faced significant and prolonged appreciation pressure, reserves may be significant. The extremis of foreign exchange targeting regime is the establishment of a currency board. In a currency board all of the actions of the central bank are subsumed into ensuring direct convertibility between domestic and target foreign currency. In this instance a currency board will look to hold enough foreign exchange reserves to ensure it can always meet demand for exchange. In recent years there has been a significant increase in the quantity of foreign exchange reserves held by central banks, particularly in emerging markets (Chart 6).

Chart 6 Global holdings of FX reserves

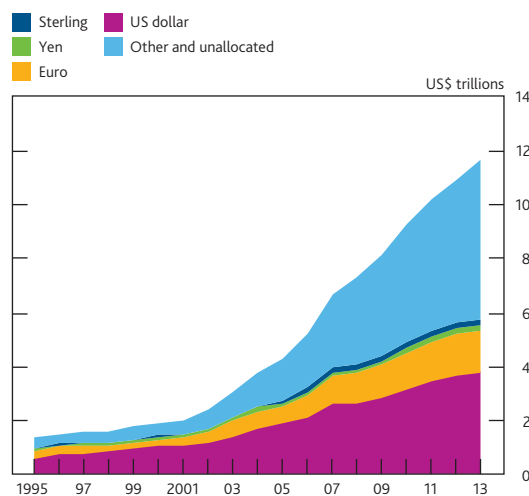


Source: IMF.

Foreign exchange reserves are often held in very liquid and safe assets, such as developed economy cash and government bonds. Central banks by their nature are risk averse and intervention often needs to be a very reactive policy hence the need for safe and liquid assets. Central banks will also likely want to hold assets in a foreign currency that is directly relevant for the countries trade and investment.⁽²⁾ For many, particularly commodity exporters this means US dollars (Chart 7).

In addition to foreign currency denominated assets, the central bank may also carry on its balance sheet foreign currency liabilities. These could be related to a number of central bank policies. In many economies where there is significant foreign exchange activity, but underdeveloped financial markets, the central bank may provide foreign currency facilities to its commercial banks. As a central bank cannot create foreign currency in the same way it can create domestic currency, such facilities must be matched either by existing holdings of foreign currency assets or an agreed swap line with the central bank of the currency provided.⁽³⁾

Chart 7 Global holdings of FX reserves by currency



Source: IMF.

Foreign liabilities may also reflect the funding of foreign exchange reserves. Should the central bank look to build foreign exchange reserves through the issuance of domestic currency assets then the process of changing these into the desired foreign currency asset will have a direct impact on the current exchange rate (as it will increase the supply of domestic currency assets and increase the demand for foreign currency assets). Therefore to remain currency neutral the central bank may issue foreign currency liabilities in exchange for foreign assets. It may subsequently swap the received funds for more suitable assets in additional currencies if required.⁽⁴⁾

Government balances

In addition to maintaining balances for commercial banks, in many countries the central bank also acts as banker for the government.⁽⁵⁾

Where government deposits funds at the central bank these appear as liabilities. Fundamentally such accounts are identical to reserve accounts, although they may be treated differently within the central banks operational framework, ie they may not be subject to reserve requirement or remunerated in the same way. Balances held on such accounts are reserves. When the government increases its

- (1) As noted by Rodrik (2006) among others, there are opportunity costs from the accumulation of foreign exchange reserves.
- (2) The IMF collates the currency composition of official foreign exchange reserves (COFER): www.imf.org/external/np/sta/cofer/eng/.
- (3) Such swap lines were an important part of the crisis response in many developed economies. In particular as US dollar funding dried up for domestic commercial banks in many countries such as the euro area and the United Kingdom, the ECB and Bank of England put in place swap arrangements with the Federal Reserve to alleviate the worst of this funding pressure allowing them to lend US dollar directly. See Goldberg, Kennedy and Miu (2010) for more details. Many central banks have maintained bilateral contingent swap lines coming out of the crisis.
- (4) The Bank of England has for a number of years funded the creation of its own foreign currency reserves through the rolling issuance of a US dollar, the proceeds of which are further swapped into a range of currencies and assets.
- (5) In some countries the government maintains some or all of its balance at commercial banks. In such instances they are treated, for central bank accounting purposes, as identical to other large institution that uses a reserve account holding bank as clearing agent.

balance at the central bank, through collecting taxes or issuing debt, it does so at the expense of the balances of commercial banks: when it reduces its balance, through expenditure or paying salaries, it does so by increasing the reserves available to commercial banks.

If over time government spending is not financed by taxation, debt sales or borrowing from commercial banks the central bank will lend to offset the deficit in the fiscal account. In doing so the central bank credits the reserves accounts of commercial bank with reserves in lieu of funds from government. The offsetting asset will be an entry due to the central bank from government. There are many instances through history where this direct monetisation of government debt has led to high inflation and poor macroeconomic outcomes.⁽¹⁾ As a result of this many countries have introduced laws that outlaw the direct financing of government debt by the central bank. The Maastricht Treaty which governs the European Union includes such a clause.⁽²⁾

Central bank operations

Given the nature of a balance sheet, the quantity of commercial bank reserves available to the banking system as a whole is determined by changes in the remaining elements of the central bank's balance sheet. In addition, as noted by Whitesell (2006), there is often a unique quantity of reserves consistent with the central bank's achievement of its desired operational target⁽³⁾ and which ensures that payments can be made between commercial banks. As the majority of changes in the other elements of the central bank's balance sheet are exogenous, the central bank requires some mechanism to respond to these changes to ensure that the optimal quantity of reserves is available to the banking system. It is through central bank operations that the central bank controls the availability of reserves to the system. Operations that *provide reserves* to commercial banks will show as *assets* of the central bank while operations that reduce the amount of reserves held by commercial banks will appear as *liabilities*. The reason as to why a central bank will either provide or absorb reserves is discussed in Section 4 below.

Types of central bank operation

Central bank operations can take a variety of forms. Operations to supply liquidity to the market include both active (open market operations) and passive (standing facilities) operations. Often the boundaries between them are blurred by the structure of the operation, but fundamentally active operations can be thought as operations that are: open to a wide range of counterparties; initiated by the central bank; and settled through an open auction mechanism. On the other hand passive operations can be thought of operations that are conducted bilaterally between commercial bank and the central bank at the initiation of the commercial bank. Central banks can also choose to operate across a range of maturities, from the outright purchase of long-maturity

assets down to the overnight repo of securities. Central banks will look to strike a balance between the flexibility needed to respond to swings in reserve availability and the desire to reduce the necessary churn of operations.⁽⁴⁾

Operations to absorb reserves involve additional complexities, as discussed by Rule (2011): 'A further choice facing central banks in the face of surplus liquidity is whether to accept the surplus of liquidity or to move to a shortage of liquidity. If the central bank accepts the surplus of liquidity it can choose to use a range of maturity instruments to absorb enough liquidity to bring the market back to balance, that is, to the point where free bank reserves are willingly held and market prices are in line with policy. In that case even the shortest-term operations are on balance liquidity absorbing. If the central bank chooses to move to a shortage of liquidity it will absorb, usually through longer maturity operations a quantity of liquidity greater than the size of the liquidity surplus leaving a shortage of liquidity that the central bank can meet through short maturity liquidity providing operations. In that case the short-term operations will on balance be liquidity providing'.

Collateral

From a balance sheet perspective, when a central bank lends to a commercial bank it creates a fresh asset, but what exactly is the asset it holds? If the central bank were to lend unsecured to the commercial bank then the asset would be a claim on the commercial bank. However, it is almost unheard of for a central bank to lend to commercial banks in an unsecured manner. Instead for risk management purposes central banks will take collateral to protect the central bank against the possibility of loss resulting from credit and market risk.⁽⁵⁾ Therefore the asset on the central bank's balance sheet is the collateral taken in return for the provision of reserves.

In addition to risk management purposes, collateral choices, coupled with the form of central bank operations, are made with the knowledge that such choices can have a significant impact on both the functioning of the central bank and the wider economy. From a central bank perspective collateral choices impact on central bank income and exposure to credit

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- (1) When coupled with a destruction of productive capacity in the economy this can in extremis lead to hyperinflation, Zimbabwe in 2008–09 being the most recent example.
 - (2) While central banks are not permitted to directly finance government deficits, most central banks are permitted to purchase government debt in secondary markets for other policy purposes.
 - (3) If the central bank maintains a symmetric interest rate corridor, that is one where deposit and lending facilities are priced at symmetric penalty rates below and above the central bank's target rate then in the absence of reserve requirements the unique quantity of reserves to maintain market rates in line with policy is zero, if reserve requirements are present then on the final day of the maintenance period the quantity is the residual reserve requirement.
 - (4) At the extremis the central could roll over all of its operations at an overnight maturity, however, this would place a heavy operational burden on the central bank and lead to a greater exposure to operational risk. In addition opening commercial banks up to potential refinancing risk could reduce their incentive to extend credit over longer horizons.
 - (5) Central bank collateral choices are discussed in more depth in Bindseil, Gonzalez and Tabakis (2009) and Rule (2012).

Box 1 Impact of central bank collateral choices

The form of central bank money market operation and the collateral it takes can have a significant impact on its balance sheet. In particular such choices can affect its income, its exposure to market, credit and churn risks and the overall

liquidity of its balance sheet. To explore these issues let's suppose there are four potential structures for a central bank's operations and collateral: the central bank can operate with short-term repurchase operations, either against government bonds or private sector assets or purchase government bonds outright with either short or long-term maturity. The impact of these choices can be summarised as follows:

	Repo of government bonds	Repo of private sector assets	Outright purchase of short maturity government bonds	Outright purchase of long maturity government bonds
Income	Positive when backing banknotes and unremunerated reserves. None when backing remunerated reserves.	Positive when backing banknotes and unremunerated reserves. Potentially positive backing remunerated reserves dependent on price charged for collateral taken.	Positive when backing banknotes and unremunerated reserves. Small when backing remunerated reserves if term premia positive.	Positive when backing banknotes and unremunerated reserves. Potentially large when backing remunerated reserves if term premia positive.
Market risk	Small	Modest, depends on the collateral taken.	Potentially modest.	Potentially significant.
Credit risk	None	Modest, depends on the collateral taken.	None	None
Churn risk	High, increases as term of repo decreases.	High, increases as term of repo decreases.	Modest	Low
Liquidity	High	Dependent on the liquidity of the underlying asset.	Modest, at extremis could be utilised in repo if required.	Lower, at extremis could be utilised in repo if required.

For the wider economy we can summarise the impacts of different operations and collateral choices as follows:

	Repo of government bonds	Repo of private sector assets	Outright purchase of short maturity government bonds	Outright purchase of long maturity government bonds
Economic impact	Minimal	Impact will increase as substitutability of collateral and reserves declines.	Some limited portfolio rebalancing effects. Potential impact on supply of assets.	Significant portfolio rebalancing effects. Potential impact on supply of assets.
Liquidity	None	Significant, dependent on liquidity of underlying asset.	Modest	Modest

and market risks, while for the wider economy choices have both a portfolio balance and liquidity impact. These impacts are summarised in Box 1. In practice, there are costs and benefits to all of the choices and central banks in practice will utilise a range of such operations and collateral.

When a central bank absorbs liquidity from the market there is no impact on the asset side of the balance sheet.⁽¹⁾ On the liability side the operation converts commercial bank reserves into other liabilities. As noted by Rule (2011) the decision to provide collateral to the commercial banks or leave them with an unsecured claim on the central bank⁽²⁾ is not made for risk reasons but wider market functioning reasons.

Off balance sheet items

Not every operation the central bank conducts will necessarily appear on its balance sheet. For example, during the global financial crisis that began in 2007 the Bank of England created a facility known as the Special Liquidity Scheme (SLS). The SLS was designed to take illiquid, legacy mortgage-backed

securities from commercial banks and swap them for liquid treasury bonds created by the UK Debt Management Office with the aim of reducing commercial bank funding costs. As these transactions were a pure collateral swap they did not appear on the Bank of England's balance sheet. The scheme had a maturity of three years and all drawings were eventually repaid before the scheme closed.⁽³⁾ The basic framework of the scheme, the off balance sheet asset swaps with the aim of improving liquidity and reducing funding costs, has been maintained by the Bank of England for both the subsequent Funding for Lending Scheme (FLS) and the permanent Discount Window Facility (DWF).

(1) Unless the central bank over absorbs and creates a shortage of liquidity which needs to be satisfied through provision operations.

(2) Should a central bank absorb using either a deposit facility or through the issuance of central bank securities, then on the balance sheet of the commercial bank entering into the transaction, will be an asset equivalent to a claim on the central bank. Such a claim is ultimately the same as the claim on the central bank it initially had when holding reserves. If the central bank repos or sells assets issued by another issuer then the commercial bank will hold that asset as collateral instead.

(3) See John, Roberts and Weeken (2012) for more details of the SLS.

Other items

Other items cover all other elements of the central bank's balance sheet that are not included in the components discussed above. On the asset side, central banks commonly have investment portfolios and property. On the liabilities side, a central bank may hold accounts for other institutions, in addition to reserve accounts for commercial banks and government, for example foreign central banks.

4 Changes in central bank balance sheets

While a snapshot of the central bank's balance sheet can reveal a significant amount of information about its policies, to truly understand the effectiveness of a central bank in achieving its policy goals one needs to look at how the balance sheet evolves over time.

Asset versus liability driven

A key determinant of how a central bank's balance sheet changes through time is whether growth in the balance sheet is driven by the assets or the liabilities.

A liability driven central bank balance sheet grows through time as demand for central bank liabilities increases. As discussed above such growth reflects an increase in nominal GDP, as both the volume and value of transactions in an economy increase and commercial banks increase the supply of credit. With growth in demand for such liabilities, the central bank, to ensure payments are made and operational targets are met, must respond by supplying the required reserves through operations. Therefore a liability driven central bank balance sheet will be characterised by a majority of central bank operations on the asset side of the balance sheet. Such a situation is commonly referred to as a **shortage of liquidity**.

On the other hand an asset driven balance will grow as a result of policy decisions made regarding the asset side of the balance. Growth in any of the main asset classes potentially outstrips growth in demand for central bank liabilities. The liabilities of the central bank are then either characterised by the presence of excess free reserves or operations to absorb such reserves. Such a situation is commonly referred to as a **surplus of liquidity**.

The two most common causes of a surplus of liquidity are growth in foreign assets and lending to government. As discussed above, central banks intervening in foreign exchange markets to support a desired exchange rate build up foreign exchange reserves. Growth in these reserves can be substantial and outstrip natural demand for domestic liabilities. Also as discussed above unsustainable fiscal policies can force the central bank to monetise the shortfall in government revenues.

Impact of a surplus

Gray (2006) notes that whether or not there is a surplus or a shortage of liquidity has implications for the central bank and has the potential to influence the following: (i) the transmission mechanism of monetary policy; (ii) the conduct of central bank intervention in the money market; and (iii) the central bank's income.

When there is a shortage of liquidity, commercial banks are forced to borrow from the central bank, potentially at penalty rates, otherwise reserve requirements will not be met and interbank payments would not be made. As a result when the central bank is lending money to commercial banks it is able to choose the terms on which it deals, such as the assets it takes to match its liabilities. This allows the central bank to limit the level of risk it is willing to be exposed to. In these circumstances, operations should earn central banks money.

When there is a surplus of liquidity, then depending on the overall size of the surplus commercial banks may need to transact with the central bank in order to meet reserve requirements and make interbank payments. The central bank therefore may be in a weaker position to dictate the terms on which it transacts with the market. In this situation, operations can cost the central bank money.

When there is a shortage of liquidity therefore, the central bank will always lend enough to the market to obtain balance, but when there is a surplus of liquidity it is harder for the central bank to drain enough to obtain balance. In many cases of surplus liquidity the central bank has less control over the first step of the monetary transmission mechanism. That is not to say that central banks that operate with a surplus of liquidity are not able to implement monetary policy effectively and there are many examples as we will see below of central banks around the world which are able to do so.

Policy regimes

The structure, volatility and evolution of the central bank's balance sheet are governed ultimately by the high-level policy objectives of the central bank and its effectiveness in attaining these objectives.

Under inflation targeting or closely related policies, the central bank's main policy instrument is a short-term interest rate. The central bank's balance sheet is therefore structured with a combination of central bank operations and reserve requirements to support the attainment of its interest rate target. Should the central bank also allow its exchange rate to float freely and not engage in monetisation of government then the central bank balance sheet will be characterised by a shortage of liquidity. The success of the central bank in achieving its inflation goals can be seen by the pace of growth in the balance sheet. If the central bank is successful in achieving its objective then growth will be steady and in line

Box 2

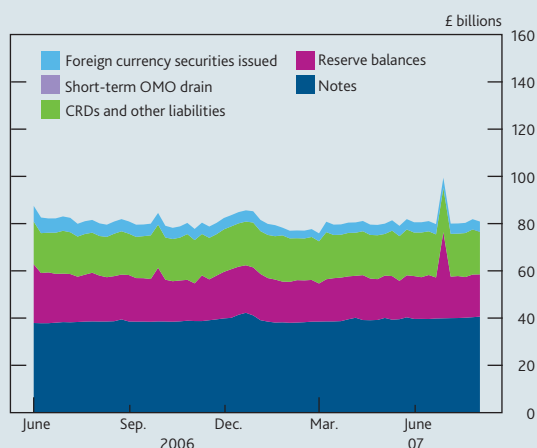
Bank of England balance sheet

The Bank of England formally has two balance sheets. The operations of the Bank are split across what have historically been known as the Issue Department balance sheet and the Banking Department balance sheet. The reason for the split relates to the decision to give monopoly power for note issuance in the United Kingdom to the Bank of England under the 1844 Bank Charter Act. The original act put limitations on the assets that could be used to back the banknote issuance, as a result banknote liabilities are even to this day separated out and presented as the sole liability of the Issue Department balance sheet. The remaining business of the Bank of England is conducted on the Banking Department balance sheet. Despite this distinction, to make understanding the structure and evolution easier it is common to see presented the consolidated balance sheet.

The United Kingdom has been an inflation targeter since 1992 and operational independence for obtaining the inflation target was granted to the Bank of England in 1997. As an inflation targeter the United Kingdom has as its operational target a short-term interest rate. The structure of the Bank of England's balance sheet is thus set up to help achieve this goal. Through time the framework used to influence short-term market interest rates has evolved and this has meant structural changes to the Bank of England balance sheet. The most significant reforms, prior to the onset of the global financial crisis were completed in May 2006.⁽¹⁾ Between May 2006 and the onset of the crisis in August 2007 inflation in the United Kingdom averaged 2.5%, just marginally above the Bank of England's target of 2%. As a result of this and stability in UK money markets, over this time period there was very little volatility in the Bank of England's balance sheet (**Charts A and B**).

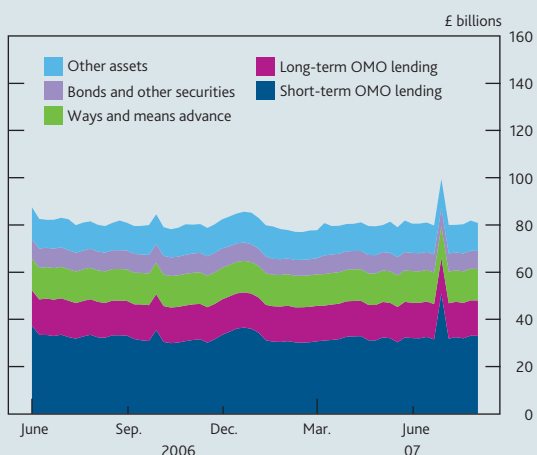
The evolution of the Bank of England's balance sheet through the global financial crisis is documented by Cross, Fisher and Weeken (2010) and Fisher (2009). Fundamentally the overarching characteristic of the Bank's response to the crisis was an attempt to ease liquidity constraints in the interbank market. The Bank did this through a range of measures by altering the collateral, term and access to its lending facilities. The crisis response can also be split into two distinct periods, the first prior to the collapse of Lehman Brothers in September 2008 when the composition of the Bank's balance sheet, in particular the asset side, was altered significantly but the size remained relatively constant and post September 2008 when the size increased significantly (**Charts C and D**).

Chart A Bank of England liabilities



Source: Bank of England.

Chart B Bank of England assets



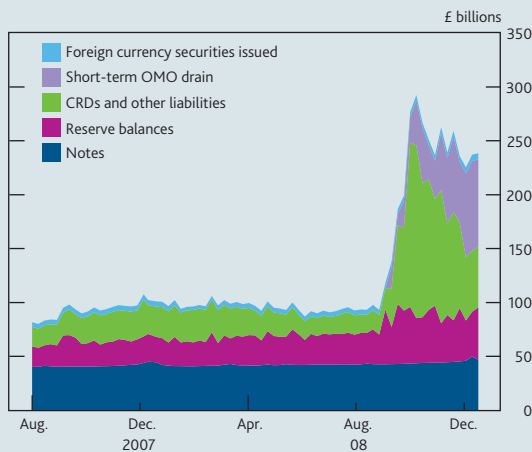
Source: Bank of England.

In January 2009 the Bank of England announced the launch of the Asset Purchase Facility (APF) and in March 2009 the terms of the APF were altered to facilitate the purchase of assets through the direct creation of reserves. The target amount for asset purchases was steadily increased until it reached £375 billion by late 2012. As a result of the asset purchases the Bank of England's balance sheet has become dominated by the asset purchases⁽²⁾ and the freshly created reserves (**Charts E and F**).

(1) See Clews (2005) for details of the Bank of England's money market reforms.

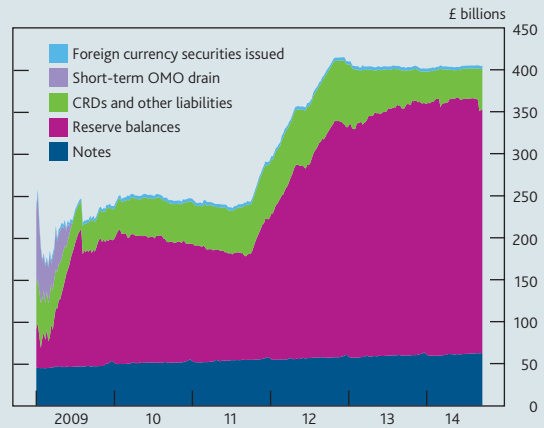
(2) The purchased assets are held on the balance sheet of a Bank of England subsidiary; the Bank of England Asset Purchase Facility Fund (BOEAPFF). What appears on the Bank of England's balance sheet is a loan to BOEAPFF on the asset side of the balance sheet contained under the heading of 'Other assets'.

Chart C Bank of England liabilities



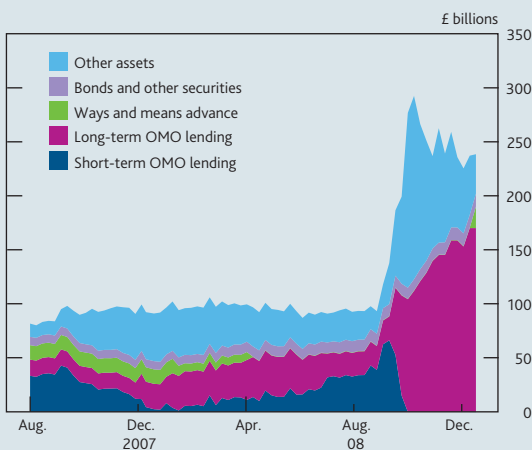
Source: Bank of England.

Chart E Bank of England liabilities



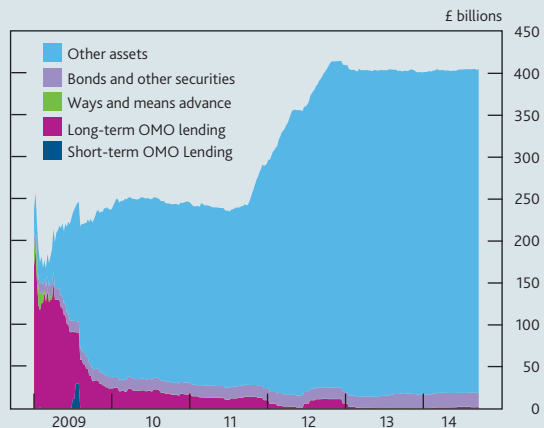
Source: Bank of England.

Chart D Bank of England assets



Source: Bank of England.

Chart F Bank of England assets



Source: Bank of England.

with desired nominal GDP. The experience of the Bank of England under inflation targeting is discussed in Box 2.

If the central bank instead targets an exchange rate then the structure of the balance sheet will support this objective, its balance sheets will be characterised by significant holdings of foreign assets. At the extremis the central bank could be structured as a currency board and would aim to hold enough foreign assets to ensure convertibility of the currency under any circumstances. As all other functions of the central bank are subsumed within this policy the central bank will hold little other assets. The size of the assets required often exceeds the demand for domestic liabilities and systems are characterised by a surplus of liquidity. The size of the central bank's balance sheet will vary depending on whether there is appreciation or depreciation pressure. The experience of the Hong Kong Monetary Authority which operates as a currency board is discussed in Box 3.

Between these two objectives many central banks want to influence both their domestic interest rates and their

exchange rates. To do so many central banks, particularly those in South East Asia, have built up significant foreign exchange reserves to intervene in currency markets, at the same time maintaining domestic monetary policy objectives. The scale of such reserves has led to many of these central banks facing a surplus of liquidity. Their balance sheets are characterised by the presence of foreign assets on the asset side and reserve requirements and absorption operations on the liabilities side. Many central banks have experienced losses from such policies a result of the cost of sterilisation and revaluation, leading to reduced or negative capital levels. The evolution of balance sheets over time can indicate whether the central bank is facing appreciation or depreciation pressure. The experience of the Bank of Thailand is discussed in Box 4.

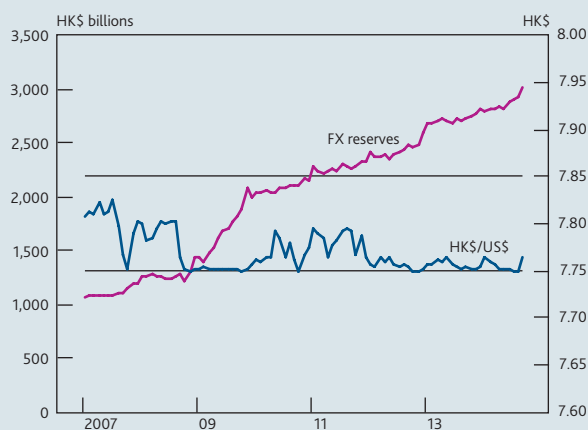
In addition to monetary policy goals central banks have financial stability goals. It is through the central bank's balance sheet that the central bank can implement policies designed to prevent systemic crisis. During the global financial crisis that began in 2007 one of the key characteristics of the

Box 3 Hong Kong Monetary Authority balance sheet

The Hong Kong Monetary Authority (HKMA) was founded in 1993 following the merger of the Hong Kong Office of the Exchange Fund and the Hong Kong Office of the Commissioner of Banking. The main goal of the HKMA is to maintain Hong Kong's long-standing currency peg regime. Since 2005 the Hong Kong dollar has been fixed within a narrow band against the US dollar of US\$1 = HK\$7.75–HK\$7.85. To maintain the peg the HKMA ensures direct convertibility between Hong Kong dollar and US dollar. To do so it holds significant quantities of foreign exchange reserves which it can use to offset depreciation or increase when offsetting appreciation. The HKMA automatically intervenes when the currency hits the boundaries of the band and retains the right to intervene at other times should market conditions warrant. The upshot of the arrangement is that the structure and size of the HKMA's balance sheet is exogenous and influenced by changes in the exchange rate. In particular, when the currency nears the

bottom of the band (ie the Hong Kong Dollar appreciates) then the HKMA automatically buys foreign currency assets in the market in exchange for domestic currency assets, this leads to an increase the size of its balance sheet (**Chart A**).

Chart A Hong Kong dollar exchange rate and HKMA FX reserves



Sources: Datastream and HKMA.

crisis was a drying up of interbank markets. Central banks to insure against bank failure and ensure payments could be made increased their lending to provide a greater amount of commercial bank reserves to the system. The experience of the Bank of England through this time is discussed in Box 2.

Finally the balance sheet can reveal unconventional monetary policy actions by central banks. Unconventional monetary policy actions such as quantitative easing have been employed by central banks when standard methods of monetary policy such as changing interest rates have reached their functional limit. The experience of the Bank of England in discussed in Box 2.

5 Central bank income

The structure of the central bank's balance sheet also plays an important role in determining the central bank's income. Ultimately income is the difference between what is due on liabilities and what is earned on assets. While central banks, aim to pursue policies that create socially optimal outcomes rather than maximising their own profits, losses can impact their ability to operate in an efficient and independent manner. In addition, in most cases income earned by the central bank is rarely kept by the central bank. Often income is paid over directly to the government, or in cases where the central bank is not wholly government owned, some income is distributed to private shareholders. In many cases the distribution of central bank profits is written into the central bank's statute.

Seigniorage income

The main source of central bank income is from what is known as seigniorage.⁽¹⁾ Seigniorage is simply the difference between the income earned from its face value and the cost of producing it.

The cost of producing banknotes is relatively small. Despite significant investment in security features and the costs of running the printing press and the distribution network, the cost of the average banknote is a fraction of the face value of the note.⁽²⁾ In addition, once banknotes go into circulation they are a zero interest paying liability. Unlike banknotes there is no physical cost to producing reserves, the central bank can create reserves simply by pressing a key on a keyboard to credit a commercial bank account. However, unlike banknotes reserves are often an interest paying liability. Many central banks remunerate required reserves, to ensure that reserves do not play a monetary policy role. The rate of remuneration is often in line with policy rate and/or the prevailing market rate, taking away the opportunity cost to commercial banks from holding reserves.

The income earned from the production of money relates to the income earned on the assets backing it on the balance sheet. In countries with a shortage of liquidity often the asset is market lending to commercial banks, either outright

(1) The word seigniorage comes from the ancient French word *seigneurie* which describes the right of a lord (seigneur) within the feudal system to issue money.

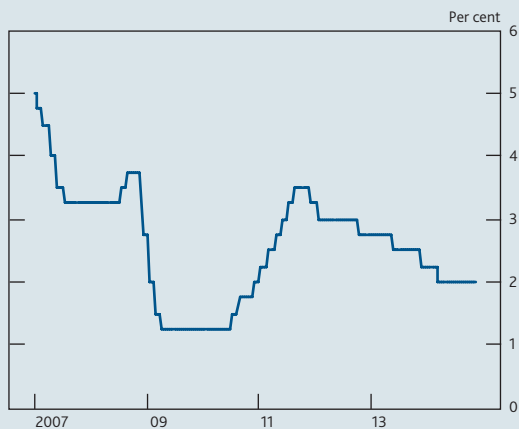
(2) The Bank of England released figures in 2006 showing the average cost of a banknote in the United Kingdom was approximately 3 pence.

Box 4

Bank of Thailand balance sheet

The Bank of Thailand has operated an inflation targeting regime since 2000. Since 2009 the Bank of Thailand has been charged with maintaining inflation between 0.5% and 3.0%. The Bank of Thailand uses a short-term interest rate as its operational target, which is adjusted frequently by its monetary policy committee (**Chart A**). In addition to targeting the domestic price level, the Bank of Thailand for many years maintained the right to intervene in foreign exchange markets to reduce what it saw as excess volatility in the Thai baht exchange rate. In recent years, as a result of a decreasing reliance on labour-intensive export industries the Bank of Thailand has permitted the baht to float more freely.⁽¹⁾

Chart A Bank of Thailand Policy Rate



Source: Bank of Thailand.

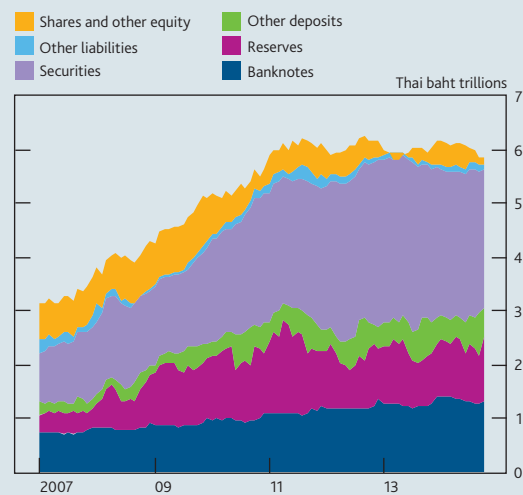
purchases or repurchase agreements. In countries with a surplus of liquidity the asset reflect the source of the surplus, be it foreign exchange reserve growth or the monetisation of government debt.

The amount of seigniorage income is determined by the proportion of banknotes and reserves on the liabilities side and the form of asset on the assets side. Most central banks with a shortage of liquidity will earn positive seigniorage income as banknotes make up a significant proportion of their liabilities and their lending to commercial banks is backed either by high-quality assets paying a positive rate of return or repurchase agreements at or close to the central bank's policy rate.

For central banks with a surplus of liquidity the liabilities side of the balance sheet is often characterised by additional liabilities from its absorption operations. Often these liabilities pay a positive rate of interest. The return on assets in these countries is often lower. Where the assets are

dominated by foreign exchange reserves, the exact form of foreign assets held is often chosen for safety and liquidity and hence returns are low. Where there is monetisation of government debt it is often done at a below market rate (if a government wanted to borrow at the prevailing market rate it would probably be able to do so without turning to the central bank). Therefore despite the presence of banknotes on its liabilities, the extra cost of the additional liabilities and the lower income from the assets potentially leads to central banks having negative income when there is a surplus of liquidity.

Chart B Bank of Thailand liabilities



Source: Bank of Thailand.

(1) See BIS (2013) for an overview of the Bank of Thailand exchange rate policies.

dominated by foreign exchange reserves, the exact form of foreign assets held is often chosen for safety and liquidity and hence returns are low. Where there is monetisation of government debt it is often done at a below market rate (if a government wanted to borrow at the prevailing market rate it would probably be able to do so without turning to the central bank). Therefore despite the presence of banknotes on its liabilities, the extra cost of the additional liabilities and the lower income from the assets potentially leads to central banks having negative income when there is a surplus of liquidity.

Do central bank losses matter?

Central banks are often structured from an accounting standpoint identically to private commercial banks and as such carry capital on their balance sheet to absorb potential losses. Unlike private commercial banks, should a central bank exhaust its capital it does not necessarily have to raise additional capital or stop operating. There are many examples of central banks operating with negative capital levels.

Fundamentally as the creator of its domestic currency, a central bank will always be able to meet its liabilities in that currency.⁽¹⁾

Therefore do central bank losses matter? Bindseil, Manzanares and Weller (2004) suggest that from a theoretical perspective there is no reason that a central bank could not achieve its monetary policy goals with a continually worsening capital position. The crucial assumption underpinning this result is that the central bank's liabilities remain a liquid and trusted method for settlement. However, as noted above, a number of studies such as Stella (2010) and Dalton and Dziobek (2005) have found at least a correlation between central bank losses and poor policy outcomes such as high inflation.

Reis (2013) argues that a central bank does face a constraint on the extent to which it can expand its liabilities to meet policy objectives as its liabilities can stop being a liquid and trusted method for settlement. This relates to the need for the central bank to be able to exchange reserves for banknotes on demand. As demand for banknotes is ultimately exogenous the central bank cannot fully control it. This means that the central bank does not fully control its policy choices. For the constraint suggested to become binding we would need a situation in which banks attempt to exchange reserves for banknotes, increasing banknotes in the system leads to inflation and ultimately the value of central bank liabilities becoming worthless. At the extremis agents are no longer willing to hold domestic currency. Ultimately, for this to happen, the general populace will have lost confidence in the central bank. Papers such as Buiters (2008) argue that the tipping point for central bank losses leading to loss of confidence in the currency comes around the point where losses exceed the net present value of the seigniorage income that the central bank can earn in the future, in other words at the point where accumulated losses exceed the potential future earnings of the central bank.

The central bank's reputation also affects its ability to operate independent of government intervention. It is possible that a government may choose to take advantage of a central bank's diminished reputation to attempt to influence policy in a potentially political expedient manner. Therefore the central bank must consider the limit of its ability to achieve policy goals when structuring its balance sheet to meet a desired policy goal.

Conclusion

The central bank balance sheet is critical to the functioning of the economy as its main liabilities, banknotes and commercial bank reserves, provide the ultimate means of settlement for transactions. Central banks exploit this role when achieving their policy goals by adjusting both the availability and the

terms of access to such liabilities in order to achieve their desired targets.

Despite the form and presentation of central bank balance sheets varying around the world as a result of different accounting practices and local idiosyncrasies, all central bank balance sheets can be generalised to a common form. Within this common form are a number of broad categories, each of which plays an important role in the central bank's function.

While a snapshot of the central bank's balance sheet can provide information on current policy goals, to fully understand its effectiveness in achieving its goals the evolution of the balance sheet needs to be observed. The high-level objectives of the central bank will play a large role in the structure and evolution of its balance sheet. For example, under inflation targeting, assuming the central bank allows the exchange rate to float freely and there is no monetisation of government debt, then the central bank balance sheet will be characterised by monetary operations designed to control the short-term interest rate. If the central bank is successful in achieving low and stable inflation there should be little volatility in the balance sheet and the balance sheet should grow as demand for central bank liabilities increase with the volume and value of transactions in the economy. On the other hand if the central bank is pursuing an exchange rate target then the central bank may build up its holdings of foreign assets either to facilitate intervention to offset devaluation or as a bi-product of intervention to offset appreciation. The resulting increase in foreign assets can outstrip the natural demand for central bank liabilities for transactional purposes. In such cases the liabilities of the central bank are characterised by either free commercial bank reserves (in excess of those needed to fulfil reserve requirements) or central bank operations to absorb such reserves.

This distinction between asset and liability driven balance sheets is not just a technical one, it has the ability to influence the effectiveness of monetary policy, the central bank's interaction with commercial banks and the central bank's income. The structure and evolution of the central bank's balance sheet is crucial in determining the level of central bank income. Many central banks with asset driven balance sheets have faced losses as a result of their policies. While from a theoretical standpoint losses, and the potential for a negative capital position, should not impact on the ability of the central bank to achieve its policy goals there is potentially a limit to the extent of losses a central bank can bear for a reputational and independence perspective.

(1) Potentially if the central bank has foreign currency liabilities it may be unable to swap freshly created domestic currency for the required currency.

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