The role of banks, non-banks and the central bank in the money creation process

The accommodative non-standard monetary policy measures taken by the Eurosystem in response to the financial and sovereign debt crisis caused the reserves of (commercial) banks in the euro area to increase sharply. In spite of this, the annual growth rate of the monetary aggregate M3 has remained at a moderate level over the past two years, reigniting interest in the connection between the creation of reserves and growth in the broader monetary aggregate.

It suffices to look at the creation of (book) money as a set of straightforward accounting entries to grasp that money and credit are created as the result of complex interactions between banks, non-banks and the central bank. And a bank's ability to grant loans and create money has nothing to do with whether it already has excess reserves or deposits at its disposal. Instead, various economic and regulatory factors constrain the process of money creation. From the perspective of banks, the creation of money is limited by the need for individual banks to lend profitably and also by micro and macroprudential regulations. Non-banks' demand for credit and portfolio behaviour likewise act to curtail the creation of money. The central bank influences the money and credit creation process in normal times through its interest rate policy, which affects the financing and portfolio decisions of banks and non-banks through various transmission channels.

Non-standard monetary policy measures, too, have effects on the creation of money and credit. One such unconventional measure, the Eurosystem's asset purchase programme, differs from interest rate policy in that it directly boosts the supply of reserves. Moreover, purchase programmes structured in this manner have an immediate expansionary impact (originating directly from the asset purchase) on the stock of money held by non-banks, though this effect is dampened in the euro area by the fact that the Eurosystem does not only purchase the assets from domestic non-banks. There are also indirect effects resulting from the transmission of the purchase programme and its impact on lending and portfolio allocation.

Critics point to the banking system's capacity to create money as one of the main culprits behind destabilising financial cycles and financial crises, hence the long-standing debate about proposals to fully back deposits with central bank money, a move intended to restrict the extent to which the banking sector can create credit. It is not evident, however, that these constraints do indeed make for a financial system that is more stable overall than might in any case be achieved through targeted regulatory action. At the same time, that kind of transition to a new system would risk impairing important functions which the banking system performs for the economy and are crucial for keeping real economic growth on a steady path.

Introduction

Money supply developments back in the public eye

Developments in the euro area's money supply have been attracting renewed public attention for some time now. The accommodative monetary policy adopted by the Eurosystem, particularly in connection with its expanded asset purchase programme (APP), has sparked fears in many quarters that the economy is being flooded with money.

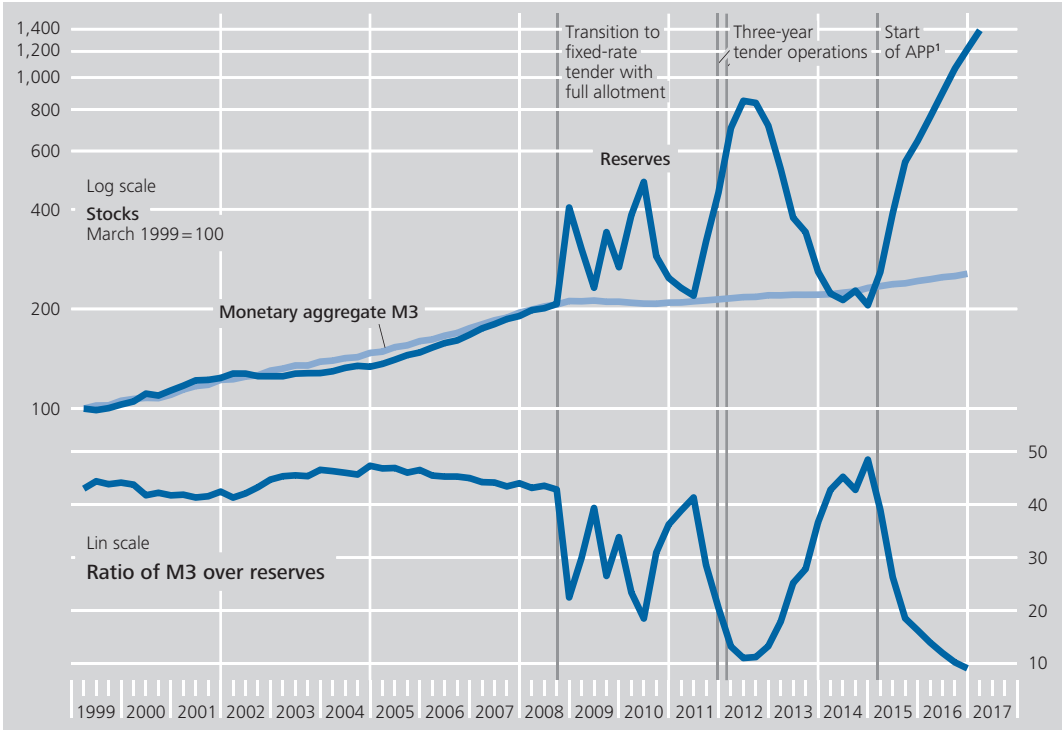
Accommodative Eurosystem monetary policy has led to a sharp increase in reserves

And it is indeed the case that reserves – that is to say, banks' holdings[1] on accounts with the Eurosystem – have increased more than sevenfold since the onset of the global financial crisis (see the chart below). These reserves are sight deposits held at the central bank by the banking sector to fulfil the minimum reserve requirements, to settle payments[2] and as a liquidity reserve, plus the deposit facility.[3] These reserves normally remain within the MFI sector, ie on the accounts of banks and central banks, because – with very few exceptions – only banks can hold an account with a central bank.[4] Movements in reserves are largely dictated by the implementation of monetary policy.[5] As a case in point, the sharp increase in reserves in the euro area in the years 2011 and 2012 shown in the chart below is mainly a reflection of the two longer-term refinancing operations with a maturity of three years. Since March 2015, the APP has been the main force behind the renewed upturn in the stock of reserves. Other non-standard monetary policy measures

1 This article uses the terms "banking sector" and "banks" to refer to the commercial banking sector and commercial banks. The central bank is not covered by these terms.
2 Further information on this topic can be found on pp 16 ff.
3 Reserves which go beyond the minimum reserve requirements are also known as excess reserves.
4 The MFI sector chiefly comprises central banks, credit institutions and money market funds (MMFs) resident in the euro area. Reserves can also be held by public institutions. These are disregarded in the following, however.
5 In addition, reserves can also be created by other central bank transactions, examples of which include asset purchases for non-monetary policy purposes and the purchase of goods and services by the central bank.

The money supply and reserves*

Quarterly



Source: ECB. * Reserves are defined as deposits on current accounts (including minimum reserve balances) plus the deposit facility. 1 Expanded asset purchase programme (APP).
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such as full allotment in refinancing operations, the targeted longer-term refinancing operations and the Eurosystem's remaining asset purchase programmes also contributed to the rise in reserves.[6]

Annual growth rate of monetary aggregate M3 persistently around 5% since launch of APP

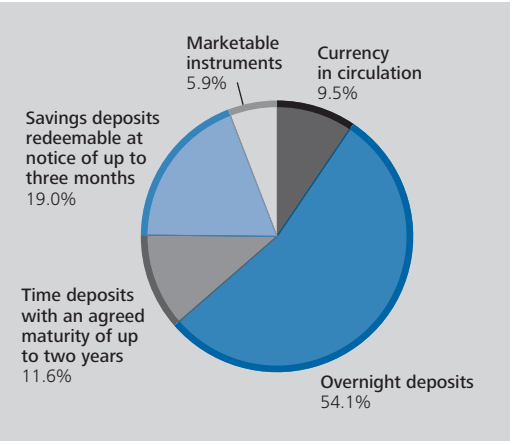
Unlike reserves, however, the broad monetary aggregate M3 has seen no more than a moderate increase in recent years. Its annual growth rate has persisted at a level of around 5% since the APP was launched. Given that M3 is defined mainly to provide insights into future price developments, it is composed only of liabilities of the domestic MFI sector to domestic non-banks (ie households, firms or general government).[7] Banks' reserves thus do not form part of the money supply.[8] The definition of the money supply is confined to MFI sector liabilities held by domestic non-banks so as to preserve a close relationship between the money supply, gross domestic product (GDP) and the price level. This is based on the assumption that the money supply held by non-banks can be transformed in the short to medium term into demand for goods and services and is therefore closely related to aggregate demand, GDP and price developments.

Interaction between banks, non-banks and central bank creates money

Disregarding currency in circulation, money within the meaning of the monetary aggregate M3 comes into being through transactions between banks and non-banks. The best example of this is sight (overnight) deposits, which account for the bulk of what the Eurosystem defines as the monetary aggregate M3 for the euro area (see the above chart). Sight deposits are created by transactions between a bank and a non-bank (its customer) – the bank grants a loan, say, or purchases an asset and credits the corresponding amount to the non-bank's bank account in return. Banks are thus able to create book (giro) money.[9] This form of money creation reflects the financing and portfolio decisions of banks and non-banks and is thus driven by the same factors that determine the behaviour of banks and non-banks. Monetary policy is just one such factor.

Components of euro-area M3

Stocks as a percentage of M3, as at 28 February 2017



Source: ECB.
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Start with a highly stylised set of accounting entries

In reality, the interactions between banks, non-banks and the central bank that are reflected in changes in the money supply are highly complex. To provide a basis for understanding the economic mechanisms underlying this process,

6 Further information on the Eurosystem's non-standard measures can be found in Deutsche Bundesbank, The implications of the financial crisis for monetary policy, Monthly Report, March 2011, pp 53-68; and Deutsche Bundesbank, The macroeconomic impact of quantitative easing in the euro area, Monthly Report, June 2016, pp 29-53.

7 Domestic non-banks comprise households and non-profit institutions serving households, non-financial corporations and non-monetary financial corporations and quasi-corporations as well as other general government, ie general government excluding central government, all resident in the euro area.

8 Since the boundaries between the various MFI liabilities that could potentially be included in the money supply are fluid, there is no clear definition of the term "monetary aggregate"; central banks decide which definition they use on the strength of theoretical and empirical criteria, eg the empirical information content about future price developments. The definition of monetary aggregates in the euro area is discussed in European Central Bank, Euro area monetary aggregates and their role in the Eurosystem's monetary policy strategy, Monthly Bulletin, February 1999, pp 29-40. According to the definition used in the euro area, the broad monetary aggregate M3 comprises currency in circulation, domestic non-banks' holdings of overnight deposits, time deposits with an agreed maturity of up to two years, savings deposits redeemable at notice of up to three months, bank debt securities with a maturity of up to two years, money market fund shares/units and repurchase agreements.

9 A detailed account of the money creation process can also be found in Deutsche Bundesbank, Geld und Geldpolitik, spring 2015, and in the frequently asked questions on the money creation process, which expand upon the information provided in that publication; see https://www.bundesbank.de/Redaktion/DE/Dossier/Service/schule_und_bildung_kapitel_3.html?notFirst=true&docId=175774#chap

Example 1a: bank A grants a loan to customer X

Customer X (borrower)

Assets	Balance sheet	Liabilities
Sight deposit with bank A	1,000	Loan from bank A 1,000

Bank A

Assets	Balance sheet	Liabilities
Loan to customer X	1,000	Sight deposit by customer X 1,000

Central bank

Assets	Balance sheet	Liabilities

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this article will begin by using a set of accounting entries to shed some light on the creation of money and credit. The economic rationale for banks and non-banks to engage in such interactions will be disregarded initially and discussed later in this article.[10]

Money and credit creation

Example 1a: bank A grants a loan to customer X

The example traditionally used to illustrate the creation of book money by a bank is one in which the bank grants a loan to a domestic non-bank in a transaction in which the loan amount is not paid out to the borrower in cash but credited to the latter's account as a sight deposit. This article also uses this example and assumes that, following an appropriate credit assessment, bank A grants its customer X a loan of €1,000. This amount is credited as a bank deposit and recorded on customer X's balance sheet as a claim on the bank; the obligation to repay the loan at a later date is posted as a matching liability of customer X to the bank (see the above table, upper account). Mirroring the customer's account, bank A's balance sheet is adjusted to show an increase in the bank's claims on, and liabilities to, the customer (see middle account). The outcome for both parties is a longer balance sheet; at the same time, these accounting entries create €1,000 of book, or giro, money.

How reserves feature in the creation of money

The central bank's balance sheet, meanwhile, remains unchanged (see the adjacent table, lower account). But the central bank nonetheless has an important role to play as a producer of reserves. That is because bank A has to assume that customer X will use the loan amount for payment transactions, and these normally result in at least some of the sight deposits created by bank A being transferred to different banks with which the recipients of those payments have an account. If this occurs, bank A will usually need to have reserves with the central bank to settle the outflow of deposits, because a large proportion of cashless payments between banks are netted via the accounts they hold with the central bank.[11]

Example 1b: customer X transfers loan amount to a customer of bank B

The stylised example shown above can be expanded upon to illuminate the role played by reserves in the creation of book money by banks (see the table on page 17). Thus, if customer X purchases a machine, say, they can transfer the €1,000 they received as a loan to the seller (customer Y). Customer X will receive the machine in return. Customer Y, who holds an account with bank B, exchanges the machine for a credit entry on their bank account. As a result of this transaction, bank A loses the sight deposit of customer X and its reserves are also reduced because in the example used here, bank A and bank B settle the transaction

10 Furthermore, the article will begin by discussing the "normal case" (that is, the central bank implements monetary policy by setting monetary policy interest rates), because this is crucial for understanding how the relationships work. The section beginning on p 27 discusses the changes relevant for the analysis in a quantitative easing policy setting.

11 Since central banks are not exposed to credit or liquidity risk in practice, many payment systems, particularly those which settle large-value transactions, use reserves. If customer X does not use a cashless payment instrument to transfer their sight deposits, but instead withdraws some or all of it in order to pay in cash, bank A will again need some holdings on its account with the central bank because the cash which bank A obtains from the central bank is charged against its reserves. See Deutsche Bundesbank (2015), Geld und Geldpolitik, op cit.

via their accounts with the central bank.[12] Mirroring these entries, at bank B there is an increase both in its reserves and in the sight deposits of customer Y. The transfer of the book money created by bank A has triggered a transfer of reserves in which the book money has flowed from bank A to bank B, as it were. The central bank's balance sheet remains unchanged on balance – only the composition of the central bank's liabilities to bank A and bank B has shifted.

Money initially created irrespective of banks' existing reserves …

If a bank lacks the reserves needed to settle the payment, it can, under certain conditions, wait until the deposits have been moved and the resulting need for reserves becomes clear and only then procure the reserves it requires; these funds can be borrowed either in the interbank market, ie from other banks, or directly from the central bank.[13] The bank can also obtain reserves via cashless transactions if it succeeds in acquiring new deposits from customers with different banks. In reality, however, bank A will try to estimate the volume of reserves it will need to cover its customers' payment transactions and bear that projection in mind in its business decisions in matters of lending and funding.[14]

Example 1b: customer X transfers loan amount to a customer of bank B

Customer X (borrower)

Assets	Balance sheet	Liabilities	Balance sheet
Sight deposit with bank A	1,000	Loan from bank A	1,000
Sight deposit with bank A	– 1,000		
Other assets	1,000		

Customer Y (customer X's business partner)

Assets	Balance sheet	Liabilities	Balance sheet
Sight deposit with bank B	1,000		
Other assets	– 1,000		

Bank A (customer X's bank)

Assets	Balance sheet	Liabilities	Balance sheet
Loan to customer X	1,000	Sight deposit by customer X	1,000
Reserves	– 1,000	Sight deposit by customer X	– 1,000

Bank B (customer Y's bank)

Assets	Balance sheet	Liabilities	Balance sheet
Reserves	1,000	Sight deposit by customer Y	1,000

Central bank

Assets	Balance sheet	Liabilities	Balance sheet
		Liabilities to bank A	– 1,000
		Liabilities to bank B	1,000

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… and also regardless of customer deposits previously accepted

What the stylised example of the creation of money shows particularly clearly is that a bank can grant loans without any prior inflows of customer deposits. In fact, book money is created as a result of an accounting entry: when a bank grants a loan, it posts the associated credit entry for the customer as a sight deposit by the latter and therefore as a liability on the liability side of its own balance sheet. This refutes a popular misconception that banks act simply as intermediaries at the time of lending – ie that banks can only grant loans using funds placed with them previously as deposits by other customers.[15]

Creating book money through the purchase of assets, …

Bank loans to non-banks are the most important money-creating transaction in terms of quantity. As the box on pages 19 and 20 illustrates, long-term observations have found that lending is the most significant factor propelling monetary growth. But other types of bank

12 If banks A and B settle the transaction via privately operated correspondent accounts (ie without the involvement of the central bank), claims on/liabilities to the correspondent bank will be created, rather than claims on/liabilities to the central bank.

13 In the latter case, the bank will need to have a sufficient quantity of collateral that is eligible for refinancing operations (eg marketable assets or credit claims). Under certain circumstances, the bank will also be able to use its loans to customers as collateral, with appropriate haircuts.

14 Newly created or newly acquired customer deposits on the bank's balance sheet imply an additional minimum reserve requirement because the overall volume of customer deposits generally determines how much minimum reserves the bank must maintain. For monetary policy reasons, minimum reserves must be kept on the bank's account with the central bank; the amount of reserves that need to be maintained for this purpose is just a fraction of the deposits held with the bank, however.

15 This topic is discussed in greater detail in M McLeay, A Radia and R Thomas, Money creation in the modern economy, Bank of England Quarterly Bulletin 2014 Q1, pp 14-27; and Z Jakab and M Kumhof (2015), Banks are not intermediaries of loanable funds – and why this matters, Bank of England Working Paper No 529.

Example 2: bank purchases securities from a domestic non-bank

Customer Z (securities seller)

Assets	Balance sheet	Liabilities
Sight deposit with bank A	1,000	
Securities	– 1,000	

Bank A

Assets	Balance sheet	Liabilities
Securities	1,000	Sight deposit by customer Z 1,000

Central bank

Assets	Balance sheet	Liabilities

Deutsche Bundesbank

transaction also create book money.[16] One is that banks commonly purchase assets (mainly securities) on quite a substantial scale as part of their trading and investment operations, and credit the corresponding amounts to the sellers' accounts (see the stylised example in the above table). Unlike the granting of loans, the transfer of these assets is final; the sellers, however, can withdraw the sight deposits created by the bank at any time, as in the example where bank A grants a loan to customer X.

… portfolio rebalancing by domestic non-banks …

Besides banks' purchases of assets, there are also transactions in which book money is created and banks play a less active role. Thus, book money also comes into being whenever domestic non-banks rebalance their portfolios, for example when they improve their liquidity position by converting longer-term bank liabilities, which are not part of the money supply (eg longer-term time and savings deposits), into short-term, more liquid bank liabilities, which do form part of the money supply (eg sight deposits).[17] Ultimately, such transactions originate from past money and credit creation processes, since longer-term bank liabilities were usually once sight deposits.

… and payments involving non-residents

Book money is also created whenever payments related to current account surpluses (eg exports of goods) or capital imports are settled via domestic banks. Where such transactions result in payments being made into the accounts of domestic non-banks[18] (eg because a domestic firm is credited with the purchase price for its export of machinery), this leads to money being created domestically in a transaction that is beyond the direct control of the bank creating the money.

Examples of how money is destroyed

Just as money can be created, so, too, can it be "destroyed", which is what happens when a previously created sight deposit is derecognised, ie removed from the balance sheet. In a reversal of the examples cited above, transactions which destroy money might include the redemption of bank loans by domestic non-banks, the sale of banking sector assets to domestic non-banks, portfolio rebalancing by domestic non-banks out of short-term into longer-term bank liabilities as well as payments which domestic non-banks make in connection with imports of goods or capital exports.

Transactions between domestic banks and non-banks key for money creation

As these examples illustrate, both the creation of money and its destruction are always the outcome of transactions in which domestic banks and non-banks must be involved; these, then, are the transactions which drive developments in the monetary aggregate M3.

16 Another transaction that creates book money is a cash deposit by a domestic non-bank into its account. This has no impact on the money supply, however, because the decline in the amount of currency in circulation is matched by the increase in sight deposits. It should be noted for the purposes of the analysis that currency in circulation was once book money that has been paid out in cash, while loans and asset purchases by banks create additional book money that did not exist before.
17 Longer-term bank liabilities, within the Eurosystem's definition, are time deposits with an agreed maturity of over two years, savings deposits redeemable at notice of over three months and bank debt securities with a term of over two years. Money is also created when banks buy back their own stock issued from domestic non-banks. In the field of monetary analysis, all these liabilities fall under the "longer-term financial liabilities" category.
18 If the money is credited to the domestic account of a non-resident, this amount does not form part of the domestic money supply but is posted on the consolidated MFI balance sheet as a decline in net external assets.

Wavelet analysis of the longer-term relationship between money growth and lending in Germany

The commercial banking sector creates money primarily through lending. The creation of money through lending or asset purchases, as described in the main text, is reflected in the presentation of the MFI sector's consolidated balance sheet under the counterparts of credit to private non-MFIs and credit to general government.[1] A close link between credit growth on the assets side of the balance sheet and the monetary components on the liabilities side is therefore to be expected.[2] The two other counterparts also showing money creation and destruction processes are the MFI sector's net external assets (money creation or destruction through current account balances or capital flows to or from abroad) and longer-term financial liabilities (money creation or destruction through portfolio shifts).

This box explores whether a close link between money supply and lending can also be established empirically. Statistical methods for analysing time series within the frequency range are employed for this purpose. These methods show the importance of cycles of specific frequencies for the development of a given time series and how closely two variables are linked at given frequencies. The methodology (wavelet analysis) also makes it possible to examine changes in the characteristics of a time series and changes in the relationship between two variables over time.[3] This is an extension compared to conventional methods in the frequency range, which, by contrast, assume that the characteristics of the time series remain unchanged over time.

The analysis of longer-term relationships between the monetary aggregate and its counterparts requires comparatively long time series. For this reason, in this box, the results of a wavelet analysis of the annual growth rates of the four counterparts mentioned above and the monetary aggregate M3 in Germany are shown for the period from 1956 to 1997.[4] The top section of the chart on page 20 shows the average estimated wavelet coherency with the annual growth rate for the monetary aggregate M3 over time for cycles lasting between 14 and 20 years for the annual growth rate of each of the counterparts mentioned above.[5] Money growth exhibits significant fluctuations within this frequency range which can be interpreted as trend movements.[6] Coherency measures the local correlation between the two series and can take values

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1 The credit to general government counterpart is affected whenever the MFI sector grants loans to the government.

2 Further information on the consolidated balance sheet can be found in Deutsche Bundesbank, The consolidated balance sheet of the MFI sector and its significance for monetary analysis, Monthly Report, July 2013, pp 55-56.

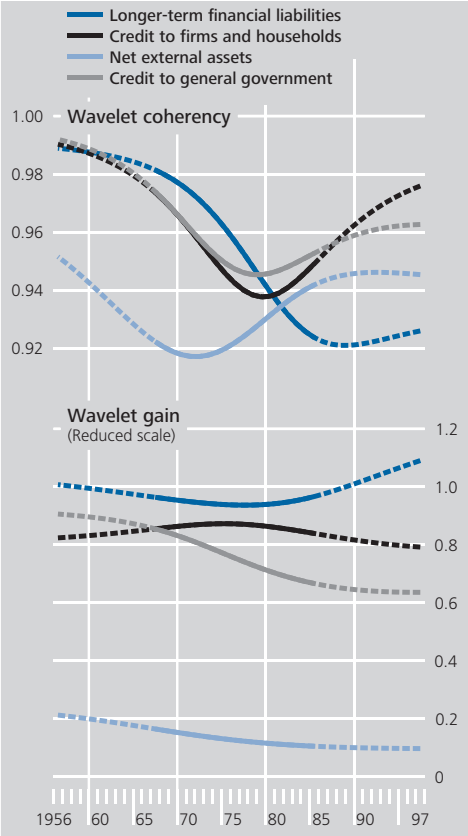
3 For an introduction to wavelet analysis, see A Rua (2012), Wavelets in economics, Economic Bulletin, Summer, Banco de Portugal, pp 71-79; L Aguiar-Conraria and M J Soares (2015), The continuous wavelet transform: moving beyond uni- and bivariate analyses, Journal of Economic Surveys, 28, pp 344-375.

4 For the euro area, data for some of the counterparts are only available from 1999 or later. After 1999, data on the monetary aggregate and its counterparts for Germany are no longer comparable with the data for the sample period on account of the changes relating to the monetary union.

5 The maximum length of the cycles to be analysed is restricted by the length of the time series. The time variability of the relationship can be analysed for up to a maximum period of 20 years. For considerably longer cycles, the time window for the estimation shrinks to such an extent that the estimation is no longer meaningful.

6 In F Drudi, P Moutot and T Vlassopoulos (2010), Monetary Analysis in the ECB's Monetary Policy Process, in: L Papademos and J Stark (eds), Enhancing Monetary Analysis, Frankfurt, European Central Bank, pp 73-127, the low-frequency component of the M3 growth rate is identified as cycles lasting over ten years. The frequency range used in this analysis was selected based on the wavelet power spectrum. The wavelet power spectrum shows that there are important cycles for each of the variables at these frequencies for the other time series, too.

Wavelet coherency and gain between the annual growth rates of the monetary aggregate M3 and selected counterparts in Germany*



* Average for cycles with lengths ranging between 14 and 20 years. The dashed sections should not be interpreted because the estimates for these periods are associated with starting and end point problems.

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between zero and one. The bottom section of the chart shows the average wavelet gain for the same frequency range. The gain can be interpreted as the regression coefficient of a time-varying regression of money growth within the selected frequency range on the growth rate of each counterpart.[7]

Coherency that is stable over time and close to one is estimated for both the relationship between M3 and lending to firms and households and the relationship between M3 and lending to general government. The average wavelet gain is consistently above 0.8 for lending to firms and households, highlighting the quantitative importance of lending for money growth.[8] For lending to general government, however, the gain decreases noticeably over time.

Though net external assets also have a high coherency with money growth, the estimated gain is comparatively low and indicates the lower quantitative relevance of this counterpart for long-term money growth. Fluctuations in the net external assets' growth rate only result in slight changes in money growth in this frequency range. The coherency for longer-term financial liabilities is at a similarly high level to the coherency for lending to firms and households, and the estimated gain even exceeds the gain for this lending, almost reaching one. This positive value seems surprising at first because portfolio shifts by non-banks from M3 to longer-term financial liabilities of the banking sector have the effect of destroying money, as explained in the main text. However, this is only true for portfolio shifts for a given length of the consolidated balance sheet. If the balance sheet grows longer over time, longer-term financial liabilities and money supply are able to increase together. The estimated relationship should therefore be interpreted as a result of this balance sheet expansion.

The results show that on the assets side of the consolidated balance sheet long-term developments in the money supply are primarily related to growth in bank lending to firms, households and, in some cases, to general government as well, which reflects the money creation processes outlined in the main text.

7 The period to which the estimations in the chart refer is shorter than the sample period because data from before and after the point in time for which coherency and gain are estimated are used in the estimation.

8 A gain of 0.8 means that a 1% increase in the growth rate of lending to firms and households within the frequency band under consideration results in a 0.8% increase in money growth within the same frequency band.

Constraints on the creation of money and credit for an individual bank

Limitations to the creation of money and credit

The (commercial) banking system may have the ability to create money, but that does not mean that banks can drive up the supply of money and credit without constraint. The granting of loans and creation of money are limited by the banking system's interaction with non-banks and the central bank, by regulations and, not least, by banks' own inherent interest in profit maximisation.

Funding needed despite ability to create money

One such constraint is the need for banks to fund the loans they create. Deposits play a major role in this regard, for while banks have the ability to create money – that is, to accumulate a stock of assets by originating liabilities themselves in the form of sight deposits – they need funding in the form of reserves. This need for funding exists because, as outlined above, banks are always at risk of losing at least some of the deposits they have created by granting loans as a result of cashless payments or cash withdrawals. This article has so far been based on the assumption that banks already hold these reserves or can procure them at any time via the interbank market or central bank. However, banks, being mindful of risk/reward considerations, will look to base their funding not just on short-term central bank loans, but predominantly on longer-term deposits and securitised paper (debt securities) as well. That is because the acquisition of such customer deposits previously held with other banks generates an inflow of reserves for a bank through the cashless payments channel, just as in the case of a short-term central bank loan. Customers are less likely to withdraw these forms of funding instrument. The benefit of longer-term forms of investment, then, is that the medium and longer-term loans which banks report as assets are better matched by the funding they carry as liabilities.[19]

The previous section of this article presented a simplified view of lending and the associated creation of money by assuming that the lending decision is made by the bank alone. But in reality, loans are normally granted on the initiative of non-banks – households and firms requiring funding compare the credit conditions offered and promoted in the competitive banking system (interest rates, terms etc) and decide whether to apply for a loan, and at which bank. Factors which have a bearing on credit demand include general economic developments, the projected profitability of investment projects, and institutional factors. The lending rate is just one of many factors which potential borrowers consider. A loan commitment is issued when the lending bank, having completed the credit assessment process, gives a positive verdict to the credit request. The decision to repay a loan prematurely and the resulting destruction of credit and money is likewise normally initiated by the borrower.[20]

Credit demand key for creation of money through lending

A key criterion for lending from an individual bank's vantage point is that the income which an additional loan granted is expected to generate – after considering the associated risks – exceeds the costs of granting that loan.[21] Costs mainly comprise funding costs for the loan but also include administrative and monitoring expenses.[22] A bank can attract stronger demand for credit by offering more favourable credit

Need for banks to lend profitably acts as a constraint on credit creation

19 Using short-term interbank liabilities as a source of funding gives rise to liquidity and interest rate risk because of the danger that the bank might, at some point in the future, no longer be in a position to prolong the short-term interbank loan or that it can only do so at a higher cost. As for interest rate risk, the risk of interest rates increasing for central bank and interbank loans could drive up funding costs, thus eroding, or wiping out altogether, the income derived from lending. Loans funded solely by overnight deposits raised by the bank are exposed to the same risk, since their future remuneration is also variable.
20 The significance of credit demand is discussed in C Goodhart (2016), Determining the quantity of bank deposits, Banking Perspective, Quarter 2, pp 52-60; and O Issing (2011), Einführung in die Geldtheorie, Munich, Vahlen, chapter 3. This becomes particularly clear when one turns to overdrafts and credit card lending.
21 The bank's lending decision is presented here in a highly stylised manner for didactic reasons. A more detailed analysis can be found, for example, in X Freixas and J Rochet (2008), Microeconomics of banking, 2nd edition, Cambridge, Massachusetts, MIT Press.
22 Funding costs are a key lever which monetary policy can use to affect the granting of loans (see below).

conditions (eg lower lending rates), but all other things being equal and assuming that funding costs remain unchanged, this also acts to depress the risk-adjusted expected income from the loan, such that continuing to expand the credit supply by offering (even) more favourable credit conditions becomes less and less attractive for the bank.

Lending constrained by capital and liquidity regulation

A bank can additionally expand its lending by taking greater risks, for instance, by lowering the credit and collateral quality standards that its borrowers have to meet. The resulting increase in credit default risk means, however, that, absent any change to the lending rate, the loan will deliver a smaller risk-adjusted expected income. If the bank takes the increased credit default risk into account in its calculations, it makes less and less sense for the bank to continue to expand lending by accepting increased default risk. However, moral hazard caused by, for instance, limited liability of the bank (or its managers), information asymmetries between the bank and its creditors,[23] deposit insurance or bail-out guarantees can cause the bank to make inadequate allowance for the risks of its lending. The purpose of microprudential and macroprudential regulation of the banking sector is to prevent such behaviour where possible. Elements of such regulation, including liquidity and, in particular, capital standards, have the effect of constraining lending. Capital regulations force banks to hold a certain quantity of capital against their lending, depending on the risks involved. This means that banks' ability to expand their lending is constrained by the capital at their disposal or by their ability to build up additional capital reserves.[24]

Constraints on the creation of money and credit caused by interaction between banks, non-banks and the central bank

Interplay between decisions by banks and by non-banks in determining money and credit growth

If a large number of banks increase their lending simultaneously, each individual bank loses, through payment transactions, a more or less considerable part of the deposits it has created itself; at the same time, however, it may receive new deposits from other banks as a result of payments to its own clients. The outflows of reserves caused by the transactions of its own borrowers can thus be offset by inflows of reserves by payments to its depositors, thereby reducing each individual bank's funding needs.[25]

Demand for credit depends on funding needs

That notwithstanding, however, the overall scope for the banking system to create money and credit is determined by the behaviour of non-banks and the central bank's monetary policy. Non-banks' impact on lending and money creation derives from their role as demanders of credit[26] and holders of bank deposits. Demand for bank loans follows from

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23 These are caused by a situation in which, for instance, a bank's creditors have little or no insight into the risks involved in lending, or if obtaining such information would cost too much in relation to the benefits.
24 For more on liquidity regulation, see Deutsche Bundesbank, Liquidity risk management at credit institutions, Monthly Report, September 2008, pp 57-71. Synopses of the theoretical underpinnings of microprudential bank regulation can be found in E Baltensperger (1996), Banken und Finanzintermediäre, in J von Hagen, A Börsch-Supan and P Welfens (eds), Springers Handbuch der Volkswirtschaftslehre 1: Grundlagen, Berlin, Springer, pp 269-304 or G Gorton and A Winton (2003), Financial intermediation, in G Constantinides, M Harris and R Stulz (eds), Handbook of the economics of finance, Elsevier, pp 431-552. For more on the arrangements in force in the European Union, see Deutsche Bundesbank, Implementing Basel III in European and national law, Monthly Report, June 2013, pp 55-71.
25 For the banking system, the newly created deposits give rise to additional minimum reserve requirements. The central bank will, however, satisfy any resulting additional demand for reserves, provided it sees no reason to change its monetary policy stance (see pp 24 and 27). This is predicated on the banking system having sufficient collateral for central bank loans.
26 See pp 21ff and C Goodhart (2016), op cit.

the funding needs of non-banks,[27] which – as described above – are determined by a whole range of factors. Given these factors, the banking system can offer more favourable lending terms in order to stimulate the additional demand needed to support an increase in lending.[28] However, the aforementioned need for banks to be able to lend profitably means that there will come a point at which the banking system will not continue to increase its lending by making lending terms ever more favourable.[29]

Increase in sight deposits causes non-banks to make adjustments

Non-banks are involved in the process of money and credit creation not only as borrowers but also as holders of the deposits thus created. As is explained on page 17, borrowers use the deposits newly created by lending to make payments. If the inflow of deposits through payments leads to the actual level of bank deposits surpassing the volume desired by the affected non-banks – ie there is a monetary overhang – this triggers adjustment processes, such as portfolio rebalancing, which can slow the increase in the money supply caused by lending.[30] The rise in the money supply can, however, also cause aggregate demand for goods to go up if non-banks use the additional deposits to purchase goods and services. Depending on the elasticity of aggregate supply, this may lead to an increase in the price level.

The central bank's interest rate policy impacts on money and credit creation

The above considerations have shown that, in the interaction between banks and non-banks, there are factors at play which prevent the unlimited creation of money and credit.[31] The monetary policy of the central bank is also a significant factor.[32] Its aim is to safeguard price stability in the medium term. In normal times, the central bank achieves this through its interest rate policy, which indirectly influences lending and monetary growth. The underlying transmission mechanisms are explained in more detail beginning on page 25. In summary, an increase in the key monetary policy rates will, all other things being equal, dampen monetary and credit growth – through changes to funding costs, the supply of credit and the terms of lending by the banking system, as well as to portfolio decisions and credit demand on the part of non-banks. By contrast, a cut in the policy rate per se stimulates money and credit creation. Given the complex interplay of banks and non-banks, however, it would be wrong to assume the existence of a mechanistic link between monetary policy and monetary growth.

Money creation as a potential cause of boom and bust cycles

Despite these factors which constrain money and credit creation, the creation of money by the banking system through lending is sometimes regarded as one of the causes of lending booms and subsequent financial crises. Whereas the majority of economists see macroprudential regulation as the appropriate response to the threat of credit-driven boom and bust cycles, proposals aimed at eliminating the ability of the banking system to create money were already under discussion during the Great

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27 For non-banks with access to market-based funding, such as bonds and shares, banks' lending terms as compared to capital market funding conditions are also an important factor.

28 For investment projects, this results from the assumption that the marginal product of capital falls as the capital stock increases, where the marginal product of capital – disregarding adjustment costs – has to be greater than or equal to the real loan rate plus the rate of depreciation for an investment to be profitable. See, for example, S Chugh (2015), Modern macroeconomics, Cambridge, Massachusetts, MIT Press, chapter 6.

29 See pp 21-22. The expansionary effect of an increase in the supply of credit and lending on real activity, the inflation rate and inflation expectations can lead to a temporary decline in the real cost of borrowing and cause credit demand to increase. However, this effect is only temporary as the monetary policy responses cause inflation to revert to its target, which is also reflected in inflation expectations.

30 The adjustments are manifold and complex and can therefore only be outlined by way of example. See, for example, A Meltzer (1995), Monetary, credit and (other) transmission processes: a monetarist perspective, Journal of Economic Perspectives 9, pp 49-72, and the references therein on adjusting to a monetary policy-induced expansion of the money supply. For example, households or firms which acquire additional sight deposits through payment transactions could pay off loans. Another possibility is that they adjust their portfolios by using sight deposits to purchase other assets. The resulting changes in asset prices and returns, in turn, have further effects on lending and portfolio decisions.

31 See also J Tobin (1963), Commercial banks as creators of "money", Cowles Foundation Discussion Paper No 159.

32 Macroprudential policy, too, aims to contain unwelcome developments in lending and thus indirectly in money creation from a financial stability perspective. See Deutsche Bundesbank, Macroprudential oversight in Germany: framework, institutions and tools, Monthly Report, April 2013, pp 39-54.

Depression in the 1930s. One such approach involves forcing banks to cover their customer deposits with reserves held with the central bank. Full coverage would be achieved, for instance, by means of a reserve ratio of 100%. It is extremely questionable, however, whether this can by itself avoid financial cycles – other factors still needed include effective microprudential regulation, rigorous oversight of the banking sector and macroprudential policy. Raising the reserve ratio to 100% could also impair key economic functions of the banking sector, which would probably cause (real economic) efficiency losses (see annex beginning on page 30).

The role of reserves

Reserves reflect interest rate policy and its impact on the monetary aggregate

Thus far, our reflections on the interaction between banks and the central bank have taken no account of the volume of reserves held by banks. However, they are an important factor in the implementation of the central bank's interest rate policy: for a central bank which manages interest rates, the volume of reserves is not an independent variable but is the result of banks' demand at a given interest rate.[33] The central bank therefore estimates demand for reserves at the interest rates it sets and meets it through its monetary policy operations.[34] In this manner, it ensures that money market rates move in line with its policy rates, which constitutes the first step in the monetary policy transmission process.

In this process, therefore, the central bank does not restrict the amount of reserves independently of its interest rate policy. If money and credit growth and the resulting demand for reserves indicate risks to price stability, the central bank adjusts its policy rates. The supply of reserves is therefore elastic only for a given monetary policy stance which the central bank considers as being consistent with price stability.

The development of the ratio of M3 to reserves reflects the actions of the various agents and can change temporarily or permanently whenever banks or non-banks change their behaviour, as well as depending on the implementation of monetary policy.[35] In order to be able to assess and explain these changes, it is therefore necessary to understand the underlying behavioural patterns of the sectors involved and their interaction. Thus, M3 and reserves moved largely in synch at times of conventional monetary policy, ie until the onset of the global financial crisis. The violent fluctuations in the ratio of M3 to reserves observed since then are closely related to the non-standard monetary policy measures taken by the Eurosystem as of 2008, the most recent example being the asset purchase programme (see chart on page 14).

Relationship between reserves and the monetary aggregate dependent on behaviour of banks, non-banks and the central bank

33 Changes in reserves do not cause the central bank's monetary policy implemented by interest rate policy to be transmitted to monetary and credit growth, they are merely a reflection thereof: the central bank sets policy rates in line with its desired monetary policy stance, which impacts on the monetary aggregate and credit volume through the transmission channels described beginning on p 25. In conjunction with other variables, this results in the banking system's demand for reserves, especially in order to meet the minimum reserve requirement on deposits.

34 For more on the operational implementation of monetary policy, see U Bindseil (2014), Monetary policy operations and the financial system, Oxford, Oxford University Press.

35 The ratio of money over the monetary base (reserves plus currency in circulation) is referred to as the "money multiplier". This, however, should not be broadly interpreted as a causal relationship between reserves and the money supply. The money multiplier is a reduced form resulting from the interaction of the various sectors when determining the money supply and the monetary base. See C Goodhart (1989), Money, information and uncertainty, 2nd edition, London, Macmillan, pp 130-137; O Issing (2011), op cit, chapter 6; European Central Bank, The supply of money – bank behaviour and the implications for monetary analysis, Monthly Bulletin, October 2011, pp 63-79. For certain analytical purposes, the simplification involved here may be useful. For other issues, however, it makes sense to look at the driving forces behind the multiplier.

The impact of policy rate changes on money supply and lending

By changing its policy rate, a central bank is able to indirectly influence developments in money supply and in lending. This box illustrates some of the relevant mechanisms in this process using the example of an interest rate increase, ie a more restrictive monetary policy. An interest rate cut, as an expansionary monetary policy measure, has the opposite effect.[1]

In the short run, a higher policy rate increases the costs for (commercial) banks' refinancing via central bank or interbank lending. At the same time, the rise in money market rates is transmitted via arbitrage relationships to yields on other maturities and on other asset classes in the financial markets. When non-banks make their portfolio decisions, bank deposits face competition from these types of investment (eg government bonds, corporate bonds, and shares), which means that banks have to raise their interest rates on short and longer-term deposits to compete for customer deposits. To continue generating sufficient profits from their lending business, banks pass at least part of their higher refinancing costs through to their lending rates, which then dampens credit demand and lending.[2]

In addition, the interest rate increase affects the volume of loans offered by the banking system via the "credit channel".[3] One element in this process is the deterioration in borrowers' balance sheets. First, the fall in asset prices (which corresponds to the yield increases) reduces borrowers' net wealth. Second, the rising interest rates and falling asset prices have a negative impact on businesses' cash flow by reducing the demand for goods. This effect is intensified by the appreciation in the exchange rate due to the interest rate increase. The deterioration in borrowers' balance sheets raises their external financing costs and thus dampens their demand for credit.[4] In addition, there are other channels through which falling asset prices hamper lending: declining collateral valuations and a valuation-related decline in banks' capital that worsens their refinancing conditions (bank capital channel) and can also have a direct effect on credit supply via capital requirements.[5] Furthermore, an interest rate increase may reduce banks' risk appetite or lead them to class lending risks as higher, resulting in a larger risk premium in their lending rates.[6]

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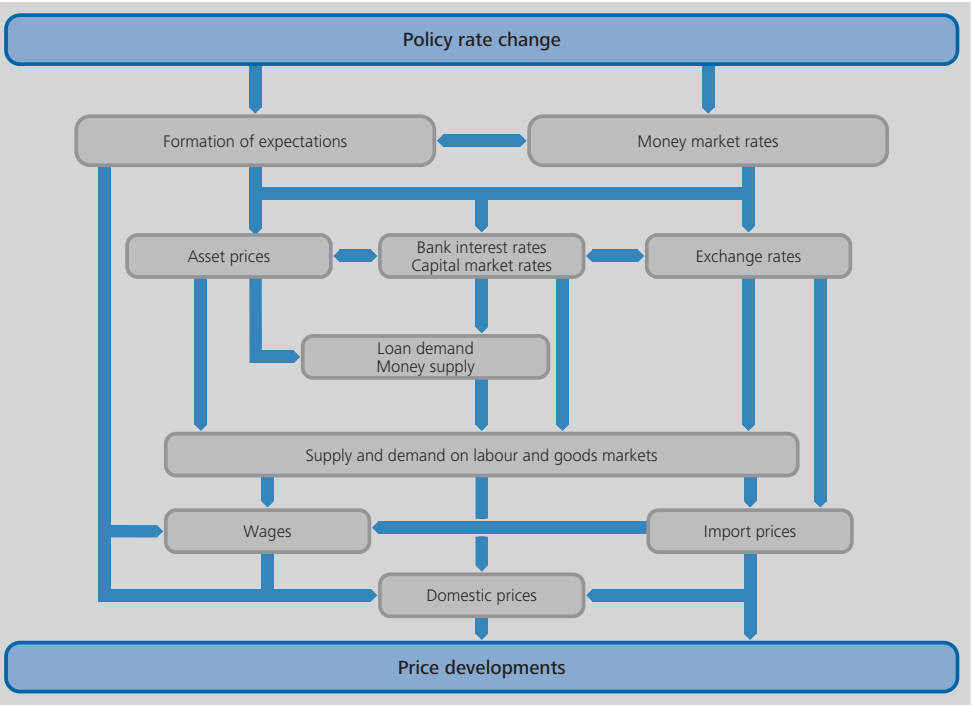
1 The mechanisms outlined here form part of the monetary policy transmission mechanisms, ie the transmission of monetary policy impulses to economic activity and the price level. This description focuses on the elements that are closely interlinked with developments in money supply and lending. For a broader overview, see Deutsche Bundesbank (2015), Geld und Geldpolitik, pp 176-182, or European Central Bank (2011), The monetary policy of the ECB, 3 A, pp 58-61.
2 The mechanisms outlined here make up the traditional interest rate channel of monetary policy transmission; see, for example, European Central Bank, The role of banks in the monetary policy transmission mechanism, Monthly Bulletin, August 2008, pp 85-91. For more information on the interest rate pass-through, see, for example, European Central Bank, Assessing the retail bank interest rate pass-through in the euro area at times of financial fragmentation, Monthly Bulletin, August 2013, pp 75-91.
3 See B Bernanke and M Gertler (1995), Inside the Black Box: The Credit Channel of Monetary Policy Transmission, Journal of Economic Perspectives 9, pp 27-48, European Central Bank (2008), op cit.
4 These effects are due to incomplete information on credit markets. This leads to an external financing premium, ie a mark-up on external financing in comparison with internal financing, which depends on borrowers' balance sheet characteristics, such as net worth or cash flow, or to lending being limited by the value of the available collateral. See B Bernanke and M Gertler (1989), Agency Costs, Net Worth, and Business Fluctuations, American Economic Review 79, pp 14-31; B Bernanke, M Gertler and S Gilchrist (1999), The Financial Accelerator in a Quantitative Business Cycle Framework, in J Taylor and M Woodford (eds), Handbook of Macroeconomics, Vol 1C, Amsterdam, Elsevier, pp 1341-1393; C Carlstrom and T Fuerst (1997), Agency Costs, Net Worth, and Business Fluctuations: A Computable General Equilibrium Analysis, American Economic Review 87, pp 893-910; and N Kiyotaki and J Moore (1997), Credit Cycles, Journal of Political Economy 105, pp 211-248. For an overview of frictions on credit markets and their macroeconomic implications, see C Walsh (2010), Monetary Theory and Policy, 3 A, Cambridge, Massachusetts, MIT Press, chapter 10.
5 See M Woodford (2010), Financial Intermediation and Macroeconomic Analysis, Journal of Economic Perspectives 24 (Fall), pp 21-44.
6 For information on the risk-taking channel, see C Borio and H Zhu (2012), Capital Regulation, Risk-Taking and Monetary Policy: A Missing Link in the Transmission Mechanism?, Journal of Financial Stability 8, pp 236-251; and European Central Bank (2008), op cit.

Transmission of policy rate changes



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Through lower expectations about future income and returns on investment, the lower level of economic activity resulting from the restrictive monetary policy stance additionally has a negative impact on the loan demand of households and firms and on the money demand for transaction purposes, thus dampening developments in lending and money supply even further. The impact of an interest rate increase on lending will often not be mirrored identically by developments in money supply, as the interest rate increase can also lead to portfolio shifts or capital movements that affect other counterparts, such as longer-term financial liabilities or the net external assets of the banking sector.

These observations show that a central bank's interest rate policy influences monetary developments in many different ways. At the same time, its decisions on its monetary policy stance are informed by developments in lending and money supply. However, a central bank's monetary policy is not primarily aimed at controlling developments in money supply and lending but at safeguarding price stability over the medium term. To assess these risks, not just monetary data but also other financial and real economic data are needed, a fact reflected in the Eurosystem's two-pillar strategy, which combines both economic and monetary analysis. A monetary policy strategy aimed at safeguarding price stability over the medium term thus essentially counteracts unwelcome developments in lending and money creation, but cannot always prevent them.[7] To achieve that, monetary policy must be accompanied by microprudential and macroprudential policies with the explicit aim of combating unwelcome developments in the financial system.

7 For a detailed analysis, see Deutsche Bundesbank, The importance of macroprudential policy for monetary policy, Monthly Report, March 2015, pp 39-72.

Asset purchase programmes and money and credit creation

The impact of a public sector purchase programme on money and credit creation will be presented conceptually below.[36] No direct conclusions regarding the programme's potential effects on GDP and prices can be inferred from its impact on monetary developments. The former were already discussed in an analytical article in the June 2016 edition of this publication.[37]

Direct effects on monetary aggregate if domestic non-banks are securities' sellers

Whereas interest rate policy impacts indirectly on monetary and credit growth, the effects on the money supply of an asset purchase programme can be both direct and indirect. Central banks' government bond purchases impact directly on the monetary aggregate only if the end seller is a domestic non-bank.[38] In this case, the transaction leads to an increase in the central bank stocks of government bonds and an increase in sight deposits held by the seller (see upper table on page 28). If the seller does not have a bank account with the central bank, as is generally the case with non-banks, the seller has to settle the payment of the purchase price through the bank where it keeps an account. In this process, the central bank credits the bank with reserves equal to the purchase price.

No direct effects on the monetary aggregate of sales by domestic banks or by non-residents

If, on the other hand, the seller of the government bonds is not a resident of the euro area, the monetary aggregate remains unchanged even if the transaction has been conducted through a bank resident in the euro area, since deposits held at domestic banks by non-euro-area residents do not count as part of the money supply. Crediting the purchase amount to the domestic bank's central bank account, however, also causes reserves to increase. If the central bank buys government bonds from the domestic banking sector's stocks, this does not change the monetary aggregate, either, since the transaction only causes the selling bank's reserves to increase, yet domestic non-banks' holdings of bank liabilities, which are part of the monetary aggregate, do not change (see lower table on page 28).

Indirect effects of asset purchases on money supply and lending

In addition to these direct effects of government bond purchases on money supply, there are also indirect effects on money and credit: these are caused by the adjustments which the securities purchases trigger at banks and non-banks, ie in the transmission process of the purchase programme (see chart on page 29).[39] The relevant economic mechanisms here correspond, in part, to the transmission channels that are relevant for conventional interest rate policy. The purchase programme, however, also operates through different channels from standard monetary policy or "skips" elements of the normal transmission mechanism (see chart on page 26).[40]

Portfolio rebalancing and signalling channels

Through the portfolio rebalancing and signalling channels, government bond purchases bring down the general level of interest rates and yields and cause looser general funding terms, thus reducing funding costs for banks.[41] The banks, in turn, pass on the reduced fund-

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36 For the Eurosystem, this corresponds to the public sector purchase programme (PSPP) as part of the asset purchase programme (APP) adopted by the Governing Council of the ECB in January 2015 and adjusted in December 2015, March 2016 and December 2016.
37 For an analysis of potential effects on GDP and prices and the relevant transmission channels, see Deutsche Bundesbank (2016), The macroeconomic impact of quantitative easing in the euro area, op cit.
38 For a detailed explanation in the context of the consolidated balance sheet of the MFI sector, see Deutsche Bundesbank, How asset purchase programmes affect the consolidated balance sheet of the MFI sector, Monthly Report, November 2016, pp 28-31.
39 Unlike the preceding discussion of how monetary policy constrains the money supply and lending, which focused on restrictive monetary policy measures, the purchase programme is an expansionary measure.
40 For instance, the central bank's interest rate policy impacts on capital market yields via short-term money market rates, while government bond purchases in the capital market affect prices and yields there directly. For more on the transmission channels, see Deutsche Bundesbank (2016), The macroeconomic impact of quantitative easing in the euro area, op cit. The description below is confined to those aspects of the transmission process which are closely related to monetary and credit developments.
41 Banks can, for instance, reduce the deposit rates they pay if the yields on other investment vehicles competing with deposits fall.

Example 3a: central bank purchases government bond from domestic non-bank

Investor X (government bond seller)

Assets	Balance sheet	Liabilities
Government bonds	– 1,000	
Sight deposit with bank A	1,000	

Bank A

Assets	Balance sheet	Liabilities
Reserves	1,000	Sight deposit by investor X 1,000

Central bank

Assets	Balance sheet	Liabilities
Government bonds	1,000	Liabilities to bank A 1,000

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ing costs in the form of lower lending rates, causing demand for credit and lending to rise. As interest rates and yields fall, asset prices rise. All other things being equal, the resulting (balance sheet) gains increase banks' capital. This increase in capital allows them to meet the capital requirements for increased lending. It also improves their funding opportunities and terms, allowing them to expand their loan supply (bank capital channel). At the same time, rising asset prices cause the value of collateral to appreciate and boost borrowers' net wealth. This results in a decline in the external finance premium:[42] essentially, borrowing will tend to become cheaper, which will, all other things being equal, drive up lending.

Example 3b: central bank purchases government bond from domestic bank

Bank B

Assets	Balance sheet	Liabilities
Government bonds	– 1,000	
Reserves	1,000	

Central bank

Assets	Balance sheet	Liabilities
Government bonds	1,000	Liabilities to bank B 1,000

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Falling opportunity costs, rising asset prices and real economic growth push up demand for money

The creation of money through lending results in an increase in deposits. At the same time, however, non-banks' demand for money also grows, owing to the increase in wealth caused by rising asset prices but also to falling yields on alternative investment vehicles, ie the falling opportunity costs of holding money. Inasmuch as, further downstream in the transmission process, the asset purchase programme causes real economic growth and prices concomitantly rise, both these developments trigger positive feedback effects on the money supply and lending.[43]

Effectiveness of asset purchase programme not predicated on direct effect on the money supply

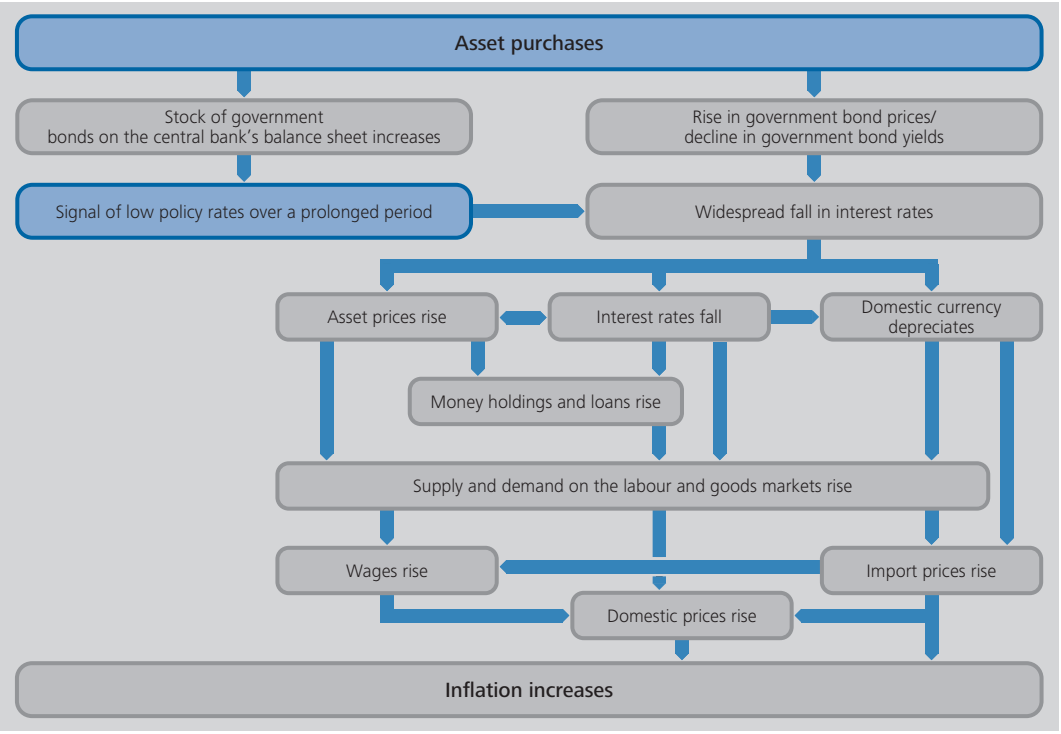
For the transmission channels of the asset purchase programme described above to be effective, it is not imperative that the purchase of government bonds by the central bank lead directly to an increase in stocks of money held by domestic non-banks. Moreover, the indirect effects of the purchase programme on the money supply show changes in the money supply to be a symptom, and not a cause, of transmission.[44] In an assessment of the effects of an asset purchase programme as part of monetary analysis, monetary developments are therefore just one of several relevant variables. They must

42 The external finance premium reflects the mark-up on the costs of external versus internal financing and derives from information asymmetries in the financial markets. See pp 25-26 for more details. Credit growth may be dampened if firms with access to the capital markets substitute bank loans with capital market funding or households or firms at the receiving end of deposits created by lending use these to pay down their bank debt. See J Bridge and R Thomas (2012), The impact of QE on the UK economy – some supportive monetarist arithmetic, Working Paper No 442, Bank of England.

43 However, indirect effects of the purchase programme may also contribute to a reduced impact of the purchase programme on the money supply. For example, if domestic non-banks use accruing deposits to purchase foreign assets, this leads to a reduction in the monetary aggregate M3. However, the asset purchase programme's positive overall impact on the money supply remains intact.

44 A direct increase in the money supply caused by the purchase programme may potentially amplify portfolio rebalancing. Such effects are emphasised in the literature on monetarist transmission channels of monetary policy; see A Meltzer (1995), op cit; J Bridges and R Thomas (2012), op cit; or McLeay et al (2014), op cit.

Transmission process*



* The blue fields denote active intervention in the transmission process by the central bank. For reasons of clarity, the chart does not take into account any feedback effects.

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be assessed in connection with the consolidated balance sheet of the MFI sector and developments in the financial and credit markets.

Increase in reserves may amplify banks' portfolio rebalancing, yet is not a precondition for expanded lending

The steep increase in reserves described above in connection with asset purchases by the central bank can amplify the general decline in long-run yields or the impact of the asset purchases on lending if banks attempt to restore the portfolio structure disrupted by the influx of reserves, for instance by purchasing long-dated bonds or granting additional loans.[45] However, the strong growth in reserves due to the securities purchases does not necessarily lead to a corresponding expansion of lending and the money supply. That depends, rather, on how strongly the changes to asset prices and yields caused by the purchase programme impact on lending and money holdings and on the size of banks' capital buffer.

Impact of monetary policy on monetary growth

In "normal" times, monetary policy operates by setting monetary policy interest rates

It becomes clear, on the whole, that a central bank can influence the banking sector's creation of money and credit, as well as monetary growth, through various channels. In "normal" times, monetary policy operates through changes in policy rates; the monetary policy impulses are transmitted through a variety of channels to the money supply and credit, but ultimately also further down the line to other key variables, such as prices and the real economy. The volume of reserves held by banks, on the other hand, results from the demand for

45 This mechanism can be interpreted as an element of the portfolio rebalancing channel; see J Christensen and S Krogstrup (2016), A portfolio model of quantitative easing, Working Paper Series WP 16-7, Peterson Institute for International Economics.

such, which means that growing reserves reflect the expansion of money and credit.[46]

Asset purchase programme causes reserves to outpace money supply

Unlike interest rate policy, an asset purchase programme directly triggers a strong rise in reserves. Its impact on the money supply, however, is more complex. The immediate direct effect of the asset purchases can, depending on how willing domestic non-banks are to sell, account for only a fraction of the actual purchase volume. This is demonstrated by the example of the APP, in which the Eurosystem purchases a significant share of securities from non-euro-area residents. In addition, the transmission of the APP and its impact on lending are having further indirect, and on the whole positive, effects on the money supply.

On balance, the development of reserves and the monetary aggregate M3 reflect different aspects of the APP. There is no mechanistic relationship between the increase in reserves and broad money. Accordingly, the money supply has not increased in proportion to the manifold increase in reserves; the ratio of M3 to reserves has fallen (see chart on page 14).[47]

46 See pp 24 and 27 for more details.
47 However, the ratio of reserves to the money supply can also increase under a central bank's interest rate policy if banks' behaviour changes. An example of this is the period after mid-2008, shown in the chart on p 14. One of the reasons for the relatively strong rise in reserves in this period was elevated demand on the part of banks compared to the "normal situation", in order, for instance, to accumulate increased liquidity reserves; the Eurosystem satisfied this demand through monetary policy refinancing operations with full allotment.

Annex

Remarks on a 100% reserve requirement for sight deposits

Experiences with the global financial and economic crisis of the last few years have led to a range of regulatory measures which have strengthened the resilience of the banking system. For some critics, however, these measures do not go far enough. In their view, the decisive weakness in the present financial system lies in commercial banks' ability to create money, which critics consider to be a major cause of damaging credit cycles (otherwise known as "boom-bust" cycles). Reforms aimed at making the banking system more stable should therefore, in their opinion, limit money creation by commercial banks. For quite some time now, proposals have been discussed which seek to achieve the full, ie 100%, backing of sight deposits by central bank money. The following remarks explore this idea and explain the conditions under which a 100% reserve ratio prevents money creation by commercial banks and whether that would be economically desirable.

As the main text already states in detail, one central service provided by profit-maximising commercial banks is that they make sight deposits (book money) available by extending loans. Lending business involves reviewing loan requests, granting the actual loans and, given the information asymmetries that exist between the lender and the borrower, requires monitoring of the projects being funded through the loans. In performing this monitoring task, banks have one particular advantage in that they harness economies of scale and so reduce the monitoring costs. As banks usually finance a number of projects simultaneously, by diversifying investment projects they are better able than individual investors to compensate for any default risk.

Although banks invest in comparatively illiquid[48] projects or assets as part of their lending operations, they provide liquid and – in principle – interest-bearing assets (from the banks' viewpoint, these are liabilities) in the form of sight deposits, which promise smoother patterns of return than other invest-

48 Liquidity can be understood as the property of an asset being convertible into other assets. In this respect, (cash) money is normally the good with the greatest liquidity. Hence, the degree of an asset's liquidity can be judged by how quickly and at what cost it can be "converted" into money. See O Issing (2007), Einführung in die Geldtheorie, Vahlen, Munich, p 180. By contrast, and as will be explained in the following, illiquidity means that securities or investment projects can only be sold at short notice by incurring a loss.

ment forms.[49] By making sight deposits available while "simultaneously" investing in illiquid projects, banks provide a maturity transformation service. They create liquidity and give depositors the ability to consume intertemporally, whenever they want to.

Banks can perform the economically important task of maturity transformation because they are better able than individual consumers to protect themselves against liquidity risk (and offer incentive-compatible contracts for sight deposits). As long as the liquidity risks of the individual depositors holding sight deposits with banks do not correlate perfectly, banks can bundle resources (and risks) such that, on balance, they only need to maintain a comparatively small fraction of liquid funds as a reserve and can invest the greater part of the available funds in illiquid and therefore higher-yielding assets.[50]

Thus, the banks can offer depositors short-term sight deposits so that depositors faced with an unexpected need for liquidity are not compelled to sell illiquid assets or long-term investment projects at a loss.[51] From the depositors' viewpoint, this is equivalent to insurance against illiquidity which can be implemented by a banking system maintaining a fractional (ie not a 100%) reserve.[52]

However, this advantage is offset by the risk of a liquidity problem arising in the event that a bank cannot meet demands to repay deposits. If more depositors than anticipated withdraw their sight deposits – not because they need liquidity unexpectedly but because they fear that other depositors may withdraw their money and cause the bank to collapse – this form of coordination among consumers can trigger a run on banks.[53]

The instruments traditionally deployed to counter the risk of a run are the effective monitoring of banks' liquidity risks, credible deposit protection and the possibility for financially sound banks to obtain liquid funds directly from the central bank. Additionally, given the potential insolvency risk, banks are subject to capital requirements.

On the other hand, what would be the consequences of a reserve ratio increase to 100% in the present system? This scenario is worth pursuing, not least because it demonstrates that the level of the reserve ratio in itself would have little impact on the banks' lending capacity.[54] This finding, which may seem surprising at first glance, is owed to the fact that central banks do not steer credit dynamics through the central bank money stock but by how they set the key interest rates. Central banks use their liquidity management to accommodate higher minimum reserve requirements – at the appropriate interest rate level for monetary policy purposes – which do not directly affect lending and, therefore, the provision of sight deposits by banks. Since the reserves are factored into the banks' optimisation calculation as a cost factor, the amount of the reserve ratio could in principle narrow the profit margin and thus indirectly affect lending and the provision of sight deposits. However, this indirect influence on the margin is essentially irrelevant, as central banks worldwide now pay interest on the required minimum reserve holdings in the amount of the refinancing costs (rate for making central bank money available). Taken in isolation, with regard to the payment of interest on reserves, lending and thus the provision of liquidity are not constrained by already existing sight deposits or by reserve holdings.[55]

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49 The demand for liquidity is closely linked to the uncertainty of investors and consumers over the point in time at which they will need (additional) liquidity. As a general rule, they will try to hedge against liquidity or consumption risk in order to achieve a smooth consumption profile over time (depending on how averse to risk the investors and consumers are). As Diamond and Dybvig (1983) have shown, resorting to the capital market in order to safeguard against illiquidity is not necessarily the best possible solution, and direct insurance against illiquidity is virtually impossible due to (assumed) information asymmetries between the investors and the insurers. Technically speaking, an insurance contract of this kind is not incentive-compatible. See D Diamond and P Dybvig (1983), Bank runs, deposit insurance, and liquidity, Journal of Political Economy 91, pp 401-419; and X Freixas and J Rochet (2008), op cit.

50 The amount of reserves therefore depends crucially on the aggregate share of those consumers who will be exposed to liquidity risk.

51 If the bank itself has to sell the illiquid assets it holds "prematurely", however, it will likewise sustain losses. See the comments on bank runs.

52 See X Freixas and J Rochet (2008), op cit, p 221.

53 It is assumed here that the central bank is not willing to meet the additional liquidity needs as lender of last resort. Such a bank run occurs when the nominal value of the sight deposits is greater than the liquidation value of the bank's assets assuming investment projects are liquidated prematurely. See D Diamond and P Dybvig (1986), Banking theory, deposit insurance, and bank regulation, Journal of Business 59, pp 55-68. Moreover, besides interest rate risk, banks are also subject to insolvency risk, as the percentage of loans that will not be repaid is not known beforehand.

54 See also H Rodriguez Mendizábal (2017), Narrow banking with modern depository institutions: Is there a reason to panic?, ADEMU Working Paper Series 2016/052.

55 As the main text explains in detail, other factors limit lending and, therefore, money creation – not least of all the central bank's interest rate policy.

Nevertheless, it cannot be concluded from this that bank lending is wholly "immune" to the level of the reserve ratio, even when interest is paid on the reserves. This is because, as higher central bank refinancing becomes necessary due to an increase in the reserve ratio, banks themselves have to put up more eligible collateral for the required amount of reserves. The stricter the regulatory requirements regarding the collateral framework are, the likelier it is that a reserve ratio hike to 100% will be accompanied by a corresponding tightening of the provision of credit and liquidity.[56] But this does not alter the fact that a 100% reserve ratio does not in itself prevent money creation by banks. Rather, the full backing of sight deposits by central bank money means that, in addition, the institutional prerequisites or existing regulatory requirements must be changed in such a way that money creation by commercial banks is effectively no longer possible.[57]

Irving Fisher and other renowned economists formulated such a proposal as long ago as the 1930s.[58] In order to curb the volatility of credit dynamics and the associated fluctuations of sight deposits (and therefore of the M1 monetary aggregate), Fisher advocated requiring banks to maintain permanently a reserve ratio of 100%, ie sight deposits would be fully backed by central bank money.[59] Yet beyond that, his proposal aimed to rid commercial banks entirely of the ability to create book money.[60] Fisher's proposal envisaged a "currency commission", which would be set up by the government and be given the exclusive right to create money. Endowed with this right, the currency commission – if a 100% reserve system were put in place – would buy bonds or other assets of the commercial banks or (alternatively) grant them a loan to enable the banking sector to fully cover the sight deposits on the liabilities side of the balance sheet with (cash) reserves. Following this idea, the banking sector would lose its power to create money; banks would simply be credit brokers between depositors and borrowers. Were the central bank to perform this task of the currency commission, it would provide the central bank money. De facto, this would be equivalent to a system in which the depositors would have access to central bank accounts.

The switch to a 100% system would transfer the right to create money to the public sector – but not lending, which would remain the responsibility of the commercial banks. However, in line with Fisher's intention, there would be a clear separation within the banking system between "lending business" (the "credit" department or sector) and "deposit business" (the "sight deposits" department or sector). Under such a system, the credit department could grant additional loans only if it increased its capital, generated income from its lending activities or acquired liabilities in the form of savings, the maturities of which largely matched those of the loans on the asset side of the bank's balance sheet.[61] Consequently, the credit department would not, as it were, engage in maturity transformation and therefore could not perform a key function of the banking sector. Such a financial system without maturity transformation would likely lead to considerable welfare losses:[62] it would be more difficult in a system without the maturity transformation function to reconcile the preferences of long-term-oriented investors with any short-term liquidity needs they might have. Given the potential economic cost of changing the system, the question arises as to whether the benefits could outweigh the drawbacks.

Fisher himself was unable to empirically examine the benefits he hoped his proposal would yield, and

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56 One possible consequence would be a lower volume of funds becoming available to the private sector for financing purposes. This would lead to a "crowding out" of private demand for credit and potentially to adverse effects on an economy's long-term growth prospects. See also A Admati and M Hellwig (2015), The parade of the bankers' new clothes continues: 31 flawed claims debunked, mimeo, p 27.

57 Some proposals go even further. For example, it is often described how changing to a system under which money is created by public institutions instead of banks could be used to reduce public (and, if need be, private) debt. This aspect will not be pursued further in this annex.

58 I Fisher (1935), 100% Money, The Adelphi Company, New York City.

59 The original initiative along these lines was launched in 1933 by a group of Chicago economists including Frank Knight and Henry Simons, and was known as the "Chicago Plan". For an extensive summary of Fisher's proposal and the Chicago Plan, see R Phillips (1995), The Chicago Plan and new deal banking reform, M E Sharpe, Armonk (NY).

60 In the long term, Fisher expected a more stable macroeconomic environment (in which boom-bust cycles would not be expected or would be significantly less pronounced) to lead to an increase in savings and, consequently, a lower interest rate level on the capital markets. Fisher believed that this would result, among other things, in a steeper economic growth path.

61 Only in exceptional circumstances, if the credit department were unable to satisfy sufficiently quickly the increased demand for credit out of its own funds or in its function as intermediary between savers and investors, would the currency commission intervene as a safety valve, so to speak, and engage in refinancing operations with the lending bank.

62 See D Diamond and P Dybvig (1986), op cit; and X Freixas and J Rochet (2008), op cit, pp 220 ff.

there has been no evidence to date of how such a system would perform in monetary policy practice.[63] The only way to examine central implications of such a proposal today is to conduct model-theoretical studies. One such study was recently carried out in the context of a dynamic general equilibrium model.[64] Here, the authors model two policy regimes. The first represents the existing system in which book money, as described in the main text, is created as a result of the interaction between banks and non-banks in the lending process. The second regime represents the 100% system. Under it, the bank first has to place the funds needed for lending with the currency commission. In other words, in a departure from Fisher's idea, the currency commission permanently refinances the lending by the "credit department".[65]

The first regime serves as a reference for examining Fisher's stabilisation hypothesis in the context of a boom-bust scenario. This scenario assumes a lower assessment of credit risk by the financial sector over several years (boom), a trend which is "one day" (by assumption) abruptly reversed (bust). Although the authors capture, to an extent, some of the long-term benefits that Fisher hoped would be achieved, they are unable to provide convincing evidence for his expectation that macroeconomic developments would be stabilised. Notably with regard to aggregate output and inflation, the desired stabilisation effect does not set in per se solely as a result of the changeover to 100% reserves. Rather, in the model context it only materialises after an additional macroprudential rule is introduced which requires a countercyclical adjustment to the capital ratio of banks (although Fisher and others abstracted from it).[66]

To conclude, it may be said that a reserve ratio increase to 100% would not necessarily bring about a stabilisation of macroeconomic growth. It would be wrong to assume that restricting money creation for a part of the financial system ("sight deposits" sector) would in itself be sufficient to make the entire financial system resilient. This would continue to require effective regulation, supervision of the banking sector and a macroprudential policy. The restriction of money creation for the entire financial system as envisaged by Fisher, on the other hand, means that an important function of the banking sector, namely the creation of liquidity (maturity transformation), would be curtailed. Moreover, there is a risk of evasive action being taken in that new, non-regulated institutions could be set up to fill the gap. There is no a priori reason why these new intermediaries should be more resilient (or even immune) to a run than the banks that exist at present. It therefore appears questionable to assume that these proposals could be implemented without further regulation or at little economic cost.

From the present perspective, the strengthening of the resilience of the financial system as a whole needs to be achieved by other means, notably by boosting its capital base as well as developing and expanding an effective macroprudential toolkit.[67]

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63 Subsequent prominent advocates of the 100% reserve, such as Milton Friedman in the 1950s and 1960s, were likewise only able to present plausibility considerations and argued for the most part in writing. See M Friedman (1959), A Program for Monetary Stability, Fordham University Press, New York City.

64 See J Benes and M Kumhof (2012), The Chicago Plan revisited, IMF Working Paper 12/202.

65 In a sense, this contradicts Fisher's idea of separating lending and money creation, as the loans are financed by central bank money. This means that maturity transformation remains indirectly ensured. However, the lending banks' solvency risk no longer rests, as Fisher envisaged, with the private depositor but with the central bank.

66 Fisher's proposal throws up other problems besides. These include a possible shift into near-money liabilities which could be issued by the banking sector as well as challenges in monetary policy practice that are linked to the estimates of potential growth.

67 See Deutsche Bundesbank (2011), op cit. Another major reform in Europe with respect to financial stability was the launch of the European banking union, one of the central pillars of which is the Single Supervisory Mechanism (SSM), which commenced operations in November 2014. Setting up the SSM entailed the transfer of extensive microprudential and macroprudential powers to the European Central Bank. See Deutsche Bundesbank, Launch of the banking union: the Single Supervisory Mechanism in Europe, Monthly Report, October 2014, pp 43-64; and Deutsche Bundesbank, Implications of the banking union for financial stability, Financial Stability Review 2014, November 2014, pp 69-88.