Chapter 16

Money in macroeconomics

> Money buys goods and goods buy money; but goods do not buy goods.
>
> −Robert W. Clower (1967).

Up to now we have put monetary issues aside. The implicit assumption has been that the exchange of goods and services in the market economy can be carried out without friction as mere intra- or intertemporal barter. This is, of course, not realistic. At best it can provide an acceptable approximation to reality only for a limited set of macroeconomic issues. We now turn to models in which there is a demand for money. We thus turn to *monetary theory*, that is, the study of causes and consequences of the fact that a large part of the exchange of goods and services in the real world is mediated through the use of money.

16.1 What is money?

16.1.1 The concept of money

In economics *money* is defined as an asset (a store of value) which functions as a generally accepted medium of exchange, i.e., it can be used directly to buy *any* good offered for sale in the economy. A note of IOU (a bill of exchange) may also be a medium of exchange, but it is not *generally* accepted and is therefore not money.[1] Moreover, the extent to which an IOU is acceptable in exchange depends on the general state in the economy. In contrast, money is characterized by being a *fully liquid asset*. An asset is *fully liquid* if it can be used directly, instantly, and without any extra costs or restrictions to make payments.

[1] Generally accepted mediums of exchange are also called *means of payment.*

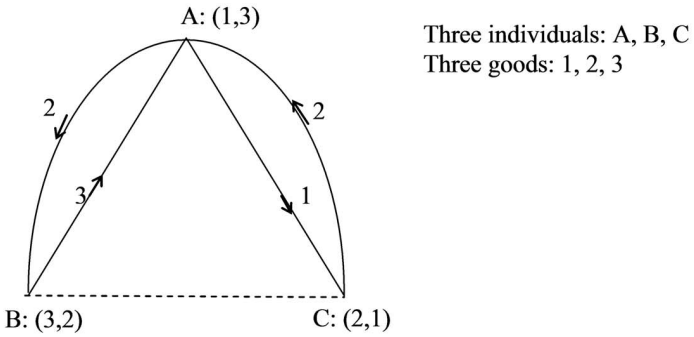

Figure 16.1: No direct exchange possible. A medium of exchange, here good 2, solves the problem (details in text).

Generally, liquidity should be conceived as a matter of degree so that an asset has a higher or lower degree of liquidity depending on the extent to which it can easily be exchanged for money. By "easily" we mean "immediately, conveniently, and cheaply". So an asset's *liquidity* is the *ease* with which the asset can be *converted into money or be used directly for making payments.* Where to draw the line between "money" and "non-money assets" depends on what is appropriate for the problem at hand. In the list below of different monetary aggregates (Section 16.2), M_1 corresponds most closely to the traditional definition of money. Defined as currency in circulation plus demand deposits held by the non-bank public in commercial banks, M_1 embraces all under "normal circumstances" fully liquid assets in the hands of the non-bank public.

The reason that a market economy uses money is that money facilitates trade enormously, thereby reducing transaction costs. Money helps an economy to avoid the need for a "double coincidence of wants". The classical way of illustrating this is by the *exchange triangle* in Fig. 16.1. The individuals A, B, and C are endowed with one unit of the goods 1, 3, and 2, respectively. But A, B, and C want to consume 3, 2, and 1, respectively. Thus, no direct exchange is possible between two individuals each wanting to consume the other's good. There is a *lack of double coincidence of wants*. The problem can be solved by indirect exchange where A exchanges good 1 for good 2 with C and then, in the next step, uses good 2 in an exchange for good 3 with B. Here good 2 serves as a medium of exchange. If good 2 becomes widely used and accepted as a medium of exchange, it is money. Extending the example to a situation with n goods, we have that exchange without money (i.e., barter) requires $n(n-1)/2$ markets ("trading spots"). Exchange with money, in the form of modern "paper money", requires only n markets.

16.1.2 Historical remarks

In the past, ordinary commodities, such as seashells, rice, cocoa, precious metals etc., served as money. That is, commodities that were easily divisible, handy to carry, immutable, and involved low costs of storage and transportation could end up being used as money. This form of money is called *commodity money*. Applying ordinary goods as a medium of exchange is costly, however, because these goods have alternative uses. A more efficient way to trade is by using currency, i.e., coins and notes in circulation with little or no intrinsic value, or pieces of paper, checks, representing claims on such currency. Regulation by a central authority (the state or the central bank) has been of key importance in bringing about this transition into the modern payment system.

Coins, notes, pieces of paper like checks, and electronic signals from smart phones to accounts in a bank have no intrinsic value. Yet they may be generally accepted media of exchange, in which case we refer to them as *paper money*. By having these pieces of paper circulating and the real goods moving only once, from initial producer to final consumer, the trading costs in terms of time and effort are minimized.

In the industrialized countries these paper monies were in the last third of the nineteenth century and until the outbreak of the First World War *backed* through the gold standard. And under the Bretton-Woods agreement, 1947-71, the currencies of the developed Western countries outside the United States were convertible into US dollars at a fixed exchange rate (or rather an exchange rate which is adjustable only under specific circumstances); and US dollar reserves of these countries were (in principle) convertible into gold by the United States at a fixed price (though in practice with some discouragement from the United States).

This indirect gold-exchange standard broke down in 1971-73, and nowadays money in most countries is *unbacked* paper money (including electronic entries in banks' accounts). This feature of modern money makes its valuation very different from that of other assets. A piece of paper money in a modern payments system has no worth at all to an individual unless she *expects* other economic agents to value it in the next instant. There is an *inherent circularity* in the acceptance of money. Hence the viability of such a paper money system is very much dependent on adequate juridical institutions as well as confidence in the ability and willingness of the government and central bank to conduct policies that sustain the purchasing power of the currency. One elementary juridical institution is that of "legal tender", a status which is conferred to certain kinds of money. An example is the law that a money debt can always be settled by currency and a tax always be paid by currency. A medium of exchange whose market value derives entirely from its legal tender status is called *fiat money*

(because the value exists through "fiat", a ruler's declaration). In view of the absence of intrinsic value, maintaining the exchange value of fiat money over time, that is, avoiding high or fluctuating inflation, is one of the central tasks of monetary policy.

16.1.3 The functions of money

The following three functions are sometimes considered to be the definitional characteristics of money:

1. It is a generally accepted medium of exchange.
2. It is a store of value.
3. It serves as a unit of account in which prices are quoted and books kept (the *numeraire*).

On can argue, however, that the last function is on a different footing compared to the two others. Thus, we should make a distinction between the functions that money *necessarily* performs, according to our definition above, and the functions that money *usually* performs. Property 1 and 2 certainly belong to the essential characteristics of money. By its role as a device for making transactions money helps an economy to avoid the need for a double coincidence of wants. In order to perform this role, money *must* be a store of value, i.e., a device that transfers and maintains value over time. The reason that people are willing to exchange their goods for pieces of paper is exactly that these can later be used to purchase other goods. As a store of value, however, money is *dominated* by other stores of value such as bonds and shares that pay a higher rate of return. When nevertheless there is a demand for money, it is due to the *liquidity* of this store of value, that is, its service as a generally accepted medium of exchange.

Property 3, however, is not an indispensable function of money as we have defined it. Though the money unit is usually used as the unit of account in which prices are quoted, this function of money is conceptually distinct from the other two functions and has sometimes been distinct in practice. During times of high inflation, foreign currency has been used as a unit of account, whereas the local money continued to be used as the medium of exchange. During the German hyperinflation of 1922-23 US dollars were the unit of account used in parts of the economy, whereas the mark was the medium of exchange; and during the Russian hyperinflation in the middle of the 1990s again US dollars were often the unit of account, but the rouble was still the medium of exchange.

This is not to say that it is of little importance that money *usually* serves as numeraire. Indeed, this function of money plays an important role for the

short-run macroeconomic effects of changes in the money supply. These effects are due to *nominal rigidities*, that is, the fact that prices, usually denominated in money, of most goods and services generally adjust only sluggishly (they are not traded in auction markets).

16.2 The money supply

The money supply is the total amount of money available in an economy at a particular point in time (a stock). As noted above, where to draw the line between assets that should be counted as money and those that should not, depends on the context.

16.2.1 Different measures of the money stock

Usually the money stock in an economy is measured as one of the following alternative *monetary aggregates*:

- M_0, i.e., the *monetary base*, alternatively called *base money, central bank money,* or *high-powered money.* The monetary base is defined as fully liquid claims on the central bank held by the private sector, that is, currency (coins and notes) in circulation plus demand deposits held by the commercial banks *in the central bank*.[2] This monetary aggregate is under the direct control of the central bank and is changed by *open-market operations*, that is, by the central bank trading bonds, usually short-term government bonds, with the private sector. But clearly the monetary base is an imperfect measure of the liquidity in the private sector.

- M_1, defined as currency in circulation plus *demand deposits* held by the non-bank general public *in commercial banks*. These deposits are also called *checking accounts* because they are deposits on which checks can be written and payment cards (debit cards) be used. M_1 does not include currency held by commercial banks and demand deposits held by commercial banks in the central bank. Yet M_1 includes the *major* part of M_0 and is generally considerably larger than M_0. The measure M_1 is intended to reflect the quantity of assets serving as media of exchange in the hands of the non-bank general public, i.e., the non-bank part of the private sector.

  Broader categories of money include:

[2] The commercial banks are usually part of the private sector and by law it is generally only the commercial banks that are allowed to have demand deposits in the central bank – the "banks' bank".

- $M_2 = M_1$ plus savings deposits with unrestricted access and small-denomination time deposits (say below € 100,000). Although these claims may not be instantly liquid, they are close to.

- $M_3 = M_2$ plus large-denomination (say above € 100,000) time-deposits.[3]

As we move down the list, the liquidity of the added assets decreases, while their interest yield increases.[4] Currency earns zero interest. When in macroeconomic texts the term "money supply" is used, traditionally M_1 or M_2 has been meant; there is, however, a rising tendency to focus on M_3. Along with currency, the demand deposits in the commercial banks are normally fully liquid, at least as long as they are guaranteed by a governmental deposit insurance (although normally only up to a certain maximum per account). The interest earned on these demand deposits is usually low (at least for "small" depositors) and in fact often ignored in simple theoretical models.

A related and theoretically important simple classification of money types is the following:

1. *Outside money* = money that on net is an asset of the private sector.

2. *Inside money* = money that is not net wealth of the private sector.

Clearly M_0 is *outside money*. Most money in modern economies is *inside money*, however. Deposits at the commercial banks is an example of inside money. These deposits are an asset to their holders, but a liability of the banks. Even broader aggregates of money (or "near-money") than M_3 are sometimes considered. For instance, it has been argued that the amounts that people are allowed to charge by using their *credit cards* should be included in the concept of "broad money". But this would involve *double counting*. Actually *you* do not pay when you use a credit card at the store. It is the company issuing the credit card that pays to the store (shortly after you made your purchases). You postpone your payment until you receive your monthly bill from the credit card company. That is, the credit card company does the payment for you and gives credit *to you*. It is otherwise with a *payment card* where the amount for which you buy is instantly charged your account in the bank.

[3] In casual notation, $M_1 \subset M_2 \subset M_3$, but $M_0 \nsubseteq M_1$ since only a part of M_0 belongs to M_1.

[4] This could be an argument for weighing the different components of a monetary aggregate by their degree of liquidity (see Barnett, 1980, and Spindt, 1985).

16.2.2 The money multiplier

Bank lending is the channel through which the monetary base expands to an effective money supply, the "money stock", considerably larger than the monetary base. The excess of the deposits of the general public over bank reserves ("vault cash" and demand deposits in the central bank) is lent out in the form of bank loans, or government or corporate bonds etc. The non-bank public then deposits a fraction of these loans on checking accounts. Next, the banks lend out a fraction of these and so on. This process is named the *money multiplier process.* And the ratio of the "money stock", measured as M_1, say, to the monetary base is called the *money multiplier.*

Let

$$\begin{aligned}
CUR &= \text{currency held by the non-bank general public,}\\
DEP &= \text{demand deposits held by the non-bank general public,}\\
\frac{CUR}{DEP} &= cd, \text{ the desired currency-deposit ratio,}\\
RES &= \text{bank reserves } = \text{ currency held by the commercial banks}\\
&\quad \text{("vault cash") plus their demand deposits in the central bank,}\\
\frac{RES}{DEP} &= rd, \text{ the desired reserve-deposit ratio.}
\end{aligned}$$

Notice that the currency-deposit ratio, cd, is chosen by the non-bank public, whereas the reserve-deposit ratio, rd, refers to the behavior of commercial banks. In many countries there is a minimum reserve-deposit ratio required by law to ensure a minimum liquidity buffer to forestall "bank runs" (situations where many depositors, fearing that their bank will be unable to repay their deposits in full and on time, simultaneously try to withdraw their deposits). On top of the minimum reserve-deposit ratio the banks may hold "excess reserves" depending on their assessment of their lending risks and need for liquidity.

To find the money multiplier, note that

$$M_1 = CUR + DEP = (cd + 1)DEP, \tag{16.1}$$

where DEP is related to the monetary base, $M_{0,}$ through

$$M_0 = CUR + RES = cdDEP + rdDEP = (cd + rd)DEP.$$

Substituting into (16.1) gives

$$M_1 = \frac{cd + 1}{cd + rd} M_0 = mmM_0, \tag{16.2}$$

where $mm = (cd + 1)/(cd + rd)$ is the *money multiplier*.

As a not unrealistic example consider $cd \approx 0.7$ and $rd \approx 0.07$. Then we get $mm \approx 2.2$. When broader measures of money supply are considered, then, of course, a larger money multiplier arises. It should be kept in mind that both cd and rd, and therefore also mm, are neither constant nor exogenous from the point of view of monetary models. They are highly endogenous and depend on several things, including degree of liquidity, expected returns, and risk on alternative assets − from the banks' perspective as well as the customers'. In the longer run cd and rd are affected by the evolution of payment technologies.

To some extent it is therefore a simple matter of identities and not particularly informative, when we say that, given M_0 and the currency-deposit ratio, the money supply is smaller, the larger is the reserve-deposit ratio. Similarly, since the latter ratio is usually considerably smaller than one, the money supply is also smaller the larger is the currency-deposit ratio. Nevertheless, the money multiplier turns out to be fairly stable under "normal circumstances". But not always. During 1929-33, in the early part of the Great Depression, the money multiplier in the US fell sharply. Although M_0 increased by 15% during the four-year period, liquidity (M_1) declined by 27%.[5] Depositors became nervous about their bank's health and began to withdraw their deposits (thereby increasing cd) and this forced the banks to hold more reserves (thereby increasing rd). There is general agreement that this banking panic contributed to the depression and the ensuing deflation.

There is another way of interpreting the money multiplier. By definition of cd, we have $CUR = cdDEP$. Let cm denote the non-bank public's desired *currency-money ratio*, i.e., $cm = CUR/M_1$. Suppose cm is a constant. Then

$$CUR = cmM_1 = cm(cd + 1)DEP. \qquad \text{(by (16.1))}$$

It follows that $cm = cd/(cd + 1)$ and $1 - cm = 1/(cd + 1)$. Combining this with (16.2) yields

$$M_1 = \frac{1}{\frac{cd}{cd+1} + rd\frac{1}{cd+1}} = \frac{1}{cm + rd(1 - cm)} = \frac{1}{1 - (1 - rd)(1 - cm)} M_0 = mmM_0. \tag{16.3}$$

The way the central bank controls the monetary base is through *open-market operations*, that is, by buying or selling bonds (typically short-term government bonds) in the amount needed to sustain a desired level of the monetary base. In the next stage the aim could be to obtain a desired level of M_1 or a desired level of the short-term interest rate or, in an open economy, a desired exchange rate vis-a-vis other currencies.

[5] Blanchard (2003).

An intuitive understanding of the money multiplier and the way commercial banks "create" money can be attained by taking a dynamic perspective. Suppose the central bank increases M_0 by the amount ΔM_0 through an open-market operation, thus purchasing bonds. This is the first round. The seller of the bonds deposits the fraction $1 - cm$ on a checking account in her bank and keeps the rest as cash. The bank keeps the fraction rd of $(1 - cm)\Delta M_0$ as reserves and provides bank loans or buys bonds with the rest. This is the second round. Thus, in the first round money supply is increased by ΔM_0; in the second round it is further increased by $(1 - rd)(1 - cm)\Delta M_0$; in the third round further by $(1 - rd)^2(1 - cm)^2\Delta M_0$, etc.[6] In the end, the total increase in money supply is

$$\begin{aligned}\Delta M_1 &= \Delta M_0 + (1 - rd)(1 - cm)\Delta M_0 + (1 - rd)^2(1 - cm)^2\Delta M_0 + ... \\ &= \frac{1}{1 - (1 - rd)(1 - cm)}\Delta M_0 = mm\Delta M_0.\end{aligned}$$

The second last equality comes from the rule for the sum of an infinite geometric series with quotient in absolute value less than one. The conclusion is that the money supply is increased mm times the increase in the monetary base.

16.3 Money demand

Explaining in a precise way how paper money gets purchasing power and how holding money - the "demand for money" in economists' traditional language - is determined, is a difficult task and not our endeavour here. Suffice it to say that:

- In the presence of sequential trades and the absence of complete information and complete markets, there is a need for a generally accepted medium of exchange – *money.*
- The demand for money, by which we mean the quantity of money held by the non-bank public, should be seen as part of a broader *portfolio decision* by which economic agents allocate their financial wealth to different existing assets, including money, and liabilities. The portfolio decision involves a balanced consideration of *after-tax expected return*, *risk*, and *liquidity.*

Money is demanded primarily because of its liquidity service in transactions. Money holding therefore depends on the *amount of transactions* expected to be carried out with money in the near future. Money holding also depends on the *need for flexibility* in spending when there is *uncertainty*: it is convenient to have ready liquidity in case favorable opportunities should turn up. Generally money

[6] For simplicity, we assume here that cm and rd are constant.

earns no interest at all or at least less interest than other assets. Therefore money holding involves a trade-off between the need for liquidity and the wish for interest yield.

The incorporation of a somewhat micro-founded money demand in macro-models is often based on one or another kind of short-cut:

- The *cash-in-advance constraint* (also called the *Clower constraint*).[7] Generally, households' purchases of nondurable consumption goods are in every short period paid for by money held at the beginning of the period. With the cash-in-advance constraint it is simply postulated that to be able to carry out most transactions, you *must* hold money in advance. In continuous time models the household holds a stock of money which is an increasing function of the desired level of consumption per time unit and a decreasing function of the opportunity cost of holding money.

- The *shopping-costs* approach. Here the liquidity services of money are modelled as reducing shopping time or other kinds of non-pecuniary or pecuniary shopping costs. The shopping time needed to purchase a given level of consumption, c_t, is decreasing in real money holdings and increasing in c_t.

- The *money-in-the-utility function* approach. Here, the indirect utility that money provides through reducing non-pecuniary as well as pecuniary transaction costs is modelled as if the economic agents obtain utility directly from holding money. This will be our approach in the next chapter.

- The *money-in-the-production-function* approach. Here money facilitates the firms' transactions, making the provision of the necessary inputs easier. After all, typically around a third of the aggregate money stock is held by firms.

16.4 What is then the "money market"?

In macroeconomic theory, by the "money market" is usually meant an abstract market place (not a physical location) where at any particular moment the aggregate demand for money "meets" the aggregate supply of money. Suppose the aggregate demand for real money balances can be approximated by the function $L(Y, i)$, where $L_Y > 0$ and $L_i < 0$ ("L" for liquidity demand). The level of aggregate economic activity, Y, enters as an argument because it is an (approximate) indicator of the volume of transactions in the near future for which money

[7] After the American monetary theorist Robert Clower (1967).

is needed. The short-term nominal interest rate, i, enters because it is the opportunity cost of holding cash instead of interest-bearing short-term securities, for instance government bonds that mature in one year or less. [8] The latter constitute a close substitute to money because they have a high degree of liquidity. They are standardized and extensively traded in centralized auction markets and under "normal circumstances" relatively safe. Because of the short term to maturity, their market value is less volatile than longer-term securities.

Let the money supply in focus be M_1 and let P be the general price level in the economy (say the GDP deflator). Then money market equilibrium is present if

$$M_1 = PL(Y, i), \tag{16.4}$$

that is, the available amount of money equals nominal money demand. Note that supply and demand are in terms of stocks (amounts at a given point in time), not flows. One of the issues in monetary theory is to account for how this stock equilibrium is brought about at any instant. Which of the variables M_1, P, Y, and i is the equilibrating variable? Presuming that the central bank controls M_1, classical (pre-Keynesian) monetary theory has P as the equilibrating variable while in Keynes' monetary theory it is primarily i which has this role.[9] Popular specifications of the function L include $L(Y, i) = Y^{\alpha} i^{-\beta}$ and $L(Y, i) = Y^{\alpha} e^{-\beta i}$, where α and β are positive constants.

One may alternatively think of the "money market" in a more narrow sense, however. We may translate (16.4) into a description of demand and supply for base money:

$$M_0 = \frac{P}{mm} L(Y, i), \tag{16.5}$$

where mm is the money multiplier. The right-hand side of this equation reflects that the demand for M_1 via the actions of commercial banks is translated into a demand for base money.[10] If the public needs more cash, the demand for bank loans rises and when granted, banks' reserves are reduced. When in the next round the deposits in the banks increase, then generally also the banks' reserves

[8] To simplify, we assume that none of the components in the monetary aggregate considered earns interest. In practice demand deposits in the central bank and commercial banks may earn a small nominal interest.

[9] If the economy has ended up in a "liquidity trap" with i at its lower bound, 0, an increase in M_1 will not generate further reductions in i. Agents would prefer holding cash at zero interest rather than short-term bonds at negative interest. That is, the "=" in the equilibrium condition (16.4) should be replaced by "$\geq$" or, equivalently, $L(Y, i)$ should at $i = 0$ be interpreted as a "set-valued function". The implications of this are taken up later in this book.

[10] Although the money multiplier tends to depend positively on i as well as other interest rates, this aspect is unimportant for the discussion below and is ignored in the notation in (16.5).

have to increase. To maintain the required reserve-deposit ratio, banks which for a few days have too little liquidity, borrow from other banks or other institutions which have too much.

This narrowly defined money market is closely related to what is by the practitioners and in the financial market statistics called the "money market", namely the trade in short-term debt-instruments that are close substitutes to holding central bank money (think of commercial paper and government bonds with maturity of less than one year). The agents trading in this market not only include the central bank and the commercial banks but also the mortgage credit institutions, life insurance companies, and other financial institutions. What is in the theoretical models called the "short-term nominal interest rate" can normally be identified with what is in the financial market statistics called the *money market rate* or the *interbank rate.* This is the interest rate (usually measured as a per year rate) at which the commercial banks provide unsecured loans ("signature loans") to each other, often on a day-to-day basis.

Open market operations The commercial banks may under certain conditions borrow (on a secured basis) from the central bank at a rate usually called the *discount rate.* This central bank lending rate will be somewhat above the central bank *deposit rate*, that is, the interest rate, possibly nil, earned by the commercial banks on their deposits in the central bank. The interval between the discount rate and the deposit rate constitutes the *interest rate corridor*, within which, under "normal circumstances", the money market rate, i, fluctuates. The central bank deposit rate acts as a floor for the money market rate and the central bank lending rate as a ceiling. Sometimes, however, the money market rate exceeds the central bank lending rate. This may happen in a financial crisis where the potential lenders are hesitant because of the risk that the borrowing bank goes bankrupt and because there are constraints on how much and when, a commercial bank in need of cash can borrow from the central bank.

If the money market rate, i, tends to deviate from what the central bank aims at (the "target rate", also called the "policy rate"), the central bank will typically through open-market operations provide liquidity to the money market or withhold liquidity from it. The mechanism is as follows. Consider a *one-period government bond* with a secured payoff equal to 1 euro at the end of the period and no payoffs during the period (known as a zero-coupon bond or discount bond). To fix ideas, let the period length be one month. In the financial market language the *maturity date* is then one month after the *issue date.* Let v be the market price (in euros) of the bond at the beginning of the month. The implicit monthly interest rate, x, is then the solution to the equation $v = (1+x)^{-1}$, i.e.,

$$x = v^{-1} - 1.$$

Translated into an annual interest rate, with monthly compounding, this amounts to $i = (1 + x)^{12} - 1 = v^{-12} - 1$ per year. With $v = 0.9975$, we get $i = 0.03049$ per year.[11]

Suppose the central bank finds that i is too high and buys a bunch of these bonds. Then less of them are available for the private sector, which on the other hand now has a larger money stock at its disposal. According to the Keynesian monetary theory (which is by now quite commonly accepted), under normal circumstances the general price level for goods and services is sticky in the short run. It will be the bond price, v, which responds. In the present case it moves up, thus lowering i, until the available stocks of bonds and money are willingly held. In practice this adjustment of v, and hence i, to a new equilibrium level takes place rapidly.

In recent decades the short-term interest rate has been the *main* monetary policy tool when trying to stimulate or dampen the general level of economic activity and control inflation. Under normal circumstances the open market operations give the central bank a narrow control over the short-term interest rate. Central banks typically *announce* their *target level* for the short-term interest rate and then adjust the monetary base such that the actual money market rate ends up close to the announced interest rate. This is what the European Central Bank (the ECB) does when it announces its target for EONIA (euro overnight index average) and what the U.S. central bank, the Federal Reserve, does when it announces its target for the *federal funds rate.* In spite of its name, the latter is not an interest rate charged by the U.S. central bank but a weighted average of the interest rates commercial banks in the U.S. charge each other, usually overnight.

In the narrowly defined "money market" close substitutes to money are traded. From a logical point of view a more appropriate name for this market would be the "short-term bond market" or the "near-money market". This would entail using the term "market" in its general meaning as a "place" where a certain type of goods or assets are traded *for money.* Moreover, speaking of a "short-term bond market" would be in line with the standard name for market(s) for financial assets with maturity of more than one year, namely *market(s) for longer-term bonds and equity*; by practitioners these markets are also called the *capital markets.* Anyway, in this book we shall use the term "money market" in its broad theoretical meaning as an abstract market place where the aggregate demand for money "meets" the aggregate supply of money. As to what kind of money, "narrow" or "broad", further specification is always to be added.

The open-market operations by the central bank affect directly or indirectly

[11] With continuous compounding we have $v = e^{-i/12}$ so that $i = 12 \ln v^{-1} = 0.03004$ when $v = 0.9975$.

all the equilibrating prices in the financial markets as well as expectations about the future path of these prices. This influence derives from the direct control over the monetary base, M_0. The central bank has no direct control, however, over the money supply in the broader sense of M_1, M_2, or M_3. These broader monetary aggregates are also affected by the behavior of the commercial banks and the non-bank public. The money supply in this broad sense can at most be an intermediate target for monetary policy, that is, a target that can be reached in some average-sense in the medium run.

16.5 Key questions in monetary theory and policy

Some of the central questions in monetary theory and policy are:

1. How is the *level* and the *growth rate* of the money supply (in the M_0 sense, say) linked to:
   (a) the real variables in the economy (resource allocation),
   (b) the price level and the rate of inflation?
2. How can monetary policy be designed to stabilize the purchasing power of money and optimize the liquidity services to the inhabitants?
3. How can monetary policy be designed to stabilize the economy and "smooth" business cycle fluctuations?
4. Do rational expectations rule out persistent real effects of changes in the money supply?
5. What kind of regulation of commercial banks is conducive to a smooth functioning of the credit system and reduced risk of a financial crisis?
6. Is hyperinflation always the result of an immense growth in the money supply or can hyperinflation be generated by self-fulfilling expectations?

As an approach to answering long-run monetary issues, we will in the next chapter consider a kind of neoclassical monetary model by Sidrauski (1967). In this model money enters as a separate argument in the utility function. The model has been applied to the study of long-run aspects like the issues 1, 2, and 6 above. The model is less appropriate, however, for short- and medium-run issues such as 3, 4, and 5 in the list. These issues are dealt with in later chapters.

16.6 Literature notes

In the *Arrow-Debreu model*, the basic microeconomic general equilibrium model, there is assumed to exist a *complete set of markets*. That is, there is a market for each "contingent commodity", by which is meant that there are as many markets as there are possible combinations of physical characteristics of goods, dates of delivery, and "states of nature" that may prevail. In such an fictional world any agent knows for sure the consequences of the choices made. All trades can be made once for all and there will thus be no need for any money holding (Arrow and Hahn, 1971).

For a detailed account of the different ways of modelling money demand in macroeconomics, the reader is referred to, e.g., Walsh (2003). Concerning "money in the production function", see Mankiw and Summers (1986).

16.7 Exercises