Framework and tools of monetary analysis

The primary objective of the ECB's monetary policy is the maintenance of price stability. The ECB organises its analysis of the assessment of risks to price stability under two pillars. Under the first pillar, money plays a prominent role, implying that monetary aggregates are thoroughly analysed for their information content relevant for monetary policy. This role is signalled by the announcement of the reference value for the growth of the broad monetary aggregate M3. Under the second pillar, a range of other economic and financial indicators relevant for future price developments are analysed. The two pillars complement each other and allow for a broadly based and robust assessment of risks to future price stability.

This article focuses on the first pillar. According to empirical evidence for the euro area, the broadly defined monetary aggregate M3 has a stable relationship with the price level and displays good leading indicator properties for future inflation. These empirical properties are preconditions both for a meaningful monetary analysis and for money to be informative for monetary policy. Based on the empirical properties, a comprehensive monetary analysis needs to take a broad view. In this respect, econometric tools and expert judgement have to complement each other in order to arrive at a well-founded assessment of monetary developments and their implications for risks to price stability in the medium term. This article presents various tools useful for supporting monetary analysis.

1 Introduction

The statement that inflation is a monetary phenomenon in the long run is one of the central tenets of economic theory. Therefore, regardless of the monetary policy strategy which they pursue, the majority of the world's major central banks attach importance to monetary analysis.[1] There is a far-reaching consensus that an analysis of the monetary side of the economy can provide relevant information for monetary policy decisions aimed at the maintenance of price stability. This is attributable to the close relationship between monetary growth and inflation at longer time horizons, which has been demonstrated for a wide variety of countries.

Empirical evidence for the euro area also reveals a close relationship between monetary growth and inflation, thus supporting the prominent role which the ECB's monetary policy strategy explicitly assigns to money.[2] This prominent role for money is signalled by the announcement of a quantitative reference value for the growth rate of the broad monetary aggregate M3. The Governing Council of the ECB set the reference value at 4½% in December 1998. This value was subsequently confirmed in December 1999 and December 2000. It has been derived on the basis of the ECB's definition of price stability (increases in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2% p.a.), an assumption for trend potential output growth (2% to 2½%), and an assumption for the trend decline in velocity of M3 (½% to 1%). This definition implies that substantial or prolonged deviations of monetary growth from the reference value of 4½% would normally tend to signal risks to price stability in the medium term.

While the reference value is the focus for the evaluation of the monetary situation in the euro area, the first pillar goes beyond a comparison between actual M3 growth and the reference value. For example, small or shorter-term deviations from the reference value do not necessarily point to threats to price stability. In addition, after a longer period in which the reference value has been overstepped or understepped, M3 growth may undershoot or overshoot the reference value temporarily without this necessarily

1 *See the papers of the ECB's "Seminar on monetary analysis: Tools and applications", November 2000, on the ECB's website.*

2 *See the articles entitled "Euro area monetary aggregates and their role in the Eurosystem's monetary policy strategy" in the February 1999 issue of the Monthly Bulletin and "The two pillars of the ECB's monetary policy strategy" in the November 2000 issue of the Monthly Bulletin.*

being a cause for concern. Moreover, monetary data may be, on occasions, subject to special influences which temporarily impair the information content on future price developments. For these reasons, there is always a need to analyse carefully the dynamics of monetary developments and to extract the underlying reasons for the deviations of M3 growth from the reference value in order to assess the risks to price stability from the monetary side.

Monetary analysis has to take a broadly based approach. A detailed evaluation, on the basis of econometric models and the consolidated balance sheet of Monetary Financial Institutions (MFIs), combined with economic and institutional knowledge, are needed to complement the comparison between M3 growth and the reference value. A number of different analytical tools and techniques can be used to explain monetary developments and to assess their implications. First, with the help of money demand models, the growth of the broad monetary aggregate M3 can be analysed (see Section 2). Second, in order to analyse the information content of M3 for future price developments, in addition to the growth of the monetary aggregate, various indicators can be used to assess the liquidity situation of the economy (see Section 3). Third, a careful analysis of the components and counterparts of M3 always needs to be carried out (see Section 4). Finally, medium-term monetary analysis can be supported by short-term analysis in order to detect changes in the dynamics of monetary aggregates in a timely manner and to identify special factors which influence M3, but have no implications for price developments (see Section 5).

The use of a range of complementary tools allows for a comprehensive explanation and assessment of risks to price stability signalled by monetary developments. The results under the first pillar of the ECB's monetary policy strategy need to be cross-checked against the analysis under the second pillar, leading to a robust overall evaluation of risks to price stability in the medium term. This is of importance for a central bank, especially if facing uncertainty with regard to the structure of the economy.

2 Analysing M3 developments with the help of money demand models

One aspect of monetary analysis is identifying the driving forces behind monetary developments. Money demand frameworks are a powerful tool in this respect. Based on theoretical grounds, their aim is to explicitly relate money to its economic determinants. The focus of this section is on money demand models for the broad monetary aggregate M3, since in the euro area M3 displays a close relationship with inflation. M3 comprises a range of relatively liquid liabilities (currency in circulation, short-term deposits and marketable instruments) of euro area MFIs vis-à-vis non-MFI euro area residents (excluding central government).

Money demand models are typically expressed in terms of "real money", i.e. the nominal money stock deflated by a price index. If a stable relationship between real money and some explanatory variables of real money demand can be found, this implies that there is also likely to be a stable long-run relationship between nominal money and prices. In econometric models, the long-run demand for real money balances can be expressed as a function of a *scale variable and a measure of opportunity costs*. From a theoretical point of view, the choice of the preferred scale variable (for example real private consumption, real GDP, real wealth) depends on whether money is seen primarily as a means of transaction or also as a store of value. In the majority of empirical models for a broad monetary aggregate, the preferred measure is real GDP. The general result of money demand models for broad monetary aggregates, such as euro area M3, is an

income elasticity of above one, implying that real money demand tends to increase faster than real GDP. This can be explained by the fact that the demand for a broad monetary aggregate such as M3 does not only depend on current income, but also on the wealth situation, which is not fully captured by current real output. In other words, it reflects the fact that broad money is held for both transactions and savings purposes.

Apart from the scale variable, modelling money demand also requires the choice of an appropriate measure of the opportunity costs of holding money, which influence the investor's portfolio decision. In order to measure the opportunity costs for the broad monetary aggregate M3, an *own rate of return of M3,* representing the interest rate paid on the monetary aggregate M3, and the *rate of return on relevant alternative assets* have to be chosen.

Short-term market interest rates are sometimes used as a proxy for the own rate of return of M3. However, M3 includes components which are not remunerated (currency in circulation) or which are remunerated below market interest rates (most short-term deposits). In addition, the remuneration of most components of M3 only adjusts sluggishly to changes in money market rates. Against this background, an alternative approach to measuring the return on M3 is to construct an own rate of return of M3 by using a weighted average of the rates of return of the components of M3 (see Chart 1 (A) and (B)).

As for the rate of return on alternative assets, from a theoretical point of view the expected returns for a broad spectrum of alternative assets should be taken into account. At the same time, mainly for technical reasons, empirical money demand models usually include only one representative interest rate. This can also be justified by the observation that interest rates of different financial assets tend to move in parallel. Furthermore, for physical assets, (expected) inflation may be seen as a rough proxy of the expected nominal return. An increase in expected inflation may induce shifts from money to physical assets, since the real value of money falls with inflation, while that of physical assets is retained.

Finally, money demand frameworks need to take into account the fact that – e.g. owing to transaction costs – economic agents do not immediately adjust their money holdings to their desired demand for real money balances in the long term, i.e. economic agents adjust their money demand sluggishly to changes in income and interest rates. Therefore, the relationship between money and its long-run determinants has to be embedded in a dynamic framework which also captures the short-term behaviour of money.

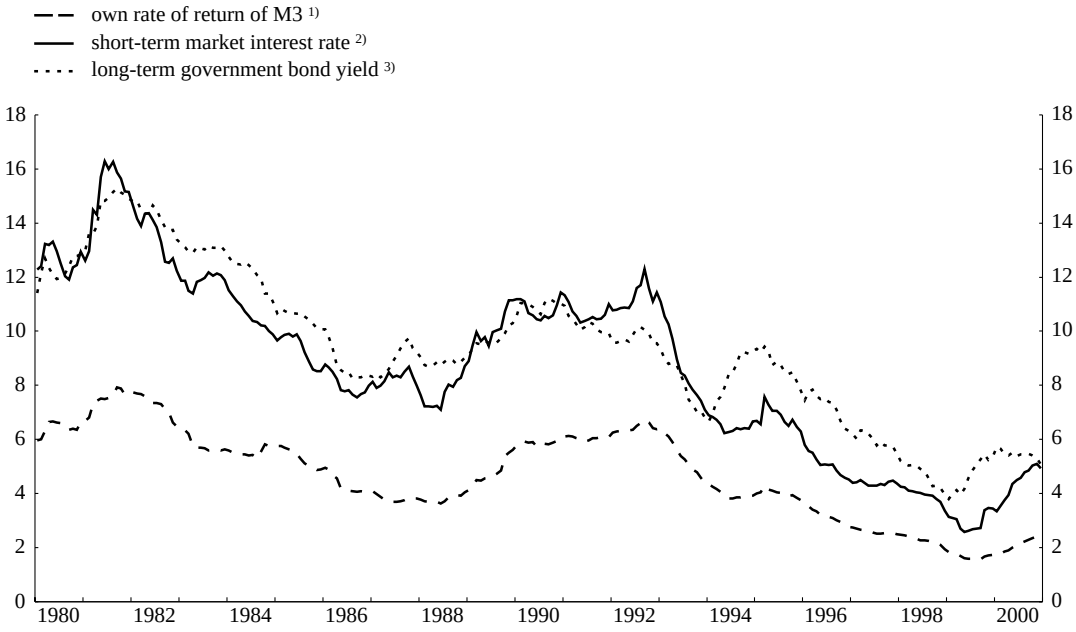
These considerations serve as a common basis for the various existing money demand models for the euro area. Box 1 provides examples of models for the monetary aggregate M3 developed by ECB staff. The use of more than one money demand model for the euro area helps to provide a robust foundation for the assessment of monetary developments. In particular, the models use different approaches to capturing the opportunity costs of holding money.

All the models provide evidence of a stable long-run money demand function for the euro area. As noted above, the feature of long-term stability is important for monetary analysis because, only if the relationship between money and its determinants is stable or at least predictable, is it possible to identify a growth rate of money which is in line with price stability over the medium term. In this context, an important feature of the models is that their long-run money demand equation supports the velocity assumption underlying the ECB's reference value for M3 growth. Hence, by using the long-term equilibrium value for output growth and the definition for price stability, the long-term model equations arrive at an equilibrium M3 growth rate of around 4½% p.a. (see Box 1).

Chart 1

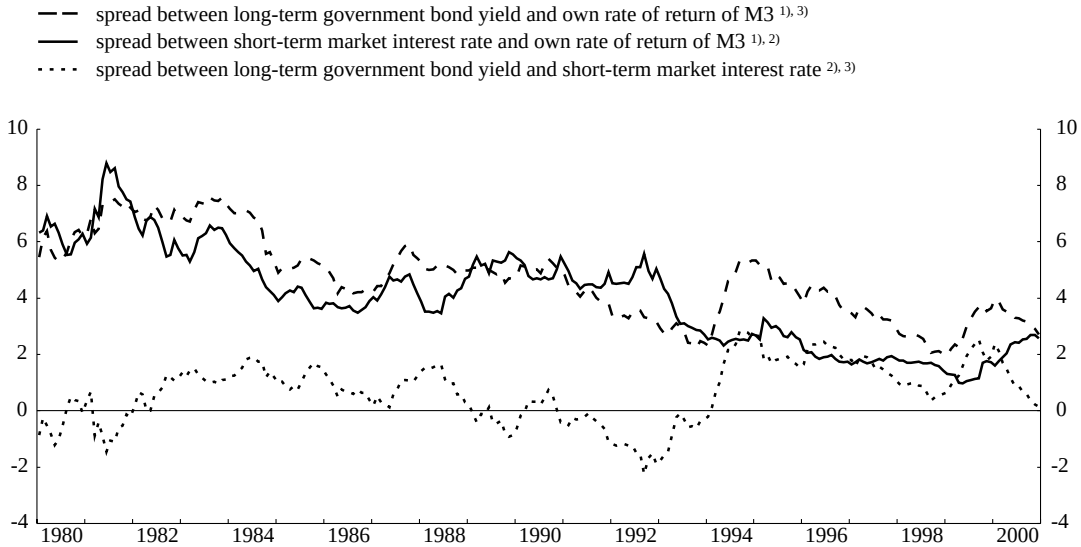
(A) Own rate of return of M3 and market interest rates

(percentages per annum; monthly data)



(B) Alternative measures of opportunity costs of money

(in percentage points; monthly data)



1) *The own rate of return of M3 is computed as the weighted average of the remunerations of the components of M3, with the weights given by the components' share in M3.*
2) *The short-term market interest rate refers to the euro area average of national three-month interbank rates until the end of 1998; and to the three-month EURIBOR from 1999 onwards.*
3) *The long-term government bond yield refers to the euro area average of yields on national ten-year government bonds or the closest substitute.*

Box 1

Money demand models for euro area M3

This box provides two examples of money demand models for the broad monetary aggregate M3 in the euro area: Brand and Cassola (Model 1) and Coenen and Vega (Model 2).[1]

In line with the empirical literature, these money demand models explain real M3 balances as a function of a scale variable and measures of the opportunity cost of holding money. Money demand models usually relate to real money, in accordance with the notion that a change in the price level will be fully reflected in nominal money in the long run. A common feature of these models is that they all include real GDP as a scale variable. However, they differ as regards the proxy for the opportunity cost included in their long-run money demand equations: while Model 1 includes the long-term government bond yield, Model 2 includes both the inflation rate and the spread between the long-term government bond yield and the short-term market interest rate.

The following table reports the income elasticities and the semi-elasticities of interest rates (or their spreads) in respect of real M3 in the long-run money demand equations of the different models (LT and ST stand for the long-term government bond yield and the short-term market interest rate, respectively, y denotes the natural logarithm of real GDP and π indicates annualised quarter-on-quarter changes in the price level):

Summary of the long-run money demand equations

Model	y	(LT-ST)	LT	π
Model 1	1.34		-2.03	
Model 2	1.28	-0.44		-1.3

Note: In both cases, money demand is modelled in terms of the natural logarithm of real money, where M3 is deflated using the GDP deflator. The coefficients in the table are estimated using quarterly data over the sample period Q1 1980 - Q3 2000. The data for M3 are aggregated using the irrevocable conversion rates fixed on 31 December 1998. Some of the estimated coefficients shown here differ somewhat from those presented in the original studies, because of changes in the sample period and the estimation procedures.

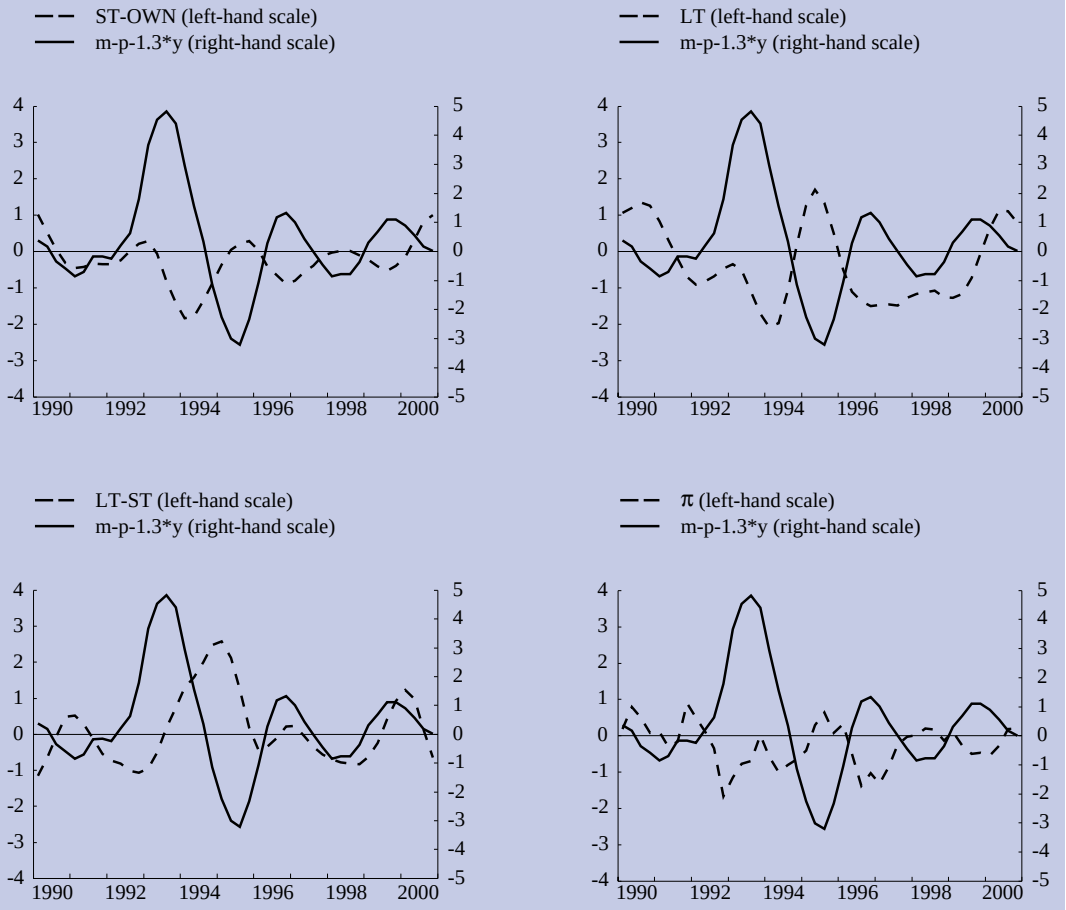
Both models show income elasticities which are above one and which are very similar. An implication of these results is that it is possible to derive the reference value for M3 growth of 4½% from the estimated money demand models. Indeed, the reference value can be obtained by multiplying the estimated income elasticities by the medium-term trend in output growth (2% to 2½%) and adding the ECB's definition of price stability (i.e. an increase in the HICP of below 2%).

The charts below serve as a simple illustration of the impact of the opportunity cost variables on the euro area demand for money. First, the difference between (1) the stocks of M3 (m) and (2) the sum of the price level (p) and real GDP (y) multiplied by the income elasticity of euro area money demand (set at the average value of 1.3 on the basis of the above results) was computed. In the context of a standard money demand framework, the resulting variable, $m - p - 1.3 \times y$, can be interpreted as an approximate measure of the part of the demand for M3 which is explained by opportunity cost variables. Thus, developments in this variable should show an inverse correlation with the individual opportunity cost variables. The figure plots the annual growth rates of $m - p - 1.3 \times y$ against the annual differences in the following opportunity cost variables: LT, (LT-ST) and π as well as the spread between the short-term interest rate and the own rate of return of M3 (ST-OWN) which, according to internal empirical investigations, seems to represent a convincing alternative measure of the opportunity cost of holding M3. The series are transformed by means of a four-quarter moving average in order to smooth those short-term developments that may blur the longer-term relationship between the variables. As the charts show, it is possible to observe a reasonably close correlation between the developments of $m - p - 1.3 \times y$ and the changes in the opportunity cost variables over the past few years.

1 *C. Brand and N. Cassola: "A money demand system for euro area M3", ECB Working Paper No. 39, 2000; G. Coenen and J.-L. Vega: "The demand for M3 in the euro area", ECB Working Paper No. 6, 1999.*

The inverse relationship between opportunity costs of money and the demand for M3

(annual differences in percentage points; annual percentage changes; quarterly data)



Note: Series are smoothed by means of four-quarter moving averages.

Money demand models can also be used to decompose total M3 growth into the determinants of money demand. The aim of such a decomposition is to gain quantitative insight into the underlying causes of monetary developments. This can assist in the explanation of ongoing monetary growth.

A decomposition shows the extent to which current monetary growth can be explained by the macroeconomic determinants of the model. For example, high monetary growth can be caused by strong real GDP growth, which, in turn, may indicate upward risks to future price stability. In addition, low interest rates can also fuel demand for money, owing to low opportunity costs with possible upward risks to price stability. In this case, however, part of the higher monetary growth could also be related to pure portfolio shifts, which would then not imply an increase in future price pressures. Such an analysis of monetary growth is important for a solid assessment of risks to price stability resulting from money, since the implications for price developments may vary according to the different reasons for M3 growth.

The decomposition of monetary growth into its macroeconomic determinants also indicates the extent to which monetary growth is not explained by the model. Hence, it may reveal additional information contained in monetary aggregates which is not captured by other macroeconomic variables. This unexplained part of current M3 growth may

or may not signal risks to price stability resulting from money. It can for instance indicate a monetary shock, for example an increase in the supply of loans owing to less restrictive rating standards of MFIs, which would be reflected in monetary growth and would be likely to have implications for price developments. However, it can also reflect special factors. A *special factor* is typically an identifiable monetary disturbance which is not captured by the macroeconomic explanatory variables of a money demand model and which may not have implications for price developments. For example, it could refer to institutional changes, such as a change in taxation affecting the relative attractiveness of monetary holdings, or to large one-off transactions (for example the financing of the German UMTS licences in August and September 2000). Ideally, a detailed institutional analysis can provide some additional insight by providing information concerning special events, thus reducing the unexplained part of monetary growth.

3 Leading indicator properties of M3 and measures of excess liquidity

Money as an indicator of future price developments

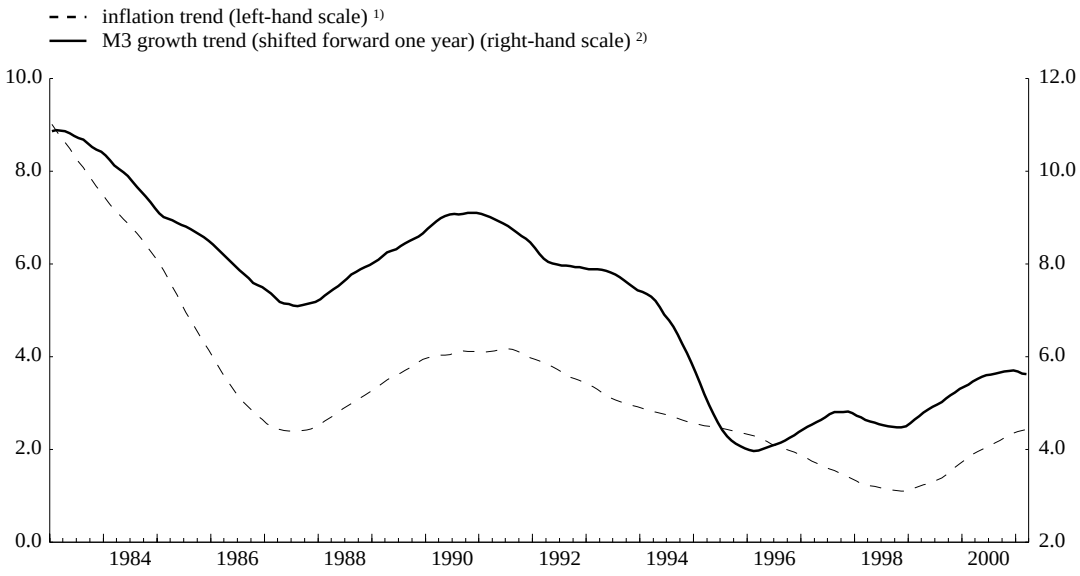
A stable, or at least predictable, long-run relationship between real money and its macroeconomic determinants is a precondition for meaningful monetary analysis. Furthermore, monetary developments are important for the conduct of monetary policy, as they contain information regarding future price developments and risks to future price stability.

According to empirical evidence for the euro area, the *broad monetary aggregate M3* possesses convincing leading indicator properties for future inflation over a medium to long-term time horizon. A simple illustration of this can be seen in Chart 2, which shows that over a medium-term horizon M3 growth broadly anticipates developments in inflation. This supports the significant role attached to nominal M3 growth under the first pillar.

Chart 2

M3 growth and inflation trends

(monthly data)



1) 24-month moving average of the annual percentage change in consumer prices (the CPI until January 1996, the HICP thereafter).

2) 24-month moving average of the annual percentage change in M3 shifted forward one year.

Excess liquidity measures

Apart from annual M3 growth, excess liquidity measures may also provide useful indications of future price developments. These measures refer to the difference between the level of the actual money stock and an estimate of the equilibrium money stock. Although commonly referred to as "excess liquidity" measures, these concepts can signal either excess liquidity or a liquidity shortfall. "Excess liquidity" refers to a positive deviation of the actual money stock from an estimate of the equilibrium money stock, while a "liquidity shortfall" is a negative deviation.

In addition to monitoring the annual growth rate of M3, these measures are useful for a comprehensive medium term-oriented monetary analysis, since a protracted upward or downward deviation of the observed money stock from its equilibrium level may bring about risks to price stability which might not be visible in the annual growth rate of M3. An in-depth analysis of the level of the money stock ensures that past excessive or weak monetary growth, which may still contain information about risks to price stability, is taken into account.

It is possible to construct various measures of excess liquidity – or liquidity shortfalls – based on the level of M3. These include the "nominal money gap", the "real money gap" and the "monetary overhang". The concepts differ in the determination of an equilibrium money stock. They may depend, for example, on the use and specification of a money demand model, the choice of a base period and the determination of equilibrium values.[3]

The simplest measure of excess liquidity is the *nominal money gap*. This refers to the excess liquidity (or, in the event of a negative gap, to the liquidity shortage) which results from the deviation of the observed nominal money stock from an equilibrium nominal money stock. The path of the latter can be based, for example, on the assumptions underlying the ECB's reference value for M3, i.e. the nominal stock of money consistent with price stability (inflation of below 2%), the assumption for trend potential output growth (2% to 2½%) and the assumption for the trend decline in velocity of M3 (½% to 1%).

A critical point when measuring this nominal money gap is that it requires a base period to be selected. The choice of such a base period is always arbitrary. Chart 3 illustrates the nominal money gap by – arbitrarily – choosing the last quarter before the start of Stage Three of Economic and Monetary Union (EMU) as the base period. The chart also takes account of the evidence that part of the money gap is caused by the holdings of non-euro area residents of money market fund shares/units (see Box 1 in the section entitled "Monetary and financial developments" in this issue of the Monthly Bulletin). It can be seen that a positive nominal money gap emerged in 1999 and 2000, reflecting monetary growth above the reference value. To some extent, this gap probably reflects the fact that actual output growth in 2000 turned out to be higher than the assumption for trend potential output growth underlying the reference value. However, part of the gap was also due to HICP inflation exceeding the level deemed compatible with price stability. As the latter factor was mainly due to a one-off oil price increase, not all of the money gap should be interpreted as indicating risks to future price stability. In addition, part of the nominal money gap can be explained by the impact on M3 caused by the holdings of non-euro area residents of money market fund shares/units. Finally, there is some evidence that part of the money gap is also related to special factors (see Box 4), as well as the statistical measurement problems of correctly identifying the holdings of non-euro area residents of money market paper and short-term debt securities included in M3 which have led to an upward distortion of M3 growth. These parts should not be interpreted as indicating risks to future price stability either.

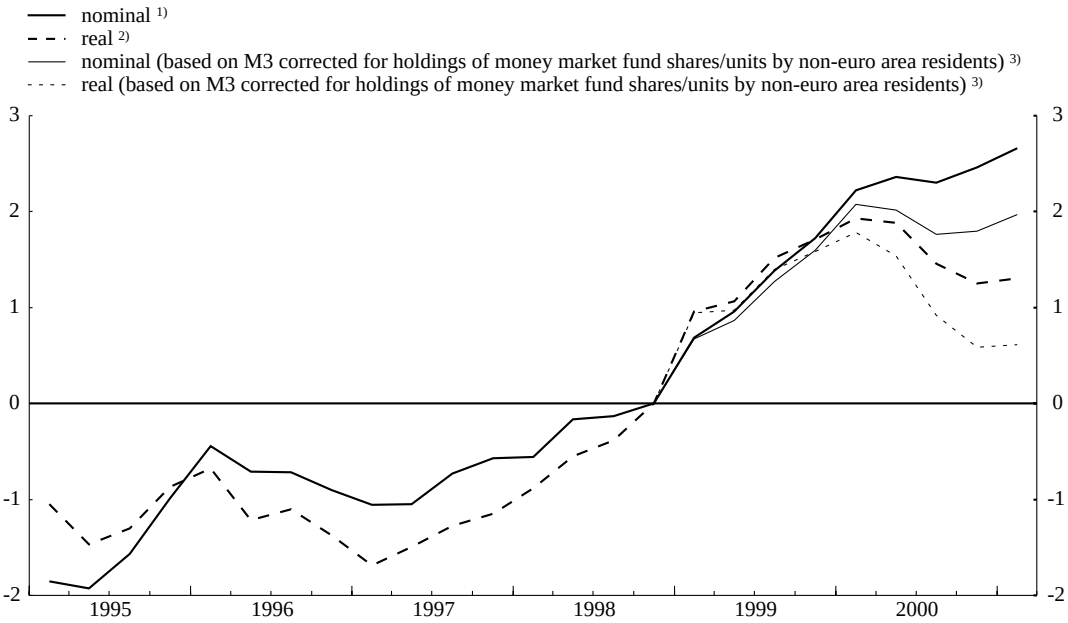
The concept of the money gap can also be defined in real terms. The *real money gap* reflects the deviation of the actual real money stock

3 *See also the article by K. Masuch, H. Pill and C. Willeke entitled "Framework and tools of monetary analysis" in the ECB's "Seminar on monetary analysis: Tools and applications", November 2000, published on the ECB's website.*

Chart 3

Estimates of the nominal and real money gap

(as a percentage of the level of M3 implied by the reference value of 4½%)



1) *The nominal money gap is constructed as the deviation of the actual stock of M3 not adjusted for special factors and measurement problems from the level consistent with monetary growth at the reference value of 4½%, taking the last quarter of 1998 as the base period.*
2) *The real money gap equals the nominal money gap less the deviation of consumer prices from the definition of price stability, taking the last quarter of 1998 as the base period.*
3) *Nominal and real money gap, respectively, corrected for holdings of money market fund shares/units by non-euro area residents (see Box 1 in the section entitled "Monetary and financial developments" in this issue of the Monthly Bulletin).*

from an equilibrium real money stock. Hence, the real money gap corresponds to the nominal money gap, except that it does not include past deviations of prices from the definition of price stability. When choosing the last quarter of 1998 as a base period, the real money gap also reveals a considerable build-up of excess liquidity in 1999 (see Chart 3). In contrast to the nominal money gap, the real money gap declined in the course of 2000, partly reflecting the fact that real monetary growth was dampened by inflation above the definition of price stability. When taking the non-euro area resident holdings of money market fund shares/units into account, the real money gap was relatively close to zero in the first quarter of 2001. Furthermore, the above-mentioned special factors and statistical measurement problems of M3 regarding the measurement of non-resident holdings of money market paper and short-term debt securities, as well as the arbitrary choice of the base period, must also be borne in mind.

Another measure of excess liquidity is the *monetary overhang/shortfall*. This describes the positive/negative deviation of the observed level of the nominal money stock from a model-estimated equilibrium money stock which is determined on the basis of the present economic situation, i.e. by inserting the current values of the macroeconomic determinants of money demand (output, prices and opportunity costs) into the long-run money demand equation. Consequently, the monetary overhang/shortfall reflects developments in money not explained by the macroeconomic variables of the long-run money demand model. It thus contains the information on money which is captured by the above-mentioned unexplained part of actual monetary growth as well as the short-term monetary dynamics. An in-depth institutional analysis can help to evaluate the monetary overhang/shortfall with regard to potential risks to price stability.

Chart 4 shows the average monetary overhang/ shortfall calculated on the basis of the two money demand models described in Box 1. It can be seen that an overhang had built up in 1999, implying that monetary growth was higher than expected on the basis of the long-run money demand equation. Since the second quarter of 2000, however, this average monetary overhang has become smaller. Taking the aforementioned special factors and measurement problems into account, it would appear that, at the end of 2000, the money stock was broadly in line with the long-term money demand resulting from the actual values of its long-run determinants.

As indicated above, apart from the growth of the monetary aggregate M3, such excess liquidity measures may display favourable leading indicator properties for future inflation. According to empirical evidence (see Box 2), some of the excess liquidity measures, most notably the real money gap, have provided good indications of future inflation in the past, in particular over a short to medium-term time horizon. Nevertheless, the uncertainties surrounding such excess liquidity measures must be borne in mind. Therefore, these measures must always be interpreted with caution, taking into account the specific economic circumstances. Box 2 also reports evidence showing that, as the time span lengthens, the growth of the broad monetary aggregate M3 is the most informative indicator for future inflation. This supports the prominent role given to nominal M3 growth under the first pillar of the ECB's medium term-oriented monetary policy strategy.

Chart 4

Estimate of the monetary overhang

(as a percentage of the equilibrium M3 stock; quarterly data)

Note: The series plotted represents the average of the monetary overhang not adjusted for special factors and measurement problems, calculated on the basis of the two money demand models described in Box 1.

Box 2

Leading indicator properties of monetary indicators for future inflation

A natural focus of monetary analysis is on the role of money as an indicator variable for future price developments. Such an approach does not necessarily account for the causes underlying monetary developments, but treats money purely as an information variable by trying to assess and exploit the predictive content of monetary aggregates for future inflation. Recent studies have shown that monetary and credit aggregates contain significant information relevant for future price developments in the euro area, especially over the medium-term horizon.

In a study by Nicoletti-Altimari,[1] a systematic examination of the leading indicator properties of a broad set of money-based indicators has been carried out by assessing the forecasting performance of the models including these indicators in predicting future inflation in the euro area over the period from 1992 to 2000. The monetary indicators considered in this study included the stocks of M1, M2, M3, loans to the private sector, and a number of other money-based indicators, such as the real money gap and the monetary overhang measure (see Section 3). The predictive content for future inflation of models, including the aforementioned monetary and money-based indicators, is compared with that of models including a number of alternative indicators derived from financial markets, real activity measures, labour market indicators and cost and price measures (such as unit labour costs and wage growth rates).

The procedure was based on performing a simulated out-of-sample forecasting exercise (i.e. using only the information available prior to the forecasting period) to predict inflation for forecast horizons varying from one quarter to three years ahead. The forecasts were based on a simple linear bivariate model containing past inflation and the selected indicator. The relative performance of the indicators at different horizons was assessed by comparing their forecast errors.[2] In order to check the robustness of the results obtained, the exercise was performed for different measures of inflation (HICP, the private consumption deflator and the GDP deflator), for different sample periods and with different specifications for the forecasting model.

The following main conclusions emerged from this study. First, the results support the idea that monetary and credit aggregates contain substantial information about future price developments in the euro area. The comparative advantages, in terms of forecasting performance, of models which include money-based indicators tend to increase as the forecast horizon is extended. This is consistent with the view that money contains information which is particularly useful for anticipating medium-term and low-frequency trends in inflation.

Second, among monetary variables, the level of the real money gap and the M3-based rate of change in a P-star indicator (i.e. the deviation of the nominal money stock from equilibrium real money balances) appear to be particularly useful for forecasting inflation at horizons of up to two years ahead. By contrast, models including the rate of growth of M3 and of loans are the best performing models for the longest horizons (beyond two years). At these longer horizons, it also proved useful to include the level of the monetary overhang derived from the Brand/Cassola model of demand for M3 (see Box 1). The analysis also clearly indicated that, at longer horizons, broad monetary aggregates show better leading indicator properties for future inflation than narrow aggregates. In general, these results are robust across the different price measures used and they are also consistent with other empirical studies,[3] which have lent broad support to the idea that the real money gap has substantive predictive content for future price developments in the euro area.

Overall, the results lend support to the idea that monetary and credit aggregates provide useful additional and independent information on medium-term inflation prospects for the euro area relative to the best non-monetary indicators, especially at horizons beyond one and a half years.

1 *See S. Nicoletti-Altimari, "Does money lead inflation in the euro area?", ECB Working Paper, forthcoming.*
2 *The method followed was to compare the ratio of the mean square error (MSE) of the model based on the different indicators.*
3 *See Gerlach and Svensson, "Money and Inflation in the Euro Area: A Case for Monetary Indicators?", NBER Working Paper No. 8025, 2000, and Trecroci and Vega, "The information content of M3 for future inflation", ECB Working Paper No. 33, 2000.*

4 Analysis of the components and counterparts of M3

In the monetary analysis, components and counterparts of M3 can also be examined within the consolidated balance sheet of MFIs. The consolidated MFI balance sheet of the euro area is based on the individual balance sheets of credit institutions (including the Eurosystem), money market funds and other MFIs located in the euro area, but excludes the interrelationships between these institutions.

Balance sheet identities as such do not reveal the underlying economic relationships. Combined with a sound institutional analysis, and relying on economic knowledge of the macroeconomic explanatory variables of balance sheet items (such as money and credit), however, they allow for a better understanding and assessment of monetary developments. An analysis of the structure of M3 growth is helpful for the explanation and assessment of M3 growth itself. The analysis of components and counterparts helps to trace M3 growth back to its economic and institutional determinants. In addition, some of the components and counterparts are directly informative with regard to economic activity or inflation. The M3 components and counterparts can also be analysed using an econometric model.[4] The possibility of making use of econometric tools is, however, limited at present, since in the case of the counterparts of M3 in particular, the time series for most items only begin in September 1997.

Analysis of the components of M3

A separate analysis of the *narrow aggregate M1,* which comprises the most liquid components of M3 (currency in circulation and overnight deposits), receives particular attention among the different components of M3. This is mainly on account of its large share in the broad aggregate M3 in the euro area (around 40%). Moreover, since M1 closely reflects the transaction purpose of money, it seems more closely related to aggregate spending than M3. In addition, M1 is highly sensitive to interest rate changes and hence usually shows a strong negative reaction to a rise in opportunity costs. Despite the resulting considerable volatility of the narrow monetary aggregate M1 in the short term, a stable demand function of M1 has been found for the euro area (see Box 3). However, owing to its volatility, M1 appears to be inferior to M3 as regards the information it contains on inflation in the medium term.

The other components of M3 (*short-term deposits other than overnight deposits and marketable instruments*) are also closely monitored, mainly in order to obtain additional information to explain and assess M3 growth. These components reflect – to a greater extent than M1 – the purpose of money as a store of wealth, but they are also relevant for transaction purposes since they can easily be transformed into cash without any significant costs. Overall, their inclusion in M3 implies that this broad aggregate is less interest-rate sensitive and more stable than M1, because portfolio shifts by non-MFIs resident in the euro area between different short-term assets are partly internalised within M3. At the same time, however, these components may prevent a significant and immediate slowdown in M3 growth in a period of rising short-term interest rates, because the remuneration of marketable instruments and part of the short-term deposits tends to be closely related to money market rates. Hence, particularly in periods when short-term market rates are changing, a careful analysis of the structure of M3 growth is required.

Analysis of the counterparts of M3

In the consolidated balance sheet of the MFI sector, any change in M3 is mirrored in the developments in the counterparts of M3,

4 *See, for example, A. Calza, A. Jung and L. Stracca, "An econometric analysis of the main components of M3 in the euro area", Weltwirtschaftliches Archiv, Vol. 136 (4), 2000.*

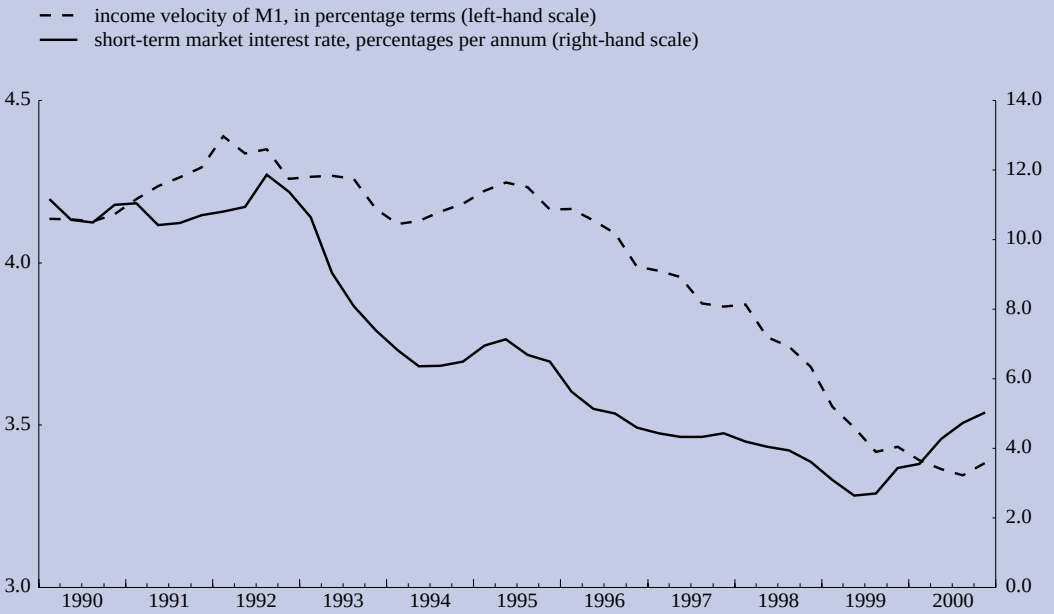
Box 3

The demand for euro area M1

The narrow monetary aggregate M1 includes the most liquid components of M3: currency in circulation and overnight deposits. M1 grew at high rates towards the end of the 1990s. As a consequence, there was a pronounced decline in M1 velocity (i.e. the ratio of real GDP to real M1 balances) in the late 1990s. As can be seen from the chart below, this occurred in parallel with a decline in short-term interest rates in the euro area.

M1 velocity and the short-term market interest rate

(quarterly data)



Note: Velocity is measured as the ratio of nominal GDP to M1 (both seasonally adjusted).

In principle, it is natural to expect M1 to rise – and M1 velocity to fall – when nominal short-term interest rates fall, since these interest rates represent the opportunity cost of holding currency and overnight deposits. However, there is also some evidence that the substantial decline in M1 velocity was related not only to the decrease in interest rates, but also to a rise in the interest rate elasticity of M1 in recent years.[1] The latter, in turn, may have been due to the fact that short-term interest rates have reached relatively low levels over the past few years. The higher interest elasticity at low levels of nominal interest rates may be related to transaction costs. Owing to the fixed transaction and learning costs involved in investing in interest-bearing assets, the increase in money demand may be stronger than that predicted by standard models when the opportunity cost for holding money falls to relatively low levels.[2] In addition, it is possible that the transition to an environment of price stability in Stage Three of EMU, and therefore to the expectation of low nominal interest rates on a lasting basis, may have changed the ways in which agents deal with financial investment and assess costs and benefits.

Since the start of Stage Three of EMU, the demand for M1 in the euro area has been affected by two special factors. First, a large increase in M1 holdings – in particular in overnight deposits – was recorded in January 1999. It is likely that this development was due, at least in part, to the new institutional and regulatory environment prevailing from the start of Stage Three of EMU (e.g. the new reserve requirement regime) and did not necessarily imply risks to price stability (see Box 4). M1 holdings may have also been temporarily influenced upwards by the uncertainties related to the transition to the year 2000, although its effect appears to have been of limited magnitude. Apart from these special factors, there is no evidence of a fundamental break in M1 demand since the launch of the euro.

1 *See L. Stracca, "The functional form of the demand for euro area M1", ECB Working Paper No. 51, 2001.*
2 *See C. Mullighan and X. Sala-i-Martin, "Extensive Margins and the Demand for Money at Low Interest Rates", Journal of Political Economy, Vol. 108, No. 5, 2000.*

most notably credit to the private sector, credit to general government, MFI longer-term financial liabilities and net external assets of MFIs. Interpreting such interdependencies is helpful in order to gain a better understanding of the reasons behind monetary growth, particularly in the shorter term. For example, shocks to monetary developments might be traced back to the supply of credit or to substitution with longer-term financial liabilities. If the latter arises in a situation of marked uncertainty in financial markets, the resulting developments in money could probably be regarded as temporary portfolio shifts which do not necessarily have implications for future inflation. By contrast, if monetary developments are related to more lasting changes in credit availability, such movements may be of relevance for the assessment of risks to price stability.

At the same time, it should be borne in mind that economic causality can run in several directions. On the one hand, higher credit growth can result in higher liquidity in the economy and thus higher growth of the monetary aggregates. On the other, an increase in money holdings of non-MFIs, for example owing to higher income growth, can induce higher credit growth. Moreover, components of the MFI balance sheet may be driven by the same economic factors in parallel, such as income growth or interest rate changes. Finally, movements in the counterparts of M3 do not necessarily imply movements in M3 itself. They can also reflect interrelations between the counterparts, for instance between credit and net external assets, for example due to the financing of investments abroad by euro area non-MFIs.

Credit to the private sector (loans and MFI holdings of securities) is the most important counterpart of M3 in quantitative terms and, hence, one of the key potential driving forces behind M3. In its regular monetary analysis, the ECB puts particular emphasis on developments in loans to the private sector, which account for around 90% of credit to the private sector and correspond to changes in net lending by the borrower. By contrast, changes in MFI holdings of securities often simply mirror transactions in the secondary market. The growth of loans deserves particular attention, since it may be closely related to aggregate spending. In addition, there is some empirical evidence which suggests that loans to the private sector in the past two decades display good leading indicator properties for consumer price inflation (see Box 2).

For a well-founded assessment of the underlying determinants of growth in loans, the quarterly data on loans by sector (non-financial corporations, financial corporations, households or government) and by purpose (loans to households are broken down into consumer credit, loans for house purchase and other loans) in the euro area are a particularly useful supplement to the regular counterpart analysis. For example, consumer credit is more likely to feed directly into aggregate spending than loans granted to financial corporations, which may be linked to a variety of purposes. A strong pace of growth of loans to the private sector is usually associated with favourable financing conditions and strong real economic activity. More specifically, according to empirical evidence for the euro area, the demand for real loans is positively related to real GDP and negatively related to real short-term and, in particular, real long-term interest rates, consistent with the rather long-term maturity structure of loans in the euro area.[5] However, loans may at times be explained by other factors, such as a profits' squeeze forcing companies to find a substitute for internal finance. Furthermore, data on mergers and acquisitions and information about prices in real estate markets can enhance the understanding of loan developments. Finally, the balance of payments statistics may also provide useful information at times, since, for example, capital outflows due to foreign direct investments may fuel the demand for loans from non-financial corporations without

5 *See A. Calza, C. Gartner and J. Sousa, "Modelling the demand for loans to the private sector in the euro area", ECB Working Paper No. 55, 2001.*

having implications for domestic price developments. Therefore, loan developments must always be scrutinised carefully.

In assessing the potential implications of credit growth for aggregate spending and inflation, the increase in the amount of financing taking place outside the MFI sector also has to be taken into account. While MFIs are the most important source of financing, the issuance of debt securities by non-financial corporations has increased substantially over the past few years.[6] In order to obtain a complete picture of the potential implications of financing and investment activities of non-MFIs in the euro area, it is therefore important to take a broader perspective. This is gathered from the analysis of the quarterly financial accounts, which complements the consolidated MFI balance sheet analysis (see the article entitled "Financing and financial investment of the non-financial sectors in the euro area" in this issue of the Monthly Bulletin).

MFI credit to general government, which at present accounts for slightly more than 20% of total credit in the euro area, is related to the borrowing requirements of the public sector. When interpreting MFI credit to general government, however, it should be taken into account that a significant part of total government debt consists of debt securities (at present about three quarters of total government debt in the euro area). Therefore, it is always necessary to analyse whether changes in MFI credit to general government are mainly attributable to corresponding changes in government debt or whether they simply reflect a change in the debtor structure of general government.

Longer-term financial liabilities mainly encompass those investment vehicles (deposits, debt securities) offered by MFIs which are less liquid and therefore not included in M3. Their development depends on real economic activity and opportunity costs, and also partly reflects substitution effects within the MFI balance sheet. Such substitution effects always have to be carefully analysed. For example, portfolio shifts into assets outside M3 due to a rise in opportunity costs may reflect a change in the decision between consumption and saving, with possible implications for price developments. However, a shift between longer-term financial liabilities and M3 can also be caused, for example, by tax changes or factors such as uncertainty in bond markets, and would then merely represent a portfolio shift without any lasting implications for aggregate spending or the outlook for price stability.

Finally, *net external assets* of the MFI sector (i.e. external assets minus external liabilities) mainly reflect the transactions of the euro area non-MFIs with residents outside the euro area. While transactions between MFIs and non-euro area residents in most cases have a similar impact on both external liabilities and external assets (with the exception of transactions in government securities or shares of non-MFIs) and, hence, leave net external assets unchanged, the settling of current account or financial transactions by non-MFIs with residents outside the euro area is mirrored in the net external asset position of the MFI sector. For example, payments for imports or foreign securities will result either in an increase in external liabilities or a decrease in external assets and, hence, a reduction in net external assets of the MFI sector. Therefore, it is worthwhile analysing this balance sheet item together with the euro area balance of payments. However, at present it is only possible to obtain a rough indication from the euro area balance of payments statistics of the underlying forces driving changes in net external assets, because a complete sectoral breakdown of the balance of payments transactions is not available.

Overall, an in-depth analysis of the components and counterparts of M3 is an important part of a detailed assessment of monetary developments under the first pillar of the ECB's monetary policy strategy. It should rely both on the consolidated MFI

6 *See the article entitled "Characteristics of corporate finance in the euro area" in the February 2001 issue of the Monthly Bulletin.*

balance sheet (possibly extended to include the analysis of quarterly financial accounts), complemented by additional knowledge of real economic and institutional developments, and on econometric models.

5 Short-term analysis of monetary developments

Owing to its medium-term orientation, the ECB's monetary policy is primarily interested in medium-term trends in monetary variables. At the same time, however, each month monetary analysis has to check whether new monetary data confirm or change the previous assessment. In particular, possible indications of a turning point in monetary trends need to be recognised as early as possible. Furthermore, monthly monetary developments should be investigated with a view to identifying special factors and measurement errors. These distortions must be taken into account in the assessment of monetary developments. For these reasons, it is also useful to exploit tools for the short-term analysis of monetary developments.

The monthly changes in the *annual* growth rates of M3 and its components and counterparts provide an initial indication of short-term monetary developments. However, for an assessment of the short-run dynamics of monetary growth, seasonally-adjusted *monthly* data give more accurate information, since they are not influenced by base effects. Moreover, monitoring the development of seasonally-adjusted monetary data over different time horizons (for example seasonally-adjusted and annualised six-month changes) is useful for an assessment of the shorter-term monetary dynamics and the detection of a change in monetary trends.

In addition to the monitoring of seasonally-adjusted data, the short-term analysis can be supported by time series models (for example reg-ARIMA models, see Box 4). Such models can be used to identify calendar effects which, on occasion, have a bearing on the change in annual growth rates. Furthermore, time series models allow the trend of a monetary time

Box 4

Identification and quantification of the distortion of M3 at the start of Stage Three of EMU on the basis of a univariate linear time series model

In the short-run analysis of monetary developments, univariate linear models such as seasonal reg-ARIMA models (Autoregressive Integrated Moving Average Models also allowing the existence of regression variables)[1] can be used for a variety of purposes. Such models are particularly useful for short-term forecasting and signal extraction, i.e. the estimation and analysis of short-term trends. One interesting application of such a model is the examination of the monetary developments around the start of Stage Three of EMU. In January 1999 the annual rate of growth in M3 increased very strongly, and this jump appeared to be only partly reversed in the following months.

In such a situation, time series analysis is a first step towards detecting the possible existence of "special events". On the basis of data up to December 1998, the one step-ahead forecast error for euro area M3 for January 1999 can be calculated. Formal tests using such models to compare the forecast with a confidence interval of 95% and the actual observed value indicated that the observed value for January 1999 could not be explained by the past values of M3. Consequently these observations needed to be analysed further.

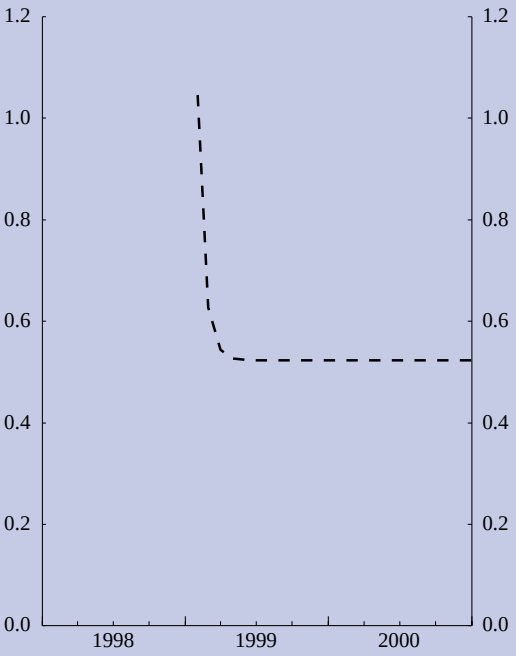
For the period around the start of Stage Three of EMU, several underlying factors were identified as possibly being at the root of this strong increase in the annual rate of M3 growth. These factors included, in particular,

1 See also the ECB publication entitled "Seasonal adjustment of monetary aggregates and HICP for the euro area", August 2000.

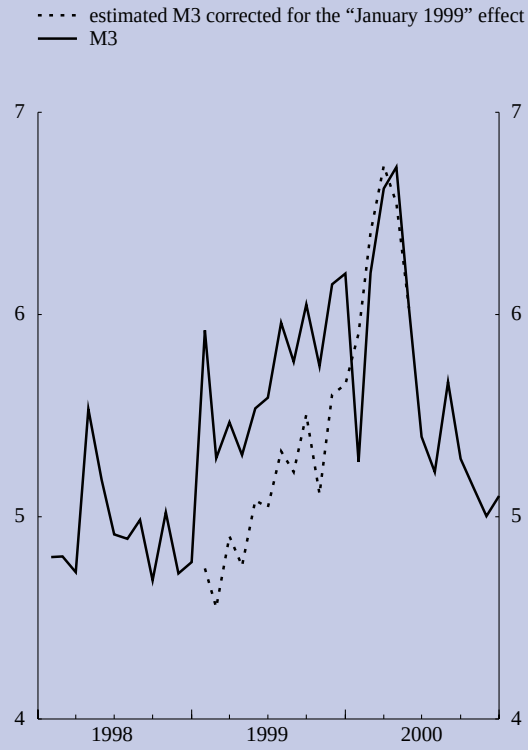
new statistical reporting systems, the introduction of remuneration of minimum reserves (which led to a flowback of funds into the euro area), changes in tax laws in some euro area countries, and financial market uncertainties related to the transition to Stage Three of EMU. For all these reasons, in early 1999 the Governing Council did not regard the increase in M3 growth in January 1999 as being a cause for concern with regard to upward risks to price stability.

In order to further underpin this assessment, a reg-ARIMA model for M3 was used to estimate the type and the magnitude of the distortion in January 1999. One plausible effect at the start of Stage Three of EMU, which it was possible to estimate using this model, was the combination of a "one-off shock" dying out exponentially and a permanent change in the level of M3. Such a combination is reasonable because some of the institutional factors mentioned seem to have been temporary (e.g. the greater uncertainty), while others would be expected to permanently change the level of M3 (e.g. changes in the statistical reporting system and the reserve requirement system). This reg-ARIMA model indicates that the level of M3 was distorted upwards by around 1% in January 1999. However, the effect partly died out exponentially within the subsequent months and converged towards a permanent change in the level of around 0.5 percentage point.

Estimation of the distortion of the level of M3 around the start of Stage Three of EMU
(as a percentage of the stock)



Growth rate of M3
(annual percentage changes)



The charts above illustrate the results of this exercise. The left-hand chart shows the estimation of the distorting effect on the level of M3 around the start of Stage Three of EMU in percentage points (a one-off shock in January 1999 which dies out exponentially, ending in a permanent change in level). The right-hand chart focuses on the impact of this distortion on the annual rate of growth of M3. As can be seen in the right-hand chart, the series corrected for the "January 1999" effect gives a much smoother and clearer picture of the developments in M3 during 1999 and up to the first quarter of 2000, without changing the general picture of growth patterns. While it should be stressed that the estimated series in the right-hand chart is subject to considerable uncertainty and serves only illustrative purposes, it may be seen as a justification for the assessment of monetary developments made by the Governing Council in 1999.

series to be separated from transitory distortions. They are, therefore, a useful additional tool with which to obtain an early indication of a possible change in the trend of monetary developments. Moreover, by comparing the monetary dynamics which can be explained by the model with the actual monetary developments, the model-based short-term analysis helps to detect and quantify special factors and measurement errors. The detection of these effects is one important input in order to arrive at a well-founded assessment of monetary developments and to avoid misinterpretation.

However, on the basis of time series models, it is not possible to immediately classify a deviation of the observed monetary growth from the growth estimated by the model. One reason for this is that a change in the monetary trend naturally requires confirmation over several months. In addition, the model alone is not able to identify a special factor or a measurement error. Hence, a detailed institutional knowledge of special events is always essential. Nevertheless, even with institutional knowledge, it may sometimes be difficult to assess the potential implications of monetary disturbances for price developments at an early stage. Therefore, a cautious attitude is warranted when assessing special factors.

6 Concluding remarks

The ECB has assigned a prominent role to money in its monetary policy strategy and has signalled this by announcing a quantitative reference value for the annual growth of the broad monetary aggregate M3 over the medium term. As this article shows, there is ample empirical evidence which justifies this approach: the demand for M3 in the euro area is stable and M3 appears to have good leading indicator properties for price developments over the medium term.

While the reference value for the growth rate of M3 plays a prominent role in the analysis under the first pillar of the ECB's monetary policy strategy, a comprehensive monetary analysis must use a range of instruments to deepen and complement the analysis of the deviation of M3 growth from the reference value. This article has reviewed a number of tools available for supporting the analysis of monetary developments. Such tools serve two main purposes: explaining monetary developments and assessing their implications for the risks to price stability. In this respect, monetary analysis must combine the use of econometric models with a detailed evaluation on the basis of the consolidated MFI balance sheet and institutional knowledge.

The various analytical approaches all help to shape an assessment of the risks to price stability signalled by monetary and credit developments. In addition, in order to arrive at a robust evaluation of risks to price stability, the results under the first pillar need to be cross-checked against the assessment provided by economic and financial indicators under the second pillar. In order to produce a sound assessment, it is necessary to consider all the information which may be relevant for a monetary policy aimed at maintaining price stability over the medium term. Since the start of Stage Three of EMU, in view of the uncertainties surrounding the structure of the euro area economy and the availability of data, this approach has proved particularly useful for the stability-oriented monetary policy of the ECB.