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BASIC MONETARY ECONOMICS

by

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Abstract: This is an introduction to money and the workings of the financial system. The creation of money is discussed in detail in Chapter 1. Chapter 2 explains how international payments can add to money creation but also generate a new type of money, usually called Eurodollars. Basic securities are defined and characterized in Chapter 3, namely bills, bonds and shares, but basic derivatives, like futures, swaps, and options, are also discussed. Chapter 4 deals with pricing by banks when extending loans, but also with price formation in markets for securities. Chapter 5 surveys possible threats to the financial system and discusses three different approaches to the problem of stabilizing it, namely crisis management, regulation, and structural reforms.

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Summary

This is an introduction to money and the workings of the financial system. The fundamental concept of money is defined and discussed in detail in Chapter 1. The *creation* of money is particularly important, since it is associated with the creation of debt, either private debt when created by commercial banks, or public debt when created by the government. Since a loan can be financed by creating money, investment can be financed without savings out of past or current incomes. Hence there can be not only savings without investment but also investment without savings in a market economy, a possibility which on one hand can raise economic growth but on the other hand support asset-price bubbles.

Chapter 2 explains, first, how international payments are made in practice and how this can add to money creation but also generate a new type of money, usually called Eurodollars. Second, it shows why a bank's ratio of capital to total assets usually is so low, sometimes less than 3 per cent instead of often more than 30 per cent for non-banks. And finally it shows how the profits of a central bank are generated and how they are related to reserves.

Basic securities are defined and characterized in Chapter 3, namely bills, bonds and shares, but basic derivatives, like futures, swaps, and options, are also discussed. Without secondary markets the only alternative to deposits at commercial banks for agents with surplus money is to buy bills or bonds issued by governments or corporations and keep them until maturity. The existence of secondary markets means not only that investment in bills or bonds becomes more "liquid", but also that investment in securities becomes an alternative to investment in real capital for many non-financial firms. And the expansion of financial markets since the 1970s has made trading in securities – buying cheap and selling dear – an expanding industry with important consequences for income distribution and financial stability.

Chapter 4 deals with pricing by banks when extending loans, but also with price formation in markets for securities. It defines the policy rate set by a central bank and explains why this is a floor to all other interest rates. More precisely, it shows how banks set interest rates on loans as mark-ups on the policy rate. It also explains how these mark-ups are influenced by profit maximization. It finally discusses the pricing of bills, bonds and shares in secondary markets, emphasizing in particular the distinction between *valuation* of securities and their *pricing* in markets organized by "match makers" or "market makers".

Chapter 5 surveys possible threats to the stability of the financial system, including mortgage lending fuelled by money creation but also runs for liquidity and trading in derivatives. The increasing importance of financial markets relative to banks may have increased the stock of debt relative to the stock of money and hence also increased the risk for insolvency in a financial crisis. Chapter 5 also contains a brief survey of financial crises since the 1970s. And three different approaches to the problem of stabilizing the financial system are discussed, namely crisis management, regulation, and structural reforms.

Chapter 1: Money

Since money is a prerequisite for the division of labour in a society, its definition is fundamental to all parts of economics. The concept is here introduced in steps, beginning in Section 1 with money created by the government in an economy with only one bank. We shall then see, in Section 2, how money is created by commercial banks in a modern market economy. Section 3 introduces notes and coins and gives a general definition of money, emphasizing the distinction between money and "liquid assets", while Section 4 concludes with a short history of money.

1.1 Money in an economy with only one bank

Consider payments in an economy with only one (central) bank (CB), which administers the payments system and is controlled by the government. All individuals and firms, as well as the government, have accounts in the CB with non-negative deposits. We assume that all payments are made by electronic transfers between these accounts, and define the stock of money as the sum of all private deposits in the CB.

Goods and services can be transferred between individuals and firms – and purchased by the government – by trade at prices agreed upon by both parties (voluntary exchange). Prices are set by sellers or an auctioneer or through competitive bidding or bargaining or according to some other market form, but in any case pricing is decentralized, and prices are always accepted by both sellers and buyers before trade takes place. The ability to purchase goods and services by transferring money between bank accounts is guaranteed by the government.

Thus, money is "purchasing power" guaranteed by the government. And since this purchasing power is conditional upon current prices on goods and services, money must also be a *unit of account* in price formation. Moreover, sellers will not accept money as a means of payment unless money also is a *store of value*, which presupposes an "acceptable" amount of inflation.

No trade can occur without money as a means of payment. Payment from a bank account presupposes a positive balance. The probability for an individual or a firm of being able to make all payments during a period depends on accumulated savings in the beginning of the period as well as the timing and profile of revenues relative to the timing and profile of payments during the period.

Suppose, to begin with, that individuals and firms can finance their purchases only by *earning money*, that is, by selling goods or services (including labour) to each other or to the

government. (At this stage we consequently exclude the possibility to borrow money.) But we also assume that the government cannot obtain money by selling goods or services, so that production for sale is completely privatized. Hence the government can only *purchase* goods and services in this simple economy.

Money and the budget deficit

All transactions between individuals and firms in this simple economy imply an increase of one private bank account and a corresponding decrease of another private bank account. This leaves the stock of money unchanged, since money is created only if a private bank account increases without a corresponding decrease of another private bank account. Money can only be created by the government through purchases from the private sector, since such purchases mean that money is transferred from the government's account to a private account, so that a private account increases without decreasing another private account. And while the government creates money by purchases from the private sector, it withdraws money by collecting taxes. Thus, it is the government's *budget deficit* which determines the net creation of money in this simple economy. And if the balance on the government's account is too small, the government simply orders the CB to increase its deposits (which is the equivalent of "printing money").

A fundamental question is how much money the government should create. It may be tempting for the government to finance its activities simply by "printing money", but this may also increase the risk for inflation. On the other hand, a growing economy cannot function properly with severe restrictions on the possibility to pay for productive transactions. Since trade is not possible without money, too little money – which means too small budget deficits in this simple economy – may imply underutilization of the economy's resources.

Money and debt

Suppose next that the government can create money not only by budget deficits but also by giving *loans* to individuals or firms. More precisely, the government can order the CB to create money by increasing the borrower's deposits with the loan against an increase of the government's assets by the borrower's obligation to repay the loan (with interest). Note that repayment of loans means withdrawal of money (to the government's account), so it is only the *net* change in the stock of loans which adds to the stock of money.

Without the possibility of loans, individuals cannot buy houses and firms cannot buy factories without accumulating large balances on their bank accounts. And large savings of

money by some individuals or firms are not possible without correspondingly large dissavings by other individuals or firms (at a given stock of money). But other individuals or firms may not be willing to realize such dissavings unless *their* accumulated savings are sufficiently large. Thus, without the possibility of borrowing, there is an obvious risk for underutilization of the economy's resources.

Government bonds

Suppose next that the government not only can give but also take loans, by selling government bonds to individuals and firms. This has the same effect on the stock of money as collecting taxes, namely withdrawal of money. But it may be easier to finance purchases by taxes in the future than by taxes today – provided the economy is larger when the bonds have to be redeemed.

The government can also sell government bonds to the CB, which is less drastic than simply ordering the CB to increase the government's deposits but has the same effect, since the CB pays for the bonds by increasing the government's deposits. This increase will also create private money if – and only if – it is used for government purchases.

The budget deficit, defined as the difference between government purchases and taxes, can now be financed by selling government bonds to either the private sector or the CB. In the first case the expansionary effect on money of the budget deficit is neutralized by the contractionary effect of the bond sales. In the second case it is not.

Saving and investment

It is often said that a fundamental purpose of a financial system is to transfer money from savers to investors. But so far the only form of *saving* in this simple economy is buying government bonds or accumulating money. And the CB does not channel funds from the government or from individuals or firms with large holdings of money to investors – at least not directly. The government uses income from selling bonds to finance its budget deficit. The CB cannot touch large financial surpluses and it doesn't have to, because to finance an investment the CB simply *creates* money, and if the investment is productive it will create a flow of income with which the loan can be repaid.

However, saving by buying government bonds reduces inflationary pressure by withdrawing money. Moreover, individuals and firms can still choose to finance investments by postponing them until they can be paid up-front with accumulated money holdings. Such money holdings will not be used for expenditures until sometime in the future and can

consequently be said to be "sterilized". Hence we can say that even if savings in bonds or money holdings are not *literally* channelled into private investment, they may be necessary to counteract an inflationary pressure from investment financed by money created by the CB.

Moreover, since it may be difficult for the CB to judge how much of accumulated money holdings which are sterilized, it may want their customers to label such money by giving them the possibility to explicitly abstain from using them for some time for a fee. Such interest-bearing *time deposits* can be switched to money for immediate payment, called *demand deposits*, but only after advance notice.

1.2 Money in an economy with commercial banks

Next we introduce commercial banks, that is, private banks which are part of the payments system.[1] Individuals and firms and other organisations, including other financial institutions like savings banks, have accounts in commercial banks with deposits called *money*, while a commercial bank has an account with deposits called *reserves* in the central bank (CB). Of course, the government also has an account in the CB.[2]

Commercial banks are linked to each other and to the CB through a *payments system*, which can clear payments through transfers which decrease the deposits of the buyers and increase the deposits of the sellers. If these accounts belong to different commercial banks, the reserves of the seller's bank will increase while the reserves of the buyer's bank will decrease as money is transferred from buyer to seller, while total reserves are not affected.

Payments are made by electronic transfers of deposits between bank accounts. The stock of money is the sum of all deposits in commercial banks. Reserves are not money but a prerequisite for money, since payments presuppose reserves unless buyer and seller have accounts in the same bank. It is easy to include cash in the analysis – as we shall see in the next section – but by abstracting from cash we first focus on the most important part of a modern banking system.[3]

Creation of money

Money is created if deposits in a commercial bank account increases without reducing deposits in another commercial bank account. The government creates money by purchasing goods or services or assets from households or firms, since it pays by drawing on its deposits

[1] Also called Monetary Financial Institutions or MFIs (Howells and Bain 2008 p. 32).
[2] In practice governments also have accounts in commercial banks, at least to collect taxes.
[3] Interestingly, nowadays some shops no longer accept payment by cash, at least in Sweden.

in the central bank and not on deposits in a commercial bank, while the payment of taxes withdraws money (reduces deposits in commercial banks) and adds to the government's deposits in the central bank. The central bank does not normally allow overdrafts on the government's account, so a government has to finance a budget deficit by selling bonds, either to firms and households (in which case money is withdrawn) or to commercial banks or the central bank.[4]

A central bank can create money by purchasing goods or services or assets from households or firms, since it pays by supplying reserves to the seller's commercial bank and ordering the bank to add deposits to the seller's bank account. Money can also be created by a commercial bank by purchasing goods or services or assets from firms or households, since it pays by drawing on its reserves in the central bank and not on deposits in a commercial bank. On the other hand, sales of services or securities by a commercial bank to a non-bank will reduce the buyer's bank deposits but increase the reserves of the commercial bank.

Money can even be created by commercial banks by making loans.[5] More precisely, a commercial bank can create money by crediting the account of the borrower with the loan against an increase of its assets by the borrower's obligation to repay the loan. A commercial bank usually creates money by lending without an explicit permission from its CB. Of course, a CB can control directly both the volume and the type of lending, as monetary history tells us,[6] but nowadays it usually controls bank lending by indirect means (as in Chapter 4).

Since a loan can be financed by creating money, investment can be financed without savings out of current or past incomes. Hence there can be not only savings without investment but also investment without savings in a market economy, a possibility which on one hand can raise economic growth but on the other hand support bubbles in asset prices. Thus, money creation by bank lending is an ingenious invention, but like all ingenious inventions it must be handled with care.

It is only *net* lending by commercial banks which increases the stock of money. This is because repayment of a loan implies destruction of money, since repayment of the principal reduces the deposits of the borrower against a decrease of the bank's assets (stock of loans). This may explain a bank's willingness to offer mortgages without amortization to home owners, since amortization reduces the interest on the loan and hence the bank's revenues. As

[4] A government may not be allowed to sell new debt to the central bank unless it replaces maturing debt and consequently leaves total debt unchanged (Cecchetti (2008 p. 434). However, in a crisis a central bank is a "lender of last resort" even to its government.

[5] As noted in passing by Dornbusch and Fischer (1981 p. 267) but emphasized, for example, by Bernstein (2008 [1965] p. 51), Benes and Kumhof (2012) and McLeay et al. (2014).

[6] See, for example, Werner (2015) on the "window guidance" of Bank of Japan.

long as the bank can be certain that the principal will ultimately be repaid, for example when the house is sold, it has in fact no incentive at all to encourage amortization. Interest payments to a commercial bank destroy money but increase reserves, since they decrease the borrower's deposits in the bank and increase the bank's deposits in the CB.[7]

A bank linked to the payments system is the only financial institution which can create money. Not only individuals and firms but also a savings bank lends money by instructing its commercial bank to transfer money from its account to the borrower's account, leaving the stock of money unchanged. If, however, a saving-bank's lending is financed by loans from a commercial bank, then its lending is financed *indirectly* by money creation.

Note finally that purchases by the CB of securities from commercial banks create reserves, not money. Larger reserves can stimulate the creation of money but only if it stimulates lending. However, if a CB purchases securities in a secondary market, and the seller is not a commercial bank, then money is indeed created, since the CB pays for purchases by transferring money to the seller's account in a commercial bank.

Protecting payments

A commercial bank could increase lending indefinitely without risking its ability to handle payments if it could be certain that all payments by new borrowers are made to sellers with accounts in the bank itself, since such payments would not reduce its reserves in the central bank. However, since the probability of leakages to other banks cannot be neglected, particularly not if the bank is small or specialized in lending, a bank runs the risk of not being able to always honour its obligation to handle its depositors' payments if its reserves at the central bank (R) become too small compared to its deposits (D), that is, if its reserve ratio ($r = R/D$) becomes too small.

One possibility to guard against exhaustion of reserves is to keep the reserve ratio above a certain value, determined either by the bank itself (a "prudential" reserve ratio) or the central bank (a "mandatory" or "required" reserve ratio). On the other hand, a profit-maximizing bank may want to expand credit and thus reduce the reserve ratio as much as possible without risking its ability to handle its customers' payments. This may reduce the risk of not providing loans to all productive investments, but it may also raise credit risk (risk for default).

An optimal reserve ratio for a bank depends on experience or more precisely on information on flows into and out of its reserves. With the help of probability theory such

[7] This seems to me to be the only possibility, but I have (so far) found no description in the literature of exactly how interest payments to commercial banks are registered.

information can be used to predict the net flow out of reserves and hence also the need for reserves to guard against exhaustion. The greater the variance of the net flow is, the greater its expected value has to be, while a perfect match between inflows and outflows of reserves would eliminate the need for reserves altogether.

An optimal reserve ratio also depends on institutions. For example, without the market for reserves at Federal Reserve Banks in the U.S., commercial banks in the US "would need to hold substantial quantities of excess reserves as insurance against shortfalls".[8] The possibility of borrowing from the central bank will also reduce the risk for shortfalls. In fact, nowadays a CB supplies reserves on demand (as loans against collateral) at its prevailing interest rate.[9]

To reduce the risk of losing reserves banks will sometimes attempt to attract funds out of demand deposits into time deposits. To be able to expand lending a bank may also use *liability management*, that is, increasing reserves by borrowing instead of increasing deposits or selling assets.[10] This applies especially to "business banks" specialized in making loans to corporations and financing their operations by borrowing from "deposit banks" specialized in collecting deposits from households.[11] Liability management was adopted by the large U.S. banks already in the 1950s and 1960s in order to expand lending.[12] Liability management also includes increasing reserves by attracting large deposits from big businesses through higher deposit rates.[13] Borrowing may be very short-term (overnight) or short-term (selling certificates of deposits) or long-term (selling bonds). Note finally that a commercial bank's *indirect* lending by buying bonds or other securities cannot be done by creating money but presupposes financing by borrowing from other financial institutions.

Restricting lending by reserve ratios

Even if a reserve ratio is not necessary for the payments system to work smoothly, it can be imposed by a central bank to restrict lending for other reasons, for example to reduce default risk. And a required reserve ratio (r) will limit lending by stipulating a lower bound for the ratio of reserves (R) to deposits (D),

$$R/D \geq r \,. \tag{1}$$

If, for example, the required reserve ratio is 10 per cent, then a bank's deposits can be at most 10 times its reserves. Note that this is an indirect restriction on lending, since lending will

[8] Cecchetti (2008 p. 430).
[9] Bain and Howells (2009 p. 96).
[10] Lavoie (2014 p. 202).
[11] Lavoie (2014 p. 200).
[12] Mishkin and Eakins (2009 p. 432).
[13] Minsky (2008 p. 98).

increase deposits, at least temporarily (until the borrower has used the deposits to pay for the purpose of the loan), while the bank risks losing the corresponding reserves when the borrower spends the deposits.

A bank cannot give new loans if its reserve constraint is binding. But if the bank obtains some excess reserves *E*, for example by additional deposits or by selling some government bonds to the CB, then it will be able to increase lending and deposits by *E* but no more, since it risks losing all of the additional deposits and the corresponding reserves to another bank. This is because the borrower may spend all of *E* on purchases of goods and services from firms with accounts in the other bank.

On the other hand, if even the second bank's reserve constraint is initially binding, not only its deposits (*D*) but also its reserves (*rD*) will increase by *E*, implying that the second bank will obtain excess reserves equal to

$$rD + E - r\left(D + E\right) = \left(1 - r\right)E, \tag{2}$$

so that the second bank will be able to increase its lending by $\left(1-r\right)E$. In other words, when the second bank's deposits increase by *E*, its reserves also increase by *E*, and it can lend $\left(1-r\right)E$ while it has to keep *rE* as reserves. And when the borrower from the second bank spends $\left(1-r\right)E$, the deposits and reserves of a third bank will increase by $\left(1-r\right)E$ so that this bank can increase its lending by at most $\left(1-r\right)^2 E$. And so on.

The sum of the deposits created by this "multiplier process" will be *at most* equal to

$$E + \left(1-r\right)E + \left(1-r\right)^2 E + \left(1-r\right)^3 E + ... = E\frac{1}{1-\left(1-r\right)} = E/r. \tag{3}$$

Note that the upper limit will only be reached if all banks can find borrowers for all excess reserves. Moreover, this upper limit will only be reached after a time which may be substantial, since it depends on how long it takes to give loans to borrowers and how long it takes for borrowers to spend the money.

On the other hand, if there is only one commercial bank in the economy, this bank will not lose any reserves at all when borrowers spend the money, which means that a monopoly bank with excess reserves equal to *E* would be able to increase its lending and deposits immediately by E/r. Moreover, in a payments system dominated by a few large banks, a loan by one of them can sometimes be spent on purchases from firms with accounts in the bank, suggesting (almost) equivalence to a monopoly when it comes to deposit expansion.

Thus, a required reserve ratio *r* restricts lending in the sense that excess reserves *E* may initiate lending and money creation by *at most* E/r. And deposits at commercial banks (*D*) are determined as a multiple of their reserves (*R*), $D = R/r$, if and *only if*: 1) banks want no excess reserves, and 2) all banks can find borrowers for all excess reserves.

1.3 Money and related concepts

So far I have assumed that all payments are made by electronic transfers of deposits between bank accounts. While such payments are expanding rapidly in some countries, checks are still used in most countries, including the U.S., to handle the majority of non-cash transactions.[14] And notes and coins are still used extensively for some types of payments and as a store of value,[15] which makes it necessary for commercial banks to supply cash on demand to the public, and necessary for a CB to supply cash on demand to commercial banks.

Definition of money

I define money as a means of payment, including in general not only deposits at commercial banks but also notes and coins in non-bank hands.

I classify not only demand deposits but also time deposits as money because these deposits can be transformed into demand deposits without being sold (often also instantaneously and without cost). In contrast, I don't classify securities as money because securities must be sold in a secondary market to obtain money. Even if some liquid securities, like shares in money-market funds, sometimes are classified as money or "near-money", securities are equivalent to money only on the margin, since they cannot be transformed into money on a large scale without adversely affecting the market price. The distinction between money as defined here and "liquid" securities (as defined more precisely in Chapter 3) is particularly important in a financial crisis.

In the literature there are also broad definitions of money, which include assets which can easily be converted into money. This is somewhat of a contradiction, but if one is interested in *monetary constraints on expenditures*, broad money can be a useful concept, at least for individual households or firms. On the other hand, not even "broad money" is an effective constraint on expenditures for an agent who has illiquid assets which can be used as collateral for borrowing.

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[14] Mishkin and Eakins (2009 p. 457).
[15] Cecchetti (2008 p. 408).

In practice, many different components and concepts related to money are measured and monitored by monetary authorities and others, especially the following:

Reserves usually mean commercial banks' deposits held with the central bank but can also sometimes – but not in this text – include "vault cash".

Vault cash includes banks' holdings of notes and coins and is closely related to the non-bank public's demand for cash (see below). The necessary amount of vault cash can normally be determined rather exactly from observed flows of deposits and withdrawals of cash.

Monetary base (M0) or "base money" consists of notes and coin outside the CB plus banks' deposits held with the CB. The components of the base are called "liabilities" of the CB since they can be interpreted as IOUs issued by the CB (as elaborated in Section 4).

Narrow money (M1) consists of notes and coins held by the non-bank public (often called currency or cash) plus the non-bank public's holdings of demand deposits at banks.

Broad money (with different labels in different countries, like M2 or M3 or M4) includes not only narrow money but also time deposits and often also some liquid assets.

M0 and M1 have "pretty much the same meaning in all monetary systems",[16] while the meaning of broad money depends on if, and what kind of, liquid assets are included. Note that definitions of monetary aggregates are subject to frequent changes in official statistics, often following changes of financial markets and institutions.[17] Note also that many economists have experimented with different definitions of money in order to find a definition for which a strong correlation between money growth and inflation exists.[18]

I have defined money as notes and coins in non-bank hands plus deposits at commercial banks. This definition differs from "narrow money" by including all deposits (i.e. not only demand deposits but also time deposits), and it differs from some definitions of broad money by excluding all "liquid assets".

The division of money between deposits and cash depends on the development of the payments system and the willingness to use it. The demand for cash also depends on the prevalence of black markets (tax evasion), the extent of organized crime, and whether the currency is a reserve currency in international trade or not. Cash is produced by the CB and supplied to the public on demand by commercial banks which pay for the cash by drawing on their reserves at the CB. If reserves are not sufficient, then the CB has to lend the required

[16] Bain and Howells (2009 p. 32).
[17] Howells and Bain (2008 p. 248.
[18] Bain and Howells (2009 pp. 19-20).

reserves to the commercial banks. Conversely, a commercial bank can increase its reserves at the CB by depositing cash with it.

The stock of money is determined by the history of its growth, that is, by the accumulation over time of yearly changes. The rate of growth is determined by the government, the central bank and commercial banks. The government creates money by financing its budget deficit by selling bonds to commercial banks or the central bank. Commercial banks create money by new lending to households and firms. And the CB can stimulate the creation of money by purchasing securities from commercial banks or lending reserves to them, but only if additional reserves also stimulate additional bank lending.

A central bank can control the stock of money or its growth, at least in principle and provided there is a binding reserve ratio. If a CB wants to restrict the growth of the money stock, it can do this by selling securities to commercial banks, which reduces the banks' reserves and also their lending, but only if the reserve ratio is binding. Restrictions on the ratio between a bank's capital and its assets may also restrict lending. In addition a CB or a government can introduce upper bounds for mortgages or lower bounds for down payments, or, as a last resort, credit rationing.

If, on the other hand, a CB wants to add to the growth of money, it can do this by purchasing securities from commercial banks. However, such attempts will succeed only if additional reserves also stimulate new lending, and this is not always the case, especially not after the collapse of an asset price bubble, when firms may give priority to repayment of debt instead of investment financed by new debt, as emphasized, for example, by Koo (2008).

The stock of money – sometimes called the money supply – is said to be *exogenously* determined if it is controlled by the CB. Normally, however, the stock of money is *endogenously* determined by the history of its growth and, in particular, by the net lending of commercial banks at interest rates controlled by the CB. In Chapter 2 we shall see how a CB controls short-term interest rates by controlling total reserves.

Total reserves

Payments between households and firms change the distribution of reserves between banks, not the sum. A bank's lending reduces its reserves if the borrower spends the loan on purchases from sellers with accounts in other banks, but lending will not change total reserves. A bank can increase its reserves by borrowing from (or selling securities to) another bank, but transactions between commercial banks will, of course, leave total reserves unchanged.

Spending by the government increases not only the demand deposits of the seller but also the reserves of the seller's bank and hence total reserves, while tax receipts will lower reserves. Total reserves can also be reduced by government sales of bonds or other assets to the private sector (households, firms or banks). Hence a budget deficit will not increase the reserves of the banking system when it is financed by selling bonds to the private sector. A central bank can reduce total reserves by moving government deposits from commercial banks to the CB.[19]

Total reserves will increase if the CB buys government bonds or other securities from a commercial bank. In most monetary systems central banks provide advances to private banks against collateral.[20] This increases total reserves and affects a CB's balance sheet by increasing its claims on domestic banks. A commercial bank can increase its reserves at the CB without reducing the reserves of other banks by depositing cash with the CB, as already noted. Moreover, a CB's purchases of foreign exchange from a commercial bank will increase total reserves. Such interventions can be neutralized by "sterilization operations", that is, a CB's sales of securities to commercial banks. In fact, according to Lavoie (2014 p. 467), commercial banks will often do their best to get rid of excess reserves obtained from selling foreign currency to the CB, either by reducing advances or buying risk-free assets. In Section 4 we shall see how reserves are affected by a CB's gold possessions.

1.4 A short history of money[21]

Money has three appearances, namely coins, notes and deposits, and each of these forms has its own history. Deposits presuppose a network of agents which register transactions between them by crediting a seller and debiting a buyer in a book. Early examples are networks of merchants. Notes were introduced by private banks issuing notes as receipts for coins deposited with them, receipts which soon became a medium of exchange since a receipt could be interpreted as an IOU, that is a promise to exchange them for coins at will.

The Roman Empire had a monetary system based on coins: gold coins for very large purchases such as land, silver coins for taxation and other large transactions, and coins of copper, zinc or tin for the most common transactions.[22] These coins were made exclusively by the state's Mint and used by Rome to finance its expenditures. The coins' purchasing power

[19] Lavoie (2014 p. 468).
[20] Lavoie (2014 p. 467).
[21] For more history on money – and theories of money – see, for example, Ingham (2004), Ferguson (2009), Eichengreen (2011), Wray (2012), Martin (2014), and Lavoie (2014 ch. 4).
[22] Ingham (2004 p. 102).

derived from the fact that taxes had to be paid with them, implying that even a coin could be interpreted as an IOU, that is, a promise by Rome to accept it as payment of taxes. Note that the Roman system is an example of the payments system outlined in Section 1, with coins instead of deposits and a Mint instead of a Central Bank controlled by the state. In the Roman Empire money could only be created by the state.

After the fall of Rome in the middle of the fourth century, coins almost disappeared. Minting was not resumed in Europe until the eleventh and twelfth centuries, and then only by a multitude of small kingdoms and principalities with many different coins. In this world money-changing bankers were needed and arose. These money-changers also took deposits of coins and permitted book clearance of transactions between their depositors. In fourteenth-century Mediterranean city-states a money-changer could become a "public bank" by purchasing a licence from a city government, which then supervised and guaranteed the bank and also became the bank's largest client. Loans to the city-states were public, while loans to larger kingdoms during the Middle Ages were personal borrowings by the king from merchants and bankers.

Thus, sovereigns after the Roman Empire could not finance their activities merely by taxes and the minting of coins. They also relied on borrowing money from bankers and rich people. Some of them controlled a mint, but gold (or silver) could now be privately owned, and owners or producers of gold could sell gold to the sovereign and obtain payment in the form of coins produced out of this gold and other metals, even if the sovereign retained a fraction of the coins created as a fee for its production, a fee called *seigniorage*.

A state's income from coinage was consequently restricted by the supply of precious metal. But the income could also be increased by debasing the currency (producing new coins out of old coins and cheap metal). At a given supply of gold this was also the only way to increase the supply of money, but without a growing production of goods and services the effect could be not only more seigniorage but also inflation.

On the other hand, private bankers eventually discovered that even they can create money even if they can't mint coins. We have already noted that paper money was introduced by private banks issuing notes as receipts for coins deposited with them. When these notes were accepted as a means of payment for goods and services, banks soon realized that they could create money by lending.

If all payments have to be made by coins, then a bank can only make loans by literally channelling coins from savers to investors. However, when payments could be made by a bank's promissory notes (IOUs), the bank could issue notes that were not receipts for deposits

of coins but payment for buying customers' acceptance of loans. Such lending was highly profitable, but it was also risky – and often secret – and soon followed by bank runs and bankruptcies, and finally the issuance of notes was monopolized by a central bank.

After the introduction of paper money, coins were increasingly replaced by notes as a means of payment, and gold was increasingly withdrawn from the production of coins. However, even when notes began to dominate payments and coins were produced without any gold at all, the relation to gold was for some time kept alive by a promise on notes to exchange them for gold at a fixed price. And then notes became a new type of IOU, namely a promise by the state to exchange them for gold at a price determined by the state. And since then gold has been kept in bank vaults exclusively as a store of value.

However, the gold standard could only work as a monetary system as long as people trusted the free convertibility into gold but didn't use it. Hence gold convertibility was suspended during the financial crises of the 1930s, when people lost confidence in the ability of their governments to maintain convertibility and consequently tried to use it. Thus, since the 1930s a banknote can no longer be interpreted as a promise to exchange it for gold but as a means of payment whose purchasing power is guaranteed by the government.

Even if a government no longer backs its currency by gold, it is instructive to see how this was done by the U.S. government during the 1960s, when the value of Federal Reserve Notes outstanding could not (by law) exceed four times the value of gold (at $35 per ounce) held in the Treasury vaults at Fort Knox.[23] The U.S. government paid for the gold it bought by issuing a check on one of the Federal Reserve Banks. When the seller deposited the check in its bank, the following happened: 1) the seller's deposits increased; 2) its bank's reserves at the Reserve Bank increased; 3) the Reserve Bank reduced the government's balance by the value of the gold purchased; and 4) the government replenished its account at the Reserve Bank by printing *gold certificates* for its new gold and depositing these at the Reserve Bank.[24] In this way the government could increase both deposits and reserves in the banking system and back the increase by gold.

Moreover, gold played an important role as a means of international payment even during the Bretton Woods system from 1945 to 1971, when each country maintained a fixed exchange rate to the dollar and the dollar was convertible into gold at a rate of $35 per ounce.[25] During this period governments and central banks had the right to convert their

[23] Bernstein (2008 p. 133).
[24] Bernstein (2008 p. 139).
[25] Cecchetti (2008 p.469).

dollars into gold even if they (to begin with) seldom used it, since dollars were badly needed in international trade after World War II. (Storing gold is also expensive while the only return of gold is capital gain.) When gold was bought from the U.S. government, it was usually deposited (and "earmarked") in the vaults of the Federal Reserve Bank of New York.[26] Only in exceptional cases was gold actually transferred from the U.S. to another country.

However, towards the end of the Bretton Woods period outflows of gold from the U.S. were triggered by inflation and trade deficits in the U.S., as well as an increasing world market price of gold, and the U.S. was finally, in August 1971, forced to suspend the conversion of dollars into gold. Since then the dominant reserve currency in international trade has been the U.S. dollar and gold has lost its role as a monetary base. And because they no longer need gold, governments are selling it – slowly.[27]

Moreover, in a modern economy most people no longer interpret money as IOUs. A banknote is no longer a promise by a state to exchange it for gold at a fixed price. Nor is it a promise by a state to accept it in payment of taxes: in fact taxes in a modern economy can only be paid by transferring deposits between bank accounts. Of course, deposits in a commercial bank can be interpreted as a promise by the bank to exchange them for notes, but these notes can no longer be interpreted as IOUs issued by a state. Instead we can interpret money as "purchasing power guaranteed by a state" based on "a payments system established by a state" and a "unit of account determined by a state". The value of money in a modern economy is consequently no longer based on a promise to exchange money for something else (gold or tax debt) but on a promise to uphold an efficient payments system and the purchasing power of money in terms of goods, that is, an "acceptable amount of inflation".

[26] Bernstein (2008 p.140).
[27] Cecchetti (2008 p.470).

Chapter 2: More on money

This chapter deals with some special topics, including money in a world with international trade, the size of a bank's capital ratio, and the profits of a central bank. First, we shall see how international payments are made in practice and how this can add to money creation but also generate a new type of money, usually called Eurodollars. Second, we shall see why a bank's ratio of capital to total assets usually is so low, sometimes less than 3 per cent instead of often more than 30 per cent for non-banks. And finally we shall see how the profits of a central bank are generated and how they are related to reserves.

2.1 International aspects

International trade presupposes international payments and we shall now see how these are made in a world with different currencies. We shall also see how an international payments system can add to money creation within a country as well as create a new type of money, namely Eurodollars.

International payments

Payments between agents in different countries presuppose that banks have deposits in accounts in *correspondent banks* abroad.[28] This means, for example, that a Swedish bank has an account in an American bank which has an account in the Swedish bank. And this relationship between two banks in different countries makes it possible for the banks to handle payments between their countries on behalf of their customers.

For example, a firm in Sweden can be paid in SEK for exports to a firm in the U.S. in the following way. First, the American firm asks its American bank to pay the Swedish firm in SEK. Second, the American bank reduces the American firm's account with the equivalent amount in dollars and uses these dollars to buy SEK in the forex market (see below). Third, the American bank transfers the SEK to its account in its correspondent bank in Sweden. Fourth, the American bank instructs its correspondent bank in Sweden to forward the SEK to the account of the Swedish firm.

Note that this increases the stock of money in Sweden while it decreases the stock of money in the U.S. This is because the results of the transactions are, first, that the deposits of the American firm in its American bank decrease without increasing other deposits in American banks, while, second, the Swedish firm's deposits in its Swedish bank increase

[28] Bernstein (2008 pp. 148-150).

without decreasing other deposits in Swedish banks. Note also that total reserves are not affected, neither in the exporting nor in the importing country.

We have seen before that a commercial bank can create money by crediting the account of a borrower with the loan against an increase of its assets by the borrower's obligation to repay the loan. But now we also see that a commercial bank can create money by crediting the account of a customer against an increase of its customer's exports. Thus, exports create money in the exporting country, while it destroys money in the importing country.

Trade in currencies

Next, consider trade in currencies. Suppose, for example, that a Swedish bank buys dollars from its correspondent bank in the U.S. The Swedish bank pays by increasing the American bank's account in the Swedish bank, while the American bank increases the Swedish bank's account in the American bank. These transactions consequently increase the quantity of money both in Sweden and the U.S., since a foreign bank's deposits in a commercial bank are counted as money.

Of course, international payments involving payment for one currency in terms of another currency presupposes an exchange rate. And exchange rates are determined in foreign exchange (forex) markets. Such a market is organized as an over-the-counter (OTC) market, with a network of dealers connected electronically.[29] Dealers (mostly large international banks) are chartered by the central bank and include some market-makers (primary dealers), who are committed to quoting prices at which they are ready to buy and sell foreign currencies (or more precisely bank deposits denominated in foreign currencies). Dealers are profit-seeking, so the selling rate has to be higher than the buying rate. But to generate profits from such a spread without excessive risk-taking, purchases have to be equal to sales during a day, at least approximately. And this is realized partly by extensive inter-bank trade (where dealers with surpluses sell foreign currency to dealers with deficits) and partly by adjusting rates (which is why exchange rates are so volatile). The outcome is consequently market-clearing, at least approximately. Unless a CB intervenes in the forex market by buying or selling its currency, the exchange rate will also be determined by market-clearing and not by a target for the exchange rate set by a CB or its government.

[29] Howells and Bain (2008 ch. 18), Hässel et al. (2001 pp. 24-26).

Exchange rates

A stable exchange rate has many advantages, but in many countries the exchange rate is no longer a variable which monetary policy attempts to stabilize. Instead of being controlled by a CB ready to adjust the supply of foreign exchange to the demand at a target rate, the exchange rate is determined by daily market-clearing in the market for foreign exchange. Since foreign exchange is obtained by selling goods and assets to foreigners and used to buy goods and assets from foreigners, market clearing implies that

$$X + S = Z + B,$$

where *X* denotes exports, i.e. foreign purchases of goods and services (including interest payments), and *S* denotes foreign purchases of domestic assets (which we can interpret as foreign saving), while *Z* denotes imports, i.e. purchases by domestic residents of foreign goods and services (including interest payments), and *B* denotes domestic purchases of foreign assets (which we can interpret as foreign borrowing). It follows that

$$(X - Z) + (S - B) = 0, \tag{1}$$

where $X - Z$ is the current account balance[30] and $S - B$ is the capital account balance. Thus, a current account deficit, $X - Z < 0$, must be balanced by a capital account surplus, $S - B > 0$. In other words, if the outflow of payments for imports exceed the inflow of payments for exports, then the inflow of payments for domestic assets must be greater than the outflow of payments for foreign assets.

If, for example, exports increase at the current exchange rate, this will raise the supply of foreign currency to the forex market and consequently lower the exchange rate (the price of the foreign currency in terms of the domestic currency). How much the exchange rate falls depends on how the other terms in (1) react to a fall. A lower exchange rate makes imports cheaper to domestic residents and exports more expensive to foreigners (at given domestic prices of export goods), which may raise imports and the demand for foreign exchange and reduce exports and the supply of foreign exchange and consequently also moderate the fall of the exchange rate.

As another example, increasing interest rates in domestic financial markets may attract foreign investors and consequently increase *S*. This will increase the supply of foreign currency to the forex market and lower the exchange rate. How much it falls depends on how the other terms in (1) react. For example, a lower exchange rate will make imports cheaper but exports more expensive, implying that *Z* may increase (increasing the demand for foreign

[30] In practice the current account also includes transfers, i.e., remittances, gifts, and grants.

currency) while *X* may decrease (decreasing the demand for domestic currency and hence also the supply of foreign currency), which may moderate the fall of the exchange rate.

In practice flexible exchange rates are very volatile and hard to predict (which also invites speculation). A central bank can always intervene in the market for foreign exchange, but its ability to support the value of a currency by selling foreign exchange is limited by its reserves of foreign exchange. On the other hand, a CB can depreciate its currency by selling it, and this possibility is unlimited. In the long run exchange rates depend on relative inflation so that, for example, an inflation rate which is higher than in foreign countries will imply a depreciating exchange rate in the long run.

Eurodollars

Deposits in American banks held by Europeans and used to finance transactions among Europeans were known as Eurodollars in the 1960s.[31] A large volume of business among Europeans is also transacted in Eurodollars, which means, for example, that payment for importing goods to Sweden from Germany can involve the decrease of a Swedish bank's account in an American bank and a corresponding increase of a German firm's account in an American bank. Thus, banks, firms, and other institutions outside the U.S. can have deposits in American banks and handle international payments through these accounts.

In the mid-1960s, however, "non-US owners of dollar deposits began to place them with European banks",[32] partly because of a regulation in the US which limited interest payments on deposits, partly because some owners from the Eastern bloc, and in particular the Soviet Union, feared that their deposits might be impounded.[33] This meant, more precisely, that many non-banks moved their dollar deposits to European banks. And this could be done because non-banks can have dollar deposits indirectly, through a European bank which has an account in a US bank.

For example, UK firms earning dollars can instruct their UK banks to set up accounts denominated in US dollars and register their dollar earnings in these accounts. A UK firm with such a dollar account can pay for imports in dollars by instructing its UK bank to decrease the firm's dollar account followed by a decrease of the bank's account in its correspondent bank in the U.S. when the correspondent bank pays the exporter. And when the UK firm exports goods to an American firm, it can instruct its UK bank to increase the firm's

[31] Bernstein (2008 p. 150).
[32] Howells and Bain (2008 p. 318).
[33] Howells and Bain (2008 p. 317), Mishkin and Eakins (2009 p. 229).

dollar account in the UK bank with the payment from the American firm after the UK bank has obtained the payment to its account in its American correspondent bank.

Note that US authorities cannot identify the true owners of the dollar deposits of a UK bank in its American correspondent bank. Note also that a UK bank with dollar deposits can give loans in dollars to UK firms and set interest rates on these loans which are not regulated by US authorities – or by UK authorities. The bank must have reserves in the form of deposits in its correspondent bank in the US, but the reserve ratio does not have to be 100 per cent.

Note, in particular, that a UK bank can create not only pounds but also dollars – or more precisely Eurodollars – by giving a loan in dollars to a customer with a dollar account. This is done by crediting the dollar account of the borrower with the loan against an increase of the bank's assets by the borrower's obligation to repay the loan in dollars. The increased volume of Eurodollars is also preserved if the borrower spends the loan on purchases which can be paid by transferring dollars between dollar accounts in UK banks.

Dollar deposits in UK banks are now the basis for the most important money market in the world, namely the Eurodollar market. The Eurodollar market has grown rapidly because less regulation means that depositors receive a higher rate of return on a dollar deposit in London than in the U.S. at the same time as borrowers can get a lower interest rate than in the U.S. market. Banks from around the world buy and sell funds in this market, originally organized by some large London banks acting as brokers, but now with brokers in all of the major financial centres in the world. US banks can even choose to borrow dollars in the Eurodollar market instead of reserves from their central bank. And the Eurodollar market is no longer limited to banks in London, since there are now dollar accounts not only in Europe but also, for example, in Japan.[34]

2.2 Restricting lending by capital ratios

Lending can be restricted not only by reserves ratios as discussed in Chapter 1 but also by stipulating a lower bound for the ratio of a bank's capital to its risk-weighted assets, for example 8 per cent as recommended by the Basel Committee in 1988 ("Basel I") and then adopted by most industrial countries.[35] Lower weights are given to less risky assets, like 0 for cash and 0.5 for mortgage loans, while commercial loans have the full weight of 1. Capital includes not only shareholders' equity but also retained profits and other reserves immediately available to cover losses.

[34] This paragraph builds on Mishkin and Eakins (2009 pp. 229-30).
[35] Howells and Bain (2008 p. 42).

However, a bank may feel that it can handle its risks without the assistance of a capital ratio set by a regulator. And then banks often attempt to circumvent capital requirements, for example by securitization of mortgages (as discussed in Chapter 3) and selling the products to final investors, like pension funds or insurance companies. Note also that banks obtain fees from “credit lines” (promises to lend when need arises) and “acceptances” (promises to pay a loan if the debtor cannot). These are not loans but potential loans which do not impact on reserve ratios or capital ratios but, when activated, may add to a bank’s risks or losses.

To see why a bank’s ratio of capital to total assets (not risk-weighted) usually is so low, sometimes less than 3 per cent instead of often more than 30 per cent for non-banks, it may be instructive to consider the development of a bank which first specializes in payment services and safe-keeping of its customers’ deposits.

The bank needs some equity and working capital to begin with, in order to finance premises, staff, and computers, etc. Before the start, its assets consist of investments in real capital and some cash, while its liabilities comprise equity, bonds, and borrowings. And then its capital ratio (equity as a share of total assets) may be quite large, say 30 per cent. Suppose that the bank has designed a very smart payment service, which it can sell to customers for a small fee. When it starts, it manages to attract deposits from households and firms and hence the bank also attracts reserves from other banks, assuming that the bank is accepted by the central bank as a part of the payments system. Restricting its activities to payment services, the bank will then have a reserve ratio equal to 100 per cent: the sum of its reserves is exactly equal to the sum of its deposits.

The bank may even announce that it treats deposits not as short-term loans from its customers but as the property of its customers, or, in other words, that it only has its customers’ deposits for safe-keeping. To emphasize this, the bank keeps the corresponding reserves outside its balance sheet. And then its capital ratio will still be about 30 per cent.

Suppose next that the bank wants to expand its activities. The bank realizes that even if it doesn’t own its customers deposits, it does own the corresponding reserves at the CB. Hence it can use these reserves to buy things. But it always has to be able to handle its customers’ payments and withdrawals. Hence it buys government securities for most of its reserves, assuming that it always can sell such assets without loss within a day or two. How will this affect its balance sheet?

Since the bank owns its reserves, it also owns the incomes from bonds bought with these reserves. Of course, the bank could argue that its reserves have been created by its customers’ deposits, so that (at least some of) the income from the bonds should accrue to its customers,

for instance in the form of an interest on deposits, that is, a deposit rate instead of a deposit fee. However, legally the bonds belong to the bank, and so does the income generated from these bonds. Hence a bank will no longer find it possible to exclude its reserves – and assets bought with these reserves – from its balance sheet. And then the asset side of its balance sheet will be increased by its government securities and the remaining reserves. And since a balance sheet has to be balanced, the bank also has to increase its liabilities by its customers' deposits (even if formally a deposit is not a loan but belongs to a customer). In this case we can also say that the bank's bonds (and reserves) are financed by its deposits. This will, of course, reduce a bank's capital ratio, perhaps from 30 per cent before business started, to 10 per cent. Hence a bank's balance sheet and capital ratio cannot be interpreted in the same way as a non-bank's balance sheet and capital ratio.

Next, the bank realizes that it sometimes can earn more money by lending to households or firms instead of the government. The bank also realizes that it can extend a loan to a customer simply by crediting the customer's account in the bank with the loan against a loan contract. This may be followed either by a corresponding decrease of its deposits and reserves (if the loan is spent on purchases from firms with accounts in other banks) or by a corresponding increase of deposits in other accounts in the same bank (if the loan is spent on purchases from firms with accounts in the same bank). Thus, the result is "as if" the bank has bought the loan contract with the corresponding reserves in the first case, or "as if" the loan has been financed by increased deposits in the second case. This makes it difficult to say unequivocally how a loan is "financed". New loans may or may not threaten to deplete the reserves of a bank and it is the risk of depletion which is crucial to the bank (apart from the default risk of new loans).

As long as reserves are sufficient to handle payments, a bank can expand its balance sheet and further reduce the capital ratio. On the other hand, if increased lending threatens to deplete a bank's reserves, the bank can replenish its reserves by borrowing, either short-term borrowing in the "money market" or long-term borrowing by selling bonds. But borrowed money can also be used to buy securities. Thus, a bank can increase its assets and reduce its capital ratio not only by incorporating its deposits in its balance sheet but also by borrowing. More assets (loans and securities) will increase revenues but also the assets' default risks. And with a relatively small capital, a bank may find it difficult to absorb a loss, even on a small part of these assets, as emphasized, for example, by Admati and Hellwig (2013). A bank's borrowings may also expose the bank to risk, particularly if the borrowings are short-term.

2.3 The profits of a central bank

The profits of a central bank (CB) are normally substantial and most of them are returned to the government. But exactly what are the profits of a central bank, how are they generated, and how are they related to reserves?

We have seen in Chapter 1 that a CB has paid for its gold possessions by increasing the sellers' deposits and the reserves of the sellers' banks. It also pays for securities – and even for goods and services – by increasing the sellers' deposits and the reserves of the sellers' banks without decreasing any "reserves" of its own. And when banks return cash to a CB, the CB pays by increasing the banks' reserves. It is this possibility to pay for things merely by crediting accounts at the CB which is the basis for a CB's profits.

To see how a CB's profits are defined and generated more in detail, suppose that a CB for bookkeeping purposes has an account which it does debit when paying for gold or securities or other things (including premises, computers and staff). In this way its "costs" can be defined and registered. On the other hand, when a CB sells gold or securities, the buyers' deposits and the reserves of the buyers' banks are reduced while the reductions are registered as "revenues" in its bookkeeping. Incomes from the securities a CB has bought but not sold also reduce the accounts of the issuers and the issuers' commercial banks and are registered as "revenues" in the CB's books. Note that possessions of gold yield no income (interest payments), only capital gains (or losses) when sold.

This means that a CB's "profits" during a period, defined as "revenues" minus "costs" in its bookkeeping, are equal to the net withdrawals of reserves from the banking system during the period. And when a CB returns its profits to the government, it increases the reserves of the government. Thus, by returning its profits to the government, a CB neutralizes the contractionary effect its profits have on the reserves of the banking system. And if a CB doesn't return all its profits to the government, its retained profits represent a withdrawal of reserves from the banking system.

A central bank is, of course, not profit maximizing. It can only buy securities or lend money for legitimate purposes or as part of legitimate activities (as regulated in law). And these include lending reserves on demand (against collateral) to banks with liquidity problems or lending foreign exchange on demand (against collateral) to banks in need. Thus, a CB makes profits by being a "lender of last resort", primarily to commercial banks but sometimes also (in a crisis) to non-banks and even (in a serious crisis) to its government.

Being a "lender of last resort" is not only necessary for the stability of the financial system but also profitable for a CB, since all loans yield income. Note, in particular, that a CB is also

a lender of last resort in foreign currencies. Hence it must have reserves in foreign currencies, often in the form of government bonds denominated in dollars. The larger these reserves are, the larger the income obtained from them, but the size of the reserves is, of course, not determined by the CB's need for profits but the economy's need for stability in its foreign affairs. Note that this function as a lender of last resort in foreign currencies is important even in economies with a flexible exchange rate. For, even if a CB normally doesn't intervene in the forex market to support the exchange rate, it may have to support a bank which suddenly finds it impossible to refinance large borrowings in foreign currencies.

While supplying coins to the public was the only source of seigniorage for a government in ancient times, this is of minor importance now and the mechanism for creating income to the government is completely different. Since banks supply notes and coins on demand to the public, banks regularly have to buy notes and coins from the monopoly producer and pay with their reserves. If then a bank's current reserves are insufficient, it may have to borrow reserves from the CB (against collateral) at an interest determined by the CB. And then – but only then – a CB also earns money from the production and distribution of notes and coins.

Next, consider the balance sheet of a CB. Its assets comprise gold (inherited from the period of the gold standard), securities and loans. Its securities may consist not only of its foreign exchange reserves (foreign government bonds) and domestic government bonds but sometimes also of corporate bonds and other securities which the CB purchases in order to support banks and financial markets. Sometimes a CB also gives loans to banks with liquidity problems. The liabilities of a CB consist of notes and coins, debt, equity, and retained profits, where debt includes banks' deposits at the CB (their reserves).

A firm's assets are normally financed by its liabilities. To see if this is a meaningful interpretation even of a CB's balance sheet, consider first the increase of reserves created by the CB when it provides loans to banks during a liquidity crisis. Then the CB's "debt" in the form of banks' reserves at the CB will also increase correspondingly. Hence a CB does finance its loans to banks by debt, but since this is debt to the same banks (reserves), this is a very awkward way of saying that a CB supplies reserves to commercial banks on demand. Moreover, outstanding notes and coins correspond to, but hardly finance, some of a CB's assets. In fact, when the public uses less cash and banks return cash to the CB, cash will be reduced while debt (reserves) will be correspondingly increased on the liability side of the CB's balance sheet. In a cashless society a CB's liabilities will only consist of reserves, equity, and retained profits, making it particularly clear that a CB's profits depend on its ability to pay for securities and other things simply by crediting banks' accounts at the CB.

Chapter 3: Securities

There are three basic types of securities, namely bills, bonds, and shares. All other securities (financial contracts) are called derivatives. Both bills and bonds are certificates which promise payments of money (including interest) to the holder, while shares represent ownership of a company. There is also an important distinction between bills and bonds, namely that a bill promises payment in the near future, for example three months or at most a year, even if the distinction has become blurred in some respects with the growth of secondary markets where bonds can be sold at any time.

Banks are no longer as important a source of financing as they once were. For example, around 1980 they accounted for virtually all of the credit in the U.S. economy, while around 2008 direct bank loans were less than 60 percent of total credits extended in the U.S.[36] Thus, securities markets are increasingly important for borrowers, but they are also increasingly important for investors.

The *supply* of securities comes from governments financing investments in infrastructure or budget deficits; from commercial banks with temporary shortages of reserves; from corporations financing trade or investment in new capacity or technology; and from institutions financing investment in residential housing and commercial real estate. Basic reasons for issuing securities instead of borrowing from banks include, in particular, the possibility to divide a large debt among many lenders.

The *demand* for securities comes from banks, insurance companies, pension funds and mutual funds, but also from corporations and households. There are two basic reasons for investors to hold securities instead of deposits in a commercial bank, namely the prospect of an *interest rate* which is higher than the deposit rate, and the prospect of *capital gain*. For bills and bonds the first reason dominates, while the second reason dominates for shares.

Uncertainty or *risk* also enters the picture. While the interest rate or rate of return is well-defined and (almost) risk-free for bills, it is more uncertain for bonds and even more uncertain for shares, since dividends and stock prices may be so variable. And while the prospect of capital gain is negligible for bills, it is important not only for shares but also for bonds.

The risk for *capital loss* is an overriding concern for investors. There is, of course, a risk for *default* (a major capital loss), which for some securities like government bonds may appear negligible – most of the time – but which for other securities may be so important that

[36] Cecchetti (2008 p.591).

it has to be compensated by a higher interest rate. But the risk for a minor capital loss when securities are sold in a secondary market is also important, since it affects the willingness to hold the securities instead of money when the immediate future is uncertain. Hence the existence, growth, and *liquidity* of secondary markets are also important. Note that liquidity is a matter of degree and depends on: 1) how quickly you can sell the asset; 2) how small the capital loss is; and 3) how much of an asset you can sell without affecting its price.

3.1 Bills

A bill is a certificate which promises to pay a sum of money to the holder at a specified time in the near future. A bill may be issued either in exchange for money or in exchange for goods or services, and is therefore either a means of borrowing money or a means of obtaining credit. Bills have large denominations, short maturity – often three months or less – and they are issued at a discount to their redemption value, which, when borrowing money, means that the issuer obtains the promised future payment less a discount, expressed either as a percentage of the promised payment (discount rate), or as a percentage of the promised payment less the discount (interest rate).

Bills are extremely liquid assets, since they are redeemable in the near future – often three months or less – and the capital value is certain (excluding exceptional cases). Thus, bills will normally transform into money in the near future without any loss at all. Secondary markets exist for most bills and make the liquidity of these securities even greater. The most important bills are treasury bills and commercial bills, but I will also characterize some other bills.

Treasury bills

Treasury bills are issued by governments to borrow money, for example with an initial maturity of 28, 91, or 182 days, as in the U.S.[37] A government may issue treasury bills to finance temporary shortages of money, for example expenditures until taxes have been received. But this alone cannot explain the enormous amount of treasury bills in the world. In fact treasury bills are also issued by governments to finance budget deficits and refinance national debt. And the basic reason for this must be that there is a large demand for treasury bills which governments both can exploit and have to adapt to.

But why is the demand for treasury bills so large? Who buy treasury bills and why? Note first that the default risk of government bills are normally negligible, since a government can

[37] Mishkin and Eakins (2009 p. 218).

always, as a last resort, "print money" (i.e. sell new treasury bills to its CB) to redeem the bills when they mature, provided, of course, that the government can control the central bank which issues its currency. Second, treasury bills offer a protection from inflation, since interest rates on securities with short maturities are adjusted to inflation.[38] Third, since both supply and demand is large in secondary markets, treasury bills are normally extremely liquid.

Treasury bills are attractive investments for all economic agents with temporary surplus funds, or agents who want to hold part of their interest-bearing wealth in liquid securities as protection against emergencies or to be able to exploit a sudden business opportunity. Hence treasury bills are bought not only by commercial banks but also, for example, by large corporations and insurance companies. Bills from the U.S. Treasury department are also kept by other governments and their central banks as foreign exchange reserves.

Commercial bills

Commercial bills (bills of exchange) are issued by firms to give credit when selling goods or services to other firms. The seller "draws" a bill on the buyer who "accepts" the obligation to pay the holder of the bill at some date after the date when the buyer receives the goods or services. After the buyer's acceptance, the seller can obtain payment directly by selling the bill in the "discount market".[39] If instead the bill is "accepted" by the buyer's bank – for a fee – the bill can be sold with a lower discount.

Often the seller obtains the accepted bill when the buyer obtains the goods. But this is not always possible, especially not in foreign trade, since the importer may not want to send the accepted bill until she receives the goods, and the exporter may not want to send the goods until she receives the bill. In this case trade presupposes a bill by the seller's bank which is accepted by the buyer's bank. Such banker's acceptances have been in use since the twelfth century and especially since the 1960s.[40] Minsky (2008 p. 256) even argues that: "The fundamental banking activity is accepting, that is, guaranteeing that some party is credit-worthy. A bank, by accepting a debt instrument, agrees to make specified payments if the debtor will not or cannot. Such an accepted or endorsed note can then be sold in the open market."

[38] Mishkin and Eakins (2009 p. 221).
[39] Howells and Bain (2008 p. 310).
[40] See Mishkin and Eakins (2009 pp. 227-28) for details.

Commercial paper

Commercial paper (CP) is issued by large corporations to borrow money in order to finance leasing or consumer loans. Most commercial paper is issued in the U.S., where the CP market now is very large, comprising between 600 and 800 sellers, about 30 dealers, and buyers which include not only commercial banks but also insurance companies, nonfinancial businesses, and pension funds. Commercial paper is issued as an alternative to bank loans, but most issuers of CP back up their paper with a "line of credit" (a promise to lend) at a bank.[41]

Certificates of deposit

A certificate of deposit (CD) is issued by a commercial bank to increase its deposits from large customers. More precisely, a CD states that a lender has deposited a specified sum of money for a specified period with a specified bank at a specified rate of interest. Whoever holds a CD at maturity receives the principal and interest, which means that a CD can be bought and sold until maturity. In most countries there also exists an active secondary market in which CDs can be traded, making them into *negotiable* CDs (NCDs) and a popular money market instrument, especially in the U.S.[42]

Repurchase agreements

A repurchase agreement (a repo) means that a borrower sells securities to a lender with an agreement to buy them back some time in the future (at a somewhat higher price specified in the agreement). This is an arrangement which the lender may prefer to lending with the securities as collateral, since a bankruptcy by the borrower can make it difficult to obtain the collateral, while a repo means that the lender already owns the securities in case of a bankruptcy before repurchase.

3.2 Government bonds and corporate bonds

While a bill is a promise to pay a large amount of money in the near future, a bond is a promise to pay a relatively small amount of money – its par value or face value – in the distant future, for example £100 in the UK or $1000 in the US. Bonds are issued by governments, corporations and other institutions to attract large funds from a large public (not only banks but also firms and households) in order to finance large and long-term undertakings.

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[41] Mishkin and Eakins (2009 p. 226), Minsky (2008 p. 256).
[42] Howells and Bain (2008 p. 306), Mishkin and Eakins (2009 p.224), Minsky (2008 p. 270).

The interest of a bond is a fixed sum of money (often called its 'coupon payment' or simply 'coupon'), expressed as a percentage of the par value and paid out once or twice a year. Many bonds are issued with an initial maturity of 20 years or more, but what matters in practice is a bond's *residual* maturity. The interest rate on government bonds with a residual maturity of 10 years is an important bench-mark rate for long-term lending.

Bonds can only be issued by large and creditworthy institutions. However, even if the *default risk* of bonds from governments or large corporations is normally negligible, it cannot be ignored, not even for government bonds. Some guidance is provided by credit-rating agencies like Moody's and Standard and Poor's, especially for corporate bonds but also for government bonds, with ratings like AAA, AA, A or BBB for so called "investment-grade" securities, that is, securities with relatively low risk of default, while bonds with ratings below BBB are called "junk-bonds" or "high-yield" bonds.[43] Funds like insurance funds and pension funds are sometimes only allowed to invest in investment-grade securities, even if reliance on ratings from specialized agencies have been reduced after the financial crisis of 2007-2008.[44]

Governments have been able to sell an enormous amount of bonds at reasonable interest rates, which suggests that not only the supply but also the demand for bonds has been large, even if commercial banks during some periods in some countries, for example in Sweden after World War II until the beginning of the 1980s, have been obliged by law to invest a substantial part of their funds in government bonds at low interest rates.[45] The buyers are not only domestic banks, firms and individuals but also foreign institutions – and sometimes even foreign governments (or "sovereign wealth funds" owned by governments).

Thus, national debts have grown over a long period of time not only by the growth of supply but also by the growth of demand. Important reasons for the growth of supply are not only the difficulty to raise taxes abruptly to finance shocks to expenditures (including in particular World War I and World War II) but also investments in infrastructure or declining taxes and rising unemployment benefits during recessions. Demand has at times been supported by wealthy individuals, as in England and France in the nineteenth century,[46] but is nowadays supported in developed countries not only by a broader class of individuals but also by insurance companies, pension funds and other institutions.

A government is normally obliged to sell its bonds to the private sector. However, even if a CB is not allowed to purchase bonds *directly* from the government, it is allowed to purchase

[43] Mishkin and Eakins (2009 pp. 102, 249).
[44] Blinder (2014 p. 452).
[45] Nyberg et al. (2006 p. 253).
[46] See e.g. Piketty (2013).

them *indirectly* from the government, by purchasing government bonds from commercial banks, especially when banks want to sell securities to the CB in order to eliminate a shortage of reserves. And a CB is always a lender of last resort even to its government, meaning that if nobody else will buy the government's bonds, the CB will.

As an alternative to bank loans, large corporations can issue *corporate bonds* to finance long-term investments. *Debentures* are bonds that are backed only by the perceived creditworthiness of the issuer.[47] *Secured bonds* are bonds that are backed by collateral, for example a building that is built for the funds raised by the bonds. Corporations can also issue *convertible bonds*, that is, bonds which can be converted into common shares.

3.3 Mortgage bonds

Mortgage bonds are based on mortgage loans. And a mortgage loan – or mortgage for short – is a long-term loan secured by real estate (as documented in a mortgage note). In the 19th century mortgage lenders in the U.S. were either *savings banks* making home loans to their members; or *mortgage brokers* who originated loans in the West and sold them to savings banks and insurance companies in the East; or *mortgage bankers* who financed their loans by selling mortgage bonds. After World War I national banks were also authorized to make mortgage loans, and mortgage lending expanded rapidly until the Great Depression in the 1930s, when the mortgage market was restructured by the federal government, which replaced short-term loans by long-term loans.[48]

After World War II most mortgage loans were originated by savings and loan institutions and mortgage departments of large banks until about 1990.[49] Since then many new firms have entered the mortgage industry, even if some newcomers are subsidiaries of banks. This introduction of specialized mortgage originators, together with the development of information and communication technology and an active secondary market for mortgage contracts, supported by government-sponsored enterprises like Fannie Mae and Freddie Mac, have made it easier to get home loans and stimulated residential construction. More precisely, it has become easier for an individual to obtain a home loan because of more mortgage originators, but also because it has become easier for a mortgage originator to sell mortgage contracts to banks or other financial institutions, and because it has become easier for intermediaries to sell bonds to final investors.

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[47] Mishkin and Eakins (2009 p. 247).
[48] Mishkin and Eakins (2009 pp. 282-83).
[49] Mishkin and Eakins (2009 p. 283).

As emphasized by Lavoie (2014 p. 202) there are two types of mortgage bonds. The first one is issued by a bank that keeps the corresponding mortgages as assets on its books. These mortgage-based bonds are consequently part of the bank's liability management (as discussed in Chapter 1). The second type of mortgage bonds is related to an institution's asset management and is created through *securitization*, which means the transformation of an asset that is not marketable into a marketable one. This transformation is typically made by a big investment bank buying mortgages from a commercial bank or a mortgage bank and creating *mortgage-backed securities* (MBSs) which can be sold to final investors, like pension funds.

An important motivation for securitization has been that it transfers credit risk from the mortgage originators to capital market investors more able and willing to hold the risks. This motivation is based on the assumption that investors – and rating agencies – also are able to judge the risks correctly, an assumption which did not apply to all MBSs during the financial crisis of 2007-2009. Securitization of mortgages also facilitates the expansion of credit to the housing market beyond the limit set by capital requirements imposed on financial institutions retaining purchased mortgages on their balance sheets.[50]

Now, mortgage loans are normally very safe investments, particularly when house prices (and hence the value of the collateral) are increasing, and especially if house prices have been increasing as long as people can remember – as was the case before 2006. Moreover, if house prices happen to fall, a mortgage is also a safe investment as long as the homeowner can pay interest and amortization. This is usually the case not only for prime mortgages but also for "subprime" mortgages, that is, loans to low-income customers, provided that the mortgages are adjusted to the customers' ability to pay. A somewhat higher interest rate on subprime loans can also compensate investors for a somewhat higher default rate.

Thus, mortgages are normally very safe assets, even subprime mortgages. Securitization makes them (normally) even safer. For risks are reduced by making an MBS depend on mortgages from different parts of a country, assuming that even if house prices can fall and mortgages default in some parts, this cannot happen simultaneously everywhere.

3.4 Shares

A joint stock company or 'corporation' can raise capital by issuing bonds or shares to the general public. There are two main classes of shares, namely *equity* (or *ordinary*) *shares* and *preferred shares* in the UK (common shares and preferred shares in the U.S.). The holders of

[50] Acharya and Richardson (2009 p. 68).

a firm's ordinary shares are the owners of the firm and have a *residual claim* on its profits, after all debts to its creditors have been settled, including bondholders.[51]

The shareholders also decide how much the managers of the firm can retain out of profits in order to finance investments, and how much to distribute among shareholders as *dividends*. Since both profits and dividends can vary a lot, the income stream from an ordinary share is much more uncertain than incomes from a bond. On the other hand, a shareholder hopes for a *capital gain* when selling the share in the stock market, and this capital gain can sometimes be very large, much larger than for a bond. *Preferred* shares pay a fixed dividend, but when profits are low not only ordinary shares but also preferred share may get nothing.

There is an important distinction between a bond's par value and a share's par value. While a bond's par value is a promise to pay a specified sum of money at a specified date in the future, the par value of a company share represents a share of the company's unspecified future residual earnings.

Originally the par value of a company share represented an investment in a certain project, often risky, at the same time as it promised a share of the project's residual earnings when the project was completed after some years. Even if residual earnings could sometimes be nil, they could sometimes be very high, which was the basis for the investment's attractiveness.

In general a company share first of all represents a share of the company's current and future *dividends*. Dividends are the basic income stream from a share and since it is related to the company's residual income it can be quite large, even if it may take some time before residual income is so large that some of it can be distributed as dividends. Moreover, a successful company will grow, including growing dividends. This will also automatically increase the market price of a share (at a given stock of shares).

However, for a firm in a growing market there is also an important trade-off between using profits for investment and using them for dividends, since reinvesting profits may increase future dividends even further and hence also increase the price of the share even further. This makes it hard to predict both future dividends and future capital gains due to increasing dividends in the far future associated with lower dividends in the near future.

Thus, future dividends and capital gains for a company's shares are closely related to the company's future growth, and this is also hard to predict. Of course, the possibility of growth for a company depends on the phase of its industry's product cycle (innovation, growth, maturity or decline), but the relative success of a particular company within a particular

[51] Howells and Bain (2008 p. 357).

industry in a particular phase of the industry's development is also hard to predict. On the other hand, predicting a winner during the innovative phase of an industry's development will usually be extremely profitable, both in terms of dividends and in terms of capital gains.

3.5 Derivatives

A *derivative* is a financial instrument whose value is *derived* from the value of other assets. While bonds and bills are simple promises to pay, derivatives are more complex promises to pay, often contingent on some event. There are three basic types of derivatives, namely futures, swaps and options. Kay (2009) also includes shorts, which are related to "short selling", that is, speculating on falling prices. Derivatives have been developed by financial institutions – particularly since the 1970s – to reduce risk associated with volatile prices of commodities, currencies, bonds and shares.

But derivatives can also be used to "gamble on movements in the prices of other instruments without being required actually to trade in them".[52] Or they can be used to "conceal future payment obligations from investors, tax authorities, and credit rating agencies".[53] Moreover, many derivatives are difficult to value, and "when assets are difficult to value, they will be owned by people who overestimate that value",[54] which may explain some spectacular crises in derivatives markets even before the financial crisis of 2007-2009.[55]

Note that the existence of derivatives depends not only on volatile prices but also on a fundamental uncertainty about future prices which implies that different agents can have different expectations of future prices. And without different expectations the markets for derivatives would be very thin.

Futures

A *future*, or *futures contract*, for a good specifies that a seller will deliver some quantity of the good on a specific date in the future for a predetermined price, which we may call the *delivery price*. Both producers and users can hedge their risks through futures markets. Producers (like farmers, mining companies or oil drillers) hedge their risks by *selling* futures, while users (like millers or oil distributors) hedge their risks by *buying* futures. By selling a future a producer insures herself against a market price below the delivery price, while a user insures herself against a market price above the delivery price by buying a future.

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[52] Howells and Bain (2008 p. 412).
[53] Cecchetti (2008 p. 215).
[54] Kay (2009 p. 154).
[55] Cecchetti (2008 p. 196).

Trading in futures presupposes an organized *spot market* for the underlying asset, which consequently has to be a homogeneous good, i.e. a commodity of a certain quality or a specific security or currency. A *futures market* is organized by a clearing cooperation (exchange) which reduces the default risk for both sellers and buyers by being the counterparty for both parties of a futures contract.[56] Exchanges in the U.S. dominated the trading of financial futures in the early 1980s, but the rapid growth of trading in futures and the high profits made initially by the American exchanges have stimulated the establishment of futures exchanges all over the world.[57]

Now, *hedgers* are not the only participants in futures markets. There are also *speculators*, that is, agents who merely bet on price movements. Speculating sellers of futures are betting that the spot price at the delivery date will be lower than the delivery price (since then they can pocket the difference between the delivery price and the spot price when they buy at the spot price and sell at the delivery price), while speculating buyers of futures are betting that the spot price at the delivery date will be higher than the delivery price (since then they can pocket the difference between the spot price and the delivery price when they buy at the delivery price and sell at the spot price).

Pricing of futures depends on the actions of a third category of market participants, apart from hedgers and speculators, namely large financial institutions acting as *arbitrageurs*. To see how price formation works in a futures market, consider the pricing of financial instruments, for example bonds. It turns out that futures prices depend on the current spot price of the instrument, P_s, and the cost of holding it from the date of purchase to the date of delivery, $P_s(i-y)$, where *i* is interest paid (or forgone) on the funds needed to purchase the instrument and *y* is any yield from the instrument while it is being held.[58]

Moreover, define

(1) $$P_r = P_s(1+i-y),$$

and assume for simplicity that transactions costs are negligible. Then the futures price P_f is equal to P_r "in equilibrium". To see this, suppose that $P_f > P_r$. In this case an arbitrageur will borrow money and buy the instrument in the spot market but also sell a futures contract on the same instrument. He will do this because on the delivery date he can deliver the instrument he has been holding and obtain the price P_f and use the funds received to repay his debt P_r and

[56] Howells and Bain (2008 p.414).
[57] Mishkin and Eakins (2009 p.648).
[58] Howells and Bain (2008 pp. 421-423).

consequently earn $P_f - P_r$ on each unit of the instrument. And as long as $P_f > P_r$ purchases of the instrument will increase on the spot market, while sales will increase on the futures market, forcing the spot price up and the futures price down until $P_f = P_r$.

It can even be argued, as e.g. Lavoie (2014 p.482) does, that banks acting as "market makers" set futures prices as mark-ups on spot prices according to (1). Thus, a bank selling a futures contract to a customer "covers" the deal by borrowing money at the interest rate *i* and buying the asset on the spot market (and keeping it until delivery). At delivery the customer obtains the asset from the bank by paying the bank P_f equal to the bank's borrowing costs plus a mark-up. Selling a futures contract for a foreign currency involves two interest rates for the bank, since the bank borrows money at its domestic interest rate i_d and, having bought the foreign currency spot, will lend this money in the foreign market until delivery at the interest rate i_f. To earn some profit the bank consequently has to set a forward price somewhat higher than P_f determined so that borrowing costs equal lending revenues,

(2) $$P_f\left(1+i_d\right) = P_s\left(1+i_f\right).$$

Swaps

A *swap* or a *swaps contract* is an agreement to swap payments. Swaps were first used when exchange control made it difficult to buy foreign exchange. And then, for example, a UK firm wanting dollars to buy US goods could swap payments with a US firm wanting pounds to buy UK goods. Nowadays "interest swaps" are the most common. For example, a firm that wants to reduce the uncertainty of a variable interest rate on a loan may swap the variable interest payments for fixed interest payments by buying a swap contract implying a promise by the seller of the contract to pay the variable interest rate while the buyer of the contract promises to pay a fixed interest rate to the seller.

The fixed interest rate to be paid is called the *swap rate* and is set by the financial firm selling the swap as a mark-up on a *benchmark rate*, e.g. the market interest rate on a government bond of the same maturity as the swap. The mark-up – called the *premium* – reflects the risk perceived by the financial firm, and the difference between the swap rate and the benchmark rate is called the *swap spread*. The average swap spread over all interest-rate swaps in an economy is often interpreted as a measure of overall risk.[59]

[59] Cecchetti (2008 p.215).

Options

An option or an *option contract* gives the buyer of the contract the right to buy or sell something (e.g. shares) at a specified price, called the "strike price", on or before some date in the future (when the option expires). An option conferring the right to buy is known as a "call option" while an option conferring the right to sell is known as a "put option". Intuitively, the value of an option should depend on the time which remains to expiry and on the difference between the strike price and the current price but also on the volatility of the market price of the underlying asset. Assuming that price changes are independent and normally distributed these ideas can even be made precise. Even if the assumptions of independence and normality are not always valid, the possibility to base option pricing on probability theory has been crucial for the expansion of derivatives markets.[60] While options on shares have existed for a long time, option contracts on financial futures have become the most widely traded option contracts.[61]

Consider, for example, a call option which gives the buyer the right to buy a certain share after one year at the strike price *s*. Suppose that the market price of the share is m_1 when the option is bought, while it is m_2 after one year. The rate of return on an investment in an option with price *p* will be

$$r_o = (m_2 - s)/p \text{ if } m_2 > s \ , \tag{3}$$

since if $m_2 > s$ the investor can buy the share at the strike price *s* and sell it at the market price m_2. However, if $m_2 \le s$ the investor will lose *p* with a rate of return of -100%. Hence an investor will only be interested in this option if *p* is rather small (unless she completely excludes the possibility of $m_2 \le s$).

On the other hand, if *p* is small, and if the strike price is not "too large", for example, if $s = m_1$, then the rate of return will be large compared to the rate of return on a "traditional" investment of buying the share and selling it after one year (ignoring dividends),

$$r_t = (m_2 - m_1)/m_1 \ . \tag{4}$$

Hence an investor who believes that the market value of a share is increasing will *magnify* the rate of return on an investment in shares by buying a call option, but only, of course, if the option price and the strike price are "sufficiently small". (This type of magnification is often called "synthetic" leverage, since it is leverage which is not based on borrowing.) And there

[60] Cecchetti (2008 p.203).
[61] Mishkin and Eakins (2009 p. 657).

are sellers of such options if and only if there are other investors with opposite expectations on the market value of the share and who consequently expect to obtain a fee without any cost.

Shorts

An investor can stabilize the value of her portfolio by "short selling" shares she fears may fall in value. This can be done by buying a *shorts contract* which promises to pay her the difference between the current price and the market price at a future date. This is a typical case of hedging. But short selling can also be used to speculate on falling prices of shares you don't own. One way of doing this is to borrow shares from another investor (like a pension fund) for a fee and then sell these shares. If the price falls the short seller can repurchase the shares, return the borrowed shares to the lender and pocket the difference between the selling price and the buying price. Instead of borrowing shares an investor can buy a "contract for difference".[62] This is simply a bet – sometimes called "naked short selling" – or more precisely an agreement which promises that the seller of the contract will pay the difference between the current market price and the market price at a future date.

Credit default swaps[63]

A credit default swap (CDS) is an insurance contract related to a bond (or loan). The seller of the contract insures the buyer against loss from default of the bond. Thus, the seller obtains a fee from the buyer and the buyer obtains the value of the bond in case of default. In this way an investor in bonds can hedge against the risk of non-payment. An investor without bonds can also buy a CDS if she can find someone who is prepared to sell it, usually with the help of an investment bank acting as a match-maker. But this is *gambling* instead of hedging.

Credit default swaps were created in the 1990s by some innovators at JP Morgan.[64] The nominal value of outstanding CDSs reached $62 trillion at the end of 2007.[65] About 80 percent were "naked", that is, were bets rather than hedges. How can this enormous expansion of CBSs be explained?

Of course, buyers and sellers can have different opinions on default risk, which normally is very small and difficult to estimate, making it easy to match buyers (convinced of default in the near future) with sellers (convinced that they by selling a CDS obtain a stream of fees for nothing). However, Soros (2009 p. 166) notes that a CDS market offers a convenient way of

[62] Kay (2009 p. 150).
[63] For details see e.g. Blinder (2014 pp. 65-68).
[64] For details see Tett (2009).
[65] Blinder (2014 p. 67).

shorting bonds, that is, speculating on the belief that bond prices will fall. And, according to Soros, ”(p)eople buy them not because they expect an eventual default but because they expect the CDS to appreciate in case of adverse developments.”

Chapter 4: Pricing in financial markets

Pricing in financial markets includes both the determination of interest rates on loans and price formation in markets for securities. The interest rate on a loan contract is determined by two parties and is usually set by the lender and accepted by the borrower (sometimes after some negotiation). In contrast, the price on a security is determined by market-clearing (matching offers to buy with offers to sell) in a market organised by a third party.

Section 1 defines the policy rate of a central bank. Section 2 explains how commercial banks set interest rates on loans as mark-ups on the policy rate and also relates these mark-ups to profit maximization. The pricing of bills in "money markets" are discussed in Section 3, which consequently deals with the determination of short-term interest rates. Pricing of bonds are characterized in Section 4, emphasizing the distinction between the *valuation* of bonds and their *pricing*. Section 5 deals with shares and their pricing.

4.1 The policy rate of a central bank

There are at least two "official rates" announced by a central bank (CB). One of these attracts major attention when it is revised, namely a rate which often is called *policy rate* in the economics literature but, for example, "base rate" or "refinancing rate" or "repo rate" or – in the U.S. – "fed funds rate" by bankers.[66] Another important rate is the *discount rate*, which is the rate which banks have to pay when borrowing reserves from the CB (against collateral). This rate is only marginally higher than the policy rate. Sometimes central banks also pay some interest to commercial banks on their reserves at the CB, which of course makes it more attractive for commercial banks to have reserves.

Now, exactly what is the policy rate and why is it so important for an economy? First, the policy rate is a *target* and not something which a CB sets (as it sets the discount rate). More precisely it is a target for the "interbank rate of reserves", so I begin by describing the interbank market for reserves. We shall also see why a CB has chosen this target and how it is achieved. And the policy rate is important for the economy because it is a benchmark rate for all other rates, and in particular a floor to lending rates.

Since reserves fluctuate daily, due to stochastic payment flows, some banks may some days have temporary excess reserves which they can lend to banks having temporary shortfalls. For example, a bank in the U.S. with excess reserves one day can contact other

[66] Howells and Bain (2008 p. 209).

banks with shortages and lend reserves to the bank which offers the highest interest rate and then instruct the Fed to transfer reserves to the borrower during the day and back to the lender the next day.[67] The interbank rate of reserves for a day is more precisely the average of the interest rates on market transactions in reserves during the day, weighted by the size of the transactions, at least in the U.S.[68]

A central bank usually intervenes in the interbank market for reserves in two steps. The first step implies that banks in need of borrowing can borrow reserves overnight from another bank at a rate which is equal to the policy rate, at least approximately. The second step implies that banks as a last resort can borrow directly from the CB at a somewhat higher rate.

The first step presupposes that the sum of all reserves is zero, so that all banks with a deficit can find a bank (or banks) with a matching surplus. We have seen (in Chapter 1) that total reserves are determined by transactions between commercial banks and the CB, in particular the buying or selling of cash or securities. Since the public's demand for cash has a seasonal pattern, the CB can predict rather accurately, at least one week ahead, what total reserves will be next week without its intervention. If a deficit is predicted, the CB can, by lending the necessary amount of reserves to banks once a week, make the sum of reserves equal to zero, at least approximately and on average over the next week.

In the first step the CB consequently attempts to make the interbank rate of reserves equal to its policy rate by adjusting the supply of reserves to the demand for reserves at the policy rate. In other words, in the first step the supply of reserves is determined "exogenously" by the CB in an attempt to make the interbank rate of reserves determined "endogenously" in the interbank market according to the CB's target. To prevent forecasting errors from causing too large deviations of the market rate from the policy rate, banks can always borrow reserves overnight directly from the CB at a somewhat higher rate whenever they face a reserve deficiency which they cannot satisfy more cheaply by overnight loans from other banks.

In practice a CB often supply reserves through repurchase agreements or "repos", meaning that the CB buys securities from banks in exchange for reserves and the banks agree to repurchase the securities – with interest – the next day or in the near future. The policy rate is therefore often called repo rate or, by ECB, refinancing rate, since repos reflect a constant need for banks to refinance their borrowing of reserves from the CB. In the U.S. the policy rate is called the *target federal funds rate*, emphasizing both its relation to the interbank

[67] Mishkin and Eakins (2009 p. 222).
[68] Cecchetti (2008 p. 430).

market for federal funds – which reserves at the Fed are called – and the difference between the rate which the Fed wants and the actual rate, called the *market* federal funds rate.

Thus, central banks have chosen not to *replace* the interbank market for reserves but to *control* it indirectly by adjusting the supply of reserves during a day so that the market rate is (approximately) equal to the policy rate. A central bank intervenes in the interbank market for reserves only when it is necessary, and then the CB also obtains information on the necessary amount of intervention. And when a bank cannot get a loan from other banks this is also important information.[69]

Note that overnight loans between banks are made without collateral, which of course simplifies operations in normal times, but may create problems in turbulent times, when trust may vanish. Discount lending may sometimes be needed to prevent the market rate from deviating too much from the CB's target, but the main function of discount lending is usually to assist banks with more than temporary liquidity problems.

Thus, even if the details differ between countries, a central bank provides reserves to commercial banks either by purchasing securities from banks such that the interbank rate equals the policy rate (approximately), or by direct lending of reserves at a rate which is somewhat higher than the policy rate.[70] To limit deviations of the interbank rate from the policy rate, the discount rate can be a cap on interbank rates, as in the U.S., or a CB can introduce "standing facilities", as in the UK,[71] constraining interbank rates to a corridor defined on one hand by the policy rate plus some basis points for borrowing overnight from the CB by banks with shortages of reserves, and on the other hand by the policy rate minus some basis points for deposits overnight at the CB by banks with excess reserves.

Since commercial banks normally want to minimize their reserves, I have assumed that banks normally have a "structural deficit" of reserves, that is, that the sum of reserves of all banks in the payments system would be negative without intervention by the CB. In this case at least some banks have to borrow reserves overnight from the CB, so that a CB can control the supply of reserves through repos.

On the other hand, a run for liquidity in a financial crisis will create an excess supply of reserves which may push the interbank rate below the policy rate and perhaps even towards zero unless the CB has a "corridor" for the policy rate. Thus, by paying interest on reserves a CB puts a floor on the interbank rate of reserves. Alternatively, and especially after a financial

[69] Cecchetti (2008 p. 430).
[70] Howells and Bain (2008 p. 208).
[71] Howells and Bain (2008 p. 317).

crisis when a CB wants to return to normal policy rates, a CB can reduce an excess supply of reserves by selling safe and interest-bearing assets like treasury bills or bonds to commercial banks – provided that the CB has accumulated a stock of such securities.

4.2 Setting interest rates on bank loans

Lending by commercial banks includes short-term financing of business activity and mortgage lending but also lending to other financial institutions. Interest rates on loans are in practice set as mark-ups on an interbank rate. We shall now first see what kind of mark-ups this implies for banks which are not only part of the payments system but also profit maximizing. And then we shall discuss the relation between these "profit-maximizing mark-ups" and the "administrative mark-ups" which banks use in practice.

Monopoly pricing

A bank's flow of profits from loans when the market price (interest rate) is *p* is

(1) $$\pi = pq - cq - f$$

where *q* denotes the firm's volume of loans, $q = q(p) \leq k$, cq its variable (direct) costs and *f* its fixed (indirect) costs. The bank's capacity for lending (*k*) may be restricted not only by its physical assets (offices, ICT) and staff but also by reserve ratios and capital ratios imposed by its CB. Assuming that a bank's market share α is independent of the market price, so that $q(p) = \alpha D(p)$, where $D(p)$ is total demand for loans at the market price *p*, a bank prefers $\max(p^m, p^k)$ as market price, where p^m maximizes $(p-c)D(p)$ and p^k is the market-clearing price, $D(p^k) = K$, where *K* denotes the banking industry's total capacity for lending.

This approach presupposes that all loans have the same price (interest rate) and the same variable costs per year. In general, of course, a new loan can have an interest rate which differs from the interest rate on an old loan. And administrative costs are not the same, since a new loan involves checking borrowers' credit ratings and writing the necessary contracts, while the cost of collecting interest on olds loans may be negligible. Suppose however, as a first approximation, that interest rates are revised once every year for all loans, and that all administrative costs are treated as fixed costs.

Now, while a bank's revenues from lending are proportional to the volume of lending (*q*), it remains to see if its financing costs also are proportional to the volume of lending and if so,

what the marginal cost of lending (*c*) is. And to clarify this issue it is instructive to first discuss a market with only one bank.

A commercial bank obtains money for a new loan simply by increasing the deposits for the borrower (instead of transferring deposits from savers). Moreover, a new loan will reduce the bank's reserves at the CB only if the loan is used for buying goods from firms with accounts in other banks. Thus, if there is only one commercial bank, then the reserves of the bank will not be affected at all, and the marginal cost of new lending will be 0 when direct administrative costs of lending are negligible. Note also that a monopoly bank's *capacity* for lending is only restricted by its capital ratio (which restricts a bank's assets to a multiple of its capital). It follows that a monopoly bank can focus on *maximizing revenues* from loans or, more precisely, maximizing *expected* revenues, since increasing the interest rate will not only reduce the demand for loans but also increase the risk for default for the loans that are granted.

Oligopoly pricing

How will this result be modified in a market with many banks? In this case perhaps most of a bank's loans will be used to buy goods or services from firms with accounts in other banks (unless the bank is very large), and this will reduce the reserves of the bank, perhaps with the entire loan. Now, if a bank has excess reserves, the marginal cost of the loan is still 0 (assuming for simplicity that direct administrative costs of loans are negligible and assuming in addition that the CB pays no interest on excess reserves). If a bank has no excess reserves but can borrow reserves from the CB, the marginal cost is equal to the policy rate set by the central bank. However, a general expansion of credit complicates the picture. For in this case a bank's reserves may increase because of loans given by other banks, and this will reduce the need to finance the entire loan by borrowing reserves at the policy rate.

Moreover, even if a commercial bank can borrow reserves at will from its CB, this cannot be done without collateral accepted by the CB, and the volume of a bank's acceptable collateral is of course limited. But a bank can also increase its reserves by increasing deposits or by borrowings, in which case the marginal cost of lending is equal to the marginal cost of borrowing from other financial institutions or the marginal cost of increasing deposits.

Deposit rates in commercial banks have sometimes been capped by the government, even in the U.S.,[72] and such restrictions have often been followed by the transfer of deposits from banks to unregulated financial institutions with higher deposit rates.[73] But a bank with

[72] Mishkin and Eakins (2009 p. 35).
[73] Mishkin and Eakins (2009 p. 461).

freedom to choose all rates, including the price for its most important input, can increase its deposits by increasing its deposit rates. Households often accept low rates because they are willing to pay for payment facilities (cheques or electronic payment) as well as safe-keeping.[74] But the marginal cost of increasing deposits is usually higher than the deposit rates which are offered to households. It may, for example, be equal to the interest rates on "certificates" issued by banks to attract large deposits from big companies. Thus, the marginal cost of financing a loan varies, probably between 0 or the (low) deposit rate for households on one hand and the (high) policy rate of the central bank on the other hand, and to be certain to cover all costs, a bank usually uses the policy rate as a benchmark for customer rates.[75]

Now, how will prices be set when there are many banks? The problem is first of all to explain how a *market price* can be established – that is, how banks can choose to set (approximately) the same price (interest rate) for the same type of loan – and in particular how different banks can adjust so quickly to the same market price for a given type of loans after a change of the policy rate, even if adjustment is not as rapid as when banks operated an interest rate cartel in the UK before 1971.[76]

The simplest way to establish a market price is by price leadership, meaning that one of the banks sets a price which the other banks match. But how will the price leader be determined and what price will the price leader set? First, if all banks prefer the same market price, then the choice of price leader is immaterial and may be expected to vary randomly or depend on which bank is assumed to have the best information on market conditions. Second, if one of the banks prefers a lower market price than all other banks, due to lower marginal cost of lending, then it can also enforce its price preference simply by announcing it.

Pricing in practice

Interest rates on loans are in practice set as "administrative" mark-ups on an interbank rate, with mark-ups which depend on time to maturity, expected inflation, collateral, credit-risk and other factors characterising the borrower.[77] More precisely, a bank's customer rates are set in relation to an internal reference rate with discounts for deposit rates and mark-ups for lending rates. A bank's head office determines "list prices", which apply to all local offices. The internal rate is determined as a mark-up on the CB's policy rate or an interbank rate for short-term loans. Moreover, a local office can only finance a loan by borrowing from the head

[74] Howells and Bain (2008 p. 197).
[75] Hässel et al. (2001 p. 154).
[76] Bain and Howells (2009 p. 106).
[77] Hässel et al. (2001 pp. 154-156), Howells and Bain (2008 pp. 208-209), Bain and Howells (2009 p. 106).

office and the cost of this borrowing is the internal rate. Thus, the marginal cost of lending which faces a loan officer is constant and equal to the bank's internal rate, in spite of the fact that a commercial bank pays no interest on money created "out of thin air" through lending.

According to a bank's "list prices" for loans, there are different mark-ups for different default risks, implying at least some "compensating price differentials" in the sense that loans with higher default risk can give the same *expected* revenues as loans with negligible default risk. But mark-ups can also be set so as to maximize profits and the question is consequently to what extent a mark-up reflects the price elasticity of the demand for credit. Note, for example, that commercial banks after large losses can rebuild capital by increasing the spreads between lending rates and deposit rates. This suggests on one hand that banks sometimes are both able and willing to exploit an inelastic demand for borrowing, especially mortgages, and on the other hand that banks do not always exploit this possibility.

The base for mark-up pricing of loans in a country is not necessarily the country's policy rate or interbank rate of reserves. The "interbank rate of reserves" in the Eurodollar market also functions as a benchmark. This rate is known as the London Interbank Offered Rate or LIBOR, and "is widely used as a benchmark rate for setting loan and deposit rates by the addition or subtraction of appropriate margins".[78] The importance of the Eurodollar market has made LIBOR a benchmark for short-term interest rates worldwide.[79]

Households and firms can also borrow from financial institutions which are not commercial banks. Savings banks finance their lending by deposits, while other institutions finance their lending by short-term borrowing in the money market or long-term borrowing in the bond market. And then interest rates are set as mark-ups on borrowing costs – for example the deposit rate for savings banks giving home loans, or the money-market rate for short-term loans, or the interest rate on bonds – where a mark-up depends on the characteristics of the loan but sometimes also on government intervention.

Interest rates on student loans are often supported by government guarantees. Interest rates on short-term consumer loans and discount rates in "factoring" (when invoices are bought by a specialized company) can sometimes be quite high, because firms are able to exploit an inelastic demand for loans or because default risks are high.

[78] Howells and Bain (2008 p. 308).
[79] Mishkin and Eakins (2009 p. 230).

4.3 Pricing in money markets

In money markets funds are lent and borrowed for very short times in large quantities by large agents, including the government, corporate treasury departments, commercial banks and other financial institutions. A money market is based on economic agents with large and temporary surpluses or shortages of money caused by revenues and expenditures occurring at different times. Apart from the interbank market for reserves, a money market is organized by a network of traders in large banks and brokerage houses, where offers refer to large and standardized posts.[80] In such a market we can say that an agent with a surplus of money offers to "sell money", while an agent with a shortage of money offers to "buy money". Hence the market is often called a "money market" even if it usually is a market for bills.

Apart from the interbank market for reserves, money markets are based on financial instruments like treasury bills, commercial bills, commercial paper (CP) and certificates of deposit (CD). Thus, participants in money markets can obtain money for short periods by selling financial instruments instead of borrowing against collateral. Most of these instruments, and especially treasury bills, can be traded in very liquid secondary markets, often organized by big investment banks acting as "market makers". And most instruments nowadays only exist in computers as "book entry securities", which greatly reduces transaction costs.[81]

In money markets interest rates must be higher than deposit rates but lower than lending rates in commercial banks, otherwise they would not exist. And they exist because of lower costs in matching borrowing to lending. Since all financial instruments in money markets are short-term and – in normal times – risk-free, they are very close substitutes, which means that arbitrage and competition will make interest differentials very small, particularly because even small differentials will imply large profit differentials for large traders.[82] Of course, the interest rate will depend on time to maturity, but since all terms are small even term differentials will be small, and interest rate differentials are therefore often measured in "basis points", where one basis point (bp) equals 1/100 of 1 per cent.

Money market mutual funds, or money market funds (MMFs) for short, are particularly important players in money markets, especially in the U.S. They were developed in the U.S. in the 1980s as a way of circumventing caps on deposits rates in banks during a period when interest rates in the money market were much higher than interest rates on saving deposits in

[80] Mishkin and Eakins (2009 p. 212).
[81] Mishkin and Eakins (2009 pp. 217, 221).
[82] Howells and Bain (2008 p. 304).

banks. Since the end of the 1990s MMFs raise trillions of dollars, which are invested in money market instruments like commercial paper and Treasury bills.[83] A MMF is financed entirely by shares (equity). The rate of return on these shares is sufficient for many firms and households to move funds from deposits in banks to shares in a MMF.

4.4 Pricing in bond markets

A bond is a commitment to pay a standardized sum of money, say €100, to the holder of the bond at some time in the future and some interest each year before payment. For example, a government bond known as "Treasury 2 % 2025" is a promise by a government to pay the holder of the bond €100 in 2025 and €2 each year before that. Someone who buys this bond for €100 is consequently guaranteed a rate of return of 2 % if she holds the bill to redemption. But why should you buy such a bond for €100 if the interest rate in money markets is 3 %?

Valuation of bonds

Of course, investment in the money market is seldom an option for an individual. But it is an option for large investors like commercial banks, corporations, pension funds and insurance companies. Such investors will not be interested in buying a bond with a coupon payment each year equal to *C* and a final payment of *M* in *n* years' time unless the price *P* of the bond is such that investing *P* in the bond is more profitable than investing *P* in the money market with a short-term interest rate equal to *r*. And, as shown in Appendix, the alternatives are equivalent – and investors are indifferent between the two alternatives – if and only if:

$$P/M = c/r + \frac{1-c/r}{(1+r)^n}, \tag{2}$$

where *c* is the coupon rate, $c = C/M$. I will call *P* determined by (2) the bond's *money-market value* (MMV). It follows from (2) that $P < (c/r)M$ if $c > r$, $P > (c/r)M$ if $c < r$, and $P \to (c/r)M$ if $n \to \infty$. Thus, the bond's money-market value *P* is approximately determined by the equality

$$rP = C, \tag{3}$$

somewhat less if $c > r$ and somewhat greater if $c < r$.

Of course, it is not always reasonable to assume that the short-term interest rate will be constant up to the redemption of a bond, and then expectations of future short-term rates will also affect the valuation, as well as expected inflation and sometimes also a risk for default.

[83] Mishkin and Eakins (2009 p. 548).

Thus, on one hand the valuation of a bond can be a useful "bench-mark" for both buyers and sellers in a market for bonds, particularly if all of them use the same money-market rate and the same software based on (2) to value a bond. But on the other hand the market price of a bond is ultimately not determined by (2) but by supply and demand in a market where buyers and sellers can have not only different expectations of policy rates and inflation in the future but also different reasons for buying or selling bonds.

Pricing of bonds

I focus on pricing in secondary markets, since prices in primary markets – where initial issues are sold – cannot deviate much from prices quoted in secondary markets. A secondary market is organized either as a matching market or a dealer market.[84] In a *matching market* trade takes place (for a fee) if "match makers" can match orders to buy and orders to sell. Orders to buy include an upper limit on price and orders to sell include a lower limit,[85] which means that match makers have to find and match overlapping orders. In a *dealer market*, "market makers" with inventories of securities announce a "bid" price at which they are prepared to buy securities and a somewhat higher "offer" price at which they will sell securities. Their profits depend not only on the spread between the offer price and the bid price but also on their ability to set prices at a market-clearing level, since unless sales approximately equal purchases during a day, market makers will either run out of inventories or run out of money. Thus, market makers have to be good at anticipating demand and supply in the market or at least quick to adjust their prices to changes in sales or purchases. In both market forms the *market price* during a day can be defined as the weighted average over all prices in individual transactions.

Price dispersion during a day is normally negligible. But the volatility of market prices between days cannot be ignored. Thus, on one hand investors wanting to sell or buy bonds during a day can base their decisions on a market price at least approximately equal to the last market price. On the other hand investors also know that they may have to accept some deviation from past market prices. But how can a new market price arise?

If, as an extreme example, all buyers in a matching market submit price offers with yesterday's market price as an upper limit, while all sellers submit price offers with yesterday's market price as a lower limit, then the market price will not change. Match makers will be able to match either all sellers to buyers or all buyers to sellers at yesterday's

[84] Howells and Bain (2008 pp. 345-347).
[85] Howells and Bain (2008 p. 374).

market price, but they will not be able to do both unless the supply of bonds happens to be equal to the demand for bonds at yesterday's market price.

In general market-clearing is only possible in a matching market if price offers are less rigid. If, for example, supply is greater than demand at yesterday's market price, it will only be possible for dealers to match all sellers to all buyers at a lower market price if at least some sellers submit price offers which show that they are willing to accept a lower price than yesterday's market price. And they may be willing to do this, for example, because they need the money urgently, or because they "value" the bond less than others.

In a market with market makers the market price changes between days if and only if the market makers announce new prices. Price offers can change even before trade takes place if dealers anticipate changes in supply and demand. They can even be so good at forecasting that they do not have to change their prices during a day in order to adjust supply to demand.

Prices determined daily by market-clearing are volatile because both demand and supply can vary discontinuously between days, as emphasized, for example, by Mandelbrot and Hudson (2008). Moreover, it seems to be a stylized fact that the price of a long-term bond is more volatile than the price of a short-term bond. And this can be explained from the demand side not only by the greater sensitivity of the MMV of long-term bonds to expected money-market rates, but also by greater diversity of buyers' and sellers' opinions on inflation and default risk in the future for long-term bonds.

The market price of a bond is usually expressed as per cent of its face value, but a bond's market price is often also, or alternatively, expressed as an *equivalent money-market rate* obtained by substituting the market price for P in (2) and solve for r. This equivalent interest rate is often called the bond's "redemption yield" or its "yield to maturity" or simply its *yield*. It is particularly relevant for an investor who plans to buy a bond at its current market price and keep it until maturity. In general (2) can only be solved for r using numerical methods, but some results can be obtained without a computer. For example, (2) implies that

$$r \to C/P \text{ if } n \to \infty, \tag{4}$$

so that C/P, often called the "current yield", approximates the yield for long-term bonds.

4.5 Pricing of shares

The "valuation" of a share in terms of the present value of its future incomes is extremely difficult because a share's future incomes are so hard to predict. Hence other methods for the "valuation" of shares have been developed, based on the actual development of market prices.

I will consequently first discuss actual pricing before I discuss "valuation" of shares – and the purpose of this valuation.

Pricing

In secondary markets share prices are determined daily through market clearing, either by match makers (matching offers to sell to offers to buy) or market makers (offering to buy and sell at announced prices), as in bond markets.[86] Stock exchanges and trading technologies have been revolutionized since the 1980s, including large financial institutions as new dealers; screen-based systems for information, trading, and settlement; and mergers between exchanges in different countries.[87]

New shares have exactly the same characteristics as existing shares (which explains why the issue price is usually well above the par value of the share), but they are not initially sold in the secondary market, since this would probably add so much to the supply during a day that the market-clearing price would fall precipitously. Instead a company sells new shares to an "underwriter" at terms agreed upon by both parties. The underwriter – an investment bank or a syndicate of several banks – will then offer the new shares to existing shareholders or others, usually at such a discount from the price in the secondary market that all of the new issue can be sold. Existing shareholders are usually offered the possibility to maintain their shares of the ownership of the firm by buying new shares.[88]

Since share prices are determined by equating supply to demand during a day, their variability will depend on the variability of supply and demand. And supply and demand can vary between days for many reasons, for example shifts in investors' valuations or expectations, or increases in sales simply because some investors need the money, or increases in purchases because some investors have surplus funds they want to invest. Upward trends in share prices may be due to increasing demand from pension funds and mutual funds, or to speculative bubbles, as elaborated in Shiller (2005). But increasing purchases of a company's shares may also be due to attempts to gain control of a company.

Valuation

I will only discuss the valuation of ordinary shares since preferred shares are (almost) like bonds. Unlike bonds, ordinary shares have no fixed redemption value at a predetermined

[86] Howells and Bain (2008 pp. 346, 373), Mishkin and Eakins (2009 p. 261).
[87] Howells and Bain (2008 pp. 374-75).
[88] Howells and Bain (2008 p. 372).

redemption date, but assuming that future dividends and market prices can be predicted accurately, the "present value" – or more precisely the money-market value – of a share which will be sold after *n* years is

$$PV = \sum_{t=1}^{n} \frac{D_t}{(1+r)^t} + \frac{P_n}{(1+r)^n}, \tag{5}$$

where D_t is the dividend per share during year *t*, P_n is the share price at the end of year *n*, and *r* is the current money-market rate. This is analogous to the valuation of a bond according to (2), with the crucial difference that the future income stream of a bond is known with certainty, while both future dividends and the "redemption value" of a share are uncertain.

In fact the "redemption date" is also uncertain, since many investors plan to choose this date at a later stage, hopefully when the market price is high. Moreover, valuation according to (5) depends not only on "fundamentals" but also on a predicted market price. Note that the possibility of capital gain often is the main attraction of investing in shares, so we cannot let *n* tend to infinity in (5). We conclude that "valuation" according to (5) is not only conceptually problematic (since it contains a market price) but also highly subjective.

Now, the purpose of "valuation" of shares must be to guide an investor in her choice of shares. And when choosing between different shares it is *relative* valuation which matters. When choosing between different securities the basic general principle is of course to search for shares with a high "rate of return". For shares the simplest measure of this type is its *yield* during a year or more precisely its *dividend yield* D_1/P_0.[89] And including capital appreciation $(P_1 - P_0)/P_0$ we obtain a more general measure,[90] which is particularly relevant for shares, namely the *rate of return* during a year,

$$r_1 = D_1/P_0 + (P_1 - P_0)/P_0 . \tag{6}$$

Of course, this measure of the rate of return is most relevant for investors who plan to buy shares and sell them after exactly one year. For investors who plan to buy shares and sell them after exactly *n* years, the "rate of return" can be defined as the *equivalent money-market rate*, obtained by solving for *r* in (5) with *PV* replaced by P_0.

Now, while decisions to buy – or sell – shares must be based on *predicted* rates of return, estimation of future rates of return (or future dividends and market prices) can only be based on *past* rates of return (or past dividends and market prices) in addition to information on the future of the share's company. First, trends and variation of past share prices and dividends

[89] Howells and Bain (2008 p. 365).
[90] Howells and Bain (2008 p. 186).

may be used to estimate the probability distribution of share prices and dividends (including correlations between different shares) in the near future on the assumption that the generating mechanism remains the same. Second, information on the company or the company's industry may suggest imminent changes of the generating mechanism. For example, when a new industry passes from its innovation phase to its growth phase, some companies may exit while other companies may start to grow even more rapidly than before. It may be difficult to predict which firms will survive, but some investors may have better information than others.

An important reason for investing in shares is the possibility of large capital gains. This possibility is based on an upward trend in average share prices (due to an upward trend in residual earnings of listed companies) but also on the *volatility* of share prices. This volatility implies both the possibility to buy shares when the market price is low and the possibility to sell when the price is high. The basic problem for an investor is consequently to decide on what and when to buy and what and when to sell. Such predictions are difficult because unlike predictions of bond prices they cannot be based on "fundamentals", only on *predictions* of fundamentals like dividends and capital appreciation. And predictions of capital appreciation must be based on predictions of the development of supply and demand for shares.

Decisions on purchases and sales of shares are consequently based on subjective predictions of future share prices. This suggests a diversity of opinions which may increase the overlap between offers to buy and offers to sell at the current market price and which consequently may increase the liquidity of equity markets.[91] On the other hand, subjective expectations may also happen to coincide. If, for example, there is an increase in the number of investors who think that a share is undervalued – or more precisely predict that the share price will go up in the future – then purchases may also increase so much that the market price does increase, verifying expectations and perhaps even initiating a speculative bubble, as elaborated in Shiller (2005) and Mandelbrot and Hudson (2008). And such bubbles reinforce the possibility of large capital gains.

[91] Howells and Bain (2008 p. 368).

Appendix. Valuation of bonds

Investors will not be interested in buying a bond with a coupon payment each year equal to *C* and a final payment of *M* in *n* years' time unless the price *P* of the bond is such that investing *P* in the bond is more profitable than investing *P* in the money market with a short-term interest rate equal to *r*. And the alternatives are equivalent – and investors are indifferent between the two alternatives – if and only if:

$$P = \sum_{t=1}^{n} \frac{C}{(1+r)^t} + \frac{M}{(1+r)^n}. \tag{1}$$

To see this, note first that obtaining the coupon payment *C* after one year is equivalent to investing P_1 in the money market and obtain $P_1 + rP_1$ after one year if

$$P_1 + rP_1 = C \text{ and hence } P_1 = \frac{C}{1+r}. \tag{2}$$

Second, obtaining the coupon payment *C* after two years is equivalent to investing P_2 in the money market, reinvesting P_2 and the interest after one year and obtain $P_2 + rP_2 + r(P_2 + rP_2)$ after two years if

$$P_2 + rP_2 + r(P_2 + rP_2) = C \text{ and hence } P_2 = \frac{C}{(1+r)^2}, \tag{3}$$

and so on for the other terms in (1).

Thus, the value of a bond according to (1) with *r* equal to the money-market rate can be interpreted as the value of the bond's payment stream in terms of the *equivalent investment in the money market*. I will call this version of a bond's "present value" its *money-market value* (MMV) in order to emphasize its dependence on the money-market rate.

Moreover, (1) can be rewritten as

$$P/M = c\sum_{t=1}^{n} \frac{1}{(1+r)^t} + \frac{1}{(1+r)^n}, \tag{4}$$

where P/M is the MMV of the bond expressed as per cent of the principal *M*, $c = C/M$, *n* is the number of years to redemption, and *r* is the interest rate in the money market (assumed to be constant until the bond matures). And using the formula for the sum of a finite geometric series, (4) reduces to

$$P/M = c/r + \frac{1 - c/r}{(1+r)^n}. \tag{5}$$

Chapter 5: Stabilizing the financial system

The financial system consists of a central bank, a small number of large commercial banks, a decreasing number of savings banks, an increasing number of other financial institutions, and an increasing volume of financial instruments traded in an increasing number of financial markets. Of course, bankruptcies can and should occur even in this part of the market sector – as part of the process of creative destruction – but they must not threaten the stability of the whole system.

Financial instability can take many forms, even if a run for currency (a panic attempt to transform deposits into cash) is no longer one of them. But a run for safer deposits is, moving deposits to a bank considered safer, perhaps in another country. A bank can loose not only ordinary deposits in this way but also short-term borrowing from the money market, when investors refuse to roll over such loans. Runs for liquidity (attempts to transform assets into deposits) can also cause panic, and then the distinction between money and so called liquid assets becomes particularly clear. We shall study the risk of such runs and other risks for instability in steps, beginning with the payments system.

5.1 Financial institutions

Commercial banks are linked to each other and to the central bank through a payments system, as elaborated in Chapter 1. Even a temporary crash of the IT-system handling payments could be disastrous.

Payments are made by cash or by transferring deposits from the buyer's bank account to the seller's bank account. If these accounts belong to different banks, the reserves of the seller's bank will increase, while the reserves of the buyer's bank will decrease, as money is transferred from buyer to seller. Payments consequently presuppose that a bank's reserves at the CB always are positive.

Commercial banks supply cash on demand to their customers (who pay with their bank deposits), and the CB supplies cash on demand to commercial banks (who pay with their reserves at the CB). The CB lends reserves on demand to commercial banks against collateral in the form of government bonds or other securities accepted by the CB and at an interest rate determined by the CB.

A CB also supplies reserves (against collateral) to a commercial bank with liquidity problems for other reasons than stochastic variation of payments. Insolvency may lead to

capital injections or other forms of support by the government – if "too big or too complex to fail" – or to reconstruction or bankruptcy, in which case the deposits of the bank's customers are nowadays usually guaranteed by the government (deposit insurance). Since people regard their deposits as their property and not loans to banks, a loss of deposits would jeopardize the legitimacy of the payments system.

Deposit insurance will also reduce the risk for movements of deposits from a bank to another bank perceived to be safer, particularly if deposit insurance applies to all deposits, even large ones. In other words, deposit insurance will stabilize deposits in a bank, including not only demand deposits but also savings deposits. Deposits will only be moved from a commercial bank to another financial institution if the owner is prepared to take some risk in order to obtain a larger rate of return than offered by the bank on savings deposits.

Commercial banks

Let us first note the difference between insolvency and bankruptcy. Insolvency is the inability to pay debts, but there are two forms of insolvency: *cash flow insolvency* (which involves a lack of liquidity to pay debts as they fall due) and *balance sheet insolvency* (when liabilities exceed assets). A firm may be cash-flow insolvent but balance-sheet solvent (if it holds illiquid assets) or balance-sheet insolvent but cash-flow solvent (if liabilities exceed assets but revenues are sufficient to pay debts as they fall due). And a firm is bankrupt if it is both cash-flow insolvent and balance-sheet insolvent.

Note that balance-sheet insolvency depends on how assets are valued. Mark-to-market valuation – i.e. valuation of assets at current market prices in secondary markets – may drastically reduce the value of some assets during a crisis when markets become illiquid and prices slump. And securities not traded at all in markets (but over-the-counter) may be difficult to value even if future incomes from the securities are well-known. This means that a bank may be balance-sheet insolvent during a financial crisis even if it is cash-flow solvent – unless the bank has to use income generated from selling assets to pay for its debts.

Now, consider first a risk-averse commercial bank with only risk-free loans and government bonds as assets. Profits can be positive even with risk-free lending, but accepting some default risk may raise interest rates and profits, or more precisely *expected* profits. Moreover, if loans to businesses and households are sufficiently many and varied, default probabilities can be estimated from historical statistics. And then a bank can develop what may be called *risk-adjusted* instead of risk-free lending, that is lending which accepts some default risks if they increase *expected* profits without at the same time increasing the (small)

risk for negative profits too much. However, a major financial crisis may invalidate all risk estimates based on historical statistics, as emphasized, for example, by Mandelbrot and Hudson (2008), so that a bank may even change its policy completely from risk-adjusted to risk-free lending.

Mortgage lending is a particularly important form of lending which may appear almost risk free to banks when house prices are increasing. Excessive lending facilitated by money creation by commercial banks may add to price increases and even fuel a house-price bubble which sooner or later will burst and initiate a financial crisis.

So far we have only considered loans which finance commerce or investment in real capital by a multitude of firms or households. Loans to other financial institutions or loans to foreign institutions may be more difficult to evaluate, at least if they are both few and large.

A commercial bank can engage not only in risk-adjusted direct lending but also in risk-free indirect lending to its government, i.e. investment in government bonds. Moreover, it can engage in risk-adjusted investment in securities like corporate bonds or government bonds from other countries, because the bank believes that average income from such bonds will be higher than income from risk-free bonds.

But a bank can also, in a special department or subsidiary, engage in trading securities, usually called *proprietary trading*, meaning simply buying cheap and selling dear, even if the price difference may be rather small (but the traded volume large). Proprietary trading introduces *speculation*, defined as trade based on expectations about the development of market prices, and is consequently risky but sometimes also very profitable.

Note also that proprietary trading is very different from market making, when a bank only keeps inventories of securities which are necessary for buying or selling securities on behalf of its customers for a fee. The risks associated with market making are, of course, negligible compared to the risks associated with proprietary trading. Investors planning to keep securities until maturity are also exposed to much less risk than traders – unless inflation complicates the picture.

A commercial bank can engage not only in *asset management*, i.e. giving loans or buying securities, but also in *liability management*, i.e. taking loans or selling securities in order to increase its reserves whenever necessary to expand profitable lending if borrowing reserves from the CB no longer is possible (perhaps because of lack of acceptable collateral), or if borrowing from other institutions is cheaper. But especially short-term loans from other financial institutions will increase a bank's sensitivity to a financial crisis. Note that commercial banks cannot lend in a foreign currency by adding deposits to a customer's

account since they have to transfer money from its account in a correspondent bank abroad to an account in a foreign bank. And to be able to do this they also have to borrow abroad.

Note also that the stability of a commercial bank depends on some activities not reflected in its balance sheet, including in particular promises to lend on demand ("credit lines") and promises to pay bills which the debtor fails to pay ("acceptances"). Large commercial banks can also be primary dealers in bonds and stocks, implying that they sometimes can have large inventories of risky securities.

Lending to businesses for investment in real capital depends, of course, on the demand for such loans. Debt-financed investment in real capital is particularly important in developing countries, without accumulated profits as a source for financing. In such countries the demand for loans for real investment may be almost limitless, and then lending by money creation is particularly ingenious, since lending does not only create money but also production and income which can repay the loans.

In developed countries, on the other hand, most investment is financed by accumulated profits,[92] suggesting that nowadays most bank lending in developed economies is *not* for investment in real capital which generate production and income which can repay the loans. Hence the stability of a commercial bank will increasingly depend on the volumes and risks of direct and indirect lending for other purposes than investment in real capital.

Investment in securities may be profitable but also risky, and instead of assuming such risk on behalf of their depositors and offering savings deposits with high rates, banks may offer investment in mutual funds to their customers. And then all risks are assumed by the banks' customers, while the banks always earn fees for administration of the funds.

A commercial bank's activities are based on its deposits and its ability to borrow reserves from the CB. But a commercial bank can also borrow money from other banks and institutions, either directly or in the money market or by issuing bonds. And it can do this to obtain additional reserves as a basis for additional lending, or perhaps because it wants to finance lending abroad by borrowing abroad. In any case, short-term borrowings from other institutions may be difficult to refinance during a crisis and consequently constitute a threat to financial stability – unless a CB always stands ready to replace them, including borrowings in foreign currencies. Note also that other financial institutions may be even more sensitive to short-term borrowings than commercial banks, since they cannot rely on the CB as a lender of last resort.

[92] See, for example, Cecchetti and Schoenholtz (2011 p. 322).

Other financial institutions

There are nowadays a multitude of specialized financial institutions. Apart from organized markets (like stock exchanges), firms linked to such markets (like brokers) and firms giving financial advice for a fee (like investment banks and rating agencies), there are financial institutions that harbour savings and offer loans, some combining both functions (like traditional savings banks or 'thrifts'). There are also institutions that specialize in wealth management, either exclusively (like hedge funds or sovereign wealth funds) or in combination with other services (like pension funds or insurance companies).

How can a financial institution offer higher rates of return to savings than a commercial bank? First, it has no costs for the payments system and probably lower administrative costs than a commercial bank. Second, it can probably obtain higher interest rates on its large deposits in its commercial bank or in the money market than its customers can obtain on their deposits. Third, it may be able to invest some of the savings in higher-yielding securities, like government bonds. Fourth, it may choose to borrow money and invest it in assets with higher yields. But to be able to do this it probably has to borrow short and regularly refinance such borrowings, which will expose the institution to the risk of not being able to refinance its investments in a crisis.

Moreover, there are institutions specialized in savings for various kinds of savers: money market funds for firms and households with temporary surpluses of money; savings banks for low-income and middle-income households saving for a home or a car or consumer durables; mutual funds for long-term saving by middle-income households; financial firms advising on direct investment in stocks or bonds for rich households; and hedge funds for rich households prepared to take some risk in order to become even richer with some non-negligible probability.

What are the effects of money market funds on the financial system? By attracting deposits from households and banks and lending money to corporations they compete with banks – and competition is usually a positive thing. But what about attracting deposits from banks which are lent to other banks? This will not only raise financing costs for banks but also expose them to additional liquidity risk. It may also affect the distribution of funds between banks, for example by attracting deposits from all banks but lending only to large banks.

Since a money market fund (MMF) is financed entirely by shares (equity), it cannot become insolvent. But unexpected losses on investments in commercial paper, for example, may make its customers so nervous that they withdraw their money. And then a MMF cannot

renew its loans to banks and corporations, so that liquidity problems are spread throughout the financial system. In other words, MMFs can seize to function almost instantaneously in a crisis, since firms with large temporary surpluses of money prefer to keep the money (as deposits in banks) as soon as they are not 100% certain that they will get it back next month.

Since hedge funds may attempt to increase the return on invested capital by using short-term borrowing to finance proprietary trading, they may expose their investors to a risk which may increase drastically in a crisis when market prices fail to develop as expected. There are also financial firms specialized in lending, including finance companies (offering instalment loans for cars or consumer durables), and credit companies (supplying consumer loans without collateral at high interest rates). Most of these firms are financed by short-term borrowing from commercial banks or money markets, which expose them to refinancing risk.

A particularly important financial institution is the modern *investment bank*, which ”typically issues securities in the primary market, makes a secondary market in securities, gives corporate advice, undertakes asset management on behalf of retail and institutional investors, and engages in proprietary trading on its own account” (Kay 2015 p. 112). Examples of important investment banks before the financial crisis of 2007-2009 in the U.S. are Goldman Sachs, Morgan Stanley, Merril Lynch, Lehman Brothers and Bear Stearns.

Investment banks are particularly important *broker-dealers*, that is, they are executing trades in securities not only on behalf of a customer (as a broker) but also for its own account (as a dealer). And according to Kay (2015 p. 111): ” The rise of the broker-dealer … gave the market-maker specific, as well as general, information about the positions and intentions of clients. … The modern investment bank derives a considerable edge not so much from its wide knowledge of the global economy as from its wide knowledge of financial markets: the identities, positions and intentions of the principal players.”

5.2 Financial markets

Deregulation and financial innovation have favoured markets over banks so much that indirect lending by buying bills, bonds or other securities is now almost as large as direct lending by banks in the U.S.[93] The expansion of markets has also made it easier for large firms to borrow by selling bonds. And households can obtain consumer loans from credit companies financed by securities like commercial paper sold in the money market.

[93] See, for example, Cecchetti and Schoenholtz (2011 p. 667).

The expansion of markets has also made not only bills but also bonds and many other securities very liquid in normal circumstances. Hence economic agents normally prefer securities (and some interest) to money even as a temporary store of wealth – which stimulates the demand for securities and raise their prices. But securities cannot be bought unless someone else wants money instead of securities, suggesting a large turnover and a widespread need to sometimes convert securities into money for various purposes.

Markets are stable as long as even large volumes of securities can be sold today at (approximately) the same price as yesterday. However, since market prices equate supply to demand during a day, they will drop discontinuously whenever preferences for liquidity suddenly become more widespread than preferences for interest-bearing assets. And a run for liquidity in a financial crisis makes the distinction between money and "liquid" securities particularly clear.

Market prices are sensitive to trading by large investors like pension funds, insurance companies, mutual funds, and sovereign wealth funds. These funds may sometimes invest in securities they intend to keep until maturity, and then they can stabilize market prices by stable flows of purchases or sales. And when a new fund is expanding it may add demand to a market and hence stabilize or even increase market prices. On the other hand, large funds may become so large that even minor readjustments of their portfolios, when selling some securities and buying others, may have important repercussions on market prices. Moreover, even if proprietary trading – buying cheap and selling dear – normally should stabilize prices, traders with large positions may add to volatility in a crisis.

The breakdown of a financial system is above all characterized by "runs for liquidity", meaning attempts by financial institutions to increase money holdings abruptly by selling securities. The supply of securities will then exceed demand so much that it initiates falling prices and financial losses for the sellers. Moreover, the risk for falling prices may depend on the relation between the stock of debt (securities) and the stock of money. If the stock of debt increases more than the stock of money in an economy, the destabilizing effects of a run for liquidity may increase.

To see why, suppose first that the stock of debt held by some financial institutions is much less than the stock of money held by other agents. At least some of these agents may have surpluses of money which they want to spend on buying interest-bearing securities, and if the stock of securities is relatively small, then it may be possible for all sellers to find a willing buyer at an acceptable price. This is not even theoretically possible if the stock of debt held by some institutions is much larger than the stock of money held by other agents.

But how can the stock of debt increase more than the stock of money when lending by commercial banks also creates money (as elaborated in Chapter 1)? This is because lending by other institutions than commercial banks does not create money, as elaborated in Chapter 1 (but transfers money from the lender's account in a commercial bank to the borrower's account). The increasing importance of "markets" relative to "banks" may consequently have increased the stock of debt relative to the stock of money, and hence also increased the risk for loss of liquidity in a financial crisis.

5.3 A short history of financial crises since World War II[94]

> "The years since the early 1970s are unprecedented in terms of the volatility in the prices of commodities, currencies, real estate and stocks, and the frequency and severity of financial crises".
>
> Kindleberger and Aliber (2005 p.1)

The Bretton Woods system – with exchange rates pegged to the dollar, the dollar convertible into gold, and restrictive capital controls – had fallen apart by 1971.[95] However, not all countries stopped pegging their currencies to the dollar and many countries intervened in the forex market when the exchange rate became "too volatile" or needed some support in order to approximate its "fundamental value" or, as emphasized by Stiglitz (2002), to protect creditors in a currency crisis. Thus, exchange rate stability has continued to be an important objective for individual countries. Attempts to establish a new system of "fixed but adjustable rates" – including adjustment by countries with chronic current account surpluses – have also been made.[96] However, exchange rate stability has proven to be difficult to reconcile with capital mobility, as we shall see in the following brief survey of financial crises after World War II. In fact the period after Bretton Woods is characterized not only by capital market liberalization but also by deregulation of all financial markets, encouraged and sometimes enforced by the IMF, as argued in detail by Stiglitz (2002).

Crisis in Latin America 1982

It took Latin America more than seven years to work its way out of the debt crisis that began in 1982.[97] This debt crisis was an indirect result of the earlier energy crisis or, more precisely,

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[94] For more history on financial crises see Kindleberger and Aliber (2005), Shiller (2005) and Reinhart and Rogoff (2009). Classical accounts of the Great Depression in the 1930s are Galbraith (2009 [1954]) and Kindleberger (1986); a thought-provoking modern account is Koo (2008 ch. 3.)
[95] See e.g. Cecchetti (2008 p. 470).
[96] See e.g. Eichengreen (2011 p. 62).
[97] Krugman (2000 p. *xvi*).

an indirect result of the sharp increases of oil prices by the Organization of Petroleum Exporting Countries (OPEC) in the 1970s. For earnings resulting from these price increases were deposited in American banks,[98] which in their search for profitable lending turned to Latin American countries willing to borrow money at high interest rates. However, with too little debt used to finance investment in real capital, repayment could not be made out of additional growth, which meant that repayment was accompanied by a prolonged slump. The crisis started when Mexico in August 1982 informed the U.S. government that it could no longer honor its debts and the crisis soon spread to most of Latin America.[99] According to Koo (2008 p.233) the ”resultant crisis virtually wiped out the capital of many if not most major U.S. banks”, but thanks to directives from the Fed to renew lending to Latin America there were no bankruptcies and no credit crunch in the U.S. On the other hand the resolution process took more than 10 years.[100]

Crises in the Nordic countries 1991-93[101]

The crisis in Sweden was preceded by financial deregulation and a boom in 1985-1990 and followed by a long recovery in 1994-2000. Quantitative controls on lending were abolished in 1985 and followed by credit expansion, inflation, asset prices increasing much faster than consumer prices, and a boom which also was fueled by the fall in oil prices in 1985 and expansionary economic policy abroad. Imports increased and exports decreased towards the end of the 1980s. The growing current account deficit was financed by capital imports, apparently mainly from Japanese banks.[102] Monetary policy had since 1982 been founded on a fixed exchange rate defended by high interest rates – which also made it tempting for domestic corporations to borrow abroad. The last parts of the capital controls were abolished in 1989, facilitating an outflow of capital.

The first speculative attack on the pegged *krona* came in October 1990. Lending started to fall in real terms in the beginning of 1991. Prices of commercial properties in Stockholm fell by 35 per cent in 1991. In September 1991 a major financial institution found itself unable to roll over maturing commercial paper. The crisis spread to the whole market of commercial paper, which dried up in a couple of days so that finance companies had to resort to bank loans. Several finance companies went bankrupt, and then the crisis spread to the banks.

[98] Eichengreen (2011 p. 63).
[99] Krugman (2000 p. 41).
[100] See also Koo (2015 pp.41-42 and Kay (2015 p.36).
[101] For details, see the many contributions in Jonung et al. (2009).
[102] According to Kindleberger and Aliber (2009 p. 142).

Increasing bank credit losses forced the government to intervene with guarantees and capital injections in all major banks except one in 1991-92.

The defence of the *krona* broke down in November 1992 and a floating exchange rate was introduced, followed by a depreciation of about 30 per cent but also a lower interest rate. Employment fell from 83 per cent of the population (16-64 years) in 1989 to 72 per cent in 1994, while unemployment rose from 1.5 per cent of the labour force in 1989 to 8.0 per cent in 1994. The recovery started in 1993 and was driven by exports, which increased from 28 per cent of GDP in 1992 to 45 per cent in 1999. But the employment intensity never rose above 73 per cent during the 1990s.

The development in Finland followed the same pattern as in Sweden but the depression was deeper. Financial deregulation set off a lending boom even in Norway, partly financed by capital inflows, followed by a currency and banking crisis accompanied by a depression.

Crisis in Japan 1991[103]

Following deregulation of bank lending in the 1980s, both land and stock prices in Japan tripled in the late 1980s, fueled by credit expansion. In 1991 land and stock prices began a steep decline and were soon 60 per cent below their peak. However, the collapse of the asset bubble was not followed by widespread bankruptcies and high unemployment but by a recession which has been called a ”growth recession” by Krugman (2000) and a ”balance sheet recession” by Koo (2008, 2015). While a *growth recession* is characterized by growth below an economy’s potential, a *balance sheet recession* is characterized by businesses and households paying down debts accumulated during a previous bubble. Even if many firms were balance-sheet insolvent after the burst of the bubble, most of them were still cash-flow solvent and could consequently avoid bankruptcy and use profits to pay down debt. But paying down debt took time and the focus on repaying debt also reduced the use of profits for financing investment. And financing investment with new borrowings was out of the question during this period, even at near-zero interest rates. Thus, the fact that the balance sheet recession in Japan in the 1990s was a growth recession and not a depression was due to fiscal policy or, more precisely, massive public works spending financed by public debt.

Moreover, public deficit spending on infrastructure was facilitated by avoiding borrowing in foreign currencies so that government debt could grow without risking default or high interest rates. And with positive net savings by the private sector – instead of borrowings –

[103] For details see Krugman (2000 pp. 60-82) and Koo (2008, 2015).

investors like pension funds and insurance companies had no alternative but buying government bonds, as emphasized by Koo (2015), and reducing the interest rate.

Crisis in Mexico and Argentina 1995[104]

With imports much greater than exports in the beginning of the 1990s, Mexico found it necessary to devalue its peso in December 1994. However, devaluation by 15% was not enough to stop speculation. Mexico had to introduce a flexible exchange rate and soon the peso had fallen to half its pre-crisis value. The currency crisis was followed by a fiscal crisis (with extremely high interest rates on government debt) and a deep recession: during 1995 real GDP fell by 7 per cent. Moreover, the ”tequila” crisis spread to Argentina and once speculation against the Argentinian peso began, and foreign lenders began withdrawing their money from Argentina, it became clear that its currency board – with one peso equivalent to one U.S. dollar – was no longer credible. For the currency board implied that the CB could not act as lender of last resort to banks that had lost financing from abroad (because it was prohibited from creating new pesos except in exchange for dollars). The dollars which Mexico needed was supplied by the IMF and the U.S. Treasury (bypassing the U.S. Congress) while the World Bank put up the dollars needed to support the Argentinian banks. But these rescues did not prevent a very severe – but short – economic contraction in 1995.

Crisis in East Asia 1997-99[105]

What before 2008 was called the ”Great Recession” by Krugman (2000 p. *xix*) and the ”global financial crisis” by Stiglitz (2002) began when Thailand had to devalue its currency (baht) in July 1997 or, more precisely, had to let it float when the foreign exchange reserves were depleted. Recall that the change in foreign exchange reserves at a fixed exchange rate is determined by

$$\Delta FER = X - Z + S_f - B_f \ , \tag{1}$$

where $X - Z$ is the current account surplus (”trade surplus”) and $S_f - B_f$ is the capital account surplus (”capital inflow”). And what had begun earlier in the 1990s as an inflow of short-term foreign capital and a small trade deficit had been transformed into a large trade deficit and a small (or negative) capital inflow in 1997. And when ΔFER is negative, it is

[104] For details see Krugman (2000 pp.38-59).
[105] For details see Krugman (2000 ch. 5) and Stiglitz (2002 ch. 4).

only a matter of time before the foreign exchange reserves are depleted and the CB is unable to sell dollars at a fixed exchange rate.

But why was the exchange rate fixed to begin with and what started the inflow of foreign capital? And exactly how was the Thai economy affected by the foreign capital? First, during the 1990s Thailand had become an ”emerging economy” with a fast-growing industrial sector. The booming economy – and deregulation of the capital market – attracted foreign investors, particularly from Japan and Europe, where interest rates were much lower than in Thailand. The big difference in interest rates also meant that firms in Thailand were tempted to borrow abroad, in a foreign currency. But without a fixed exchange rate both investing in Thailand and borrowing abroad would be risky for short-term capital.[106]

Hence the devaluation was followed by panic and a free fall of the baht, which the CB tried to prevent by raising interest rates. Thus, dollar debts became more burdensome because of the devaluation and baht debts became more burdensome because of higher interest rates, so the devaluation was followed by bankruptcies and a recession. But the recession could also be interpreted as an aftermath of the collapse of an asset price bubble fueled by domestic credit and foreign capital. And then the crisis spread to all of East Asia, including Malaysia, Indonesia and even South Korea, apparently through ”emerging market funds” withdrawing capital not only from Thailand but also from all other countries in the region.

Moreover, instead of moderating the panic, the IMF helped feed it, as argued by Krugman (2000) and Stiglitz (2002), by insisting on higher taxes, lower government spending and higher interest rates as conditions for lending dollars to Thailand. As argued in detail by Stiglitz (2002), the effect of the IMF program was primarily to support foreign creditors in the following way. First, the IMF loans meant that foreign investors had time to withdraw (most of) their short-term capital at the old exchange rate and consequently without (substantial) loss. Second, the recession reinforced by the IMF program reduced incomes in Thailand and hence also its imports, creating a trade surplus which made it possible to repay the IMF loans.

The recession in Thailand also spread to neighbouring countries by reducing imports from them. And the recessions in East Asia reduced global growth and hence also commodity prices – with dramatic effects on Russia and, indirectly, on a hedge fund in the U.S., as discussed below. Stiglitz (2002 p. 238) even argues that the IMF *initiated* the financial crisis

[106] More precisely, if a country has announced a fixed exchange rate it has to stick to it – and any devaluation, however small, will destroy ”confidence”. But why should a country choose a fixed exchange rate? If the exchange rate is floating investors have to base their decisions on this fact and should not feel betrayed by a fall in the currency’s value. And a floating exchange rate is the norm for countries like Britain and the United States. Is it really so that emerging economies cannot attract foreign capital without a fixed exchange rate? Or will rich people in an emerging economy move their money abroad unless the exchange rate is fixed?

by insisting on complete deregulation of financial markets. For example, the restrictions on speculative real estate lending introduced by Thailand in the 1980s were opposed by the IMF and finally removed. And inflows of short-term and speculative capital are sensitive to rumours and consequently volatile and destabilizing.

Note, however, that the East Asian crisis did not spread to Hong Kong, for interesting reasons. Apparently a small group of hedge funds planned to make money by selling Hong Kong stocks short and use the HK dollars obtained in this way to buy U.S. dollars.[107] The idea was to *either* provoke a devaluation and make money by selling U.S. dollars for HK dollars *or*, if the Hong Kong Monetary Authority (HKMA) would defend its currency by raising interest rates and drive down the stock market, make money by buying the borrowed stocks cheap before returning them. However, the HKMA used its resources to buy stocks and consequently drive their prices up. And the government introduced new rules which forced the Hong Kong investors who had rented out their stocks to call them in and consequently punish the speculators.

Crisis in Russia 1998[108]

The privatization program in Russia in the 1990s enriched a small group of ”oligarchs” sending money abroad.[109] But it also attracted an inflow of capital from foreign investors dreaming of fortunes and accepting the risks involved, including the risks of devaluation of the ruble and default on government debt at a time when the ability to collect taxes was poorely developed. For a long time the IMF also supported Russia by lending dollars to it; the last loan was made only three weeks before a suspension of payments and a devaluation of the ruble in August 1998.[110] As always the IMF insistence on a stable exchange rate was based on a belief that devaluation will be followed by inflation – as in Latin America.

The Russian default was triggered by the high interest rates and the low price of oil caused by the East Asian crisis.[111] The IMF loans made it possible for Russian oligarchs and foreign investors to move most of their money to foreign accounts before devaluation.[112] And the Russian crisis spread to developing countries, in particular Brazil, Ecuador and Colombia, by raising interest rates even further. It even triggered a crisis for a big hedge fund in the U.S.

[107] Krugman (2000 pp. 125-129).
[108] For details see Stiglitz (2002 ch. 5).
[109] Krugman (2000 p.130).
[110] Stiglitz (2002 p.149).
[111] Stiglitz (2002 pp. 145, 149).
[112] Stiglitz (2002 p. 150).

Crisis in Brazil 1998

In the summer of 1998 there was also a run on Brazil's *real*, triggered by the Russian default.[113] Brazil went to the IMF for help, since a fixed exchange rate was a centerpiece of the country's program for price stability after generations of high inflation. The IMF program advocated high interest rates and low budget deficits. Even if such measures raised the markets' confidence in the exchange rate they also created a severe recession. To raise employment and growth the currency was finally devalued and interest rates reduced. And the devaluation was *not* followed by bankrupticies caused by debts in foreign currencies increasing in domestic terms, since Brazilian firms are mainly financed by equity, not debt.[114]

Crises in the United States 1980-2000

Before 2007 four minor financial crises in the U.S. exemplified the kind of problems financial deregulation could imply, namely the Savings and Loans debacle in the 1980s; the Black Thursday in 1987; the debacle of the hedge fund Long Term Capital Management (LTCM) in 1988; and the burst of the stock market bubble in 2000.

In the beginning of the 1980s Savings and Loan (S&L) associations were losing money on long-term fixed-rate mortgages, because of inflation. They were also losing deposits to money market funds, because of a ceiling on the deposit rate they could offer. After deregulation in 1980 and 1982 S&Ls could invest in whatever they liked – and not just long-term mortgages. They could also attract depositors by paying competitive interest rates for deposits still insured by the government. And then speculation with other people's money became too tempting, sometimes involving even fraud. Nearly five hundred S&Ls collapsed or were forced to close down, and the final cost to taxpayers of the S&L bailouts between 1986 and 1995 was almost 3 per cent of GDP.[115]

In October 1987 the U.S. stock market (S&P 500) experienced a fall of 20 per cent in a single day. No compelling explanation of how and why this happened has ever been provided, but Kay (2015 p. 36) suggests a scheme called portfolio insurance in "the new world of concentrated shareholding and active trading". As argued by Fox (2010 p. 229), "(t)he crash of 1987 was the first alarming demonstration of the inherent instability of mathematical risk-management models in finance."

[113] Krugman (2000 pp. 111-12).
[114] Krugman (2000 p. *x*, Stiglitz (2002 p. 221).
[115] For details on the S&L debacle see, for example, Ferguson (2009 pp. 254-260).

LTCM was a big, very sophisticated, and highly leveraged hedge fund. It threatened to collapse in the summer of 1998 when the Russian default undermined the prerequisites for some of its bets. This nearly caused panic on Wall Street, since some of the major banks were not only large lenders to LTCM but also had similar portfolio positions.[116] And to avoid panic the Federal Reserve persuaded fourteen large banks to take over the hedge fund.[117]

Stock market prices (as measured by The Dow Jones Industrial Average) peaked in January 2000. The price level had then tripled in five years, while basic economic indicators, like corporate profits, did not come close to tripling.[118] The burst of the bubble after 2000 was also dramatic, even if the price level after the crash was still very high by historical standards.[119] The stock market crash was followed by a recession which, however, was both exceptionally small and exceptionally short.[120] On the other hand, Kindleberger and Aliber (2005 p.165) argue that ”(t)he implosion of a bubble always leads to discoveries of frauds and swindles”, exemplified this time by the bankruptcies of Enron and MCI-WorldCom.

Crisis in the United States 2007-2009[121]

The financial crisis of 2007-2009 in the U.S. was a classical one. Thus, it was preceded by an asset price bubble fueled by a credit boom and realized by a price collapse and a credit crunch. However, this time the assets concerned were not stocks, as in the 1930s, but houses. And the credit boom was reinforced by exceptionally low interest rates, while the credit crisis was reinforced by some new derivatives, particularly mortgage-backed securities (MBSs) and credit default swaps (CDSs).

House prices stopped rising in 2006 and the crisis started in early 2007 with the collapse of several hundred nonbank mortgage lenders when the market realized that these institutions had made “toxic” loans and withdrew its funding.[122] In March 2008 there was a run on Bear Sterns, the fifth-largest investment bank in the U.S., followed by a takeover by JP Morgan Chase supported by government guarantees. And in September 2008 there was a run on the fourth-largest investment bank, Lehman Brothers, followed by its bankruptcy and a full-scale financial crisis.

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[116] Kindleberger and Aliber (2005 p. 100).
[117] For details on the bailout of LTCM see, for example, Kindleberger and Aliber (2005 pp. 99-100 and p. 219).
[118] Shiller (2005 pp. 2-6).
[119] Shiller (2005 p. 9).
[120] For a succinct characterization of the 2001 recession in the U.S. see Knoop (2010 pp. 174-77).
[121] There is by now an enormous literature on the global financial crisis of 2007-2009, including, for example, Acharya et al. (2009), Stiglitz (2010), and Blinder (2014). Lybeck (2011) contains a detailed chronology of financial events from January 2007 to June 2011.
[122] Acharya and Richardson (2009 p. 8).

Mortgage-backed securities played a decisive role in this crisis for three reasons: first, because the volume was enormous and MBSs were spread all over the world; second, because MBSs soon turned out to be difficult to value; and third, because many financial firms (including banks) choose to keep some MBSs on their balance sheets instead of selling them to final investors.[123]

First, the volume of MBSs was large because not only supply but also demand was large. The basic reason for a large demand must have been a very large demand for "safe assets with high yield" from final investors (like pension funds and insurance companies). Otherwise it is difficult to understand why investment banks found securitization of mortgages so profitable.

Second, because it was so easy to sell mortgages to securitizers, it was tempting for originators to try to adjust the supply of mortgages to the demand for them. Of course, the supply of home mortgages depends, first of all, on the demand for homeownership, which is very high in the U.S. However, given the strong demand for mortgages from investment banks, and without any control of the quality of mortgages by regulators, originators were soon tempted to offer mortgages which later on were characterized, for example, as NINJA loans – granted to people with" no income, no jobs, and no assets".[124]

Third, since MBSs had higher yields than government bonds, many financial firms (including banks) choose to keep some on their balance sheets instead of selling them to final investors. And when it was realized that MBSs were not necessarily safe, the solvency of a financial institution with an unknown number of MBSs of unknown quality could suddenly be questioned. Eventually many MBSs were even classified as "toxic", particularly when transformed into "tranches" with different risk or combined into even more complex derivatives, like "collaterized debt obligations" or CDOs.[125] And the negative effect of these "toxic" securities on the financial system was greatly magnified in the crisis by trillions of dollars of CDS related to mortgage-based bonds.

A financial crisis is characterized by "runs" on banks and other financial institutions and markets. A classical bank run is characterized by customers withdrawing cash from a bank. Today a bank run means losing deposits to other banks, which did happen to Washington Mutual, the largest saving and loan association in the U.S. before it was closed and its banking operations sold to JP Morgan Chase.[126]

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[123] Acharya and Richardson (2009 p. 24).
[124] On "disgraceful practices" in mortgage lending see, for example, Blinder (2014 pp. 68-72).
[125] See, for example, Blinder (2014 pp. 72-76).
[126] Blinder (2014 p. 155).

A run on a money market fund (MMF) is almost like a classical bank run, but instead for being a run for transforming bank deposits into cash, it is a run for transforming shares in an MMF into bank deposits. And once customers of one of the MMFs (which had invested in Lehman) couldn't do this fully, investors in all MMFs panicked.

However, most "runs" during the crisis meant that institutions could not renew their short-term borrowing or, in other words, that the money market stopped functioning, including not only the interbank market for reserves but also the repo market, which is the primary source of short-term funding of security purchases.[127] Thus, agents with temporary surpluses of money suddenly stopped lending them to agents with temporary deficits. This created particularly severe problems for institutions which financed assets like mortgage-backed securities by short-term borrowing.

Moreover, runs on financial *institutions* were accompanied by runs on financial *markets* in the sense that agents trying to obtain money by selling securities in normally liquid secondary markets suddenly found market prices falling precipitously. Hence, excluding markets for "safe assets" (like Treasury bills) liquidity could only be obtained by selling securities at a loss, especially in markets for mortgage-backed securities.

The government responded to the possibility of bank runs by extending deposit insurance from $100,000 to $250,000, with an implicit guarantee to uninsured deposits. The government also guaranted all money market funds. "Since banks were not lending to each other and were not lending to nonbank financial institutions, and financial firms were not even lending to the corporate sector, the Fed ended up backstopping the short-term liabilities of banks, nonbank financial institutions, and nonfinancial corporations".[128] The Fed was even allowed to purchase commercial paper from the corporate sector. Thus the Fed, usually only the "lender of last resort" to commercial banks, became the lender of last resort not only to all financial institutions but also to some non-financial institutions. And by guaranteeing loans to important institutions it also became the "insurer of last resort" and eventually even the "market-maker of last resort" by buying securities in important secondary markets ("quantitative easing").

[127] Acharya and Richardson (2009 p. 8).
[128] Acharya and Richardson (2009 p. 11).

Crisis in the euro area 2010[129]

Since American MBSs were spread all over the world, the collapse of Lehman in September 2008 immediately hurt the solvency of banks and other financial institutions in Europe. The burst of real estate bubbles in Irland and Spain added to the debt overhang and the balance sheet recession (when private agents use earnings to reduce debt instead of spending them on consumption and investment).

In 2010 private capital flows between euro countries suddenly stopped and the crisis became a eurozone crisis, that is, a crisis reinforced by the structure of the euro system. First, the introduction of the euro had facilitated capital flows previously constrained by exchange rate risk. In the case of Greece they financed unsustainable public deficits and in Spain and Ireland excessive real estate investment and private consumption. And because of the common currency, short term capital could be withdrawn without loss.

Second, withdrawal of private capital created a sovereign debt crisis, particularly in Greece, but also in Spain and Portugal and (potentially) even in Italy. Before 2010 yields on government bonds from different euro countries had converged on the implicit presumption that all bonds were somehow guaranteed by ECB. After 2010 uncertainty increased interest rates on government bonds issued by countries with large public deficits and default risks no longer perceived to be negligible by investors. Thus, when private savings became large in a country, due to the balance sheet recession, investors did not have to invest their savings in the country's bonds, as in Japan, but could turn to securities perceived to be safer, for example German instruments. And this type of capital mobility not only increased the cost of financing a public deficit in Southern Europe but could even make public borrowing impossible.

Third, when sovereign default could only be avoided by bailouts, repayment of loans by the IMF and others could only be guaranteed by increasing currency reserves with traditional methods as used, for example in East Asia, that is, by reducing imports by reducing incomes through ”austerity”. Alternatively, exports could be increased by increasing ”competitiveness”, which in practice has meant lowering wages by increasing unemployment.

5.4 Crisis management, regulation, and structural reforms

There are – at least – three different approaches to the problem of stabilizing the financial system, namely: 1) crisis management, 2) regulation, and 3) structural reforms. The first approach takes regulations and the structure of the financial industry as given, and accepts as

[129] For details see, for example, Wolf (2014 ch. 2), Koo (2015 ch. 5) and Turner (2016 pp.156-59).

a fact of life that shocks can happen for a variety of unpredictable reasons. The second approach attempts to stabilize the financial system by formulating rules on capital ratios etc within the existing structure, while the third approach attempts to reduce the need for crisis management or detailed regulation by establishing a more robust structure of the financial system. Of course, these approaches can be thought of as applicable in the short run, in the medium run, and in the long run, respectively, but they can also be thought of as alternatives.

The ultimate objective of *crisis management* is to eliminate the effects of a financial crisis on all functions of the financial system. In practice this means extending the role of a CB as a lender of last resort – and the role of the government as a guarantor – to every part of the financial system, including the money market (providing liquidity on demand to all financial institutions) and securities markets (buying securities whenever necessary to stabilize prices and hence also liquidity). But since a financial crisis often involves a "credit crunch", crisis management can also include support of lending, particularly to small and medium firms in new and innovative industries. Crisis management also means a swift reconstruction of insolvent banks, including, for example, temporary nationalization. And deposit insurance guarantees a complete and prompt replacement of all deposits lost in a bankruptcy.

Regulation means not only the introduction but also the supervision of rules designed to increase the stability of commercial banks, other financial institutions, and financial markets. Rules for banks may include high capital ratios, as suggested by Admati and Hellwig (2013), and "liquidity insurance", as suggested by King (2016 ch. 7). Regulation may include all financial institutions, not only banks. Rules for mortgage lending may concern down payment, amortization, and credit rating. There may be rules for securitization of mortgages which makes the products easy to understand for final investors. There may be rules which restrict speculation with borrowed money. And there may be rules for the design and trading of derivatives.

Structural reforms may be more or less far-reaching. The breaking up of banks that are "too big or too complex to fail", and the separation of investment banking from commercial banking, are reforms which may appear very far-reaching, but it may be fruitful to widen the perspective. For example, instead of a payments system financed by the profitability of money creation (as discussed in Chapter 1), an economy can have a payments system financed by fees, and instead of having money created by private banks we can have money created by the central bank or the government.

Consider, more precisely, a system consisting of "payment banks" with deposits and corresponding reserves in the CB and assume that these banks cannot lend, neither directly

(by giving loans) or indirectly (by buying securities). All individuals and institutions as well as the government have an account in a payment bank, while a payment bank has an account in its CB. For simplicity we also assume that there is no cash, so that all payments are electronic. It follows both that the reserve ratio is 100% and that payment banks have to finance their services (payments and safe keeping) by fees. Since deposits are the property of the depositors, deposits are kept outside of the banks' balance sheets. A bank run only implies that deposits are moved from one bank to another with the corresponding reserves also moving to other banks. If for some reason a bank stops functioning altogether, the CB can move the bank's deposits and corresponding reserves to another bank.

Lending and other financial services are supplied by special banks, called "commercial banks" (if specialized in financing commerce), "mortgage banks" (if specialized in financing real estate), "innovation banks" (if specialized in financing new industries), or "investment banks". A special bank has an account in a payment bank and gives a loan by transferring money from this account to the borrower's account (and not by creating money). A special bank obtains funds to lend by payments from owners (equity), by long-term borrowing (selling bonds), by short-term borrowing, and by retained profits. A basic form of short-term borrowing can be "deposits" by households and firms. However, these deposits are not saving deposits in the usual sense but short-term loans with a specified time to maturity. Short-term borrowing can also include sales of "commercial paper" to firms with temporarily large deposits in a payment bank.

Obviously, with this structure of the financial system, money cannot be created by private banks. But money can be created by the central bank, for example by buying securities from private or public institutions. This is because a CB pays for such securities merely by increasing the deposits of the seller in the seller's payment bank (and also the reserves of the seller's payment bank). Money can also be created by the government by running a budget deficit which is financed by selling bonds to the CB.

This is an example which shows that even fundamental aspects of the financial system can be changed. A structural reform may also be necessary if the present system turns out to be fundamentally deficient in some important respects, for example by creating asset price bubbles by excessive lending too often, or by giving priority to speculation instead of lending to productive investments in new industries, infrastructure, or housing.

In fact a structural reform of the banking system along the lines suggested above was widely discussed in the wake of the Great Depression. Proposals to reform the banking system were put forward by economists at the University of Chicago in a memorandum in March

1933. The recommendations of this memorandum, and an expanded version in November 1933, are known as the Chicago plan. However, its proposal to abolish the fractional reserve system was not adopted in the Banking Act of 1935, which instead introduced Federal deposit insurance and the separation of commercial banking and investment banking.

A Program for Monetary Reform, coauthored by Paul Douglas, Irving Fisher and four others in 1939, resurrected the proposals of the Chicago plan after the recession of 1937-1938 in the U.S. It is a ”first draft” which was distributed to academic economists in the U.S. for comment. In the foreword the authors note that 235 economists have expressed their general approval of the program, 40 more have approved with reservations, and 43 have expressed disapproval. But this first draft was not completed, nor followed by new legislation.

After the financial crisis of 2007-2008 the Chicago plan has been resurrected once more, for example by Benes and Kumhof (2012), Wolf (2014 pp. 209-213) and Turner (2016 pp. 187-90). It has even been argued that: ”A system that is based, as today, on the ability of profit-seeking institutions to create money as a by-product of often grotesquely irresponsible lending is irretrievably unstable” (Wolf 2014 p. 350). And Turner (2014 p. 62) argues that ”banks left to themselves will produce too much of the wrong sort of debt”, namely debt which supports increasing prices of existing buildings instead of investment in real capital. Moreover, according to Kay (2015 p. 256), ”instability in the financial system is the result of the interdependencies inherent in an industry that deals mainly with itself” – and not with customers in the real economy. And to eliminate this ”trading culture”, Kay (2015 p. 259) suggests structural reforms that will reduce the amount of capital available to support trading in securities instead of investment in real capital.

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