(primary) current account? (Hint: think of the impact on the interest rate, on private wealth, and on stock prices.)

11 Over the next 10 or 20 years, Greece, Portugal, and many other European countries will have to raise taxes to reduce their public debts. What does this mean for consumption, now and in the future?

12 In Ireland, Spain, and the UK, housing prices increased considerably over the 2000s, until they fell abruptly in 2008. Is there any reason why this price decline should affect consumption?

Essay Questions

1 A great deal of debate has arisen in Germany on the financing of the expenditure necessary to improve the much-neglected infrastructure in its new eastern states. One side favours increased taxes, which would fall largely on households. The other side favours an increased budget deficit. Which side is right? How important is it to know whether the spending increase is permanent or temporary?

2 Should wars—temporarily but abnormally high expenditures of the government—depress or raise consumption of households? In formulating your answer, think about all the budget constraints discussed in Chapter 6.

3 Over the past 20 years the price of computers and software—an essential investment good for modern companies—has dropped steadily. At the same time, the rapid rate of technical change has increased the rate of obsolescence of equipment and programs. In addition, the development of new service companies has made it easier to install and employ these new innovations. Explain, carefully, using the concepts you have learned, how these developments should affect the user cost of capital, Tobin's q, and investment.

4 The public debt crisis forces some countries to precipitously cut their budget deficits because governments cannot borrow any more. Most raise taxes on households and firms, which are taxpayers. Some economists argue that this is a self-defeating strategy. What is your view?

5 Booming economies frequently show negative current account balances. International organizations like the International Monetary Fund must often judge whether a current deficit is 'good' or 'bad'. Explain what this might mean or imply. Use your answer to interpret the case of Poland: in the period 2003–2007 Poland grew 5.1% per annum, as compared to 2.4% in the EU. During this period the current account deficit was 2.6% of GDP, declining from an average deficit of 4.6% of GDP in the period 1998–2002.

Money and Interest Rates

9

The invention of a circulating medium, which supersedes the narrow, cumbrous process of barter, by facilitating transactions of every variety of importance among all sorts of people, is a grand type of advance in civilization.

Chambers *Encyclopaedia*, 1870

Money frees you from doing things you dislike. Since I dislike doing nearly everything, money is handy.

Groucho Marx (1890–1977)

9.1 Overview

Until Chapter 5, we discussed the macroeconomy in real terms, that is, things that really matter—goods, labour, capital, technology. But goods are rarely exchanged in barter for goods or for labour. Workers' wages, interest rates, and profits are not measured in goods for that matter, either. In fact, introducing money was an essential step towards a market economy: it establishes a means of payment which does not in itself use up resources. In addition, money is a measuring rod for the value of goods, labour, and assets in a common, value-neutral way. Instead of stating wages and prices in haircuts, cigarettes, or cups of coffee, or weeks of rent, we quote them in pounds, dollars, euros, or yuan. In Chapter 5, we saw that the monetary neutrality principle implies that the sheer volume of the money stock should not affect our standard of living directly. Rather, as the great Scottish philosopher and economist David Hume put it, money is 'not, properly speaking, one of the subjects of commerce; but only the instrument which men have agreed upon to facilitate the exchange of one commodity for another. It is none of the wheels of trade: It is the oil which renders the motion of the wheels more smooth and easy.'[1]

Even if it is merely the oil which lubricates the wheels of our economic system, the quality of that oil matters. At the very minimum, money has this **convenience function**. It also represents wealth, it is widely accepted, it can be readily exchanged for goods and services and it is a yardstick for the value of goods and services. It also creates a veil which can mask the real value of those things. In addition, money plays a crucial role in determining the interest rate, which drives financial markets (Chapter 7). So far, we never really explained what money *is*, or who creates it, how it does so, and for what purpose. Answering these questions is the task of this and the next chapter. It seems strange to have to explain something that we use every day, yet it is surprising how little most people understand what it is.

We will start by defining money. We will then look at the supply of money, where in fact it comes from. This will lead us to introduce the central bank, an important institution with great influence over the supply of money and monetary conditions in general. The next step is to study the demand for money. When this is done, we will be ready to see how demand and supply are equilibrated in the money market, as well as how that market works. Along the way, we will discover how money is created, in a complex dance between the central bank, the banking system, and the real economy. Finally we will ask hard questions about the future of money in our economic lives.

[1] Hume (1752) *Essays, Moral, Political, and Literary*: Part II, Essay III, 1.

9.2 Money: What is it and Where Does it Come From?

Virtually every civilization has used one form of money or another. We have defined money as a form of wealth—a means of transferring consumption across time—which is generally and readily accepted by others in market transactions. Despite its very low rate of return—banknotes yield no interest at all—people and companies use it. This is because money uniquely facilitates commercial transactions, big and small alike. As a result, it lies at the heart of any economy.

The nineteenth-century British economist William Jevons defined money in his time as having four attributes or functions: (1) means of payment, (2) unit of account, (3) store of value, and (4) standard of deferred payment. These features described well the coins and sterling banknotes as well as the growing use of paper cheques, promissory notes, and other negotiable instruments of his day. Yet do they describe adequately what we use today and what we will use as money in the future?

9.2.1 Technical Definitions of Money

Despite our definition of money, there is room for disagreement on the details. Most of us would agree that banknotes and coins are money. But what about bank account balances? Savings accounts? Other financial instruments? Foreign exchange? Bitcoin? Once upon a time, only gold, silver, and other commodities were used as money in the form of coins or bulky ingots. Over time, paper money (banknotes) edged out these **commodity monies**. Paper money 'backed' by commodity money became the dominant form of money by the end of the nineteenth century. At the beginning of the twentieth century, central banks began issuing paper money and coins that were not really backed by any precious metal. Devoid of any intrinsic value, **fiat money**—from the Latin word '*fiat*' meaning 'let it be done'—is legal tender simply because the government decrees it to be. Money changed again with the widespread use of bank accounts for making payment, technically known as sight deposits or demand deposits, which can be converted at banks for cash on demand or accessed at points of sale using 'debit cards'—electronically secure pieces of plastic that grant their owners rapid and safe access to means of payment. In a growing number of countries, including those with only poor access to banking services, smartphones have assumed this function.

To understand the nature of money is to understand that it is accepted by others as a means of payment. Paper money arose as a convenient way of safekeeping precious metals; a certificate of gold ownership issued by a trustworthy trustee of gold and silver was as good as the real thing. Other IOUs (IOU = 'I owe you') also emerged over the ages as a means of payment. Bills incurred by individuals, banks, or companies of excellent reputation have also been accepted as payment for hundreds of years, but not by everyone. In the nineteenth century, there were doubts whether paper money could ever be as trustworthy as coins made from precious metals. Today, we use paper cash or metal coins—together known as **currency**—to pay for whatever we want to buy without caring about lack of intrinsic value of the banknotes. In many countries, currency itself is slowly becoming something of a relic. Figure 9.1 displays the stock of currency in circulation as a proportion of nominal GDP.

The figure shows two different trends in the four different monetary areas. In the UK and the US, the demand for currency is stable, even slightly rising since 2000 (to be sure, more than half of US cash circulates outside the country!) In contrast, the volume of currency used in Sweden and Norway has fallen sharply. What do Swedes and Norwegians use instead? To pay for the goods or services or houses or assets they buy, they increasingly move funds electronically using the internet and computer terminals or smartphones, which

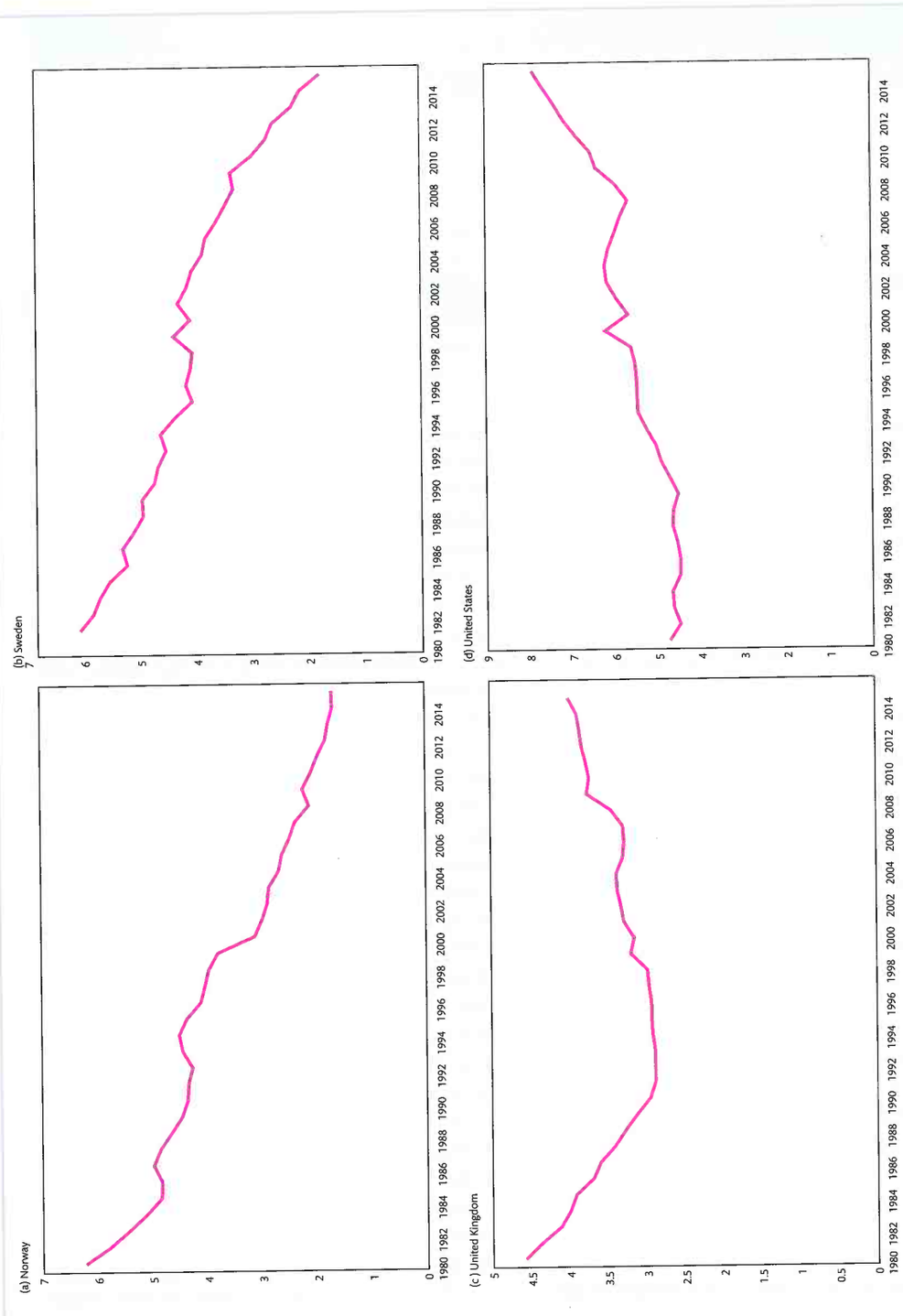


Fig. 9.1 Currency in Circulation (in per cent of nominal GDP)
The stock of currency (banknotes and coins) is displayed in relation to GDP in four countries. In the two Scandinavian countries, it is clearly trending downwards, reflecting the increasing use of sight deposits to pay for goods and services, accessed instead by bank transfer, credit, and debit cards. In contrast, the use of cash in both the UK and the US exhibits a slightly increasing trend, due most likely to increasing circulation of banknotes abroad as well as a rising tendency to underdeclare market income.
Source: IMF.

means that they transfer ownership of parts of their bank accounts to others. What are bank accounts? They are liabilities of banks. As Table 9.1 shows, most of what macroeconomists consider to be money is in fact bookkeeping entries in bank ledgers—that is, bank accounts. Most people see little difference between coins, banknotes, and bank deposits, and treat them as almost identical in transactions. This is our first definition of money: currency in circulation plus immediately accessible, or 'sight' deposits. This **monetary aggregate** is known as M1:

M1 = currency in circulation + sight deposit accounts at banks.

Sight deposits at banks—commonly known as 'giro', cheque, or current accounts—have three main characteristics: (1) they may be converted into cash on demand at the issuing bank, (2) cheques can be written or bank transfers can be made against them, and these claims are accepted by other banks, (3) the interest paid on those deposits is either nil or very low. They are convenient for making purchases, but not particularly attractive as a way of holding wealth. This is why banks often offer other types of accounts that bear higher interest rates, but whose funds cannot be used as easily as normal money—i.e. by writing cheques or stopping at a cash machine. Yet such funds can be conveniently transferred into regular sight deposits—usually a few keystrokes on a smartphone and an internet connection are enough, possibly with a little waiting time on top. Ease of transfer renders these assets very similar to sight deposits in the eyes of their holders. This is why they are included in a broader definition of money, M2:

M2 = M1 + time (or savings) deposits at banks with unrestricted access.

An even broader measure includes instruments such as large certificates of deposit, or time deposits with a longer term and possibly restricted access, foreign currency deposits, and deposits with non-bank institutions. The precise meaning of 'larger' and 'longer maturity' depends on national rules and regulations. The distinction is one of degree: these instruments are less liquid, meaning that they are more costly or difficult to convert into cash or demand deposits. Thus the definition of M3:

M3 = M2 + larger, fixed term deposits + accounts at non-bank institutions.

Because M1 is highly liquid, it can be used for commercial transactions, unlike the other components of M2 and M3, which must generally be converted into M1 for that purpose.

Every country has its own preferences for means of payment and it is not surprising that definitions of monetary aggregates differ across the world. For instance, the Bank of England focuses on M4, a concept slightly wider than M3. While not fully comparable, the examples in Table 9.1 show that, in the UK, people use less cash than on the continent and in the USA, but that the other monetary aggregates are proportionately larger—a sign of more sophisticated retail banking. Indeed, in Poland, the difference between M2 and M3 remains small, suggesting that customers do not yet have access to higher-yield bank deposits in M3 or that these are not very attractive relative to the more liquid alternative M2.

The pace of technological development in banking has revolutionized the definition of money over the past century, and more change is certainly in store. Many believe we are not far from the limit of this process, a cashless society that the Swedish economist Knut Wicksell once imagined and which is described in Box 9.1; indeed, Figure 9.1 and Table 9.1 suggest that the Swedes themselves are leading the charge. We will generally refer to money without being specific about its definition, calling it simply M and thinking of it as:

M = currency in circulation + bank deposits.

9.2.2 The Money Makers: Central and Commercial Banks

Table 9.1 shows that currency (coins and banknotes) is only a small fraction of what we call money, regardless of the definition we use. Bank deposits—liabilities of the banks—make up the

Table 9.1 Money in Five Places, 2015

		Currency	M0	M1	M2	M3
United Kingdom	(£ bn)	67.4	373.3	1464.3	2130.6	2401.3
	% of GDP	3.6	20.0	78.5	114.3	128.8
Euro Area	(€ bn)	1110.8	1930.8	6630.8	10234.5	10836.8
	% of GDP	10.7	18.6	63.7	98.3	104.1
United States	($ bn)	1380.8	3611.4	3147.0	12401.5	
	% of GDP	7.7	20.1	17.5	69.1	
Poland	(Zl bn)	163.0	215.0	692.1	1145.7	1155.4
	% of GDP	9.1	12.0	38.7	64.0	64.6
Sweden	(SEK bn)	73.5	144.4	2289.4	2728.9	2788.7
	% of GDP	1.8	3.5	55.1	65.7	67.1

Note: US stopped publishing M3 statistics after 2006.

rest. While currency is produced by the so-called monetary authorities—the central bank and/or the Treasury—the bigger part, **bank deposits**, is created by commercial banks. Think of bank deposits as liabilities of banks—effectively what they owe to their customers.

It may surprise readers that money is actually created by the private sector! Although it is seen as a symbol of national identity, most modern money is not directly produced by the government or a government agency. How does that happen? Can banks do this without limits? Ultimately the answer is no. First, deposit-talking banks create money only if it is profitable for them to do so. Second, and perhaps more importantly, they create money under the control and supervision of the central bank. This is what we now examine.

Box 9.1 Wicksell's Cashless Society

Once upon a time, money was gold or silver, or seashells, or large stones on South Pacific islands. Such commodity money has an intrinsic value, since it can be used for other purposes. These goods are 'wasted' when used as money, and this is one reason why paper and cheap metal have replaced silver or gold. A century ago, the Swedish economist Knut Wicksell (1851–1926) went further. He asked: why have money at all? He envisioned a central record keeper who would keep a tally of all credits and debits. Whenever an individual worked, his balance would be credited; whenever he spent, the balance would be debited. In principle, it would be possible to run a negative balance, i.e. to borrow from the system, as long as the debt was repaid. Instead of producing currency, the central bank would simply operate and guarantee this record-keeping system and determine the value of the unit of account.

At the time, Wicksell's moneyless society was dismissed as impractical science fiction. A century later, the technical problems of a 'moneyless society' have been largely solved. Computers and the internet allow accurate, up-to-date record-keeping and investigate the creditworthiness of households and businesses. Credit and debit cards already represent the preferred means of payment. Because banks regularly exchange information about the creditworthiness of their customers, the use of credit cards has made it easy to borrow money in most countries (up to agreed limits). While credit cards themselves do not represent money per se, they allow individuals to access credit—which takes place at the same time as money is created and paid to the vendor of goods or services purchased with the credit card. Throughout Europe, payments systems have been introduced, some more successful than others. All can be activated by a few keystrokes on the computer or a handheld telephone. Some of the greatest strides have been made recently in Africa, where the low cost of cellular phones and internet access has made it easy to leapfrog older, traditional forms of payment.

Central banks

The central bank is a public or quasi-public agency with an explicit, exclusive legal mandate to control money and credit conditions.[2] Think of it as the 'bankers' bank'. Just as households and firms keep money at the bank to execute their daily transactions, banks themselves maintain deposit account balances at the central bank.[3] They can use these funds to settle payments against other commercial banks, for example, when customers transfer funds from one bank to another. Central banks generally do not take deposits from households and firms. However, they often serve as the bank for the national and local governments in which they reside.

Central banks produce two sorts of money. Both represent liabilities vis-à-vis those who own them. One is currency, that is, banknotes held by the non-bank public (households, firms, government), including coins. These liabilities of the central bank can be verified simply by inspecting a banknote, sometimes in fine print.[4] Second, they create **bank reserves**, those funds held by commercial banks at the central bank. Bank reserves do not circulate outside commercial banks, but they can be used immediately and thus are close substitutes for currency. The sum of currency in circulation and commercial bank reserves is known as the **monetary base**, and is known as M0. Other terms sometimes used are 'high-powered money', 'base money', or 'central bank money'.[5]

Table 9.1 shows that M0 is not much larger than the amount of currency in circulation, implying that the reserves of commercial banks are relatively small. Yet, the supply of bank reserves is the tool through which central banks can control money creation by commercial banks.

Commercial banks

Most people associate banks with the taking of funds from depositing customers and lending to others who want to borrow. As discussed in Chapter 7, this is why they are also called **financial intermediaries**. But in fact, banks play many different roles in our economic lives. They advise customers on how to manage their wealth, provide insurance, and may even trade financial assets on their own account. Most important, they are custodians of the **payments system**: they create most of the means of payment and enable households, firms, and governments to transact with each other. These functions are all intimately related. During the financial crisis which

[2] The Bank of England was a private institution from its founding in 1694 until it was nationalized in 1946. Similarly, the Banque de France began its existence in 1800 as a private entity and nationalized in 1945. The Deutsche Bundesbank was established in 1949 as a post-war successor to the Deutsche Reichsbank, founded in 1876. The oldest central bank is the Swedish Riksbank, founded in 1668. Other central banks are: Bank of Japan, 1882; Banca d'Italia, 1893; Austrian National Bank, 1816; Swiss National Bank, 1905. The Federal Reserve of the USA started out in 1913 and is owned by member banks, although profits above a statutory maximum are remitted, as in most countries, to the government (Goodhart 1988).

[3] Details vary from country to country, and sometimes smaller banks can satisfy their clearing needs by using a much larger partner, 'correspondent' bank. The central bank performs this function for the largest of banks.

[4] For example, pound sterling banknotes are marked 'Bank of England' and by the Queen's promise 'to pay the bearer on demand the sum of … pounds', reminiscent of times past when they could be redeemed for gold or silver. The currency of the euro area is marked simply with 'ECB' and the equivalent abbreviation of 'European Central Bank' in other languages of the European monetary union. US banknotes simply feature the words 'Federal Reserve Note'.

[5] Bank reserves and currency are highly substitutable for each other. To guarantee this, the central bank prints and warehouses (under great security) large quantities of banknotes ready to be converted at a moment's notice for bank reserves. A bank need only place a telephone call and the banknotes will be delivered to the commercial bank, usually in an armoured truck. Until the moment of delivery, however, those banknotes are simply paper.

Box 9.2 Money, the Payments System, and the Role of the Banks

We saw that money has many functions in our economy. The most important is the means of payment. While banknotes are **legal tender**—that is, decreed by law to be acceptable in transactions, they represent only a small fraction of the money supply that we call M1 or M2. The bulk of the money supply is made up of claims on the banking system (look for those liabilities in Figure 9.2). In most countries, banks are privately organized entities; so why are claims on banks owned by firms and households generally accepted as a means of payment? Several things are necessary: (1) credibility of the deposit-issuing bank, (2) trust of the owners of the deposits, (3) trust of those who accept the deposits, and (4) trust of other banks involved in the transactions. Trust and credibility among banks are the most important ingredients of the monetary system. Banks lend to each other and hold demand deposits with each other. While they can always 'clear' debits and credits with the central bank, much clearing is done without the central bank's direct involvement. In the next chapter, we will see that the regulation of banks also increases trust in their activities.

All around the world, the financial crisis 2007–2008 severely damaged the credibility of banks and destroyed trust that they had in each other. Assets owned by some banks lost a great deal of value in a short period of time. Because information is incomplete, many depositors and creditors simply assumed that their own bank was also involved, either that they were hiding their investments in offshore operations ('vehicles') or were themselves a depositor at a troubled bank. Banks began to wind down (sell off, cash in) their asset holdings and call in their money lent to other banks. While reducing these loans does not affect the money supply directly—remember that only deposits held by *non-banks* count as money—many financial institutions were thereby forced to call in loans to non-banks to generate liquidity. This activity had real consequences, leading to a 'liquidity squeeze'. In Chapter 10 we discuss in detail how the collapse of trust and credibility has attenuated the ability of monetary policy to affect credit conditions in the economy.

Paying insufficient attention to banks can have dire consequences, as the experience of the euro—one of the greatest macroeconomic experiments in modern times—has shown. While the introduction of the common currency in 1999 (bank reserves) and 2002 (banknotes) is generally considered a stroke of technical genius, the role of banks in creating the money supply was largely ignored. Insufficient integration of national banking systems, lack of coordination of national deposit insurance, and the failure to introduce uniform euro-area banking regulation remain unsolved issues of the euro area.

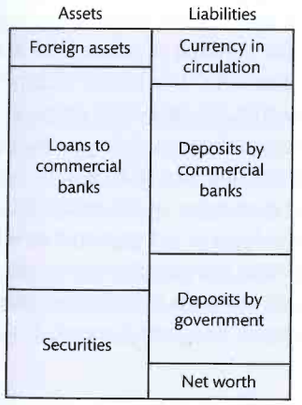
started in 2007, the payments system was under threat because other functions had run into difficulties. It started first in the United States and Ireland, spread to the UK and the European continent, and continues to leave its trace on the macroeconomies of the world today. Box 9.2 gives an impression of the role and importance of banks in that crisis.

When you deposit money in your bank, you may have assumed that it is there, waiting for you to withdraw or spend it whenever you would like. In fact, the money you deposited was most likely lent to one of the bank's many customers. For the bank, your deposit is a liability of immediate or short maturity, most frequently 'due on demand', sometimes after some period of notice. For this reason they are often called 'demand deposits' or 'sight deposits'. Banks make loans to people who buy cars or houses, or to firms that buy inventories, raw materials, or wages, and these loans are generally paid back over months or even years. These loans are the bank's assets, and they tend to be of much longer term or maturity than its liabilities.[6] The practice of taking on short-term liabilities and using them to acquire long-term assets is called **maturity transformation**.

Maturity transformation is the primary business model of banks—borrow short, lend long. In doing so, they provide an important **liquidity service** to lenders: the ability to convert more profitable loans into cash in short time. Although it is standard practice, maturity transformation is a fundamentally risky activity, and this is why banks are regulated. To see why, it is useful to present a snapshot of the state of a bank's financial operations, its **balance sheet**. The balance sheet is a summary statement of what the bank owns—its assets—and what it owes—its liabilities—at a particular point in time, such as the end of the year. Figure 9.2 presents a simplified balance sheet of a typical bank. The balance sheet shows that the bank's primary liability is the deposits of its customers. Additionally, it may have borrowed funds from the central bank. On the asset side, a commercial bank keeps some cash in its vaults or as a deposit (bank reserves) with the central bank. It also holds various securities that can be traded on financial markets. Its main activity, however, is to make loans. These loans are assets, since its customers owe them to the bank. The excess of assets over liabilities is the bank's net worth. Net worth is treated like a liability on the balance sheet since the bank 'owes' the net worth to its owners.

To see why maturity transformation can be risky, imagine that all customers of a bank withdrew all the money that they had deposited. This would be their right, because those deposits are means of payment, perfect substitutes for cash; banks are legally obligated to convert these deposits on demand into currency. Since most of the money has been lent out, it is no longer in the bank. A mass conversion of deposits to currency at short notice would simply be impossible, despite the fact that the bank is a going concern with positive net worth. Such sudden, overwhelming surges of withdrawals are called **bank runs** or **bank failures**.

In a sense, every bank is gambling that such an event will not happen, just as insurance companies do not expect everyone's house to burn down on the same day. Bank runs are unlikely events associated with widespread panic; they are usually caused by worries about the financial health or solvency of one particular bank which is presumed to suffer large losses from disappointing deals. When a run occurs, the afflicted bank is unable to meet its obligations and it must close, leaving



UniCredit Bank (consolidated), December 31 2015, EUR millions

Assets		Liabilities	
Demand deposits at ECB and cash	10303	Liabilities to central bank*	28412
Financial assets held for trading	90997	Deposits from customers	449790
Loans and receivables with customers	473998	Deposits from other banks	111373
Loans and receivables with banks	80073	Other liabilities	220771
Other assets	285135	Net worth	50087
Total assets	860433	Total liabilities plus net worth	860433

Fig. 9.2 Balance Sheet of a Typical Commercial Bank, Abstract and Concrete

The left-hand side of Figure 9.2 is an abstract representation of a commercial bank's balance sheet. The right-hand side displays the balance sheet of a prominent euro area financial institution which is active in many countries.

Source: UniCredit S.p.A., 2015 Consolidated Reports and Accounts, authors' calculations.

**Refinancing operations collateralized by securities and loans.*

[6] The term or maturity of an asset was discussed in Chapter 7.

angry customers pounding at the door, unless it can be rescued or 'bailed out', either by another bank or the government in some form.[7] A **bailout** simply means that depositors, creditors, and owners are shielded from losses that they would incur, had the bank gone out of business.

So why, you may ask, is the economic system willing to trust bank deposits—backed by loans to the economy made by commercial banks—as Hume's oil to grease the wheels of commerce in the first place? There are two good reasons. First, it is in the business interest of any commercial bank to be seen as acting responsibly. Any fear can trigger a bank run, which normally leads to bankruptcy. Second, banks are tightly regulated and supervised, precisely to reassure their customers that their deposits are safe.[8]

9.2.3 Details on the Money Creation Process

Yes, banks actually create money when they grant loans—when they extend credit to customers. This can be seen in the representative balance sheet in Figure 9.2—the snapshot of the banks shows that only a fraction of their deposits is actually 'backed' by cash. But how did this come to be? In this section and the next, we will answer this question by telling two stories.

Consider Ms A, who receives €1,000 in cash from abroad and deposits it in her bank, Bank No. 1. This represents an injection of cash that had not been in the banking system before, perhaps locked away in a safe.[9] The new deposit, to the extent that the foreign cash had not been counted, is now part of the money supply. Now Bank No. 1 has extra funds which can be lent or used for other purposes. Looking for a profitable use for these funds, Bank No. 1 lends this money to Mr B, another trustworthy customer. Mr B needs the money to buy a sofa. Soon enough, the €1,000, initially deposited by Ms A, will be handed over to the store that sold the sofa to Mr B. The shopkeeper now owns €1,000. Yet Ms A also owns €1,000. As far as she is concerned, her money is in the bank. In fact, she owns a deposit in her bank which is backed by a loan in the amount of €1,000, yet the €1,000 in currency has long since left the bank. Through the creation of a credit, the initial €1,000 has given rise to €2,000 in balances at banks. And the story does not end here. If the sofa storeowner deposits his money in his own account at Bank No. 2, which could lend it to Ms C, who will spend it to buy a laptop for her business, the computer store will rightfully think that it possesses an additional €1,000—because it does! Each loan amounts to the creation of new credit and money, and the process can seemingly go on and on. Will it ever end?

To see why the process of credit and money creation does in fact stop, imagine that Ms A—the original character in this play—wants to withdraw her money from the bank, say to take a vacation abroad. Will Bank No. 1 tell her that the money is gone and will only be back in two years' time? Of course not! A natural part of the banking business is to anticipate this possibility; Bank No. 1 will have planned for it. One possibility is to have some cash on hand, that is, not to lend it out. Another possibility is that someone down the chain is likely also to be a Bank No. 1 customer, so that at least some of the initial €1,000 will return. *On average*, Ms A is not expected to withdraw all of the money that she initially deposited.[10]

For this reason, modern banking is often called a 'fractional reserve banking system'. If the bank determines that, say, only 10% of the sums deposited will be withdrawn at any point in time, it needs to keep only 10% of its deposits in reserves, and can lend out the rest. In the case of Ms A's deposit, the bank will keep €100 in cash and lend the remaining €900. In that case, the initial amount of money created is only €900. After it is deposited in Bank No. 2, a new loan of €810 (this is €900 less 10%), will be arranged, and the process will go on as shown in Figure 9.3. At each step, the amount of newly created money declines by 10%. After a while, it will have become tiny. This is why the money creation process is not infinite. A little bit of algebra tells us that the initial €1,000 will lead to a succession of loans that add up to €9,000:[11]

$$€900 + €810 + €729 + €656.1 + \ldots = €9{,}000.$$

There is another side to this story. Bank No. 1 received €1,000 and put aside €100, Bank No. 2 received €900 and put aside €90, Bank No. 3 received €810 and put aside €81, etc. Jointly, all banks put aside €1,000.[12] In the end, the initial €1,000 has led to a series of loans for a total of €9,000 and to the setting aside of €1,000. It all worked as if the €1,000 were fully set aside (more cash in the vaults) by the banking system taken together to support the creation of new money for a total of €9,000 (shown in the asset side in Figure 9.2). On the liability side, deposits increased by €10,000 as well: the initial €1,000 deposit and the €9,000 loans which have been credited to customers' accounts.

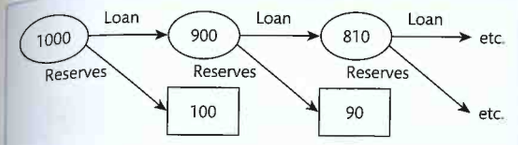


Fig. 9.3 The Money Multiplier
An initial deposit triggers a succession of loans, paid in the form of deposits. When the bank keeps 10% of any deposit as reserves (cash or deposit at the central bank), each new loan is 90% of the previous one. Thus the chain of loans and deposits eventually dies out.

This chain of money and credit creation is known as the **money multiplier** process. It says that any time new money is injected in the economy—in the example we assumed that the initial €1,000 came from abroad—the result is an increase in money stock which is a multiple of that initial increase. This process explains two fundamental characteristics of modern fiat money systems. First, as we just saw, money is created by private commercial banks as they make loans to customers who want to borrow. Second, as we explain in the next section, central banks can still control the size of the money stock if they want to.

The new money is created 'at the stroke of a pen'—this old-fashioned expression is better described as a series of keystrokes in the bank's computerized accounting systems. The money is 'backed' by trust in the banks—trust in the underlying value of the loans and other securities on the asset side of the banks' balance sheets. Money will be trusted ultimately as long as those assets are known to have adequate value.

9.2.4 Central Bank Control of the Money Supply

In the previous example, commercial banks set aside 10% of any money deposited on their customers' accounts. Presumably, they kept it in the form of cash—which often requires an expensive and secure (robber-proof) vault. The more convenient alternative is to deposit these amounts with the central bank. Just as households and firms own sight-deposit accounts at commercial banks, commercial banks also maintain sight-deposit accounts at their central banks. They can draw on these accounts to obtain cash if needed. In effect, cash in the vault and deposits at the central bank are two forms of bank reserves:

Bank reserves = cash held in bank vaults + bank deposits held at the central bank.

[7] The spectacular failure of Northern Rock in the autumn of 2007 is a relatively recent example of a bank run. Bank runs are relatively rare events in most countries—before that, the last one in the UK took place more than 140 years ago. Bank runs will be examined in more detail in Chapter 10.

[8] Naturally there are always some bankers who bend or break the rules, or pursue dangerous lending policies. More details on bank supervision and regulation can be found in Chapter 10.

[9] The money could also come from under her mattress, or from a long-lost treasure chest. The important fact is that it represents an injection of cash (currency) from outside the banking system.

[10] If Bank No. 1 were the only bank in the country and if people never held currency, the money would always come back. In practice, because there are many other banks and because people keep some money in cash, Bank No. 1 knows that it cannot rely on returning monies to pay back Ms A. But the bank also has many other customers and it knows that they tend to keep a big part of the sums that they deposit on their accounts for a long time.

[11] If a proportion p is lent at each step, the sum of all loans made is $1{,}000p + 1{,}000p^2 + 1{,}000p^3 + \ldots = 1{,}000p(1 + p + p^2 + p^3 + \ldots) = 1{,}000p/(1 - p)$. If $p = 0.9$, we find indeed 9,000.

[12] Continuing to denote the proportion that is lent at each step by p, the amounts put aside are $1{,}000(1 - p) + 1{,}000p(1 - p) + 1{,}000p^2(1 - p) + \ldots = 1{,}000(1 - p)(1 + p + p^2 + \ldots) = 1{,}000(1 - p)/(1 - p) = 1{,}000$.

Table 9.2 Reserve Ratio Requirements in Selected Countries, 2015

Country	Deposits subject to reserve requirements	Mandatory reserve ratio requirement
Australia	None	
Canada	None	
Denmark	None	
China	Deposits at large financial institutions	18.5%
Czech Republic	Deposits with maturity up to 2 years	2.0%
Euro area	Deposits with maturity up to 2 years	1.0%
Hungary	All deposits	2.0%
New Zealand	None	
Poland	All deposits except funds from repurchase agreements	3.5%
Sweden	None	
Switzerland	Deposits with maturity up to 3 months	2.5%
United Kingdom	None	
United States	Transaction accounts in excess of $15.2m but less than $110.2m	3.0%
	Transaction accounts in excess of $110.2m	10.0%

Source: National central banks.

Together with the amount of currency in circulation, bank reserves make up the monetary base M0:

Monetary base M0 = currency in circulation + bank reserves.

The proportion of deposits set aside in the form of bank reserves is called the **reserve ratio**.[13] In the previous discussion, we presented the reserve ratio as a prudential measure taken by banks to be able to pay out requests for withdrawals by customers. In some countries, banks are free to choose their reserve ratios; in others, the reserve ratio is imposed by the central bank. Table 9.2 provides some examples of mandatory reserve ratios.

In the previous example, the initial bank deposit by Ms A came from abroad. Most of the time, however, new money is created domestically. In our second example of the money supply process we illustrate how the act of borrowing money from the bank by firms or households can give rise to money creation.

[13] In some countries, it is called the liquidity requirement.

Our second story starts when Mr D requests a loan of, say, €1,000 from his bank. After carefully checking Mr D's ability to repay—possibly even asking Mr D to put up **collateral**, meaning to pledge his own assets that would be forfeited should he fail to repay his debt—the bank then makes the loan and does so by crediting Mr D's bank account with €1,000. As before, money creation by banks occurs hand-in-hand with lending activities. The only hitch is that the new loan, hence the new deposit, immediately raises the amount of reserves that the bank wants or needs to hold. If the reserve ratio is 10%, the bank must find an additional amount of reserves of €100. It may have these excess reserves at hand, but if it doesn't, it will have to find them somewhere.

Because banks are in the business to make profits, they have an incentive to lend as much as they can while holding as few reserves as they must. This is where the reserve ratio kicks in. Whether it is imposed by law or simply chosen for prudential purposes, the reserve ratio rr implies that reserves

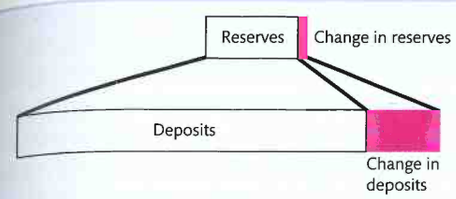


Fig. 9.4 The Reserves–Money Stock Link
When reserves are a constant proportion (rr) of deposits ($R = rrD$), deposits cannot grow without an increase in reserves. Conversely, a change in reserves ΔR allows banks to increase their deposits—by granting loans—in much larger amounts. The reserve multiplier is the inverse of the reserve ratio.

must be at least a fraction of deposits, which can be formally stated as follows:

(9.1) reserves ≥ rr × deposits.

If banks have no incentive to hold more reserves than this, the inequality becomes an equality:

(9.1′) reserves = rr × deposits.

This relationship is represented in Figure 9.4 as a pyramid linking reserves to existing deposits. But the figure may also be viewed in reverse: the volume of deposits that banks issue cannot exceed a multiple of existing reserves. Rearranging (9.1) results in:

(9.2) deposits ≤ (1/rr) × reserves.

The factor (1/rr) is sometimes called the **reserve multiplier**.[14] Equation (9.2) means that together, commercial banks cannot expand their deposits, i.e. create money beyond a multiple of existing reserves. If, as in the previous example, rr = 10%, then 1/rr = 10, which explains why reserves are rather small, as we noted earlier when looking at Table 9.1. If (9.1) holds as an equality, then (9.2) does as well, and we now have:

(9.2′) deposits = (1/rr) × reserves,

which implies that, by choosing the volume of reserves, the central bank can control total bank deposits. A small catch: technically the central bank controls M0, defined as reserves of commercial banks *plus* currency in circulation. Since M = currency in circulation + bank deposits, the relationship is somewhat more complicated than simply (1/rr) times M0. Only if no currency is held by firms and households will this be the case. *The larger the fraction of M held by the non-bank public in the form of cash, the lower the money multiplier*. It is easy to show this mathematically under a few simple assumptions and the details are spelled out in Box 9.3.

Ultimately, the central bank can set M0 rather precisely and control the money supply for any particular behaviour of the banking system. How central banks do this in practice is the subject of the next chapter. In this chapter, we will assume that the central bank can control the money supply with the precision necessary to conduct monetary policy.[15]

9.3 The Demand for Money and the Market for Money

9.3.1 The Money Market and its Players

We have learned that banks create most of the money that we use, and we have learned how they do so in the process of taking and lending money to the economy. Banks are usually busy places, making loans to customers and taking deposits on a daily basis. Because they are custodians of the payments system, banks are handling funds of their customers and others on a constant basis; loans are repaid, funds are withdrawn, new customers arrive, and old ones may leave. For a large bank, deposits

[14] Since reserves are a (small) fraction of deposits, rr is less than one. Then 1/rr is (much) larger than one.

[15] Technically, we are assuming at this stage a constant money market multiplier. For more than half a century since the end of the Great Depression this was a valid assumption, and economists were not much concerned with excess bank reserves, This was because the opportunity cost of holding them (interest rates) was high and the risk of lending them out was low. In Chapter 10 we explore why this relationship has broken down again and may be a long time in mending.

Box 9.3 The Money Multiplier

Both bank reserve and currency-holding behaviour exert a strong influence on the money multipler. Suppose that the public (firms and households) hold currency in proportion *cc* to *M*, defined as the sum of currency and bank deposits, in the form of currency. Further assume that banks hold reserves *R* at the central bank as a fraction *rr* of their customers' deposits *D*. Then:

Definition of money $M \Rightarrow M = ccM + D$ *(money equals currency plus deposits)*

Bank reserves $\Rightarrow R = rrD$ *(bank reserves equal rr time deposits)*

High-powered money $M0 \Rightarrow M0 = ccM + R$ *(M0 definition: currency plus bank reserves).*

This is a system of three equations in four unknowns, *M*, *R*, M0, and *D*. Thus, if the central bank fixes M0, then the money multipler can be determined. Solve the first equation in the form $D = M(1\text{-}cc)$. Use the second equation to eliminate *R* from the last, obtaining $M0 = ccM + rrD$. Combining these results and eliminating *D* yields $M0 = ccM + rrM(1\text{-}cc)$, which can be rearranged to yield:

$$M = \frac{1}{cc + rr(1 - cc)} M0. \quad (9.3)$$

According to equation (9.3), an increase of M0 in the UK banking system of 1 pound leads to an increase in the money supply of $\frac{1}{cc + rr(1 - cc)}$ pounds. Since both *cc* and *rr* take values from 0 to 1, the money multiplier can range from one to infinity. It is easy to show that the larger *cc* or *rr*, the smaller the money multiplier. Note that if $cc = 0$, we obtain the reserve multiplier, the money multipler in a world without currency. If there are no banks and only currency, the multiplier equals one. M1/M0 in the European Monetary Union has been roughly 4 over the past 10 years; in the UK, where there are no reserve requirements, it is well over 15.

Computing the money multiplier is interesting and informative, but rests on the assumption that *cc* and *rr* are constant. In the next chapter, we will see that the financial crisis changed reserve-holding behaviour of financial institutions (less so the currency-holding behaviour of households), making the multiplier quite volatile.

and withdrawals are likely to more or less cancel out at the end of the day. If the day has been good, more loans were made than paid off, and the loan portfolio grew. The discussion of the previous section implies that the bank might need additional reserves. On another less active day, total loans outstanding might contract, possibly leaving the bank holding excess reserves.

The normal reaction of an individual bank short on reserves will be to try to borrow from some other bank holding excess reserves that it is willing to part with—for a price. It will go to the **money market**, often called the **interbank market** or the **open market**. This is not a physical marketplace, rather it is a network of banks that facilitates buying (borrowing) and selling (lending) of reserves, i.e. deposits at the central bank (high-powered money). If the total reserves in the banking system are just sufficient to cover the reserve requirements of the outstanding volume of deposits in the banking system, then some banks having excess reserves implies that others are short. Overall, they can just deal among themselves to resolve the shortfall.

It becomes more complicated when all banks collectively face a growing demand for loans and try to satisfy that demand, and collectively need more reserves. The central bank will then have to decide whether or not to create these additional reserves. However, normally the central bank does not respond face-to-face to a given bank. Instead, it generally deals with the money market as a whole.

When the central bank creates reserves, it makes a loan to commercial banks through the money market, pretty much like commercial banks provide loans to their customers. It also charges interest for these loans. Similarly, when banks lend reserves to each other, they also charge interest. Money markets vary from country to country, but

they typically bring together large banks and financial institutions, such as insurance companies or mortgage lenders, which handle large amounts of cash. In normal times, they all are highly reputable institutions that know each other well, they lend and borrow large amounts, usually without asking for collateral or guarantees.

9.3.2 The Interest Rate is the Price of Money

The interest rate at which they do so is the rate at which large financial institutions can fund themselves. In effect, for them, the **interbank interest rate** is the ultimate cost of financing their needs. This rate is the basis for all interest rates. Indeed, a bank charges its customers the money market rate *plus* a premium that represents their riskiness. The interbank rate is called EONIA (European Overnight Interest Average) in the euro area, the Fed Funds in the US, the Sterling interbank rate in the UK, etc. Figure 9.5 shows that the various rates charged by commercial banks follow the same evolution as in the interbank rate in the euro area.

9.3.3 The Demand for Money

Households and corporations need money to carry out their daily transactions. This is the basis for demand for money *M*. The private sector is either holding the money already and paying an opportunity cost of forgone interest, or it can borrow at a bank, at the cost of interest paid. In order to satisfy this demand, commercial banks create much

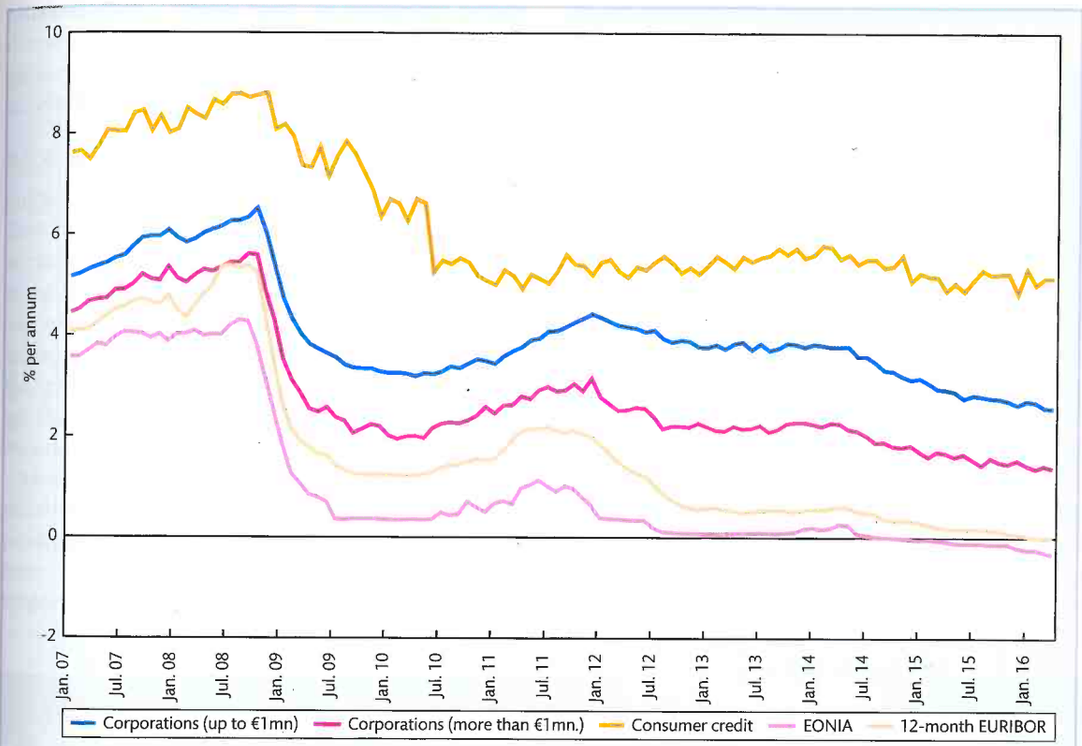


Fig. 9.5 Interest Rates in the Euro Area, 2007–2015

EONIA is the interbank interest rate in the euro area. The figure also displays the interest charged to corporations for large (more than €1 million) and smaller (less than €1 million) loans and the interest charged for consumer credits, in all cases for a one-year loan. Lenders charge a higher interest rate to borrowers that they perceive as riskier, but all rates tend to follow the EONIA.

Source: ECB.

of what we call money when they grant loans to their customers. As they do so, they need to acquire sufficient reserves to meet their reserve ratio. Thus the demand for money M by the private sector translates into the **derived demand** for central bank money M0.

First, we need to understand the determinants of the public's demand for money, M. The first simple answer is that it is driven by the volume of transactions measured as value in the local currency, since this is what makes money useful in the first place. We discussed this issue in Chapter 5, where money demand was represented as a constant proportion k of nominal GDP PY. That proportion is the inverse of the velocity V of money ($k = 1/V$)—the number of times money is 'spent' on GDP each year on average (i.e. $V = PY/M$). To assume that k is constant, however, is simplistic and is contradicted by the evidence. In fact, we will see that the velocity of money moves positively with the interest rate, or that the factor k moves in the opposite direction of interest rates.

The logic behind the interest rate as the cost of money is simple. Suppose that you want to hold more money (cash and 'money in the bank'). How do you get it? One way is to borrow from your bank and pay the corresponding interest rate. Another way is to sell assets and bank the proceeds. In that case, you give up the interest that you can earn on your assets to receive cash, which does not yield interest, or for deposit at the bank, which yields a very low interest. In both cases, the interest rate emerges as the opportunity cost of holding money. This is why the demand for money declines when the interest rate increases, as shown in Figure 9.6. Thus, while money demand

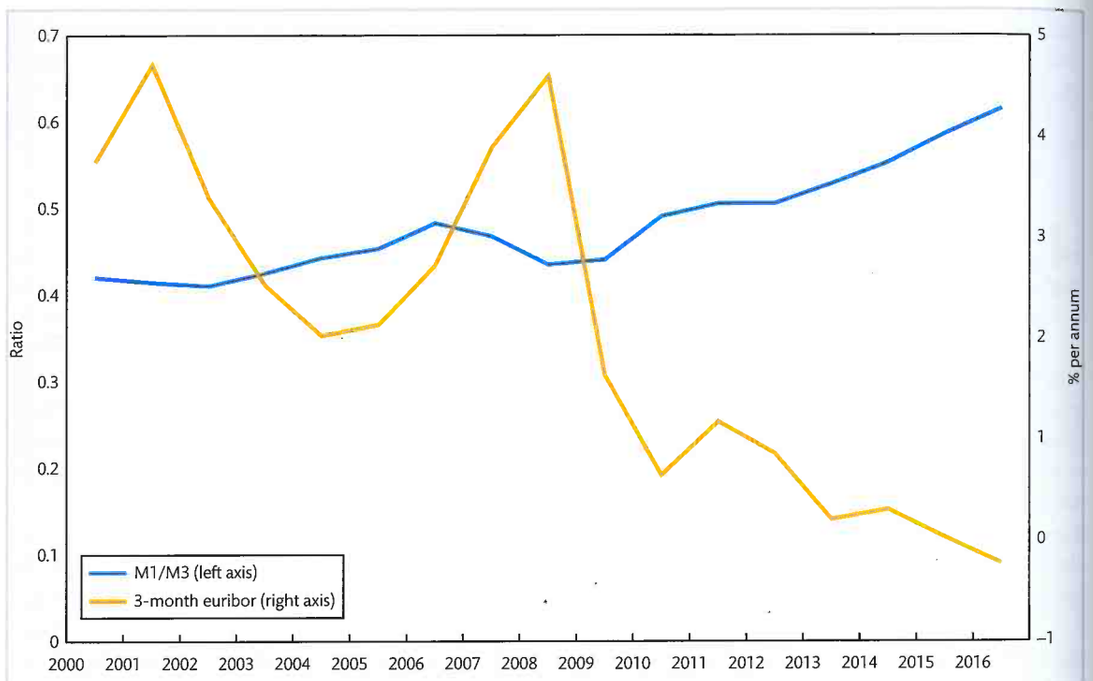


Fig. 9.6 The Composition of Money Demand and Interest Rates, Euro Area, 2000–2016

The left-hand scale is the fraction of M3 held in the form of M1, cash, and demand deposits (which pay little or no interest); the scale on the right is the 3-month interest rate (annualized). This figure shows that interest rates and holdings of low interest-bearing money move in opposite directions.

Source: ECB.

is a proportion k of nominal GDP, this proportion is not really constant. It becomes smaller when the interest rate increases.

As we saw, different borrowers face different interest rates, depending on how risky they appear to their banks. On the other hand, Figure 9.5 shows that all these rates move together. For simplicity, we think of a single interest rate, denoted by i. The demand for money is represented as:

$$M^d = k(i)PY, \tag{9.4}$$

where $k(i)$ declines when i rises (formally, $k(i)$ is a decreasing function of i).

Now the derived demand for M0 by commercial banks is a fraction of the public demand for M, since any new bank lending, which means more bank deposits, must be accompanied by an increase in reserves as indicated by (9.2′). It follows that the derived demand for M0 also declines with the interest rate. It is represented by the downward-sloping schedule D in Figure 9.7.

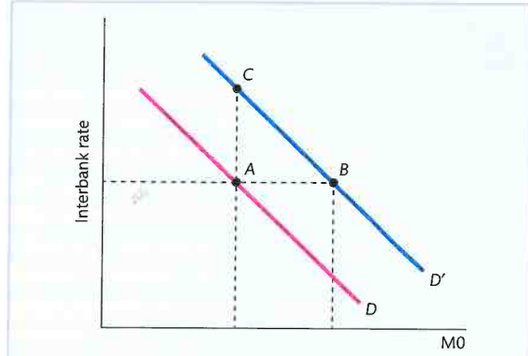


Fig. 9.7 The Money Market

The public's demand for money is negatively related to the interest rate i, which represents the cost of borrowing from commercial banks. This demand translates into a derived demand for the monetary base (M0) by commercial banks, denoted in the figure by the negatively sloped schedule D. If the public wants to hold more money, the derived demand schedule shifts to the right from D to D′. The central bank may decide to keep the interest unchanged (point B), or not to respond, in which case the interest rate rises (point C), or it can pick any combination of M0 and the interest rate as long as it lies on the demand schedule.

9.3.4 Money Market Equilibrium

Suppose now that, starting from point A, nominal GDP increases. This means more transactions will occur, so an increase in money demand Md is to be expected. Households and firms will try to borrow the extra money that they need from banks. As banks respond by granting loans, their own need for reserves increases. This is captured in Figure 9.7 by the rightward shift of the derived demand schedule from D to D'.

How can the central bank respond to the new situation? It has many options, since it is the sole producer of M0. One option is to keep the initial interest rate unchanged. This requires the central bank to provide the additional monetary base M0 needed, moving to point B. Another option is to keep M0 unchanged, which means that we move to point C and the interest rate rises accordingly. In that case, the interest rate must rise enough to offset, via a decline in $k(i)$, the impact on money demand M^d due to the increase in nominal GDP. In fact, the central bank can pick any point on the new derived demand schedule D'. Where it decides to go is the central question of monetary policy. We return to this choice in Chapter 10. A stunning development of recent years, told in Box 9.4, is that central banks can even choose negative interest rates.

9.4 Money: Past, Present, and Future

In the next chapter we will explore monetary policy in detail: how the central bank of a nation or economic zone controls interest rates in the money market or affects the supply of money in an economy in general. This is an important practical dimension of the monetary sphere, because the

Box 9.4 How Can Interest Rates be Negative?

A close look at Figure 9.5 shows that in 2015, the EONIA turned negative. Interest rates are negative when a creditor lends, say €1,000 and receives *less* than €1,000 in a year's time! In this case—the EONIA applies to loans between banks—it means that it pays to borrow! How could that be possible? The following can help clarify why interest rates are different for different borrowers and lenders of different types and highlights the limits of monetary policy examined in Chapter 10.

Can a household really be *paid* to borrow money? Not really, unless banks want to give away money to their customers. Suppose the interest rate was –3%, meaning that a borrower of €1,000 would have to pay back €970 in a year's time. Why not then borrow €1,000, put €970 under the mattress to be paid in a year's time, and get €30 for free? If you want €3,000, just borrow €100,000! This doesn't sound sustainable, because finding *lenders* under such circumstances is likely to be difficult. Even if there was *deflation*—if the price of goods was falling and was expected to fall in the future, repayment in more valuable money would still be possible by the 'mattress operation'. Suppose prices were falling by 5% per year, meaning that repayment of debts occurred in more valuable money (in terms of goods and services). Then a –3% loan is not a free lunch for the borrower, since the €1,000 must be repaid a year later in 5% more hard-earned goods and services. Putting the cash under the mattress would be a better investment for the lender, with a 5% return compared with only 2% for the loan (–3 – (–5) = 2). The difficulty of reducing interest rates in an environment of low interest rates is called the **zero lower bound** problem. As long as there is currency that can be hoarded—and as long as central banks do not tax money directly—it is difficult to push interest rates in the economy below zero.[16]

Negative interest rates observed in Figure 9.5 are a special case which apply to financial institutions and their dealings with the central bank. Recently, banks in the euro area, Denmark, Sweden, and elsewhere have paid to deposit their reserves with the central bank. This is like a tax on banks for not lending their reserves. If instead financial institutions wish to borrow, interest rates are still positive or close to zero. Commercial banks could only charge negative interest rates and make a profit if the central bank itself were giving away money—which they generally don't.

neutrality principle predicts that the inflation rate is determined by the growth rate of money less the rate of economic growth. Yet we learned in this chapter that money is a social convention, meaning that our theory of money should be flexible enough to help us imagine a world in which money looks very different from that which we use today. Indeed the world is changing rapidly and the digital age holds many surprises in store for the years to come.

9.4.1 A Private Convenience

As Groucho Marx states at the beginning of the chapter, money is handy—it is convenient to have in hand. Who has not been caught waiting for that taxi in the rain, only to be out of cash, or after an expensive meal at a restaurant which doesn't accept credit cards? While being short on cash has become less and less of a problem over time, cash can still be extremely useful in emergencies, and there are still businesses that do not accept credit or debit cards.

More significant is the desire to use money to remain anonymous. Those who engage in illegal transactions prefer not to be associated with those deals. Organized crime generally uses cash when doing business or investing, and the laundering of profits requires the use of cash. Restaurants and other businesses sometimes try to 'manage' provable income and reduce tax liabilities, especially in hard times. Some vendors give discounts on transactions paid in cash. The technology of paper money means that cash transactions are untraceable, and some people like not only the convenience, but also the privacy of doing things not immediately observed by banks, other financial

[16] The real interest rate is the one that matters. If there is inflation, it eats away at the value of the money under the mattress, so lenders are unlikely to lend unless they are compensated for this loss (higher nominal interest rate). Borrowers will understand this as well. Only if the marginal productivity of capital is negative will lenders and borrowers be happy with negative real rates. Also, a risk premium for 'unsafe' assets (as discussed in Chapter 7) could explain negative interest for safe ones. More on this in Chapter 10.

agents, or the government. As Figure 9.1 suggests, it may be difficult to eliminate currency from the economy, especially if the incentives to use it are strong enough.

9.4.2 A Public Good Provided by the State

Money's fascinating history points us to two interesting episodes—and there are many others. In Scotland in the eighteenth century—in the age of David Hume and Adam Smith—the rise of banks gave them an unprecedented level of prominence. Scottish kings were dependent on the banks for finance, probably because the Bank of Scotland, established one year after the Bank of England in 1695, was not allowed to make loans to the King without parliamentary approval. At any rate, the Bank of Scotland became an issuer of high denomination banknotes for the wealthy, leaving a gap in the market for the means of payment. After the Bank of Scotland's monopoly lapsed around 1716, the Royal Bank of Scotland[17] and other banks emerged as competitors, also issuing banknotes. The interesting aspect of this competition was potential takeover as a disciplining device for excessive banknote issue—the competitor banks could simply purchase the less valuable notes and then use them to buy the over-issuing bank! This period of **free banking** led Scotland to important innovations in finance, such as the overdraft credit and the taking of deposits. However, by the 1760s, a proliferation of banks had led to an expansion of the money supply of often dubious quality. Widespread bank failures in the Commercial Crisis of 1772 led to the first regulatory efforts to prevent excessive banknote issue. Later, because Scottish banks were generally more successful than their English counterparts, the English Parliament tried to restrict the circulation of Scottish banknotes in the south. In 1845, the Peel Act regulated the issue of banknotes by Scottish banks and to this day, three Scottish banks—Bank of Scotland, Royal Bank of Scotland (RBS), and the Clydesdale Bank—may issue banknotes, all 100%-backed by deposits at the Bank of England, the central bank of the UK. In practice, only the banknotes of the RBS are in circulation and are not legal tender in England and Wales—but are still accepted in large cities and by cash processing machines.

Similarly, after gold was discovered in large quantities in California in 1848 and the territory joined the US in 1850, an economic boom ensued which led the new US state to be one of the richest in the country. As always, strong economic growth led to a proliferation of banks. At the time, the United States had no central bank to manage monetary conditions; as in Scotland, private banks in California stepped into the breach, issuing banknotes against gold deposits. But the quality of the money's reputation is ultimately only as good as the issuing bank. The history of California free banking was not one of great confidence; wildcat banks often took gold and moved far away to make withdrawals difficult. Banknotes traded at discount to each other and to gold dollars. Bank failures were rampant in the years surrounding economic and financial crises. Yet during the early twentieth century California banks introduced the branch banking concept, which remains to this day an important aspect of the business.

One important lesson from these two episodes is that while confidence may allow a successful private money to emerge and compete, the establishment of a central bank and legal tender was a crucial improvement in terms of the management of trustworthiness and credibility. At the same time, innovation in money and banking often comes during times when the banking sector is expanding rapidly and regulation is light. This is a dilemma for regulators and we will return to this subject at many points in the rest of the book.

9.4.3 A By-product of Banking and Credit Creation—or not?

Fast forward to the modern era. Since the late 1800s, the money supply has become increasingly elastic and responsive to the private and public sectors' needs for means of payment. The increasingly professional practice of central banking has contributed

[17] The Royal Bank of Scotland still exists today. It emerged from a bailout of the Darien Company, which was a failed overseas trading firm that had tried unsuccessfully to establish a colony in Panama. It was also in the business of issuing banknotes.

to this development. In the next chapter, we will see that fluctuations in interest rates may be quite extreme in the absence of a central bank. This follows from inspecting Figure 9.7. Yet banks are subject to the same forces present in financial markets: boom and bust, exuberance and fear. More often than not, banks participate and fuel the frenzies associated with speculative bubbles. This was the case in the South Sea Bubble and the Darien Scheme (the Bank of England and Scottish banks), the US stock market boom which preceded Great Depression, and the US real estate boom and bust preceding the Great Recession 2007–2009 (US mortgage financing companies and US banks).

Since the financial crisis of 2007–2008 and the recession which ensued, there have been many discussions surrounding the fundamental soundness and stability of the banking system. Some have argued that the banking system is so important to the economy's health that it should be owned by the government. This is an extreme view which downplays the importance of private initiative and profit in guiding investment decisions. The opposite view, that the central bank should be abolished, has also found proponents. Yet others have challenged the fractional reserve system as the cause of recurrent crises. The extreme vulnerability of the financial system to bank runs—originating either with customers or other banks—is certainly a cause of concern, leading to economic disturbances of increasing severity. A much-discussed proposal is **positive money** or ***Vollgeld*** (full money), which would separate the means-of-payment function from the credit function, effectively turning money creation into a utility like water, sewage treatment, or electricity. Chapter 10 will deal with these issues in more detail.[18]

Because the payments system—the money supply—is so fundamentally important to the economy, it seems reasonable to shield it from crises. At present money is a mixture, primarily a privately supplied inside liability (bank deposits) and a publicly provided one (currency). The central bank is, when supervision is tight, in a position to control monetary conditions in order to keep the economy on an even keel. Most importantly it is tasked with preserving the functioning and integrity of the payments system.

Nations are made and destroyed by the quality of their institutions; one of the most important is the means of payment. It is for this very reason that a currency is normally an attribute of the State, but there are a few exceptions such as the European Monetary Union. Central banks must keep an eye out for innovations in the future which may render their control and influence obsolete or superfluous. One is the arrival, with the innovations of the internet, large databases, and social media, of payments systems that might suddenly displace those created or sponsored by central banks. PayPal has become an enormous player in payments systems, as have online retailers (Amazon), search engines (Google), and social media (Facebook); these well-endowed companies could eventually render banks obsolete in their payment function. Even more interesting is the rapid evolution of 'crypto-money' such as Bitcoin, the product of developments in encryption and so-called distributed ledger technology which keeps records in a decentralized and unfalsifiable fashion. Never before has the emergence of payments systems like those envisioned by Wicksell (Box 9.1) been within our reach—possibly without any need for government involvement at all.

[18] The proposal is noteworthy because it achieved the status of a referendum question in Switzerland and has been advocated by some economists. It has features similar to the famed Glass–Steagall Act of 1934, a US law which forced deposit-taking banks to divest themselves of investment banking and securities trading operations.

Summary

1 Money is a form of wealth which is generally accepted as a means of payment in an economy. Holding and using it has a convenience function, but comes at a price: forgone interest.

2 There are different definitions of money, but broadly speaking it is the sum of currency in circulation and deposits in banks and, possibly, other financial institutions.

3 Most of what we call money and employ in everyday transactions are demand (sight) deposits created by commercial banks at the same time they make loans to customers. These deposits—the banks' liabilities—are considered a close substitute for currency and are therefore accepted as a means of payment. The rest of the money supply—banknotes, and coins—is produced by the monetary authorities.

4 The banking system is therefore a crucial participant in the monetary economy. The acceptance of money depends on the trustworthiness of the banks as well as their solvency.

5 Banking involves maturity transformation, a risky operation which produces a mismatch between liabilities (which are short-term and convertible into cash) and assets (which may be long-term investments subject to valuation changes). Good banking practice is a juggling act, requiring holding sufficient reserves to cover withdrawals while making sound, profitable investments.

6 For both prudential or regulatory reasons, commercial banks therefore hold cash—currency or deposits at the central bank—in proportion to their customers' deposits. These reserves are liabilities of the central bank and are the main source of influence of central banks on the money creation process.

7 The reserve ratio forces commercial banks to acquire more reserves whenever they create more money. The banks' demand for reserves is derived from the public demand for money, which in turn is equivalent to the volume of bank loans to non-banks.

8 The central bank directly controls the amount of currency in circulation. It controls indirectly the other component of the money stock, bank deposits, by deciding whether to provide commercial banks with bank reserves.

9 Facing the derived demand for the monetary base, central banks can decide on which quantity to supply, or to supply whatever quantity is demanded to achieve a particular interest rate. An additional instrument available to the central bank is the required reserve ratio, when it exists.

10 The history of money shows that central banks serve a key function in the economy. Cash will have a demand as long as there is a demand for anonymous transactions.

11 The acceptability of money is a public good, and central banks can help provide this public good. Experience with privately issued money without government sanction has proved to be innovative, yet subject to recurrent crises.

12 New innovations in payments systems will continue to pose a challenge to central banks in the present and in the future.

Key Concepts

- convenience function
- commodity money
- fiat money
- currency
- monetary aggregates (M0, M1, M2, M3)
- bank deposits
- bank reserves
- monetary base
- financial intermediaries
- payments system
- legal tender
- maturity transformation
- liquidity service
- balance sheet
- bank run, bank failure
- bailout
- money multiplier
- bank reserves
- reserve ratio
- collateral
- reserve multiplier
- money market, interbank market, open market
- interbank interest rate
- derived demand
- zero lower bound
- free banking
- positive money, *Vollgeld*

Exercises

1 Table 9.1 shows that the size (relative to GDP) of the monetary aggregates can vary significantly from country to country. What might account for these differences?

2 We saw that households in the UK hold M1 in relation to nominal GDP of about 0.20 in 2015. Suppose that the function $k(i)$ is well-described by the form $k(i) = \frac{0.1}{\sqrt{i}}$ where i is the nominal interest rate in per cent, and that the interest rate for short-term non-money bank deposits (the opportunity cost of holding M1) is 1%. Suppose that in the next few years the nominal interest rate rises to 4%. What is the resulting demand for money (as a fraction of GDP). What is the elasticity of the demand for money, measured in terms of the observed change in interest rates?

3 In Exercise 2, we saw that the real demand for money declined in response to an increase in interest rates. What happens to the supply of money? Draw a graph of before and after, assuming that the central bank is fixing the interest rate 1% and raises it to 4%. Suppose instead that the nominal supply of money is held constant while the interest rate is raised. How could equilibrium be restored? How would your answer change if the price level is fixed instead?

4 Suppose that the demand for money is $(M/P)^D = 0.1Y/i$, where i is the nominal interest rate in per cent. If real GDP is given by €17 trillion and the interest rate is 1%, what is the demand for money? What is the consequence of a rise of the interest rate to 2%? If the nominal money supply is constant, how can the real money supply achieve this? If the price level instead is constant?

5 Given the demand for money in the previous problem: suppose now that the interest rate is 1% and is maintained constant by the central bank. What is the consequence of an increase in real GDP of 2% for the real demand for money? How must this real demand for money be satisfied if the nominal money supply is constant? If the price level instead is constant?

6 What is a balance sheet? Why do you think the balance sheet is important in the economic system? Name some ways in which balance sheets are important for macroeconomics.

7 Consider the following commercial bank (based on real data): cash and bank reserves: €25 bn; investments in securities €250 bn; loans: €550 bn; other assets: €25 bn; liabilities to central bank €50 bn; total deposits: €500 bn; total (non-central bank) debt: €200 bn; other liabilities: €50 bn.

(*a*) Construct the balance sheet in the manner of Figure 9.2. How 'long' is the bank's balance sheet (what are total assets)? What is the net worth of the bank?

(*b*) What is the reserve ratio for this bank?

(*c*) Compute a crude capital ratio of the bank—defined as the ratio of net worth to total assets.

(*d*) Suppose there was a sudden decline in the value of investments and securities of €20 bn. If the bank reduces ('marks down') the value of those securities it shows in its balance sheet, how do your answers to questions *(a)*, *(b)*, and *(c)* above change?

8 In macroeconomics, balance sheets are usually reported by sectors in *consolidated* form, that is, netting out (cancelling) all claims (assets and liabilities) on any other entity in that same sector. For example, the ECB reports data for all commercial banks, savings banks, and other financial institutions taken together, in which loans or bonds issued by banks and held by banks are cancelled out. Data for households, firms, and the government are sometimes reported in consolidated form, sometimes they are not.

(*a*) Consider the following example of a banking sector comprised of only four banks with assets and liabilities as follows, in billions:

	Bank A	*Bank B*	*Bank C*	*Bank D*
Reserves at central bank	20	40	30	30
Securities held that are issued by other banks	60	50	60	30
Securities held that are issued by non-banks	100	140	200	300
Loans to banks	80	40	60	20
Loans to non-banks	370	400	300	500
Other assets	20	30	10	20
Debt owed to central bank	40	30	25	60
Deposits	450	520	460	650
Securities issues to other banks	80	80	20	20
Debt owed (securities issued) to other banks	70	60	70	0
Debt owed to non-banks	20	30	30	80

Construct the consolidated balance sheet of the banking sector.

(*b*) What is the money supply in this economy? Why is the sum of all deposits at all banks much greater than the money supply as defined by central banks? When reporting money supply statistics, why do central banks report consolidated deposits of the banking sector?

(*c*) Why might consolidation be a good idea when constructing balance sheets? When might it be misleading?

9 Suppose the non-bank sector in a particular country holds 10% of its money holdings as

currency, and that the consolidated banking system holds reserves in the same relation to its deposits as the hypothetical bank in Question 7.

(*a*) Using the tools of Box 9.3, compute the money multiplier for this country.

(*b*) How would your answer change if, as in Denmark and Sweden, the non-bank public 'goes off' cash, choosing to hold only 2% of their total M1 in the form of currency?

(*c*) Suppose that banks choose to hold more reserves at the central bank than the previously derived rate; in fact, the consolidated banking system chooses to hold reserves in the amount representing 10% of their deposit liabilities. What is the money multiplier now?

10 Explain why trust in the banking system is the same thing as trust in the payments system. How might a run on the bank damage the viability of money? How can a banking system deal with this threat?

Essay Questions

1 State Jevons' definition of money. Compare it with central banks' definitions as well as that provided in this book. Which definition do you think is the most practical? Which is most likely to endure the new technical innovations in payments systems?

2 Gresham's Law states that 'bad money drives out the good'. This means that, when two monies circulate at the same time, firms and households tend to spend the 'inferior' form of money and keep or hoard the 'better' one. Is this behaviour consistent with our definition of money or those features stressed by Jevons? Explain.

3 Name some ways in which the central bank can establish trust in the currency. How can trust be damaged or destroyed? How can the government, to the extent it is a separate entity from the central bank, damage or reinforce trust? Do you think that political influence on bank regulation is a positive or a negative aspect, and why or why not?

4 Hong Kong, while a part of the People's Republic of China, does not use the Chinese yuan (also called renminbi), but rather the Hong Kong dollar. Even more remarkable, Hong Kong does not have its own central bank, but uses banknotes and reserves issued by the three major private banks. This system functions extremely well without a central bank. How can you explain this? How might the Hong Kong banking system differ from that in California in the 1850s?

5 Cybermoney is, simply put, a decentralized system based on the internet—of which Bitcoin is the best-known example—in which ownership of each unit of the means of payment is validated by all members of the cybermoney-using community in question. In this way it is very difficult to counterfeit money. Explain why Bitcoin money fulfils the definition of money. Some have argued that the central bank should not regulate or prohibit the use of bitcoin, but should rather encourage it and increase the confidence that the public has in its use. What do you think? What are the advantages and disadvantages of such regulation?

Monetary Policy, Banks, and Financial Stability

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