Fundamentals of Monetary Policy in the Euro Area

Concepts – Markets – Institutions

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1 Introduction and motivation

Central banks are among the most powerful actors in today's financial markets. At the same time, and despite a recent trend towards more transparency, little is known about their structures, the way they work in practice and the way they arrive at concrete decisions – there is still a mysterious aura around these institutions. This book aims at shedding more light at central banks and monetary policy, with a particular focus at the euro area.

2 Basic concepts

2.1 Learning objectives

In this chapter, we introduce some basic economic concepts that are particularly useful in the analysis of monetary policy. We also aim at describing a number of particularly useful statistical and econometric tools.

2.2 Some economic concepts

There are various kinds of data in economics and statistics and it is important to recognise the nature of these data. Stocks, such as for instance, the stock of money in an economy usually refer to a specific point in time, say, for example to the end of the quarter or the end of the year. It is fact of life that stocks can accumulate or decumulate. By contrast, flows are measured over a specific interval in time. They are calculated, for instance, by taking the difference between the stock at the end of the current and the stock at the end of the previous period. Sometimes, flows have to be adjusted for reclassifications, foreign exchange revaluations and other kind of revaluations in order to get a coherent picture of the underlying transactions. As a rule, however, caution is needed, since stocks and flows can often not be directly compared in a meaningful way.

Stock and flow data usually form the basis for the calculation of growth rates. Many economic variables, such as for instance, inflation or real growth are mostly expressed in terms of annual growth rates, which basically summarise the information of today's stock and the respective development one year ago in a single figure. This is, however, just by international convention and not the only way of expressing developments in these data.

More precisely, there are basically there ways of calculating the annual growth rates of a variable Y in percentages:[1]

$$\Delta Y = \left[\frac{Y - Y_{t-12}}{Y_{t-12}} \right] \cdot 100 \tag{2.2.1}$$

$$\Delta Y = \left[\frac{Y - Y_{t-12}}{Y_t} \right] \cdot 100 \tag{2.2.2}$$

$$\Delta Y = \left[\log(Y) - \log(Y_{t-12}) \right] \cdot 100 \tag{2.2.3}$$

For rather small values of change, the first two options are basically similar. In case of more substantial changes, the first alternative will yield larger values. Economists involved in empirical analysis often make use of the third alternative that represents a good compromise.

A second concept of relevance is the one of elasticity. In economics, an elasticity expresses the responsivenes of one variable to the change in another variable. For instance, the income elasticity of money demand shows, by how many percent money demand changes, if income changes by one percent. This figure can be very important in monetary economics, and this is why we will return to the issue at a later stage.

2.3 Some statistical concepts

In this section, a number of statistical and econometric concepts will be introduced, all of which represent necessary and very helpful tools in today's economics.

A first tool deemed to be of help in data analysis are time series charts or, alternatively, time series graphs. By definition, such a chart shows the time dimension on the horizontal axis and the variable under review on the vertical axis. In economic analysis, these charts often turn out to be very useful as they help the reader to get a first impression about magnitudes, trends, variability, cycles, outliers, periods, and many more things.

The next tool is also less of a statistical and more of a graphical nature. The so-called "scatterplot" is a graph that contains two series, in which the values of the second series are plotted against the values of the first series. Why could this be of help? Well, it is often not intuitively clear, what the relationship between two time series is. For instance, how do inflation and money behave vis-à-vis each other? When you are confronted with such a question, scatterplots allow you to examine visually the relationship between the two variables and that is often quite telling.

Another important measure is the so-called "correlation coefficient". It is basically a measure of the degree of association between two variables and can be computed as follows:[2]

$$CC = \frac{\sum \left[(X_i - \bar{X}) \cdot (Y_i - \bar{Y}) \right]}{\sqrt{\sum (X_i - \bar{X})^2 \cdot \sum (Y_i - \bar{Y})^2}} \tag{2.3.1}$$

While the formula looks quite impressive at first glance, you should not be worried too much, as in practice, most software programs can do it quite easily for you. What could be the use of this measure? For instance, it does play a role in modern portfolio analysis, as for reasons of diversification, you are supposed to aim at holding stocks in your portfolio that are uncorrelated since in case one declines, the other one rises.

It is worth taking note of some important properties of this coefficient: First, it is non-dimensional, since the numerator and the denominator are measured in the same unit of account. Second, it can be positive or negative, the sign depending on the term in the numerator. Third, it lies between the limits of -1 and +1. Fourth, it is symmetric in nature, that is the coefficient of correlation between X and Y is the same than the one between Y and X.[3] Fifth, if X and Y are statistically independent, the corresponding correlation coefficient is zero. If, however, the correlation coefficient is zero between two variables is zero, it does not mean that the two variables are independent. Note however that this measure will only reflect the degree to which variables are linearly related. For instance, two variables might be perfectly related in a non-linear way (e.g. $Y = X^2$) and still result in a low value for the correlation coefficient.

While there is no general agreement on the fact, when a correlation (coefficient) can be called "high" or low, in practice, quite often values of the correlation coefficient between -0.3 to -0.1 or 0.1 to 0.3 are termed as a "small" correlation, values between -0.5 to -0.3 or 0.3 to 0.5 are seen as indicating a "medium" correlation and values between -1.0 to -0.5 or 0.5 to 1.0 a "large" correlation.[4]

A very simple but nevertheless very helpful graphical device is a "histogram".[5] On the horizontal axis of this kind of chart, the variable of interest is divided into suitable intervals and the number of observations in that class is then indicated by the height of the corresponding rectangles.[6] Such a chart usually gives a good indication of the frequency of specific observations and, thereby, of the distribution of the underlying data.

At the same time, a number of other descriptive statistical measures can prove useful in complementing the histogram. For instance, the "mean" represents the average value of the series under investigation. It is obtained by simply adding up the series and afterwards dividing by the number of observations. By contrast, the "median" is represented by the middle value (or average of the two middle values) of the series when the values are ordered according to size, i.e. from the smallest to the largest value. The median is a very popular measure in applied empirical work as it represents a robust measure of the centre of the distribution that is much less sensitive to outliers than for instance the mean.[7] In many cases, also the maximum and minimum values of the series under investigation give useful insights.

In statistics, the "standard deviation" represents a rather simple tool to measure the variability or dispersion of a given data set. In this context, a low standard deviation indicates that the data points tend to be very close to the mean, while a high standard deviation reveals that the data are more "spread out". Among other things, the standard deviation is of particular relevance for finance, where the standard deviation of a rate of return is generally interpreted as a measure of risk.

A related concept is the one of "skewness". The latter represents a measure of data distribution that shows whether large deviations from the mean are more likely towards one side than towards the other. In the case of a symmetrical distribution, deviations either side of the mean are equally likely. As a consequence, the skewness of a symmetric distribution is zero. A positive skewness is equivalent to saying that the distribution has a long right tail and, therefore, large upward deviations are more likely than large downward ones. Negative skewness means that the distribution has a long left tail and, thus, large downward deviations are more likely than large upward ones.

The concept of "kurtosis" is a suitable tool to measure the "peakedness" or flatness of the distribution of a series. It can be shown that the kurtosis of the normal distribution equals exactly a value of 3. If the kurtosis of the series under investigation exceeds the value of 3, the distribution is peaked (i.e. "leptokurtic") relative to the normal distribution. By contrast, if the kurtosis is less than the value of 3, the distribution is flat (i.e "platykurtic") relative to the normal distribution.[8] As will be shown in the next chapters in more detail, financial data often are often particularly interesting in that respect.

A large number of economic time series also typically exhibit a pattern of cyclic variation widely known as seasonality. As the name implies, seasonality can thought of as occurring in a repetitive and predictable fashion. It is, for instance, a well-known fact in economics and statistics that retail sales and, in parallel, currency in circulation increase before and during the Christmas period and decline afterwards.

Seasonality can often very be easily be detected simply by visual inspection. It can also be removed by a number of statistical techniques. One quite popular approach for seasonal adjustment is the use of dummy variables.[9]

📖 Key concepts

Stocks and flows, levels, growth rates, elasticity, time series chart, scatterplot, correlation coefficient, histogram, standard deviation, skewness, kurtosis, seasonality, stocks, flows, growth rates.

☑ Questions for review

- What is the key difference betwen stocks and flows?
- What is behind the concept of an elasticity?
- In which way can time series charts and scatterplots be of help when analysing the data?
- What is behind the concept of the correlation coefficient?
- In which way can a histogram be of help? How does this link to the concept of skewness? What is behind the idea of kurtosis?
- What is behind the concept of seasonality?

3 A short history of EMU

3.1 Learning objectives

In this chapter, we give a brief overview on the roadmap to EMU. We also aim at explaining the convergence criteria. Moreover, we take a closer look at the concept of an optimal currency area and summarise the advantages and disadvantages of a monetary union. Finally we reflect on some of the controversies about the road.

3.2 The roadmap to EMU

The abbreviation "EMU" stands for "European Economic and Monetary Union". The EMU is a currency union located in the heart of Europe that can be characterized by the fact that the participating countries have adopted one common currency, the euro.

The idea of having a common currency in Europe is not new. In 1988, the then acting President of the European Commission, Jaques Delors, chaired a committee that developed a three-stage plan to reach full economic union, including the establishment of a central bank and a single currency which would replace the national currencies. The final outcome of the work of this committee (the so-called "Delors Report") then proposed the introduction of an Economic and Monetary Union (EMU) in three concerted and sequential steps.[10]

The first stage, which basically consisted of a liberalisation of all capital transactions, was launched on 1 July 1990. The second stage of EMU started on 1 January 1994 and was mainly characterised by the establishment of the European Monetary Institute (EMI).[11] The third stage began on 1 January 1999 with the irrevocable fixing of the exchange rates of the participating currencies and with the start of the single monetary policy under the responsibility of the European Central Bank (ECB).

The plans for the euro were legally formalized in provisions within the Maastricht Treaty, which was signed in 1992, subsequently ratified by all Member States and then called EU Treaty. The EU Treaty also sets up the conditions or, alternatively, the "convergence criteria", that countries of the European Union have to fulfil before they can join EMU.

☑ Box: History of the euro area

1962	The European Commission makes its first proposal (Marjolin-Memorandum) for economic and monetary union.
May 1964	A Committee of Governors of central banks of the Member States of the European Economic Community (EEC) is formed to institutionalise cooperation among EEC central banks.
1962	The European Commission makes its first proposal (Marjolin-Memorandum) for economic and monetary union.
May 1964	A Committee of Governors of central banks of the Member States of the European Economic Community (EEC) is formed to institutionalise cooperation among EEC central banks.
1970	The Werner Report sets out a plan to realise an economic and monetary union in the Community by 1980.
Apr. 1972	A system (the "snake") for the progressive narrowing of the margins of fluctuation between the currencies of the Member States of the European Economic Community is established.
Apr. 1973	The European Monetary Cooperation Fund (EMCF) is set up to ensure the proper operation of the snake.
Mar. 1979	The European Monetary System (EMS) is created.
Feb. 1986	The Single European Act (SEA) is signed. June 1988 The European Council mandates a committee of experts under the chairmanship of Jacques Delors (the "Delors Committee") to make proposals for the realisation of EMU.
May 1989	The "Delors Report" is submitted to the European Council.
June	The European Council agrees on the realisation of EMU in three stages.
July 1990	Stage One of EMU begins.
December	An Intergovernmental Conference to prepare for Stages Two and Three of EMU is launched.

Feb. 1992	The Treaty on European Union (the "Maastricht Treaty") is signed.
Oct. 1993	Frankfurt am Main is chosen as the seat of the European Monetary Institute (EMI) and of the ECB, and a President of the EMI is nominated.
November	The Treaty on European Union enters into force. December Alexandre Lamfalussy is appointed President of the EMI, to be established on 1 January 1994.
Jan. 1994	Stage Two of EMU begins and the EMI is established.
Dec. 1995	The Madrid European Council decides on the name of the single currency and sets out the scenario for its adoption and the cash changeover.
Dec. 1996	The EMI presents specimen banknotes to the European Council.
June 1997	The European Council agrees on the "Stability and Growth Pact".
May 1998	Belgium, Germany, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Austria, Portugal and Finland are considered as fulfilling the necessary conditions for the adoption of the euro as their single currency; the Members of the Executive Board of the ECB are appointed.
June	The ECB and the ESCB are established.
October	The ECB announces the strategy and the operational framework for the single monetary policy it will conduct from January 1999.
Jan. 1999	Stage Three of EMU begins; the euro becomes the single currency of the euro area; conversion rates are fixed irrevocably for the former national currencies of the participating Member States; a single monetary policy is conducted for the euro area.
Jan. 2001	Greece becomes the 12th Member State to join the euro area.
Jan. 2002	The euro cash changeover: euro banknotes and coins are introduced and become sole legal tender in the euro area by the end of February 2002.
May 2004	The NCBs of the ten new EU Member States join the ESCB.

Jan. 2007	Bulgaria and Romania bring the total number of EU Member States to 27 and join the ESCB at the same time. Slovenia becomes the 13th Member State to join the euro area.
Jan. 2008	Cyprus and Malta join the euro area, thereby increasing the number of Member States to 15.
Jan 2009	Slovakia joins the euro area.
Jan 2011	Estonia joins the euro area.

Source: Scheller (2004), p. 16, updated by the author.

Eleven member states initially qualified for the third and final stage of EMU on 1 January 1999. Those states were Belgium, Germany, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Austria, Portugal and Finland. The number of participating Member States increased to 12 on 1 January 2001, when Greece joined the third stage of EMU. In January 2007, the number of participating countries changed again to 13 with the entry of Slovenia into the euro area. Cyprus and Malta joined the Eurosystem on 1 January 2008. Finally, Slovakia joined on 1 January 2009 and Estonia on 1 January 2011.

3.3 Convergence criteria

As already mentioned, the criteria that a member state of the European Union must fulfil in order to join the European Monetary Union, i.e. the economic and legal conditions for the adoption of the euro, are generally known as "convergence criteria" (or sometimes also as "Maastricht criteria"). They are laid down in Article 140(1) of the EU Treaty and the Protocol annexed to the EU Treaty on the convergence criteria. More precisely, the convergence criteria include:[12]

- Low inflation: the average inflation rate observed during a one-year period before a country is examined for admission to the single currency must not exceed by more than 1.5% the average of the three best performing Member States in terms of price stability.
- Low interest rates: during the year preceding the examination, the average long-term interest rate must not exceed by more than 2% that of the three best performing Member States in terms of price stability.
- Sound public finances: the government deficit must not exceed 3% of gross domestic product (GDP) and the public debt must not exceed 60% of GDP, unless the ratio is sufficiently diminishing and approaching the reference value at a satisfactory pace.[13]
- Stable exchange rates: candidate countries must have withstood the normal fluctuation margins provided for by the exchange rate mechanism of the European Monetary System for at least two years, without devaluing their currency against that of any other Member State.

In addition to meeting these economic convergence criteria, a euro-area candidate country must also ensure the criterion of "legal convergence" to be satisfied. In particular, the legislation of the member state must be in accordance with both, the EU Treaty and the Statute of the ESCB and of the ECB, thus guaranteeing, for instance, the independence of the respective national central bank. If the latter is not the case, the remaining incompatibilities have to be adjusted.

The Treaty requires the ECB and the Commission to report to the Council of the European Union at least once every two years or at the request of a Member State with a derogation, on the progress made by Member States in terms of their fulfilment of the convergence criteria.[14]

On the basis of the convergence reports submitted separately by the ECB and the Commission, and on the basis of a proposal by the Commission, the European Council (having consulted the European Parliament) may decide on the fulfilment of the criteria by a Member State and allow it to join the euro area. Since the beginning of Stage Three, the ECB has prepared convergence reports in 2000, 2002, 2004, 2006, 2007, 2008 and 2010.

The convergence criteria have been criticized heavily for various reasons.[15] First, they are completely backward-looking in nature. Second, the reference values for public deficit and public debt are widely seen as arbitrary.[16] Third, and perhaps most fundamentally, they are not related to the criteria for an optimum currency area as have been laid down in the economic literature, such as, for instance, the mobility of labor. More broadly speaking, there are in essence no convergence criteria that refer to real developments, such as, for instance, unemployment rates or real growth in GDP in the member states.

3.4 The concept of an optimal currency area

The theory of an "optimum currency area" or "optimal currency area" (OCA) was pioneered by the Canadian economist and nobel prize winner Robert Mundell. The starting point of his deliberations was the idea of an "optimal currency union", which can be thought of as a region which economic efficiency would be maximised, if the region would share one common currency. It is obvious that an optimal currency union must not necessarily coincide with the borders of a specific country. In fact, it might perfectly make economic sense if some countries share a common currency. But what exactly are the criteria that would help in deciding whether a country would fit into such an optimal currency union? This is indeed a difficult question. The basic idea lies in the fact that in a currency union, one important instrument gets lost, namely the flexibility of the exchange rate. Under which conditions can a country afford this? The literature has suggested the following criteria:[17]

- Labour mobility: in case, countries in a monetary union are hit by asymmetric shocks, labour mobility might help to foster an asymmetric stabilisation. In such a case, mobility of labour ensures that unemployed people will migrate from a country with less demand to another country with more demand, thus ameliorating the effects of the asymmetric shock and, as a consequence, reducing the need for an independent monetary and exchange rate policy.
- Flexible wages: similarly, if wages react to rising unemployment figures by a significant decrease, then wage flexibility can be a valid substitute for flexible exchange rates.
- Capital mobility: if capital is mobile, this allows for a temporary increase of debt vis-à-vis foreign countries and thus can lead to a stabilisation in real developments.
- Fiscal transfer arrangements: Finally, financial transfers from financially sounder countries to financially weaker countries can allow for a convergence and stabilisation in economic developments.
- Other authors have added to these deliberations. For instance, McKinnon and Kenen have proposed to include the criteria of the openness of the economy and product diversification, respectively, as additional criteria.[18]

It has been argued on the one hand that – according to these criteria – the euro area would not constitute an ideal optimal currency union. On the other hand, it has to be admitted, that these studies mainly concentrate on the question, under which conditions exchange rate devaluations do not have any negative repercussions. This is a too narrow and too easy view of the world. A more systematic view is missing.

3.5 Advantages and disadvantages of a monetary union

Already some time ago, the literature has, therefore, engaged into a deeper and systematic discussion of the advantages and disadvantages of a monetary union. To begin with, a currency union tends to reduce the transaction costs incurred by traders and travellers exchanging the home currency for other currencies. Second, a currency union would clearly eliminate the nominal exchange rate uncertainty for trade with the country or countries forming part of the currency union (and probably reduce the real exchange rate uncertainty also). As a result of this reduction in exchange rate uncertainty within the currency union, it seems very likely that a currency union would stimulate trade with other parts of the currency union, thus leading to productivity gains inside the currency union. Third, the aforementioned developments also add to an increased transparency in prices of goods and services. Fourth, in case a strictly stability-oriented monetary policy is successfully implemented, high-inflation countries might have a good chance to enter a low-inflation regime with rates that come close to, or even equal, the ones faced by the most successful country. Fifth, when applied to the euro, it is fair to say that the United States of America and Japan have millions of inhabitants and strong economies. The newly founded European Monetary Union and the new currency in Europe could easily have the potential to become a serious rival to the "Big Two".

It is fair to say, however, that such a currency union also has a number of disadvantages. First and foremost, the empirical research on the effects of currency uncertainty on trade is, unfortunately, not very conclusive, with some studies suggesting that the effects of currency uncertainty are actually rather small and others suggesting that they are quite significant. Second, it is also the case that a currency union would remove any chance of domestic interest rates deviating from those in the partner countries. In fact, the principle of "one size fits all" would prevail in a currency union. A potential major disadvantage would consist in the loss of an independent monetary policy tool, and hence the loss of a very important instrument of moderating aggregate demand shocks. Also the exchange rate instrument will disappear as an active instrument from the toolkit of a country.

Views will differ on how important these losses would be. But recent international experience seems to suggest that these losses can have very substantial and sometimes very adverse implications. Third, on the political side, it is sometimes argued that an independent central bank is undemocratic. Governments must be able to control the actions of the central banks because governments have been democratically elected by the people, whereas an independent central bank would be controlled by a non-elected body. Moreover, there would be a considerable loss of sovereignty, since power would be transferred away from the individual countries to a supranational institution. Finally, such a currency union can be expected to put downward pressure on inefficient tax and social security systems forcing a downward adjustment in the long run.

This begs the question of how to weight the pros and cons? As just outlined above, joining a currency union, or adopting the currency of another country, has potentially important implications which go well beyond economic issues. But even focusing on the economic issues, weighting the various pros and cons is not easy and would clearly depend on a careful case-by-case assessment.

3.6 Some controversies about the road

It is fair to say, however, that there have occasionally been heated debates about the "best way" to achieve a monetary union. In particular, two schools expressed different and deeply rooted-views on this issue. One group, comprising mainly French and Italian economists held the view that monetary integration could play a key role in the convergence process. The creation of a common central bank would lead to a change in policy regime and, hence, to a change in inflation expectations. Therefore, an institution-building element was crucial in their argumentation.

By contrast, another group of economists, mainly led German economists, put a lot of emphasis on the coordination of economic policies which should foster the convergence process and, hence, in the end lead to the creation of a monetary union. Given the weight put on stability and convergence by this group of economists, this approach was also often referred to a "coronation theory". From today's point of view and with the benefit of hindsight, it seems as if these two schools have at some stage more or less agreed on the fact that a compromise integrating both elements in a balanced fashion could be seen as the most promising avenue.[19]

📖 Key concepts

Three stages of EMU, convergence criteria, academic critique, optimum currency area, advantages and disadvantages of a monetary union, controversies about the road.

☑ Questions for review

- Which main steps towards the European Monetary Union can be distinguished?
- What was the main critique coming from academia?
- What does the concept of an optimum currency union say?
- What are the advantages and disadvantages of a currency union?
- Which different views about the "best way" to monetary union have been held in the past?

4 Institutions

4.1 Learning objectives

In this chapter, we introduce the European Union and the European Central Bank. We also aim at getting familiar with the Presidents of the European Central Bank. Finally, we take a closer look at various other central banks.

4.2 The European Union

The European Union (EU) is an economic and political union consisting of 28 independent member states. As it stands, the EU does not constitute a federation like the United States of America or an organisation for cooperation between governments, like the United Nations. In essence, the countries that form the European Union remain independent sovereign nations, but they operate through a system of shared supranational independent institutions created by them and also through intergovernmental negotiated decisions by the member states.

☑ Members of the European Union and year of entry

Austria (1995), Belgium (1952), Bulgaria (2007), Croatia (2013), Cyprus (2004), Czech Republic (2004), Denmark (1973), Estonia (2004), Finland (1995), France (1952), Germany (1952), Greece (1981), Hungary (2004), Ireland (1973), Italy (1952), Latvia (2004), Lithuania (2004), Luxembourg (1952), Malta (2004), Netherlands (1952), Poland (2004), Portugal (1986), Romania (2007), Slovakia (2004), Slovenia (2004), Spain (1986), Sweden (1995) and United Kingdom (1973).

Source: http//europa.eu.

A closer look reveals that the EU's decision-making process involves three main institutions: the European Parliament – consisting of 738 Members of Parliament and meeting in Strasbourg (France), Luxembourg and Brussels (Belgium) – which basically represents the EU's citizens and is directly elected by them every five years; the Council of the European Union (often also informally described as "EU Council"), which basically represents the individual member states since the national ministers from each EU country meet there; and the European Commission (with its headquarters located in Brussels), which seeks to uphold the interest of the Union as a whole. The European Commission also drafts proposals for new European laws and manages the day-to-day business of implementing EU policies and of spending EU funds.

Other institutions are the Court of Justice which upholds the rule of European Law and the Court of Auditors which checks the financing of the Union's activities. Among the other European institutions, especially the European Central Bank is worth mentioning, as it is responsible for European monetary policy.

4.3 The European Central Bank

The 17 national central banks (NCBs) in the euro area and the ECB together form the so-called "Eurosystem".[20] The Eurosystem needs to be clearly distinguished from the European System of Central Banks (ESCB) since the latter body also comprises EU Member States which have not yet adopted the euro. The NCBs of those Member States which have not adopted the euro still conduct their own monetary policies and are, therefore, not involved in the decision-making process vis-à-vis the single monetary policy for the euro area.[21] The basic tasks of the Eurosystem are to:[22]

- define and implement the monetary policy for the euro area;
- conduct foreign exchange operations and to hold and manage the official foreign reserves of the euro area countries;
- promote the smooth operation of payment systems.

☑ Members of the European Economic and Monetary Union and year of entry

Austria (1999), Belgium (1999), Cyprus (2008), Estonia (2011), Finland (1999), France (1999), Germany (1999), Greece (2001), Ireland (1999), Italy (1999), Luxembourg (1999), Malta (2008), Netherlands (1999), Portugal (1999), Slovakia (2009), Slovenia (2007) and Spain (1999).

Source: Gerdesmeier (2011), pp. 116 ff.

Further tasks are to:

- authorise the issue of banknotes in the euro area;
- give opinions and advice on draft Community acts and draft national legislation;
- collect the necessary statistical information either from national authorities or directly from economic agents, e.g. financial institutions;
- contribute to the smooth conduct of policies pursued by the authorities in charge of prudential supervision of credit institutions and the stability of the financial system.

The highest-ranking decision-making body of the ECB is the Governing Council.[23] It consists of the six members of the Executive Board and the governors of the NCBs of the euro area.[24] The key task of the Governing Council is to formulate the monetary policy for the euro area. More specifically, it has the power to determine the interest rates at which credit institutions may obtain liquidity (money) from the Eurosystem. Thus the Governing Council indirectly influences interest rates throughout the whole euro area economy.

The Executive Board of the ECB consists of the President, the Vice-President and four other members.[25] The main responsibility of the Executive Board consists in implementing the monetary policy as decided by the Governing Council and giving the necessary instructions to the NCBs for this purpose. At the same time, it also prepares the meetings of the Governing Council and manages the day-to-day business of the ECB.

The third decision-making body of the ECB is the General Council that comprises the President and the Vice-President of the ECB and the governors and presidents of all 28 NCBs of the EU Member States. As already mentioned above, the General Council has no responsibility for monetary policy decisions in the euro area. Instead, it contributes mainly to the coordination of monetary policies of the Member States that have not yet adopted the euro and also plays a role in the preparations for the possible enlargement of the euro area.

4.4 Presidents of the European Central Bank

So far, the ECB has witnessed three presidents. Willem Frederik "Wim" Duisenberg was born in 1935 in Herentveen (Netherlands). After a successful career in the International Monetary Fund, as a professor at the University of Amsterdam, as a finance minister in the Netherlands and President of De Nederlandsche Bank, he was appointed as the first President of the European Central Bank and, therefore, in office during the introduction of the Euro in twelve European countries in 2002.[26] Wim Duisenberg became well-known as "Mr. Euro" and even more famous for his statement "I hear you but I do not listen", with which he responded to the pleas of politicians for lower interest rates. On 31 July 2005, Wim Duisenberg died from a heart attack at the age of 70, while on vacation in his villa in Southern France.

Jean-Claude Trichet was born on 29 December 1942 in Lyon (France) as the son of a professor of Greek and Latin.[27] He graduated in the Institut D' Etudes Politiques de Paris (better known as "Sciences Po") and the Ecole Nationale d' Administration ("ENA") and was nicknamed "Justix" for his dedication to workers' rights. In 1993, Jean-Claude Trichet was appointed Governor of Banque de France. On 1 November 2003 he took Wim Duisenberg's place and became second President of the European Central Bank.

Mario Draghi was born on 3 September 1947 in Rome (Italy). He graduated from La Sapienza University of Rome and earned a Ph.D. in ecomomics from Massachusetts Institute of Technology in 1976.[28] After holding positions as a full professor at the University of Florence, Executive Director of the World Bank, Director General of the Italian Treasury, Vice Chairman and Managing Director at Goldman Sachs, he became Governor of Banca d'Italia. In November 2011, he succeeded Jean-Claude Trichet as third President of the European Central Bank, after the German candidate Axel Weber withdrew from his candidature.

The mandate of the ECB is laid down in the Treaty establishing the European Community. Article 127 states that "…the primary objective of the ESCB shall be to maintain price stability. Without prejudice to the objective of price stability, the ESCB shall support the general economic policies in the Community with a view to contributing to the achievement of the objectives of the Community…". In this respect, Article 3 of the Treaty mentions as objectives of the Community, inter alia, "[…] the sustainable development of Europe based on balanced economic growth and price stability, and a highly competitive social market economy, aiming at full employment and social progress […]". The Treaty thus establishes a clear hierarchy of objectives for the Eurosystem and assigns overriding importance to price stability.

Moreover Article 130 adds: "When exercising the powers and carrying out the tasks and duties conferred upon them by this Treaty and the Statute of the ESCB, neither the ECB, nor a national central bank, nor any member of their decision-making bodies shall seek or take instructions from Community institutions or bodies, from any government of a Member State or from any other body. The Community institutions and bodies and the governments of the Member States undertake to respect this principle and not to seek to influence the members of the decision-making bodies of the ECB or of the national central banks in the performance of their tasks".

4.5 The Rise of the Euro

The name of the new currency of the euro area was decided on the meeting of the European Council in Madrid in December 1995. It was generally felt and agreed that the name of the new currency should be the same in all official languages of the European Union, easy to pronounce and – at the same time – simple and representative of Europe. It was exactly for these reasons that alternative proposals, such as for instance "ducat", "ecu", "florin", "franken", or the use of the euro as a prefix to existing currency names – "euromark", for example were rejected.[29] As regards its specific denomination, it was agreed to have seven euro banknote denominations (i.e. €5, €10, €20, €50, €100, €200 and €500) and eight euro coins (i.e. 1 cent, 2 cent, 5 cent, 10 cent, 20 cent, 50 cent, €1 and €2).

4.6 A closer look at the U.S. Federal Reserve System

On 23 December 1913, almost a hundred years ago, the Federal Reserve Act created a central bank for the United States. The Federal Reserve System (Fed) consists of twelve regional Federal Reserve Banks located in major cities throughout the United States and a seven-member Federal Reserve Board of Governors with headquarters in Washington, D.C.[30]

The seven members of the Board of Governors are appointed for a term of 14 years term, which is almost twice as long as the eight-year term for members of the Executive Board. In both cases, members may serve only one full-term, so their appointments are nonrenewable. In reality, however, the actual term for a member of the Board of Governors could last much longer as a member, that has been asked to complete an unexpired term of a previous member, can then be appointed to a full 14-year term. The chairman and vice chairman of the Board of Governors are then nominated by the President of the United States and confirmed by the U.S. Senate. Both then serve for four-year terms that may be renewed as long as their terms on the Board have not expired.

A distinguishing feature of both currency areas worth mentioning is that the national central banks that form together the Eurosystem correspond to political entities, namely to the Member States of the euro area. This is clearly not the case for the twelve Districts of the Federal Reserve System. The latter are divided along county lines and, thus, often comprise not only several states but also shares of states.

The mandate of the Federal Reserve System states that "the Board of Governors of the Federal Reserve System and the FOMC[31] shall maintain long-run growth of the monetary and credit aggregates commensurate with the country's long-run potential to increase production, as to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates".[32]

It is a striking feature of this mandate that, by contrast to the Eurosystem's mandate, price stability does not receive a higher priority than the other goals. And, while in the long run all three goals are compatible, this does not necessarily hold in the short run. It is exactly for this reason that the Fed's policymakers are often forced to assign at least an implicit ranking to these goals.[33]

4.7 A closer look at the Bank of Japan

The central monetary authority for Japan is the Bank of Japan (BoJ).[34] It was established in 1882 and its highest decision-making body is the Policy Board. The Board comprises the Governor, two Deputy Governors and six other members. Each of these nine members is appointed by the Cabinet for five years, and his or her appointment must be approved by the Diet. The Board members elect the Chairman of the Policy Board among themselves and the Policy Board takes its decisions by a majority vote. In principle, the Bank of Japan operates more as a head office than a federal system of central banks, and is in charge of 32 domestic local branches and 12 local offices.[35]

The mandate of the Bank of Japan is laid down in the Bank of Japan Act which mentions as its main objectives, first, "to issue banknotes and to carry out currency and monetary control" and, second, "to ensure smooth settlement of funds among banks and other financial institutions, thereby contributing to the maintenance of stability of the financial system".[36] The Act also stipulates that "currency and monetary control by the Bank of Japan shall be aimed at achieving price stability, thereby contributing to the sound development of the national economy".[37]

Moreover, on March 9, 2006, the Bank of Japan introduced a new framework for the conduct of monetary policy, and additionally reviewed its thinking on price stability. More precisely, price stability was seen as being consistent with a change in the price index of zero percent (after excluding a measurement bias). In quantitative terms, however, an approximate range between 0% and 2% was deemed to be consistent with the views of the Board members on medium- to long-term price stability. Furthermore, the Bank of Japan also stated that it regarded a consumer price index (CPI) as an adequate measure for evaluating price developments.

4.8 A closer look at the Bank of England

The Bank of England (BoE) is the central bank of the United Kingdom. Founded in 1694 and located in London (hence the popular name of the "Old Lady of Threadneedle Street"), the BoE certainly represents one of the oldest central banks in the world. The Bank was nationalised on 1 March 1946 and gained independence in 1997.[38] Before that date, interest rate decisions could only be taken subject to the approval of the Chancellor of the Exchequer of the Treasury.

The decision about the appropriate level of interest rates is with the Bank's Monetary Policy Committee (MPC), which is made up of nine members – the Governor, the two Deputy Governors, the Bank's Chief Economist, the Executive Director for Markets and four external members appointed directly by the Chancellor. According to the BoE, the appointment of external members serves the purpose of ensuring that the MPC benefits from thinking and expertise in addition to that gained inside the Bank of England.

The mandate of the Bank of England can be found in the 1998 Bank of England Act. The latter mentions as policy objectives "to maintain price stability" and "to support the government's economic policy".

4.9 Decision-making modalities

While there are many similarities in the structures of the Eurosystem, the Fed, the Bank of Japan and the Bank of England, there remain some key differences. One substantial difference relates to the voting rights in the respective decision-making bodies. Currently, all NCB governors have an equal vote in all policy decisions taken by the Eurosystem's Governing Council. Similarly, all members of the Policy Board of the Bank of Japan and of the Bank of England's MPC have the right to vote. In case of the FOMC, however, the participation in the voting is more restricted. In essence, all seven members of the Board of Governors of the Federal Reserve System have a permanent voting right, as does the president of the New York Fed, whereas the presidents of the Chicago and Cleveland branches alternate annually, and the other nine reserve bank presidents share only four votes on a rotating basis. This notwithstanding, they do attend all FOMC meetings and participate in the discussions even when not being allowed to vote.

It is worth noting that the voting system in the euro area might possibly change in the distant future. This is due to the fact that the Governing Council felt that it had to stay in a position to take decisions in a timely and efficient manner, even with further enlargements of the euro area. In line with this request, the Governing Council decided on 19 March 2009 to implement a rotation system for voting rights in the Governing Council.

In this respect, it was decided that once the number of euro area countries exceeds 18, the Governors will be allocated to groups according to a specific key.[39] More particularly, under this new system, all six members of the Executive Board will maintain a permanent voting right, but the voting rights of NCB governors will be subject to a rotation system. In essence, governors will be allocated to three groups and will rotate in and out of voting rights after one month. In the concrete case of 27 countries participating in the euro area, three groups will exist: the first group will comprise five governors and four rotating votes; the second group will include fourteen governors and eight rotating votes and the third group will comprise eight governors and three rotating votes.[40] This system is designed to ensure a high participation of members combined with relative stability of the composition of the voting college. Most importantly, all governors attend all meetings of the Governing Council, irrespective of whether they hold a voting right at the time.

4.10 Independence and accountability

Twenty years ago or even earlier, many central banks in the world essentially found themselves to be just departments of the respective ministeries of finance. Recent decades, however, have witnessed a trend towards increasing the independence of central banks. This topic has been at the core of important academic research for a long time – albeit not always uncontroversial.

Why is central bank independence of relevance at all? This is due to the basic insight, that in a paper-money regime, there is always the inherent temptation, a so-called "inflation bias", for a government to use such money in an opportunistic manner. The latter temptation of excessive money creation turns out to be even more dangerous as the short-term effects will be felt immediately in form of higher growth and employment, whereas as the long-run effects, in terms of higher inflation rate, will only be paid over the medium to long-term.[41]

One solution to this problem, which has been advocated in the economic literature was to delegate monetary policy to a "conservative central banker" or, more generally, to an independent central bank.[42] There is indeed ample evidence that central bank independence brings about (or is at least negatively correlated with) lower inflation, which ensures a more stable environment for economic and employment growth.[43]

In the literature, a number of aspects of central bank independence have been mentioned, among them functional, institutional, personal and financial independence.[44]

- Functional independence: In general terms, this refers to the fact that an independent central bank should be free to set its policy instruments with the aim of achieving its objectives. The latter objectives should be set in a clear and legally certain way.
- Institutional independence: this aspect basically covers the freedom from instructions for the central bank. Some studies have even asked for a somewhat broader concept, namely the freedom from instructions and the legal personality of the central bank, which must be an institution separate from other government bodies.[45]
- Personal independence: this condition relates to the specific arrangements that the central bank's decision-making bodies are subject to with respect to the political authorities. More concretely, this touches upon issues such as appointment procedures and rules for dismissal, the length of the terms of office, the possibility of a renewal of mandate and many other issues.[46]
- Financial independence: This item relates to the budgetary independence of the central bank. Behind this is the reasoning that a central bank cannot fulfil its tasks properly without adequate financial means. Therefore, rules on the management of the central bank's budget as well as on the distribution of central bank's profits and (possible) losses have to be established. It is often felt that it is with respect to financial independence where national central banks are most vulnerable to outside influence.[47]

Central bank independence also seems to be widely and strongly supported by the citizens and international organisations. As regards the set of criteria outlined above, it seems of relevance that all aforementioned institutions can be classified as independent.

However, the trend towards more central bank independence has not been unconditional; it has come at a cost. Democratic principles demand that the delegation of authority to a non-elected institution must be accompanied by a higher degree of accountability and transparency.[48]

Accountability can be understood as "a principle which requires public authorities to explain their actions and be subject to scrutiny (…)".[49] But to whom should a central bank be accountable? The answer is rather straightforward: in essence, a central bank should be ultimately accountable to the public.

In case of the Federal Reserve System, this should be the Congress, since the members of the Congress are the direct representatives of the American people. In practice, accountability is then fulfilled by the Chairman's testimony before the Senate Banking Housing and Urban Affairs Committee and the House Banking and Financial Services Committee twice a year. Prior to the Chairman's appearance before these Congressional Committees, a written report containing inter alia the FOMC's forecast of economic conditions and monetary and credit aggregates has to be submitted.[50]

In the euro area, it is a widely accepted fact that the ECB should be accountable to the European Parliament which represents the European Public. Moreover, the EU Treaty also requests the ECB to report annually "on the activities of the ESCB and on the monetary policy of both, the previous and the current year" to the European Parliament, the ECOFIN, the European Commission and the European Council.[51]

☑ ECB Press Release

Monetary policy decisions
5 July 2012

At today's meeting the Governing Council of the ECB took the following monetary policy decisions:
The interest rate on the main refinancing operations of the Eurosystem will be decreased by 25 basis points to 0.75%, starting from the operation to be settled on 11 July 2012.
The interest rate on the marginal lending facility will be decreased by 25 basis points to 1.50%, with effect from 11 July 2012.
The interest rate on the deposit facility will be decreased by 25 basis points to 0.00%, with effect from 11 July 2012.
The President of the ECB will comment on the considerations underlying these decisions at a press conference starting at 2.30 p.m. CET today.

Source: http//www.ecb.int.

Transparency can be understood as an "environment in which the central bank provides the general public and the markets with all relevant information, on its strategy, assessments and policy decisions as well as its procedures and does so in an open, clear and timely manner.[52] It is also often understood as transparency in goals, in decisions and in the outlook.[53]

When focusing for the time being on the issue of transparency with respect to vis-à-vis policy decisions, crucial differences emerge. As a rule, the ECB issues a short press release describing the outcome of the meeting but leaving the explanation of the reasons underlying the decisions to the press conference that usually follows the first Governing Council meeting of the month. In this context, the explanation of the background underlying the monetary policy decision is then also followed by a question and answers session.

By contrast, the Federal Reserve does not hold such a press conference, but also issues a press release following each FOMC meeting. In fact, the latter is much more detailed than the one issued by the ECB. Most importantly, since March 2002, the release includes the vote of the FOMC and thereby, in case of dissent from the approved policy action, the name of the member is named and the preferred policy action of the member. Moreover, a day or so following its next scheduled meeting, the FOMC releases the minutes of the previous meeting which in essence provide a more detailed summary of the economic conditions, outlook, and reasons underlying the policy stance adopted at the meeting.[54]

The ECB has always refrained from releasing the minutes of the Governing Council meetings. When being put under pressure to do so, the members of the Governing Council have defended themselves by arguing that such a release minutes would limit the exchange of ideas during the meeting and, moreover, the press conference would already provide the public with a (real-time) summary of the meeting.[55]

📖 Key concepts

European Union, European Central Bank, Eurosystem, European System of Central Banks, Federal Reserve System, decision-making bodies of the ECB, Governing Council, Executive Board, General Council, Presidents of the ECB.

☑ Questions for review

- What is the essence of the European Union?
- What is behind the concept of the European Monetary Union?
- What is the difference between the European System of Central Banks and the Eurosystem?
- Which decision-making bodies of the ECB do you know? What exactly are their tasks?
- Which presidents of the ECB do you know?

5 Inflation

5.1 Learning objectives

This chapter aims at providing some more detailed information about the concepts of inflation and deflation. It also tackles measurement of inflation issues and related problems, as well as the reasons for and the costs of inflation and some basic ideas about possible central bank reactions.

5.2 Basic concepts

What is inflation? In essence, inflation and deflation must be seen as important economic phenomena. At its most basic level, inflation is defined as a protracted and broadly-based increase in the general price level (i.e. an increase over an extended period) which, consequently, leads to a decline in the value of money and thus its purchasing power.

The opposite of inflation is deflation. Deflation (as for example, expressed by a rate of -1%) occurs when the general prices actually decreases over a sustained period of time. It is worth noting at this stage already that deflation is not the same as disinflation, which is when the rate of inflation decreases but stays positive (for example, a change from a 3% rate to a 2% rate).

It is also important to distinguish between an increase in the general price level and an increase in the prices of individual goods. Frequent changes in individual goods prices are not uncommon in market-based economies and such a phenomenon is indeed quite "normal" in the sense that it reflects ongoing changes in supply and/or demand conditions of these individual goods. The stability of the overall price level is, therefore, not in danger unless the increase spreads to (or leads to price increases in) a variety of other goods.

5.3 Effects of inflation

The table below gives a quantitative impression of the impact of inflation on the purchasing power of money.[56] It shows for instance that, assuming an inflation rate of five percent and a ten-year horizon, only around 61% of the initial amount invested would remain in your hands.

Costs of Inflation				
Annual inflation rate	1%	2%	5%	10%
1 year later	99.0%	98.0%	95.2%	90.9%
2 years later	98.0%	96.1%	90.7%	82.6%
3 years later	97.1%	94.2%	86.4%	75.1%
4 years later	96.1%	92.4%	82.3%	68.3%
5 years later	95.1%	90.6%	78.4%	62.1%
6 years later	94.2%	88.8%	74.6%	56.4%
7 years later	93.3%	87.1%	71.1%	51.3%
8 years later	92.3%	85.3%	67.7%	46.7%
9 years later	91.4%	83.7%	64.5%	42.4%
10 years later	90.5%	82.0%	61.4%	38.6%

Besides these more generic effects, inflation clearly has effects on the distribution of wealth. In particular, inflation can be harmful to fixed-income returns. While the rate of interest, or coupon, on most fixed-income securities remains the same until maturity, the purchasing power of the interest payments declines as inflation rises. In much the same way, rising inflation erodes the value of the principal on fixed-income securities. It might easily be possible that negative results will result, when adjusted for inflation. As a consequence, investors will demand an extra return (a so-called "inflation risk premium") to compensate them for the inflation risks associated with holding nominal assets over the longer term.

Another problem related to inflation consists of the fact that some tax and welfare systems are not realy well equipped to deal with inflation. In particular, fiscal systems do not normally allow for the indexation of tax rates and social security contributions to the inflation rate. In line with this, salary increases that are meant to compensate workers for inflationary developments could result in employees being subject to a higher tax rate, a phenomenon that is known as "cold progression".

In fact, many economists would agree with the idea that inflation can be interpreted as being equivalent to a hidden tax on holding cash. In other words, people who hold cash experience a decline in their real money balances and thus in their real financial wealth when the price level rises, just as if part of their money had been taxed away.

More generally, imflation can be seen as implying higher "shoe-leather costs" of inflation, because nflation implies more frequent visits to the bank (to withdraw money from interest paying accounts) and walking to the bank causes one's shoes to wear out more quickly. In the same vein, higher "menu costs" are implied as firms must change their prices more often in orde to keep up with the ongoing changes. "Menu costs" and "shoe leather costs" would even materialise if inflation were to be fuly and perfeclty anticipated.

Moreover, inflation has effects in savings and investment as the uncertainty about the future purchasing power of money makes the estimation of future revenues unpredictable. Furthermore, since it becomes hard, if not impossible to distinguish between changes in relative prices changes in the general price level, misallocations of resources will inevitably result. Finally, there is a high probability that effects on unemployment and the business cycle will materialise, an issue to which we will return in later chapters.

5.4 Measuring inflation

How is inflation measured? When economists try to quantify the rate of inflation, they generally focus on a small number of price indices. The two most popular indicators are the Producer Price Index (PPI) and the Consumer Price Index (CPI).

The PPI generally measures changes in prices paid to producers, mostly from retailers, for their output. In line with this, the producer price index mainly reflects the costs, producers have to incur for their raw materials. Higher costs can then, in principle, be passed on to consumers or they could be absorbed in the form of smaller profits, Against this background, the PPI picks up price trends relatively early in the inflation cycle.

The indicator that is more generally used to depict movements in prices is the CPI. The CPI is based on monthly survey that analyses price changes for a basket of goods which is somehow representative for the average consumer in an economy. This basket does not only include items which consumers buy on a day-to-day basis (e.g. bread and fruit), but also purchases of durable goods (e.g. cars, PCs, washing machines, etc.) and frequent transactions (e.g. rents). The costs of this basket are then compared over time, thus rendering a time series for the price index. The annual rate of inflation can then be calculated by expressing the change in the costs of the market basket today as a percentage of the costs of the identical basket the previous year.

Finally, the Gross Domestic Product Deflator (GDP Deflator) represents a broad measure of inflation reflecting price changes for goods and services produced by the overall economy. In contrast to the CPI and the PPI, which are calculated on a monthly basis, the GDP deflator is reported only at a quarterly frequency in conjunction with the figures for the Gross Domestic Product.

5.5 Core and non-core inflation

The fact that headline inflation rates are driven by a variety of determinants at different frequencies has also given rise to another important distinction, namely the one between "core inflation" and "non-core inflation". The expression "core inflation" refers to that part of inflation that is caused by developments in fundamental factors, such as, for instance, the interaction of aggregate supply and demand, or the external environment as reflected in exchange rates and international commodity prices. By contrast, the term "non-core inflation" reflects the influence of factors other than fundamentals, such as, for instance, the influence of a rise in administered prices (for instance, an increase in VAT) or the element of "food price inflation" (caused for instance by crop diseases), which can by their very nature be considered as being very volatile.

It is often claimed that core inflation measures can be a very useful guide for monetary policy decision-makers as the headline inflation measures are often blurred by the noise coming from the aforementioned volatilities. In fact, there is not much can be said against the construction and use of such an indicator.

5.6 Measurement problems

As we have just seen, measuring inflation is, in practice, equivalent to quantifying the changes in the price of a large basket of representative goods and services, For various reasons, there are some difficulties associated with any attempt to express the overall change in prices as one number.

For instance, as time goes by, the basket has to be modified, be it with respect to the relative weights of the goods in the basket, or be it that goods and services existing at present have to be put into comparison with goods and services from the past. It is intuitively clear an existing basket usually becomes less and less representative over time as consumers increasingly substitute more expensive goods for cheaper ones.

Moreover, changes in quality are sometimes not easy to incorporate into the price index. If the quality of a product improves over time and the price also rises, not all of the price increase can be preceived as being negative. In particular, price increases which are due to quality changes cannot be considered as giving rise to inflation, as they do not reduce the purchasing power of money.

Finally, the inclusion of new products poses an additional challenge, as there is the question of when and how to best invorporate them in price statistics.

🕮 Key concepts

Inflation, deflation, measurement of inflation, measurement problems, core inflation and non-core inflation, "cold progression", "shoe-leather costs", "menu costs", effects of inflation.

☑ Questions for review

- What is the meaning of the terms "inflation" and "deflation"?
- How can inflation be measured? Which problems do arise?
- What is at the root of the concept of "core inflation"?
- What is the essence of the term "cold progression"?
- What are the effects of inflation? Can they be regarded as being linear in nature?

6 Causes of inflation

6.1 Learning objectives

This chapter aims at providing some more detailed analysis of the causes of inflation. It also outlines a number of existing theoretical approaches and reviews some empirical evidence.

6.2 The Quantity Theory

But what can central banks do about inflation?? After all, the mandate of the Eurosystem (and many other central banks) was to maintain price stability. It is, however, obvious from the previous considerations that it is impossible to directly control such a process. In order to answer this question, a closer look into the causes of inflation is warranted. Our review basically shows that monetary policy is a key factor in determining the rate of inflation in an economy.

A first key concept that describes the link between money and prices is the "quantity theory", which provides us with a rather clear and transpaernt framework for the analysis of the links between money and prices. The starting point is the so-called "quantity equation" – which is basically an identity – and states that:[57]

$$M \cdot V = P \cdot TR \tag{6.2.1}$$

where *M* represents the money stock, *TR* the volume of real transactions in an economy, *P* the price level and *V* the (transactions) velocity of circulation. The unknown transactions variable is in practice usually replaced by a measure of real income (Y^r), leading to:

$$V = (P \cdot Y^r) / M \tag{6.2.2}$$

Velocity is thus defined as the ratio of the current value of total nominal transactions to the stock of money. Or, more precisely, velocity can be defined as the frequency with which money is transferred between different money holders and reflects the stock of money required to service a particular level of nominal transactions. Rearranging and writing this expression in terms of growth rates yields:

$$\Delta M = \Delta Y^r + \Delta P - \Delta V \tag{6.2.3}$$

According to this identity, the change in the money stock in an economy equals the growth of nominal transactions (approximated by the change in real GDP plus the change in the price level) minus the change in velocity. To draw economic conclusions, however, further assumptions about the variables involved in this identity have to be made.

Following common economic knowledge, in the long run real income is viewed as being determined by supply-side factors. Velocity can be expected to be related to a small number of explanatory variables, where the relationship is stable or, at least, predictable. Finally, the quantity of money in an economy is assumed to be determined independently of the other three variables as it is determined by the central bank.

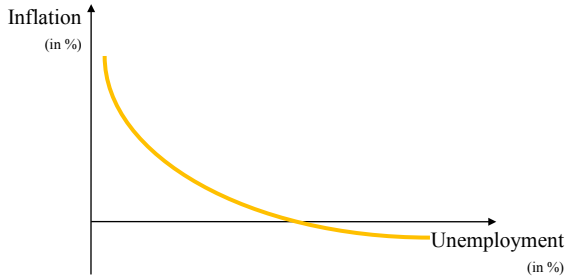
These assumptions allow the identity to be transformed into the "quantity theory of money", which implies a stable relationship between the money stock and the price level. One implication of this – the so-called "neutrality" of money – states that changes in the money supply will in the long run lead to changes in nominal but not in real variables. An even stronger concept is the one of "superneutrality of money", which postulates that not only the level of the money supply but also the rate of money supply growth translates into price pressures.

If "neutrality of money" holds, changes in the money supply will have no long-run effect on real output or employment. Furthermore, prolonged periods of monetary growth in excess of the amount needed to finance an economy's growth potential eventually result in inflation. It is obvious that the behaviour of velocity is of crucial importance for central banks as changes in this variable directly affect the link between money and prices.

6.3 The Phillips Curve

In 1958, the New Zealand economist Arthur W. Phillips presented the results of a study that had investigated the relationship between the change in wages and unemployment for the United Kingdom over a period of 1861 to 1957.[58] For the period under investigation, he found an inverse non-linear relationship between the two variables. In 1960, however, the US economists Paul Samuelson and Robert Solow took Phillips' results up and reformulated them in a way that allowed for a more explicit link between inflation and unemployment.[59] Assuming the stability of the latter relationship, it could be argued that a government or a central bank could not fight inflation and unemployment at the same time. They could either tolerate a reasonably high rate of inflation and achieve a lower unemployment rate or they could fight inflation at the expense of a higher unemployment.

Chart: Phillips Curve



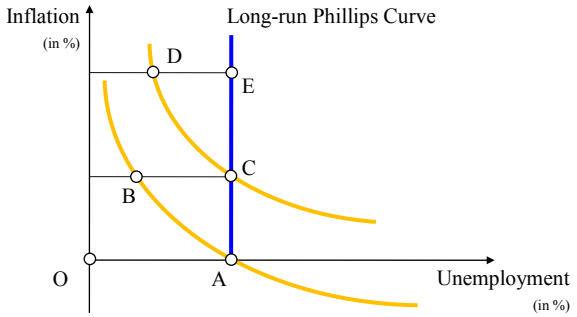
Source: Own illustration.

How does the mechanism exactly work? For instance, monetary policy or fiscal policy could be used to stimulate the economy, thus raising gross domestic product and lowering the unemployment rate. The related move along the Phillips curve would lead to a higher inflation rate, the cost of enjoying lower unemployment rates. In this context, the government or the central bank would face a trade-off between inflation and unemployment and, consequently, a need to prioritize. At the same time, the government or the central bank could select from a "menu of choice" its preferred option but would, of course, have to pay a price.

In the course of the 1970s, however, many countries started to experience high levels of both inflation and unemployment at the same time; a phenomenon that became widely known as the so-called "stagflation". The latter outcome was hard to explain in terms of the Phillips curve and, as a consequence, the concept came under heavy attack from a group of economists headed by Milton Friedman and Edmund Phelps.[60] Following their work, the idea that there was a simple, predictable, and persistent relationship between inflation and unemployment was abandoned by most if not all macroeconomists.

To begin with, Friedman and Phelps started from the assumption of a "natural rate of unemployment", a rate that can be seen as consistent with a stable inflation rate. Now suppose that policy-makers face an inflation-unemployment rate trade-off marked by the initial curve below. They will then decide in favour of an expansionary policy and, therefore, move the economy from point A to point B, thus reducing the unemployment rate. But in point B inflation has risen and workers that do not suffer from "money illusion" will realise that their real wages have decreased.[61] Following this, they will adjust their expectations and ask for compensation in form of higher nominal wages.[62]

Chart: Short-run and long-run Phillips Curve



Source: Own illustration.

Assuming that they have sufficient bargaining power, their nominal wages will increase and the initial real wages will be restored. As a consequence, however, firms will demand less labour when facing higher real wages and thus the economy will move to point C. Another round of expansionary policy might follow and, in the end, leave the economy in point E. Therefore, any reduction in unemployment below the "natural rate of unemployment" will be temporary and lead only to higher inflation in the long run. In essence, higher employment effects are just temporary.[63]

Expressed in other terms, there is a need to distinguish between the short-term Phillips curve and the long-term one, where the long-run Phillips curve is vertical. In the long run, only a single rate of unemployment is consistent with a stable inflation rate. In line with this, in the long run, there is no trade-off between inflation and unemployment.

Some economists prefer to substitute the "natural rate of unemployment" with the expression "non-accelerating inflation rate of unemployment" ("NAIRU"). The logic of the latter expression is caused by the observation that an actual unemployment rate below the natural rate will often lead to an acceleration of inflation, while with unemployment above the natural rate, inflation generally decelerates. With the actual rate equal to it, inflation is stable, neither accelerating nor decelerating.

6.4 The P-Star Approach

In two seminal contributions, the US-economists J.J. Hallman, R.D. Porter and D.H. Small have laid down their own re-interpretation of the quantity theory and – at the same time – developed a meanwhile very popular indicator of inflationary pressures.[64] The starting point is the well-known quantity theory:

$$P \cdot Y^r = M \cdot V \tag{6.4.1}$$

When recurring on the level of potential real GDP and the equilibrium level of velocity, the equilibrium price level can be defined as:

$$P^* \cdot Y^{r,*} = M \cdot V^* \qquad \text{or, equivalently,} \qquad P^* = \frac{M \cdot V^*}{Y^{r,*}} \tag{6.4.2}$$

And similar considerations for the quantity theory result in:

$$P \cdot Y^r = M \cdot V \qquad \text{or, equivalently,} \qquad P = \frac{M \cdot V}{Y^r} \tag{6.4.3}$$

Dividing and re-arranging then yields:

$$\frac{P^*}{P} = \frac{\frac{M \cdot V^*}{Y^{r,*}}}{\frac{M \cdot V}{}} = \frac{M \cdot V^*}{Y^{r,*}} \cdot \frac{Y^r}{M \cdot V} = \frac{M}{M} \cdot \frac{V^*}{V} \cdot \frac{Y^r}{Y^{r,*}} \tag{6.4.4}$$

Letting lower case letters denote logarithms, it then follows:

$$p^* - p = (v^* - v) + (y - y^*) \tag{6.4.5}$$

The left-hand side of this equation is then often labelled as the so-called "price gap". The first term on the right-hand side then represents the so-called "velocity gap", which in turn expresses the liquidity overhang or shortfall in an economy. The second term stands for a measure of the so-called "output gap". The P-Star model has become quite popular as it expresses the price situation in a country in close connection with its two main driving forces, namely the business cycle situation and the liquidity situation in a very elegant way.[65]

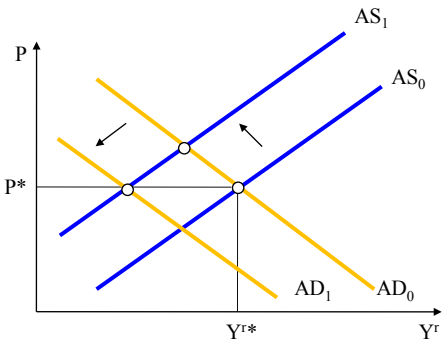
6.5 The aggregate supply and demand models

Another widely accepted model, namely the standard macroeconomic model of aggregate supply and demand, offers additional interesting insights into the sources and implications of the inflationary process. According to this model, inflation can be caused by various factors, namely first, by pressures from the supply side (i.e. "cost-push inflation") and, second, by pressures from the demand side (i.e. "demand-pull inflation"). Cost-push inflation can, for instance, arise from all kinds of negative supply shocks, such as, for instance, an increase in administered prices or an increase in oil prices.[66]

Factors contributing to demand-pull inflation include, for instance, a high demand for goods and services relative to their availability or a too expansionary monetary policy. In a broader economic context, the first condition can, for instance, be illustrated by real output exceeding potential output.

A third factor impacting on inflation figures, that has not been mentioned very prominently so far, consists of inflation expectations. Suppose, the private sector has, for whatever reason, taken the view that future inflation will be higher than today's inflation. To the extent that these forward-looking expectations feed into the price-setting behavior of producers and into the wage negotiations of households, it might very well be that this behaviour ultimately leads to inflation, i.e. the expectations become self-fulfilling. It is not by accident that central banks have started communicating to markets in a very active way their view of the future thus starting "to manage" inflation expectations.

Chart: Cost-push inflation and central bank reaction

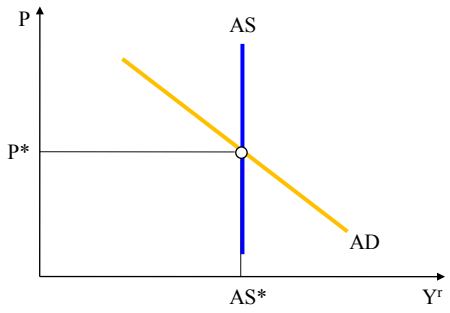


Source: Own illustration.

Does it make a difference for a central bank, whether inflation originates from the supply or the demand side? Yes, indeed. Let us suppose that the shock originates from the supply side, making the aggregate supply curve shifting to the left. In the new equilibrium, prices have risen and real income has fallen, compared to the original level. Assume further, that the central bank is not willing to accept this situation and, therefore, initiates a restrictive monetary policy. As a consequence, the aggregate demand curve shifts to the left until the original price level has been restored. But this has been achieved at at the cost of a further decline in real income. The central bank has, therefore, worsened the real economic situation. It is easy to verfy that this does not apply in case of a shocks ocurring on the demand side.

From a long-run perspective, however, it can be shown that employment and production are independent from price developments. This would imply that the long-run aggregate supply curve is vertical. The model then illustrates that the behaviour of aggregate demand plays a crucial role for the general price level an economy is experiencing in the long run. If the aggregate supply curve is vertical, then changes in aggregate demand affect prices, but not real output in the long run. If, for instance, money supply were to increase, the aggregate demand curve would shift rightwards and the economy would thus – in the long-run – shift to a new equilibrium where real production has remained the same but prices have risen.

Chart: Aggregate demand and long-run aggregate supply



Source: Own illustration.

Now recall that inflation was defined as a "sustained increase in the general level of prices". This would ask for a permanent upward shift in the aggregate demand curve. So, obviously, inflation must be ultimately caused by a demand factor that shows a permanent increase over time. But consumption, investment or budget deficits cannot rise forever. The latter fact leads many economists to believe, that, ultimately, inflation can only be caused by a permanent increase in the money supply.

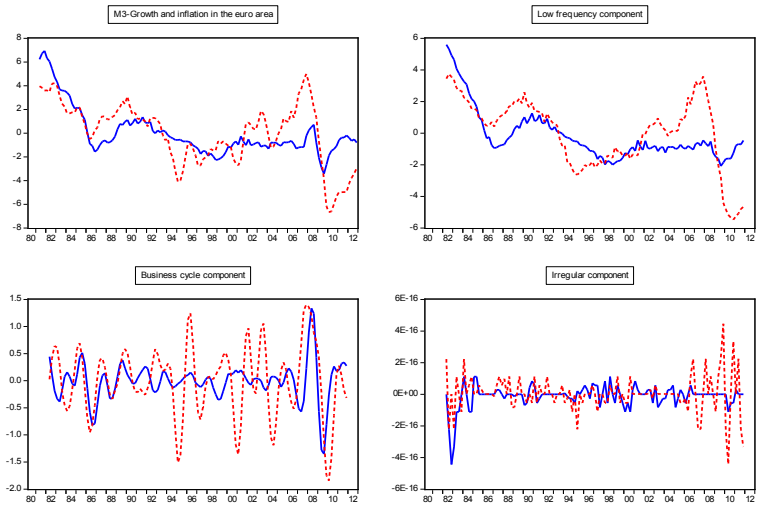
6.6 The frequency decomposition approach

The aforementioned considerations, however, neglect one important aspect, namely the fact that the effects of the various determinants of inflation will unfold over different frequencies. One way to illustrate this, is by use of statistical filtering techniques, namely the so-called "frequency domain techniques".[67]

A simple illustration of these relationships would then start from the decomposition of observed inflation over the past thirty years into three components: the low frequency component (defined as those movements in inflation with a periodicity of more than 8 years); the business cycle component (defined as movements with a periodicity of more than 2 years, but less than 8 years) and the higher frequency component (defined as movements with a periodicity of less than 2 years).[68]

When confronting the results with the ones of similar exercise for money, it can be shown that developments in the low frequency component of euro area M3 growth tend to lead developments in euro areanflation by about 2–3 years. This component of M3 growth is thus a very useful leading indicator of inflation.

Chart: Frequency decomposition of money and inflation
(Source: own calculations, euro area data)



Source: Own calculatiions, euro area data.

The latter property of course constitutes a very attractive feature that coincides – as will be shown in later paragraphs in more detail – with the results of other studies using alternative empirical methods for the euro area. At the same time, the charts illustrate that the relationship between monetary and price dynamics at the business cycle frequency is more complex. Finally, at an even higher frequency both series seem to contain also a lot of "noise".

6.7 Role and limitations of monetary policy

What are the implications of these models? What can a central bank do and where are its limits? In his well-known Presidential Address to the American Economic Association, the famous US-economist Milton Friedman summarised his views about the role and limitations of monetary policy. In essence, monetary policy cannot be used to produce real goods and services or to create employment. Furthermore, it cannot peg either the real interest rate or the unemployment rate. Rather, monetary policy can create an environment in which the economy will operate most efficiently. Ignoring this contribution, as central banks have done at times in the past, can have disastrous consequences.[69]

More particularly, the current wisdom amongst academics and practitioners of central banking can be summarised as follows:[70]

- There is no permanent trade-off between inflation and unemployment.
- High and unstable inflation hurts growth, so it makes sense to pursue price stability, usually understood as a low and stable rate of inflation.
- The best way to achieve this objective is to delegate the task to the central bank.
- Further efficiency gains are obtained when the commitment to price stability is made credible, typically by a law that give the central bank independence.
- There is a trade-off between the variances of inflation and unemployment.
- In going about its task, a central bank can benefit from sophisticated statistical analyses of how the economy behaves in a variety of circumstances, including in response to changes in the monetary stance.
- Issues of financial stability are best handled by the prudential supervision of banks and other intermediaries, not by monetary policy.

6.8 Empirical evidence for the euro area

Unravelling the evidence of the linkages between money, prices and real GDP is not an easy task.[71] This notwithstanding, it is an essential task, as the relationship between interest rates, money, real income and ultimately prices forms an integral part of the transmission mechanism and, therefore, inevitably stands at the heart of monetary analysis policy. The dynamics, strength and timing of the effects of changes in policy interest rates on these variables are key questions for any central bank. When trying to quantify these effects, various econometric methods have been used, including Vector Autoregressive models (VAR models), small structural models and large macro-econometric models. This section aims at presenting quantitative evidence on the interplay between interest rates, money, real GDP and prices in the euro area by making use of such VAR models.[72]

VAR models have become very popular in empirical economics and also in the analysis of monetary policy effects. The general representation of such a model is as follows:

$$Y_t = A + B Y_{t-1} + C(L)X_t + \varepsilon_t \quad (6.8.1)$$

where Y_t is a vector of several (euro area) variables measured over the same sample period (t = 1, .., T), A is a vector of absolute terms, B is a vector of autoregressive coefficients, C is a vector of exogenous variables and ε is a vector of error terms. The vector X is included to allow for a contemporaneous influence of exogenous variables such as, for instance, oil prices. This specification implicitly assumes that there is no feedback from the euro area to the exogenous variables. In line with these considerations, a standard VAR widely used in the literature would read as follows:

$$Y_t = A + B Y_{t-1} + C(L)X_t + \varepsilon_t \quad (6.8.2)$$

$$Y'_t = [s_t \quad yr_t \quad p_t] \quad (6.8.3)$$

$$X'_t = [oilp_t] \quad (6.8.4)$$

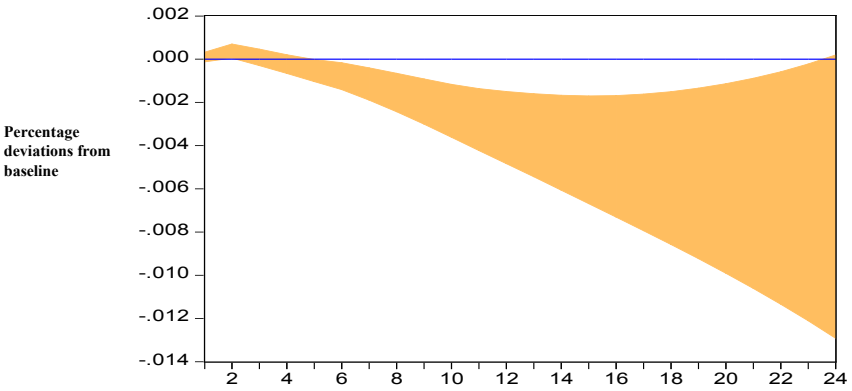
where *s* stands for a short-term interest rate, *p*, *yr* and *oilp* stand for a consumer price index, real GDP and the oil price, respectively. The small letters – with the exception of the interest rate – would denote logarithms. In such a framework, monetary policy effects have often been described in terms of reactions of the other variables in the system to a unexpected rise (i.e. a "shock") in short-term interest rates. Given that the VAR system attempts to mirror the historical behaviour of the date, a contractionary monetary policy shock is then defined as a positive deviation of the interest rate from the average reaction function of the central bank for the sample period.

The dynamic response pattern of the reactions of the other variables to a shock are then often illustrated in terms of the so-called "impulse response functions". The basic reason why the impulse response analysis of the effects of monetary policy focuses on the impact of the unsystematic shock to short-term interest rates is that this approach addresses the so-called "identification problem". In essence, the transmission mechanism describes how a change in monetary policy affects other macroeconomic variables (in particular, prices), other things equal. If monetary policy changes because of a shock to output or prices (as emphasised, for instance, in the literature on "reaction functions" of central banks), it is often not possible to separate the impact of monetary policy on other variables from the impact of the initial shock. Only the unsystematic part of monetary policy is (by definition) identified separately from developments in other variables and thus allows the transmission mechanism itself to be traced out.

The underlying system includes as key variables the euro area HICP, real GDP, nominal M3 and a short-term nominal interest rate. In addition a linear trend, a commodity price index and an oil price index were used as exogenous explanatory variables.[73] The linear trend allows trend long-term growth and the prolonged disinflation over the sample to be controlled for. Since the focus of this box is on the long-run relationships between the variables, a VAR in levels is estimated and solved for its dynamic responses. As is quite common in the literature, the three-month interest rate is chosen as the policy variable. The charts below then illustrates the reaction of (euro area) real GDP and the (euro area) HICP in response to a transitory (i.e. one-off) shock in the interest rate by 100 basis points and the respective 65% confidence interval. The reactions of the variables included in the system are then shown for a time horizon of 24 quarters.

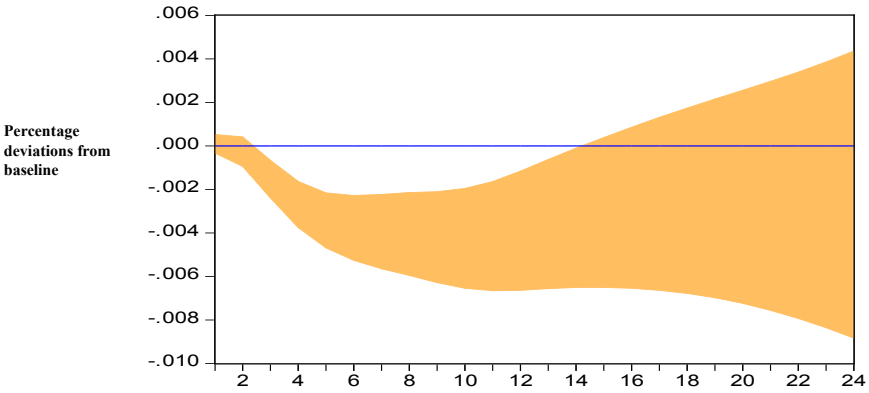
Expressed in non-technical terms, the exercise described above will then cause an upward movement in the interest rate response by 1 percentage point (i.e. 100 basis points) reflecting the exogenous shock. The subsequent movements in the selected variables are then endogenous i.e. caused by the reactions of the variables in the system and the lagged values of the interest rate.

Chart: Reaction of price level



Source: Own calculations, euro area data.

Chart: Reaction of real GDP



Source: Own calculations, euro area data.

According to the results, the increase in the short rate by 100 basis points leads to an immediate decline in real income, reaching its trough after six quarters. After 24 quarters, however, the effect seems to have faded away, pointing towards long-run neutrality of money. Moreover, the rise in the short-term interest rate is followed by a significant decline in decline in the HICP. Taken together, these results are absolutely in line with theoretical considerations.

📖 Key concepts

Monetary policy strategies, monetary targeting, exchange rate targeting, inflation targeting, price level targeting, two-pillar strategy of the ECB, functions of money, forms of money, Phillips curve, quantity theory, P-Star model, frequency decomposition, role and limitations of monetary policy, empirical evidence for the euro area.

☑ Questions for review

- Which key monetary policy strategies do you know?
- What are the three basic functions of money? Which forms of money do you know?
- Which models explaining the relationship between money and prices do you know? What are their assumptions and key results?
- What can be said about the euro area evidence?

7 Monetary policy strategies

7.1 Learning objectives

In this chapter, we consider possible indicators and intermediate targets of monetary policy and discuss various monetary policy strategies used in practice. We then explain the monetary policy strategy of the European Central Bank in more detail before we consider the nature of money and its key properties.

7.2 Intermediate targets and indicators

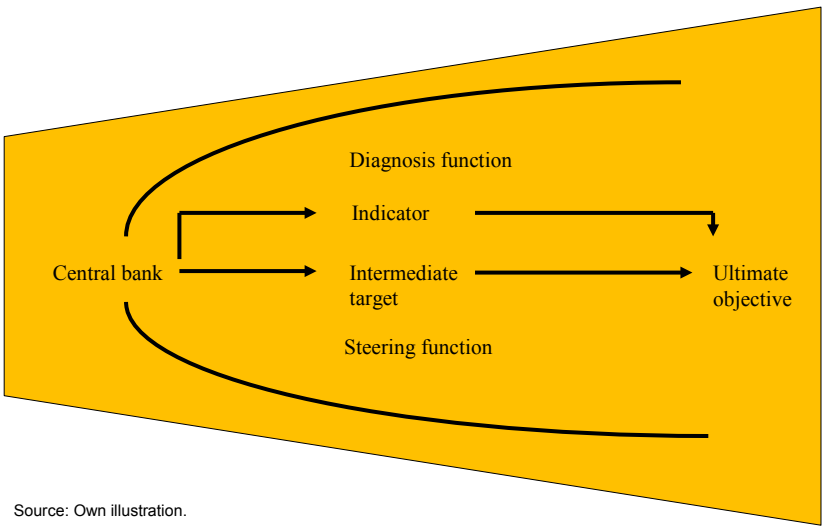
One of the main problems in actual monetary policy consists of the fact that the ultimate objectives of monetary policy that are often laid down more precisely in the mandate of central banks are not under direct control of the central bank. Moreover, as we will see in later chapters in more detail, the process of monetary policy transmission takes time, is subject to long and variable lags and, moreover, to considerable uncertainties (as illustrated in the chart below by means of the widening confidence band).

This raises immediately the question what a central bank can do against an unsatisfactory development in form of a high inflation rate in the same month. The answer is, however, very disappointing from an economic perspective, since there is nothing a central bank can do against an unsatisfactory development in today's inflation – it will be too late. The central bank can only influence tomorrow's inflation rate.[74]

The fact that monetary policy actions can take a significant amount of time to work their way through the system has led most central banks to search for and to finally find an alternative solution. If a variable can be found that, first, has a close relationship (or, technically speaking, a high correlation) with the ultimate objective of monetary policy and, second, can be controlled by the central bank with a sufficient degree of precision, then the central bank could base its monetary policy actions towards the behaviour of this so-called "intermediate target", thus saving valuable time.[75]

In addition, in order to determine whether its actions are rather restrictive or rather expansive and, if so, to what extent, the central bank might want to make use of monetary indicators. The latter help to assess the direction and strength of the monetary policy stance and this are of invaluable help for the decision-makers in central banks. Among the latter, especially various types of interest rates have proven to be very popular.

Chart: Intermediate targets and indicators



Source: Own illustration.

7.3 Monetary policy strategies

The more medium-term procedure selected by a central bank to ensure the achievement of the final objectives of monetary policy via the appropriate use of the available monetary policy instruments is often described as the "monetary policy strategy" of the central bank.[76] The three strategies commonly referred to in the literature are exchange rate targeting (ERT), monetary targeting (MT) and inflation targeting (IT).[77]

Exchange rate targeting is a strategy that has often successfully been followed by many countries, among them the so-called "small open economies" ("SMOPECs"), but also by countries that have been subject to some kind of exchange rate constraints. In reality, this strategy can take many forms, such as, for instance, the establishment of a fixed exchange rate regime or of a crawling target or peg, in which the currency is foreseen to depreciate at a steady rate.

A strategy of exchange rate targeting can claim a number of advantages. In fact, among other reasons, the stabilisation of the exchange rate can prove very useful as it allows via the stabilisation of the prices of imported goods for a stabilisation of the overall price level. Similarly, those countries can import the price stability of the "anchor country" and thus gain credibility and an anchoring of inflation expectations to the ones of the anchor country. Finally, it is a very simple and easy-to-understand strategy.

However, this strategy does not only go hand in hand with a complete loss of control over domestic monetary policy, but it also implies that instabilities in the anchor country can be imported, thus leading to a higher volatility in output and prices. Moreover, such an exchange rate target might – under certain circumstances – also be tested by the markets and, thus, be subject to speculative attacks.[78]

A second strategy that has in the past been very popular is monetary targeting. A monetary targeting strategy focuses on controlling inflation by use of pre-announced monetary aggregates as intermediate targets. Such a strategy rests in essence on three conditions. First, there must be a close relationship (i.e. in a technical sense, a high correlation) between money and prices. Second, monetary developments must be in some sense controllable by the central bank. Third, the strategy must be combined with more or less flexible exchange rates, since else there is the danger that the central bank loses control over the process of money creation.

It is obvious that, if just one of the aforementioned conditions is not fulfilled, then either the monetary signal is blurred or the control of the central bank over monetary developments gets lost. This has, for instance, been the case, when financial innovation tended to weaken the link between money and prices mainly in some anglo-saxon countries.[79]

It is fair to say, however, that the monetary targeting implemented by central banks in reality has never been similar to the one advocated at the time by the famous US economist and nobel prize winner Milton Friedman (1912–2006), who had argued heavily in favour of a constant growth rate of money irrespective of the state of the economy. In reality, central banks have always used a more flexible version of monetary targeting or, in other words, a kind of "pragmatic monetarism".

In this context, it is also worth noting that the apparent instabilities in the money demand functions observed for a variety of countries have often been explained in the sense that a previously stable money demand function might prove unstable, when a monetary authority attempts to use a stable relationship for monetary targeting (so-called "Goodhart's Law).[80] This popular view has been challenged by the former Bundesbank and ECB chief economist Otmar Issing who argued that the estimated money demand functions also contain elements of the money supply process, the effect being that a stable money demand function could possibly be "contaminated" by an unstable money supply process. More broadly, Issing claimed that a credible and reliable monetary policy process might strengthen the stability of the financial system and vice versa (so-called "Issing's Law").[81]

Inflation targeting is a relatively new and quite popular approach in central banking. Although it is sometimes reported in a different way in the literature, it was originally rather a compromise solution rather than a theoretically superior solution. Inflation targeting is a monetary policy strategy that involves five main elements: (1) the public announcement of medium-term numerical targets for inflation; (2) an institutional commitment to price stability as the primary goal of monetary policy, to which other goals are subordinated; (3) an information-inclusive strategy in which many variables, and not just monetary aggregates or the exchange rate, are used for deciding the setting of policy instruments; (4) a transparent monetary policy strategy that ascribes a central role to communicating to the public and the markets the plans, objectives, and rationale for the decisions of the central bank; and (5) mechanisms that make the central bank accountable for attaining its inflation objectives.[82]

In essence, this approach focuses on the developments of the inflation forecasts in relation to a pre-announced inflation target (over a specific time horizon). A higher-than-foreseen inflation forecast would then lead to an increase in central bank interest rates and vice versa. The forecasts thus play a decisive role in policy-making as well as in the communication of the central bank.

The advantages of inflation targeting are obvious. The strategy works even if the basic stable relationships between money and prices are blurred and, nevertheless, allows to concentrate on domestic conditions (different from exchange rate targeting). It is also an easy-to-understand and easy-to-communicate strategy. Moreover, it focuses the political debate on what a central bank can do on a sustainable basis – i.e. to control inflation, rather on than what it cannot do, i.e. to raise output growth, lower unemployment, or increase external competitiveness. This, of course, requires a clear and unambiguous mandate for the central bank and a clear guidance, how to set priorities in case of conflicting goals.

☑ Inflation targeting countries and year of introduction

New Zealand (1990), Canada (1991), United Kingdom (1992), Sweden (1993), Finland (1993), Australia (1993), Spain (1995), Czech Republic (1997), Israel (1997), Poland (1998), Brazil (1999), Chile (1999), Colombia (1999), South Africa (2000), Thailand (2000), Corea (2001), Mexico (2001), Iceland (2001), Norway (2001), Hungary (2001), Peru (2002), Philippines (2002), Guatemala (2005), Slovakia (2005), Indonesia (2005), Romania (2005), Turkey (2006), Serbia (2006) and Ghana (2007).

Source: Roger (2009).

At the same time, disadvantages have to be mentioned. The implementation of a regime of inflation targeting places a high burden on communication and transparency. Starting with the Bank of England, central banks have been dealing with these challenges by publishing so-called "inflation reports" to present their views about the past and future performance of inflation and monetary policy. It is also obvious that inflation targeting is not a "silver bullet" in the sense that it does not guarantee success. The latter is due to the fact that monetary policy lags are by their very nature long, variable and uncertain. Therefore, the success of this strategy critically hinges on the quality of the inflation forecasts.

The strategy of price level targeting is very close to the one of inflation targeting with the crucial difference consisting of the fact that in the latter case, the central bank focuses on the rate of change in prices, whereas in the former case, the central bank makes an attempt to target the price level. Does that really make such a big difference? Indeed, while this does not sound too different at first glance, in practice this makes quite some difference. Suppose for instance, a government would increase the value-added tax (VAT) and this increase would feed through into the general price level. This will most probably cause a jump in the inflation rate in a particular month but afterwards, the inflation rate might remain stable again. In this case, an inflation-targeting central bank might be tempted to ignore the one-off jump and then concentrate on maintaining a stable inflation rate afterwards. The same would, however not hold, for a central bank adhering to price level targeting since the latter would need to take action in order to restore the original price level prevailing in the economy. Therefore a strategy of price level targeting is in fact a very ambitious strategy that has so far not been followed by any central bank in practice.[83]

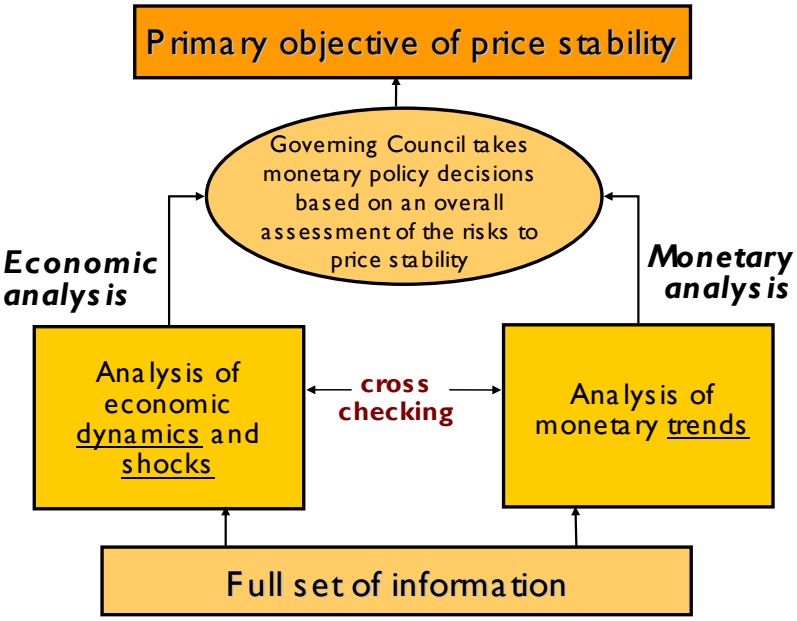
7.4 The monetary policy strategy of the ECB

While the ECB's approach contains a number of the aforementioned elements, it is in a way unique as it does not follow any of these strategies. In essence, the ECB's assessment of the risks to price stability rests on two complementary analytical perspectives, commonly referred to as the two "pillars".[84] The first perspective tries to identify the short to medium-term determinants of price developments, with a specific focus on real activity and financial conditions in the economy. This rests on the basic insight that price developments over those horizons are influenced largely by the interplay of supply and demand in the goods, services and factor markets. The ECB has labelled this perspective as the "economic analysis".[85]

By contrast, the second perspective aims at identifying the possible risks to price stability over medium-term to longer-term horizons. This pillar is generally referred to as the "monetary analysis", since by its very nature, it tries to reveal the signals that can be disclosed from long-run relationship between money and prices. In the view of the ECB, this serves mainly as a means of cross-checking, from a medium to long-term perspective, the short to medium-term indications for monetary policy coming from the economic analysis.

The choice of the ECB's monetary policy strategy has clearly to be seen against its background. Given the fact that, in the beginning of its term, the ECB was confronted with a considerable degree of uncertainty and a number of practical problems, it had to adopt a new and distinct monetary policy strategy of its own; a strategy that was designed to ensure that all relevant information is used and that appropriate attention is paid to different perspectives and the cross-checking of information.[86]

Chart: The ECB's Monetary Policy Strategy



Source: ECB (1999, modified 2003).

7.5 Definition and role of money

Money is a key feature in today's economic life. While, from a purely theoretical point of view, it remains unclear what exactly money is, economists often define that "money is what money does"[87] and, consequently, describe money in terms of the three main functions it provides, namely the function as a medium of exchange, as a store of value, and as a unit of account.

The most important function of money is clearly the function as a medium of exchange. If money did not exist, all transactions would need to be carried out by barter, that is via a direct exchange of goods. Suppose, for instance, a farmer who, for instance, wanted a haircut in exchange for some wheat would have to find a hairdresser willing to accept the wheat in exchange for a haircut. However, if the hairdresser needed a dress instead, he would have to wait until a tailor would be willing to get a haircut in exchange.

This illustrates one of the main difficulties of such a successful barter activity. In essence, a successful deal to be made would require at the same time the presence of a supplier and a demander, whereby the supplier has exactly the good the demander asks for (in the right amount, quality, colour etc.) on offer, while the demander has exactly the good the supplier wants to obtain, available.

Expressed in other words, in a barter system, exchange can only take place, if a "double coincidence of wants" between two transacting parties materialises. Such a constellation does not only place a high burden of information costs on all parties, but may also ask for the involvement of other goods as an interim solution. While, at first glance, the involvement of money further complicates the situation, in essence, it eliminates this double coincidence of wants, thus rendering the whole process much easier.

If money is able to maintain its value over time, it can – in addition – serve as a store of value. This has the additional advantage, that the act of purchasing and selling can be separated in terms of timing, thus allowing for savings and investment. It is obvious that some goods have a natural advantage as a store of value, namely those goods that are durable, not easily reproduced, relatively scarce easily transported and divisible.

Finally, money also serves as a unit of account, in the sense that it provides a common measure of the value of goods and services being exchanged. The latter function is due to the fact that, even if the difficulty of the double coincidence of wants is overcome, people would still have to find the exact exchange ratio between wheat bread and haircuts or between haircuts and shoes, for example. This "exchange ratio", namely the number of barrels of wheat worth one haircut, is called the "relative price" or "terms of trade". In the market place, the relative price would have to be set for each pair of goods and services and, of course, everybody involved in the exchange of goods would need all the information about the terms of trade between all goods.

It is easy to show that, for two goods, there is only one relative price, while for three goods there are just three relative prices (namely bread against haircuts, haircuts against shoes and bread against shoes). In the case of ten goods, however, there are already 45 relative prices, and with 100 goods the number of relative prices amounts to 4950.[88]

As a matter of fact, the greater the number of goods being exchanged, the more difficult it becomes to gather information on all possible "exchange rates". In other words: collecting information on these "terms of trade" involves substantial costs for the participants in a barter economy; i.e. costs that can be expected to increase disproportionately with the number of goods exchanged. The latter problem can, however, be mitigated if one of the existing goods serves as a unit of account (a so-called "numéraire"). In this case, the value of all goods can be expressed in terms of this "numéraire" and the number of prices which consumers have to identify and remember can be reduced significantly.

But where does the expression "money" come from? The English word "money" is actually of Roman origin. In ancient Rome, the word "Monetor" or "Moneta" described an advisor, i.e. a person who warns or who makes people remember. According to historians, the meaning of the word dates back to a rather dramatic key event in Roman history. During an invasion of a Gallic warband in 390 B.C., the Roman defenders had to retreat into a sanctuary of the Goddess Juno on Capitoline Hill. One night, the exhausted Roman guards fell asleep, not being aware that some Gaul warriors tried to assault the walls of the sanctuary with wooden ladders. However, a flock of geese squawked an alarm thus alerting the Roman defenders who could then fight back the attackers. In return, the Romans built a shrine to Moneta, the goddess who warns or who gives advice. In 289 B.C. the first Roman mint was built in or near this temple, initially producing bronze and later silver coins. Many of these coins were cast with the head of Juno Moneta on their face. Hence the words "money" and "mint" are derived from her name.[89]

From a historical perspective, it is fair to say, that a variety of goods have performed monetary functions. While in the beginning, trade was mainly carried out by barter, over time the so-called "commodity money" came into use.[90] A variety of items have served as commodity money, among them the wampum (beads made from shells) of the American Indians, cowries (brightly coloured shells) in India, whales' teeth in Fiji, cattle and salt in early Ireland, tobacco in the early colonies in North America, large stone disks on the Pacific Island of Yap and cigarettes and liquor in post-World War II Germany.

However, using commodities as money had other problems. Most of the goods used as commodity money were difficult to store or were perishable that is they were decaying in value over time. The introduction of metallic money was a way by which ancient societies tried to overcome these problems. While it is not known exactly when and where metallic money was used for the first time, it seems that it came into use in around 2000 B.C. in Asia.[91] Chunks or bars of gold and silver were used since they were easy to transport, did not decay and were more or less easily divisible. Moreover, it was possible to melt them in order to produce jewellery.

Europeans were among the first to develop standardised and certified metallic coins. After the Lydians had started to make coins around 700 B.C., the Greeks introduced silver coins around 700 B.C.; Aegina (595 B.C.), Athens (575 B.C.), and Corinth (570 B.C.) were the first Greek city-states to mint their own coins which at the same time also allowed for an easier comparison of costs. By contrast, the Chinese began using paper money around 800 A.D. and continued to do so for several hundred years. This paper money had no commodity value at all and represented money only by imperial decree (so-called "fiat money", i.e. money without intrinsic value). Paper money was most widespread in China around 1000 A.D., but it was abandoned around 1500 when Chinese society went into decline following the Mongol Conquest. [92]

The Italian city-states were the first to introduce certificates of indebtedness (so-called "obligations" or "bills of exchange") as a means of payment. To reduce the risk of being robbed on their journeys, merchants took these obligations with them. Debtor and lender were mentioned in the certificates, a payment date was fixed, and the amount of gold or silver noted. Soon, merchant bankers began to trade these obligations.

Obligations continued to be used mostly by Italian merchants, and the bi-metal scheme remained dominant until the Thirty Years' War. Due to the economic turmoil caused by the war, rulers such as the Swedish kings started to prefer paper money. This was subsequently introduced by the Bank of England in 1694 and the Banque Générale de France in 1716. The advent of paper fiat money in Europe marked the beginning of a new phase in the evolution of money. Fiat is the Latin word for "let it be done" which implies that this money was – and still is – given value only by a government decree. As a consequence, the responsibility for establishing and regulating the system of fiat money in a country remained with the governments, but other public or private institutions, such as central banks and the financial system, played an increasingly crucial role in the success of the national currency.

However, the evolution of money has not stopped. Nowadays, various forms of intangible money have emerged, among them so-called "electronic money" ("e-money"), or electronic means of payment, which first appeared in the 1990s. This kind of money can be used to pay for goods and services on the internet or using other electronic media. Upon receiving authorisation from the buyer for the payment to take place, the vendor contacts the issuing bank and is transferred to the funds. At present, there are various card-based electronic money schemes in Europe, generally operated by financial institutions.

It seems a well-established fact among historians that the expression "dollar" derives from the word "Thaler" (or "Taler"), which stands for a medieval silver coin from the city of Joachimsthal in Bohemia. By contrast, the origin of the "$" money sign seems to be less clear. Many historians trace the $ money sign to either the Mexican or Spanish "P's" for pesos, or piastres.[93]

🕮 Key concepts

Monetary policy strategies, monetary targeting, exchange rate targeting, inflation targeting, price level targeting, two-pillar strategy of the ECB, functions of money, forms of money,

☑ Questions for review

- Which key monetary policy strategies do you know?
- How can the ECB's monetary policy strategy be summarised?
- What are the three basic functions of money? Which forms of money do you know?

8 Financial markets

8.1 Learning objectives

In this chapter, we explain the functions of the financial system before we reflect in more detail upon direct and indirect finance. Finally, we take a closer look at various types of financial institutions.

8.2 Functions of the financial system

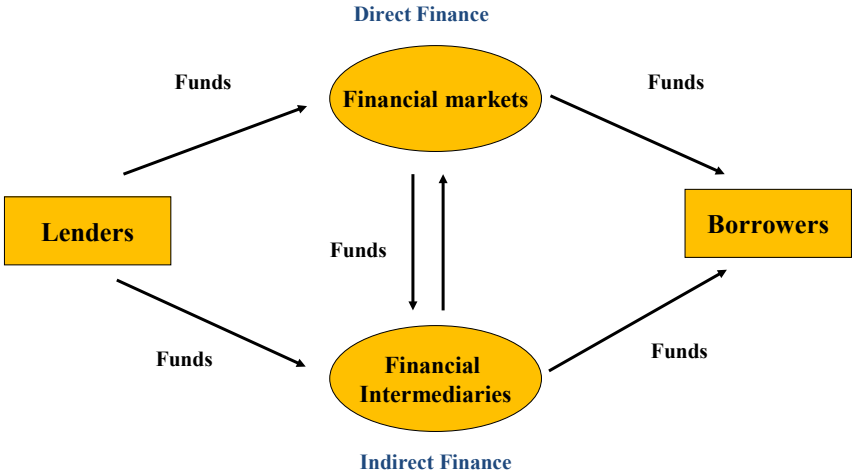
The financial system performs a vital function within the economic system. In essence, financial markets channel funds from those having a surplus to those, who are net spenders. In other words, the financial system allows net savers to lend funds to net borrowers. In a broad sense, therefore, the financial system enables individuals to exchange current against future income and to transform savings into investment, thus contributing to higher income, more employment and better living standards. The functions of the financial system are shown schematically in the chart below.

From a general perspective, it is mostly households that act as lenders, but occasionally, also firms and governments channel funds into the markets. Seen from an international point of view, also foreigners inject excess funds into the system. By contrast, typically firms and the government can be found on the borrowing side, but households and non-residents also sometimes borrow to finance their consumption or their real estate projects.[94]

In this context, it is worth noting that within this book, the expression "markets" is deliberately used in plural form. This is due to the fact that in most highly-developed countries, a variety of different markets do co-exist, each of them usually focusing on a somewhat different segment or type of financial instrument and also on different types of customers.

Against this background, it has proven useful, not least for didactical reasons, to classify markets according to several criteria, which basically illustrate the different essential features of these markets.[95]

Chart: Functions of the financial system



Source: Own illustration.

A first distinction refers to the difference between markets for physical and markets for financial assets. Physical assets comprise products such as, for instance, real estate property or commodities, whereas financial markets deal with instruments, such as bonds, stocks and so-called "derivatives".

Another distinction can be made with regard to the question whether the financial transaction relates to the first purchase of a new security that has never been issued before or rather represents a trade of a security previously issued. This is the difference between primary and secondary markets. Primary and secondary markets are usually closely interlinked. Primary markets are the markets in which, for instance, corporations raise new capital. It is worth noting that the corporation selling the newly created stock or going public receives the proceeds from the sale in a primary market transaction. By contrast, secondary markets are markets in which the existing, already outstanding securities are traded among investors. Unlike in the case of a primary markets transaction, the firm whose securities are being traded is not involved in this secondary market transaction and, thus, does no receive any funds from such a sale. This notwithstanding, the volume of trading in secondary markets is usually higher that in primary markets.

The secondary market can in principle be organised in two ways. One alternative is to rely on "organised exchanges", where buyers and sellers of securities meet in a central location or conduct trades via an electronic system (so-called "exchange-traded markets"). An alternative method of organising a secondary market is to have an over-the-counter (OTC) market, in which dealers at different locations stand ready to buy and sell securities over the counter.

A third possible classification relates to the original maturity of the financial contract. Generally, a distinction can be made between original maturities of less than one year and those of one year or more.[96] Accordingly, money markets and capital markets can be distinguished. Money markets are markets for short-term highly liquid debt securities. The money markets differ somewhat from other financial markets due to the fact that they are typically (wholesale) inter-bank markets where transactions are quite large. Moreover, central banks are able to influence the conditions on the money markets to a considerable degree by means of their monetary policy operations, the latter fact being due to the characteristic feature that central banks are the monopoly suppliers of central bank money and, by virtue of this monopoly, can set the refinancing conditions for credit institutions. This, in turn influences the conditions at which credit institutions and other money market participants transact in the money markets. By contrast, capital markets are the markets for intermediate or long-term debt and corporate stocks. The Frankfurt Stock Exchange ("Frankfurter Börse"), where (among other assets) the stocks of the largest German corporations are traded, is a prime example of a capital market.

A fourth distinction refers to the actual date of exchange. While in spot markets, assets are traded and delivered immediately (i.e. "on the spot", usually between one or two business days), in futures markets, the asset is bought or sold at some future date (i.e. for "future delivery"). The Chicago Mercantile Exchange, for instance, can be regarded as one of the biggest financial exchanges in the world specialized on futures (and options).

A final, commonly used classification relates to the form of the financial instrument (i.e. equity or debt market). The main distinction between equity and debt is that equity does not have to be repaid, whereas debt is a financial claim which usually does have to be repaid (in specific amounts and at a pre-defined interest rate). In reality, however, this distinction has become somehow blurred since a variety of mixed forms, such as, for instance, convertibles do exist.

Another important category of financial instruments that often receives considerable attention are derivatives, i.e. financial contracts whose value derives from underlying securities prices, interest rates, foreign exchange rates, market rates, market indices or commodity prices. The basic classes of derivatives are futures, options, swaps and forward rate agreements. For example, the holder of a call (put) option has the right, but not the obligation, to buy (sell) a financial instrument (e.g. a bond or share) at a given price at a specified time in the future. Many other derivative contracts have been developed by combining basic categories. Recently, a variety of structured products have become available to address specific needs that cannot be met by the basic products available in the markets. In principle, derivative markets assist the function of financial markets, because they improve the pricing and allocation of financial risk.

A number of other classifications could be made, but this preliminary breakdown seems sufficient to convey a first impression on the variety of financial markets. It should be noted, however, that the distinctions among financial markets are in reality often somehow blurred and, therefore, should not be taken at face value.

8.3 Direct and indirect finance

When taking an economic perspective, funds flow from lenders to borrowers via two routes. In "direct finance" or "market-based finance", debtors borrow funds directly from lenders in financial markets by selling specific financial instruments (such as, for instance, stocks or bonds) to them, without going through any type of financial institution. In essence, the business delivers its securities to savers, who in turn give the firm the money it needs.

If financial intermediaries are involved in the channelling of funds, an "indirect finance" or "bank-based finance" takes place. In this context, the intermediaries obtain funds from savers in exchange for their own securities. The intermediaries then use its money to purchase and then hold businesses' securities. For example, a saver might give his savings to a bank, receiving from it a certificate of deposit, and then the bank might lend the money to a small business, for instance in form of a mortgage loan. Thus, intermediaries literally create new forms of capital, thereby increasing the efficiency of the flow of funds and creating money and capital markets.

In modern financial systems, however, financial markets and financial intermediaries are strongly interlinked and funds can flow in both directions. A flow of funds from markets to banks would, for instance, materialise when financial intermediaries issue debt and equity securities to raise funds in order to finance their activities. If, by contrast, financial intermediaries purchase securities issued by governments and firms, a flow of funds from banks to markets could be recorded.[97]

8.4 Financial institutions

Today's highly-developed financial system can be characterised by the sometimes rather complex interplay of a variety of financial market participants. Besides the central bank, there are a number of other financial institutions being active in the market. In stark contrast to central banks, however, these are profit-seeking institutions in the sense that they all follow a specific business model that enables them to generate profits.

Perhaps the most important financial institutions are commercial banks. From an economic point of view, banks accept deposits from savers and grant loans to customers, such as households and firms. It is obvious that, in order to earn a profit, the interest rate paid on deposits has to be lower than the ones charged on loans.

Just like commercial banks, credit unions aim at granting credit but – as they are in a legal sense – member-owned financial cooperatives, they perform this service only for their members.

The business of investment banks differs significantly from the one of commercial banks. Investment banks offer a variety of services to their customers, among them underwriting of debt and equity offerings, acting as an intermediary between the issues of securities and the investing public, providing market-maker services, initiating mergers and other corporate reorganizations and acting as a broker for larger institutional clients. Generally speaking, investment banks are also subject to less regulation than commercial banks.

Insurance companies are institutions that insure their customers against certain risks, such as, for instance, accident, illness, or fire damages. They can provide such services, as they are able to forecast on the basis of statistical methods, how many customers will be subject to an accident at the same time, so by collecting premiums from a large number of clients, they can pool the risk and make the agreed payments at the same time.

Mutual funds are financial intermediaries that allow savers to invest into a diversified and professionally-managed portfolio of financial assets that might consist of stocks, bonds, mortgages or money market securities. In doing so, they allow private investors to build up portfolio diversification at relatively low costs.

As will be shown in later chapters in more detail, money market funds aim at holding high-quality short-term assets. In doing so, they have become very popular, as they provide savers with a valuable alternative to traditional commercial bank checking and savings accounts, which typically pay a lower rate of interest.

While there is no generally accepted definition of a "hedge fund", one could, in a very simplistic way, define it as a potentially highly-leveraged private investment vehicle that could follow a wide range of investment strategies with the aim of achieving high absolute rates of return.

📖 Key concepts

Borrowers, lenders, physical and financial markets, spot and futures markets, primary and secondary markets, debt and equity, derivatives, market-based and bank-based finance, financial institutions, commercial banks, investment banks, insurance corporations, mutual funds, money market funds, hedge funds.

☑ Questions for review

- What are the main functions of a financial system?
- What is the difference between physical and financial asset markets?
- What is the difference between spot and futures markets?
- What is the difference between primary and secondary markets?
- Which other classifications do you know?
- What is the difference between market-based and bank-based finance?
- Which financial institutions do you know?

9 Interest rates

9.1 Learning objectives

In this chapter, we first outline the present value and future value concepts. We then explain the determinants of interest rates in more detail before we proceed by analysing the determinants of the term structure.

9.2 Basic considerations

It is a basic economic principle, that the price system is the main driving force behind the allocation of resources. In line with this, interest rates decide about the allocation of the available capital within an economy and, therefore, play a key role in modern economics.[98]

In economic terms, the interest rate simply stands for a price charged to a borrower for the loan of capital. Interest rates are usually expressed in per cent per annum, but this is just by convention. Assume for instance, that a mortgage loan would cost an interest rate of 4 per cent per annum on €100.000 for one year. This is equivalent to saying that the borrower has promised to pay a fee of €4.000 (i.e. 4 per cent of €100.000) in return for the use of the loan for a year. This fee would, of course, need to be paid in addition to the repayment of the loan principal, which must occur at the end of the contract.

Finally, in order to take account of the fact that most interest rates change by only a fraction of a whole percentage point, it is quite common to rely on the concept of basis points. A basis point equals 1/100 of a percentage point; therefore for instance the decline in the key interest rate announced by the Governing Council of the European Central Bank on 5 July 2012 from 1.00% to 0.75% represents a decrease of a quarter of a percentage point or 25 basis points.

9.3 Present value and future value

Interest rates perform a number of important functions in an economy. Among other things, they serve the purpose of allocating capital, distributing income and, as we will see in later chapters in more detail, of stabilising the economy.[99]

Perhaps the most important function, however, lies in its ability to calculate present and future values. If someone offers you a hundred euros now or in ten years, what would you choose? It is easy to imagine that a hundred euros in hand are worth more than the same amount to be received at some future point in time. The latter is simply due to the fact that if you receive it now, you could invest it, earn a return and end up with more than a hundred euros in the future.[100] The process of deriving from today's value (or present value, *PV*) the final amount (or future value, *FV*) is called "compounding".

For the sake of simplicity, assume you would invest an amount of €100 for one year and earn 20 percent over this period. In this case, the future value can be calculated as follows:

$$FV_1 = PV \cdot (1+i) = 100 \cdot (1+0.20) = 120 \tag{9.3.1}$$

where *PV* stands for the initial amount (or present value) and *i* denotes the interest rate (i.e. 20 percent or, in decimals, 0.20). Finally, *FV* represents for the final amount (or future value). In line with the expression above, the future value (*FV*) at the end of one year equals the present value multiplied by one plus the interest rate. If, by contrast, the whole investment would last for two years, it would follow:

$$FV_2 = FV_1 \cdot (1+i) = PV \cdot (1+i)^2 = 100 \cdot (1+0.20)^2 = 144 \tag{9.3.2}$$

And in general, it follows for an investment of *n* years:

$$FV_n = PV \cdot (1+i)^n \tag{9.3.3}$$

which would – in our example – yield a future value of approximately €619 for an investment horizon of ten years.

The opposite process, namely the way of deriving the present value knowing the future value, is called "discounting" and it can simply be regarded as the reverse of compounding. To illustrate this, recall that our compounding equation was:

$$FV_n = PV \cdot (1+i)^n \tag{9.3.4}$$

Therefore, solving for the present value yields:

$$PV = \frac{FV_n}{(1+i)^n} \tag{9.3.5}$$

9.4 Determinants of interest rates

The nominal interest rate represents the rate that can be observed in the markets. In generic terms, it can be seen as consisting of a number of different components that reflect various underlying considerations. Following the literature, the nominal interest rate can be defined as:[101]

$$i = r + IP + DRP + LP + MRP \tag{9.4.1}$$

More specifically, the nominal interest rate (*i*) is composed of a real risk-free rate of interest (*r*) plus several premia that basically reflect inflation (*IP*), the riskiness of the security per se (*DRP*), the security's marketability or liquidity (*LP*) and the risk that is due to the maturity of the security (*MRP*).[102]

To begin with, the real risk-free rate of interest (*R*) can be seen as the interest rate that would exist on a risk-less security if no inflation were expected. Expressed in other words, the real rate would be equivalent to the inflation-adjusted risk-free market rate.

In order to protect themselves from the loss in purchasing power caused by inflation, investors will demand an inflation premium (*IP*) that compensates them for the expected average inflation rate over the life of the investment. Therefore, if the real risk-free rate of interest would be r = 2.5% and if inflation were expected to be 1.9% (and hence IP = 1.9% during the next year), then the nominal rate of interest on one-year government bond would be 2.5% + 1.9% = 4.4%. It is important to note that the inflation rate built into interest rates is based on expectations as regards the future inflation rate and not the rate experienced in the past.

Another component is meant to "insure" investors against the risk of non-payment, i.e. the risk that the borrower will default on a loan. Quite obviously, the higher the risk of non-payment, the higher the default risk premium (*DRP*) and, therefore, the interest rate charged.[103]

In case, an investor needs his money back at very short notice, he is interested in the ability to sell at "fair market value". In other words, it is of relevance for him, whether markets are rather "thin" or rather liquid. As a rule, markets for real assets are generally less liquid than markets for financial assets. Since liquidity is important from the point of view of an investor, interest rates usually include a liquidity premium (*LP*).

Finally, a maturity risk premium (*MRP*) covering for risks associated to changes in interest rates needs to be added. The latter relates to the fact that more years to maturity for a bond, the higher the risk that interest rates rise in the meantime, thus leading to a decrease in bond prices.

9.5 Determinants of the term structure

If interest rates for similar bonds embodying identical risk, liquidity and tax considerations but different maturities are depicted graphically, the so-called "yield curve" (for a given date) can be derived.

This yield curve can take various forms and shapes. The term structure can, in principle, be upward-sloping, horizontal or downward-sloping. In most cases, the term structure will be upward-sloping, but the opposite can also occur.

Broadly speaking, there are three theories of the term structure. The expectations theory of the term structure of interest rates, which in essence dates back to the work of the US economist Irving Fisher (1867–1947), postulates that the long-term interest rate is driven by the expectations vis-à-vis the behaviour of future short term interest rates (over the same horizon).[104] Starting from the assumption that bonds over various maturities can be seen as perfect substitutes, an investor has the choice to invest a given amount of money, say, twice successively into a one-year bond or once into a two year's bond. In the first case, the return R_{ST} would be:

$$R_{ST} = (1+i_{ST1}) \cdot (1+i_{ST2}^{e}) \tag{9.5.1}$$

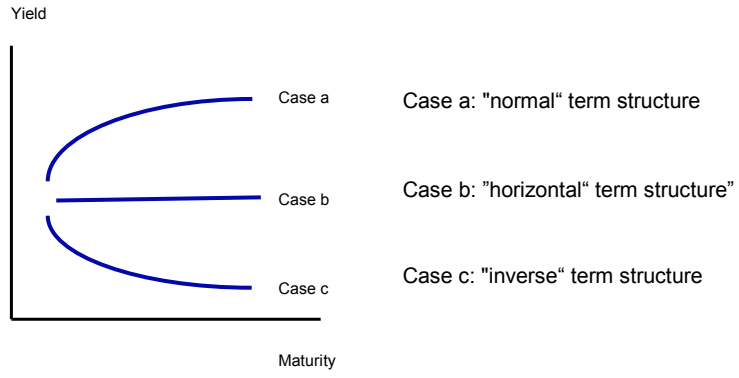
where i_{ST1} and i_{ST2} denote the (short-term) interest rates for the first year and the second year, respectively. In the second case, the return would be as follows:

$$R_{LT} = (1+i_{LT}) \cdot (1+i_{LT}) = (1+i_{LT})^2 \tag{9.5.2}$$

where i_{LT} stands for the (long-term) interest rate paid for the two-year bond. It is worth noting in this context, that the interest rate for the second year of the one-year bond is not known for sure, whereas the other interest rates are known with certainty. In equilibrium, the following condition would hold:

$$(1+i_{LT})^2 = (1+i_{ST1}) \cdot (1+i_{ST2}^{e}) \tag{9.5.3}$$

Chart: Stylised term structure
(in % p.a.)



Source: Own illustration.

And if markets are not in equilibrium, we would expect that arbitrage takes place, in the sense that investors sell the asset yielding the lower return (thus driving its price up) and buy the asset with the higher return (thus driving its price down), until the equilibrium has been re-established. It is rather straightforward to solve the last equation for the long-term interest rate:

$$i_{LT} = \left[(1+i_{ST1}) \cdot (1+i_{ST2}^{e})\right]^{1/2} - 1 \qquad (9.5.4)$$

which corresponds exactly to the geometric mean of the short-term interest rates minus one.

Suppose, for instance, the following situation would be given: the interest rate level would be at 5% and it would generally be expected that this level is going to prevail also for the second period. It then follows:

$$i_{LT} = [(1+i_{ST1}) \cdot (1+i_{ST2}^{e})]^{1/2} - 1 \qquad \text{or, equivalently,} \qquad (9.5.5)$$

$$i_{LT} = \sqrt{(1.05) \cdot (1.05)} - 1 = 0.05$$

If, by contrast, an increase in interest rates to seven per cent is expected, it follows:

$$i_{LT} = [(1+i_{ST1}) \cdot (1+i_{ST2}^{e})]^{1/2} - 1 \qquad (9.5.6)$$

$$i_{LT} = \sqrt{(1.05) \cdot (1.07)} - 1 = 0.06$$

The implications are rather straightforward: first an expected increase in short-term interest rates will lead to a parallel increase in long-term interest rates, albeit to a lesser extent, since the long-term rate represents only an average of expected short-term rates.

☑ The Fisher effect

The US-economist Irving Fisher (1867-1947) was among the first economists to closer investigate the exact relationship between the nominal interest rate (i), the real interest rate (r) and expected inflation (π^e). According to him, the following equations hold:

(i)	$(1+r)=(1+i)/(1+\pi^e)$	or, equivalently,
(ii)	$(1+r)\cdot(1+\pi^e)=(1+i)$	or, equivalently,
(iii)	$(1+r+\pi^e+r\cdot\pi^e)=(1+i)$	and, therefore,
(iv)	$i=r+\pi^e+r\cdot\pi^e$	

Assuming regular and rather small interest rate payments and a comparatively low inflation rate allows to ignore the last term in practice. The so-called "Fisher effect" then explains the level of the nominal interest rate in comparison to the real interest rate.

Source: Gerdesmeier (2011, p. 61).

Moreover, the different levels of the longer-term interest rates would reflect the prevailing expectations.

This theory is, therefore, able to explain why yields usually move in parallel. It also allows to easily calculate the long-term interest rate if both short-term rates are known. However, it somehow fails to explain the mostly positive shape of the yield curve since this observation would imply that investors generally expect raising interest rates. Moreover, uniform and certain expectations have to be assumed as well as an investor's behaviour that focuses only on return considerations and not on risk (i.e. investors are risk-neutral). Finally, the causality clearly runs from short-term to long-term interest rates.

The British economist Sir John Hicks (1904–1989) has added further extensions to the expectation theory. In his view, investors prefer short-term to long-term investments and are only willing to hold longer-term bonds if they are compensated for this by a premium, the so-called "term premium" or "liquidity premium". When the term premium is added to the equations derived above, it follows:

$$(1+i_{LT})^2 = (1+i_{ST1}) \cdot (1+i_{ST2}{}^e + TP) \quad \text{or, equivalently,} \tag{9.5.7}$$

$$i_{ST2}{}^e + TP = \left[(1+i_{LT})^2 / (1+i_{ST1}) \right] - 1 \tag{9.5.8}$$

It is obvious that now, even in case of expectations in favour of constant interest rates, the term structure must be upward-sloping due to the existence of the term premium.

A third theory is the so-called "market segmentation theory". This theory stipulates that different, "segmented" markets with no apparent interrelationship exist, on which interest rates determined according to supply and demand conditions. The latter conditions for each maturity segment then determine the shape of the yield curve.

📖 Key concepts

Interest rate, compounding, discounting, real risk-free rate of interest, nominal risk-free rate of interest, inflation premium, default-risk premium, liquidity premium, maturity premium, term structure of interest rates, slope of the term structure, expectations theory of the term structure, liquidity premium theory of the term structure, market segmentation theory of the term structure, Fisher effect.

☑ Questions for review

- What is the essence of an interest rate? How are interest rates measured?
- Please explain by means of an example the meaning of an inflation premium, a default-risk premium, a liquidity premium and a maturity-risk premium!
- What is the essence of the term structure of interest rates? How can its slope be explained?
- What are a "normal" and "inverted" yield curves and under which constellations regarding market expectations do they occur?
- What is the essence of the Fisher effect?

10 Money markets

10.1 Learning objectives

In this chapter, we first try to understand the key features of the money market. We then proceed by getting acquainted with some key interest rates worldwide.

10.2 Basic considerations

In an economic sense, the money market consists of the marker for short-term funds, usually with a maturity up to one year. In the same vein, the 'euro money market' denotes the market for euro-denominated short-term funds and related derivative instruments. It can be seen as one of the largest and most liquid money markets in the world.[105]

Among the market participants, mostly banks, investment funds and other financial intermediaries (such as investment funds other than money market funds), insurance companies and pension funds as well as large non-financial corporations can be found. Credit institutions (i.e. banks) play a particularly important role in this market which is due to the need to manage their short-term liquidity positions and – as we will see in later chapters in more detail – the need to obtain central bank liquidity in order to fulfil their minimum reserve requirements.

The most important money market segments are the unsecured deposit market (with various maturities, ranging from overnight to one year) and the secured repurchase agreement markets (often called "repo", with maturities ranging from overnight to one year) and, more recently, the derivatives markets (which can be grouped into various exchange-traded instruments). In this context, it is worth noting that a repurchase agreement entails the combination of the sale of an asset with the subsequent repurchase of that same asset (for a slightly higher price) at a specific price on a future date or on demand.[106]

It goes without saying that these instruments are characterised by different risk profiles. If a bank, for instance, provides unsecured interbank deposits for a specific period of time, it assumes full counterparty risk (i.e. the risk that the counterparty is unable to repay at the maturity date) for that period. By contrast, in the secured repo market, this counterparty credit risk is mitigated as the bank that provides liquidity receives collateral (e.g. bonds) in return. In the event of a credit default, the liquidity providing bank can make use of the collateral received to satisfy its claim against the defaulting bank. In line with these considerations, secured repo rates are usually somewhat lower than unsecured deposit rates.[107]

10.3 Some key interest rates worldwide

Apart from the ECB's key interest rates – which will be described in more detail in later chapters – there are three important market interest rates for the money market:

- the EONIA (euro overnight index average) exists since 1999 and represents a measure for the effective overnight reference rate prevailing in the euro interbank overnight market. It is computed daily as a volume-weighted average of the unsecured euro overnight lending transactions in the interbank market denominated in euro, as reported by a representative panel of contributing large banks.
- the EURIBOR (euro interbank offered rate) also exists since 1999 and represents the benchmark rate at which a prime bank is willing to lend funds in the large unsecured euro money market for maturities longer than overnight (one week to one year). Based on the rates of the same sample of banks as mentioned above, the EURIBOR rates are calculated for different maturities up to 12 months.[108]
- the EUREPO (the repo market reference rate for the euro) exists since 2002 and stands for the benchmark rate for the repo market for different maturities. In essence, it is the rate at which one prime bank offers funds in euros to another prime bank when the funds are secured by a repo transaction using general collateral.[109]

The London Inter-Bank Offered Rate (LIBOR) represents the interest rate that London clearing banks charge each other for loans between themselves on the London interbank market.[110] It is officially fixed once a day by a small group of large London banks. By contrast, the federal funds rate is the interest rate that banks pay each other for the overnight use of bank reserves. As will be shown in later chapters, it is of high relevance for the FED's monetary policy operations.

📖 Key concepts

Interest rate, money market, unsecured deposit market, secured repo market, derivatives market, EONIA, EURIBOR, EUREPO, LIBOR, fed funds rate.

☑ Questions for review

- What is the essence of an interest rate?
- What does the abbreviation "EONIA" stand for?
- What does the abbreviation "EURIBOR" stand for?

11 Bond markets

11.1 Learning objectives

In this chapter, we first try to understand the key features of a bond. We then distinguish between various types of bonds before analysing the valuation of a bond. Finally, we examine the characteristica of bond ratings.

11.2 Basic considerations

From a purely legal perspective, a bond represents a contract in which a borrower promises to make payments of interest and principal on specific dates to the holders of the bond.[111] Bonds are, therefore, long-term borrowing instruments. Typically, bonds are issued by companies, governments or government agencies.

Conventional bonds can be characterised by three major components, namely the face (or par value), the residual maturity (or redemption date) and the fixed rate of interest (or coupon rate).[112] The face value of a bond is the total amount, the issuer of the bond will repay to the buyer of the bond. It is often 1000 Euro, a multiple of that amount or other currency. The redemption date is the day, when the issuer of the bond must pay to the buyer of the bond the face value of the bond. Bonds are usually classified into short-term bonds (up to five years), medium-term bonds (from five to fifteen years) and long-term bonds (over fifteen years). Finlly, the coupon rate is the percentage of the face value that the bondholder receives each year until the bond matures. This payment, which is always fixed at the time of the issuance of the bond remains in force during the lifetime of the bond.

As has been shown in earlier chapters, differences in the financial situation of the issuer will inevitably lead to differences in contractual provisions and hence to differences in bonds' risks, prices and expected returns. Notwithstanding all differences, all bonds have some common characteristics.

11.3 Types of bonds

There are various types of bonds.[113] For instance, Floating Rate Notes (FRNs) are bonds where the coupon will be adjusted at pre-determined dates in accordance with developments in a specific benchmark rate.

There are, however, other bonds that do not pay any coupon at all, but are offered at a substantial discount below their par values and, hence, reward the issuer by capital appreciation rather than by interest income. These securities are called "zero coupon bonds".

Index-linked bonds represent bonds, where both the value and the coupon rate will be adjusted each year in line with changes in a pre-specified price index.

By contrast to domestic bonds, which are issued in the home currency, foreign bonds are bonds issued in the country of denomination by a firm based outside that country. Thus, a US firm might issue a euro bond in Frankfurt.

Convertible bonds are corporate bonds that grant the bondholder and/or the issuer the right to convert the bond into some other asset (often ordinary stock) on specified terms at a future date.

Callable bonds are bonds that can be redeemed at the issuer's discretion prior to the specified maturity (redemption) date. Putable bonds grant the right to the bondholder to sell the bond back to the issuer on a specified date (prior to the redemption date).

Finally, junk bonds are bonds, whose issuers are regarded by the bond credit rating agencies as being of high risk. Therefore, they will carry a rate of interest above the corresponding bonds issued by high-quality borrowers.

11.4 Calculating the value of a bond

A key feature of the pricing process in financial markets says that the price of a specific financial asset is equal to the present value of the future payments that are expected to be received from it. In line with these considerations, the value of any financial asset can be derived by calculating the present value of the cash flows the asset is expected to produce.[114] In the case of a bond, the cash flows obviously depend on its contractual features. As a rule, for a n-year fixed coupon-bearing bond, the valuation of the bond (i.e. its price P_B) would look as follows:

$$P_B = \frac{CF}{(1+k)^1} + \frac{CF}{(1+k)^2} + \ldots + \frac{CF}{(1+k)^N} + \frac{A}{(1+k)^n} \tag{11.4.1}$$

where CF denotes the cash flows amount of interest paid each year. The letter A stands for the amount that must be paid off at maturity or, in other words, the par or maturity value of the bond. In addition, n represents the number of years before the bond matures. Finally, k denotes the bond's market rate of interest. This is the discount rate that is used to calculate the present value of the bond' cash flows.

For instance, suppose a bond at par value of €1.000 pays 6% (i.e. the coupon rate multiplied by the par value = 0.06 · €1.000 = €60) for 3 years. The bond's market rate of interest is equal to 10% and the par value of €1000 will be paid at maturity. Inserting precise values for this actual case yields:

$$P_B = \frac{60}{(1.10)} + \frac{60}{(1.10)^2} + \frac{60}{(1.10)^3} + \frac{1.000}{(1.10)^3} = 900.53 \tag{11.4.2}$$

It is worth noting in this context that the cash flows consist of an annuity of n years plus lump-sum payment at the end of year n.

The rate of discount stands for the required rate of return from a bond. In essence, it can be seen as the sum of the yield on bonds that are free from default risk (such as, for instance, government bonds) and a risk premium to reflect the default risk of the bond. It is easy to show that, in case the default risk rises, a higher required rate of return and, hence, a higher discount rate will result. Therefore, for a given stream of future cash flows, high-risk bonds would have higher rates of discount and lower fair prices than low-risk bonds. It can, therefore, be concluded that bond prices have an inverse relationship to interest rates and risk of default.

11.5 Bond ratings

Since the early 1990s, bonds have been evaluated or "rated" in terms of their quality in order to assess the creditworthiness of an issuer or, in other words, its probability of going into default. As a rule, it can be stated that the more likely the bond issuer will pay the face value of the bond at maturity and – at the same time – will meet all scheduled coupon payments, the higher the bond's rating can be expected.

While a number of rating agencies exist, the three major rating agencies are Moody's Investors Service (Moody's), Standard & Poor's Corporation (S&P), and Fitch Investor's Service (Fitch) which dominate the market and usually summarise their assessment in terms of letter designations.[115] More specifically, Moody's assigns bond ratings of Aaa, Aa, A, Baa, Ba; B, Caa; Ca and C, whereas Standard & Poors and Fitch assign bond credit ratings of AAA, AA, A, BBB, BB, B, CCC, CC, C and D. The ratings are shown in more detail in the table below.

Fitch, Moody's and S&P ratings			
Agency	Moody's	S&P	Fitch
Investment grade	Aaa	AAA	AAA
	Aa	AA	AA
	A	A	A
	Baa	BBB	BBB
Non-investment grade	Ba	BB	BB
	B	B	B
	Caa	CCC	CCC
	Ca	CC	CC
	C	C	CD
	(-)	D	D

Source: websites of various rating agencies.

When looking at the table, it is worth noting that the triple- and double-A bonds are generally regarded as safe investments. Single-A and triple-B bonds are also strong enough to be called "investment-grade bonds" and they are widely regarded as safe unless unforeseen events or problems occur. These bonds are the lowest-rated bonds that many banks and other institutional investors are permitted by law to hold. Double-B and lower bonds are seen as speculative investments, or "junk bonds". These bonds are facing a significant probability of an inability to pay.

📖 Key concepts

Bonds, central government bonds, local government bonds, corporate bonds, foreign bonds, floating rate notes, zero-coupon bonds, index-linked bonds, callable and putable bonds, par value, coupon payment, coupon interest rate, redemption date, bond valuation, rating agencies, ratings.

☑ Questions for review

- What is the difference between central government bonds, local government bonds, corporate bonds and foreign bonds in terms of default and exchange rate risk?
- Which types of bonds do you know?
- How can a can a bond be valued?
- Which rating agencies do you know and what are the ratings used by them?

12 Stock markets

12.1 Learning objectives

In this chapter, we first try to understand the key features of a stock. We then proceed by examining the valuation of a stock and make an attempt to distinguish between fundamental and technical analysis. Finally, we reflect on the nature of stock market indices.

12.2 Basic considerations

From a purely legal perspective, stockholders are the owners of a corporation, and as such they have certain rights and privileges, among them to attend the annual meetings and to elect the Executive Board of the company.

From a firm's perspective, using the stock market serves the purpose of raising funds for the firm. From a more investment-oriented perspective, however, a stock represents a chance to obtain dividends and capital gains. In this context, it is worth noting that none of the two features are guaranteed. While in case of a bond, a contractual right for interest rate payment exists, this is not the case for a stock.

This notwithstanding, stocks provide an expected future stream of income. This is the reason, why a stock's value can be derived along the same lines as the value of other financial assets – namely by calculating the present value of the future cash flows. In this context, the expected cash flow thereby contains two salient ingredients, namely, first, the dividends expected in each year and, second, the expected future price of the stock.

In this context, it is worth noting, however that there are different kinds of stocks. In general, companies sell common stocks through public offerings and later on, they are traded among investors on the secondary market. Common stocks represent a partial ownership and common shareholders are basically residual claimants, in the sense that they are entitled to participate in the profits, which remain after bondholders and preferred shareholders have been paid.

Like common stocks, also preferred stocks are sold by companies and then traded among investors on the secondary market. However, preferred stocks do not allow for voting rights of its owners but, instead, entitle its holders to a fixed contractual amount of dividend payments for a specific time. The following deliberations, however, focus on the case of common stocks as the latter are more widely known.

☑ The DAX

The abbreviation "DAX" stands for "Deutscher Aktien Index". This widely–known stock market index includes German 30 Blue Chips and, thereby, conveys important information about the state of the German economy. The 30 companies stocks included in the DAX are the following: Adidas, Allianz, BASF, Bayer, Beiersdorf, BMW, Commerzbank, Continental, Daimler, Deutsche Bank, Deutsche Börse, Deutsche Post, Deutsche Telekom, EON, Fresenius, Fresenius Medical Care, Heidelberg Cement, Henkel, Infineon, K+S, Lanxess, Linde, Lufthansa, Merck, Munich Re, RWE, SAP, Siemens, Thyssen Krupp, VW.

12.3 Calculating the value of a stock

In light of the fact, that stocks have no explicit lifetime, they are – for the sake of simplicity – often regarded as providing an infinite stream of future dividends. As in previous chapters, the challenge is to calculate the present value (PV) of this stream of cash flows. It then follows:

$$PV = P_S = \frac{D_1}{(1+k)^1} + \frac{D_2}{(1+k)^2} + \ldots + \frac{D_\infty}{(1+k)^\infty} = \sum_{i=1}^{\infty} \frac{D_t}{(1+k)^n} \qquad (12.3.1)$$

where PV stands for the present value and P_S for the fundamental value of the stock today. Furthermore, D_n represents the dividend that is expected to be received in the respective year. Finally, *k* denotes the discount rate. Some economists prefer to call it the "required rate of return on the stock or on equities". As was shown in previous chapters in more detail, the estimates of *k* should include the real rate of return, the expected inflation and various forms of risk. In the literature, the resulting risk premium is also often denoted as "the equity premium" because it basically represents the additional return, investors must earn in order to invest into stocks rather than into (risk-free) government bonds.

While representing an elegant way of formulating the process of calculating the present value, it should not be overlooked that the aforementioned equation includes a big challenge, namely the task of forecasting all future dividends. If this can be done easily, then the solution of the valuation problem is quite straightforward. It is, however, in many cases not so easy to forecast such future dividends, as a variety of factors need to be taken into account.

Fortunately, for many stocks, the stream of dividends can be shown to grow at a (more or less) constant rate. If this is the case, the equation above can be rewritten as follows:[116]

$$\begin{aligned} P_S &= \frac{D_1 \cdot (1+g)^1}{(1+k)^1} + \frac{D_2 \cdot (1+g)^2}{(1+k)^2} + \ldots + \frac{D_\infty \cdot (1+g)^\infty}{(1+k)^\infty} \\ &= \frac{D_0 \cdot (1+g)}{(k-g)} = \frac{D_1}{(k-g)} \end{aligned} \tag{12.3.2}$$

where, in addition to the terminology explained above, *g* represents the foreseen constant growth rate. This specific variant of the general valuation approach is in the literature well-known as "constant growth model".[117]

For the sake of simplicity, assume that a firm just paid a dividend of €3.00 (which is equivalent to saying that $D_0 = 3.00$). Its stock has a required rate of return (*k*) of 10 percent, and investors expect the dividend to grow at a constant 5 percent rate in the future. Hence, the estimated dividend for the next year would be D_1 = €3.00 · (1.05) = €3.15, while for the second year, the dividend (D_2) would be €3.31, and the estimated dividend five ahead would be €3.83. In other words:

$$D_5 = D_0 \cdot (1+g)^5 = 3.00 \cdot (1.05)^5 = 3.83 \tag{12.3.3}$$

In a similar fashion, all future dividends could be calculated and then used to determine the fundamental current stock value, P_S. On the other hand, one could just insert the illustrative data into the equation derived above to find the stock's intrinsic value:

$$P_S = 3.00 \cdot \frac{(1.05)}{(0.10-0.05)} = 63.00 \tag{12.3.4}$$

In this context, it should be kept in mind, however, that a necessary condition for the derivation of the equation is that k > g. If the equation is used in situations, in which k is not greater than g, the results will be both wrong and meaningless.

12.4 Technical and fundamental analysis

In order to carry out their investment decisions, investors are often making use of various kinds of analysis. Two basic approaches have received particular attention over the last decades.

As the name suggests, the advocates of the so-called "fundamental analysis" start their analysis on the basis of an investigation of the balance sheet, the income statement and the cash flow statement of a company. In doing so, they try to form a view about the company's "true" (or "intrinsic" or "fundamental") value. The reasoning is obvious. Should the company's stock price trade below the intrinsic value, one might consider an investment (and under specific circumstances, vice versa).

Some of the variables that fundamental analysts base their decisions upon are:[118]

- the earnings per share, which represents the net profits of a company (i.e. after corporation tax and interest have been paid) divided by the number of shares;
- the dividends per share, which stands for the profits that are distributed to he shareholders, divided by the number of shares;
- the dividend yield, which is the dividend per share divided by the price of the share;
- the price-to-book ratio, which represents the ratio of the price per share divided by the book value of the company per share;
- the price-earnings ratio, which stands for the current price of the share divided by the earnings per share;
- the current ratio (i.e. current assets divided by current liabilities); and
- the liquid asset ratio (i.e. current assets minus inventories divided by current liabilities) and many others more.

By contrast, technical analysts believe that the relevant information on the company's fundamentals is already embedded in the actual share price. The information that is needed for trading is the correct timing and that can then be found mainly in the dynamics of the share prices. Assuming that stock market history tends to repeat itself, the challenge lies in identifying past trends and patterns of prices and volumes that have been followed by particular price movements and can, therefore, be used for predictions. There are many technical analysis and trading techniques, including graphical and non-graphical ones. It is probably fair to say that price charts, such as for instance line charts, moving averages, candle stick charts and many more, are among the more frequently used techniques.

It is often claimed that the main difference between these two alternatives lies in the relevant time horizon. While fundamental analysis takes a more long-term view, technical analysis focuses rather on a time window of weeks, days or even shorter intervals. At the same time, it might well be the case, that a fundamentally-oriented investor makes use of technical analysis in order to derive the right timing for his investment. Seen from this perspective, the two approaches are not necessarily mutually exclusive.

12.5 Stock market indices

Broader trends in a specific stock market are often described in terms of a so-called "stock market index". Commonly followed indices in the euro area include the Dow Jones EURO STOXX®, which includes the 50 Blue Chips of the euro area, and the DAX® which comprises the 30 biggest Blue Chips in Germany.[119]

☑ Selected international stock price indices

Argentina (Merval), Austria (ATX), Belgium (BEL20), Brazil (Ibovespa), China (SSE composite), Cyprus (CySE General), Czech Republic (PX 50), Denmark (OMX Copenhagen), Finland (OMX Helsinki 25), France (CAC 40), Germany (DAX), Hong Kong (Hang Seng Index), India (NSE-50), Italy (MIBTel), Netherlands (AEX), Russia (MICEX), Saudi Arabia (Tadawul), Spain (IBEX 35), United Kingdom (FT30 Index), United States (NASDAQ).

Source: various internet websites.

Indices may differ according to the number of stocks included and their weighting scheme. In price-weighted indices, such as, for instance, the Dow Jones Industrial Average, the prices of each stock determine the value of the index, which might, therefore, be subject to considerable variation in nervous markets. By contrast, market-value weighted or capitalisation-weighted indices, such as, for instance, the Hang Seng Index, takes the size of the company into account. It is worth mentioning that some indices exist in parallel in different versions.

📖 Key concepts

Stock market, stock market valuation, constant growth model, stock market index, Dow Jones EURO STOXX 50, DAX, price-to-earnings ratio, price-to-cash flow ratio.

☑ Questions for review

- What are the main differences between a stock and a bond?
- How can a stock be valued?
- How does the valuation change when the stock exhibits constant growth?
- What is the essence of a price-to-earnings ratio?

13 Foreign exchange markets

13.1 Learning objectives

In this chapter, we first try to understand the basic definitions of an exchange rate. We then proceed by exploring the concepts of the purchasing power parity and the interest rate parity and, more specifically, its two variants. We then make an attempt to distinguish between various exchange rate regimes. Finally, we take a closer look at the key characteristica of the ERM II.

13.2 Basic considerations

Basically all international transactions involve the use of exchange rates. In essence, exchange rates denote the price of one country's currency expressed in another country's currency. There are basically two methods of expressing such an exchange rate, namely first in domestic currency units per unit of foreign currency (e.g. in euro per US dollar or EUR/USD) and, second, in foreign currency units per unit of domestic currency (e.g. in US dollar per euro or USD/EUR). It is easy to see that the second method is merely the inverse of the former.

While it is not really of relevance, which method of expressing the exchange rate is applied, it matters when discussing about a rise or fall in the exchange rate, because the meaning will be very different depending on which definition is used. A rise in the euro per dollar exchange rate means that (from the perspective of a euro area resident) more euros have to be given to obtain one US dollar, that means that the euro has depreciated in value, or, equivalently, the dollar has appreciated in its value.

If the second definition is employed, a rise in the exchange rate would mean that (from the perspective of a euro area resident) more US dollars are obtained per euro, so that the euro has appreciated or, equivalently, the US dollar has depreciated.

In the following considerations, the second definition, i.e. the exchange rate as foreign currency per unit of domestic currency (e.g. in USD/EUR) – will be used, in line with large parts of the literature. This definition offers the advantage that a rise in the exchange rate will coincide with an appreciation of the domestic currency (i.e. of the euro).[120]

In today's financial markets, a variety of well-known symbols have been introduced which stand for specific currencies. For instance, the symbol "$" stands for (US) dollars, the symbol "€" represents (Euro area) euros, the symbols "£"and "¥" denote (British) pounds and (Japanese) yen, respectively. The table below lists some of the most popular international currency symbols and the (three letter) international standard (ISO 4217) codes widely used in the financial world.[121]

Some international currency symbols			
Country	Currency	Symbol	ISO Code
Australia	Dollar	A$	AUD
Canada	Dollar	C$	CAD
China	Yuan	(-)	CNY
Euro area	Euro	€	EUR
India	Rupee	Rs	INR
Iran	Rial	RI	IRR
Japan	Yen	¥	JPY
Kuwait	Dinar	KD	KWD
Mexico	Peso	Ps	MEXP
Saudi Arabia	Riyal	SR	SAR
Singapore	Dollar	S$	SGD
South Africa	Rand	R	ZAR
Switzerland	Franc	SF	CHF
United Kingdom	Pound	£	GBP
United States	Dollar	$	USD

Source: van Marrewijk (2004), p. 24.

The use of these codes helps to eliminate any confusion regarding currency names and symbols that can occur during transactions. An interesting development could be observed in early June 2012. All of a sudden, a new Bloomberg-code named "XGD" (as compared to the old code standing for Greek Drachma before beginning of 2001) could be observed. The reason was that some Greek parties had announced to leave the euro are in case of victory and, hence, also to abandon the euro. Therefore, the markets, fearing a Greek exit (a so-called "Grexit") apparently prepared for the worst.

Some other concepts are worth mentioning. The expression "spot exchange rate" describes the current exchange rate, i.e. the rate for buying and selling currencies at this point in time. By contrast, the expression "forward exchange rate" stands for the exchange rate that is quoted today, but for payment and delivery at a specific future date.

The real exchange rate denotes the nominal exchange rate adjusted for relative prices between the countries under investigation.[122] By contrast, the effective exchange rate illustrates whether a currency is appreciating or depreciating against a weighted basket of foreign currencies. Against the background of a situation, in which a currency is appreciating vis-à-vis some currencies and – at the same time – depreciating vis-à-vis some other currencies, an effective exchange rate in essence constitutes a useful tool to combine such divergent movements in (bilateral) exchange rates into an overall key (index) number.

13.3 Purchasing power parity

In the previous chapter, we introduced various exchange rate concepts and discussed their advantages and disadvantages. In this chapter, we will proceed by have closer look at the fundamentals driving exchange rates. More specifically, we will derive one of the earliest and simplest models of exchange rate determination, which is widely known as the so-called "purchasing power parity" ("PPP") theory. Although it is widely acknowledged that the purchasing power parity was first developed by the Swedish economist Gustav Cassel (1866–1945) in 1918, it is often claimed that its origins date back to the writings of the British economist David Ricardo (1772–1823).[123]

In essence, the purchasing power parity is based on the idea of the so-called "law of one price". The latter states that in a market can be characterised by competitive pressures and the absence of transport costs and tariffs or any kind of other barriers to trade, identical goods must have one price. In case of deviations, arbitrage forces will equalise goods prices once the price of goods is measured in the same currency. Such arbitrage occurs when economic agents exploit price differences to realise a riskless profit by buying the good in the marketplace where it is cheaper and selling it in the marketplace where a higher price can be obtained.

While the literature often refers to "the" purchasing power parity theory, it is fair to say that several variants do exist in parallel. The so-called "absolute version" of the purchasing power parity claims that if the price of a bundle of goods in the home country is compared to the price of an identical bundle of goods sold in a foreign currency (converted by the exchange rate into a common currency of measurement), then prices will be equal. For example if a bundle of goods costs €100 in the euro area and the same bundle costs $200 in the United States, then the exchange rate (defined as $ per €) will be equivalent to 200 / 100 = 2.00 $/€. In algebraic terms, the absolute version of the purchasing power parity can be stated as:[124]

$$S = \frac{P^A}{P} \tag{13.3.1}$$

where S denotes the exchange rate (defined in terms of foreign currency units per unit of domestic currency), P stands for the price of a bundle of goods in the home country (expressed in the domestic currency), and P^A represents the price of an identical bundle of goods in the foreign country (expressed in terms of foreign currency).[125] Following this version of the purchasing power parity, a rise in the home price level relative to the foreign price level will inevitably lead to a proportional decrease (and thus a proportional depreciation) of the home currency against the foreign currency. Taking up the aforementioned example, an increase in the price of the euro area bundle to €150 and an unchanged price of the US bundle, remaining at $200, will then result in a depreciation of the euro to 1.33 $ per €.

In light of the existence of transport costs, imperfect information and the distorting effect of tariffs and other forms of protectionism, it is often argued that it is not realistic to expect the absolute version of the purchasing power parity to hold. This notwithstanding, a weaker form of the purchasing power parity widely known as the "relative version" of the purchasing power parity can be expected to hold even in the presence of such distortions. Expressed in simple terms, the relative version of purchasing power parity states that the exchange rate will adjust by the amount of the inflation differential between the two economies. In algebraic terms, this can be expressed as follows:

$$\Delta s = \Delta p^A - \Delta p \tag{13.3.2}$$

Where, Δs stands for the percentage change in the exchange rate (i.e. the change in logarithms, hence the small letters), Δp represents the domestic inflation rate and Δp^A is the foreign inflation rate. According to this version of purchasing power parity, if the inflation rate in the euro area is two percent whilst its equivalent in the US is four percent, the euro per dollar exchange rate should be expected to increase, that is to appreciate by approximately two percent.

So far, we have assumed the purchasing power parity to hold for all types of goods. A more subtle distinction for the purchasing power parity distinguishes between "tradable" and "non-tradable" goods.[126] Tradable goods are exposed to the headwinds of international competition, such as most manufactured goods, whereas non-tradable goods are those that cannot be traded internationally (for instance houses and certain services such as a haircut). The reason underlying such a distinction is that on a priori grounds, the purchasing power parity is more likely to hold for tradable than for non-tradable goods.

This is due to the fact that the prices of tradable goods will tend to be kept "under control" by international competition, while the prices of non-tradable goods will be determined predominantly by domestic supply and demand considerations.

What are the implications of such a distinction for purchasing power parity? Let us start by assuming that the theory of purchasing power parity only holds for tradable goods, which means that

$$P_{TR}^{A} = S \cdot P_{TR} \tag{13.3.3}$$

where S represents the exchange rate, P_{TR} stands for the price of tradable goods in the home country (measured in terms of the domestic currency) and P_{TR}^{A} is the price of tradable goods in the foreign country (in terms of the foreign currency).

The aggregate price index (P) for the domestic currency consists of a weighted average of the prices of both tradable (P_{TR}) and non-tradable goods (P_{NT}), both being priced in domestic currency. Likewise, the foreign aggregate price index (P^A) is made up of a weighted average of the prices of tradables (P_{TR}^{A}) and non-tradables (P_{NT}^{A}), both in terms priced in the foreign currency. This yields:

$$P = \alpha \cdot P_{TR} + (1 - \alpha) \cdot P_{NT} \tag{13.3.4}$$

where α is the proportion of tradable goods in the domestic price index. Moreover, for the aggregate price index in the foreign country, the following expression holds:

$$P^{A} = \beta \cdot P_{TR}^{A} + (1 - \beta) \cdot P_{NT}^{A} \tag{13.3.5}$$

and β is the proportion of tradable goods in the foreign price index. When dividing the latter equation by the former equation, we obtain:

$$\frac{P^{A}}{P} = \frac{\beta \cdot P_{TR}^{A} + (1 - \beta) \cdot P_{NT}^{A}}{\alpha \cdot P_{TR} + (1-\alpha) \cdot P_{NT}} \tag{13.3.6}$$

If we divide the numerator by $P_{TR}{}^{A}$ and the denominator by $S \cdot P_{TR}$, this yields:[127]

$$\frac{P^A}{P} = \frac{\beta + (1-\beta)\cdot(P_{NT}{}^{A}/P_{TR}{}^{A})}{(\alpha/S) + (1-\alpha)\cdot(P_{NT}/S\cdot P_{TR})} \tag{13.3.7}$$

Rearranging this expression yields:[128]

$$\frac{P^A}{P} = S\cdot\left[\frac{\beta + (1-\beta)\cdot(P_{NT}{}^{A}/P_{TR}{}^{A})}{(\alpha) + (1-\alpha)\cdot(P_{NT}/P_{TR})}\right] \tag{13.3.8}$$

$$S = \frac{P^A}{P}\cdot\left[\frac{\alpha + (1-\alpha)\cdot(P_{NT}/P_{TR})}{\beta + (1-\beta)\cdot(P_{NT}{}^{A}/P_{TR}{}^{A})}\right] \tag{13.3.9}$$

The last equation must be seen as an important modification to the simple purchasing power parity, which implies that the latter does not necessarily have to hold in terms of aggregate price indices, but only for tradable goods. In particular, the equation suggests that the relative price of non-tradable relative to tradable goods will have an impact on the exchange rate. A rise in the domestic price of non-tradable goods relative to tradable goods, that is an increase in $(1-\alpha)$ will ceteris paribus (and, thereby, especially keeping the aggregate price index constant) lead to an increase in the exchange rate and, thus, to an appreciation of the home currency.

Taken together, the overall evidence on the empirical evidence on the purchasing power parity theory is not very supportive, and the results show that, first, at least for some rates the deviations from purchasing power parity are both substantial and prolonged. Second, it can be shown that exchange rates have been much more volatile that the corresponding price levels.[129] Third, from an empirical perspective, the purchasing power parity seems to hold better in the long run than in the short run. This is due to the fact that fundamentals and arbitrage must be seen as predominantly long-run economic forces. Fourth, purchasing power parity seems to hold better for tradable than for non-tradable goods.[130]

13.4 Interest rate parity

The previous chapter has shown that a long-run relationship between exchange rates and price levels, the so-called "purchasing power parity", exists. The following paragraphs will focus on the analysis of the short- and medium-run relationship between exchange rates and interest rates and the arbitrage forces that links these variables.

While earlier considerations have analysed the relationship of goods prices, this section focuses exclusively on financial investment opportunities. In today's world, there is a variety of possible investments. For reasons of simplicity, we will – at the current stage – just focus on two alternative investments, namely a domestic asset and a foreign asset. We will further assume that the domestic and the foreign asset under consideration are "perfect substitutes".[131] Now suppose, for instance, that you have a large amount (A) of euros to invest for one time period and you only care about the return in euros.[132] What are your alternatives? Well, on the one hand, you can purchase a euro area bond. If the euro area interest rate is equal to $i_{EA,t}$, your return at the end of the period (R) will be:

$$R = (1 + i_{EA}) \cdot A \tag{13.4.1}$$

An alternative investment would consist of buying a US bond. Since the latter is denominated in US dollars, such an investment would automatically ask for a number of transactions on the foreign exchange market.

More precisely, the amount of A euros would first need to be converted into $A \cdot S$ US dollars on the spot market, where S represents the spot exchange rate of the US dollar at the current point in time. Second, the amount of $A \cdot S$ US dollars would need to be invested in US bonds. Now, if the US interest rate is equal to i_{US}, the return of the investment will be equal to $(1 + i_{US}) \cdot A \cdot S$ US dollars by the end of the period. You are, however, not interested in the return in US dollars, but only in the return in euros. In other words, you will have to convert these dollars at the end of the period back to euros. This poses a problem because at the moment you are deciding about your investment, you do not know what the future spot exchange rate of the US-dollar is going to be. Fortunately, the forward exchange market provides a solution. Making use of the forward rate (F), you can express your return in euros, which is:

$$R = (1 + i_{US}) \cdot (S / F) \cdot A \tag{13.4.2}$$

In sum, you exactly know the return to your investment independent of the fact whether you choose to invest into euro area or US bonds and, like many other participants in financial markets, you will choose the asset with the highest return.

As a matter of fact, if the two assets are perfect substitutes and both are held in equilibrium, the return of the two assets must be the same to ensure that the market does not prefer one asset over the other. Taken together, this yields the following equilibrium condition for the choice between an investment in domestic and in foreign bonds:[133]

$$(1+i^A)\cdot(S/F)\cdot A = (1+i)\cdot A \tag{13.4.3}$$

or, equivalently

$$\frac{F}{S} = \frac{1+i^A}{1+i} \tag{13.4.4}$$

It goes without saying that the time horizon for all variables in the last equation must be consistent, so if the forward rate is, for example, the three-month forward rate at the current point in time three months ahead, then both, the domestic and the foreign interest rates must also be represented by three-month interest rates.

Recalling the convention that – with the exception of interest rates – lower case letters of symbols denote the natural logarithm of the respective variable, and using an approximation, namely $(1+x)\approx x$, we can rewrite the last equation as:

$$f - s = i^A - i \tag{13.4.5}$$

This equation then states that the (logarithmic) difference between the forward rate and the spot rate must be equal to the difference between the foreign and the domestic interest rate. In the literature, this expression is known as the so-called "covered interest rate parity condition" because you have fully covered your exposure vis-à-vis the return in foreign currency on the forward exchange market. It provides a powerful and crucial relationship between interest rates and spot and forward exchange rates.

Now assume that, for some reason, you are either not in the position or do not want to make use of the forward market. In such case, your return in US dollars at the end of next period will have to be converted into euros at the then prevailing exchange rate. In other words, the exchange rate at the end of next period is the relevant variable for you. It then follows:

$$R = (1+i_{US})\cdot(S/S^e)\cdot A \tag{13.4.6}$$

It is worth mentioning, however, that one of these returns, namely the one on euro area bonds remains certain, whereas, the other return, namely the return on US bonds is subject to some uncertainty and, therefore, needs to be forecasted. Again, the equilibrium condition would state that the return on the euro area and on the US bonds should be the same. It then follows:

$$(1+i_{EA}) \cdot A = (1 + i_{US}) \cdot \frac{S}{S^e} \cdot A \tag{13.4.7}$$

Making use of some approximation and the same logarithmic transformation as before, we are in the position to derive the so-called "uncovered interest rate parity condition", which states that

$$s^e - s = i^A - i \tag{13.4.8}$$

would hold as an equilibrium condition between an investment in domestic and in foreign bonds.

In essence, this equation says that the difference in the foreign and the domestic interest rate must be equal to the expected appreciation or depreciation of the foreign currency. As it stands, however, the equation cannot directly be used for empirical testing since it contains the expectation of the future exchange rate and the former cannot be measured directly.[134] In combination with the covered interest parity condition, however, it is rather easy to see that the forward exchange rate should be equal to the expected value of the future spot exchange rate:

$$s^e = f \tag{13.4.9}$$

Starting with the empirics of the covered interest parity condition, an empirical investigation would ask for a number of issues to be taken properly into account. First, it has to be ensured that the home and foreign assets are indeed comparable in terms of maturity and default and political risk.[135] Second, potential transaction costs need to be taken into consideration. Third, a number of possible econometric problems need to be avoided. How would such a test look like? A number of authors have tested the following relationship:

$$f - s = \alpha_1 + \alpha_2 \cdot \left[i^A - i \right] + u \qquad (13.4.10)$$

where *f* is the logarithm of the forward exchange rate, *s* is the logarithm of the spot exchange rate, *i* represents the domestic interest rate, i^A denotes the foreign interest rate and *u* is the random error with zero mean and normal distribution. For the covered interest rate parity to hold, the restrictions of $\alpha_1 = 0$ and $\alpha_2 = 1$ would need to be tested.

Appropriate empirical tests seem to show that the covered interest parity almost perfectly holds.[136] Against the background of the modern computer and communication equipment used today in modern foreign exchange dealing rooms, which – as a consequence – tend to make transaction costs small and covered interest parity indeed riskless, this result cannot be seen as a real surprise.

When comparing the returns from purchasing a euro area bond with the revenue from purchasing a US bond in the previous section, we noted that the euro area individual was exposed to foreign exchange risk when purchasing the US asset. In general, various types of risks, among them political and economic risks do exist. In this respect, it seems quite plausible to assume that economic agents are "risk averse" that is, other things equal, they prefer less risk to more risk.

This does not imply that risky assets will not be held in equilibrium, but that risk-averse investors will demand a compensation for holding these assets. Such compensation is called a "risk premium". In general, it can be expected that such a risk premium will rise if, first, the degree of risk aversion rises and, second, the perceived riskiness increases. Including both a risk premium and transaction costs into our previous considerations, the following relationship can be expected to hold:

$$i = i^A - (s^e - s) + \text{risk premium} + \text{transaction costs} \qquad (13.4.11)$$

This equation indicates that the return from investing at home is equal to the return from investing abroad minus the expected appreciation (or depreciation) of the exchange rate plus a risk premium to compensate for the exposure to foreign exchange risk if investing abroad plus any transaction costs involved in foreign investments. Taken together, there is good reason to expect the uncovered interest rate parity condition not to hold perfectly.

At the same time, there are, however, a number of reasons, why the uncovered interest rate parity may hold (at least approximately) for some markets.[137] First, transaction costs can be shown to have declined considerably over time. In terms of the equation above, this would tend to narrow the band within which uncovered interest parity should hold. Second, for most of the regularly traded currencies we should expect the risk premium to be within reasonable (but non-zero) limits, which again narrows the band within which uncovered interest parity should hold. Third, and perhaps most importantly, the aforementioned equation was derived from a euro area perspective. For an economic subject located in the US, the euro area must be seen as the foreign country demanding a risk premium and involving transaction costs. Since actual observations are based on the aggregate behaviour of both euro area and US citizens, the deviation from uncovered interest parity caused by the aforementioned equation and its American counterpart should at least to some extent cancel out in the aggregation process, yet again narrowing the band within which uncovered interest parity should hold. However, this does not mean that risk premia and transaction costs are not important for explaining aggregate behaviour.

In line with previous considerations, a test for the validity of the "uncovered interest rate parity condition" could have the following form:

$$s^e - s = \beta_1 + \beta_2 \cdot \left[i_{EA} - i_{US} \right] + u \qquad (13.4.12)$$

where s^e is the logarithm of the expected exchange rate, s is the logarithm of the spot exchange rate (in domestic currency per unit of foreign currency), i_{EA} represents the domestic interest rate, i_{US} denotes the foreign interest rate and u is the random error with zero mean and normal distribution. For uncovered interest rate parity to hold, the restrictions of $\beta_1 = 0$ and $\beta_2 = 1$ would need to be tested.

It is easy to see that the test of the uncovered interest parity condition is clearly much more difficult than the test of its covered equivalent. This is mainly due to the fact that testing for the former condition involves the testing of the joint hypotheses of risk neutrality and a pre-specified form of expectations. In practice, it is often assumed that financial markets have rational expectations, which means that, on average, they forecast the correct value for the exchange rate. It then follows that:

$$\ln (s_{t+i}) = \ln (s_{t+i}^{e}) + u \qquad (13.4.13)$$

Notwithstanding a number of specific empirical and econometric problems (such as, for instance the non-constancy and non-linearity of risk premia or the so-called "simultaneity bias"), it is often found that the uncovered interest rate parity does not hold. Besides the expectations problem mentioned above, this result may be caused by the existence of transaction costs as well as by the fact that investors are not risk-neutral.

A number of economists have recently argued in favour of another key feature of exchange rate markets that – in their view – has not been adequately reflected in the literature yet. In essence, the basic idea of the "carry trade" phenomenon consists in exploiting existing interest rate differentials across countries and it seems a well-known fact that the strategy is widely used by investors in international financial markets. In its simplest version, an investor borrows a certain amount in a low-interest rate currency (the so-called "funding" currency"), converts the funds into a high-interest rate (the so-called "target" currency) and invests the resulting amount in the target currency at the high-interest rate.[138]

Some studies suspect that such behaviour can result in sizeable and quite persistent exchange rate movements.[139] In particular, as this strategy involves the selling of the funding currency and the purchase of the target currency, this would lead to a depreciation of the former currency and an appreciation of the latter currency, which can – due to its additional potential in raising profitability – not only encourage further trades along those lines but – at the same time – further amplify exchange rate movements. While the strategy apparently seems to be quite lucrative in "normal" times, in turbulent phases, it might prove necessary for investors to liquidate their holdings in the target currency and revert back to the funding currency, thus driving the target currency down and the funding currency up. If, however, the target currency then depreciates against the funding currency, the initial amount borrowed will basically increase (in terms of the target currency), thereby effectively increasing the borrowing costs and initiating further withdrawals out of the target currency. Against this background, foreign exchange markets might "go insane" and apparently act against all economic intuition. Indeed, some studies seem to show that the behaviour of exchange rates, while often matching the "traditional" theory" quite well, sometimes can be better explained by "carry trade" considerations.[140]

13.5 Exchange market interventions

The aforementioned equation can also be of help when assessing in more detail the effectiveness of exchange market interventions carried out by a central bank. According to our previous considerations, the following relationship can be expected to hold:

$$i = i^A - (s^e - s) + \text{risk premium} + \text{transaction costs} \tag{13.5.1}$$

or alternatively,

$$s = (i - i^A) + s^e - \text{risk premium} \tag{13.5.2}$$

when abstracting from transaction costs. A closer look then reveals that the overall effects of an exchange market intervention carried out by the central bank can be decomposed into three individual channels: (i) a risk premium effect, (ii) an interest rate differential effect and (iii) an expectations effect.[141]

The risk premium effect works as follows: a purchase of foreign currency against domestic currency by the central bank lowers (other things equal) the risk premium. The decline in risk makes the foreign currency more attractive, thus leading to an appreciation of the foreign and a depreciation of the domestic currency. Moreover, the interest rate differential effect works as follows: a purchase of foreign currency against domestic currency increases the domestic money supply and, thereby, lowers the domestic interest rate which in turn leads to a decline in the interest rate differential and, as a consequence, to a depreciation of the home currency. From this perspective, the interest rate differential effect reinforces the portfolio effect.

Finally, the equation postulates a direct one-to-one relationship between the expected exchange rate and the actual exchange rate. This is equivalent to saying that a central bank that manages to change the expected exchange rate, also influences the actual exchange rate; the effect can be said to be based on a kind of "information function" of the exchange rate intervention.

Regarding this information function, this leads to an important distinction, namely the one between the "systematic" part of such information and the "innovative" part of such information. It can be expected that market participants have already included the systematic part in their information set. But the innovative part can by definition be regarded as "news" and will, therefore, lead to an adjustment in the expected exchange rate. It is crucial, however, that the direction of this effect depends on the concrete interpretation of the "news" by the market participants.

13.6 Exchange rate regimes

The way an authority manages its own currency is reflected in the choice of the exchange rate regime. The two polar cases are a system of floating exchange rates and a system of fixed exchange rates. While in the latter case, the home currency is tied to another currency (or basket of currencies), in the former case the exchange rate determination is left to the foreign exchange market. Somewhere between these two solutions lies the so-called "managed float", in which the central bank keeps the value of the currency within a certain band. A variant of the latter approach is represented by the so-called "crawling peg", in which a predetermined rate of depreciation against the foreign currency is selected.

☑ Fixed exchange rates and monetary policy

Under perfect capital mobility, the uncovered interest rate parity must hold. It then follows:

(i) $s^e - s = i^A - i$

Now assume, the central bank decides to (or is forced to) peg the exchange rate at a specific level, so that the change in exchange rate (as reflected on the left-hand side of the equation) equals zero, thus leading to:

(ii) $i = i^A$

It is then obvious to see that, under those conditions, investors will demand the same nominal interest rate in both countries.

Source: Blanchard (1997), p. 263.

In case of the so-called "dollarisation", a sound foreign currency is used either in parallel to the home currency or all on its own. In the latter case, this avoids any kind of speculative attacks on the domestic currency (as it has ceased to exist).[142]

In case of a currency board, an explicit legislative commitment vis-à-vis a pre-specified foreign currency with a fixed exchange rate exists. This leads to a situation in which the domestic currency is fully backed by a foreign currency and, therefore, can only expand when more foreign exchange reserves are available. This leave relatively limited scope for discretionary policy to the home central bank.[143]

13.7 ERM II

As already mentioned, up to now seventeen countries have joined the euro area and, therefore, introduced the euro as their currency. The relationship between the euro and the currencies outside the euro area, however, is laid down in the so-called "Exchange Rate Mechanism (ERM II)". The ERM II was set up on 1 January 1999 and thus succeeded the ERM. Its main purpose is to help potential euro area members in their preparation for participation in the euro area and – at the same time – to create an evaluation mechanism for those countries. Participation in ERM II is voluntary although the convergence criterion on exchange rate stability clearly requires participation in the ERM II mechanism without severe tensions for at least two years.[144]

The main features of ERM II lie in the fact that the exchange rate of a non-euro area Member State is fixed against the euro and is only allowed to fluctuate within set limits. More precisely, it involves:

- An agreement about a 'central' exchange rate between the euro and the country's currency. The currency is then allowed to fluctuate by up to ±15% above or below this central rate.
- When these limits are broken, the currency is supported by foreign exchange market interventions to keep the exchange rate against the euro within the ±15% fluctuation band. Interventions are coordinated by the ECB and the central bank of the non-euro area Member State.
- Countries participating within ERM II can unilaterally decide to maintain a narrower fluctuation band, but this decision has generally no impact on the official ±15% fluctuation margin.[145]

In general, the co-ordination of the monetary and exchange-rate policies, and thus also the monitoring of ERM II and the related administration lie in the hands of the General Council, of course, in close cooperation with the member state's central bank.

At the current stage, the ERM II includes the following currencies: the Danish kroner (with a narrow fluctuation band of ±2.25%), the Lithuanian litas (with a standard fluctuation band of ±15%), and the Latvian lats (with a fluctuation band of ±15%, but Latvia unilaterally maintains a 1% fluctuation band around the central rate).

Key concepts

Spot exchange rate, bid and ask prices, bid and ask spreads, appreciation and depreciation, (triangular) arbitrage, effective exchange rates, law of one price, purchasing power parity (PPP), absolute and relative version, tradable and non-tradable goods, transaction costs, differentiated goods, fixed investment costs and thresholds, purchasing power parity corrections, perfect substitutes, imperfect substitutes, covered interest parity, uncovered interest parity, risk neutrality, rational expectations, risk aversion, risk premia, ERM II.

☑ Questions for review

- What is the exact meaning of an exchange rate?
- In which way do spot exchange rates differ from forward exchange rates?
- How can the mechanics of arbitrage be described? Is there a difference between direct and triangular arbitrage?
- What could be the reasons underlying persistent deviations between the spot and the forward exchange rate?
- What is the essence of the so-called "law of one price"?
- In which way do the absolute and the relative version of the purchasing power parity differ?
- What are the implications of the distinction between tradable and non-tradable goods for purchasing power parity?
- How do the different variants of the purchasing power parity perform in empirical tests? Which reasons could be responsible for such empirical results?
- Show, how exchange rates and interest rates are linked! What is the basic idea behind the covered interest rate parity?
- What is the essence of the uncovered interest rate parity?
- What are risk premia and how does their existence change the uncovered interest rate parity?
- How do the covered and the uncovered interest rate parity perform in empirical tests?
- What can be said about the functioning of the ERM II?

14 Derivative markets

14.1 Learning objectives

In this chapter, we first try to understand the key features of a typical derivative instrument. We then proceed by analyzing the characteristica of forward and futures contracts, swaps and options. Finally, we reflect upon the nature of credit default swaps.

14.2 Basic considerations

This section focuses on derivative instruments (or derivatives), which are securities that derive their value from an underlying asset, such as, for instance, a stock or a bond. In essence, derivatives are intended to allow investors to benefit from price movements in the underlying asset. Derivatives generally include forward contracts, futures contracts, options and swaps.

An important use of derivatives is "to hedge" against negative outcomes. Suppose, you are a farmer and worried about a possible decline in the price of wheat, when selling it in fall. At the same time, the miller you are doing business with is concerned about the price he would have to pay in fall.[146] The risks, the miller and yourself are facing could be reduced if you could agree on a price for the wheat delivery in fall already now and put it down into a contract. Both parties would benefit from such a transaction in the sense that the risks they are facing are reduced.

Against this background, hedging with futures can be seen as beneficial as it tends to reduce aggregate risk in the economy. However, derivatives can also be used "to speculate", that is to bet on a specific outcome regarding asset price developments in the expectation of a substantial financial profit. Agaisnt this background, speculators are often regarded as being of less use for an economy, but as we will see in later paragraphs, this is not necessarily the case.

14.3 Forward and futures contracts

Forward contracts are private agreements, where one party agrees to buy (or sell) one commodity at a specific price (i.e. the forward price) on a specific future date and the other party agrees to sell (or buy).[147] The underlying goods are actually delivered under forward contracts. In essence, nothing happens between the contracting date and the date of delivery as the payment only takes place on the date of delivery. However, unless both parties are financially strong, there is always a danger that one party will financially default in the contract (i.e. a "counterparty risk"), especially if the price changes markedly after the agreement is reached.

A futures contract is similar to a forward contract but with some key differences. First, futures contracts are legally binding commitments. Second, futures contracts are generally standardized instruments that are traded on organised exchanges, whereas forward contracts are generally tailor-made, negotiated between the two parties, and not traded after they have been signed. Third, following the "marking to market"-methodology, the potential gains and losses are noted on daily basis and money must be put up to cover losses. Fourth, in the case of futures, physical delivery of the underlying is virtually never taken – the two parties simply settle up with cash for the difference between the contracted price and the actual price on the expiration date.

As a matter of principle, the buyer is described as being "long", whereas the seller is called being "short". From a historical perspective, it is also worth noting that future and forward contracts were originally developed for commodities such as, for instance, wheat. In today's world, however, commodities contracts still play an important role, but far more trading takes place in foreign exchange and interest rate futures.

14.4 Swaps

As the name states, a swap represents an agreement between two parties (i.e. "counterparties") to swap something – generally obligations to make specific payment flows. Nowadays, most swaps involve either interest payments or currencies. Swaps represent over-the-counter (OTC) contracts and, hence, expose the counterparties to counterparty risk.

The payments involved in a swap are generally based on some predetermined principal amount (i.e. "notional principal amount"). The only payments that are exchanged between the counterparties are the agreed-upon payments, not the notional amount.

Suppose, for instance, the following constellation: the company A has 20-year, €200 million floating rate bond outstanding, while company B has €200 million, fixed rate issue outstanding over the same period. Therefore, each company has an obligation to carry out specific interest rate payments, but one payment is fixed, whereas the other one will vary in the future. Now for some reason, company B prefers to have a variable debt. If the companies swapped their payment obligations, an interest rate swap would occur. Company A would now have to make fixed payments and company B would have a floating stream.[148] Similarly, in the case of currency swaps, the counterparties swap the exchange rate risk.

14.5 Options

An option is a contract in which the option seller grants the option buyer the right (but not the obligation) to enter into transaction on an underlying asset at some predetermined price within a specified period of time. The specified price is called the "strike price" (or alternatively, the "exercise price") and the specified date is called the "expiration date". The option seller is called the "option writer", whereas the option buyer is called the "option holder". The asset, that is the subject of the option, is called the "underlying" and it can be an individual stock, a stock price index, a bond or any other derivative instrument.

In case of a so-called "call option", the option holder has the right to purchase the underlying. By contrast, in case of a "put option", the option holder has the right to sell the underlying.

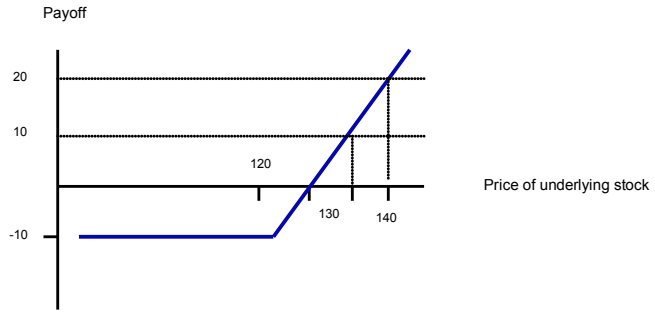
Moreover, a "European option" can be exercised only at the expiration date of the contract, whereas an "American option" can be exercised any time before the expiration date.

A final terminological issue refers to the question, whether the strike price (or exercise price) is higher or lower than the actual stock price. When the strike price exceeds the current stock price, a call option is said to be "out-of-the-money". If, by contrast, the exercise price is below the current stock price, the option is said to be "in the money".

Options are very important instruments in today's financial markets and it is worth understanding their basics. Suppose you would buy a call option on the stock of company A for €10 and a strike price of €120. When the actual price of company A is between zero and €120, you would not exercise the option (i.e. you are "out-of-the-money") and, thus, inevitably incur a loss of €10. When the price exceeds €120, you (being the option holder) are "in-the-money" and will take advantage from exercising it. In case the price exceeds €130, you will earn a profit from exercising the option.

In today's financial world, options are not only available for individual stocks but also, for instance, for broader stock price indices. A further important difference refers to the question, whether you actually possess the stocks that you are selling. In case, these stocks are part of your portfolio, you are said to deal with "covered options", if this is not the case, your business refers to "naked options".

Chart: Payoff profile for a call option



Source: Own illustration

14.6 Credit Default Swaps

A credit default swap (CDS) is a financial swap arrangement in which the seller of the CDS commits to the buyer for compensation in the event of a loan default. In a way, the name CDS is a bit misleading since, in essence, the buyer then receives compensation (usually the face value of the loan) and the seller takes possession of the defaulted loan. From this perspective, a CDS can be seen as similar to a credit insurance. Credit default swaps have been invented in the 1990s and their use has become more widespread over the last decades.

The corresponding price of such a CDS (i.e. the so-called "spread") is then equivalent to the annual amount that the protection buyer must pay to the protection seller over the length of the contract (generally expressed as a percentage of the notional amount). Payments are usually made on a quarterly basis and continue until either the CDS expires or the underlying entity defaults. For example, if the CDS-spread on company A is 50 basis points (or 0.5%), then an investor willing to insure an amount of €100 million, must pay the CDS-seller €500'000 for his protection.

It is also possible to buy and sell CDSs without the underlying being actually part of the investor's portfolio. In line with the previous terminology, this is called a "naked" CDS. In essence, naked CDS allow traders to speculate on the creditworthiness of the issuer of the underlying. Naked CDSs actually constitute most of the CDS market. As will be shown in later chapters, they also played a significant role in the most recent sovereign debt crisis. As a consequence, since 1 December 2011, the European Parliament has banned naked CDSs on the debt for sovereign nations.

📖 Key concepts

Derivative markets, options, interest and exchange rate futures and swaps and commodity futures, call option, put option, strike price, option writer, covered option, naked option, in-the-money, out-of-the-money, forward contracts, futures contracts, swaps, credit default swaps.

☑ Questions for review

- What are derivatives and which types do you know?
- What is the essence of an option?
- What is the basic idea behind a swap?
- What is the essence of a credit default swap and when would you use them?

15 Market efficiency

15.1 Learning objectives

In this chapter, we first try to understand the different forms of efficiency. We then proceed by examining the nature of behavioural finance.

15.2 Forms of efficiency

After having now reviewed the theoretical evidence for a variety of markets, the question turns up: is it possible to "beat the market" systematically and, thereby, to earn "abnormal returns"? And, if so, how easy is it, to do so? The so-called "efficient market hypothesis" (EMH) – a theory that is widely known in the financial literature – claims that, first, financial prices are always in equilibrium and, second, that it is impossible for any investor to consistently beat the market.

To see this in more detail, suppose, that, first, all investors have (more or less) free access to all currently available information and, second, all investors are well acquainted with the existing models of financial analysis. Following these assumptions, it seems reasonable to expect that all investors immediately adjust their holdings if new information arises and, hence, an asset price will always be reasonably close to its "fair value" since it can be expected to adjust almost immediately to any new development. In other words: in such an (information) efficient market, any relevant information is immediately reflected in asset prices.[149]

It is obvious, however, that in order to arrive at such a conclusion the information set available to the investor is of crucial relevance. Accordingly, the financial literature has discussed three forms, or levels, of market efficiency.[150]

A market can be regarded as being "weak-form efficient", if actual security prices promptly and fully reflect all available information of the past history. The relevant information set, therefore, comprises the complete history of security prices and, accordingly, it should not be possible to earn excess returns in a systematic way by trading on the basis of past price developments.[151]

A market can be regarded as "semi-strong efficient" if actual security prices promptly and fully reflect all publicly available information.

☑ Testing for market efficiency – the Runs-test

The question whether stock prices really follow a random walk can be addressed by means of the so-called "Runs-test".[152] Assume a "+"denotes an increase in (daily) stock prices, whereas a "-" stands for a similar decrease. The following time series can then be observed:

(++++) (------) (+++++++) (------)

There are four increases, followed by six declines, seven increases and another six declines. Taken together, there are four runs.[153] In the next step, the question arises, whether these four runs and 23 observations differ from the ones that could be expected on the basis of a strictly random sequence of 23 observations.

This test for the randomness of runs can be done as follows: we define n as the number of overall observations ($=n_1+n_2$). Moreover, n_1 stands for the number of + symbols and n_2 for the number of – symbols, respectively. Finally, k represents the number of runs. Then under the null hypothesis that successive outcomes are independent and assuming that $n_1>10$ and $n_2>10$, the number of runs is (asymptotically) normally distributed with

(i) $$mean\ E(k)=\frac{2\cdot n_1\cdot n_2}{n_1+n_2}+1$$

(ii) $$\text{variance } \sigma_k{}^2=\frac{2\cdot n_1\cdot n_2\cdot(2\cdot n_1\cdot n_2-n_1-n_2)}{(n_1+n_2)^2\cdot(n_1+n_2-1)}$$

In our example $n_1=11$ and $n_2=12$, $E(k)=12.478$ and $\sigma_k=2.338$. Therefore the bounds $[\,k\pm1.96\cdot\sigma_k\,]$ consist of the interval [7.895, 17.061]. Since the number of runs is 4 and, hence, clearly outside this interval, the null hypothesis of stock prices behaving in a random way is clearly rejected.

The relevant information set, therefore, comprises the past history of prices and, in addition, all publicly information such as, for instance, the company's annual reports, its ad-hoc press statements but also more general news regarding the current state and future evolution of the macroeconomy. It should, therefore, not be possible to earn excess returns in a systematic way by trading on the basis of publicly available information.

A market can be regarded as "strong-form efficient", if actual security prices promptly and fully reflect all publicly and private information. The relevant information set, therefore, comprises both, public and private information and, hence, it should not be possible to earn excess returns in a systematic way by trading on the basis of inside information.[154]

Tests for the efficiency of markets usually show that asset markets are highly efficient and capable of processing relevant information into asset prices at a very high speed. Therefore, investors cannot easily expect to earn abnormal profits trading on publicly available information.[155]

15.3 Behavioural finance

The view of highly efficient asset markets is, however, increasingly challenged by the popular field of behavioural finance, which has nowadays evolved into a separate branch of financial analysis. More specifically, behavioural finance highlights certain inefficiencies and among these inefficiencies are under-reactions or over-reactions to information, as causes of market trends and – in extreme cases – of bubbles and crashes. Over time, also psychological effects have been incorporated into behavioural finance. In line with this, such mis-reactions are then attributed to various causes, among them limited investor attention, over-confidence or over-optimism, herding instinct and noise trading. Taken together, numerous examples of unexplained abnormal returns have been identified. Therefore, the debate about the validity of the "correct" degree of market efficiency will continue.

📖 Key concepts

Concept of an efficient market, forms of market efficiency, weak-form efficiency, semi-strong form efficiency, strong-form efficiency, implications of market efficiency, behavioural finance.

☑ Questions for review

- What is the exact meaning of an efficient market?
- Which forms of market efficiency do you know?
- Is it possible to beat the market on a permanent basis?
- What is at the core of behavioural finance?

16 Money supply and money demand

16.1 Learning objectives

In this chapter, we try to understand the key features of monetary aggregates and to explore the determinants of money supply and demand. We also aim at becoming familiar with the channels of monetary policy transmission and the related time lags. We then consider the monetary policy instruments in the euro area. Finally, we investigate monetary policy in times of financial crisis and reflect upon the way forward.

16.2 Monetary aggregates

So far, we have been talking about money, but what does money exactly mean in practical terms? This is indeed not an easy question and the answer is by no means straightforward. The latter is due to the fact that in today's world, a variety of different financial assets exist that perform the functions outlined in the previous chapter. Moreover, many of these assets are close substitutes and that their nature changes over time, thus making it difficult to come up with a clear definition of how exactly money should be defined.

Following international conventions, however, most central banks define and monitor at least a narrow, an intermediate and a broad monetary aggregate. The different types of money are usually classified as "M"s. M1 consist of the currency in circulation and private non-banks overnight deposits. M2 represents money and some "close substitutes" for money, such as, for instance, certain forms of time deposits. M3 adds in addition some longer-term deposits, such as, for instance, savings deposits to M2.

Another important monetary aggregate is the so-called "monetary base" (or, alternatively the "central bank money stock"). It consists of currency in circulation (*CU*) and the reserves held by commercial banks with the central bank (*RE*). This yields $MB = CU + RE$.

Why is the monetary base so important? This is due to the fact that the central bank can directly control this monetary aggregate. In order to show this, let us have a look at a simplified and highly stylised balance sheet of a central bank. The latter looks as shown below:

Stylised balance sheet of a central bank	
Assets	Liabilities
Claims vis-à-vis the foreign sector	Currency in circulation
Claims vis-à-vis the government	Deposits of domestic banking sector
Credit to the domestic banking sector	Net balance of other assets and other liabilities

The asset side includes holdings of assets vis-à-vis the foreign sector and the domestic government as well as credit to domestic commercial banks. More particularly, the holdings of foreign assets comprise the central bank's international reserves.

The liabilities' side of the balance sheet comprises currency in circulation and deposits of commercial banks.[156] Why do commercial banks hold deposits within the central bank? This is in essence required by law as a number of central banks (among them the ECB) force banks to hold deposits within the central banks in order to (at least partially) back for commercial banks' liabilities. It is easy to see that the first two positions together just add up to the monetary base. Therefore, in principle, the latter can be controlled by the central bank and changes in the monetary base can stem from any kind of change on the asset side.

While, in theory, the aforementioned definitions are uncontested and universally agreed, in practice there are differences in the concrete definitions and the measurement of these monetary aggregates. For instance, the ECB bases its definitions of euro area monetary aggregates on harmonised definitions of the money-issuing sector and the money-holding sector, as well as of categories of monetary financial institution (MFI) liabilities.[157] The money-issuing sector comprises MFIs resident in the euro area, whereas the money-holding sector includes all non-MFIs resident in the euro area, excluding the central government sector.

Based on conceptual considerations and empirical studies, the Eurosystem has defined a narrow (M1), an intermediate (M2) and a broad monetary aggregate (M3). These aggregates basically differ with regard to the degree of liquidity of the assets incorporated in the respective definition. M1 comprises currency in circulation (i.e. banknotes and coins) as well as balances that can immediately be converted into currency or used for cashless payments, such as overnight deposits. M2 includes M1 and, in addition, deposits with an agreed maturity of up to two years or redeemable at a period of notice of up to three months. These deposits can relatively easy be converted into components of narrow money, but only with some restrictions, such as, for instance, the need for advance notification, penalties and fees. M3 comprises M2 and certain marketable instruments. The latter are repurchase agreements, money market fund shares/ units and debt securities with a maturity of up to two years (including money market paper).[158] As these assets are generally characterised by a high degree of liquidity, they can be regarded as close substitutes to the more traditional deposits.

☑ Central bank balance sheet and exchange market interventions

Monetary policy is by no means independent from foreign exchange markets. This can easily be demonstrated from the stylised central bank's balance sheet. Suppose, the home currency depreciates in value, so that the central bank decides to intervene by buying the home currency against foreign currency. This in turn leads to a reduction in the position "foreign reserves" (essentially containing foreign currencies, foreign bonds and gold) on the asset side of the central bank's balance sheet and, consequently, to a similar decline in the monetary base on the liabilities' side. Money multiplier effects would then imply a (rather direct and mechanic) corresponding decline in broad monetary aggregates.

Is there anything that can be done about this unwarranted effect? Indeed, the decline in foreign reserves could be counterbalanced if the central bank "neutralises" or "sterilises" the impact of its foreign exchange intervention on the money supply by carrying out a transaction of similar magnitude, but with opposite sign on the asset side. If, for instance, the position "foreign reserves" decreases, bonds of the same amount could be bought, thus leading to a redistribution within the asset side of the central bank balance sheet, but leaving the liabilities' side in essence unchanged.

Source: Gerdesmeier (2011, p. 18).

It is easy to show that broader monetary aggregates, i.e. aggregates that include various assets, are less affected by substitution effects within the aforementioned assets and are, hence, more stable. Taken together, it follows:

Definitions of euro area aggregates			
Definition	M1	M2	M3
Currency in circulation	X	X	X
Overnight deposits	X	X	X
Deposits with agreed maturity up to 2 years		X	X
Deposits redeemable at notice up to 3 months		X	X
Repurchase agreements			X
Money market fund (MMF) shares/units and money market paper			X
Debt securities up to 2 years			X

Source: ECB (1999b), p. 35.

For various reasons, it is also worth looking in more detail at the relative shares of the various components in M3. This is shown in the table below for the end of the year 2012.

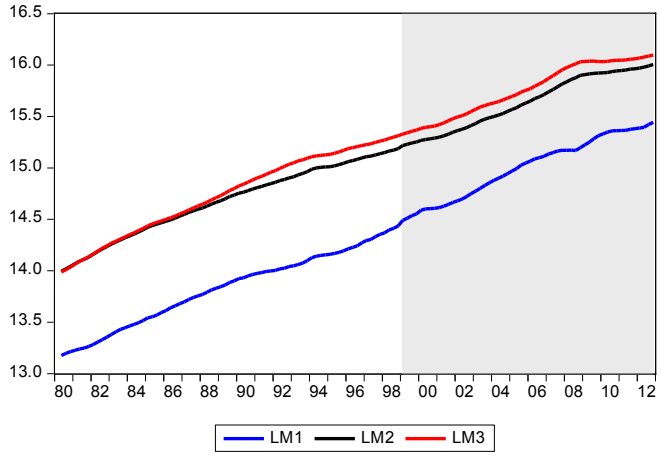
Percentage shares of components of M3	
Component	Share
Currency in circulation	9%
Overnight deposits	43%
Deposits with agreed maturity up to 2 years	19%
Deposits redeemable at notice up to 3 months	21%
Repurchase agreements	1%
Money market fund (MMF) shares/units and money market paper	5%
Debt securities up to 2 years	2%

Source: ECB Monthly Bulletin, June, pp. 12 and 13, figures rounded.

First, the figures demonstrate in a quite impressive way that, in modern economics, relatively little of the stock of broad money is in physical currency. For example, in the end of 2012, only around nine percent of the broad monetary aggregate M3 consisted of currency in circulation (i.e. banknotes and coins). At the same time, it is obvious that overnight deposits as well as the two categories of deposits represent the lion's share of the stock in M3. This underlines the importance of having these instruments included in a well-defined and realistic definition of monetary liquidity.

A closer look at the developments of the euro area monetary aggregates by means of a time series chart shows that they increase over the selected sample from the beginning of the 1980s to end-2012.[159]

Chart: Monetary developments in the euro area



Source: own illustration based on ECB data

What would a simple correlation analysis for these three monetary aggregates tell us? In principle, one would expect the correlations to be positive as the narrower monetary aggregates are included in the broader ones. The figures below show that this is indeed the case. The correlation of the levels – although being quite high – is not perfect.[160]

Correlation matrix for euro area monetary aggregates			
	M1	M2	M3
M1	1.000 (1.000)	0.993 (0.328)	0.990 (0.155)
M2	0.993 (0.328)	1.000 (1.000)	0.999 (0.932)
M3	0.990 (0.155)	0.999 (0.932)	1.000 (1.000)

Source: own estimations, sample: 1999.1–2012.4.

The corresponding values for the annual growth rates (shown in brackets) are substantially lower, but still highly positive. Expressed in other words, the three aggregates tend to move quite closely together, both on the basis of levels as well as on the basis of annual growth rates.

It is fair to say, however, that the traditional measures are not undisputed. Already in the eighties, proposals for a more consistent aggregation procedure have been made. In essence, simple-sum monetary aggregates are based on balance sheet or accounting principles. The fact that they are constructed by simple summation is – according to microeconomic theory – equivalent to saying that they are considered as perfect substitutes.[161]

In reality, this is clearly not the case. The different assets contained in money possess different degress of "moneyness" and thus, the microeconomic foundations underlying the assumption of perfect substitution do not seem appropriate.[162]

Accordingly, these different degrees of "moneyness" should be reflected in the respective weights, when constructing the appropriate monetary aggregate. More precisely, the financial assets with more 'moneyness' than the others shall be given larger weights and vice versa. In view of these considerations, the US-economist W.A. Barnett proposed the use of so-called "Divisia monetary aggregates" to better gauge the total monetary services provided by financial assets.[163] Such a Divisia aggregation is consistent with the microeconomic theory and better accomodates for the fact that the financial assets are less than perfect substitutes. More particularly, financial assets that are more frequently used for transaction purposes are given higher weights. Conversely, financial assets that are used for saving purposes and incur fewer transactions are assigned lower weights.

How can this be done in practice? In principle, the monetary services can be regarded as a loss of income and are, consequently, related to the respective opportunity costs, where the latter are often approximated by the return of a long-term government bond. When subtracting from this "reference rate of interest" the own rate of the respective component, this gives the (real) price that an economic subject is willing to pay for the monetary services of that asset. For instance, the growth rate of Divisia-M1 equals the relative opportunity costs of currency in circulation times the growth rate of currency in circulation plus the relative opportunity costs of sight deposits times the growth rate of sight deposits. More concretely, if the reference rate is arbitrarily set at a level of five percent, the relative opportunity costs of holding cash are five percent, since the own rate of return on currency in circulation is equal to zero. By contrast, the relative opportunity costs of holding sight deposits are four percent, if an own rate of one percent on holding sight deposits is taken into account.

While Divisia aggregates avoid the basic shortcomings of the traditional measures, they are not without problems. First and foremost, it is at the current juncture still unclear, which level of aggregation is "optimal" or, expressed in different terms, which assets have to be included in the respective monetary aggregates. This issue is currently the subject of various types of empirical tests.[164] Moreover, it seems as if an inverse term structure poses a significant problem for the concept per se, as it would – in principle – imply a negative price for monetary services. Finally, the choice of the proper reference value for the interest rate is not uncontroversial. Taken together, Divisia aggregates have proven an extremely useful concept, but they still suffer from a number of shortcomings.

16.3 The money supply process

In the previous paragraphs, we have seen how the monetary authority can increase the amount of central bank money available to the economy. This was a rather straightforward exercise, since all the central bank had to do was to lengthen its balance sheet by means of appropriate operations.[165] But how much will the increase in the various M's be, that follows out of such an initial increase in central bank money?

In fact, it can be shown that commercial banks are able to create additional money by multiplying the base money created by the central bank through fractional reserve banking. Expressed in other words, through fractional-reserve banking, the modern banking system expands the money supply of a country beyond the amount initially created by the central bank.

In fact, two types of money can be distinguished in a fractional-reserve banking system, namely, first currency originally issued by the central bank and, second, bank deposits created at commercial banks.

When a commercial bank loan is extended, new deposits and, therefore, new commercial bank money is created. Because of this money creation process by the commercial banks, the money supply of a country is usually a multiple larger than the money issued by the central bank. The exact mechanism being at work is typically called the "money multiplier". The size of the multiplier is among other things determined by the reserve ratio.

In the process of money creation, two kinds of restrictions have to be taken into acount. First, banks are required to hold a certain ratio of their deposits at the central bank. This ratio (r) is called the reserve ratio. Second, banks face a so-called "cash-holding ratio" (k), which in essence means, that a certain percentage share of bank deposits have to be held in cash in order to prepare for cash withdrawals from customers. For didactial reasons, however, we abstract from the existence of the cash-holding ratio for the time being when illustrating the functioning of such a process by means of a simple example.

The process starts with an injection of €400 of central bank money as a deposit into Bank A. Bank A takes €80 (i.e. 20%) and sets it aside as reserves. Subsequently, it loans out the remaining €320 (i.e. 80%) to a customer (as a consequence, Bank A now only has €80 of central bank money on its books). At the same time, the loan recipient now deposits his €320 in Bank B. Bank B then sets aside €64 as reserve and lends out the remaining €256 to another customer. The latter customer deposits €256 with Bank C and so on and so forth. It is easy to see that by means of new loans, additional deposits are created at each stage and, since deposits, form part of the monetary definition, the money supply is expanded.

But how large is the increase in money supply? It can be shown that, if the reserve ratio is r, then the money multiplier corresponds to the reciprocal, namely m = 1/r and it represents the maximum amount of money, commercial banks can create for a given quantity of reserves. Given the fact that the multiplier can be shown to be m = 1/r for a reserve ratio of r = 0.2 (i.e. a reserve ratio of 20%), the multiplier would equal a value of 5.

In case, the cash-holding ratio is additionally taken into account, it can be shown that the multipier changes to $m = 1/(r - r \cdot k + k)$. And if on top of the existing reserve ratio, k = 0.25 can be assumed, then the multiplier can be shown to equal $m = 1/(0.2 - 0.2 \cdot 0.25 + 0.25) = 2.5$.

But this process only describes the maximum amount of money that an initial deposit can be expanded to with a given reserve ratio. It assumes, for instance, that any kind of loans the commercial banks offer are immediately and to their full extent demanded by the private sector; in reality a quite unrealistic assumption. In order to analyse what really happened and not, what could have happened (under some assumptions), we have to recur on another model.

What is the relationship between the monetary base and the other monetary aggregates? Let us first assume a multiplicative relationship between M1 and the monetary base (*MB*).

$$M1 = m \cdot MB \tag{16.3.1}$$

We also know from previous considerations that the monetary base is defined as the sum of currency (*CU*) and reserves (*RE*):

$$MB = CU + RE \tag{16.3.2}$$

And *M*1 is defined as the sum of currency (*CU*) and deposits (*DE*). It thus follows:

$$M1 = CU + DE \tag{16.3.3}$$

Let us now assume that banks are required to hold a certain ratio of their deposits at the central bank. This ratio (*R*) is called the reserve ratio. It then follows:

$$RE = r \cdot DE \tag{16.3.4}$$

Moreover, most people would like to hold a part of their money in the form of currency. The currency deposit ratio (*c*) measures how much currency people want to hold as a ratio of their deposits. It then follows:

$$CU = c \cdot DE \tag{16.3.5}$$

Taken together, it follows that:

$$M1 = m \cdot MB \quad \text{or, equivalently,} \tag{16.3.6}$$

$$M1/MB = m \quad \text{or, equivalently} \tag{16.3.7}$$

$$(CU + DE)/(CU + RE) = m \tag{16.3.8}$$

At the same time, it also follows that:

$$M1 = c \cdot DE + DE = (c+1) \cdot DE \tag{16.3.9}$$

and

$$MB = c \cdot DE + r \cdot DE = (c+r) \cdot DE \tag{16.3.10}$$

And hence:

$$\left[(c+1) \cdot DE\right] / \left[(c+r) \cdot DE\right] = (c+1)/(c+r) = m \tag{16.3.11}$$

The term m is called the money multiplier. It basically tells us by how much $M1$ exceeds the monetary base. If the reserve ratio and the currency deposit ratio can be regarded as fixed during the process, by controlling the monetary base, the central bank could control $M1$. The money market multiplier equals $1/r$ if the public holds no currency (c=0) and it is equal to 1 if all deposits are held in the form of reserves.

It is easy to see that the money supply process then turns into a two-step procedure. In the first step, the central bank directly controls the amount of base money and then in a second step, indirectly influences the broader monetary aggregates. The indirect influence, however, critically hinges on the stability of the two factors determining the multiplier, namely the reserve ratio and the currency deposit ratio. This became obvious in the course of the financial crisis, when banks reacted to the worsened macroeconomic environment by starting to accumulate excess reserves. As could be expected, the prevailing stable link broke down and, therefore, central bank money creation did not translate into commercial bank money creation but, instead, remained in the form of (unlent) excess reserves.

In line with this, in the empirical literature, the long-run stability of the relationship derived above has sometimes been tested by means of the so-called "cointegration tests", but the results have been mixed.[166]

16.4 Money demand

Just as is the case for money supply, the question for the determinants of money demand or, in other words, the reasons for holding money are regarded as a crucial issue in monetary theory and policy. Over past decades, a variety of money demand approaches have been developed and presented in the literature. Among them are the quantity theory, the Keynesian approach, the Baumol-Tobin and the Tobin approach as well as the Friedman approach.

For a long time, the theory of money demand was dominated by the so-called "older" quantity theory. The latter was due to the fact that the "classical economists" regarded money mainly as a medium of exchange. One of the main variants focused on velocity and its behavior with the main advocate being the famous US-economist I. Fisher, who had developed the well-known "equation of exchange".[167]

$$M \cdot V = P \cdot T \tag{16.4.1}$$

where M stands for the stock of money and V for velocity. Moreover P and T denote the price level and the volume of transactions, respectively. As it stands, the equation just represents an identity, since the volume of transactions in an economy can either be expressed in monetary or in real terms. In economics, it is not uncommon, to approximate the (unknown) level of transactions by real GDP. It then follows:

$$M \cdot V = P \cdot Y^r \tag{16.4.2}$$

In the next step, however, a number of assumptions might change the picture completely. If it is assumed that real income is driven mainly by real factors and velocity is constant in the short run (hence the bars on top of the variables), it follows:

$$M \cdot \bar{V} = P \cdot \bar{Y}^r \tag{16.4.3}$$

And this equation turns out to be a money demand equation. This is due to the fact that the inverse of velocity is exactly the cash holding coefficient. Then the following equation holds:

$$M = \frac{1}{V} \cdot P \cdot Y^r \qquad \text{or, equivalently,} \qquad (16.4.4)$$

$$\frac{M}{P} = \frac{1}{V} \cdot Y^r \qquad (16.4.5)$$

It is crucial, that Fisher regarded velocity as being constant in the short run, since over such a horizon, it seemed to be determined by institutional factors, such as, for instance, payment habits or the density of population. These factors might vary substantially in the long run, but certainly not in the short run.

By contrast, the UK-economists A.C. Pigou (1877–1959) und A. Marshall (1842–1924) made already an early attempt to develop a micro-founded theory of money demand by asking how much money an individual is willing to hold.[168] Consequently, factors such as, for instance, the level of overall wealth, possible advantages and alternative costs of holding money had to be taken into account. Given the assumption, however, that these factors can be regarded as constant over shorter horizons, it follows:

$$M = \frac{1}{V} \cdot P \cdot Y^r = k \cdot P \cdot Y^r \qquad \text{or, equivalently,} \qquad (16.4.6)$$

$$\frac{M}{P} = k \cdot Y^r \qquad (16.4.7)$$

Taken together, it follows that:

$$M = k \cdot P \cdot Y^r \qquad (16.4.8)$$

where the desired money holdings increase with a higher cash holding coefficient (i.e. a lower velocity), a higher price level and higher real income.

The views of the "older" quantity of money were rigorously challenged in the work of the UK-economist J.M. Keynes.[169] In particular, Keynes distinguished three different motives for holding money, namely transactions balances, precautionary balances and speculative balances.

Transactions balances are held for the purchase of goods and services. In line with this, the transactions demand for money is positively related to real income and prices. If an individual's income rises or if prices in the shops increase, an individual will have to hold more cash to carry out his everyday transactions. The quantity of nominal money demand is, therefore, proportional to the price level in the economy.

Precautionary balances are held to cover for unexpected items of expenditure. As the transactions demand for money, precautionary balances are positively correlated with real income and the price level.

Speculative balances are held to ensure that an investment into other assets is possible at any moment. In Keynes' case, the assets under review were longer-term bonds (so-called "consols"), which can be characterized by an inverse relationship between the price of a bond and the rate of interest. More specifically, if the market rate of interest falls, the price of the bond will increase in order to secure the same return. Conversely, if the rate of interest increases, the price of bonds will fall. Taken together, there is an inverse relationship between interest rates and the market prices of (fixed interest) government securities.

Keynes argued further, that each individual has a clear view about an 'average' or 'normal' rate of interest. If the current interest rate was above the average rate, then a rational individual would expect interest rates to fall. Similarly, if current rates are below the average rate, then obviously interest rates would be expected to rise. At high rates of interest, individuals expect interest rates to fall and bond prices to rise. To benefit from the rise in bond prices, individuals use their speculative balances to buy bonds. Thus, when interest rates are high, speculative money balances are low. At low rates of interest, individuals expect interest rates to rise and bond prices to fall. To avoid the capital losses associated with a fall in the price of bonds, individuals will sell their bonds and add to their speculative cash balances. Thus, when interest rates are low, speculative money balances will be high. Therefore, an inverse relationship between the rate of interest and the speculative demand for money exists.

The total demand for money is obtained by summing the transactions, precautionary and speculative demands for money. When illustrated in graphical terms, the aforementioned relationship is sometimes called the "liquidity preference" curve and it is inversely related to the rate of interest.

Taken together, money demand can be expressed as follows:

$$L = L^T + L^S = L^T(Y^r, P) + L^S(i) \tag{16.4.9}$$

whereby Y^r denotes real income and *P* and *i* stand for the price level and the interest rate, respectively. The Keynesian theory of the demand for money was further elaborated in the fifties by several other influential authors.

In their work, Baumol and Tobin showed that the transactions demand for money also depends on the interest rate.[170] Why is that? Suppose, an individual or a household receives an income paid at the start of a period and expenditures would occur evenly throughout the period. At the start of the following period, the individual again receives income and the situation is repeated. The income that the subject receives at the start of the period can be deposited in bonds bearing a fixed yield. The bonds are then periodically converted into money in order to pay for the expenditures. Each conversion of bonds to money is, however, necessarily connected with certain transaction costs (so-called "brokers fee") and, consequently, also with the loss of income, which bonds bear.

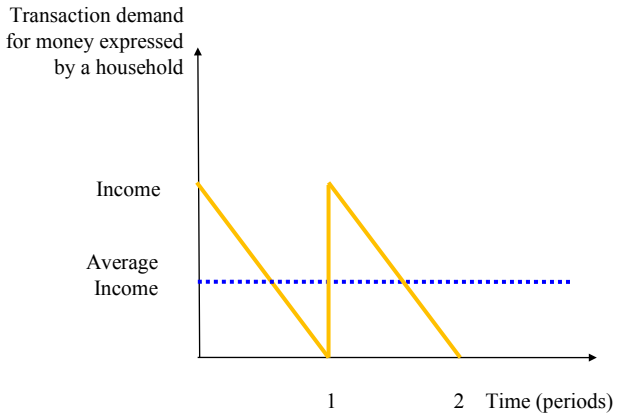


Chart: Transactions demand for money
Source: Own illustration.

If the individual decides to hold a large amount of money in the beginning, and, thus, avoids converting bonds into money too often, then his expenses for conversion are reduced, but large opportunity costs (in the form of foregone interest rate income) arise to him. If, by contrast, the individual decides to hold less money, his opportunity costs will be lower but the conversions from bonds into money will have to take place more often.

What will be the amount of optimal cash holdings? If the individual behaves rationally, the amount of money will be chosen in a way that exactly minimises total costs, which are, by definition, the sum of transaction costs (i.e. the costs for conversion) and opportunity costs (i.e. the loss of alternative income). The mathematical derivation then yields the following solution for the optimal transaction demand for money:

$$L^T = \frac{1}{2} \cdot \sqrt{\frac{2 \cdot b \cdot Y^r}{i}} \cdot P \tag{16.4.10}$$

Quite obviously, the optimal transactions demand for money is equal to the square root of two times the brokers fee (b) times real income (Y^r) divided by the interest rate (i). The higher the broker's, the higher cash holdings, while the higher the interest rate, the lower these holdings. Baumol and Tobin, therefore, showed that, even in case a speculative motive does not exist, money demand will depend on the interest rate.[171]

Another shortcoming of Keynes' theory of speculative money demand was the fact that individuals hold all their wealth either in form of money or in the form of bonds (so-called "all-or-nothing individual"). Therefore, a diversification at the individual level was not foreseen.[172] In his work, J. Tobin further extended Keynes' speculative demand for money and developed it into a fully-fledged portfolio-selection theory.[173] His main assumption was that individuals do not only consider the yield of the assets, but also their level of risk, when making their choice. In this respect, money can be seen as an asset which usually gives a yield of zero but, at the same time, does not carry a risk. By contrast, bonds usually return a positive yield, but also carry a certain risk.

At the same time, people have different levels of risk. There are, for instance, 'risk-loving' individuals (i.e. investors willing to take on additional risk for an investment that has a relatively low expected return), 'risk-neutral' individuals (i.e. investors that do not care about risk) and 'risk-averters' (for the latter, risk is a "bad" and, consequently, they would like to be compensated for more risk by a higher return). According to Tobin, the normal case is the one of a 'risk-averter', implying that the indifference curve of such a risk-averse individual would be upward-sloping. The optimal portfolio is then determined in the point, where the indifference curve touches the budget constraint, which in turn then determines the share of bonds in the total portfolio.

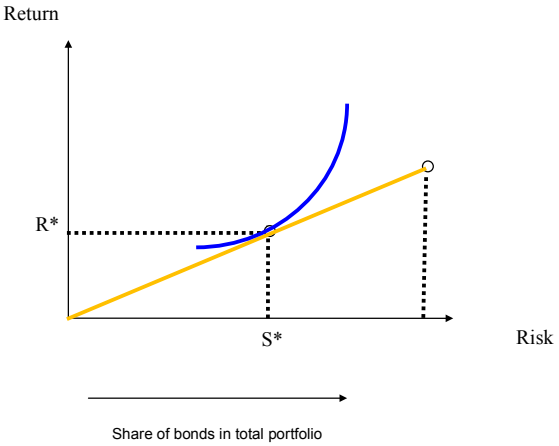


Chart: Portfolio selection approach
Source: Own illustration.

On the basis of a comparison of yields and risks assigned to the assets under consideration, an optimal portfolio structure can be found. It is important to see that – under quite realistic assumptions – a diversified portfolio results at the micro-economic level; a result that has given rise to the popular statement: "don't put all your eggs into one basket". Rational investors, therefore, diversify their portfolio across various assets with varying degrees of risk. This is clearly a step ahead when compared to Keynes' theory, where a diversified portfolio was only possible at the macro-level. It is worth noting, however, that in both approaches, the speculative demand for money remains a declining function of the interest rate.

M. Friedman's approach to money demand was based on the view that the demand for money could be treated similar to the demand for any other particular good along the lines of microeconomic theory.[174] More precisely, according to Friedman, the demand for money can be expressed as follows:

$$L = f(i_M, i_B, i_E, P, \pi, w, Y_p) \tag{16.4.11}$$

It is easy to see that the interest variable entails three components, namely first, the interest paid on money (i_M), which has a positive effect on the demand for money. The other two variables are the interest rates on bonds (i_B) and on equities (i_E), which both tend to decrease the demand for money.

Following Friedman, two additional other variables influencing the demand for money are the price level (P) and inflation (π). While an increase in the price level increases the demand for money, an increase in inflation decreases the demand for money.

Another determinant is represented by wealth. Friedman's definition of wealth is, however, not equivalent to any other wealth variable as it incorporates non-human wealth (i.e. bonds, stocks etc.) as well as human wealth (i.e. the sum of an individual's abilities which, when discounted, will form the background for an individual's current and future earnings). In Friedman's view, however, the fraction of non-human to human wealth (w) represents a determinant of money demand with a positive sign, as non-human wealth can be liquidated much easier in case of emergency.

Finally, Friedman mentions an income variable as a driving force of money demand. As in the case of the wealth variable, also the income variable is not equivalent to the actual income variable used in other approaches, but is represented by the "permanent income" (Y_p), the latter variable being equal to the discounted value of the wealth variable mentioned above.[175]

A very useful and somewhat integrated approach to think about money demand consists of the portfolio-balance approach advocated by Frankel (1983) and Obstfeld (1982).[176] In this approach, investors allocate fractions of their financial wealth (W) to various financial assets, such as money, domestic bonds, domestic stocks as well as their foreign counterparts. The determinants influencing the portfolio allocation are the various rates of return, the exchange rate as well as the relevant risk measures. It then follows:

$$M = b_M \cdot (i, i^*, \Delta e, \sigma) \cdot W \tag{16.4.12}$$

$$B = b_B \cdot (i, i^*, \Delta e, \sigma) \cdot W \tag{16.4.13}$$

$$s \cdot F = b_{e \times F} \cdot (i, i^*, \Delta e, \sigma) \cdot W \tag{16.4.14}$$

where the relative shares add up to one due to the wealth constraint. The specific charme of this model lies in the fact that it is able to explain in a very elegant way, why for instance increased risks in the bond markets lead to a portfolio shifts into the money market and vice versa.

In this context, it is also worth noting that most economists assign a pivotal role to money demand rather than money supply when explaining monetary developments. This is due to the fact that the central bank cannot force individuals to hold money against their will. Individuals can always transfer money into other assets and, thereby, delete it from bank's balance sheets. While this explanation does not negate the overall role of money supply for an economy, it speaks in favour of a careful analysis of the motives underlying money demand, when trying to explain money holdings in an economy.

☑ Money demand studies – a survey

This box summarises the results of a few selected studies on euro area money demand and the reported parameter estimates for the income elasticity.

Authors	Sample	Income elast.
Coenen and Vega (2001)	1980Q4 - 1997Q2	1.28
Calza, Gerdesmeier and Levy (2001)	1980Q1 - 2001Q4	1.33
Gerlach and Svensson (2003)	1981Q1 - 1998Q4	1.06
Bruggeman, Donati and Warne (2003)	1980Q2 - 2001 Q4	1.38
Greiber and Lemke (2005)	1980Q1 - 2004Q4	1.26
Brand and Cassola (2004)	1980Q1 - 1999Q3	1.33
Carstensen (2006)	1980Q1 - 2004 Q4	1.25
Dreger and Wolters (2006)	1983Q1 - 2004 Q4	1.24
De Santis; Favero and Roffia (2008)	1980Q1 - 2007 Q3	1.84
Beyer (2009)	1980Q1 - 2007Q4	1.70

Taken together, all studies report an income elasticity above unity for the broad euro area monetary aggregate M3.

Source: various studies.

From an empirical perspective, it should be mentioned that a large number of studies has been analysing the demand for money in the euro area.[177] Probably the most promising of these studies is the one by De Santis, Favero and Roffia (2013).[178] The latter authors take, in addition to the traditional (domestic) determinants such as prices, income and interest rates, also international cross-border transactions into account. Not surprisingly, this model fares quite well against the background of substantial cross-border investment flows over the past decade.

Taken together, a number of points are worth being mentioned: first, all studies report evidence in favour of a stable money demand for the broad euro area aggregate M3. Second, this evidence seems to have suffered from a break in stability starting in 2004. Third, while the concrete set-up differs in various respects, all studies report an income elasticity of above unity in the most preferred specification. How can this be explained? In fact, it can be shown that this coefficient value reflects the effect of the missing wealth variable in the specification, i.e. the results suffer from an "omitted variable" bias.[179]

Money demand cannot only be analysed at the aggregate level but also at a sectoral level. In fact, such an investigation can prove particularly useful, as it could allow to draw some conclusions regarding the (relative) stability of the respective sector and its (relative) contribution to (potential) inflationary developments. Against this background, a few studies have been conducted for the euro area. In sum, they seem to hint at the existence of substantial cross-sectoral variations in money demand behaviour.[180] In particularly, household money demand can be shown to follow rather traditional patterns and to be most closely correlated with inflation trends over the medium term. By contrast, firms (or in the language of the ECB, of "non-financial corporations") seem to behave in a more cyclical way than households. Among all sectors, the money demand of other financial intermediaries (i.e. other corporations and quasi corporations other than insurance corporations and pension funds) seems to show the highest interest rate sensitivity of all sectors, obviously reflecting the fact that many funds in this sector are managed by professional investors who continuously seek to optimise their returns.[181]

16.5 On the control of money supply

As we have seen in earlier chapters, the money supply is composed of currency in circulation and various deposits held with the banks. For instance, the monetary base was composed of currency in circulation and reserves. Hence, a central bank that wants to tighten the money supply has in principle two options. It can, first, diminish the amount of notes and coins in circulation and it can, second, increase the amount of reserves held with the central bank.

The first option is very easy to implement since the central bank is the sole supplier of banknotes and also coins, although the right to coin mint is in many countries with the government. But in many cases, the central banks buy the coins from the government at face value to keep the process under control.

The second option basically consists of the regulation of the minimum reserve requirements held by banks. Increasing the minimum reserve requirements can help to reduce the credit-creation process and, thereby, limit the growth in the money supply.[182]

But this approach to control money supply would only work in an accurate way, if the multiplier would prove to be absolutely stable. In reality, however, this is not the case. Moreover, it has been shown that an alternative to the control of money supply, namely the control of interest rates, might be much more effective.[183] This is due to the fact that in case, money demand proves to be particularly unstable, i.e. subject to erratic shifts, the combination with a given level of money supply will inevitably result in unforeseeable swings in the interest rate (i.e. the price in the money market). If, by contrast, the interest rate is set, the erratic changes in money demand will be reflected in instabilities in money supply behaviour. Should the central bank, however, decide to accommodate the latter movements, it might end in a situation of a de facto management of interest rates. Under such a policy, interest rates are more or less officially declared and the amount of money, that is demanded, is then exactly supplied to the market. In other words: the central bank is effectively fixing the interest rate for the money market and then managing the desired supply through open market operations to ensure that the market price for money is the same as the central bank‘s desired rate.

Open-market operations can in essence be seen as the purchase or sale of bonds from or to credit institutions by the central bank. If a central bank sells bonds to a bank, the bank has in exchange to transfer funds to the central bank and this transaction would in turn limit the credit-creation process. In real life, however, central banks use open-market operations mostly to provide the banking system with a sufficient amount of liquidity.

Finally, some central banks also make use of changes in the minimum reserve ratio. As has been shown in earlier chapters, this ratio appears in the denominator of the bank-expansion multiplier formula. Therefore, a lowering in the reserve ratio by the central bank will increase the bank-expansion multiplier and, hence, the amount of loans provided. Conversely, when facing a decline in the reserve ratio, banks will find themselves with excess reserves and can, therefore, increase lending.

Taken together, central banks can exercise control over the money supply through use of open-market operations, changes in the reserve ratio and changes in key interest rates.

16.6 The monetary policy transmission process

Over the recent decades, economic research has made enormous efforts to explore in more detail the various channels through which monetary policy actions affect aggregate demand and, ultimately, inflation. In today's literature, it is widely agreed that some of these channels warrant particular attention. More specifically an interest rate channel, an exchange rate channel, some alternative asset price channels and a credit channel are often mentioned.[184]

The so-called "interest rate channel" postulates that an expansion of the money supply or, equivalently, a reduction in the key interest rate of the central bank sets in motion similar changes in a variety of other interest rates, such as, for instance, bank's lending and deposit rates, albeit the two latter ones usually adjust in the same direction but not necessarily by the same amount as the policy change.[185] Given the fact that prices are sticky (at least in the short run), this leads to a decline in real interest rates, to which firms and consumers respond by adjusting their investment and spending patterns. As a result, consumer spending (C), fixed capital formation (I) and real output (Y) start to respond. Following the simple, yet adequate, framework widely used in the literature, the interest rate channel can be presented as follows:[186]

$$\text{key interest rates} \downarrow \rightarrow {}^{\text{®®}} \text{(real) interest rates} \downarrow \tag{16.6.1}$$

$$\rightarrow (I\uparrow,\ C\uparrow) \rightarrow Y\uparrow$$

☑ Interest rate pass-through in the euro area – empirical results

There are a number of papers that empirically investigate the interest rate pass-through at the euro area level. When applying (vector) error-correction and vector autoregressive models, it is generally found that the pass-through from official interest to market interest rates is complete for money market interest rates up to three months, but not for market interest rates with longer maturities.
As regards the time profile, the immediate pass-through of changes in market interest rates to bank deposit and lending rates is found to be at most 50%, whereas the final pass-through is typically found to be close to 100%, in particular for lending rates. Empirical results for a sub-sample starting in January 1999 show qualitatively similar findings and are supportive of an even faster interest rate pass-through since the introduction of the euro.

Source: De Bondt (2005).

In the context of the so-called "exchange rate channel", the expansionary monetary policy, that is mirrored in a decline in domestic real interest rates, makes deposits denominated in domestic currency become less attractive than deposits denominated in foreign currencies, thus affecting the exchange rate in the sense of a depreciation of the home currency.[187] In the next step, the lower value of the home currency (S) makes domestic goods cheaper compared to imported goods, hence causing a rise in net exports (NX) and also in aggregate output. The schematic illustration of the exchange rate channel is:

$$\text{key interest rates} \downarrow \rightarrow \text{(real) interest rates} \downarrow \rightarrow S\downarrow \tag{16.6.2}$$

$$\rightarrow NX\uparrow \rightarrow Y\uparrow$$

Further evidence is added by the so-called "wealth channel", which in essence claims that monetary policy impulses are also transmitted through the prices of assets such as stocks, bonds and real estate into the real economy. There are mainly three different types of transmission mechanisms involving asset prices mentioned in the literature:

- For instance, Modigliani's life cycle model states that consumption is determined by the lifetime resources of consumers.[188] The latter consist primarily of financial assets, mostly stock, and real estate. Interest rate cuts entail a rise in stock and real estate prices and, accordingly, boost household wealth. At the same time, consumers' life cycle resources expand, thus fuelling consumer spending and aggregate demand. It then follows:

  $$\text{key interest rates} \downarrow \rightarrow \text{equity prices and house prices} \uparrow \rightarrow \text{wealth} \uparrow \rightarrow C \uparrow \rightarrow Y \uparrow \quad (16.6.3)$$

- Moreover, Tobin's q theory adds another important mechanism through which movements in stock prices can affect the economy.[189] In essence, Tobin's q is defined as the market value of firms divided by the replacement cost of capital. If q is high, the market price of firms is high relative to the replacement cost of capital, and new plant and equipment capital is cheap relative to the market value of firms. In line with this, companies are able to issue stock and get a high price for it. As aconsequence, investment spending will rise because firms can now buy a relatively large amount of new investment goods with only a small issue of stock. An interest rate cut entailing a rise in stock prices will therefore reduce companies' capital costs and, consequently, boost investment spending.

  $$\text{key interest rates} \downarrow \rightarrow Q \uparrow \rightarrow I \uparrow \rightarrow Y \uparrow \quad (16.6.4)$$

- More generally, a rise in stock and real estate prices improves corporate and household balance sheets. Higher net worth translates into higher collateral for lending to companies and households. This in turn increases lending, investment spending and hence higher aggregate spending. This can be shown as follows:

  $$\text{key interest rates} \downarrow \rightarrow \text{balance sheets} \uparrow \rightarrow \text{collateral} \uparrow \rightarrow (C \uparrow, I \uparrow) \rightarrow Y \uparrow \quad (16.6.5)$$

Another monetary policy transmission channel, the so-called "credit channel" has accentuated the role of asymmetric information in financial markets. The credit channel in essence distinguishes two different channels.[190]

In the context of the so-called "bank lending channel", the expansionary central banks' monetary policy actions increase commercial banks' deposits and, hence, allow for an expansion in the amount of loans. The latter expansion in loans will then cause investment and consumer spending to rise, contributing to an acceleration of growth and, possibly, inflation.

It is important to mention that this effect can be expected to be stronger for those firms that are more bank-dependent than others, that is, in most cases smaller firms.

$$\text{key interest rates} \downarrow \rightarrow \text{bank deposits} \uparrow \rightarrow \text{bank loans} \uparrow \rightarrow (I \uparrow, C \uparrow) \rightarrow Y \uparrow \quad (16.6.6)$$

The so-called "balance sheet channel" also arises from asymmetric information in credit markets. The basic problem consists of the fact that firms with a lower net worth have less collateral to offer and, therefore, losses resulting from adverse selection are more severe. At the same time, the lower net worth also might give rise to moral hazard problems, since owner might be tempted to engage into riskier projects. Since the engagement in riskier projects might increase the probability of the lender to default, a decline in net worth might lead to a decline in lending and, hence, in investment spending.

An expansionary monetary policy might then be followed by a rise in equity prices and, therefore, in net worth. This in turn leads to more collateral available for loans and together with a parallel improvement in the cash flow situation, the banks' potential losses from adverse selection and moral hazard tend to shrink. Taken together, it follows for the balance sheet channel of monetary policy transmission:[191]

$$\text{key interest rates} \downarrow \rightarrow \text{equity prices} \uparrow, \text{cash flow} \uparrow \rightarrow \text{adverse selection} \downarrow, \text{moral hazard} \downarrow \rightarrow \text{lending} \uparrow \rightarrow (I \uparrow, C \uparrow) \rightarrow Y \uparrow \quad (16.6.7)$$

☑ Moral Hazard and Adverse Selection

The term "moral hazard" in essence describes the behaviour of an economic subject to take risks because the costs will not be borne by the subject itself, but by others. This could, for instance, be the case, when a car owner decides to drive more aggressively, knowing that the insurance will cover for possible damages. Similarly, at the macroeconomic level, it could well happen that banks take more risk assuming that they are "too big to fail" and will, eventually, be saved by the government.[192]

The terms "adverse selection" or "negative selection" basically derive from the insurance business, where it describes the situation of a bad outcome, which is in essence due to asymmetric information. The US-economist G. Akerlof has demonstrated this by use of the example of the market for used cars.[193] In principle, there are good used cars ("cherries") and bad used cars ("lemons"). While the seller is fully informed about the quality of his car, the buyer cannot know beforehand, whether he is confronted with a cherry or a lemon. The buyer will, therefore, have the best guess that this is a car of average quality and this will form the basis of his bidding behaviour. This, in turn, implies that the owners of good used cars will never be able to get a fair price and will, therefore, withdraw from offering their cars at this market, hence causing an overall reduction in the average quality of the cars offered for sale. As a matter of fact, buyers will revise downward their expectations, implying that the owners of moderately good cars will also withdraw. At the end of the day, only the lemons remain on offer.

Source: Gerdesmeier (2011), pp. 214–215.

Finally, in the context of the so-called "risk-taking channel", substantial swings in financial intermediaries' and investors' risk perceptions threaten normal access to credit for the purpose of financing entrepreneurial activity in the economy.[194]

This admittedly quite simple overview already shows that the transmission process of monetary policy must be regarded as a very complex phenomenon. While it does not constitute a "black box" anymore, economists are still far away from a complete understanding. At the same time, it is clear that no "automatisms" are at work. Sometimes, channels have amplified effects and, on other occasions, channels are "blocked", depending on the general state of the economy, the concrete situation in some important sectors, the global environment and many things more.

In order to complete the picture, it is worth noting that, in reality, economies are continually affected by various kinds of external influences, disturbances and shocks. Against this background, the role of monetary policy consists in fostering the return of the economy to its longer-term equilibrium.

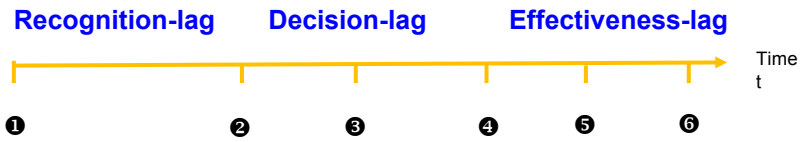
16.7 Time lags of monetary policy

Independent of the concrete variables involved in the respective monetary policy transmission channel, it is worth noting that all channels have one key feature in common, which is that effects of monetary policy actions need time. Expressed in other words, the time-lags that occur between the emergence of an economic problem and the full impact of the policy intended to correct the problem to materialise, can be quite substantial.

Following the seminal work by the US-economist M. Friedman (1912–2006), the literature usually distinguishes an "inside-lag" (including a "recognition-lag" and a "decision-lag") and an "outside-lag" (including an "effectiveness-lag").[195] In a schematic way, this can be shown as in the chart below.

The expression "inside-lag" basically describes the time span it takes between the emergence of a problematic development and the launching of the corrective action by policy-makers. In this context, the "recognition-lag" covers the fact that, before a policy action can be taken, the existence of the problem must be identified within the data. It is a fact of life, however, that economic data become often only available with a lag. For instance, while data on inflation or money are generally available one month later, GDP data are usually reported with a lag of one quarter and sometimes even more. Once data have been collected, they must be analysed and evaluated to ensure the actual unsatisfying outcome does not represent just a statistical reporting error, but in fact points towards the emergence of an actual problem.

Chart: Time lags of monetary policy



❶ Unwarranted development
❷ Development reflected in the data
❸ Decision taken by the central bank
❹ Measures are set into force by central bank
❺ Effect within the banking sector
❻ Effect within the non-banking sector

Source: Own illustration.

Once the policy-makers have identified the problem, they need to make a decision on suitable policy measures. Such a decision could easily take days, weeks or months, especially in case governments and parliaments have to be involved. Moreover, after a suitable course of action has been selected, appropriate steps towards an implementation of that policy need to be taken. These actions, however, do not take much time for central banks. First, the decision-making bodies can hold a conference (or, if needed, a teleconference) at very short notice. Second, the implementation of the measures can be set in force rather quickly, if not (more or less) instantaneously. Therefore, different from other cases, a significant "decision-lag" may not arise for monetary policy.

The "outside-lag" is the time it takes after a policy is selected and implemented up to the point where the impact is fully felt by producers and consumers. The effectiveness-lag can easily take from six months up to two years for a monetary policy action to have its full impact on the economy.[196]

Taken together, it can be said that monetary policy does encounter some time lags. While the decision lag and the implementation lag are relatively short for a central bank, the effectiveness lag seems to be considerably longer.

16.8 Interest–rate decisions of the ECB

But how often do such monetary policy actions occur? The table below illustrates the interest rate decisions of the ECB's Governing Council since the start of the year 1999. A number of results emerge from that table. First of all, decisions seem to have been mostly taken in the first meeting of the month. This is, however, not too surprising, given that the Governing Council announced on 8 November 2001 to have monetary issues only on the agenda of the first meeting. Second, given the fact that there have been just 37 changes in, broadly speaking, fourteen years, the modal, or most frequent, event is clearly not to change its interest rate. This is also in in line with the frequency observed in other central banks worldwide. Third, from the table, it can also be deduced that, when official rates for the euro area do change, the changes are either 25 or 50 basis points. Only in one case, a decision to lower by 75 basis points has been taken. This is also similar to the changes in central bank rates observed in the United States and other OECD countries.[197]

Phase	Date	Level (in %)	Change (in %)
I	22/12/1998	3.00	(-)
	08/04/1999	2.50	- 0.50
II	04/11/1999	3.00	+ 0.50
	03/02/2000	3.25	+ 0.25
	16/03/2000	3.50	+ 0.25
	27/04/2000	3.75	+ 0.25
	08/06/2000	4.25	+ 0.50
	31/08/2000	4.50	+ 0.25
	05/10/2000	4.75	+ 0.25
III	10/05/2001	4.50	- 0.25
	30/08/2001	4.25	- 0.25
	17/09/2001	3.75	- 0.50
	08/11/2001	3.25	- 0.50
IV	06/12/2002	2.75	- 0.50
	06/03/2003	2.50	- 0.25
	05/06/2003	2.00	- 0.50
V	01/12/2005	2.25	+ 0.25
	02/03/2006	2.50	+ 0.25
	08/06/2006	2.75	+ 0.25
	03/08/2006	3.00	+ 0.25
	05/10/2006	3.25	+ 0.25
	07/12/2006	3.50	+ 0.25
	08/03/2007	3.75	+ 0.25
	06/06/2007	4.00	+ 0.25
	09/07/2008	4.25	+ 0.25
VI	08/10/2008	3.75	- 0.50
	06/11/2008	3.25	- 0.50
	04/12/2008	2.50	- 0.75
	15/01/2009	2.00	- 0.50
	05/03/2009	1.50	- 0.50
	02/04/2009	1.25	- 0.25
	07/05/2009	1.00	- 0.25
	07/04/2011	1.25	+ 0.25
	07/07/2011	1.50	+ 0.25
	03/11/2011	1.25	- 0.25
	08/12/2011	1.00	- 0.25
VII	05/07/2012	0.75	- 0.25
	02/05/2013	0.50	- 0.25

Table: Changes in key interest rates in the euro area
Note: Main refinancing rate of the ECB, source: http//www.ecb.int.

How can we judge whether the ECB's measures have been successful? To begin with, it is worth mentioning that the size of the change in any central bank's interest rate may be a bad guide as regards the likely impact of monetary policy on that economy. For instance, if market interest rates, the exchange rate, credit or other asset prices do not respond in a meaningful way to changes in the official interest rate (i.e. the channels are blocked or not fully functional), monetary policy will have little effect on the economy.

Second, central banks change interest rates to stabilise the economy in the face of shocks. However, it should be noted that if such a successful stabilisation is achieved, the trend in inflation and output would remain fairly stable, whereas the trend in interest rates would be more volatile.[198] A number of observers have, therefore, concluded that monetary policy instruments have become powerless and – at the same time – unnecessary in a rather stable economy. Recently, however some studies have concluded that the apparent decline in the effectiveness of monetary policy in fact rather reflects the opposite, namely an improvement in the conduct of monetary policy since the 1980s.[199]

Third, it is worth noting that the lags in transmission differ from country to country and – as we have seen already – also within the same country from time to time. The asymmetries in monetary policy transmission are certainly to a large extent attributable to the differences in the financial structures, which in turn are due to differences in the legal structures in countries.[200] Fourth, it is well accepted that ongoing financial market innovation and globalisation exert an impact on these lags at the current juncture and, most probably, will continue to do so also in the future.

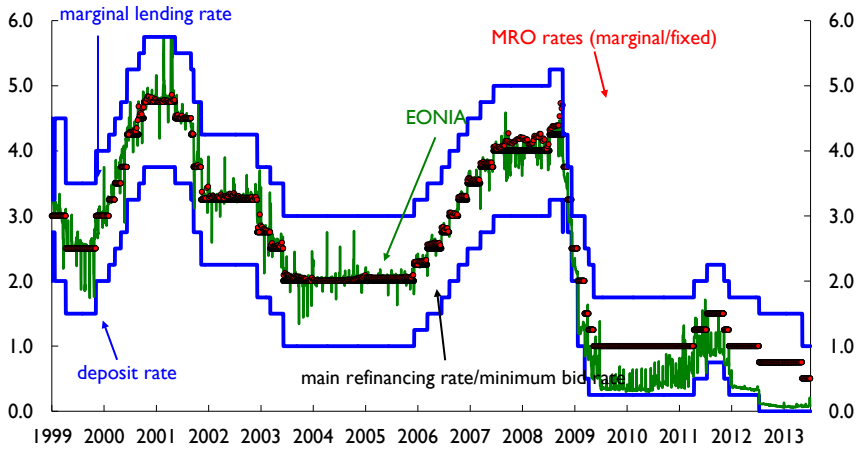
16.9 Monetary policy instruments in the euro area

As outlined above, the transmission mechanism of monetary policy starts with the ECB's management of liquidity and steering of short-term interest rates in the money market.[201] The money market, as part of the financial market, plays a crucial role in the transmission of monetary policy decisions, since it is the first market to be affected by changes in monetary policy.[202] In order to ensure that short-term interest rates are in line with the target level, the Eurosystem has at its disposal a set of monetary policy instruments, namely reserve requirements, standing facilities and open market operations.[203]

First, the Eurosystem requires credit institutions to hold a specified percentage (currently 1%) of their own customer deposits (as well as of some other bank liabilities) in a deposit account – the so-called minimum reserves – in accounts with their respective national central banks over a reserve maintenance period of around one month. These reserves are remunerated, i.e. the Eurosystem pays a short-term interest rate on these accounts. The purpose of the minimum reserve system is to create a liquidity shortage (i.e. a structural liquidity deficit), that makes the banking system dependent on the ECB's liquidity-providing mechanism.[204]

At the same time, the Eurosystem also offers two standing facilities. The latter allow credit institutions, on their own initiative, to either borrow overnight liquidity from the national central banks in the Eurosystem against eligible assets (using the marginal lending facility) or to deposit overnight liquidity with their national central banks in the Eurosystem (using the deposit facility). Since, in practice, no bank would (under normal circumstances) ask for liquidity from the market for a higher rate than the one charged by the Eurosystem or deposit liquidity in the market for a lower rate than the one offered by the Eurosystem, the marginal lending facility and the deposit facility de facto form a corridor around the short-term money market rate, that is, they provide a ceiling and a floor for the latter.

Chart: ECB key interest rates and money market rates
(in % p.a., daily data)



Source: ECB data.

Finally, the ECB provides liquidity to banks or withdraws surplus liquidity from banks through a suite of open-market operations that differ in terms of aim and regularity:

- main refinancing operations are regular liquidity-providing transactions with a frequency and maturity of one week that are usually carried out as variable rate tenders;
- longer-term refinancing operations are liquidity-providing transactions with a monthly frequency and for a term of three months;
- fine-tuning operations allow the ECB to respond on a very-short-term basis and, at the same time, very effectively to unforeseen changes in the liquidity situation in the market and to smooth the effects on interest rates; and
- structural operations are carried out by the Eurosystem through reverse transactions, outright transactions and issuance of debt certificates to influence the structural liquidity position of the euro area credit institutions.

☑ Example of a liquidity–providing tender transaction

Suppose, the ECB decides to provide liquidity to the market by means of a reverse transaction organised with a fixed rate tender procedure. Three counterparties decide to participate and submit the following bids (all figures in million €):

Counterparty	Bid
Bank 1	30
Bank 2	40
Bank 3	70
Total	140

Upon receipt of the offers, the ECB decides to allot a total of 105 million. The percentage of allotment is then calculated a follows:

$$\text{Allotment} = \frac{105}{(30+40+70)} = 75\%$$

And the final allotment to the counterparties is:

Counterparty	Bid	Allotment
Bank 1	30	22.5
Bank 2	40	30.0
Bank 3	70	52.5
Total	140	105.0

Source: EMI (1997), pp. 57, changes by the author.

16.10 Monetary policy in times of financial crisis

The currently ongoing crisis can, as regards its severity and duration, probably only be compared to the Great Depression of the 1930s. The crisis has its roots in the year 2007, when a bubble in the US subprime market (an originally rather small but then increasing segment of the US housing market) turned into a bust. It is probably fair to say, that a variety of factors, among them steadily decreasing interest rates, large inflows of foreign funds and a (more or less implicit) government guarantee created an atmosphere of easy credit conditions and, in combination with a number of complex but very popular financial products fuelled a housing boom as well as encouraged a relatively high level of debt-financed consumption.

When faced with bad loans and toxic assets in the balance sheet, various large US-banks and also European banks got into troubles. One of the first victims was Northern Rock, a medium-sized British bank which had relied on a business model based on a relatively high leverage. Northern Rock then asked for help from the Bank of England, which, when revealed to the public, led to investor panic and a bank run.

In the next step, the crisis developed further and spread into a global economic shock. It is at this stage that the contagion to the euro area started. From a euro area perspective, several main phases need to be distinguished:[205]

- 9 August 2007–12 September 2008: For the ECB, the crisis in essence started on 9 August 2007 with the period of financial turmoil, when severe tensions in interbank markets arose and, fuelled by an evolving lack of confidence and widely perceived counterparty risk, led to an increase in risk premia on interbank loans and, therefore, a widening of money market spreads.
- 15 September 2008–7 May 2010: On 15 September 2008, the US financial institution Lehman Brothers collapsed. In parallel, the period of financial turmoil intensified and turned into a global financial crisis. A large number of financial markets literally dried up and money markets broke down as illustrated by abnormally high levels in short-term interest rate spreads. Banks reacted to these developments by a "liquidity hoarding", leading in essence to a breakdown of all segments of the euro area money market. At the same time, they started shedding risks off their balance sheets and tightening loan conditions. In the course of 2009 and, following the successful implementation of the ECB's non-standard measures, financial markets increasingly showed signs of stabilisation in financial market conditions. While a number of markets showed signs of a revitalisation, economic activity rebounded and the supply of loans somehow stabilised, albeit in some segments at low levels.
- 8 May 2010–present: In early 2010, however, the euro area government bond markets came under mounting pressure. More particularly, increasing market concerns about the sustainability of public finances in view of rising government deficits and debt in some countries were followed by a widening of the spreads of longer-term government bond yields vis-à-vis their German equivalents. Finally, signs of a banking crisis in some selected countries emerged, followed by the world's biggest debt restructuring in Greece.

As a consequences, serious implications for the monetary policy transmission process materialised. In particular, the functioning of the interest rate channel, the credit channel and the asset price channel were hampered.

To begin with, in normal times – with well-functioning financial markets – the signals sent out by the official interest rates are transmitted in a rather smooth fashion to the short-term money market rates, and from there to the longer-maturity rates, that are of key importance for the economy. During the crisis, however, the pass-through of this "interest rate channel" was substantially impaired. Moreover, the resulting effect on government bond yields spread further, as the latter serve as a basis for the pricing of a variety of other financial instruments.

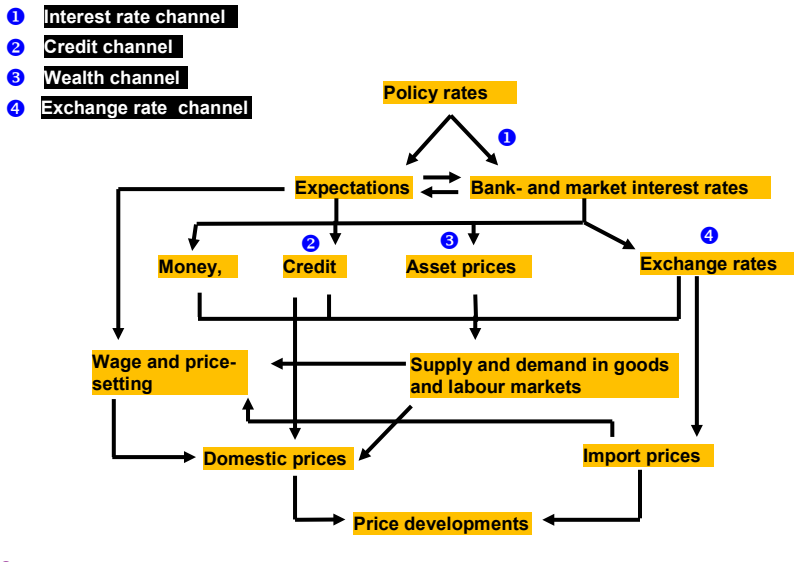
Second, the funding problems arising for banks in the course of the financial crisis forced credit institutions to adjust also the asset side of their balance sheets, thereby increasing the risk of a sharp and abrupt contraction of banks' loan supply (i.e. the "bank lending channel").[206]

Third, the cyclical downturn, combined with the fall in asset prices, impacted significantly on the balance sheets and creditworthiness of banks' borrowers (i.e. the "balance sheet channel"). These effects were further exacerbated by the sovereign debt crisis, causing losses in portfolios of financial and non-financial investors and adversely impacting on their lending ability.

Finally, significant changes in financial intermediaries' and investors' risk perceptions took place and, as a consequence, threatened normal access to credit for the private sector (i.e. the "risk-taking channel"). More particularly, the excessive risk-taking behaviour in the financial system prior to the crisis later changed into a complete unwillingness of the financial sector to take on any type of risk.

In response to these developments, the ECB took a number of standard measures and some so-called "non-standard monetary policy measures"; measures that are in the history of the euro area unprecedented in nature and scope. The latter measures taken as the financial turmoil turned into a crisis comprise the Enhanced Credit Support, the Securities Markets Programme, the three-year longer-term refinancing operations, the Outright Monetary Transactions and the "forward guidance".

Transmission process in the euro area



Source: ECB, adaptations by the author.

As regards the standard measures, the swift reduction in the key interest rates to historical lows has to be mentioned, with the rate on the main refinancing operations now standing at 0.50%. These steps are often referred to as "standard" policy measures, since changes in short-term interest rates are the main tool adopted by the ECB to achieve its price stability objective.[207]

The non-standard monetary policy measures taken by the Eurosystem in response to the financial crisis were aimed at supporting the effective transmission of interest rate decisions to the wider economy. They have been targeted mainly at the banking sector, owing to its important role in the transmission of monetary policy and the financing of the economy in the euro area (in comparison with, for instance, the situation in the United States).

16.11 Enhanced credit support

The ECB's Enhanced Credit Support comprises various non-standard measures aiming at the support of financing conditions of banks and the flow of credit to the private sector. These measures were set into force in October 2008 and complemented in May 2009.[208] More particularly, the bundle of measures included (i) an extension of the maturity of liquidity provision (an extension of the maturity of the ECB's longer-term refinancing operations to twelve months and supplementary refinancing operations with maturities of three and six months; (ii) fixed rate full allotment (unlimited access to central bank liquidity at the main refinancing rate (subject to adequate collateral); (iii) currency swap agreements (the temporary provision of liquidity in foreign currencies, most notably in US dollars, at various maturities); (iv) collateral requirements (the extension of the list of eligible collateral accepted in Eurosystem refinancing operations, in essence allowing banks to use a larger range and proportion of their assets to obtain central bank liquidity); and, finally, the covered bond purchase programme (the purchase of euro-denominated covered bonds issued in the euro area aiming at the revival of the dried-up segment of the important financial segment covered bonds market).

16.12 The Securities Market Programme

On 10 May 2010, the Securities Markets Programme was introduced. The latter was launched in response to tensions in some segments of the financial market, in particular in the euro area sovereign bond markets. In the context of this programme, Eurosystem interventions were carried out in the euro area public and private debt securities markets to ensure depth and liquidity in dysfunctional market segments and to restore the proper functioning of the monetary policy transmission mechanism.[209]

It is worth noting that in line with the provisions of the Treaty on the Functioning of the European Union, Eurosystem purchases of government bonds were strictly limited to secondary markets. Moreover, to ensure that liquidity conditions are not affected, all purchases were fully neutralised through liquidity-absorbing operations.

As regards the success of this action, it has sometimes been claimed that the interventions have been ineffective. It is a fact, however, that the effectiveness can in the end only be judged in relation to the counterfactual scenario which could have been observed, had the intervention not been carried out. This notwithstanding, it can be shown that SMP purchases had a positive albeit short-lived effect on market functioning.[210]

16.13 Three-year longer-term refinancing operations

Moreover, in two three-year longer-term refinancing operations (in the words of M. Draghi "die dicke Bertha"), the ECB allotted €489.19bn in December 2011 and €529.53bn in February 2012.

The background was a renewed intensification of turbulence in sovereign debt markets in the second half of 2011, which quickly spilled over to the banking system. As a consequence, the access of euro area banks to market-based funding came under strain.[211]

The LTROs were aimed at alleviating these adverse funding conditions and banks were able to satisfy their additional liquidity needs. While the full supportive impact of the three-year LTROs took a certain time to unfold, funding conditions for banks have since then generally improved, and there has been increased issuance activity and a re-opening of some segments of funding markets.[212]

16.14 Outright Monetary Transactions

On 6 September 2012, the ECB announced a new instrument, the so-called "Outright Monetary Transactions". An overwhelming majority of the Governing Council agreed to "address severe distortions in government bond markets, which originate from, in particular, unfounded fears on the part of investors of the reversibility of the euro".[213] Markets regarded this "fully effective backstop" as credible and, consequently, "tail risks" for peripheral countries were reduced significantly.[214] It turned out that this announcement substantially helped the peripheral economies to buy the necessary time to implement the consolidation and reforms needed to provide fundamentals consistent with continued Euro participation.

In order to qualify for the new Outright Monetary Transactions (OMT) program, countries will need to be participating in either a full or precautionary EFSF/ESM programme and accept the implied conditionality. IMF involvement will be sought in this context. Failure to fulfil the conditions established in the programme would lead the ECB to cease purchases. Purchases will concentrate on bonds with a maturity from one to three years and will be fully sterilised. In the legal documentation establishing the OMT, the ECB will explicitly renounce any claim to seniority of its sovereign debt holdings under the programme.

☑ The ESM

The new European Stability Mechanism (ESM) represents an intergovernmental institution established under public international law by a treaty signed by the euro area countries. It would be activated if indispensable to safeguard financial stability in the euro area as a whole.[215]

The most important decisions in relation to the ESM will be taken by its Board of Governors. The Board of Governors will be made up by the finance ministers of the euro area countries, i.e. the members of the Eurogroup. A second decision-making body, the Board of Directors, will be responsible for specific tasks delegated by the Board of Governors. Each euro area country will appoint one Director and one alternate Director, with the European Commission and the ECB as observers. A Managing Director responsible for the day-to-day management of the ESM will chair the Board of Directors. The ESM will be based in Luxembourg, as is the EFSF. This will help ensure a smooth transition from the EFSF to the ESM.

The ESM will have a total subscribed capital of €700 billion, of which €80 billion will be paid in capital and €620 billion callable capital. This capital structure has been put in place to ensure the highest possible credit rating for the ESM while also guaranteeing a lending capacity of €500 billion, the same as the combined lending capacity of the EFSM and the EFSF. Euro area countries will contribute to the ESM's capital according to their share in the ECB's capital key, which gives equal weight to the country's shares in the total population and total GDP, respectively, of the EU.

Source: ECB (2011e), Monthly Bulletin July, pp. 71–84.

The Securities Markets Programme (SMP) was decided to be terminated with immediate effect, with the ECB retaining its senior creditor status for bonds purchased under the SMP. Existing programme countries can also qualify for the OMT, if they have regained bond market access.

The ECB also widened collateral eligibility to foreign currency denominated bonds and, for countries benefiting from EFSF/ESM support, suspended the minimum credit rating threshold. Finally, the ECB suspended the application of the minimum rating threshold for programme countries.[216]

16.15 Forward guidance

Finally, in its meeting on 4 July 2013, the ECB's Governing Council introduced a new element into the discussion, the element of "forward guidance". In the press conference, President Draghi informed the public that, based on an unanimous decision, the Governing Council "expects the key ECB interest rates to remain at present or lower levels for an extended period of time. This expectation is based on the overall subdued outlook for inflation extending into the medium term, given the broad-based weakness in the real economy and subdued monetary dynamics".[217] This was a clearly a novelty for the ECB, being well known to "never pre-commit", since it introduced for the first time an explicit bias into its decision-making.

16.16 TARGET-2 issues

TARGET 2 stands for Trans-European Automated Real-time Gross Settlement Express Transfer System 2. Target 2 is a platform that is jointly run by the central banks of the Eurosystem. It was established in November 2007 It is owned and operated by the Eurosystem. A country joining the Eurosystem is automatically obliged to join TARGET 2. Central banks that have not joined the euro area yet, can voluntarily participate in TARGET 2. At the current stage, 24 central banks are members of the system, namely, the 17 Eurosystem NCBS, the ECB and central banks from Bulgaria, Denmark, Latvia, Lithuania, Poland and Romania.[218]

What does TARGET do? In essence, TARGET 2 allows commercial banks in Europe to conduct their payment transactions in euro on a shared platform. At the same time, it is also used to settle central bank operations in the euro area. When a bank makes a payment to a bank in another country through the payment system TARGET2, the transaction is settled in central bank money, which changes the banks' current account balances at their respective central banks. The settlement of such cross-border payments between banks in the euro area in TARGET2 thus results in intra-Eurosystem balances. These balances are automatically aggregated and, at the end of each day, netted out throughout the Eurosystem, leaving each NCB with a single net bilateral position vis-à-vis the ECB. As a result, some NCBs have a TARGET2 claim and others a TARGET2 liability vis-à-vis the ECB.

Before the financial and sovereign debt crisis, the NCBs' TARGET2 claims and liabilities were relatively stable. This is because the cross-border payment flows tended to be broadly balanced across euro area countries. With the crisis, TARGET2 liabilities have increased sizeably for some NCBs. This is because their banking systems have faced payment outflows in euro which have not been matched by payment inflows in euro, even taking into account public money inflows (including in the form of EU-IMF loans, which eventually end up in the banking systems). This has been the case for Ireland, Greece and Portugal, and, more recently, also for other countries. More recently, however, and especially following the announcement of the Outright Monetary Transactions, TARGET2 liabilities have started to decline considerably.

16.17 The way forward

In addition to the aforementioned monetary policy interventions by the ECB, Member States have also undertaken widespread reforms.[219] This was due to the fact that the incompleteness of EMU's institutional framework and its vulnerabilities became apparent in the coruse of the crisis.

In particular, three main weaknesses have been recognized as being of particular importance. First, given the fact that, in the absence of a complete fiscal union (as, for instance, in the United States), the euro area does not possess a federal budget with redistributive features and, therefore, national fiscal discipline proves more than essential. In this context, the newly introduced 'fiscal compact' has two main elements, namely first the mandatory introduction of a balanced budget rule and a correction mechanism for deviations from balanced budgets at the national level and, second, a strengthening of the excessive deficit procedure within the Stability and Growth Pact (SGP). The European Court of Justice will supervise this process.

A second weakness consisted in an uneven supervision, regulation and resolution procedures across Eurozone countries. Against this background, the need for a new supervisory framework emerged. The latter consists of two pillars. At the level of micro-prudential supervision, the European Banking Authority (EBA) as well as the European Insurance and Occupational Pensions Authority (EIOPA) and the European Securities and Markets Authority (ESMA) are involved. Art the level of macro-prudential supervision, the focus is on the European Systemic Risk Board (ESRB), which can issue warnings and macro-prudential recommendations whenever deemed necessary. The latter steps are accompanied by the new Basel III directives.

Remaining weaknesses are tackled by the establishment of 'firewalls' (that is, the EFSF and the ESM). It is worth noting, however, that further steps are needed to complete the institutional framework.

📖 Key concepts

M1, M2, M3, central bank balance sheet, base money, exchange-market interventions, money multiplier, money demand, transactions motive, precautionary motive, asset motive, portfolio-balance approach, money-supply targeting, interest-rate targeting, minimum reserve requirements, standing facilities, open-market operations, Enhanced Credit Support, Securities Market Programme, 3-years longer-term refinancing operations, outright monetary transactions, forward guidance, TARGET 2, European Stability Mechanism (ESM).

☑ Questions for review

- Under which circumstances would an interest-rate targeting be preferable to a money-supply targeting?
- What are the main monetary policy instruments of the Eurosystem?
- Which stages of the financial crisis can be distinguished?
- Which monetary policy measures have been taken in the course of the crisis? How can the essence of outright monetary transactions be described?
- What are the key characteristics of the European Stability Mechanism?

17 Monetary policy in practice

17.1 Learning objectives

In this chapter, we try to become familiar with real interest rate measures, to understand the salient features of Monetary Condition Indices and to explore the McCallum rule. We also investigate the Taylor rule and consider the usefulness of various monetary indicators.

17.2 Real interest rates

One of the most popular monetary indicators is the real interest rate in comparison with its equilibrium value.[220] If the former is below the latter, monetary policy can be regarded as being rather expansive and vice versa. It is a fact, however, that the real equilibrium interest rate cannot be observed directly and, thus, has to be quantified in an empirical manner. In this respect, one common way is to approximate it by its historical average. Alternatively, it can often be derived as a steady-state value embodied in empirical macro-models. Estimations for the euro area mostly give a value of around 2% to $2^{1/2}$%.

One of the main caveats of the concept of real interest rate gap lies, however, in the fact that the monetary authority might exclusively focus on the interest rate, when deciding on the monetary policy stance. In reality, however, a number of different factors can also influence broad monetary conditions. Among those variables, clearly the exchange rates have to be mentioned. For instance, it might well be the case that interest rates are quite high, signalling a rather restrictive monetary policy, but – at the same time – overall conditions are quite loose.

17.3 Monetary Condition Indices

The concept of a Monetary Conditions Index (MCI) was originally developed in the Bank of Canada and has since then been used extensively in academia, central banks and international organisations.[221] The basic idea of an MCI is to summarise the prevailing monetary conditions in a single figure. More precisely, it can be expressed as follows:

$$MCI = w_S \cdot (s^R - s^{R,0}) + w_r \cdot (r - r^0) \tag{17.3.1}$$

where t is a time index, $t = 0$ is the base period, g_w and g_i are the respective weights on the exchange rate interest rate and the interest rate. Moreover, s^R and r stand for the real exchange rate and the real interest rate, respectively.

☑ One size fits all?

Since the beginning of 1999, the European Central Bank has assumed responsibility for the single monetary policy in the euro area. This, however, does not imply that real interest rates are similar across the euro area countries. By contrast, the existence of different inflation rates leads to different real interest rates, as can be illustrated by the situation prevailing in the euro area in autumn 2002.

Country	ECB rate	Inflation rate	Real interest rate
Germany	3.25	1.0	2.25
Belgium	3.25	1.2	2.05
Finland	3.25	1.4	1.85
Austria	3.25	1.6	1.65
France	3.25	1.8	1.45
Luxembourg	3.25	2.2	1.05
Italy	3.25	2.8	0.45
Spain	3.25	3.5	- 0.25
Netherlands	3.25	3.7	- 0.45
Greece	3.25	3.8	- 0.55
Portugal	3.25	3.8	- 0.55
Ireland	3.25	4.5	- 1.25

Taken together, it can be shown that, even within a currency union, relatively different monetary conditions can prevail. While the German economy was at the time facing relatively high real interest rates, Ireland was confronted with even negative real interest rates.

Source: Gerdesmeier (2011, p. 186), rates expressed in percentages.

Taken together, the calculated MCI depends upon the selected measures for the exchange rate and the interest rate, the relative weights and the base period. It is also worth noting in this context, that the exchange rate is usually denoted in logarithms or in percent deviations from its baseline value, whereas the interest rate is expressed in levels.

The choice of the base period turns out to be crucial for the interpretation of the MCI. If the base period just mirrors the conditions in a certain period, the conditions can be described as "relatively restrictive" or "relatively expansive" compared to that period. If the base period reflects a period with a neutral monetary policy, the monetary conditions can be characterised as "neutral", "expansive" or "restrictive".

The basic idea of the weights is that they should reflect the relative influence of the two components on aggregate output. In theory, this seems to be a very simple exercise. In reality, however different specifications yield different results, which renders the choice of variables a non-trivial exercise.

Quite obviously, such an MCI embodies a number of attractive features. First of all, it is easy to calculate. At the same time, it is an intuitively convincing concept as the focus on exchange rates as well as on interest rates may be important in understanding an economy's behaviour (even more so for small open economies), and so the MCI might serve as useful (model-based) policy guide. Moreover, other variables that seem to play a role in the monetary policy transmission process, such as, for instance, longer-term interest rates, stock prices or house prices, can easily be taken into account.

This notwithstanding, MCIs have also been subject to serious criticisms in the literature.[222] Some authors have criticized that the weights very much depend on the underlying specification. Moreover, the fact that the weights should be time-varying is often not properly reflected in most MCIs. Finally, the sources of shocks have not been adequately represented in the underlying specifications. In practice, however, MCIs have remained quite popular and widely used.

17.4 The McCallum rule

The US-economist Milton Friedman was the first one to advocate a strictly rule-based monetary policy. In his view, the task of the central would consist in allowing money supply to grow at a constant rate (so-called "Friedman-rule" or "k-percent rule"). Expressed in a formal way, this would yield:

$$\Delta M = k \tag{17.4.1}$$

Following Friedman, this growth rate of money should be set up as to be in line with the growth in potential output. The aim of the US-economist Bennett McCallum was to substitute this rather rigid rule by a more flexible version that takes the trend in nominal GDP and velocity into account as well cyclical variations in nominal GDP (so-called "McCallum rule").[223] Moreover, he tailored his rule for the monetary base, as this is the only monetary aggregate that is fully under control of the central bank.

If the quantity theory is expressed in terms of the monetary base and in growth rates, it follows:

$$\Delta MB = \pi + \Delta Y^r - \Delta V_{MB} \tag{17.4.2}$$

And as regards the money multiplier, it can be shown that:

$$\Delta M = \Delta m + \Delta MB \tag{17.4.3}$$

Moreover, in line with the quantity theory of money, the following relationship holds:

$$\Delta M = \pi + \Delta Y^r - \Delta V_M \tag{17.4.4}$$

If the latter equation is inserted into the former one, this yields:

$$\pi + \Delta Y^r - \Delta V_M = \Delta m + \Delta MB \qquad \text{or, equivalently,} \tag{17.4.5}$$

$$\pi + \Delta Y^r - \Delta V_M = \Delta m + \pi + \Delta Y^r - \Delta V_{MB} \qquad \text{and hence} \tag{17.4.6}$$

$$\Delta V_{MB} = \Delta m + \Delta V_M \tag{17.4.7}$$

As regards the target value for inflation, McCallum suggested a value of zero. As regards the target value for real growth, he selected a figure of three percent, a value that seemed to broadly correspond to the long-term annual average of the US-economy in the post-war period. In line with these considerations, the target value for nominal US-GDP is then 3% (or, on a quarterly basis, around 0.74%). It then follows as a target value for the growth rate of the monetary base:

$$\Delta MB = \pi + \Delta Y^r - \Delta V_{MB} = 0.0074 - \Delta V_{MB} \tag{17.4.8}$$

As far as the change in velocity of the monetary base is concerned, McCallum proposed not to make use of the actual value but, instead, to use an average over the last 16 quarters.[224] The purpose of this averaging procedure was to smooth out cyclical variations in velocity. It then follows:

$$\Delta MB = \pi + \Delta Y^{r} - \Delta V_{MB} = 0.0074 - \frac{1}{16}\sum_{i=1}^{16} \Delta V_{MB,t-i} \tag{17.4.9}$$

Finally McCallum added another anti-cyclical component, namely the difference between the actual growth rate of nominal GDP of the previous episode (Y^{N}_{t-1}) and the corresponding target value for nominal GDP (Y^{N*}). It then follows:

$$\begin{aligned} \Delta MB &= \pi + \Delta Y^{r} - \Delta V_{MB} \\ &= 0.0074 - \frac{1}{16}\sum_{i=1}^{16} \Delta V_{MB,t-i} + \lambda \cdot (\ln Y^{N*} - \ln Y^{N}_{t-1}) \end{aligned} \tag{17.4.10}$$

Following these results, the central bank should increase the growth rate of the monetary base, if the actual growth of nominal GDP in the previous period is below its trend value and vice versa. The λ-parameter is, therefore, key for the concrete application of the McCallum rule and, in essence, determines the "speed of adjustment" of the US-economy. Based on his own empirical research, McCallum proposes to set λ at a value of 0.25.

17.5 The Taylor rule

In 1993, the US-economist John Taylor (1946) proposed a simple monetary policy rule that rapidly gained a lot of popularity. In its simplest form, the rule can be expressed as follows:[225]

$$i_t = r_t^* + \pi_t^* + \alpha \cdot (\pi_t - \pi^*) + \beta \cdot (y_t - y^*) \tag{17.5.1}$$

where π_t stands for the inflation rate, π^* for the desired rate of inflation and $(y_t - y^*)$ denotes the output gap. Moreover, α,β represent the weights assigned to the objectives by the monetary authority.

The rule, therefore, recommends a tight monetary policy when inflation is above its target and output is above its full employment level and vice versa. In case, both inflation and output are at their desired levels, the interest rate should just equal the equilibrium nominal interest rate, which is composed of the equilibrium real rate and equilibrium inflation.

In his original study, Taylor assumed a real equilibrium rate of 2% and a growth rate for potential output of around 2.2%. As regards the inflation objective, he selected a value of 2%. Finally, the weights were – as a rule of thumb – chosen to be of equal magnitude (i.e. 0.5). When applying his rule for the Fed over a period from 1987 to 1992, the rule seemed to mirror the Fed's behaviour so well that Taylor concluded: "In this sense, the FED policy has been conducted as if the FED had been following a policy rule much like the one called for by recent research on policy rules".[226] In related work, Taylor also showed that his rule is compatible with the quantity theory and, therefore, also with a number of monetary policy regimes followed in the past. Moreover, he emphasised that his rule showed a remarkably robust performance in a number of simulation studies aiming at the stabilisation of inflation and output. Taken together, he suggested to use his rule as a device to identify "policy mistakes".[227]

The Taylor rule has a number of advantages. First, it is simple, easy to understand and intuitively convincing. Moreover, the determinants of central banking behaviour are fully in line with the mandate of monetary policy – at least as far as the Fed is concerned. Third, empirical estimates for a variety of countries tend to give the correct signs and plausible magnitudes. Insofar, the Taylor rule seems to show a rather good empirical "fit". Finally, the rule can – under certain assumptions – shown to be micro-founded.[228]

This notwithstanding, a number of disadvantages have to be mentioned. First, a number of uncertainties remain, among them the selection and concrete choice of important variables, such as, for instance, the real equilibrium interest rate or potential output. Second, while a number of authors interpret this rule as a "reaction function" of a central bank, it is de facto a "reduced form". Third, the information set of a central bank also includes monetary and credit data, exchange data and many other variables, and is, therefore, much richer than the information set used in a Taylor rule. Fourth, some studies have shown that Taylor rules can be a source of instability for economic systems. In case, forward-looking expectations are used, multiple equilibria could result.[229] In case, backward-looking expectations are used, economic systems tend to be more stable; they are, however, less convincing from a theoretical point of view.

Fifth, the Taylor neglects some key considerations of practical monetary policy. It is, for instance, a well-known fact in monetary-policy-making that a central bank should react to different kinds of shocks in different ways. In reality, it might often pay to abstain from a policy reaction for the moment and to adopt a policy of "steady hand", if, for example, a pass-through of the central banks' interest rate reaction along the yield curve should be avoided. The latter behaviour is, however, not captured in the simple framework of a basic Taylor rule. Finally and most importantly, it has been shown that most studies are based on ex post data, i.e. data that have often been revised after a certain time. However, central banks tend to base their decisions on real time data, i.e. data that are available at the time of the decision-making process. The use of (possibly revised) ex post data in Taylor rule estimations might, therefore, yield misleading results.[230]

Notwithstanding these considerations, Taylor rules can be seen as very useful indicators and guideposts. They have, however, to be taken with some caution and should not be applied in a strictly mechanical way.

More recently, the Taylor rule framework has been extended in various ways.[231] A first important extension consisted in the introduction of the so-called "Taylor principle".[232] The latter postulates that the weight assigned to the inflation term must be larger than one, since a less-than-proportionate reaction of the central bank to an increase in inflation, might lead to a decline in real interest rates, thus fuelling inflationary pressures even further. This is why a central bank is well-advised to initiate a more-than-proportionate reaction in such a case.[233]

Other studies have tried to change the basic framework, be it by introducing additional variables or by changing the underlying specification. For instance, a number of studies have tried to include an exchange rate variable as an additional determinant into the rule. This choice can be motivated either by the existence of some sort of exchange rate constraint or by the attempt to better mirror the economic situation faced by some countries, for instance, by small open economies.

Other authors have made an attempt to better integrate a forward-looking Taylor rule framework with the interest rate-setting process initiated by the central bank. Suppose, the Taylor rule would look as follows:

$$i_t = i_t^* + \alpha \cdot \left[E(\pi_{t+k} \mid \Omega_t) - \pi^* \right] + \beta \cdot E_t(y_t - y^*) \tag{17.5.2}$$

where, different from the basic specification, the expected values of inflation and the output gap form the determinants. The latter expectations are derived on the basis of the information set Ω available in time *t*.[234]

Moreover, it is assumed that the central bank tries to move the actual interest rate closer to its (implicit) target rate in a stepwise approach. This yields:

$$i_t = (1-\rho) \cdot i_t^* + \rho \cdot i_{t-1} + \varepsilon_t \tag{17.5.3}$$

where the term (1-ρ) stands for the speed of adjustment selected by the central bank. The fact that the central bank attempts to move the actual rate towards the target rate in a cautious manner has given rise to the expressions "gradualism" and "interest rate smoothing".[235] If the latter equation is inserted into the former, it follows that:

$$i_t = (1-\rho) \cdot \left[\delta + \alpha \cdot E_t(\pi_{t+k}) + \beta \cdot E_t(y_t - y^*) \right] + \rho \cdot i_{t-1} + \varepsilon_t \tag{17.5.4}$$

where $\delta = i - \alpha \cdot \pi^*$. It then follows that:

$$i_t = (1-\rho) \cdot \left[\delta + \alpha \cdot \pi_{t+k} + \beta \cdot (y_t - y^*) \right] + \rho \cdot i_{t-1} + \varepsilon_t \tag{17.5.5}$$

if, for reasons of simplicity, the expected values are substituted their ex post equivalents. The latter formulation allows to empirically test for the existence of such an interest rate smoothing. At the same time, it is possible to extract the central bank's target inflation, if the values for the real equilibrium interest rate are given.[236]

More recent studies have also shown that the empirical fit of such rules can be improved if the output gap is substituted by the growth rate of real GDP. It then follows:[237]

$$i_t = (1-\rho) \cdot \left[\delta + \alpha \cdot \pi_{t+k} + \beta \cdot (\Delta y_t) \right] + \rho \cdot i_{t-1} + \varepsilon_t \tag{17.5.6}$$

Such a behaviour can be explained on the basis of the fact that the uncertainties regarding the correct level of the output gap can be so large that central banks tend to move their attention towards growth rates. Other studies have tried to model potential asymmetries in central bank's behaviour[238] or the existence of various regimes.[239]

17.6 Monetary indicators

But in reality, many central banks tend to look at a variety of different variables, among them – most prominently – money and credit variables. Traditionally, the latter variables are expressed and assessed in terms of annual growth rates. This is (among other reasons) due to the fact that annual growth rates tend to attract most attention in the public debate and, therefore, provide a natural starting point for a central bank's communication.

As emphasised already several times, a substantial money growth might signal imminent dangers for price stability. But when is growth too high? This is indeed a very good question and the answer depends on a variety of factors. Very clearly, for a proper assessment, a benchmark is needed. One way to derive such a benchmark is provided by the quantity theory discussed in earlier chapters.

Expressed in terms of growth rates, the quantity theory can be summarised as follows:

$$\Delta M = \Delta Y^r + \Delta P - \Delta V \tag{17.6.1}$$

In case, some "normal" or "target" values can be specified for the variables shown on the right-hand side of the equation, it should be possible to derive a "normal" growth rate for money, i.e. a growth rate that would be compatible with no imminent risks for price stability. By contrast, a growth rate that exceeds this "normal" level significantly and over longer horizons should signal the need to take action.

Indeed, the prominent role assigned to money in the ECB's monetary policy strategy is also signalled in the derivation and announcement of a so-called "reference value". The latter has been defined in terms of the growth rate of the broad (euro area) monetary aggregate M3. The choice of this aggregate is based on a number of empirical studies that strongly support the view, that this aggregate possesses a number of requested properties, namely, first, the existence of a stable money demand function and, second, satisfying leading indicator properties for future price developments for the respective aggregate in the euro area.

☑ The ECB's reference value

As already mentioned, the ECB's reference value for the growth of M3 has been derived so as to be consistent with the achievement of price stability.[240] The concrete derivation of the reference value is based on the well-known fundamental relationship linking changes in monetary growth, inflation, real GDP growth and velocity.

(i) $$\Delta M = \Delta Y^r + \Delta P - \Delta V$$

In the process of quantifying the proper values for the right-hand side values, the ECB makes use of its definition of price stability as an increase in the HICP for the euro area of below 2% per annum, the medium-term assumptions regarding potential output growth (2% – 2½% per annum) and the trend in the velocity of circulation of M3 (a decline of M3 velocity in the range of ½% – 1% per annum). Taken together, the results pointed to a decline of M3 velocity in the range of ½% – 1% per annum. On the basis of these assumptions, the ECB's reference value was set at 4½% per annum by the Governing Council in December 1998, and has not changed since. The Governing Council decided to monitor the validity of the conditions and assumptions underlying the reference value, and communicates any changes to the underlying assumptions as soon as they become necessary.

Source: ECB (1999b), p. 40 ff.

More concretely, the key growth rate for the ECB's analysis of M3 developments (in relation to the reference value) consists of a centred three-month moving average of annual M3 growth rates.[241]

It is worth noting, however, that a monthly growth rate that exactly corresponds to the reference value (being a growth concept) is by no means a guarantee for price stability. This is due to the fact that the aforementioned considerations tend to neglect past developments. For instance, it is very well possible that money growth is on track at the current juncture, but has overshot over the past years.

More generally, a central bank is well advised to also closely monitor the level of the money stock and various measures of excess liquidity. These measures constitute additional information that might help to assess the overall picture of the liquidity situation.

Various measures of excess liquidity exist in parallel. They all share the fact that – by construction – they are calculated by subtracting from the observed money stock various measures of equilibrium money balances and, therefore, abstract by their very nature from the short-term or dynamic aspects of the money demand equation and, thus, are by construction more medium term-oriented concepts.[242]

The so-called "money gap" is calculated as the deviation of the actual stock of M3 from the level implied by the reference value. By contrast, the so-called "monetary overhang" (or "shortfall") is defined as the difference between the actual money stock and the equilibrium money holdings as identified by a suitable money demand model.[243]

But why do central banks sometimes react and sometimes abstain from taking action? This is due to the fact that monetary developments might have their origin in different kinds of sources, which have to be identified first before triggering implications.

On the one hand, monetary developments may result from current changes in the determinants of money (e.g. high current monetary growth caused by high current output growth or lower interest rates). For instance, a higher monetary growth resulting from real GDP growth above its sustainable level or an inappropriately low level of interest rates may signal inflationary pressures associated with overheating of the economy. Developments in monetary aggregates may, therefore, be particularly useful to summarise valuable information contained in a variety of other indicators. If this is the case, using money as a convenient "summary measure" is likely to be of help for policy-making.[244]

On the other hand, it is easy to imagine that – at some stage – uncertainties in, for instance, stock markets materialise. In line with previous considerations and, thereby, especially the fact that money must be seen as one asset in a well-specified portfolio, investors might for instance decide to temporarily withdraw from the stock market and to "park" liquidity in short-term assets, thus increasing the demand for money, The latter developments are, however, not related to the emergence of risks to price stability. In order to ensure that no misleading conclusions are drawn in face of such portfolio changes, it might, therefore, be helpful to adjust M3 for such "portfolio shifts". In any way, the assessment of the information in money should take account of such identifiable portfolio shifts.

But how can such as systematic assessment be carried out? One way to illustrate the systematic interrelationships between some of the key economic variables at the aggregate level involves the use of the so-called "consolidated balance sheet of the MFI sector". The latter looks as follows:[245]

Assets	Liabilities
(I) Credit to euro area residents	(III) Longer-term financial liabilities
(II) Net external assets (positions with non-euro residents)	(IV) Deposits of the public sector
	(V) Other factors
	(VI) Monetary aggregate (e.g. M3)

A simplified MFI consolidated balance sheet

Given the balance sheet identity, each item of the consolidated balance sheet can be expressed as the sum of all the other items. From an accounting perspective, it then follows for M3:

$$I + II - III - IV - V = VI \tag{17.6.2}$$

For the monetary aggregates, this results in the following accounting identity:

Monetary aggregate (M3) = (17.6.3)
(I) credit to euro area residents +
(II) net external assets -
(III) longer-term financial liabilities -
(iv) deposits of the public sector -
(v) other items

From a purely quantitative perspective, it can be shown that external developments have exerted a non-negligible influence on monetary and credit developments in the euro area over recent years.

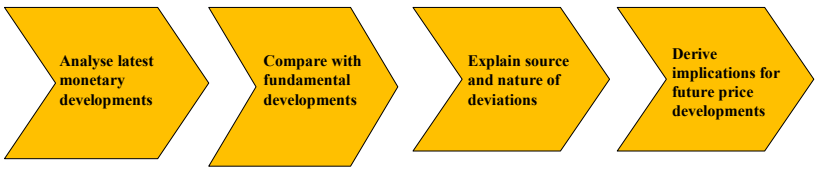


Chart: The Monetary Analysis Process
Source: Gerdesmeier (2001), p. 13.

How could a systematic approach to monetary analysis look like? The process starts with a first step, consisting of a detailed analysis of the most recent monetary data in terms of its components, counterparts and sectoral contributions. It is necessary to keep both, return and risk considerations in mind.[246] This step is complemented by an additional step, in which the latest developments are compared with the fundamental situation, the latter being mirrored, for instance, in terms of money demand or loan demand models, but in terms of current and expected developments in the real economy. In case, substantial deviations occur, views about the underlying reasons and, in particular, their persistence have to be developed in a third step. Finally, conclusions vis-à-vis the outlook for future price developments have to be drawn.

Key concepts

Real interest rates, Monetary Conditions Index, McCallum rule, Taylor rule, forward-looking Taylor, rule backward-looking Taylor rule, ex-post data, real-time data, interest rate smoothing, money growth, reference value, monetary overhang, money gap, consolidated MFI balance sheet.

☑ Questions for review

- What are the key characteristics of a Monetary Condition Index?
- What are the key characteristics of a McCallum rule?
- What are the key characteristics of a Taylor rule?
- What is the difference between a backward-looking specification and a forward-looking specification?
- What is the difference between ex-post data and real-time data and why could in matter?
- What is the essence of an interest-rate smoothing?
- What can be said about money growth and the reference value?
- What is behind the money gap and monetary overhang?

18 Asset price imbalances and monetary policy

18.1 Learning objectives

In this chapter, we try to understand some definitions of the asset price imbalances; and to explore some historical examples in more detail. We then proceed by illustrating some measurement issues related to asset price booms and busts. Finally, we investigate various types of early warning indicator models and reflect upon possible monetary policy measures.

18.2 Asset price imbalances

The dictionary defines asset prices as "the prices of assets, including land and buildings, productive equipment and securities".[247] In recent decades, asset markets and their prices have increasingly caught the attention of academia and policy circles. This is probably due to a variety of observations, among them the fact that the last decades have seen prolonged build-ups as well as sharp declines in asset prices in many markets (such as equity and housing) and in both the industrialised and the developing world. In many cases, also serious adverse and long-lasting consequences for the macro-economies of these countries could be observed. This has led to heated debates regarding the appropriate monetary and regulatory response to these dramatic shifts.

The following considerations try to briefly summarise some of the main issues addressed in the literature, to put them into perspective and to draw some lessons.[248]

Despite a widespread agreement about the often devastating effects of a bursting of an asset price bubble, it is not really clear what a "bubble" or a "financial market crisis" in essence are. While the general notion prevailing in the public and also in parts of the literature is that an asset price bubble is somewhat "excessive", the definition of asset price bubbles have in the literature also been discussed on the basis of more theoretical grounds.[249] In line with these considerations, it seems useful to distinguish, at least conceptually, between those instances in which asset prices are driven by changes in current and expected future "fundamentals" (i.e. the present value of the discounted flow of returns) and those cases in which asset prices deviate from those fundamentals; the latter case being often denoted as an asset price bubble.

More generally, a precise definition of an asset price bubble seems to embody three elements, namely (i) an element of deviation from fundamentals, (ii) an element of momentum and (iii) a psychological element.

As regards the element of deviation from fundamentals, an asset price bubble can be characterised as a situation in which "an asset price tends to grow persistently out of line with fundamentals, often in a frothy way, and tends to end unexpectedly with a sharp correction".[250] Moreover, "a bubble is an asset market event where prices rise, potentially with justification, rise further on the back of speculation, and then fall dramatically for no clear reason when the speculation collapses".[251]

As regards the element of momentum, an asset price bubble can be seen as an "upward price movement over an extended range that then implodes"[252] or, alternatively, "a bubble may be defined loosely as a sharp rise of the price of an asset or a range of assets in a continuous process, with the initial rise generating expectations of further rises and attracting new buyers – generally speculators interested in profits from trading in the asset rather than its uses of earnings capacity".[253]

As regards the psychological element, an asset price bubble represents "a situation in which news of price increases spur investor enthusiasm, which spreads by psychological contagion from person to person, in the process amplifying stories that might justify the price increases and bringing in a larger and larger class of investors, who, despite doubts about the real value of an investment, are drawn to its partly through envy of others successes and partly through a gamblers's excitement".[254]

Taken together: there seem to be the following elements: (i) a continuous rise fuelled by positive or even "excessive" expectations but not justified by fundamentals and (ii) a subsequent strong decline.

But why are asset price imbalances so dangerous? Recently a number of studies have been analysing historical boom-bust cycles in asset prices in order to detect regularities with regard to the costliness of booms, and to assess the potential for identifying dangerous booms at an early stage. An IMF survey analysed periods of bust in housing and equity markets and reached the following conclusions:[255]

- Housing price busts appear less frequently than equity price busts. Housing price peak to trough periods on average last longer than equity price busts (four years versus two and a half years).
- Price declines during housing (equity) price busts are in the order of around 30% (45%) on average. 40% (25%) of housing (equity) price booms are followed by busts.
- The output losses associated with asset price busts are substantial. The loss incurred during a typical housing (equity) price bust amounts to 8% (4%) of GDP.
- Bank-based financial systems incur larger losses than market-based financial systems during housing price busts, while the opposite is true for equity price busts.
- All major banking crises in industrial countries during the post-war period coincided with housing price busts

Other work focuses on aggregate asset price boom periods. By distinguishing between high and low cost booms, the following facts could be derived:[256]

- High cost booms typically last around a year longer than low cost booms (four versus three years), lead to a build-up of larger real and financial imbalances and are accompanied by stronger real estate price booms and higher inflation towards the end of the booms.
- During the early stages of booms, real money growth and real credit growth are larger for high cost booms.
- Towards the end of high cost booms, the stance of monetary policy is typically looser than during low cost booms.

Given the potentially destabilising and devastating nature of financial market crises, it is quite natural that the academic literature has since many years focused on the design of so-called "early warning indicator models".

18.3 Some historical examples

The expression "tulipmania" (or, alternatively, "tulipomania") originates from a specific period in the history of the Netherlands.[257] From a historical perspective, tulips probably arrived in the so-called "United Provinces" in the late 16th century from Ottoman Turkey and soon became a luxury good, in essence boosted by the desire of members of the upper classes for possession of the rarest tulips as a status symbol.

In this context, it is important to note some peculiarities related to (past) tulip cultivation.[258] At the time, tulips were often subject to a mosaic virus, known as the "Tulip breaking potyvirus", whose effect was to produce remarkable patterns in form of vivid colours, lines and flames on the petals on the flower. The valued mosaic pattern could, however, only be reproduced by cultivating the buds from the original bulb and, therefore, a virus-infected tulip bulb represented de facto a monopoly on the value of future tulips of the same type.[259]

The price of one special rare typus of tulip bulb, called "Semper Augustus", was 1000 guilders in 1623, 1200 in 1624, 2000 in 1625, and 5500 guilders in 1637.[260] Another bulb was sold in February 1637 for 6700 guilders, while the average annual income at the time was only 150 guilders. It goes without saying that tulips were also exchanged for land, valuable livestock, and houses.[261]

By 1636, tulips were traded on the stock exchanges of numerous Dutch towns and cities by all members of society. During the winter of 1636–37, an unregulated futures market in common bulbs developed, when some traders started to sell tulip bulbs that had only just been planted or those they intended to plant (in effect, representing a "tulip futures contract"). This phenomenon was widely known as "windhandel" and took place mostly in local taverns of small towns between ordinary people, further fuelled by the fact that there was no margin requirement necessary to get involved in these deals.[262] While the local authorities had banned all short sale contracts where the seller would actually not possess the underlying object, in practice, authorities did not prosecute people participating in proscribed futures contracts, but simply refused legal enforcement of such contracts.[263]

In February 1637, the bubble started to burst.[264] Various attempts were made by the local authorities to resolve the situation to the satisfaction of all parties, but they failed.[265] After the crash, prices are said to have fallen to less than 10 percent of their peak values and by 1639 prices had fallen to 1/200 of the peak price. It is reported that thousands of Dutch citizens were financially ruined. It is worth mentioning that – according to some sources – lesser versions of the tulipmania also occurred in other parts of Europe, although matters never reached the state they had in the Netherlands.

The expression "dot-com bubble" refers to a speculative bubble covering the period from broadly-speaking 1997 to 2001. The main characteristic of thus bubble was a rapid increase in stock market valuations in many countries predominantly in the new Internet sector and related fields, which was then followed by a sharp decline.[266]

Two main developments can be seen as key characteristics for this period. At the microeconomic level, the period was marked by the founding (and later on, spectacular failure) of a group of new Internet-based companies commonly referred to as "dot-coms". At the macroeconomic level, the period was marked by the notion of a emerging "New Economy", i.e. a regime characterised by a permanently higher rate of productivity growth.

The "dotcom bubble" finally burst on March 10, 2000, when the technology heavy NASDAQ Composite index peaked at 5,048.62 (with an intra-day peak of 5,132.52), more than double its value just a year before. By contrast, the Dow Jones peaked on January 14, 2000 (with an intra-day peak of 11,750.28) and the broader S&P 500 on March 24, 2000 (with an intra-day peak of 1,553.11). By 2001, the bubble's deflation was in full strength. The bursting of the dotcom bubble marked the beginning of a lengthy, albeit relatively mild recession.

18.4 Detecting asset price booms and busts

Designing an early warning system for asset price imbalances can, in essence, be divided into three basic steps.[267] In the first step, the asset price misalignments need to be defined. In this respect, a variety of approaches have been used to define such misalignments, ranging from purely statistical methods to more model-based approaches. In the second step, suitable variables are identified that could serve as leading indicators and they are then integrated in an appropriate model set-up. In the third and final step, the predictive performance of the indicators over a specific sample period is assessed and conclusions are drawn.

In order to examine the effectiveness of individual indicators, one could think of assessing the performance of each indicator in terms of the following matrix:[268]

	Crisis (within specific horizon	No crisis (within specific horizon)
Signal issued	A	B
No signal Issued	C	D

In this matrix, A is the number of periods in which the indicator issues a good signal, B is the number of periods in which the indicator issues a bad signal, C is the number of periods in which the indicator failed to issue a signal when the crisis occurred and D is the number of periods in which the indicator refrained from issuing a signal when in fact there was no crisis.

A perfect indicator would only produce observations that belong to A or D cells. Similarly, an indicator that issues a signal when no crisis follows (as denoted by the matrix field B) is said to commit a "false alarm" (or a "type I error"). If, by contrast, no signal is issued but a crisis follows (i.e. matrix field C), one speaks of a "missed crisis" (or a "type II error). Although a variety of approaches are used in parallel in the literature, the usefulness of an indicator is often typically assessed by comparing the share of false alarms with the share of correct signals given by the indicator. In this context, the so-cled "noise-to-signal ratio" ("N-t-S") is often defined as the ratio of the share of bad signals to the share of goods signals that is:

$$\text{N-t-S} = \frac{B/(B+D)}{A/(A+C)} \tag{18.4.1}$$

A perfect indicator would the obviously minimize the noise-to-signal ratio.

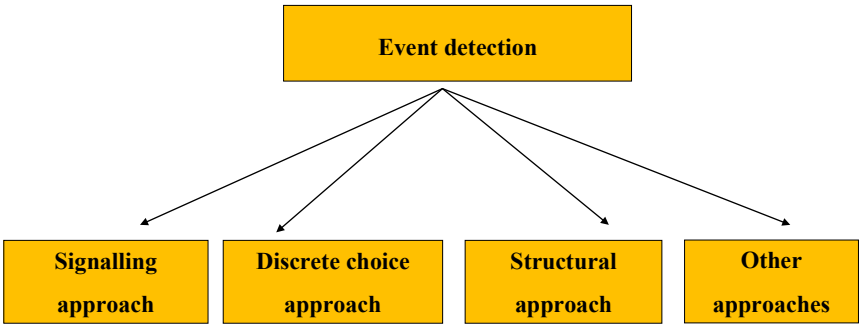
18.5 Early warning indicator models

In the literature, a number of generic approaches have been used to predict asset price misalignments. The first strand followed in the literature is the "signalling" method, in which a signal is issued as a warning of a boom (or bust) over a specific period whenever the selected indicator breaches a threshold. This is, for example, the approach used by Kaminsky, Lizondo and Reinhart (1998), who applied this specific approach to currency crises and others.[269] In their original study, the authors monitor the evolution of a number of economic variables. When one of these variables deviates from its normal level beyond a certain threshold value, this is taken as a "warning signal" of a possible crisis within a specified period of time, whereas a crisis is defined as a situation in which a sharp fall in the variable of interest exists.

It is obvious that the choice of the threshold is crucial for the validity of this approach. As a rule, threshold levels are often selected in a way that a balance is found between the risks of having too many false signals and the risk of missing too many crises.

The second strand followed in the literature is the "discrete choice" method, which in essence uses probit/logit regression techniques to evaluate an indicator's ability to predict either a boom or a bust by estimating the probability of such an episode occurring within a given time frame.[270] A warning signal is issued when this probability exceeds a certain threshold. This is the approach used in a second set of studies.[271] The latter are often carried out on the basis of panel data, which have the advantage of incorporating across countries information as well as along the time dimension.[272]

Chart: Designing early warning indicator models



Source: Chui and Gai (2005), p. 72, adaptations by the author.

The third strand followed in the literature focuses on structural models. More particularly, recent papers have focused on the method of quantile regressions, applying them to the stock as well as to the housing market in the euro area.[273] Such a procedure offers a number of potential advantages.[274] In this context, an underlying model (based on fundamentals) is developed and tested. Booms and busts are then selected as episodes when the selected asset price index deviates excessively (i.e. for instance exceeds the 80th percentile or undershoots the 20th percentile) from the levels which would be implied by these economic fundamentals.

18.6 Monetary policy, asset and consumer prices

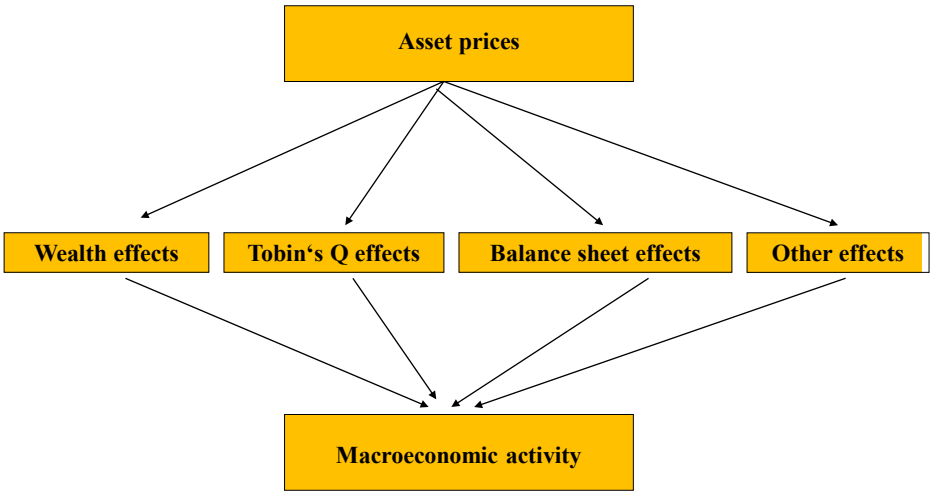
A possible impact from monetary policy actions on asset prices and then into consumer prices is not a new phenomenon. In fact, basically all monetary policy transmission channels postulate an involvement of asset markets before monetary actions "end up" in consumer prices. According to the literature, asset price developments might have effects on the real side of the economy through a variety of channels, such as, for instance, via wealth effects on consumption, via Tobin's Q effects on investment, via balance sheet effects and via exchange rate changes on net trade.[275] These various channels can be briefly summarised as follows.

- Wealth effects: Looking through the several channels of the transmission mechanism, an increase in property or equity prices which increases private sector wealth will lead to higher consumption demand, and may finally feed through to higher consumer prices. The latter effect is usually known as "the wealth effect". Such an effect might become more visible as the share of asset property in private portfolios increases and/or the higher the number of individuals that benefit from the rise in property or equity prices as a share of total population. In this respect, the literature seems to agree that (perceived) permanent rather than (perceived) transitory effects seem to matter. The exact classification of permanent versus transitory changes for the euro area remains, however, an open issue and clearly warrants further investigation.

- Tobin's Q effects: Tobin's Q-theory of investment represents another channel which links investment demand and equity prices.[276] As discussed in earlier sections, Tobin's Q is defined as the market value of capital relative to the replacement cost of capital. For example, if equity prices are relatively high, the cost of replacement of a given capital good is lower than its market (equity) valuation and, therefore, there may be a stronger incentive to increase investment. If the increase in equity prices is of substantial magnitude and/or the number of firms that are financed by equity is significant, an investment boom might occur.
- Balance sheet effects: more generally, an increase in asset prices tends to make asset holders wealthier. This effect, however, also works in downward direction, fortified by existing information asymmetries. In an environment in which firms need to borrow funds against collateral, banks might – in light of a decline in collateral and existing information asymmetries – ask additional risk premia or simply cut back the supply of loans. In such a perspective, credit must be seen as the decisive hinge between asset prices and consumption or investment.

The aforementioned effects are summarised in the stylised chart below

Chart: Asset and consumer prices



Source: Own illustration.

When assessing the available quantitative evidence for the euro area, earlier studies seem to show that the wealth channel is the most important of the various channels.[277] There is little evidence so far indicating that Tobin's Q, balance sheet and confidence considerations play any major independent role in the transmission of asset price effects to economic activity.

As regards the spillover effects from asset price developments into consumer price developments, it is worth noting that, via its impact on consumption and investment, spillover effects into inflationary or deflationary developments might be generated. In parallel, risks to the financial system might emerge. At the same time, however, it is obvious that asset price developments must not necessarily feed into consumer price developments. This speaks against any kind of naïve analysis. In the extreme case, excess liquidity can entirely go abroad and finance some investment there or "get stuck" in the process.

18.7 Monetary policy responses

The repetition of boom-bust cycles and the potentially very high costs for macroeconomic stability associated with the typically abrupt reversal of asset price bubbles beg the question: should monetary policy give more weight to asset prices?

In this context, a variety of approaches have been discussed in the literature. To begin with, the two extreme cases would consist of a "do nothing approach" and an approaching aiming at "asset price targeting". The first approach would the regard boom-bust cycles as a characteristic feature of market economies that should not be tackled by policy intervention. The second approach would, in some sense, represent the other extreme: in order to avoid the negative outcomes associated with boom-bust cycles for the real economy, central banks should attempt to target asset prices. These two extremes are of course unrealistic for various reasons.

A third approach considered is the so-called "mop up" strategy which has, for a long time, been broadly shared in the central banking and academic community. In essence, this view postulates that it is better to wait for the bubble to burst on its own and then to aggressively inject enough liquidity to avoid a meltdown in the banking system and the economy. In line with these considerations, this approach is called the so-called "mop up after" approach.[278] While this approach can be seen as being supportive of both price stability and financial stability, it can – at the same time – be suspected of providing incentives towards the creation of moral hazard and excessive risk-taking in future boom times. Moreover, it restricts the role of the central bank to an entirely passive status during the build-up of a bubble and to the status of the "saviour" after the bursting of the bubble.[279]

An alternative approach widely discussed in academia and policy circles consists of the so-called "leaning against the wind" strategy. According to this approach, monetary policy should be conducted in a "symmetric" manner over the financial cycle. In other words, it should be accommodative at a time of falling asset prices, but restrictive during a financial market boom. For instance, the central bank should conduct a slightly tighter monetary policy than warranted by its price stability objective, when the build-up of a potentially detrimental asset price boom is identified. By doing so, the central bank would "buy insurance" against the risk of a harmful asset boom-bust cycle, with its potential costs in terms of macroeconomic and financial stability.[280] In other words: in order to maintain price stability over the medium to long term, it would accept a possibly higher consumer price variability in the short to medium term.[281]

In arriving at an overall assessment, various arguments have to be taken into account and carefully weighed against each other. On the one hand, it is a well-known fact that bubbles are extremely difficult to identify in real time. Assessing whether or not asset prices are being driven by fundamentals proves to be a difficult task that is surrounded by significant uncertainty. Moreover, the question arises whether the necessary steps in policy rates (that would be needed to curb boom and bust cycles in asset prices at times of overly enthusiastic expectations) could of such a dimension that it would entail adverse implications for macroeconomic stability in the short term.[282] This would clearly speak against a "leaning against the wind strategy".

On the other hand, recent studies have shown that there are indicators based on money and credit developments that can provide guidance on the nature and the consequences of extraordinary asset price developments, and thereby help to define the need for policy action. Moreover, as the current ongoing financial crisis seems to illustrate in a very impressive way, the macroeconomic costs of financial instability and the challenges that it poses for the maintenance of price stability provide support to the case for a flexible "leaning against the wind" strategy.[283]

📖 Key concepts

Definition of a bubble, stylised facts, Type I error, Type II error, Noise-to-signal ratio, signalling method, discrete choice methods, structural models, Logit model, Probit model, structural model, in-sample exercise, out-of-sample exercise, "do nothing" approach, asset price targeting, "mop up" approach, "leaning against the wind" approach.

☑ Questions for review

- How can a bubble be defined??
- Which stylised facts have been spelled out by the literature?
- Which methods of predicting financial crises do you know?
- What is the essence of a noise-to-signal ratio?
- Which kind of possible monetary policy responses could you imagine?

19 Questions for review

The correlation coefficient…?

- ☐ is non-dimensional
- ☐ lies between the limits of -1 and +1
- ☐ can be positive or negative
- ☐ measures linear as well as non-linear relationships

A scatterplot plots…?

- ☐ the values of the series against a time axis
- ☐ the values of a trend against its cyclical variation
- ☐ the values of the second series against the ones of the first series

Which of the following countries form the "Baltic countries"?

- ☐ Latvia
- ☐ Estonia
- ☐ Russia
- ☐ Norway
- ☐ Lithuania

The name "Europe" derives from…?

- ☐ one of the six continents
- ☐ a Greek princess
- ☐ a Phoenician princess
- ☐ a Greek island

How many countries are currently members of the euro area?

- ☐ 15
- ☐ 17
- ☐ 27
- ☐ 50

Which of the following persons are currently members of the ECB's Executive Board?

- ☐ Gertrude Tumpel-Gugerell
- ☐ Peter Praet
- ☐ qJürgen Stark
- ☐ Axel Weber
- ☐ Sirkka Hämäläinen

At which point in time have the euro coins and banknotes been introduced?

- ☐ 1999
- ☐ 2001
- ☐ 2002
- ☐ 2006

The criteria, a country has to fulfil, before entering the euro area, are called…

- ☐ Independence criteria
- ☐ Convergence criteria
- ☐ Progress criteria
- ☐ Sustainability criteria

How many persons are currently members of the Governing Council?

- ☐ 15
- ☐ 17
- ☐ 23
- ☐ 27

Which of the following countries has a harp on one of its coins?

- ☐ Finland
- ☐ Greece
- ☐ Ireland
- ☐ Portugal

Which of the following countries has not introduced the euro as its currency yet?

- ☐ Germany
- ☐ Denmark
- ☐ Slowenia
- ☐ Romania
- ☐ Norway
- ☐ Bulgaria
- ☐ Hungary
- ☐ Croatia
- ☐ Canada
- ☐ France
- ☐ Luxembourg
- ☐ Greece
- ☐ Turkey
- ☐ Czech Republic

What is the name of the current President of the ECB?

- ☐ Jean-Claude Juncker
- ☐ Jean-Claude Trichet
- ☐ Mario Draghi
- ☐ Axel Weber

Which country will join the euro area in January 2014?

- ☐ Estonia
- ☐ Latvia
- ☐ Lithuania
- ☐ Croatia

20 List of symbols and abbreviations

CC	=	*Correlation coefficient*
CF	=	*Cash flow*
CU	=	*Currency in circulation*
DRP	=	*Default risk premium*
€	=	*Euro*
f	=	*Future exchange rate*
FV	=	*Future value*
i	=	*Nominal interest rate on a security*
i_{ST}	=	*Short-term interest rate*
i_{LT}	=	*Long-term interest rate*
IP	=	*Inflation premium*
LP	=	*Liquidity (or marketability) premium*
M	=	*Money*
MRP	=	*Maturity-risk premium*
n	=	*Number of years*

P	=	*Price level*
P_B	=	*Price of a bond*
P_S	=	*Price of a stock*
PV	=	*Present value*
π^e	=	*Expected inflation rate*
r	=	*Real interest rate*
R	=	*Return*
r^*	=	*Real risk-free rate of a security*
RE	=	*Reserves*
δ	=	*Standard deviation of a distribution*
δ^2	=	*Variance of a distribution*
S	=	*Spot exchange rate*
TP	=	*Term premium*
V	=	*Velocity of money*
Y^r	=	*Real GDP*
*	=	*Equilibrium variable*
^{A}	=	*Foreign variable*

21 Glossary

Arbitrage: the simultaneous purchase and sale of a financial asset in order to exploit price differences and to realise a (risk-free) profit.

Bank of England: the central monetary authority of the United Kingdom, located in London.

Bank of Japan: the central monetary authority of Japan, located in Tokyo.

Basis point: one basis point is equivalent to 0.01 percentage point.

Behavioural finance: an area of financial analysis that focuses on certain market inefficiencies.

Business cycle: an expression that basically describes the fluctuations of real economic activity around its trend. The term "business fluctuations" is often used as a synonym in the literature.

Carry trade: a popular strategy in international financial markets aiming at making profits in foreign exchange markets by exploiting existing interest rate differentials across countries.

Convergence criteria: the criteria that a member state of the European Union must fulfil in order to join the European Monetary Union and, therefore, the Eurozone.

Correlation coefficient: a measure of the degree of association between two variables.

Crawling peg: an exchange rate arrangement, in which a predetermined rate of depreciation of the home currency against the foreign currency is foreseen.

Credit default swap (CDS): a financial swap arrangement in which the seller of the CDS commits to the buyer for compensation in the event of a loan default. In a way, a CDS can be seen as being similar to a credit insurance.

Currency area: a geographic area in which the same currency holds.

Derivatives: securities that derive their value from an underlying asset, such as, for instance, a stock or a bond.

Dollarisation: an exchange rate arrangement, in which a sound foreign currency is used either in parallel to the home currency or all on its own.

ECB: European Central Bank, the monetary authority of the euro area.

Economic analysis: one of the two pillars of the ECB's monetary policy strategy. In essence, this pillar tries to identify the short to medium-term determinants of price developments, with a specific focus on real activity and financial conditions in the economy.

Efficient market: a market in which any relevant information is immediately reflected in prices.

EMI: European Monetary Institute.

EMU: European Economic and Monetary Union.

EONIA: Euro Overnight Index Average, the effective interest rate prevailing in the euro interbank overnight market.

ERM II: Exchange Rate Mechanism II.

EURIBOR: Euro Inter Bank Offered Rate.

Euro: the name of the currency of the euro area.

European Stability Mechanism (ESM): an intergovernmental institution established under public international law that will enter into force on 1 July 2013.

European Union (EU): an economic and political union currently consisting of 27 independent member states.

Eurosystem: the central banking system that consists of the 17 national central banks (NCBs) in the euro area and the ECB.

Exchange rate: the price of a currency expressed in terms of another currency.

Exchange Rate Mechanism II (ERM II): an exchange rate arrangement between the euro and the currencies outside the euro area.

Exchange rate targeting: a monetary policy strategy that, in essence, focuses on maintaining a given level or change of the exchange rate.

Executive Board: one of the decision-making bodies of the European Central Bank.

Federal Reserve Board (Board of Governors of the Federal Reserve System): A committee that consists of seven members and establishes monetary policy in the United States.

Federal Reserve System (Fed): consists of twelve regional Federal Reserve Banks located in major cities throughout the United States and a seven-member Federal Reserve Board of Governors with headquarters in Washington (D.C.).

Fisher effect: a concept originally advocated by the US-economist Irving Fisher that explains the exact relationship between the nominal interest rate, the real interest rate and expected inflation.

FOMC: Federal Open Market Committee.

Forward contract: a private agreement, where one party agrees to buy (or sell) one commodity at a specific price on a specific future date and the other party agrees to sell (or buy).

Frequency decomposition: a statistical technique that (in one of its variants) in essence decomposes a time series into three components, namely into a low frequency component, into a business cycle component and into a higher frequency component.

Futures contract: a contract that is in principle similar to a forward contract but with some key differences.

General Council: one of the decision-making bodies of the European Central Bank.

Goodhart's Law: an empirical regularity, brought about by the British economist Charles Goodhart, explaining the apparent instabilities in the money demand functions observed for a variety of countries in the sense that a previously stable money demand function might prove unstable, when a monetary authority attempts to use a stable relationship for monetary targeting.

Governing Council: one of the decision-making bodies of the European Central Bank.

Histogram: a chart that contains on its horizontal axis the variable of interest whose values are divided into suitable intervals and the number of observations in that class is indicated by the height of the corresponding rectangles.

Inflation: a sustained increase in the general price level.

Inflation targeting: a monetary policy strategy that, in essence, focuses on the developments of the inflation forecasts in relation to a pre-announced inflation target over a specific time horizon.

Interest rate: the price charged to a borrower for the loan of certain amount of money.

Interest rate parity: an equilibrium condition claiming a short- and medium-run equilibrium relationship between exchange rates and interest rates to hold.

Issing's Law: a challenge to the well-known Goodhart's Law, proposed by the former Bundesbank's and ECB's chief economist Otmar Issing, arguing that the estimated money demand functions also contain elements of the money supply process, which might have the consequence of a stable money demand function being possibly "contaminated" by an unstable money supply process. More broadly, Issing claimed that a credible and reliable monetary policy process might strengthen the stability of the financial system.

Kurtosis: a statistical tool to measure the "peakedness" or flatness of the distribution of a series.

LIBOR: London Inter-Bank Offered Rate.

McCallum rule: a policy rule first advocated by the US-economist Bennett McCallum.

Monetary analysis: one of the two pillars of the ECB's monetary policy strategy. In essence, this pillar tries to identify the possible risks to price stability over medium-term to longer-term horizons.

Monetary policy indicator: an economic variable that helps the central bank to judge the direction and strength of its monetary policy stance.

Monetary intermediate target: an economic variable that can be controlled by the central bank with a sufficient degree of precision, thus allowing the central bank to base its monetary policy actions towards the behaviour of this "intermediate target".

Monetary policy strategy: the medium- to long-term procedure adopted by a central bank in order to allow the achievement of its ultimate objective.

Monetary targeting: a monetary policy strategy that, in essence, focuses on controlling inflation by use of pre-announced monetary aggregates as intermediate targets.

Money: a good that provides three main functions, namely the function as a medium of exchange, as a store of value, and as a unit of account.

Money market: the marker for short-term funds, usually with a maturity up to one year.

Optimal currency area (OCA): a concept that was pioneered by the Canadian economist and nobel-prize winner Robert Mundell.

Option: a contract in which the option seller grants the option buyer the right (but not the obligation) to enter into transaction on an underlying asset at some predetermined price within a specified period of time.

Phillips Curve: a key economic concept that – in the interpretation of Samuelson and Solow – describes the link between inflation and unemployment in an explicit way.

P-Star approach: a popular economic concept that, in essence, links the so-called "price gap" to the "velocity gap" and the "output gap".

Purchasing power parity: one of the oldest and simplest models of exchange rate determination which is based on the idea of the "law of one price". The purchasing power parity in essence claims that a long-run relationship between exchange rates and price levels exists.

Quantity theory: a key concept in economics that basically describes the link between money and prices.

Scatterplot: a graph that contains two series, in which the values of the second series are plotted against the values of the first series.

Seasonality: a pattern of cyclic variation occurring in a repetitive and predictable fashion. Such a behavior is not uncommon for many economic time series.

Skewness: a measure of data distribution that shows whether large deviations from the mean are more likely towards one side than towards the other.

Swap: an agreement between two parties to swap something – generally obligations to make specific payment flows. Most swaps today involve either interest payments or currencies.

Standard deviation: a statistical tool to measure the variability or dispersion of a given data set.

Taylor rule: a policy rule first advocated by the Stanford professor John B. Taylor.

Time series chart: a chart showing the time dimension on the horizontal axis and the variable under review on the vertical axis.

Unemployment: status when people are without work and actively seeking for work.

VAR models: Vector Autoregressive models.

Yield curve: a graphical illustration of interest rates for similar bonds embodying identical risk, liquidity and tax considerations but different maturities.

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23 Endnotes

1. See MicroTSP (1987), p. 9.6.
2. In the empirical literature, the correlation coefficient is usually denoted with the letter r. However, we avoid this in order to avoid a potential confusion with the real interest are.
3. See Studenmund (1992), p. 51 ff.
4. See Brigham and Houston (2004), p. 184.
5. See Bleymüller, Gehlert and Gülicher (1983), p. 9 ff.
6. See Gujarati (2003), p. 147.
7. See, for instance, the considerations outlined in Bleymüller et al. (1983), p.15 ff.
8. See also Gujarati (2003), 148 ff.
9. For more details, see, for instance, Johnston and DiNardo (1997), pp. 134–135.
10. For a more detailed description, see Gerdesmeier (2011), pp. 50 ff. but also Scheller (2006).
11. The two main tasks of the EMI included the strengthening of central bank cooperation and monetary policy coordination and the contribution to the preparations required for the establishment of the ESCB, for the conduct of the single monetary policy and for the creation of a single currency in the third stage. See Gerdesmeier (2011, p. 52) but also Scheller (2006).
12. See Gerdesmeier (2011), p. 54 ff. These criteria were laid down in the Maastricht Treaty, and were signed by the members of the European Union on 7 February 1992.
13. As will be shown in later chapters, this criterion has not always been applied in a very strict manner.
14. See Gerdesmeier (2011), p. 55.
15. See, for instance, De Grauwe (2000).
16. See Pasinetti (1998).
17. See Mundell (1961), Frankel and Rose (1996, 1997).
18. See McKinnon (1963) and Kenen (1969).
19. See Molle (2001), pp. 372–373.
20. The expression was selected by the Governing Council of the ECB in 1998.
21. As mentioned before, however, once the convergence criteria have been fulfilled, an EU country can adopt the euro.
22. See Article 127 of the Treaty establishing the European Community.
23. See Gerdesmeier (2011), p. 55 ff.
24. Both the Governing Council and the Executive Board are chaired by the President of the ECB.
25. All six members of the Executive Board are appointed by common accord of the Heads of State or Government of those countries that together form the euro area.
26. See Marshall (1999), but also Issing (2008), p. 27.
27. See Irwin (2013), p. 112 ff.
28. See Irwin (2013), p. 300 ff.
29. See European Central Bank (2007), pp. 10 ff.

30. See Pollard (2003), pp. 11 ff. but also the website of the Federal Reserve Board.
31. FOMC stands for "Federal Open Market Committee" and it represents the body that is responsible for the setting of interest rates and credit policies of the Federal Reserve System. The FOMC comprises 12 members.
32. See Federal Reserve Act, Section 2A.1.
33. See Gerdesmeier, Mongelli and Roffia (2007), pp. 1787 ff.
34. For more details, see the website of the Bank of Japan (www.boj.or.jp) as well as Gerdesmeier, Mongelli and Roffia (2007).
35. See Bank of Japan (2012), pp. 25 ff.
36. See Nishimura (2010) for more detail.
37. See Bank of Japan (2003).
38. See the website of the Bank of England (www.bankofengland.co.uk for more details).
39. It is also worth mentioning that, on 18 December 2008, the Governing Council decided to continue its current voting regime and to introduce the rotation system only when the number of governors and presidents of the euro area NCBs exceeds 18, and not 15 as initially foreseen.
40. See ECB (2011c) for details.
41. This has been impressively demonstrated in the work of Kydland and Prescott (1977). See also some further developments in Barro and Gordon (1983).
42. See Rogoff (1977).
43. See, for instance, Cukierman (1992), but also Grilli, Masciandaro and Tabellini (1991).
44. See EMI (1996), pp. 100–103. It is worth mentioning, however, that in the literature also other classifications such as, for instance, "legal independence", "goal independence", "operational independence" and "management independence" can be found.
45. See Smits (1997), p. 155.
46. In this context, there is widespread agreement that the legislated term of office of top central bank officials has to be clearly longer than the electoral cycle in order to limit political influence.
47. See Bini Smaghi (2007), p. 4.
48. These paragraphs draw heavily from Pollard (2003), pp. 25 ff. and ECB (2011c), pp. 86 ff.
49. See 'The New Oxford Companion toLaw', www.oxfordreference.com.
50. See Bernanke (2010), p. 4
51. See Article 15.3 of the Protocol (No 4) on the Statute of the European System of Central Banks and the European Central Bank.
52. See ECB (2011c), p. 86.
53. See Pollard (2003), p. 26.
54. See the much more detailed and excellent presentation in Pollard (2003), pp. 26 ff.
55. See for instance Hämäläinen (2000).
56. See Gerdesmeier (2011), p. 78. It is assumed that the amount in the base year equals 100. The table then shows the remaining purchasing power after n years for a given inflation rate. The figures are expressed in percentages.

57. See Fisher (1911) and the brief summary in Brand, Gerdesmeier and Roffia (2002).
58. See Phillips (1958).
59. It is worth mentioning, however, that some economists claim to have found such kind of relationship already in the writings of Irving Fisher.
60. Milton Friedman and Edmund Phelps received the Nobel Prize in Economics in 1976 and 2006, respectively.
61. In the words of Friedman: "But people, who are forming anticipations are not fools – at least some of them are not. They are not going to persist in being wrong. And more generally they are not going to base their anticipations solely on the past history of prices". See Friedman (1976), p. 231.
62. Friedman explicitly referred to the so-called "adaptive expectations" when deriving his results. We will come back to the issue of the various forms of expectations and their implications in later chapters.
63. Again Friedman: "The only way unemployment can be kept below the natural rate is by an ever-accelerating inflation, which always keeps current inflation ahead of anticipated inflation". See Friedman (1976), p. 227.
64. See Hallman, Porter and Small (1989, 1991).
65. See Tödter and Reimers (1994) for a concrete application for the case of Germany.
66. See Gerdesmeier (2013) for a more detailed desciption of the model.
67. See Gerlach und Assenmacher-Wesche (2006) as well as Pill und Rautanen (2006).

68. It is worth noting, however, that defining the exact boundaries of the decomposition is in some sense arbitrary and that the decomposition also constitutes an accounting exercise as the sum of the various frequencies must necessarily add up to the headline series.
69. See Friedman, M. (1968), especially pp. 5 ff.
70. These considerations are quoted from Fraga (2007), p. 56.
71. For details, see Gerdesmeier and Roffia (2009).
72. For a more detailed description of VAR models, see Sims (1980).
73. In a technical sense, the reason for introducing the trend variable is the problem of "spurious correlation". This expression describes the fact that economic time series often tend to move in the same direction, reflecting an upward or downward trend. Therefore, a simple regression of the variables might not necessarily reflect the 'true' relationship, but might instead simply reflect this common trend. There are various ways to cope with this phenomenon. One way consists of the introduction of a linear time trend into the model. Another way would be to explicitly "de-trend" the variables and run the regression on the de-trended variables.
74. See also Mishkin (2003), p. 458 ff.
75. See Friedman, B. (1991) for a more detailed description of the issue.
76. See Issing (1996), p. 24. Translation by the author.
77. See Mishkin (2003), pp. 508 ff.
78. One example of such a successful speculator was George Soros, "the man who broke the Bank of England". See Mallaby (2010), esp. Chapter 7 for a detailed description of this episode.
79. As Gerald Bouey, the then Governor of the Bank of Canada once put it: "We did not abandon monetary aggregates, they abandoned us".
80. See Goodhart (1975) for details.
81. See Issing (1997) for a more detailed explanation..
82. See Mishkin and Sevastano (2001)
83. See Gaspar, Smets and Vestin (2007), but also some working papers of the Bank of Canada.
84. See ECB (2011c), pp. 62 ff.
85. See ECB (2003), pp. 87 ff.
86. See Issing (2005), in particular, pp. 2 ff.
87. The literature usually attributes this statement to Sir John Hicks.
88. See the deliberations in Gerdesmeier (2011)), p. 17 ff.
89. See Davies (1994) for a more detailed overview.
90. See Davies (1994) for a much more detailed overview on the topic.
91. Although existing evidence points towards the fact that – at times – neither the weight of such metallic money seems to have been standardised nor its value seems to have been certified by the ruling authorities.
92. See also ECB (2011b), especially pp. 18 ff.
93. See North (1995), p. 87.
94. See ECB (2011c), p. 39 ff.

95. See for instance, Rose (2003), pp. 4 ff. as well as Brigham and Houston (2004), pp. 118 ff.
96. One particular example is the one of a perpetual which is a bond without a maturity date. It pays coupons forever but the issuer does not have to redeem them.
97. See, for instance, ECB (2011c), p. 40.
98. See Issing (2011), p. 94 ff. for a much more detailed overview on the issue.
99. See ECB (2011c), pp 57 ff.
100. See the seminal contributions by E. von Böhm-Bawerk (1921).
101. See Brigham and Houston (2004), p. 136 ff.
102. See Brigham and Houston (2004), p. 132 ff. for a more detailed overview.
103. See Mishkin (2003), pp. 128 ff.
104. See Lutz (1941).
105. See ECB (2008), pp. 66 ff.
106. See ECB (2011c), p. 147.
107. See ECB (2008), p. 67.
108. See ECB (2011), p. 139.
109. See de Haan, Osterloo and Schoenmaker (2012), pp. 138.
110. See Pillbeam (1998), p. 316.
111. See Brigham and Houston (2004), p. 266
112. See, for instance, Arnold (2008), pp. 730 ff.
113. See, for instance, Pillbeam (2005), pp. 138 ff.
114. See Sharpe, Alexander and Bailey (1999), pp. 386 ff.
115. See Rose (2003), p. 208 and Pillbeam, (2005), p. 134 ff.
116. This solution was first introduced into the literature in the writings of Myron J. Gordon (1959).
117. See Gordon (1959).
118. See, for instance, Brigham and Houston (2004), p. 77.
119. The expression "blue chip" derives from casinos, where blue chips stand for counters of the highest value and, according to some sources, was applied by Oliver Gingold of Dow Jones sometime in 1923 or 1924 to the world of finance. In essence, a blue chip stock generally represents a stock of a well-established company which shows a serious business model and more or less stable earnings. From an investment perspective, it is of relevance that most blue chips pay regular dividends, even when the current situation is worse than usual.
120. The opposite definition is frequently used in the academic literature.
121. See van Marrewijk (2004), p. 24.
122. It is normally expressed in index form.
123. Some economists even argue that the ideas underlying purchasing power parity have a history dating back at least to scholars at the University of Salamanca in the 15th and 16th century, see Officer (1982).
124. This description builts heavily on Claassen (1980, pp. 424 ff) and Pillbeam (2005, pp. 138 ff).
125. The time index t is omitted for the sake of simplicity.

126. See Balassa (1964), Samuelson (1964) as well as Isard (1977).
127. Such a transformation can be done on the basis of the assumption of the purchasing power parity for tradable goods. See also Pillbeam (1998, pp. 140 ff).
128. For the following considerations, see also Dornbush (1976).See Mussa (1979).
129. See Officer (1982).
130. This would imply that there is no difference in the "perceived riskiness" of one asset relative to the other.
131. Another way of saying the same thing, is that the investor does not care about the underlying risks to the return, which are often illustrated by means of probability distributions for the return.
132. This, however, raises the question why the investor does not look at real returns, as it was shown in earlier chapters that economic subjects do not care about nominal returns but rather focus on real returns. The answer is very straightforward. Notwithstanding both alternatives, the investor only cares about the domestic price level as he can be assumed to reside in the home country. Therefore, in principle, both sides of the equation should be divided by the domestic price level. By simply multiplying with the domestic price level, however, the equation can be derived as it stands.
133. The expression can, however, be used to define exchange expectations under the assumption of "risk neutrality".
134. It is for this reason that mostly euro-currency deposits are used for testing, see for instance Levich (1985).

135. In an analysis of five major currencies against the US dollar, Clinton (1988) found that the neutral band, which is determined by transaction costs, should be within 0.06 per cent per annum from parity. Before the advanced computing and communication equipment was available the margins were, of course, considerably larger. See Clinton (1988).
136. See van Marrewijk (2004) for details.
137. See Cavallo (2006), p. 1.
138. See Burnside et al. (2006).
139. See Brunnermeier, Nagel and Pedersen (2008).
140. See Schaefer (1988) for details.
141. See Mishkin (2003), p. 512.
142. See Mishkin (2003), p. 513.
143. See Article 140(1) of the Treaty establishing the European Community.
144. Exceptions to this rule are only possible if all ERM II stakeholders agree.
145. The example is taken from Brigham and Houston (2004), pp. 687.
146. See also Gastineau (1992).
147. It is worth noting in this context, that such swap arrangements could also very well include additional side payments to cover, for instance, for different credit risks of the parties involved.
148. See Fama (1970), p. 383.
149. See Fama (1970), p. 383.
150. See also Pillbeam (2005), pp. 248 ff.
151. In the literature, this test is also known as the "Geary-test". The latter represents a so-called "non-parametric test", in the sense that it does rely on any assumption regarding the distribution from which the observations are drawn. See Geary (1970) for details.
152. A "run" is defined as an uninterrupted sequence of the same element, whereas the length of a run is defined as the number of elements inside the set.
153. When recurring on our earlier considerations in the context of stock markets, it is easy to see, that in the case of weak-form efficiency, technical analysis techniques will not create systematic excess returns. Stock prices will be entirely determined by the continuous flow of new information which – by definition – arrives in a random fashion and, hence, stock prices must follow a "random walk". By contrast, semi-strong-form efficiency would imply that neither technical nor fundamental analysis represent appropriate tools to earn excess returns in a systematic way. Such returns can only be achieved, if an investor has continuous access to valuable "inside information" (i.e. information that is not publicly available at the time). Finally, the existence of strong-form efficiency would imply that investors cannot earn excess returns in a systematic way in the respective market at all. In this respect, it is also important to note that it is very well possible that some outstanding investment managers beat the market over longer horizons, but this is due to the fact that they either have above-average skills, or above-average luck.
154. See Malkiel (2011), as well as Fama (1965).
155. It goes without saying that, as a rule, the sum of all assets has to equal the sum of all liabilities.

156. See ECB (1999) for more details.
157. Moreover, holdings by euro area residents of liquid assets denominated in foreign currencies are also included if they are held with MFIs located in the euro area. This is due to the fact that, from an economic point of view, they can be regarded as close substitutes for euro-denominated assets. See ECB (1999).
158. Since the scale is logarithmic, the slope indicates the rate of change in the respective aggregates.
159. More precisely, for these calculations, the levels are specified in logarithmic form.
160. See Barnett (1982), pp. 689 ff.
161. See, for instance, Friedman and Schwartz (1970), p. 15 f.
162. See Barnett (1982).
163. This touches upon the tests for "weak separability".
164. Just to emphasise an important principle again: in modern economies, the process of money creation does not rely anymore on the physical production of paper currency or metal coins. Instead, the central bank can simply expand the money supply by means of open market operations. When doing so, the central bank credits quasi automatically the accounts that commercial banks hold at the central bank, which form part of the monetray base. Commercial banks may then at any time draw on these accounts to withdraw physical money from the central bank.
165. See Nautz (2000), pp. 17 ff. for an application for German data.
166. See Fisher (1911).
167. See Pigou (1917) and Marshall (1923).
168. See Keynes (1936) and, in particular, the interpretation by Hicks (1937).
169. See Baumol (1952) and Tobin (1956).
170. Expressed in terms of the traditional IS-LM-diagram, this is equivalent to saying that the LM curve is upward-sloping, even in the absence of a speculative demand for money.
171. A theoretical exception could be the case, when the expected yields of money and bonds would be exactly identical.
172. See Tobin (1958) and Markowitz (1959).
173. See Friedman (1956) for details.
174. See also Gerdesmeier (2011), pp. 47 ff.
175. See Frankel (1983) and Obstfeld (1982)
176. See, for instance, Coenen and Vega (2001), Calza, Gerdesmeier and Levy (2001), Gerlach and Svensson (2003), Bruggeman, Donati and Warne (2003), Brand and Cassola (2004), Greiber and Lemke (2005), Carstensen (2006), Dreger and Wolters (2006). De Santis, Favero and Roffia (2008) and Beyer (2009).
177. See De Santis, Favero and Roffia (2008).
178. See, for instance, Ueda(1990) for the case of Japan.
179. See von Landesberger (2007).
180. See Moutot, Gerdesmeier, Lojschová and Von Landesberger (2007).

181. As matter of fact, however, banks are not very fond of holding minimum reserves since this can prove costly when the money can be lent out more profitably to customers.
182. See Poole (1970).
183. See, for instance, Mishkin (1996).
184. See, for instance, Mahadeva and Sinclair (2001), who explore the econometric link between official interest rates and interest rates on loans and deposits in a number of countries.
185. See Mishkin (1996) for details.
186. It goes without saying that this channel does not operate in case, the country maintains fixed exchange rates.
187. See Modigliani (1971).
188. See Brainard and Tobin (1968).
189. To our best knowledge, the first studies on the credit channel have been published by Bernanke and Gertler (1995), Cecchetti (1995) and Hubbard (1995).
190. Overall, this channel might amplify the influence of interest rates on investment behavior, which is referred to as the "financial accelerator effect".
191. See Stiglitz and Weiss (1981).
192. See Akerlof (1970).
193. See Borio and Zhu (2008) as well as Adrian and Shin (2009).
194. See Friedman (1961).
195. See Peersman and Smets (2003).

196. This stands in stark contrast to (quarterly) changes of around 300 basis points and more in central bank rates for some Latin American countries and some transition countries. See Mahadeva and Sinclair (2001) for details.
197. The latter is due to the fact that the interest rate was used as an instrument to affect the stability in output and inflation. While, from an ex-ante perspective, the causalities are then quite obvious, from an ex-post perspective, the linkages become somewhat ambiguous and, often, difficult to disentangle.
198. See, for instance, the discussion in Boivin and Gianonni (2006).
199. See Cecchetti (1995).
200. See in particular ECB (2011a), pp. 21 ff. but also, more generally, Bindseil (2004).
201. t is worth noting in this context, that, from a central bank perspective, the existence of a deep and integrated money market is essential for an efficient monetary policy, since it ensures an even distribution of central bank liquidity and a homogeneous level of short-term interest rates throughout the single currency area.
202. For a more detailed overview, see ECB (20011c), especially pp.93ff.
203. Another purpose consists in stabilising money market interest rates, although it is widely acknowledged that this is rather achieved by the averaging provision.
204. See ECB (2010), pp. 64 ff.
205. See ECB (2010), p. 60 ff.
206. See Praet (2012)
207. See ECB (2011), pp. 126 ff.
208. See ECB (2011c), p. 128.
209. See Manganelli (2012).
210. See Praet (2012).
211. It is also worth noting that a key feature of the design of the three-year LTRO lies in the fact that the interest rate on the three-year operations is indexed to the ECB's main policy rate, i.e. the rate on the main refinancing operations. Thus, if ECB were to increase this rate, the costs for the remaining period of the three-year LTROs would also rise. See, in particular, Abbassi and Linzert (2011).
212. See ECB (2012), p. 1.
213. See ECB (2012), p. 4.
214. See ECB (2011e), p. 71.
215. On 18 July 2013, the ECB further altered its collateral framework. In particular, three changes were announced: (i) the ECB will accept a broader range of ABS as collateral, (ii) the ECB reduced haircuts on higher-rated sovereign bonds, while raising haircuts on lower-rated sovereign debt, and (iii) the Governing Council harmonised collateral rules applying to additional credit claims (ACCs). See ECB (2013b) for details.
216. See ECB (2013a), p. 1.
217. See Ulbrich and Lipponer (2012) as well as Bindseil, Cour-Thimann and König (2012) for details.

218. See Drudi, Durré and Mongelli (2012).
219. See Wicksell (1898): "At any moment and in any economic situation there is always a certain rate of interest, at which the exchange value of money and the general level of commodity prices have no tendency to change. This can be called the 'normal rate of interest'". In the same vein, Laubach and Williams (2003) argue: "The natural rate is the short-term real interest rate consistent with output equalling its natural rate and constant inflation".
220. See Freedman (1995). It is also worth mentioning that the Bank of Canada has used its MCI in the sense of an operational target for monetary policy.
221. See, for instance, Eika, Ericsson and Nymoen (1996).
222. See McCallum (1987, 1988 und 2000).
223. See McCallum, B.T. (1987), p. 14.
224. See Taylor (1993a, 1993b)
225. See Taylor (1993a), p. 203.
226. See Taylor (1993b), pp. 321 ff.
227. See Woodford (1999).
228. See Carlström and Fürst (1999, 2000).
229. See Orphanides (2001).
230. See Kozicki (1999).
231. See Henderson und McKibbin (1993).
232. Such a more than-proportionate reaction is often also subsumed as an "aggressive" Taylor rule in the literature.
233. See Clarida, Gali and Gertler (1998, 2000) for more details.
234. See Goodfriend (1991) and Bernanke (2004).
235. For a more detailed explanation, see Rudebusch (2005).
236. See Orphanides und Williams (2002).
237. See Cukierman and Muscatelli (2003), Ruge-Murcia (2003), Surico (2007) and Gerdesmeier, Mongelli and Roffia (2010).
238. See Assenmacher-Wesche (2006) who distinguishes "dovish regimes" and "hawkish regimes".
239. This box follows closely the deliberations in ECB (2001), pp. 127 ff.
240. As regards the concrete application in the euro area, the analysis of the ECB focuses on a centred three-month moving average of annual M3 growth rates. In fact, the use of such a three-month average of annual growth rates has a smoothing effect, as it avoids over-emphasising specific monthly developments in the annual growth rate.
241. See Polleit and Gerdesmeier (2005).
242. Given the fact, that money demand functions are usually estimated in real terms, this of course raises the question of how to best calculate a nominal equilibrium on the basis of a real equilibrium. We return to this question at a later stage.
243. See Roffia and Zaghini (2007).
244. See Gerdesmeier (2011), p. 253.

245. For the following deliberations, see Gerdesmeier (2001). A different view is expressed in Drudi, Moutot and Vlassopoulos (2010), pp. 79 ff.
246. See 'A Dictionary of Economics', www.oxfordreference.com.
247. See also the seminal contribution of Reinhart and Rogoff (2008) for more details.
248. See Gerdesmeier, Reimers and Roffia (2009).
249. See Filardo (2004).
250. See Simon (2003).
251. See Kindleberger (1978).
252. See Kindleberger (1988).
253. See Shiller (2005).
254. See Helbling and Terrones (2003), pp. 72 ff.
255. See Detken and Smets (2004).
256. See Kindleberger (1978), Garber (1986, 1990) and Dash (1999).
257. See Garber (1986, 1990) for details.
258. See also French (2006) for details.
259. See Mackay (1841).
260. See the illustrative examples in Dash (1999).
261. See Dash (1999), pp. 187 ff.
262. See van Nieuwkerk (2005) for more details.
263. See, for instance, Thompson (2006), pp. 114 ff.

264. See Mackay (1841), especially chapter 3.
265. See the detailed and colourful description in Malkiel (2011), pp. 80 ff.
266. See ECB (2011), Annual Report, pp. 28 ff.
267. See Kaminsky, Lizondo and Reinhart (1998) and Kaminsky and Reinhart (1999).
268. See Kaminsky, Lizondo and Reinhart (1998), Kaminsky and Reinhart (1999) and Alessi and Detken (2008, 2009). In the original study of Kaminsky and Reinhart, a crisis is defined as a situation in which a sharp fall in the variable of interest (i.e. if the monthly percentage change of the variable is above its mean by more than three times the standard deviation) occurs.
269. It is worth noting in this context, that these methods do no only seem to work in case of advanced economies, but also when applied to emerging markets. See Ponomarenko (2012) for details.
270. See, for instance, Berg and Patillo (1999), Berg and Coke (2004), as well as Gerdesmeier, Reimers and Roffia (2010, 2011).
271. See Baltagi (1995).
272. Quantile regressions have first been introduced by Koenker and Bassett (1978) and Koenker and Hallock (2001) into the literature. For a more recent application in the field of asset price misalignments, see Machado and Sousa (2006) as well as Gerdesmeier, Lenarcic and Roffia (2012).
273. Quantile regressions have a number of advantages. First, the methid can be shown to be more robust than the traditional OLS estimator. Second, it allows to distinguish between individual responses across different quantiles. Finally, it offers a particularly elegant way of defining asset price booms and busts.
274. See, for instance, Altissimo et al. (2005)
275. See Tobin (1969).
276. See Altissimo et al. (2005), p. 34 ff.
277. See, for instance, Issing (2009), p. 46.
278. See Issing (2009), p. 46.
279. See Gonzalez-Paramo (2009).
280. See Detken, Gerdesmeier and Roffia (2010), p. 320. For related ECB work, see the article entitled "Asset price bubbles and monetary policy", Monthly Bulletin, ECB, April 2005 and the article entitled "Asset price bubbles and monetary policy revisited", Monthly Bulletin, ECB, November 2010.
281. See Papademos (2009) for a review of recent arguments challenging the view that monetary policy is too blunt a tool to lean "against the wind".
282. This has been advocated on various occasions by high-ranking ECB representatives. See, for instance, Issing (2009); Gonzalez Paramo (2009) and Bini Smaghi (2009).