Framework and tools of monetary analysis

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1. Introduction

In October 1998, the Governing Council of the ECB announced the main elements of its monetary policy strategy.

First, it provided a quantitative definition of the primary objective of monetary policy in the euro area, namely price stability. Price stability was defined as an annual increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2%.

Second, the Governing Council defined a framework for structuring the analysis and assessment of economic data which underlies monetary policy decisions. In recognition of the fundamentally monetary nature of inflation over the medium term, the ECB assigned a prominent role to money in the formulation of policy decisions aimed at the maintenance of price stability. This "first pillar" of the strategy was signalled by the announcement of a quantitative reference value for monetary growth. Moreover, acknowledging the influence of non-monetary factors on price developments and recognising the important information relevant for monetary policy decisions contained in other indicators, the ECB announced that, in addition to a thorough analysis of monetary developments, a broadly based assessment of a wide range of other economic and financial variables would also be undertaken and constitute a further basis for monetary policy decisions. This assessment is labelled the "second pillar" of the strategy.

This paper describes the framework and tools of monetary analysis from the point of view of ECB staff. It explains in more detail some of the tools and approaches which are used by ECB staff for monetary analysis under the "first pillar" and others which are under development or may be used in the future. The remainder of the paper is organised as follows. Section 2 recalls some general issues underlying the strategy as a whole. Against this background, Section 3 outlines the main arguments

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for assigning a prominent role to money in the strategy and briefly describes the general role of the quantitative reference value for monetary growth. Section 4 discusses the features of the regular monitoring of various monetary aggregates and their components and counterparts. Section 5 describes various tools and concepts based on money demand models which may contribute to deriving the information content of monetary aggregates for monetary policy. Section 6 provides some evidence regarding the information content of monetary aggregates for future price developments and discusses the uses and limitations of money-based projections. Section 7 briefly concludes.

2. General strategic issues

Before turning to a description of the role of monetary analysis in the ECB's strategy, it is worth making a number of more general observations regarding the strategy. In particular, several common misconceptions should be clarified.

First, the ECB's strategy is often misunderstood by external observers as implying multiple targets for monetary policy. On the one hand, the prominent role for money is associated with an intermediate monetary target, whereas, on the other hand, the "second pillar" is often characterised as a direct inflation target.

However, at the outset it should be emphasised that the maintenance of price stability in the euro area is the only target (or, more formally, "primary objective") of the ECB's strategy. Both pillars of the strategy should be understood as instrumental in facilitating the achievement of this ultimate and overriding objective. Taken together, the two pillars of the strategy form a framework which organises the analysis and presentation of the broad set of information relevant for monetary policy-making. Monetary analysis is therefore of value insofar as it helps policy-makers take decisions which serve the maintenance of price stability. Specific rates of monetary growth are not assigned a status of intermediate target. Monetary analysis is given prominence which reflects its relevance for policy decisions aimed at achieving price stability.

Second, in the academic discussion of monetary policy strategies, the long-running debate on the respective merits of rules and discretion is often couched in rather extreme terms. On the one hand, a rule-based monetary policy is characterised as following a contingent path in an entirely mechanical fashion. On the other hand, a discretionary policy is viewed as one which pursues varying and intransparent objectives[1] and/or which is formulated in an inconsistent manner over time.[2] The practical discussion of monetary policy has eschewed such extremes and emphasised the need to create policy-making frameworks that facilitate the implementation of a credible, consistent and forward-looking policy which remains focused on the maintenance of price stability over the medium term.

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[1] Walsh (1998) talks of "targeting rules" which restrict the discretion available to policy-makers by imposing "rules under which the central bank is judged in part on its ability to achieve a prespecified value for some macroeconomic variable" (pp. 362-3).

[2] In other words, approaching the problem afresh each period, instead of following a consistent approach which recognises the interdependency of current and future policy decisions, for example in the sense of a contingent rule, e.g. Barro and Gordon (1983).

The ECB's strategy should be viewed in this light. While the strategy is intended to facilitate the policy-making process and provide both a discipline to, and useful benchmarks for, monetary policy decisions aimed at price stability, neither the first nor the second pillar of the strategy are seen by the ECB as providing "mechanical" guidance for interest rate settings. Rather the two pillars represent distinct, but nonetheless complementary, frameworks for analysing macroeconomic data and their implications for monetary policy (ECB, 2000).

Against this background, monetary policy decisions should always be based on an overall assessment of the analysis and information evaluated under both pillars of the strategy. An assessment of the role of monetary analysis in the ECB's strategy should always keep this in mind. Basing monetary policy on information from both pillars naturally implies that the relationship between policy decisions and monetary developments will always be conditional on developments in other indicator variables, and therefore may, at times, be complex.

3. A prominent role for money

3.1. Rationale behind the prominent role for money

With these strategic issues in mind, this section first briefly reviews the main arguments for assigning money a prominent role in the ECB's strategy and then outlines the role of the reference value for monetary growth.

One of the most remarkable empirical regularities in macroeconomics is the ubiquitous long-run relationship between the price level and the money stock. A positive and often almost one-to-one relationship between monetary growth and inflation at longer horizons has been illustrated for a wide variety of countries, using a number of different analytical and empirical tools and employing various definitions of money and data sets.[3] There is a broad consensus in the literature that any well-specified model of a monetary economy should exhibit this feature. On both empirical and theoretical grounds, the literature provides ample justification for assigning money an important role in monetary policy-making.

In this context, it should also be recognised that ultimately it is the power to control the supply of base money which gives a central bank its influence over short-term interest rates and, ultimately, price developments. If the central bank injects more liquidity than the economy needs to service a sustainable level of real activity, this will eventually be reflected in higher prices.

The connection drawn between money and prices has a long pedigree, dating back at least as far as Hume's work in the eighteenth century. More recently, "monetarist" approaches to economic analysis, which place the evolution of monetary aggregates at the centre of explanations of price developments, have exerted a powerful influence on developments in both economic theory and policy-making.[4] The Chicago monetarist "oral tradition"[5] and the "classical monetarism" of Milton Friedman and his associates[6] emphasised the importance of assigning an important role to monetary developments for prices and the economy more broadly.

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[3] Lucas (1995); McCandless and Weber (1995).
[4] De Long (2000).
[5] Tavlas (1997).
[6] Friedman (1956, 1960); Brunner (1968); Brunner and Meltzer (1972).

More recent literature has also assigned an important role to the analysis of monetary aggregates and, in particular, credit, for understanding the transmission process. For example, Bernanke has offered an explanation of the Great Depression which emphasises the importance of the collapse in credit (associated with the US banking crisis) as a determinant of real outcomes. Investigations of the credit channel of monetary transmission also analysed the sectoral pattern of credit growth. At the same time, theoretical advances have been made in "cash/credit" and "limited participation" models, which introduced financial market frictions into real business cycle models and thereby assigned an "active" causal role to money. Advocates of such models have argued that they offer a better empirical explanation of the economy's response to monetary policy than alternative "sticky price" models with frictions in goods markets which attribute no or only a purely passive role to money.

As yet, these theoretical models have not been used extensively in regular policy analysis. Rather, the models inform an empirical approach which relates various measures of monetary and credit growth or "excess liquidity" to inflationary pressures. As argued by Laidler (1997), these models have a "disequilibrium character". The main behavioural explanation of why current monetary developments contain information about the future price outlook follows from the view that *excess* money holdings are spent (so as to re-establish monetary equilibrium), thereby increasing demand and inflationary pressures. The theoretical basis for such a disequilibrium approach is not as elegant as for alternative equilibrium models. Yet this framework has a strong intellectual tradition (albeit more "oral" or qualitative than based on an explicit set of structural equations) and appears to have empirical relevance (e.g. in the context of so-called P-star models[7]).

Regarding the euro area, the available empirical evidence continues to point to the existence of a stable relationship between broad monetary aggregates (in particular M3) and the price level over the medium term.[8] Moreover, monetary and credit aggregates appear to demonstrate some leading indicator properties for future price developments, especially at longer horizons.[9] Thus evidence for the euro area provides justification for the prominent role of money in the ECB's strategy.

As argued by Engert and Selody (1998) (and Selody (2001) in this volume), the large body of theoretical and empirical literature emphasising the role of monetary and credit developments in the transmission of monetary policy and the determination of the price level provides ample justification for giving monetary analysis an important role in the monetary policy process in parallel with the analysis of other cyclical and real economy indicators. In the ECB context, these arguments also support the prominent role assigned to money in the ECB's strategy.

Furthermore, compared with plausible alternative indicators of future price developments, money exhibits a number of desirable practical features. Monetary data are typically available in a more timely fashion and may be of better quality than other macroeconomic data (e.g. real GDP, which is only available quarterly after a significant lag and is often revised substantially). Monetary analysis may therefore provide prompter

[7] Hallman, et al. (1991). See also Orphanides and Porter (2001) in this volume.
[8] Coenen and Vega (1999); Brand and Cassola (2000).
[9] Trecroci and Vega (2000); Gerlach and Svensson (2000); Nicoletti Altimari (2001).

and more accurate guidance for policy-makers.[10] Finally – and this is of relevance for the ECB – monetary data have a euro area-wide focus. In contrast, even after the introduction of the euro, indicators such as GDP and inflation often continue to be viewed and analysed in national terms by outside observers. Emphasising money may therefore be conducive to fostering the appropriate area-wide perspective in public discussion of the single monetary policy.

Of course, as a practical matter, the successful example of other central banks which assigned an important role to money and monetary analysis in their monetary policy strategies in the past (e.g. by announcing an intermediate monetary target or monitoring ranges) naturally encouraged the ECB to study whether assigning a prominent role to money should also be a central component of its own strategy. As a new central bank assuming monetary sovereignty in an environment of considerable uncertainty, the ECB naturally wished to draw on the experience of its predecessor national central banks (NCBs), thereby inheriting some of their credibility.[11] However, attributing the choice of the prominent role of money in the ECB's strategy to a process of learning from successful central banks does not diminish the relevance of the economic argumentation presented here.

3.2. Signalling the prominent role for money: the reference value for monetary growth

The prominent role assigned to money in the ECB's strategy was signalled by the announcement of a reference value for broad monetary growth.

In line with the general strategic framework outlined above, the reference value represents a public commitment by the ECB to analyse monetary developments thoroughly in a manner that offers a coherent guide for monetary policy aimed at the maintenance of price stability, ensuring that monetary developments are given an appropriate weight in the assessment on which policy decisions are based. Moreover, the public nature of this commitment helps to ensure that adequate weight (which honestly reflects their role in the decision-making process) is given to monetary analysis in the presentation of monetary policy decisions to the public.

Against this background, in order to fulfil the role assigned to it by the ECB, the reference value should exhibit two key features.

First, the reference value should be derived in a manner which is consistent with – and serves the achievement of – price stability. In order to fulfil this criterion, the monetary aggregate used to define the reference value *should exhibit a stable (or at least predictable) relationship with the price level* at some time horizon. Typically, the stability of the relationship between money and prices is evaluated in the context of a money demand equation. The existence of a stable long-run money demand equation implies that the relationship between money and the price level, conditional on developments in other key macroeconomic variables such as interest rates and real GDP, is stable over the longer-term.

Second, prolonged and/or substantial deviations of monetary growth from the reference value should, under normal circumstances, signal risks to price stability. This criter-

[10] Orphanides (2000): This issue may be of particular relevance for the euro area since – especially at the start of Stage Three – many other macroeconomic data series are not constructed or consolidated on an area-wide basis.

[11] European Monetary Institute (EMI, 1997).

ion requires that the monetary aggregate used to define the reference value should normally *contain information regarding future price developments.*

The reference value was given an explicitly medium-term orientation (see ECB, 1999b). In consequence, the reference value represents the rate of M3 growth *over the medium term* which is consistent with the maintenance of price stability over the medium term.

This approach has two main advantages. First, it emphasises the necessarily medium-term orientation of a monetary policy aimed at price stability, given the long and uncertain lags in the monetary transmission mechanism. Second, the derivation of a reference value with such a medium-term orientation is based on the longer-term empirical relationship between money and prices, which is simpler, and likely to be more reliable and more stable than the relationship at shorter horizons. If the reference value is given such a medium-term orientation, it will naturally have an open horizon rather than be applied to a specific period.[12]

The ECB has made clear that it does not set its instruments with the aim of controlling monetary growth so as to hit the reference value at a specific horizon (ECB, 2000). Such a mechanical approach to interest rate decisions would not be consistent with the general strategic principles outlined in Section 2. In particular, in an economy where major shocks to money demand cannot be excluded, gearing interest rate changes to controlling monetary growth in order to achieve a pre-announced target would clearly not always be consistent with taking monetary policy decisions which best serve the maintenance of price stability.[13]

Notwithstanding the importance of the reference value as a commitment and a communication tool, it should be emphasised that the ECB does not interpret the prominent role of money solely in terms of the reference value. In practice, various monetary and credit aggregates and the Monetary Financial Institution (MFI) balance sheet are analysed for the information they contain which is relevant for a monetary policy aimed at price stability.

The remainder of this paper describes various aspects of the broader analytical framework and of the evaluation and interpretation of monetary data under the "first pillar", without claiming to be exhaustive.

4. Monitoring monetary developments

4.1. Definition of monetary aggregates

Based on conceptual considerations and in line with international practice, the ECB has defined a narrow (M1), an intermediate (M2) and a broad monetary aggregate (M3). These aggregates differ with respect to the degree of "moneyness" of the assets included. The narrow aggregate M1 includes currency in circulation as well as balances that can immediately be converted into currency or used for cashless payments, i.e.

[12] In line with this approach, the Governing Council announced its *first* reference value in December 1998, *confirmed* this value in December 1999 and *re-confirmed* it in December 2000, rather than announcing a value for the years 1999, 2000 and 2001 respectively.

[13] Since the ECB's strategy does not commit it to controlling monetary aggregates in the shorter term by manipulating short-term interest rates, the issue of controllability – a topic of intense debate in the literature on intermediate monetary targeting – does not arise in the context of the reference value.

overnight deposits. M2 comprises M1 plus deposits with an agreed maturity up to two years and deposits redeemable at a period of notice of up to three months. M2 has been defined in this way to facilitate the analysis and monitoring of a monetary aggregate that includes, in addition to currency, liquid bank deposits. The broad aggregate M3 includes M2 plus repurchase agreements, money market fund shares, money market paper and debt securities issued by MFIs with an original maturity up to two years. These "marketable instruments" have a high degree of liquidity and price certainty and, hence, can be regarded as close substitutes for deposits.

The decision to identify M3 as the key aggregate used to define the reference value was taken on the basis of both conceptual considerations and empirical investigations. The former suggested that broader monetary aggregates such as M3 were likely to exhibit a more stable relationship with the price level, since they internalised much of the substitution between conventional bank demand deposits and other MFI liabilities which had the potential to lead to instabilities in money demand. As regards the latter, the preliminary empirical studies available in Autumn 1998 also tended to support this conclusion as they showed a relative advantage of M3 regarding the stability of money demand and the leading indicator properties in respect of inflation.[14,15]

4.2. Monitoring M3 developments over different time horizons

A natural starting point for a regular monetary analysis is the comparison of M3 growth with the reference value (see Chart 1). Although, as already emphasised, conclusions cannot be mechanically drawn from such a comparison, the evolution of the deviation of actual M3 growth from the reference value over time may give a first indication of potential news in the data.

The key growth rate for the ECB's analysis of M3 developments in relation to the reference value is a centred three-month moving average of annual M3 growth rates. It was decided to focus on annual growth rates as these tend to attract most attention in the public debate and therefore are a natural focus for the comparison of monetary developments relative to the reference value. Moreover, seasonal adjustments for the euro area monetary aggregates were initially deemed rather unreliable, since a detailed study of the seasonal patterns had been precluded by the absence of long runs of data. Using annual growth rates largely avoided the need to make seasonal adjustments. Taking a three-month average of these annual growth rates has a smoothing effect which avoids over-emphasising monthly changes in the annual growth rate. This is important as, for example, end-of-month peculiarities may, on occasions, have a temporary but visible effect on the annual growth rate.

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[14] These preliminary econometric studies were complicated by the lack of reliable historical data series on monetary aggregates for the euro area with which to assess the empirical properties of the various series. Because the statistical definitions underlying euro area money and banking statistics did not correspond in all cases to those underlying the previous national systems, historical series for the euro area monetary aggregates had, in part, to be based on approximations and estimations.

[15] The choice of the specific definition of M3 (e.g. the decision to include the shares of money market funds (MMFs) within M3) was also based on preliminary empirical investigations into the stability of demand for variants of M3 and the leading indicator properties of these aggregates for inflation.

Chart 1. M3 growth and the reference value
(annual percentage changes, monthly data)

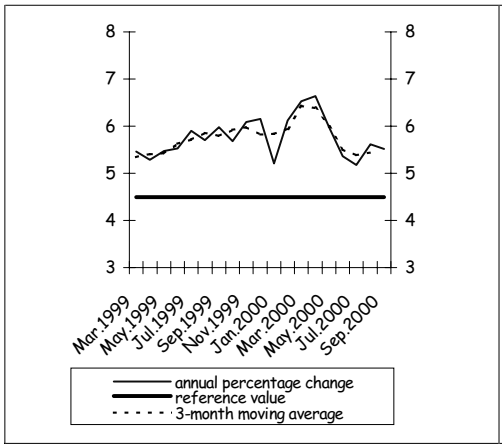
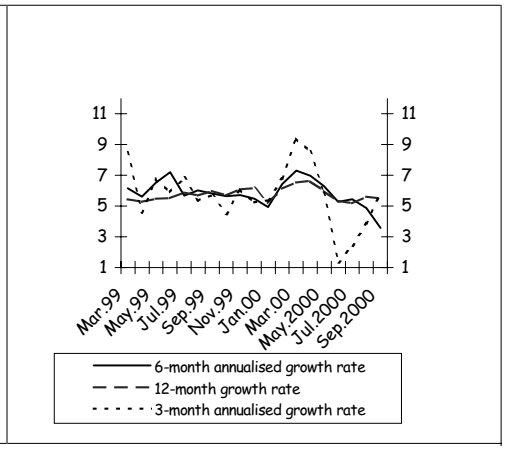


Chart 2. Growth rates of M3
(annualised percentage changes based on seasonally adjusted data)



Note: The time series shown in these charts (and the charts provided elsewhere in the paper) are based on (estimates of) data available in early November 2000 up to and including the third quarter of 2000.

However, not only the three-month average of the annual growth rates but also the annual rate of growth itself and shorter-term (seasonally adjusted) growth rates are closely monitored (see, for example, Chart 2). Looking at several growth rates in parallel ensures that changes in the underlying monetary trend are detected in a timely manner. Moreover, this approach avoids confusion between base effects and recent developments when analysing changes in growth rates.[16] At the same time, it always needs to be taken into account that shorter-term developments have to be interpreted with caution. The shorter the time horizon, the more volatile the growth rates are and the higher the possibility that changes reflect pure noise (see, for example, the volatility of the three-month annualised growth rate of M3 shown in Chart 2).[17] Moreover, monetary growth over a period of only a few months is not so relevant per se for future price developments unless it adds to a cumulated deviation from the reference value or signals a fundamental change in future growth dynamics.

In spite of the medium-term character of the reference value, multi-annual growth rates do not play a prominent role in regular monetary analysis. While in situations where there is a high degree of volatility in monetary variables the focus on longer periods may help to detect the underlying trend, multi-annual growth rates have the disadvantage that they react very sluggishly to changes in monetary dynamics and, hence, changes in the monetary situation may be signalled too late. Overall, it seems to

[16] Growth rates which are calculated against a moving base entail the difficulty that changes in the growth rate from one month to another are not necessarily due to the development in the last month. By contrast, the growth in the month which drops out of a specific growth rate is equally important.

[17] This volatility is partly due to the fact that euro area monetary statistics are only available as end-of-month figures while, for example, in some of the euro area countries prior to Stage Three of EMU monthly averages were available at least for the key monetary aggregate.

be more appropriate to supplement the monitoring of annual and shorter-term growth rates by also analysing the level of M3 in order to guarantee the medium-term character of monetary analysis (see Section 5.6).

4.3. Analysis of components and counterparts

A significant element of both the monthly and the quarterly monetary assessment is an analysis of the components and the counterparts of M3. The motivation for such an analysis is twofold. First, it can help to better explain M3 growth. Second, some of these variables are directly informative in respect of inflation or GDP growth.

Among the components, M1 – consisting of currency in circulation and overnight deposits – receives much attention. This component is the most liquid one and is immediately available for transactions. Moreover, under normal circumstances, movements in M1 do not reflect pure portfolio motives. In the euro area there is some evidence that M1 growth may exhibit leading indicator properties for real GDP growth. However, this narrow aggregate seems to be inferior to M3 regarding its information content about future inflation, partly as M1 is much more sensitive to interest rate changes and, therefore, more volatile.

Other short-term deposits and marketable instruments are also closely monitored, mainly to obtain additional information for explaining and assessing M3 growth. Such an analysis is of particular importance in periods of frequent interest rate changes. As these components bear interest rates which are in part closely linked to market rates, they may in the short run react positively to short-term market rates. Hence, in the months after a change in ECB interest rates the same M3 growth rate may be interpreted differently according to the structure of M3 growth.

Regarding the counterparts to M3, the focus of the analysis is mainly on loans to the private sector.[18] Among the counterparts, loans are not only the most important candidate among possible driving forces behind M3 in the longer-term but are also the indicator which is most informative about the state of the economy. A close monitoring of loans is essential in order to detect changes in the demand for loans or the availability of loans in a timely manner. This information, in turn, complements the picture of the monetary situation in the euro area gained on the basis of the analysis of M3.

On a monthly basis, only data for total loans to the private sector (including seasonally adjusted data) are available in the euro area. This allows for a first inspection of whether recent developments are continued or whether there are signs of a change in growth dynamics. In addition, on a quarterly basis data on loans by sector (in particular, non-financial corporations, households, financial corporations), purpose (loans to households are broken down into consumer credit, loans for house purchase and other loans), and maturity are provided. These data are a valuable source of information regarding the main determinants of loan developments and their assessment.

Monetary analysis usually also encompasses the other main counterparts to M3, namely credit and loans to the general government, longer-term financial liabilities, net external assets of the MFI sector and the deposits of the central government sector. A

[18] Credit to the private sector includes, in addition to loans, the MFI holdings of shares and securities other than shares. Changes in these balance sheet items, however, often reflect secondary market transactions and, hence, not necessarily the granting of new credit to the respective issuers.

reliable interpretation of these items for the euro area, however, faces some difficulties which are mainly related to data problems. Since time series only start in September 1997, systematic studies of the relationship between the individual counterpart items and their determinants, between the counterparts and M3, or between different counterparts are difficult to undertake. Hence, the assessment of particular developments in counterparts is still surrounded by significant uncertainty.[19]

As a first step towards explaining and assessing developments in M3, its components and counterparts, the movements in these variables need to be linked to factors which systematically or on occasion are behind monetary developments. Close attention should be paid, for example, to news about economic activity, market and retail interest rates, the overall financial market situation, mergers and acquisitions and real estate markets. Such an analysis does not only improve the understanding about what is behind the monetary data but also helps to assess the extent to which the latter might be of relevance for future inflation or growth.

The national contributions to euro area monetary variables as such lack any political content in the context of Monetary Union. The monetary policy of the Governing Council of the ECB is geared towards the euro area as a whole and, hence, based on an assessment of area-wide developments. At the same time, however, a close monitoring of the national contributions can also provide, on occasion, insights which are helpful for the assessment of euro area variables. For example, since the financial systems and money holding behaviour in the individual countries of the euro area are still quite heterogeneous and financial integration between the countries in some sectors (in particular, retail banking) remains relatively low (e.g. within the euro area there are only limited cross-border holdings of deposits), the analysis of national contributions adds information to that obtained by monitoring the area-wide aggregates. A close inspection is, inter alia, useful for obtaining a first hint of the existence and relevance of special factors influencing monetary growth. Moreover, explanations of (short-term) monetary developments which seem reasonable on the basis of euro area data can be cross-checked on the basis of national data (e.g. whether a specific development in M3 growth can be reasonably linked to real activity). Obviously, the existence of cross-border flows within the euro area has to be duly taken into account when interpreting those national contributions.

5. The information content of monetary aggregates for monetary policy – approaches based on money demand models

5.1. Money demand frameworks

One natural starting point for the econometric analysis of monetary developments is a money demand equation. A number of specifications have been estimated for the euro area.

[19] Moreover, additional problems exist for individual counterparts. For example, the monitoring of longer-term financial liabilities which, in principle, could give valuable insights into the relative demand of economic agents for short-term or long-term assets and also for financial and real assets is hampered by the fact that this item also includes the purchases of debt securities by non-euro area residents. The current statistical framework of the Eurosystem does not allow to identify the holders of the debt securities issued by banks (with the exception of the holdings of the Monetary Financial Institutions themselves).

The Brand/Cassola (BC) money demand system for euro area M3 has been developed using a structural cointegrating vector autoregression (VAR) approach (Brand and Cassola, 2000). The core of the model consists of three long-run economic relationships: a money demand function for euro area M3 which establishes a stable relationship between real M3 balances, long-term interest rates and real GDP; a Fisher parity relationship between long-term nominal interest rates and inflation; and a stable relationship between short-term and long-term interest rates (the yield curve). An important feature of the resulting dynamic system is that these three long-run relationships have implications for changes of inflation, interest rates, money and income. Therefore, all the variables in the system are simultaneously determined.

From an economic perspective, the salient features of the model can be summarised as follows. First, if M3 grows faster than originally foreseen on the basis of the model, this may (in part, by generating higher GDP growth) lead to higher inflation. Second, M3 developments are relevant in two respects: on the one hand, they reflect current developments in GDP and, on the other, they help to predict future GDP growth. Finally, in the long term (although not at the shorter horizons typically considered for the controllability of monetary aggregates), higher short-term rates would lead to a decrease in money growth.

Given the results reported in Coenen and Vega (1999) (henceforth CV), the CV specification makes it possible to model money demand as a single equation, rather than within a system. The single equation relates changes in real M3 to deviations from a long-run money demand relationship, changes in GDP growth, inflation, short and long-term interest rates. The long-run money demand relationship links the level of real M3 to that of real GDP, the spread between short-term and long-term rates and inflation. Both inflation and the yield curve spread are incorporated in order to capture opportunity costs of holding M3.

More recently an attempt has been made to model M3 demand in a system which includes the spread between the short-term market interest rate and the own rate of return on M3 balances. Preliminary results based on this new specification support the stability of M3 demand and the velocity assumptions underlying the reference value.

Given the important role of M3, it is not surprising that most studies focus on this aggregate. Nevertheless evaluation of other monetary aggregates has also taken place. A study by Calza, Jung and Stracca (2001) is available which investigates the components of M3. Moreover, recent preliminary analysis has suggested that (for the sample period 1980–98) a stable money demand relationship can be found for the narrower aggregate M1 if the interest rate semi-elasticity of money demand is allowed to vary positively with the level of interest rates.[20]

5.2. Money demand and the derivation of the reference value

From an empirical point of view, the studies presented above (see Section 5.1) have largely supported the decision to identify M3 as the key aggregate used to define the reference value. In particular, they suggest that M3 exhibits the required stable relationship with the euro area price level at longer horizons.

[20] See Stracca, 2001.

With M3 identified as the key aggregate, the quantitative derivation of the reference value for monetary growth was presented using the well-known quantity equation relationship between, on the one hand, monetary growth (Δm) and, on the other hand, developments in the price level (Δp), real GDP (Δyr) and the income velocity of circulation (Δv).

$$\Delta m = \Delta yr + \Delta p - \Delta v\,.$$

Within this framework, the derivation was based on the ECB's definition of price stability and medium-term assumptions for developments in real GDP and M3 income velocity.

As noted in the introduction, the ECB has defined price stability as an annual increase in the HICP for the euro area of below 2%. In the derivation of the first reference value in December 1998, it was assumed that the trend growth rate of real GDP was in the range 2% to 2 ½% per year. This assumption was based on an assessment of the historical behaviour of GDP in the euro area over the preceding twenty years and estimates of potential GDP growth made by various international organisations and the ECB itself.[21]

In the derivation of the reference value, it was also estimated that the trend decline in M3 income velocity was in the range ½% and 1% each year. Based on the assumptions mentioned above, the first reference value for monetary growth was set at an annual rate of 4 ½% for M3.[22, 23]

The assumption for the velocity trend can be derived from historical trends estimated using data from 1980 onwards.[24] The analysis underlying the velocity assumption also drew on money demand studies. In this context, attention focused on the long-run money demand relationship, which – together with the assumption on real trend growth – was viewed as capturing the medium-term velocity behaviour relevant for the reference value. Given that price stability is to be maintained according to the ECB's

[21] Relying on an analysis of historical trends is essentially a backward-looking approach. Nevertheless, neither in 1999 nor in 2000 was there clear evidence that future trends would deviate from the 2% to 2 ½% growth rate observed in the past.

[22] The first reference value was announced as a specific rate rather than in the form of a range. The ECB decided that announcing a specific reference rate would help to avoid suggesting to the public that interest rates would be manipulated in a quasi-automatic manner in order to maintain observed M3 growth of a particular "threshold" magnitude. Suggesting such a mechanical response was deemed to be inconsistent with the ECB's monetary policy strategy in general, and the concept of a reference value in particular (ECB, 1999a).

[23] The Governing Council arrived at this figure by noting that summing the three upside extremes of the assumed ranges for the components of the reference value would lead to a rate of 5.5%. In view of the definition of price stability, which indicates that inflation should be *below* 2%, and noting that the actual trend decline in velocity was likely to lie somewhat below the extreme of the range described above, the reference value was then set at an annual growth rate of 4½%. By taking the mid points of the ranges mentioned above, some observers have derived an implicit point inflation objective of 1½% (in terms of the GDP deflator) from the derivation of the reference value. However, the ECB has not endorsed this view and has not identified a specific focal point within the range of inflation rates below 2% it deems consistent with price stability.

[24] A more detailed analysis of the time series properties of M3 income velocity shows that while conventional unit root tests were inconclusive as to whether velocity can be described as stationary around a deterministic trend, analysis has shown that the likely behaviour of velocity over the medium term (e.g. a horizon of around ten years) remains consistent with the assumed decline of ½% and 1% per annum.

definition in the euro area in the future, inflation and, more arguably, nominal interest rates will be stationary time series in the future. This implies that the medium-term behaviour of M3 velocity can be determined solely on the basis of the long-run income elasticity of the demand for M3 and the assumption for trend real GDP growth, i.e. if the money demand relationship is represented by (1), where m represents the logarithm of M3, p is the logarithm of the price level, y is the logarithm of real GDP, i is the interest rate and π is inflation, then:

$$m - p = \alpha + \beta \cdot y + \gamma \cdot i \tag{1}$$

Given the definition of velocity and taking differences, this implies:

$$\Delta v \equiv \Delta y + \Delta p - \Delta m = \Delta y + \Delta p - \Delta p - \beta \cdot \Delta y - \gamma \cdot \Delta i \tag{2}$$

Assuming an environment of price stability and stationary real interest rates, this yields:

$$\Delta v = (1 - \beta) \cdot \Delta y \tag{3}$$

In the context of a money demand equation, the reference value can also be derived directly as the steady-state rate of monetary growth that is consistent with price stability and the assumed trend behaviour of real GDP. Using the generic money demand equation (1) above, taking first differences and substituting the inflation rate consistent with price stability and the assumption for trend real GDP growth gives:

$$\Delta m_t^{\text{ref val}} = \pi^* + \beta_y \, \Delta y_t^{\text{potential}} \tag{4}$$

For example, given the income elasticity of real M3 demand from the long-run BC money demand equation (of approximately 1.3), the 4 ½% reference value for M3 growth is consistent with an inflation rate of 1 ½% (which is consistent with the definition of price stability) and the steady-state growth rate of real GDP of 2 ¼% which is implied by the model.

5.3. Decomposing money growth based on money demand models

The money demand models can be used to explain monetary developments. The models allow for a quantitative analysis of the contributions of the various determinants of money demand to monetary growth.

At least two exercises are possible. First, on the basis of a M3 demand equation, M3 growth can be decomposed into the contribution driven by the error-correction term (i.e. the deviation of the actual money stock from its long-run equilibrium value); the contribution caused by the dynamic elements of the money demand model; and the component of current monetary growth that is not explained by the model (i.e. the residual). Second, M3 growth can be decomposed into the contributions arising from each of its determinants in a money demand equation (i.e. output, interest rates etc.), thereby combining the dynamic and the "error-correction" factors for each variable.

Obviously, such decompositions rely on the specification and estimated parameters of the underlying equation. If more than one money demand equation is available – as is the case for M3 in the euro area – then it is possible to decompose monetary growth on the basis of several approaches, allowing scope for cross-checking and the exercise of judgement regarding which approach better explains current developments.

5.4. A semi-structural approach based on money demand – combining the model-based and the judgmental approach

5.4.1. Starting from a money demand model

While accounting and decomposition exercises may be helpful for developing a deeper understanding of the causes of monetary growth, a more ambitious approach would be to identify and classify (or to estimate) the type of shock underlying monetary developments and their implications for future price developments on the basis of a *semi-structural* analysis.

Taking a money demand model as starting point, this section illustrates an attempt to offer an explanation of *why* monetary developments have implications for the risks to price stability, thereby providing information needed for designing the appropriate monetary policy response. In this sense the approach may be called "structural".

To illustrate, a money demand equation is outlined below, where the notation is conventional. Δm_t denotes the change in the logarithm of nominal stock of money; p_t and y_t denote the logarithm of the price level and of real output, respectively; i_t is an interest rate (or a spread) and ε_t denotes shocks to (or the unexplained part of) money growth. Volatility in financial markets (denoted *vol*) is included within the specification, on the basis that such volatility may increase the demand for money if individuals wish to hold deposits as a safe haven.

$$\Delta m_t = k + \Delta p_t + \gamma_{\mathrm{p}} \Delta y_t + \gamma_{\mathrm{s}} \Delta i_t + \gamma_v \, vol_t - \alpha(m - p - \beta_y y - \beta_{\mathrm{s}} i)_{t-l} + \eta_t + \varepsilon_t \quad (5)$$

In this context, broadly speaking, four different categories of monetary development can be distinguished.

First, monetary developments may be attributable to identifiable "special factors" and "distortions" (represented in equation (5) by the dummy variable, η_{t}) which are seen as benign with regard to prospective price stability, since they represent the effects of statistical or institutional distortions which are not of economic relevance. In other words, "headline" monetary growth would have to be adjusted for these special factors in order to yield a measure of "corrected" monetary growth which can be used more directly as an indicator of future price developments (i.e. the corrected M3 growth figure would be $\Delta m_t - \eta_{\mathbf{t}}$). This highlights the importance of both detailed institutional analysis and explicit model-based assessment of monetary developments in order to identify and extract such effects.

Second, monetary developments that result from current changes in the determinants of money (e.g. high current monetary growth caused by high current output growth ($\Delta \boldsymbol{y}_t > 0$) or lower interest rates ($\Delta i_t < 0$)) may be a signal of future price developments. For example, higher monetary growth resulting from real GDP growth above its sustainable level may signal inflationary pressures associated with overheating of the economy. Similarly, if monetary growth is strong because of an inappropriately low level of interest rates, this may also be associated with the emergence of inflationary pressures.

Although the monetary developments caused by other underlying economic phenomena simply reflect information available from other indicators, it may nevertheless be useful to evaluate them in monetary analysis. A monetary aggregate may, in practice, summarise the information relevant for monetary policy decisions that is contained in a variety of other indicators. If this is the case, using money as a convenient summary is likely to ease communication with the general public.

Third, monetary developments may be caused by developments in other determinants of money which are *not* associated with the emergence of risks to price stability. For example, higher short-term volatility in financial markets may increase the demand for money in the short run, even if it does not suggest threats to price stability. Monetary developments arising from these sources may therefore not signal (new) risks to price stability. In principle, one would also wish to correct monetary growth for such effects (e.g. to obtain a measure of "underlying" monetary growth, such as $(\Delta m_t - \gamma_v vol_t - \eta_t)$) in order to obtain a truer indication from monetary data of the evolution of those determinants (namely output and interest rates) which are likely to have implications for price developments.

Furthermore, some specifications of money demand model the portfolio shifts between monetary and non-monetary assets explicitly using a proxy for the difference between the own rate of M3 and the return on alternative assets. To the extent that shifts between monetary and non-monetary assets simply reflect portfolio allocation based on yield differentials (rather than deriving from the general level of interest rates), they may not signal the emergence of risks to price stability. In monetary analysis, the assessment of the information in money should take account of such identifiable portfolio shifts, e.g. by deducting their estimated amount from headline money growth (as indicated above for the effects of financial market volatility) in order to derive underlying money growth.

Finally, price developments may be influenced by "monetary shocks", i.e. monetary developments which are not caused by other variables included in the money demand equation (ε_t). Since these developments are not associated with the evolution of other variables, they constitute information about economic shocks – and thus the risks to price stability – that would be ignored if money were not analysed thoroughly. Obviously, if underlying M3 growth (once adjusted for possible identifiable distortions) were relatively strong even though output growth was estimated to be modest and interest rates were relatively high, all other things being equal this would be a cause for greater concern regarding upward risks to price stability than if M3 growth were lower, and thus in line with its determinants.

One example of such a monetary shock would be the impact of a – possibly temporary – increase in the efficiency of the banking sector. In this context, the cost of financial intermediation may fall, credit become more readily available and, in consequence, demand pressures rise, building inflationary pressures. A positive monetary shock may also result when financial intermediaries' and/or investors' expectations regarding productivity growth, and thus the equilibrium real interest rate, increase, but short-term real rates are kept unchanged. As variables such as expected productivity growth or the equilibrium real interest rate are not directly observed by the central bank, it could be higher money and/or credit growth – triggered by the optimism of financial intermediaries or investors and thus their increased willingness to lend or borrow at the same (i.e. unchanged) level of central bank rates – which signals that monetary policy would need to be adjusted if price stability is to be maintained in the medium term. In both of these examples, monetary shocks may largely reflect developments in underlying "latent" variables, such as credit spreads or a diverse set of other yields and financial prices relevant for monetary transmission, which are not readily observable.

5.4.2. Combining econometric models and judgement

The advantage of applying a model-based contributions exercise in general is that the explanation of past developments is footed on firmer grounds and does not exclusively

rely on experts' judgement. At the same time, it is important to recognise that for a number of factors which may determine money demand no reliable long-term data series are available. These factors are therefore not captured in estimated money demand models. Moreover there is always uncertainty regarding the appropriate specification of money demand models and for a number of aggregates and components satisfactory estimated models are not available. Furthermore, it is sometimes not straightforward to identify those determinants of money demand which do not signal new risks to price stability. Against this background, experts' judgement is indispensable. Reconciling the explicit model-based analysis with the judgmental approach should help to improve the overall analysis, as it allows a more comprehensive explanation of the developments in M3, its components and counterparts. Close attention should be paid, for example, to news about economic activity, market and retail interest rates, the overall financial market situation, mergers and acquisition and real estate markets.

In particular some efforts should be made to analyse the part of M3 growth which cannot be explained by the determinants contained in the estimated money demand models. Assuming that there are no structural breaks in the models, the unexplained part can either be the consequence of transitory special factors or reflect the existence of monetary disequilibria (i.e. a deviation of the money stock from its long-run equilibrium level). In order to distinguish these two effects using the money demand models, it would be necessary to identify and, to the extent possible, quantify "special factors" on the basis of detailed institutional analysis and time series models so that the monetary data can be corrected for their effect. Then an M3 series could be constructed which is adjusted for all special factors which were relevant in the past.

Given that, in reality, such an undertaking is not possible with a sufficient degree of reliability, the analysis needs usually to be restricted to an ad hoc consideration of the most important special factors in the latest data and the recent past. If there is still a sizeable unexplained element after due account has been taken of these special factors, it can be concluded that either a structural break has occurred in the demand for money or that some monetary shocks or disequilibria had built up in a specific period (which normally tends to signal risks to price stability).

5.4.3. Identifying special factors – an example

As emphasised above, one part of judgmental analysis is to see whether there is any evidence of M3 growth being affected by special factors, i.e. those factors affecting M3 which fall outside the range of the main traditional determinants of estimated money demand models for which long and reliable data series are available (e.g. output and interest rates). Special factors can be identified and roughly quantified by applying an institutional and statistically-oriented approach.

In order to detect the existence of special factors, several sources of information need to be combined. The national contributions to euro area monetary variables are a valuable source for identifying distortions which may be of relevance also at a euro area-wide level. Finally, at least in some cases, events which may trigger distortions in monetary aggregates are known in advance (e.g. changes in the tax system).

For example, portfolio shifts triggered by the change in the minimum reserve system at the start of 1999 had an impact on M3 growth. This special factor worked in different directions in different countries. For German MFIs, the introduction of remuner-

ated minimum reserves was advantageous in comparison to the system prior to Stage Three of Economic and Monetary Union (EMU). Hence, more attractive conditions for short-term deposits and negotiable instruments could be offered to customers. As a consequence, funds were repatriated from Luxembourg and the United Kingdom. In order to approximate the impact on M3 growth in the euro area, use can be made of the Deutsche Bundesbank's statistics on the foreign branches and subsidiaries of German banks (including a regional breakdown). These data allow for an analysis of the developments of the short-term deposits held at branches and subsidiaries in the United Kingdom with past trends. In Luxembourg and Italy the switch to the new system of minimum reserves had the opposite effect than in Germany and led to a flow of funds outside M3.[25] In these cases, the impact on M3 can be estimated by comparing actual developments with those developments which could have been expected to occur in the absence of the special factor. It is self-evident that such estimations are surrounded by a considerable degree of uncertainty and have to be interpreted with due caution.

5.5. Implications for analysis of deviations from the reference value

As explained above, the reference value has a medium-term orientation which helps to emphasise consistency with the maintenance of price stability over the medium term. The above discussion indirectly also shows that the medium-term orientation of the reference value implies that shorter-term deviations of monetary growth from the reference value may not in all circumstances be a good indicator of (new) threats to price stability.

Consequently, the ECB has made clear that it will not react mechanistically to deviations of M3 growth from the reference value. The reasons for such deviations should always be carefully analysed in order to identify the economic disturbance that caused the deviation (ECB, 1999a). The analysis of current monetary developments should recognise the context (and, in particular, take note of explanations of monetary developments gained on the basis of model-based analysis and judgement[26]) in order to obtain a richer picture of the overall liquidity situation from a medium-term perspective. This may also include analysis of the level of the money stock – and by implication the potential existence and magnitude of any excess liquidity, as discussed in the following section.[27]

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[25] In the case of Italy, additional institutional factors, for example the tax reform implemented in July 1996 and structural shifts in portfolio preferences, also contributed to the downward distortion of the national contribution to euro area M3.

[26] For example, if annual M3 growth is more rapid in the short term because the stock of money was initially below its "equilibrium" level (associated with the current level of prices and real activity), as would be implied by conventional error-correction money demand specifications, then a positive deviation of annual M3 growth from the reference value would be expected in the future under the assumption of stable money demand. However, in this instance, the resulting monetary growth at rates above the reference value would be an equilibrating phenomenon, which does not, in itself, contain new information about price developments. Detailed analysis of monetary developments in the context of other variables can reveal such an interpretation and can therefore inform the policy discussion.

[27] The medium-term nature of the derivation of the reference value implies that estimates of the medium-term trend in monetary growth (which may be defined as a longer-term growth rate of "headline money" corrected for some predictable short-run dynamic effects on M3 growth, which are not considered as signalling risks to price stability, and corrected for the impact of identifiable distortions and special factors; see Section 5.4) are typically also useful for making a comparison with the reference value.

5.6. Various measures of excess liquidity derived from monetary aggregates

As mentioned above, although the reference value is expressed as a growth rate, a thorough analysis should also made of the level of the money stock and various measures of excess liquidity. These measures constitute additional money-based indicators that may be useful for the monetary analysis undertaken as part of the first pillar. The remainder of this section defines and compares various measures of excess liquidity derived by subtracting from the observed money stock various measures of equilibrium money balances. These measures of the equilibrium money stock share the feature that they abstract from the short-term or dynamic aspects of the money demand equation and thus are more medium term-oriented concepts.

While the following three sections introduce various concepts of excess liquidity, the final section discusses their usefulness and limitations.

5.6.1. The money gap

One measure of excess liquidity (which is labelled the "money gap") is the deviation of the actual stock of M3 from the level implied by the reference value. Since the reference value is expressed as a growth rate of 4 ½% per annum, a base period must be chosen to obtain this reference value-consistent stock. The choice of base period is to some extent arbitrary, yet it will have important implications for the magnitude of the gap measured in this way.[28]

$$\begin{aligned} m_t^{\text{ref val}} &= m_0 + 0.045t \\ &= m_0 + t(\pi^* + \beta_y \, \Delta y_t^{\text{potential}}) \end{aligned} \tag{6}$$

The second expression in (6) simply substitutes the reference value from (4). This definition of excess liquidity is normative, since the reference value is derived to be consistent with price stability. Charts 3 and 4 illustrate the calculation of the money gap using quarterly data, taking the last quarter of 1998 as the base period.

5.6.2. The monetary overhang/shortfall

Alternative measures of excess liquidity can be explicitly derived from the money demand equations. For example, the "monetary overhang" (or "shortfall") could be defined using the long-run money demand relationship, substituting in the observed values of the determinants of M3, in order to determine "equilibrium (nominal) money", viz. (taking a generic description of money demand which could be seen as encompassing both of the actual frameworks used in the regular analysis outlined above):

$$m_t^{\text{eqm}} = k' + p_t + \beta y_t + \gamma i_t \, . \tag{7}$$

The overhang/shortfall would then be defined as the difference between the actual nominal money stock and m_t^{eqm} (the equilibrium money stock consistent with the observed value of other variables). A positive shock to the actual price level, all other things being equal, directly reduces this measure of excess liquidity.

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[28] For example, December 1998 (the date the reference value of 4 ½% was first announced) can be used as the base period. In expression (6), potential output growth is assumed to be 2.25% per annum, an inflation objective consistent with the Eurosystem's definition of price stability is 1.5% per annum and the long-run income elasticity of the demand for M3 is 1.33.

Chart 3. M3 consistent with the reference value and actual M3
(base period 1998 Q4 = 100)

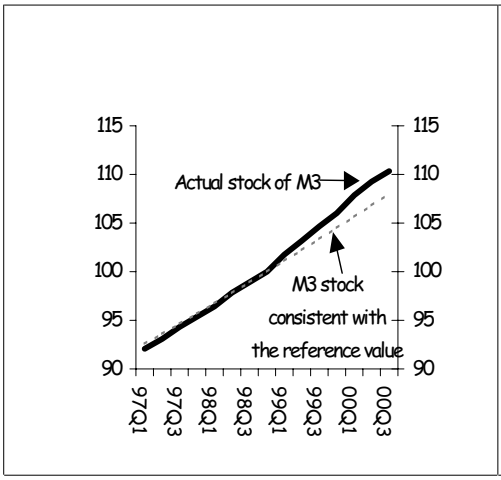
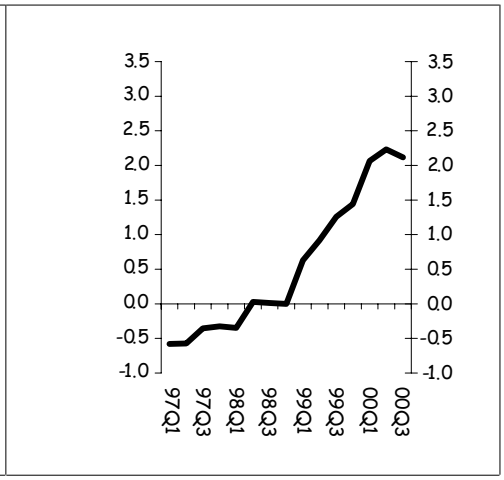


Chart 4. An estimate of the money gap
(as a percentage of the stock of M3)



Such a monetary overhang/shortfall measure can be constructed for example on the basis (of the long-run relationship) of the BC money demand framework (see Chart 5).[29]

5.6.3. The real money gap (or the P-star-based measure of excess liquidity)

A third measure of excess liquidity can be derived by comparing the actual money stock with a measure of equilibrium money holdings evaluated at potential output and actual prices. This concept can be labelled $m_t^{\text{eqm}*}$, where:

$$m_t^{\text{eqm}*} = k' + p_t + \beta y_t^{\text{potential}} + \gamma i_t^*. \tag{8}$$

This concept also implicitly underlies the "P-star" model of inflation (Hallman, et al., 1991). Conventionally, the P-star model relates the evolution of inflation to the "output gap" (capturing the deviation of output from potential) and the "velocity gap" (capturing the deviation of velocity from its long-run equilibrium level).[30]

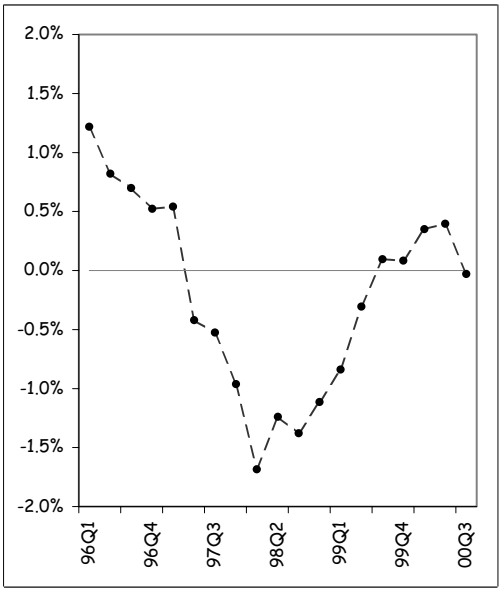
In order to allow comparisons to be drawn, it is useful to compare the characterisation of the P-star-based measure of excess liquidity in equation (8) with the derivation

[29] If equilibrium money is not evaluated at the current price level, but at a normative price level, then an overhang/shortfall measure *based on a normative price level* could be derived. Such a "normative monetary overhang" (or "shortfall") could be defined using the long-run money demand relationship, substituting in the observed output value and a price level which would be consistent with a price level objective, in order to determine "equilibrium money":

$$m_t^{\text{eqm}*} = k' + (p_0 + t\pi^*) + \beta y_t + \gamma i_t \tag{7a}$$

[30] Since the P-star model relies on an equilibrium notion of velocity, in the context of the money demand framework discussed in this paper it would be natural to use the equilibrium or "neutral" nominal interest rate (consistent with price stability) in the money demand equation. This contrasts with other measures (such as the real monetary overhang/shortfall) where it is more sensible to include actual interest rates, thereby creating consistency with the choice of actual price level and actual output in deriving the measure of excess liquidity.

Chart 5. A measure of the monetary overhang *(as a percentage of the stock of M3)*



presented in Orphanides and Porter (2001) (a paper which also appears in this volume). Using the quantity identity expressed in logarithms,[31] Orphanides and Porter define p^* as the price level consistent with the current stock of money and equilibrium value of velocity (v^*) and the potential level of output. p is the current price level (note that because the quantity relationship is an identity, this is the price level consistent with the current money stock and *actual* levels of velocity and output). Therefore:

$$p^* = m + v^* - y^{\text{potential}} \tag{8a}$$

$$p = m + v - y \tag{8b}$$

Using an error correction approach, inflation is then related to the "price gap" between p and p^*, assuming that the price gap is a leading indicator of inflation:

$$\pi_{t+l} = \pi_t + \alpha(p_t - p_t^*) \tag{8c}$$

In practice, the price gap is typically decomposed into a velocity gap and an output gap by subtracting (8b) from (8a) and substituting in (8c).

$$\pi_{t+l} = \pi_t + \alpha'(v_t - v_t^*) - \alpha''(y_t - y_t^{\text{potential}}) \tag{8d}$$

The relationship between this approach and the characterisation offered in equation (8) is as follows. Rather than defining an equilibrium level of velocity explicitly, the approach adopted here defines v^* implicitly using the money demand equation.[32] Moreover, rather than deriving p and p^* as in equations (8a) and (8b), the approach derives

[31] For simplicity, notation is used consistently throughout this paper. When making comparisons, it should be recalled that in the Orphanides and Porter paper, output is denoted as q (rather than y) and potential output is denoted as q^* (rather than $\boldsymbol{y}^{\text{potential}}$).

[32] In practice, this implies that $v^* = -k' + (1 - \beta)\, y_t^{\text{potential}} - \gamma i_t^*$, where i_t^* is the "neutral" or equilibrium nominal interest rate consistent with price stability.

the level of the money stock consistent with equilibrium velocity and potential output (i.e. $m^* = m_t^{\text{eqm}*}$) and compares this with the actual money stock.

Using the quantity identity rather than money demand equations, the relationship between the price gap from Orphanides and Porter (2001) and the P-star-based measure of excess liquidity is demonstrated in equations (8e) through (8g).

$$m^* = m_t^{\text{eqm}^*} = p + y^{\text{potential}} - v^* \tag{8e}$$

$$m = p + y - v \tag{8f}$$

$$(m - m^*) = -(v_t - v_t^*) + (y_t - y_t^{\text{potential}}) = -(p - p^*) = (m - m_t^{\text{eqm}^*}) \tag{8g}$$

In other words, the price gap and the P-star-based measure of excess liquidity (or the real money gap) represent the same concept, but simply express it using different variables and with the sign reversed. If the P-star-based measure of excess liquidity is positive, the price gap is negative and vice versa.

As shown by Gerlach and Svensson (2000) in an application to the euro area, this framework can be re-expressed in terms of a relationship between inflation and the real money gap, $[(m_t - p_t) - (m_t^{\text{eqm}^*} - p_t])$, thereby facilitating comparisons with other measures of excess liquidity.[33] The P-star model therefore suggests that deviations of the stock of real money balances from their equilibrium level defined by the relationship with potential output help to predict future developments in inflation.

5.6.4. Comparisons of various measures of excess liquidity

The money gap defined above can also be expressed in terms of a money demand framework, since (as shown in Section 5.2) the reference value can also be derived using a money demand equation. In that case, the difference between the money gap (based on a normative price level) and the monetary overhang/shortfall is:

Money Gap – Monetary Overhang

$$\begin{aligned}
&(m_t - m_t^{\text{ref val}}) - (m_t - m_t^{\text{eqm}}) \\
&= (k' = p_t + \beta y_t + \gamma i_t) - (m_0 + t(\pi^* + \beta\, \Delta y_t^{\text{potential}})) \\
&= (m_0^{\text{eqm}} - m_0) + (p_t - (p_0 + t\pi^*)) + \beta(y_t - (\mathbf{y}_0 + t\, \Delta y_t^{\text{potential}})) + \gamma(i_t - \boldsymbol{i}_0)
\end{aligned} \tag{9}$$

The difference between the money gap $(m_t - m_t^{\text{ref val}})$ and the monetary overhang $(m_t - m_t^{\text{eqm}})$ is therefore related to: (a) the extent to which the money stock in the chosen base period differs from a level consistent with long-run money demand at the macroeconomic variables obtained in the base period; (b) the difference between the actual price level and that extrapolated from the base period on the basis of the inflation objective; (c) a term related to the cumulated output gap since the base period; and (d) a term related to the difference between nominal interest rates in the current and base periods.

If the base period is chosen appropriately, component (a) of this difference will be zero.[34] If nominal interest rates are broadly speaking unchanged (as one might expect over a period of several years in an environment of price stability), then component (c) is also zero. Therefore, there are two main substantive differences between the money gap and the monetary overhang, as each concept is defined above.

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[33] Gerlach and Svensson (2000) also set the interest rate terms to their equilibrium level.

[34] This statement defines a criterion for determining the base period, namely it should be a period during which the actual money stock was at the level consistent with long-run money demand at equilibrium or normative values of the determinants of money.

First, the money gap measure of excess liquidity implicitly includes the cumulated impact on the money stock of deviations of the actual price level from a price level path which is determined ex ante (e.g. a price level objective determined by the base period and the desired inflation rate). In contrast, the monetary overhang automatically accepts "base drift" in the price level. In other words, at a conceptual level the money gap is an indicator more consistent with price level objectives, whereas the monetary overhang as defined above is more consistent with an inflation objective (and allows the price level to behave as a random walk, accepting one-off shifts in the price level on the principle that "bygones are bygones").

Second, the money gap increases relative to the monetary overhang in proportion to the output gap. In other words, the money gap incorporates the impact on the money stock of cumulated deviations of actual output from potential. Thus, if real growth since the base period is higher than potential growth, the money gap is larger than the overhang. In this sense, the money gap is a form of summary statistic, whereas the overhang merely reflects the additional information in money which is not included in its determinants (e.g. GDP and interest rates).

A similar comparison can be made between the money gap and the real money gap (i.e. the P-star-based excess liquidity indicator).

Money Gap – Real Money Gap

$$\begin{aligned}
&(m_t - m_t^{\text{ref val}}) - (m_t - m_t^{\text{eqm}*}) \\
&= (k' + p_{\text{t}} + \beta y_t^{\text{potential}} + \gamma i_t) - (m_0 + t(\pi^* + \beta\, \Delta y_t^{\text{potential}})) \\
&= (m_t^{\text{eqm}} - m_0) + (p_t - (p_0 + t\pi^*)) + \gamma(i_{\text{t}} - i_0)
\end{aligned} \tag{10}$$

A comparison of expressions (9) and (10) demonstrates that the real money gap from the P-star approach represents an intermediate approach, where the impact of the output gap (i.e. cumulated deviations of actual output growth from potential) on the money stock is included in the measure of excess liquidity (in this respect the real money gap is similar to the nominal money gap), but the impact on the money stock of cumulated deviations of the actual price level from an implicit price level objective are not (in this respect the real money gap is similar to the overhang concept).

In assessing which of the measures of excess liquidity is most useful for monetary policy purposes, a number of considerations have to be borne in mind.

First, at a conceptual level, the importance of price level objectives, as opposed to inflation objectives, needs to be considered. If price level objectives are deemed important, a money gap measure may be more appropriate since this measure incorporates the impact on the money stock of deviations of such an objective.

Second, consideration should be given to whether money should be used, at least in part, as a *summary* statistic of developments in the determinants of money or whether the focus of attention should be on the information in monetary developments which is not provided by alternative indicators which are included in the money demand framework. In the former case, focusing on estimates of the money gap or real money gap (the P-star approach) may be more useful, since, for example, these measures encompass developments in the output gap. Alternatively, if analysing the *additional* information in monetary developments is deemed more useful, a focus on the monetary overhang/shortfall may be more appropriate since this does not incorporate the effects of

the output gap or deviations of the price level from a desired level on the stock of money and measure of excess liquidity. Obviously, the weight assigned to the gap measure relative to the overhang measure may thus also depend on the uncertainty regarding the estimates of the output gap in real time.

Third, the usefulness of the various measures of excess liquidity can be assessed on empirical grounds, in terms of their relation with future price developments. A systematic comparison of the indicator properties of various measures of excess liquidity for future price developments has not, as yet, been undertaken. Gerlach and Svensson (2000) and Trecroci and Vega (2000) find that P-star-based measures of the real money gap (using certain specifications of money demand) help to predict future inflation in within sample exercises. In simulated out-of-sample forecast exercises, Nicoletti Altimari (2001) also finds favourable results for the P-star model, although other indicators of excess liquidity (and headline M3 growth) perform better at some longer horizons.

6. The information content of monetary aggregates for future price developments and money-based projections

6.1. A brief summary of empirical results on the leading indicator properties of monetary variables[35]

The above discussion has described a number of techniques used to analyse monetary variables. Many of these approaches involve decomposing monetary developments on the basis of various accounting frameworks (most of which follow from money demand equations), with the aim of developing a better understanding of the underlying causes of monetary dynamics.

A natural complement to such a semi-structural approach is to treat money as an indicator variable for future price developments. Naturally, such an approach does not allow the causes of monetary developments to be identified – and thus does not provide information about the nature of potential threats to price stability to policy-makers – but instead simply gives an indication of the future path of price developments. On this basis, the various decompositions described above can also be interpreted as methods of constructing monetary indicators of various types. The relative performance of such indicators as predictors of future inflation is then an empirical question.

Nicoletti Altimari (2001) performs an extensive systematic evaluation of the leading indicator properties of monetary and credit aggregates for future inflation in the euro area. The forecasting performance of models including money-based indicators is assessed in a simulated out-of-sample forecasting exercise over the period 1992–2000. Forecasts are evaluated for horizons varying from one quarter to three years ahead. The performance of money-based indicators is compared with the forecasting performance of models based on a broad range of non-monetary indicators.[36]

One reassuring message from these studies is that monetary indicators do appear to contain information which helps to predict price developments in the euro area. Broadly speaking, the relative forecasting performance of money-based indicator mod-

[35] This section has benefited greatly from the contribution of S. Nicoletti Altimari and draws on his working paper (Nicoletti Altimari, 2001).

[36] The methodology used to perform the simulated out-of-sample exercise closely follows Stock and Watson (1999). The details of the procedure and of the specification of the models used can be found in Nicoletti Altimari (2001).

els tends to improve with the length of the forecast horizon. At forecast horizons up to one year ahead only a few models based on a single indicator outperform a simple univariate model of inflation. Among the money-based indicators, only the P-star indicator derived from the Brand and Cassola (2000) M3 demand framework outperforms the univariate model. As the forecast horizon is enlarged, however, many models – in particular those including money-based indicators – show an improved relative performance and eventually outperform the forecasts based on the simple univariate model.

At forecast horizons between one and two years ahead the best performing models are those based on loans to the private sector and the P-star indicator. The latter result accords both with theoretical priors – since the P-star model is essentially an error-correction framework where the P-star indicator would help to predict inflation at relatively short horizons – and with the results for other countries (in particular, the results for Switzerland (Jordan, et al., 2001) reported in this volume).

At forecast horizons between two and three years, the best performing models are those based on M3 and its main counterpart credit, together with the models including the M3-based real money-gap and money-overhang measures. At forecasting horizons close to three years ahead these models result in a substantial reduction of the forecast mean squared error (MSE), in some cases up to 50% of that produced by the simple univariate model. The M3-based model is the best performing model among those considered at the longest forecast horizon (three years ahead). In general, broader aggregates show better leading indicator properties with respect to future price developments, with the models based on M3 and loans outperforming the M2-based model, which in turn outperforms the M1-based model.

These results provide some supporting evidence for the reference value announced by the ECB. Cumulative inflation over the next three years ahead is relatively well predicted by headline annual M3 growth (and lagged values of M3 growth). This result is consistent with the view that medium-term and low frequency trends in inflation can be predicted using M3 growth. Consequently "large or prolonged" deviations of M3 growth from the reference value – although not deviations on a month-to-month or even quarter-to-quarter basis – can be interpreted as signals of emerging risks to price stability. Such an interpretation would be consistent with the medium-term orientation of the reference value.

Nicoletti Altimari (2001) also shows that, on the basis of tests of the relative information content of different indicators, monetary aggregates appear to provide useful *additional* information for forecasting future inflation relative to the best non-monetary indicators. The additional information content is particularly significant at longer horizons. Vice versa, indicators based on real activity or price and costs measures appear to provide useful information relative to M3 in forecasting inflation, especially at horizons up to two years ahead. Among monetary indicators, P-star and money gap/overhang measures appear to contain additional information with respect to M3, especially at horizons up to two years ahead.

The above results seem to be robust to all measures of price inflation considered. Broadly speaking, the same indications arise when using the HICP index, the consumption deflator or the GDP deflator.

Overall, the findings in Nicoletti Altimari (2001) support the idea that monetary and credit aggregates provide significant and independent information for future price developments in the euro area, especially at horizons beyond one and a half years.

6.2. Uses and limitations of money-based projections and forecasts

Before concluding, the preceding results should be placed in the context of a broader discussion of the role of money-based forecasts in the analysis underlying monetary policy decisions.

In general, an "optimal" monetary policy needs to be based on an analysis of the current economic situation and the underlying economic shocks. However, to the extent that a satisfactory and fully structural model which gives a prominent role to money and helps to clearly identify structural monetary and other shocks is not available, non-structural or reduced form money-based projections of inflation may be useful for illustrating the information content of past and current monetary developments, provided that the limitations of such analysis are taken into account.

Against this background, monetary models of the transmission mechanism can also be used to make forward-looking analyses of price and output prospects. For example, the BC money demand framework is embedded within a system which includes equations for inflation and real GDP growth. In the context of vector error correction models (VECMs) like the BC model, the simultaneous determination of all model variables implies that simultaneous predictions of all the variables involved, including inflation and real GDP growth can be produced. Moreover, a projected path for short-term interest rates is also produced. The resulting projections are therefore based on an assumed set of monetary policy responses (i.e. an implicit "reaction function"), rather than being based on the assumption of unchanged rates typically embodied in central banks' conventional macroeconomic forecasting exercises. This always needs to be kept in mind when interpreting the projections and cross-checking and comparing them with those produced under the "second pillar" of the ECB's strategy in the context of conventional macroeconomic forecasting exercises (ECB, 2000).

The inflation and GDP growth outlook produced using the BC system (the former, given the specification of the model, applies to the GDP deflator rather than HICP inflation) are limited in the sense that the BC model was not explicitly designed for the purpose of making projections for real GDP or inflation, but rather for analysing the role and stability of M3 growth in the context of a system approach.

In parallel with the semi-structural analysis described in Section 5.4 above, monetary and credit aggregates can also be used in *reduced-form indicator models*. Various studies suggest money-based indicators may predict inflation well, especially at a medium-term horizon.

When used in this pure indicator role, these monetary indicators do not distinguish among the various explanatory roles of money outlined above, but rather treat them (implicitly) as follows. First, a simple (headline) measure of monetary growth does not control explicitly for special factors. Implicitly, special factors are assumed to cancel out (i.e. to be "white noise") over the sample period in which indicator properties are investigated (or to be introduced ex post as a matter of judgement). Second, monetary growth typically summarises the information in a range of likely inflation indicators, e.g. money growth is related to output growth, and therefore implicitly incorporates a component related to output growth (inter alia), which in itself may be a useful inflation indicator. Finally, measures of monetary growth incorporate monetary shocks and thereby encompass both shocks to money demand and measurement errors in the determinants of money.

However, because they are not associated with a structural interpretation, the indicator properties of monetary growth may break down out of sample. For example, infla-

Chart 6. Real M1 and real GDP
(annual percentage change)

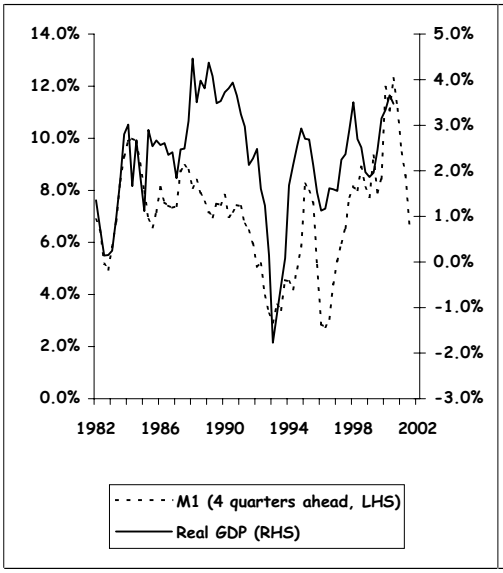


Chart 7. Assessment of real GDP prospects from the M1 vector autoregression
(annual percentage change, 95% confidence bands)

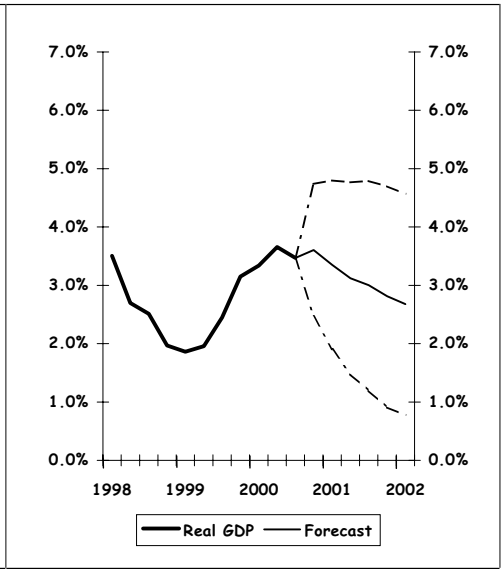


Chart 8. HICP inflation assessment based on developments of M3
(annual percentage change; 90% confidence bands)

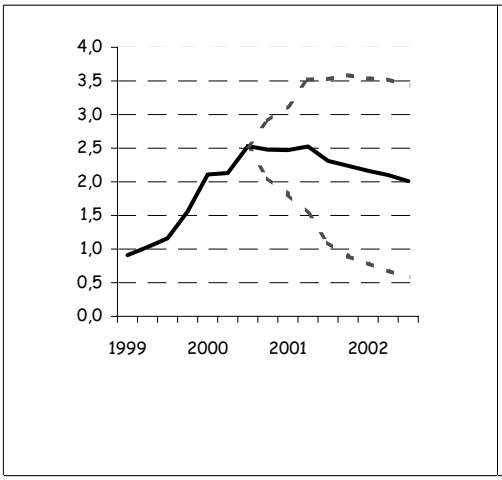
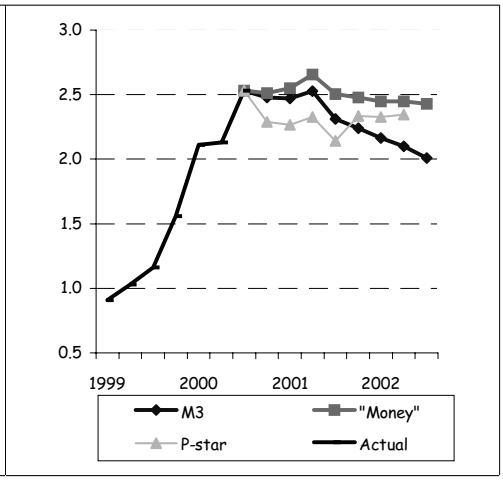


Chart 9. HICP inflation assessment based on alternative monetary indicators
(annual percentage change)



Note: In Chart 9, "money" is the average of the forecasts obtained with models based on M1, M2, M3 and loans to the private sector. P-star is the forecast based on a measure of a measure of excess money growth computed as the difference between current money growth and "equilibrium" money growth, as derived from a standard money demand equation.

tion projections over the medium term based on simple monetary indicator models have to be treated with caution also because they incorporate an implicit reaction to monetary growth. This reaction reflects the past response of the monetary authorities to developments in the monetary indicator. To the extent that monetary policy reacts differently to monetary developments now than on average in the past, medium-term forecasts of inflation using monetary indicator models would not be the best-unbiased money-based forecast. Therefore, the structural or semi-structural and reduced-form indicator approaches should be treated as complements and conducted in parallel.

For real GDP growth M1 has been found to have good leading indicator properties (which are illustrated in simplified form in Chart 6). Therefore a small vector autoregression (VAR) model can be used to produce short-term projections for real GDP which are partly based on M1 developments (see Chart 7).

Regarding money-based inflation projections, M3, other monetary aggregates, the components of M3 and the counterparts (notably credit) may be used. The projections produced by the indicator models estimated in the study by Nicoletti Altimari (2001) can be presented in the form shown in Charts 8 and 9 above.

7. Concluding remarks

Analysis under both pillars of the ECB's monetary policy strategy focuses on extracting the information in monetary and other economic and financial developments that is relevant for monetary policy decisions, and therefore focuses mainly on evaluating the economic situation, identifying the nature of the economic shocks to the euro area and the resulting risks to price stability. The "first pillar" represents a set of analytical approaches and tools which all share the feature that monetary developments or, more generally, various measures of liquidity derived from monetary aggregates, have important implications for monetary policy and determine, or at least provide useful information regarding, the evolution of the price level over the medium term.

This paper has described a number of tools and approaches of monetary analysis. The experience over the last two years suggests that adopting a variety of approaches to explain and assess monetary and credit developments is helpful in achieving a well-founded and detailed picture of the monetary situation in the euro area. This illustrates that the "first pillar" of the ECB's strategy does not consist solely of the reference value. This pillar should be understood to encompass a broad range of monetary analyses extending to the components and counterparts of M3, in particular credit. Of course, this analysis always takes place in the context of other indicators (e.g. the determinants of money demand, such as real income and interest rates). While simple comparisons of annual M3 growth with the reference value alone cannot encompass the rich set of analyses presented in this paper, the reference value constitutes an important commitment device in giving monetary analysis the prominent role it has been assigned within the ECB's strategy. Moreover, although obviously and necessarily in a highly simplified form, the reference value provides a useful starting point for analysis and presentation which facilitates communication with the general public. Experience during the first two years of Monetary Union has demonstrated that the prominent role assigned to money in the ECB's monetary policy strategy, signalled by the announcement of a reference value and underpinned by thorough econometric and judgmental analysis, has helped to ensure that discussions of monetary policy decisions and their justification, both within the ECB and in the public domain, include a medium term-oriented monetary dimension.

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