MONETARY ANALYSIS IN REAL TIME



The primary objective of the ECB is to maintain price stability in the euro area. In both theoretical and empirical economic literature, it is widely recognised that the money stock and the price level are closely related in the long run. Given that inflation is thus a monetary phenomenon over the medium to long term, the ECB has assigned a very important role to money in its monetary policy strategy. Cross-checking with economic analysis, monetary analysis thereby contributes significantly to the decision-making process of the Governing Council of the ECB and to the ECB's monetary policy.

This article illustrates how tools developed and used by ECB staff and others have been employed over recent years to identify the monetary signals concerning risks to future price stability. Undertaking such analysis has proved challenging, since the exceptional economic, financial and geopolitical uncertainties between 2001 and 2003 affected short-run monetary dynamics and thus complicated the extraction of signals regarding risks to price stability from monetary developments. Nevertheless, using a combination of institutional and model-based analyses, it has been possible to assess in real time the implications of monetary developments for future price changes.

I INTRODUCTION

Many empirical studies have demonstrated that monetary developments contain information relevant for the assessment of medium to longer-term risks to price stability. As a result, in October 1998 a prominent role was assigned to money in the ECB's monetary policy strategy.²

At the time, empirical analyses of the euro area relied on "synthetic" data constructed from national statistics. Because the euro area was an entirely new economic entity, no genuine euro area time series existed. Euro area data now span a period of more than five years – still a short sample for analytical purposes, but nonetheless sufficient to develop an insight into the behaviour of the new area-wide economy.

Exploiting the available data and, more generally, using the experience of implementing monetary policy in the euro area since 1999, the Governing Council of the ECB undertook an evaluation of its monetary policy strategy in May 2003.³ One aspect of this evaluation was an assessment of the role played by monetary analysis. A number of empirical studies were undertaken.⁴ Moreover, recent developments in literature on money and monetary policy were reviewed.⁵ The evaluation confirmed the very important role of money in the ECB's monetary

policy strategy. The Governing Council clarified that monetary analysis is used, from a medium to longer-term perspective, to crosscheck the assessment of short to medium-term risks to price stability obtained from the economic analysis (which focuses on shorter-term cost developments and demand-supply imbalances).

This cross-checking is an essential feature of the ECB's monetary policy strategy. It helps to ensure that the Governing Council, in forming its overall judgement of the risks to price stability, does not overlook important information concerning future price trends. All complementarities between the monetary analysis and the economic analysis are

- 1 For a review, see G. T. McCandless and W. E. Weber (1995), "Some monetary facts", Federal Reserve Bank of Minneapolis, Quarterly Review 19 (3), pp. 2-11, and M. A. King (2002), "No money, no inflation the role of money in the economy", Bank of England, Quarterly Bulletin, Summer 2002, pp. 162-177.
- 2 See "A stability-oriented monetary policy strategy for the ESCB", ECB press release, 13 October 1998, and "The stability-oriented monetary policy strategy of the Eurosystem", Monthly Bulletin, January 1999, pp. 39-50.
- 3 See "The outcome of the ECB's evaluation of its monetary policy strategy", Monthly Bulletin, June 2003, pp. 79-92.
- 4 For a review of these studies, see O. Issing (2003), "Background studies for the ECB's evaluation of its monetary policy strategy", ECB, Frankfurt am Main.
- 5 As part of this exercise, the renewed academic interest in the relationship between monetary developments and asset prices was also critically surveyed (see the box entitled "The link between asset prices and monetary developments", Monthly Bulletin, September 2004, pp. 20-21).

exploited to ensure that the broadest possible set of information is used in a consistent and efficient manner. This approach stimulates a deeper understanding of the overall economic situation and reduces the risk of policy mistakes caused by over-reliance on a single indicator, forecast or model. Such an approach enhances the robustness of the ECB's monetary policy in an inevitably uncertain environment. Moreover, by giving appropriate consideration to monetary analysis in the policy-making process, the cross-checking also guarantees that monetary policy maintains a firm medium-term orientation.

Implementing such cross-checking in practice is typically a challenging exercise. Short-run monetary developments are often affected by transitory shocks. Similarly, price developments at short horizons are strongly influenced by many non-monetary phenomena. Therefore, the short-run relationship between monetary developments and inflation is complex. Recognising this complexity, the Governing Council has always emphasised that monetary policy does not react mechanically to monetary developments, but rather responds to the information in monetary aggregates that is relevant for the maintenance of price stability over the medium term. Monetary analysis must therefore be able to see through the noise in the monetary data to recover those underlying trends which are relevant for monetary policy decisions. The challenge for monetary analysis is thus to extract the signal contained in monetary developments regarding medium to longer-term inflationary risks.

Meeting this challenge has not been straightforward in recent years. The protracted decline in stock market indices after spring 2000 and the exceptionally high financial, economic and geopolitical uncertainty between 2001 and 2003 blurred the underlying signal from money regarding the outlook for price developments. Nonetheless, through the application of a thorough institutional analysis and a variety of statistical and econometric techniques, the ECB has been able to identify

the main drivers of monetary developments in real time and to extract information about risks to price stability of relevance for monetary policy decisions.

Against this background, this article illustrates some major elements of the monetary analysis conducted within the ECB over recent years. Due to space constraints and for expositional convenience, the article does not attempt to be fully comprehensive. It focuses mainly on the analysis of developments in M3 and, in particular, on some of the methods used to extract signals in M3 developments regarding risks to price stability. Other important elements of the monetary analysis are not covered in detail.

The remainder of the article consists of five sections. First, a brief overview of monetary developments since 1999 is presented. Second, these developments are analysed using conventional money demand models. Third, several measures of underlying monetary dynamics are constructed in an attempt to capture those M3 developments that are most likely to embody risks to future price stability. Fourth, some of these measures of underlying monetary developments are used to construct a scenario-based assessment of the risks to future price stability stemming from the monetary analysis. Finally, some brief concluding remarks are offered.

2 REVIEW OF MONETARY DEVELOPMENTS SINCE 1999

In the first year of EMU, annual M3 growth hovered somewhat above the ECB's reference value of 4½% for monetary growth, despite the very strong growth of loans granted by monetary financial institutions (MFIs) to the private sector at that time (see Chart 1). In

6 The institutional analysis is defined here as the analysis of monetary developments that combines information from a number of sources such as MFI balance sheet items, components and counterparts of M3, financial accounts data, balance of payments data and financial data. This analysis is to an important extent based on judgement.

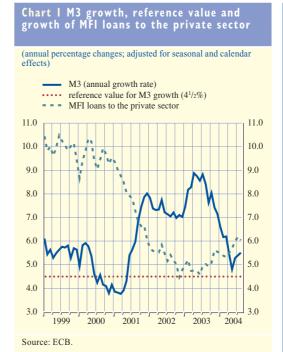
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retrospect, it appears that euro area residents were borrowing heavily in order to finance investment in or acquisitions of foreign companies at the height of the "New Economy" boom in the United States. This boom reached its peak in early 2000. From that point onwards, loans to the private sector moderated and M3 growth declined modestly, falling below the reference value in mid-2000.

After declining between the spring of 2000 and early 2001, the annual growth rate of M3 rose significantly from April 2001, reaching levels well above the ECB's reference value for monetary growth. At the time, it was noted that this upswing in monetary growth initially reflected an equilibrating process, since monetary growth had been relatively weak in the preceding period.

However, with the benefit of hindsight, it appears that other factors were also at play, factors which became progressively more important over the subsequent months and quarters. These factors were recognised in the ECB's analyses from mid-2001 onwards. Specifically, early 2001 marked the start of extraordinary portfolio shifts into M3, as the combination of declining equity prices and worsening economic conditions led to a rise in the demand for safe and liquid monetary assets. This process received a significant additional impetus in the aftermath of the terrorist attacks on 11 September 2001, which led to a considerable further rise in financial, economic and geopolitical uncertainty. By the end of 2001, the annual rate of M3 growth stood at close to 8%, more than twice the rate recorded at the start of the year.

The sharp increase in M3 growth in 2001 also had a significant impact on various measures of so-called "excess liquidity". Excess liquidity can be defined as the deviation of the actual money stock from its estimated equilibrium level. Of course, the estimated stock of excess liquidity will depend crucially on how the equilibrium level of money is defined. Alternative methods of estimating the



equilibrium stock of money will result in different measures of excess liquidity. Two specific measures of excess liquidity are monitored regularly at the ECB and published in the Monthly Bulletin, namely the nominal and the real money gap. The nominal money gap, which is typically shown in the Bulletin, is defined as the difference between the actual level of M3 and the level of M3 that would have resulted from constant M3 growth at its reference value of 4½% since December 1998. The real money gap corrects the nominal money gap for the accumulated deviation of inflation from the ECB's definition of price stability. In calculating measures of excess liquidity in this way, it should be recognised that the choice of December 1998 as the base period is arbitrary. The level of the gap measures therefore has to be interpreted with caution.⁷

Both the nominal and the real money gap measures rose sharply in the course of 2001, starting an upward trend that continued over the

⁷ For a discussion of these measures, see "Framework and tools of monetary analysis", Monthly Bulletin, May 2001, especially pp. 48-50, and the box entitled "Estimates of the nominal and real money gap in the euro area". Monthly Bulletin, June 2001, pp. 9-10.

Chart 2 Estimates of the nominal and real money gaps

(as percentages of the stock of M3; adjusted for seasonal and calendar effects; December 1998 = 0)



Note: ECB.

Note: The measure of the nominal money gap is defined as the difference between the actual level of M3 and the level of M3 that would have resulted from constant M3 growth at its reference value of 4½% since December 1998 (taken as the base period). The measure of the real money gap is defined as the difference between the actual level of M3 deflated by the HICP and the deflated level of M3 that would have resulted from constant nominal M3 growth at its reference value of 4½% and HICP inflation in line with the ECB's definition of price stability, again taking December 1998 as the base period.

ensuing two years (see Chart 2). However, the two measures rose to different extents. The nominal money gap reached a level of almost 9% in the summer of 2003 and, after stabilising, increased further in July 2004, while the real money gap reached 6% in late 2003. These differences beg the question of which measure is the more relevant estimate of excess liquidity. The real money gap takes into account the fact that part of the excess liquidity accumulated over the past few years has, in the meantime, been absorbed by higher prices, reflecting upward deviations of inflation rates from the ECB's objective of price stability.

In this respect, it is important to recall that the shocks to euro area inflation between 2000 and 2004 (such as those stemming from oil and food price increases) were mainly one-off in nature. To the extent that these shocks were not

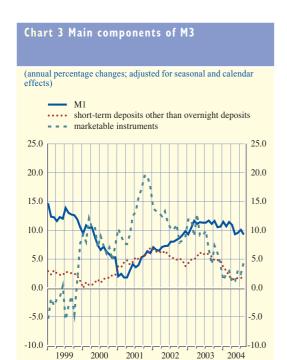
followed by significant second-round effects, the real money gap should, in principle, be regarded as a more appropriate indicator of recent risks to future price stability.

Although tentative signs of a moderation in monetary growth were observed in the first few months of 2002, following a temporary recovery in the equity market, M3 subsequently accelerated again as equity prices resumed their fall and financial uncertainty increased further. In early 2003 these factors were compounded by rising geopolitical tensions in the Middle East. In the spring and summer of 2003, the annual growth rate of M3 fluctuated around 81/2%. Given the prevailing low level of inflation, the first half of 2003 represents one of the periods of most rapid money creation in real terms over the last thirty years. Moreover, the strong monetary growth during this period added considerably to the stock of excess liquidity in the euro area, as measured by both the nominal and the real money gaps.

Developments in the components and counterparts of M3 supported the view that the increase in monetary growth in 2001 was associated with extraordinary portfolio shifts into money. First, on the components side, marketable instruments in general, and money market fund shares/units in particular, grew rapidly during this period (see Chart 3). These components are often used by firms and households to store funds temporarily in a safe and liquid form at times of heightened uncertainty. Second, on the counterparts side, MFIs' net external assets rose significantly between 2001 and 2003. Since this counterpart reflects transactions between the euro area money-holding sector and non-residents, the rise observed in MFIs' net external assets was consistent with reduced purchases of foreign securities by euro area residents and thus with portfolio shifts by the money-holding sector out of riskier instruments and into money (see Box 1).

Although extraordinary portfolio shifts into M3 played a dominant role in driving strong

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monetary growth from 2001 to 2003, other factors also supported the strength of M3 dynamics. Concerns about future labour market prospects appear to have led to an increase in the precautionary demand for money. Moreover, after a series of reductions in key

ECB interest rates between May 2001 and June 2003, M3 growth was also fuelled by the historically low level of interest rates in the euro area and, hence, of the low opportunity costs of holding money. The latter phenomenon influenced in particular the demand for the most liquid components of M3. As a result, the narrow aggregate M1 became a very important contributor to monetary growth.

In the summer of 2003, annual M3 growth started to moderate, a process which continued through the rest of the year and into 2004. The portfolio shifts into monetary assets halted and then began to unwind as economic and financial uncertainty receded in the context of a gradual recovery of economic activity in the euro area. However, this moderation in monetary growth proceeded more slowly than would have been expected on the basis of prior experience, as the liquidity preference of euro area firms and households remained strong. It is possible that the experience of significant capital losses in equity markets from 2000 has permanently raised the risk aversion of euro area households and thus increased their preference for liquidity. Despite the moderation of monetary growth, the nominal and real money gaps merely stabilised in the second half of 2003.

Box I

Source: ECB

WHAT WERE THE COUNTERPARTS TO THE EXTRAORDINARY PORTFOLIO SHIFTS INTO MONETARY ASSETS BETWEEN 2001 AND 2003?

From 2001 to 2003, the money-holding sector in the euro area (essentially households, non-financial corporations and non-monetary financial corporations) shifted funds from longer-term securities into monetary assets. As discussed in the main text, these extraordinary portfolio shifts reflected an increased demand for safe and liquid monetary assets at a time of heightened economic, financial and geopolitical uncertainty.

If longer-term financial assets sold or issued by one entity in the money-holding sector are purchased by another entity in the money-holding sector, a transfer of money holdings within that sector takes place, leaving the aggregate money stock unchanged. Such transactions cannot therefore explain the overall increase in monetary growth seen between 2001 and 2003. To have an impact on monetary dynamics, transactions must involve transfers of money from the money-holding sector to another sector, either MFIs or non-residents. In order to understand these

transactions, additional information on the counterpart in the purchase of longer-term financial assets must be gathered.

To analyse the monetary implications of portfolio shifts, a monthly estimate of the *net* purchases of non-monetary securities by the money-holding sector from MFIs and non-residents is constructed below. While certain simplifying assumptions are necessary for statistical reasons, conceptually the construction of this estimate relies on the consolidated balance sheet identity of the money-holding sector, expressed in flow terms.

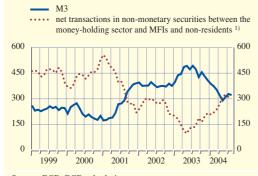
This estimate of the net purchases by the money-holding sector of non-monetary securities from MFIs and non-residents is shown in Chart A, together with the annual flows into M3. The strong negative correlation between these two series illustrated in the chart confirms the existence of sizeable shifts between holdings of non-monetary securities and M3 in the portfolio of the money-holding sector in recent years.

Solely by analysing this estimate of the money-holding sector's purchases of non-monetary securities it is not possible to distinguish whether MFIs or non-residents were the main counterparts for the transactions underlying portfolio shifts into monetary assets. In order to address this issue, it is necessary to distinguish the net securities transactions of the money-holding sector with MFIs on the one hand and non-residents on the other. The latter transactions are encompassed in MFIs' net external assets.

Chart B shows a strong correlation between the evolution of the net securities transactions of the money-holding sector with non-residents, as reflected in the MFIs' net external assets, and the overall net purchases of non-monetary securities since the middle of 2001. This correlation suggests that non-residents have been the main counterparts of the portfolio shifts from non-monetary securities into money over recent years.

Chart A M3 and net purchases of nonmonetary securities by the consolidated money-holding sector

(annual flows; € billions)



Source: ECB, ECB calculations.

1) Calculated as loans to euro area residents plus issuance of securities by the consolidated money-holding sector plus current account balance minus instruments included in M3, minus long-term deposits with MFIs and net external transactions of the money-holding sector other than in securities.

Chart B Net purchases of non-monetary securities by the consolidated moneyholding sector by counterpart sector

(annual flows; € billions)

- net external assets of the MFI sector (opposite sign)
 net transactions in non-monetary securities between the money-holding sector and MFIs ¹⁾
- net transactions in non-monetary securities between the money-holding sector and MFIs and non-residents ²⁾



Source: ECB, ECB calculations.

1) Calculated as long-term financial liabilities issued by MFIs and held by the money-holding sector except long-term deposits minus securities issued by euro area residents purchased by MFIs.

2) See footnote 1 to Chart A.

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The counterparts analysis presented in this box is one example of how the transactions underlying the portfolio shifts into money that have been observed in recent years may be investigated more deeply. The analysis reveals that M3 dynamics have been associated in large part with transactions involving non-residents, thereby focusing attention on international financial flows.

3 ASSESSING RECENT MONETARY DEVELOPMENTS USING CONVENTIONAL MONEY DEMAND MODELS

So far monetary developments have been examined in isolation. However, in order to develop a full picture, developments in money must be analysed in the context of other macroeconomic variables. Evidence on the behaviour of money relative to other macroeconomic variables can be derived using money demand models. Conventional money demand models explain the dynamics of monetary aggregates on the basis of developments in fundamental determinants, such as the price level, economic activity and interest rates. Money demand models constitute a natural benchmark against which to assess monetary developments. In particular, they provide a framework to distinguish between those changes in M3 that can be explained on the basis of developments in other macroeconomic variables (assuming that historical experience is a good guide to the present) and those changes in M3 which are specific to the situation at hand.

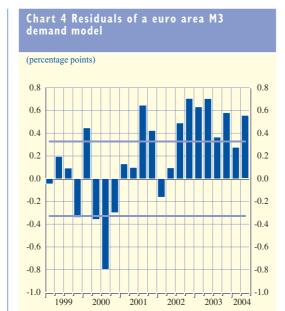
Tracking the evolution of actual M3 developments against the paths implied by estimated money demand models is an important component of the ECB's monetary analysis. A number of such models are now available for the euro area. Of course, these models only constitute a meaningful benchmark against which to compare observed monetary developments if they exhibit certain statistical properties, notably parameter stability. In order to check whether they meet this criterion, the ECB closely monitors the stability of various money demand models on an ongoing basis, using a variety of institutional analyses and statistical techniques.

The annex summarises an ECB study of long-run money demand stability from an econometric point of view. Keeping in mind the difficulties of detecting instabilities in economic time series relationships at the end of the sample period, the annex concludes that there are no clear indications as yet that the long-run money demand relationship in the euro area has broken down.

Analysis based on money demand models suggests that factors other than the traditional determinants of money have played a significant role in recent monetary dynamics. This is illustrated in Chart 4, which shows the residuals derived from a quarterly model of euro area money demand estimated by ECB staff. 10 The residuals should be interpreted as the changes in M3 that cannot be explained using the conventional determinants of money demand (i.e. real GDP, the price level and interest rates). Prior to 2001, the residuals are evenly distributed around zero and generally not very large. This suggests that, at the time, the estimated model provided a good explanation of M3 developments.

By contrast, the residuals of this model show a succession of relatively large positive values after mid-2001. In particular, following the terrorist attacks on 11 September 2001, a very

- 8 See "Framework and tools of monetary analysis", Monthly Bulletin, May 2001, especially pp. 42-47, and K. Masuch, H. Pill and C. Willeke (2001), "Framework and tools of monetary analysis", pp. 117-144 in H.-J. Klöckers and C. Willeke (eds.), "Monetary analysis: Tools and applications", ECB, Frankfurt am Main.
- 9 For a review of existing studies see O. Issing (2003), op. cit.
- 10 See A. Calza, D. Gerdesmeier and J. Levy (2001), "Euro area money demand: Measuring the opportunity costs appropriately", IMF working paper No 01/179. Given the potential instability of the short-run parameters of the money demand equation after the second quarter of 2001, the parameters have been kept fixed at the level estimated using a sample up to this quarter.



Source: ECB.
Note: The residual is the difference between the observed value of M3 growth and the value of M3 growth predicted by the model (the "fitted value"). The lines denote one standard error confidence bands. Residuals are derived from the model presented in A. Calza, D. Gerdesmeier and J. Levy (2001), "Euro area money demand: Measuring the opportunity costs appropriately," IMF working paper No. 01/179.

large positive money demand shock was recorded in the third quarter of 2001. Although the residuals could not be distinguished from zero during the first half of 2002 as monetary growth stabilised temporarily,11 a series of further positive residuals was recorded during the second half of 2002 and throughout 2003 as M3 growth increased again. The size of these residuals diminished in early 2004, suggesting a moderation in the exceptional factors that had contributed to the increase in M3 growth. This is consistent with the improvement in financial market conditions and the outlook for economic activity in the euro area, and with the associated normalisation of portfolio behaviour after mid-2003.

Further insights into the behaviour of money demand in the past few years can be drawn from a decomposition of the quarterly nominal rate of growth in M3 into the contributions stemming from each of the determinants of money demand. In quantitative terms, the contributions approximate the impact on

monetary growth of current and lagged developments of the various explanatory variables, such as output, prices and interest rates. Of course, such an exercise is modelspecific, in that the contributions will depend on which explanatory variables are included in the model and the estimated parameter values. After completing this exercise, an "unexplained" component of monetary growth remains. This component embodies the impact of current and lagged unmodelled influences on money demand. As compared with Chart 4, the unexplained component can be regarded as the cumulative effect of all previous residuals to the money demand equation on the current quarteron-quarter growth rate of M3.

Applying this decomposition technique to euro area money demand demonstrates that the rise in annualised quarter-on-quarter M3 growth after the third quarter of 2001 cannot be accounted for on the basis of increased contributions from the conventional determinants of money demand (see Chart 5). Indeed, developments in the traditional determinants suggest that M3 growth should have remained close to the reference value between 2001 and 2003, contrary to what has been observed. Thus, based on this simple exercise, the conclusion can be drawn that the strong monetary growth observed between mid-2001 and the summer of 2003 was entirely due to the impact of unmodelled – i.e. exceptional – factors.

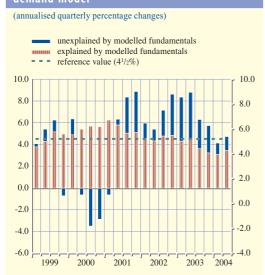
4 DERIVING MEASURES OF UNDERLYING MONETARY DYNAMICS

The institutional analysis in Section 2 suggested that extraordinary portfolio shifts into money have strongly influenced monetary developments in recent years. The assessment based on money demand models in Section 3 confirmed that monetary growth in the same period cannot be explained using the conventional determinants of money demand. Against this background, a crucial element of

11 The residuals fell into the one standard error confidence bands.

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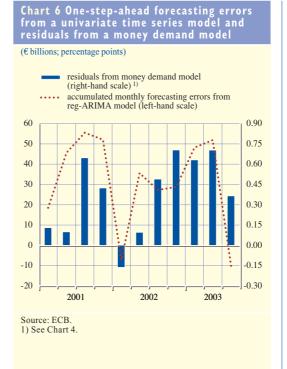
Source: ECB.

Note: Contributions are derived from the model presented in A.
Calza, D. Gerdesmeier and J. Levy (2001), "Euro area money
demand: Measuring the opportunity costs appropriately", IMF
working paper No. 01/179.

any quantitative assessment of recent monetary developments and their implications for price stability is thus the estimation of measures of M3 corrected for the estimated impact of portfolio shifts.

Broadly speaking, two approaches are possible. First, one could attempt to smooth or filter the official M3 series so as to recover the underlying trend in monetary dynamics. This approach is discussed in Box 2 and is, in principle, quite general in nature. By using structural filters that take into account information from inflation, M3 growth and indicators of real activity, the box demonstrates that monetary growth mainly impacts inflation over the medium to longer term. This relationship holds even in periods where inflation is relatively low and does not show a clear trend. The application of the filter produces a smoothed M3 series, which should provide information on inflationary pressures at horizons relevant for monetary policy.

Alternatively, one could attempt to estimate the magnitude of portfolio shifts more directly



and to use these estimates to adjust the official series. Of course, by its nature, such an approach is specific to the particular circumstances associated with the portfolio shifts seen in recent quarters and relies more heavily on judgement and institutional analysis.

In pursuing the latter approach, a box in an earlier issue of the Monthly Bulletin has already provided some quantitative estimates of the magnitude of portfolio shifts. ¹² A variety of techniques were presented on that occasion. In this article, only a simple univariate method of estimating the size of recent portfolio shifts is considered. This is based on the analysis of a univariate time-series model of M3, i.e. a model in which the current dynamics of M3 are explained on the basis of previous developments in M3. ¹³ The pattern of one-stepahead forecast errors generated by the univariate model is similar to the residuals from

¹² See the box entitled "Estimating the size of portfolio shifts from equity to money", Monthly Bulletin, May 2003, pp. 11-14.

¹³ See "Framework and tools of monetary analysis", Monthly Bulletin, May 2001, especially pp. 56-57, for further details of the model.

THE USE OF SIMPLE STRUCTURAL FILTERS TO EXTRACT MONETARY SIGNALS CONCERNING RISKS TO FUTURE PRICE STABILITY

Evidence of a positive relationship between monetary growth and inflation over longer horizons is widespread and robust. However, in the short run, transitory shocks to either money or inflation can obscure the signals concerning future price developments stemming from money. From a monetary policy perspective, it is important to identify those movements in M3 that are associated with longer-term inflationary pressures and discard other movements which constitute "noise". Beyond the information obtained from various econometric models and detailed expert institutional analysis discussed in the main text, the use of a structural filter – a statistical procedure that identifies and extracts specific underlying components of time series dynamics – may serve as a useful complementary tool in identifying the risks to price stability associated with monetary developments.

A recent ECB study shows that medium to longer-term movements in monetary growth and inflation have been highly correlated within the period from 1986 to 2004 (see Chart A). Moreover, the study demonstrates that indicators of real activity only provide additional information about inflation dynamics at business cycle frequencies (here defined as developments with a persistence of between one-and-a-half and eight years) and that the information from money at that frequency is rather modest (see Chart B). Finally, the study provides evidence confirming that there is no close relationship between monetary

Chart A Longer-term components of HICP and M3



Source: ECB calculations.

Note: The longer-term components of inflation and M3 growth (defined as cycles with a length of above 8 years) were derived as residual using the difference between the observed series and the sum of the cyclical and the short-term components (see Charts B and C) using the symmetric version of the band-pass filter as described in Christiano, L.J. and T.J. Fitzgerald, (2003), "The Band Pass Filter," International Economic Review, 44 (2), pp. 435-465.

Chart B Cyclical components of HICP and M3



Source: ECB calculations.

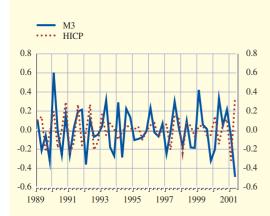
Note: The cyclical components of inflation and M3 growth were derived using the Christiano-Fitzgerald band-pass filter (symmetric version) including all frequencies between 6 and 32 quarters. Technically, the application of such a filter results in a loss of data at the start and the end of the sample.

¹ See A. Bruggeman, G. Camba-Mendez, B. Fischer and J. Sousa (2004), "Structural filters for monetary analysis: inflationary movements of money in the euro area", forthcoming ECB Working Paper. The sample period has been chosen because formal tests demonstrate that euro area inflation can be considered as stationary over this period.

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Chart C Short-term components of HICP and M3

(annual percentage changes)



Source: ECB calculations.

Note: The short-term components of inflation and M3 growth were derived using the Christiano-Fitzgerald band-pass filter (symmetric version) including cycle lengths of below six quarters. Technically, the application of such a filter results in a loss of data at the start and the end of the sample period.

Chart D M3 and filtered M3

(annual percentage changes)



Source: ECB.
Note: The filtered series is based on the statistical procedure outlined in A. Bruggeman et al. (2004), "Structural filters for monetary analysis: Inflationary movements of money in the euro area", forthcoming ECB Working Paper.

developments and inflation in the short run (defined as developments with a persistence of less than one-and-a-half years) (see Chart C).

On the basis of these results, the study has attempted to extract those components of M3 growth that are linked to inflation using a simple model of monetary growth, inflation and real activity. In order to extract this information (i.e. to apply the statistical filter to the most recent data), it is necessary to construct forecasts of future money growth. Therefore, the quality of the filtered series hinges on the quality of the money forecasts and thus on the reliability of the forecasting model.

One estimate of "underlying" monetary growth constructed using this filtering procedure is shown in Chart D, together with the official M3 series. The filter smooths money growth considerably. For example, the strong portfolio shifts affecting M3 growth between 1993 and 1996 – which subsequently appear to have had no impact on inflation – are to a large extent removed by the filter from the underlying money growth series. Using the filtered series would have led to the exclusion of these developments from the analysis and thus given a more accurate impression of the inflationary risks stemming from monetary developments. As shown in the study, the proposed filtering methodology could have detected this result relatively well in real time, since it was possible to make sufficiently good forecasts of money growth.

Over the past few years, the estimated measure of underlying M3 growth that is linked to inflationary pressures again differed significantly from the growth rate of the official M3 series. The strong downward movements of M3 growth in 2000 and the strong increases between 2001 and 2003 are to a large extent smoothed out by the filtering procedure. Nonetheless, underlying M3 growth is currently clearly above the reference value of 4½%. It is noteworthy that the pattern of underlying monetary growth over the period

from 2001 to 2003 is broadly comparable to that of the M3 series corrected for the impact of portfolio shifts discussed in the main text. The similarity between these two series indicates that the general direction of the adjustments made to the official M3 series in the monetary analysis is appropriate.

These techniques demonstrate that longer-term movements in monetary growth and inflation are highly correlated. This applies even to the period between 1986 and 2004, when inflation did not exhibit a clear trend. Although they only constitute one additional tool in the monetary analysis, simple structural filters for money growth appear able to help identify and extract that component of monetary developments which has a persistent impact on price dynamics. However, the tools presented in this box should be seen as simple illustrations of the underlying techniques and the results therefore have to be assessed with caution. Nonetheless, the filtering techniques have the important advantage that they are general in nature rather than specific to a particular situation. As shown by the analysis of the most recent quarters, their most useful role may be in providing a robustness check for other tools that are designed for a specific set of circumstances.

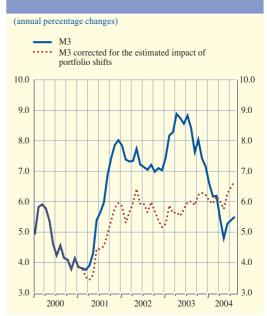
a money demand model. Specifically, there is a prolonged sequence of positive forecast errors with similar peaks for the period between 2001 and 2003 (see Chart 6).

A number of additional intervention variables (i.e. dummies and trends) aiming to capture the impact of portfolio shifts are introduced in the model. These intervention variables are constructed and calibrated on the basis of the institutional analysis. However, since the univariate model cannot, by its nature, distinguish the impact of portfolio shifts from the effects of other variables, such as the low level of interest rates, on monetary dynamics, and because the construction of the intervention variables is to some extent arbitrary, the resulting estimates of portfolio shifts should be interpreted with caution.

Chart 7 shows annual M3 growth for both the official M3 series and a measure of M3 corrected for the estimated impact of the extraordinary portfolio shifts on the basis of the univariate time series model. Divergences between the two growth rates were greatest in the last quarter of 2001 and the first half of 2003, corresponding to the two periods of greatest portfolio shifts identified by both the institutional analysis in Section 2 and the model-based analysis in Section 3. Nonetheless, it should be recognised that even the series corrected for the estimated impact of portfolio shifts has grown relatively

robustly, at annual rates close to 6% over the past few years. In the second quarter of 2004, the annual growth rate of the adjusted series has, for the first time in the period covered by Chart 7, grown more rapidly than the official series, consistent with a continuing unwinding of past portfolio shifts.

Chart 7 M3 and M3 corrected for the estimated impact of portfolio shifts



Source: ECB.
Note: Estimates of the magnitude of portfolio shifts into M3 are constructed using the univariate time series model approach discussed in the main text.

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(as percentage of the stock of M3; adjusted for seasonal and calendar effects; December 1998 = 0)

nominal money gap based on official M3
 nominal money gap based on M3 corrected for the estimated impact of portfolio shifts



Source: ECB.
Note: The measure of the nominal money gap is defined as the difference between the actual level of M3 and the level of M3 that would have resulted from constant M3 growth at its reference value of 4½% since December 1998 (taken as the base period).

The measure of M3 corrected for the estimated impact of past portfolio shifts can also be used to compute measures of the money gaps in the euro area. These are illustrated in Charts 8 and 9, together with measures constructed using the official M3 series, as already shown in Chart 2. As regards the official M3 data, both the real and the nominal money gap measures currently point to the existence of a significant stock of excess liquidity. Yet, in line with the moderation of M3 growth since summer 2003, both measures have stabilised during the past few quarters, as past portfolio shifts have started to unwind.

The picture that emerges when analysing the money gap measures corrected for the estimated impact of portfolio shifts is quite different. First, the level of the money gaps is considerably lower. In the case of the real money gap, the measure of excess liquidity is relatively low even in absolute terms. Second, the evolution of the gap measures corrected for

Chart 9 Estimates of the real money gap

(as percentage of the stock of real M3; adjusted for seasonal and calendar effects; December 1998 = 0)

real money gap based on official M3
real money gap based on M3 corrected for the estimated impact of portfolio shifts



Source: ECB.
Note: The measure of the real money gap is defined as the difference between the actual level of M3 deflated by the HICP and the deflated level of M3 that would have resulted from constant nominal M3 growth at its reference value of 4½% and HICP inflation in line with the ECB's definition of price stability,

taking December 1998 as the base period.

the summer of 2003.

the estimated impact of portfolio shifts varies significantly from those based on official M3 data. In particular, the adjusted real money gap measure remained close to zero until spring 2003, since when it has increased. This pattern differs from that observed in the measure derived from the official series, which rose

rapidly from mid-2001 but has stabilised since

5 IMPLICATIONS OF MONETARY ANALYSIS FOR THE OUTLOOK FOR PRICE STABILITY

Having identified and quantified the impact of various exceptional influences on recent M3 growth, it remains to assess quantitatively the risks to future price stability stemming from monetary developments. One important issue that immediately arises in this context is the question of how the impact of portfolio shifts on monetary developments should be treated. In particular, it is necessary to address whether the

estimated extraordinary portfolio shifts should be excluded from the monetary series used to assess risks to price stability.

This question has already been addressed in a box published in a previous issue of the Monthly Bulletin. 14 On that occasion, three possibilities were outlined. First, past portfolio shifts could unwind, as money holders normalise their portfolio allocation behaviour, shifting their liquid assets into longer-term assets such as equity. Second, the higher money holdings arising from the portfolio shifts may be associated with a permanent increase in the demand for liquid assets, consistent with the view that investors' aversion to risk and desire for safe and liquid assets has been permanently raised by the experience of large capital losses on equity between 2001 and 2003.

On either of these two interpretations, it would be natural to assume that the monetary implications of past portfolio shifts are benign with regard to the outlook for price stability, since they do not lead to the creation of transaction balances that could be used for spending and thus add to demand and inflationary pressure. ¹⁵ In this context, it would be appropriate to focus attention on the M3 series corrected for the estimated impact of portfolio shifts when analysing the implications of monetary developments for price stability.

However, the possibility also exists that the money holdings built up as a consequence of past portfolio shifts are transformed into transaction balances. In this third possibility, the accumulated liquidity would lead to higher spending and inflationary pressures from the demand side. Clearly, on this basis, analysis should focus on the official M3 series, which includes the impact of portfolio shifts.

Of course, it is impossible in practice to be certain which of these three possibilities best describes the behaviour of money holders. In practice, a combination of all the scenarios is also possible. One approach to addressing the risks and uncertainties inherent in such a situation is to analyse quantitatively various scenarios, thereby giving an impression of the range of possible outcomes. This approach is illustrated in the rest of this section.

On the basis of a number of simple empirical tools, the remainder of this section illustrates how the preceding analysis can be transformed into a quantitative assessment of the inflationary risks stemming from monetary developments. First, the leading indicator properties of monetary growth for inflation over longer horizons are exploited. Second, a more elaborate set of scenarios that assume different uses of accumulated excess liquidity in the euro area is developed.

FORECASTING INFLATION USING THE BIVARIATE RELATIONSHIP WITH M3 GROWTH

An ECB staff study provides an assessment of the leading indicator properties of monetary growth for inflation in the euro area. 16 It shows that the inclusion of monetary indicators improves the out-of-sample forecasting performance of a pure autoregressive model of price developments (in which inflation is forecast using only lagged values of itself). Furthermore, the study demonstrates that the performance of money-based indicators relative to other economic indicators improves as the horizon of the forecast lengthens. This simple bivariate leading indicator model can be used to forecast average inflation several quarters ahead. In Chart 10, a relatively short forecast horizon of six quarters has been chosen in order to allow a comparison with the observed data. In Chart 11, the forecast horizon has been extended to twelve quarters, closer to the medium to longer-term horizon where money is most useful in explaining inflation. In order to have a sense of the possible impact on monetary

¹⁴ See "What could happen with the accumulated excess liquidity in the euro area?", Monthly Bulletin, October 2003, pp. 8-10.

¹⁵ The reallocation of existing liquidity to financial assets may, in principle, have an impact on asset prices. While this may, in turn, affect aggregate spending via wealth effects or improved financing conditions, its effect is likely to be limited.

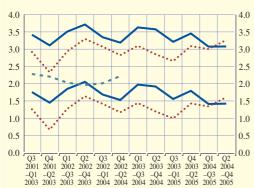
¹⁶ See S. Nicoletti-Altimari (2001), "Does money lead inflation in the euro area?", ECB working paper No 63. The methodology employed in this paper is based on J. Stock and M. Watson (1999), "Forecasting inflation", *Journal of Monetary Economics* 44 (2), pp. 293-335.

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(annualised percentage changes)

- forecast range for inflation using official M3 series
 forecast range for inflation using M3 corrected for the
 estimated impact of portfolio shifts
- - observed inflation



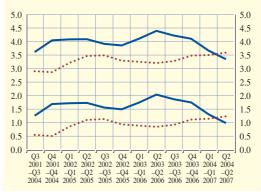
Source: ECB.

Note: The forecasts were constructed as soon as data for the first quarter mentioned in the forecast interval were available. The ranges shown in this chart are derived from the 95% confidence interval surrounding the point inflation forecasts.

Chart II Real-time forecast of annualised HICP inflation 12 quarters ahead based on a bivariate model using M3 and M3 corrected for the impact of portfolio shifts

(annualised percentage changes)

forecast range for inflation using official M3 series forecast range for inflation using M3 corrected for the estimated impact of portfolio shifts



Source: ECB

Note: The forecasts were constructed as soon as data for the first period mentioned in the forecast interval were available. The ranges shown in this chart are derived from the 95% confidence interval surrounding the point inflation forecasts.

developments and the implied risks to price stability of past portfolio shifts, it is useful to present an analysis based on both the official M3 series and the series corrected for the estimated impact of portfolio shifts.

Charts 10 and 11 show the historical performance of the bivariate forecasting model in real time. This real time assessment uses only information available at the time the forecast was made. The charts therefore give an accurate impression of the signals derived from the model in the circumstances then prevailing.

The charts illustrate two important points. First, they suggest that both the official M3 series and the M3 series corrected for the estimated impact of portfolio shifts have indicated some upside risks to price stability stemming from monetary developments over recent years. These risks are illustrated by the inflation forecast ranges typically lying, in large part, above the 2% upper bound of the ECB's definition of price stability. However, it has to be kept in mind that these forecasts are surrounded by a high degree

of uncertainty, as reflected by the width of the ranges themselves.

Second, the aforementioned charts also show that, over the period from 2001 to 2003, forecasts based on the M3 series corrected for the estimated impact of portfolio shifts have implied lower inflationary risks than forecasts based on the official M3 data. In particular, this is apparent in late 2001 and early 2003, the two periods when portfolio shifts were most important. This is one illustration of the importance of identifying and quantifying the drivers of monetary dynamics in coming to an assessment of their implications for the evolution of risks to price stability.

While the available sample is clearly much too short to come to any definitive judgement, Chart 10 also shows that the forecasts based on M3 growth – in particular when using the series corrected for the estimated impact of portfolio shifts – performed relatively well in real time.

FORECASTING INFLATION USING EXCESS LIQUIDITY MEASURES

Inflation indicators based solely on the evolution of money growth neglect the potential impact of accumulated excess liquidity on future price developments. It is thus also important to assess the information content of measures of excess liquidity for future price developments. The analysis presented here investigates three scenarios for the future use of excess liquidity and its impact on price stability, two of which could be presented as opposite ends of a spectrum of possible outcomes. The analysis can thus be understood as another illustration of the upper and lower limits of risks to price stability stemming from the monetary side.

The first scenario is based on the assumption that the accumulated excess liquidity will be transformed into transaction balances and may thus imply risks to price stability in line with historical regularities. To implement this scenario empirically, the official M3 series is used. The scenario implies a rather rapid fall of M3 growth in the future, as the model for M3 assumes that the current stock of excess liquidity will unwind over time to bring it down to levels consistent with historical patterns.

The second scenario is a variant of the first. It assumes that the empirical relationship between monetary dynamics and inflation prevails, but that excess liquidity in the euro area accumulated during the recent period of strong M3 growth will unwind more slowly in the future than has been the case on average over the last two decades. Such an analysis is motivated by the observation that the stock of excess liquidity has shown more persistence in the past few years than would have been expected on the basis of earlier experience. This could be linked to a greater aversion to risk by money holders following the prolonged period of stock market declines between 2000 and

2003. This scenario, which implies a more persistent period of excess liquidity than the first scenario, can be seen as an illustration of the upper bound for the risks to price stability stemming from the monetary side.

In the third scenario, it is assumed that the recent rapid money growth associated with extraordinary portfolio shifts has been of an entirely exceptional nature and thus should not be analysed on the basis of historical relationships. In this scenario, the M3 series corrected for the impact of portfolio shifts is employed. This scenario also assumes some correction of the excess liquidity in the future. It can be seen as an illustration of the lower bound for risks to price stability stemming from the monetary side.

The possible implications of excess liquidity for the outlook for price stability under each of the scenarios discussed above are illustrated with a small econometric indicator model for the euro area. This model relies on a real money gap measure derived from a money demand equation.¹⁷ A number of empirical studies suggest that this measure of excess liquidity has helped to predict price developments in the euro area. 18 The model underlying this analysis is a variant of the so-called P-star approach, which has been prominent in economic literature on the leading indicator properties of money for future price developments (see Box 3). 19 Of course, such indicator models are very simple and subject to a number of limitations. The

¹⁷ Note that this real money gap measure differs from that presented in Chart 2 in that it is based on a long-run money demand equation rather than on the cumulated deviations of M3 growth from its reference value.

¹⁸ See, for example, S. Gerlach and L. E. O. Svensson (2003), "Money and inflation in the euro area: A case for monetary indicators?", *Journal of Monetary Economics* 50, pp. 1649-1672, and C. Trecroci and J.-L. Vega (2002), "The information content of M3 for future inflation", *Weltwirtschaftliches Archiv* 138 (1), pp. 22-53.

¹⁹ See J. J. Hallman, R. D. Porter and D. H. Small (1991), "Is the price level tied to the M2 monetary aggregate in the long run?", *American Economic Review* 81 (4), pp. 841-858.

THE P-STAR MODEL

The simple P-star model underlying the projections presented in the main text can be expressed using the following equation:

$$\pi_{t+1} = \pi_{t+1}^{obj} + \alpha_{\pi}(L)(\pi_t - \pi_t^{obj}) + \alpha_{m}(REALMONEYGAP)_{t-j} + \alpha_{z}(L)Z_t + u_{t+1}$$
[1]

This equation implies that deviations of inflation π_{t} from the central bank's objective π_{t}^{obj} are closed gradually. The real money gap and other variables (denoted Z) add to inflationary pressure, with the magnitude of such pressures being determined by the parameters a_m and a_γ . The real money gap used in this exercise is constructed in a different way from that shown in Charts 2, 8 and 9 in the main text. As shown below, it is calculated as a deviation from the equilibrium implied by a money demand model. In the simple model used in this article, Z represents oil prices. Including oil prices in the P-star equation acknowledges that monetary developments are not decisive in predicting the shorter-term dynamics of inflation. The inclusion of oil prices can be seen as an attempt to control for short-term inflation volatility, thereby emphasising the medium to longer-term relationship between money and price developments.

In order to produce inflation forecasts for longer horizons with such a P-star model, projections for money growth are needed, which in turn rely on assumptions about other macroeconomic variables. For illustrative purposes, the exercise presented in this article simply takes the published figures from the ECB staff macroeconomic projections of September 2004. Based on these assumptions, the evolution of M3 growth can be derived using a money demand system.²

In addition to deriving projections for inflation using the real money gap, the P-star model also allows a decomposition of projected deviations from the inflation objective on the basis of the various components of the real money gap. In particular, the real money gap can be decomposed into the "monetary overhang" (the deviation of the observed real money stock from what would be consistent with observed levels of real activity), a term related to the cyclical state of real activity in the economy and a term related to interest rates.

To see this, it is useful to define the real money gap as the deviation of the observed stock of real money (real M3) from that which would be implied by a money demand model in which both the traditional determinants of money demand (income y, and interest rates i,) are at their equilibrium levels. Of course, this is analogous to the definition based on the ECB's reference value for monetary growth, since the derivation of the reference value is implicitly based on assumed paths for equilibrium output and interest rates. A money demand equation approach implies:3

REALMONEYGAP_t =
$$(realM3)_t - (c + \beta \cdot y_t^* + \gamma \cdot i_t^*)$$
 [2]

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¹ For details, see the box entitled "ECB staff macroeconomic projections for the euro area," Monthly Bulletin, September 2004, pp. 60-61.

² The money demand system used in this exercise is that developed for euro area M3 by A. Calza, D. Gerdesmeier and J. Levy (2001),

³ Real M3 and income enter in logarithms in equations 2 and 3

where y_i^* is the estimated equilibrium level of national income, i_i^* is the estimated equilibrium level of interest rates and c, β and γ are the parameters of the money demand function. Of course, the observed level of money can always be expressed using a money demand equation, once a "residual" (ε_i) is included to capture that part of the money stock which is not explained by the traditional determinants in the long run. Rewriting the stock of real M3 in this way gives the following decomposition of the real money gap:

REALMONEYGAP_t =
$$\left(c + \beta \cdot y_t + \gamma \cdot i_t + \varepsilon_t\right) - \left(c + \beta \cdot y_t^* + \gamma \cdot i_t^*\right)$$
 [3]
= ε_t + $\beta \cdot (y_t - y_t^*)$ + $\gamma \cdot (i_t - i_t^*)$

where ε_i is the "monetary overhang", defined as the difference between the actual level of real M3 and the "equilibrium" or "desired" level of real M3 given by the long-run relation from a money demand model; β ($y_t - y_t^*$) is the contribution stemming from the cyclical state of the economy; and γ ($i_t - i_t^*$) is the contribution from interest rates. These components of the real money gap can then be substituted into the inflation forecasting equation [1] so as to identify separately the contributions of each of these components, as well as the contribution stemming from oil prices which act as a control for short-term inflation volatility.

If the monetary overhang contains information useful for predicting the future development of inflation beyond that contained in indicators of the cyclical state of the economy or interest rates, a strong case exists for analysing monetary developments closely when analysing the inflation process. Using data for the last two decades, several papers in economic literature have demonstrated that the monetary overhang helps to predict inflation in the euro area.⁴

It is clear that forecast models such as that presented in this box are relatively simple. Moreover, projections derived from these models are surrounded by a high degree of uncertainty. Nonetheless, the results of simulation exercises based on these models offer some useful illustrative insights into the risks posed by excess liquidity for future price developments.

4 See, for example, C. Trecroci and J.-L. Vega, op cit.

results of such models should therefore be treated as indicative, giving a general sense of the direction, magnitude and uncertainty surrounding the risks to price stability stemming from monetary developments and excess liquidity rather than a precise forecast of inflation prospects at short horizons.

Inflation projections up to the end of 2006 based on the P-star model are shown in Table 1. As noted before, three scenarios are distinguished. In the scenario based on official M3 data, the model projects annual HICP inflation in the range 11/4% to 23/4% at the end of 2006. This range is based on the 95%

confidence interval around the point estimate of annual inflation and illustrates the sizeable uncertainties surrounding the money-based forecast. By contrast, if the current stock of excess liquidity were to adjust more slowly than anticipated on the basis of past experience (in line with the second scenario outlined above), inflation projections would remain skewed above 2% over the full forecasting horizon.

In any case, for both scenarios based on the official M3 series, a large part of the forecast range for inflation is above 2%, pointing to some upside risks to price stability. These results contrast somewhat with the scenario

(annual percentage changes; contributions in percentage points)

	Inflation in 2005 Q4 1)	Contribution of the monetary overhang to inflation ²⁾	Inflation in 2006 Q4 1)	Contribution of the monetary overhang to inflation ²⁾
Scenario 1: official M3 growth with relatively rapid correction of excess liquidity 3)	13/4-3	2 ½	11/4-23/4	2
Scenario 2: official M3 growth with slow adjustment of excess liquidity 4)	13/4-3	23/4	13/4-31/4	2½
Scenario 3: M3 growth corrected for the estimated impact of portfolio shifts	1-21/4	2	1-2½	13/4

Note: The forecasts were derived on the basis of monetary data up to the second quarter of 2004.

- 1) The forecast ranges are based on the 95% confidence interval around the point estimate of annual inflation.
- 2) The contribution of the money overhang to inflation shows the inflation rate that would prevail on the basis of the P-star model if the impact of oil prices and the cyclical state of the economy were removed from the forecast, to give a "pure" money-based forecast. The forecast for oil prices was taken from the assumptions of the September ECB staff macroeconomic projection exercise. The indicator of the cyclical state of the economy (including forecasts) was derived as an average of estimates derived from using a standard Hodrick-Prescott filter, a production-function based approach as provided in T. Proietti, A. Musso and T. Westermann (2002), "Estimating potential output and the output gap for the euro area: a model-based production function approach," EUI working paper No ECO 2002/9 and an estimate provided by the OECD. Forecasts for the first two indicators were derived using the results of the September ECB staff macroeconomic projection exercise. The indicator of the cyclical state of the economy from the OECD is only forecast until the end of 2005. It was extended to the end of 2006 by using the quarter-on-quarter changes from the indicator of T. Proietti, A. Musso and T. Westermann (2002).
- 3) In line with parameter estimates for the money demand equation over the period from 1980 to mid-2001.
- 4) The slower adjustment was simulated by assuming that the future adjustment of the overhang occurs in line with an estimate of the above-mentioned money demand model between 1980 and the second quarter of 2004.

based on the M3 series corrected for the estimated impact of portfolio shifts. In this case, annual HICP inflation is expected to remain consistent with the ECB's definition of price stability in 2005 and 2006. The results of the final exercise are thus closer to the projections embodied in the main scenario published in the context of the September ECB staff macroeconomic projection exercise, whereas the other two scenarios, especially the second one, are suggestive of some upside risks to price stability stemming from the monetary side.

As discussed in Box 3, the real money gap underlying the P-star model can be broken down into various components so that their individual impact on the inflation projection can be identified. In particular, the importance of the monetary overhang – the deviation of the actual money stock from the level that would be expected on the basis of historical experience, given the prevailing level of the conventional determinants of money demand – can be

assessed. The contribution stemming from the monetary overhang can be characterised as the purely monetary impulse to price developments.

In the case of the two scenarios based on the official M3 series, the contribution to the inflation projection coming from the monetary overhang is always positive and, most of the time, points to HICP inflation above 2%. If the overall inflation forecast in this scenario is below 2%, it is the consequence of a negative contribution of the cyclical state of the economy. Table 1 shows that when using the series for M3 corrected for the estimated impact of portfolio shifts, the contribution to inflationary pressures stemming from the monetary overhang is slightly more modest and results in a more moderate inflation projection overall.

Table 2 shows the historical performance of the P-star forecasting model for the euro area in real time. The table illustrates a number of important issues. First, it demonstrates that the

Table 2 Real-time forecast of HICP inflation nine quarters ahead based on P-star model using M3, M3 with slow adjustment and M3 corrected for the estimated impact of portfolio shifts

(annual percentage changes; contributions in percentage points)

Last available observation	Forecast annual inflation	мз	M3 with slower adjustment	M3 corrected for the estimated impact of portfolio shifts
2001 Q3	2003 Q4	1/2-21/4	1/2-21/4	1/2-2
2002 Q1	2004 Q2	1/2-21/4	1/2-2	1/2-2
2002 Q3	2004 Q4	3/4-21/4	3/4-21/4	1/2-2
2003 Q1	2005 Q2	1-21/2	11/4-21/2	3/4-21/4
2003 Q3	2005 Q4	11/4-21/2	11/4-23/4	3/4-21/4
2004 Q1	2006 Q2	11/4-23/4	1½-3	3/4-21/4
2004 Q2	2006 Q3	11/2-23/4	13/4-3	1-21/4

Note: The forecasts were derived as soon as data for the first period mentioned in the forecast interval were available. The ranges shown in this table are derived from the 95% confidence interval surrounding the point inflation forecasts.

risks to price stability are relatively modest when assessed on the basis of the P-star model (based on measures of excess liquidity). However, while the P-star framework forecasts relatively low levels of inflation in 2001, the inflation forecasts show an upward trend over time, as the impact of the accumulated excess liquidity starts to build up. Overall, the indications of inflationary risks stemming from the P-star model appear more moderate than those provided by the bivariate indicator models (which focus on monetary growth). The richer structure of the P-star model, which takes into account the cyclical state of the economy, in addition to monetary developments, may account for this different assessment.

These results emphasise again the importance of a careful assessment of risks to price stability stemming from monetary developments that takes into account the specific nature of the factors driving monetary developments at different periods of time.

To conclude, this section has presented the results of monetary analysis applying some simple illustrative tools which demonstrate how the monetary analysis can provide information relevant for monetary policy decisions aimed at maintaining price stability. Of course, the simplicity of the approaches shown implies that inflation projections based largely on monetary data can only constitute one part of the overall

monetary analysis. As is apparent from the nature of the methods, the assumptions underlying these tools and the caveats mentioned above, the tools presented here cannot be applied in a mechanical way to derive concrete policy conclusions. Consistent with the strategy announced at the outset of Stage Three of EMU in October 1998, rather than reacting to monetary developments in a mechanical fashion, the ECB has used this analysis to identify those developments in M3 which pose potential risks to price stability in the medium to longer term. This analysis has been used as a cross-check against the assessment stemming from the economic analysis. This cross-checking is an essential feature in the ECB's monetary policy strategy that ensures that the Governing Council responds in a manner which serves to fulfil the ECB's mandate. Nevertheless, the exercises presented in this section should be seen as convenient heuristic and expositional devices which permit the implications of the detailed monetary analysis to be presented and understood more clearly.

6 CONCLUSION

In recent years, extracting the signals from monetary developments regarding the risks to price stability over the medium term has proved a challenging task. A number of

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shocks have influenced both monetary and price developments at short to medium-term horizons, thereby blurring the underlying relationship between monetary growth and inflation over the longer term.

In the challenging environment faced over the past few years, the ECB's monetary analysis has employed a variety of analytical tools and conceptual frameworks to recover the information in monetary developments relevant for monetary policy decisions. Some of these tools have been described in this article. It is apparent that a mechanical use of any single indicator or tool is unlikely to be a successful method of extracting the information in monetary developments relevant for monetary policy decisions. As has been demonstrated by the scenario-based exercises presented in this article, similar headline money growth figures can lead to quite different assessments of the risks to future price stability, depending on prevailing macroeconomic conditions and, in particular, on the underlying factors driving monetary growth.

Using the institutional analysis and econometric techniques discussed in the article, it has been possible to develop a good understanding of monetary developments in real time over recent years, in particular with regard to understanding some of the underlying causes of variations in M3 growth and their possible implications for future price developments.

ANNEX

TESTING THE STABILITY OF LONG-TERM MONEY DEMAND IN THE EURO AREA

A number of studies have shown that the demand for broad money in the euro area exhibits a stable relationship with prices, economic activity and interest rates.²⁰ However, the exceptional growth of M3 between mid-2001 and the summer of 2003, which is well beyond that which would have been anticipated on the basis of developments in the conventional determinants of money demand, has given rise to concerns about possible statistical breaks in this historical relationship.

When assessing the stability of money demand relationships, it should be recognised that the empirically relevant definition of money is not clear-cut. In an environment of financial innovation and changes in financial structure, those instruments which perform the traditional roles of money - unit of account, means of payment and store of value - are constantly changing. Moreover, the nature of these three roles is itself also evolving over time, as technology advances and new instruments are introduced. A comprehensive monetary analysis must encompass developments in the components and counterparts of the key monetary aggregate and continually consider whether, in a specific set of circumstances, the holdings of some components really represent money balances in the conventional sense or rather instruments with an alternative economic role, such as longer-term savings vehicles. This notwithstanding, in line with the main text of this article, the focus of the assessment in this annex is on the stability of the key broad monetary aggregate, M3.

In principle, two forms of money demand instability can be distinguished. First, there may be short-run instabilities that leave the long-run demand relationship between the money stock, prices, real incomes and interest rates unchanged. Such instabilities are to some extent inevitable, given the complexity of the short-run relationship between monetary dynamics and inflation, which is conditional

on developments in many other economic variables. Second, and more fundamentally, the long-run money demand relationship itself may break down. While this simply represents instability in a specific econometric formulation of money demand and does not necessarily put into question the underlying long-run relationship between monetary developments and prices, it nonetheless poses significant practical problems for monetary analysis since the statistical benchmarks against which monetary developments are typically judged would then become less meaningful.

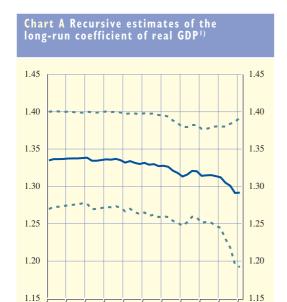
This annex assesses the stability of euro area long-run money demand over the period from the first quarter of 1980 to the first quarter of 2004 using a money demand equation developed by ECB staff.21 This equation is embedded in a vector error correction (VEC) system estimated by applying the Johansen cointegration procedure to a set of variables comprising M3 deflated by the GDP deflator (m-p), real GDP (y) and a measure of the opportunity cost of holding money defined as the spread between the short-term market interest rate (ST) and the own rate of return of M3 (OWN). The own rate is computed as the weighted average of the rates of return on the individual components of M3 (using the relative importance of each component in M3 as its weight).22 The estimated long-run demand for

²⁰ See for recent examples C. Brand and N. Cassola (2004), "A money demand system for euro area M3", Applied Economics 36 (8), pp. 817-838; A. Bruggeman, P. Donati and A. Warne (2003), "Is the demand for euro area M3 stable?", ECB working paper No 255; A. Calza, D. Gerdesmeier and J. Levy (2001), op. cit.; G. Coenen and J.-L. Vega (2001), "The demand for M3 in the euro area", Journal of Applied Econometrics 16 (6), pp. 727-748; and M. Funke (2001), "Money demand in Euroland", Journal of International Money and Finance 20 (5), pp. 701-713.

²¹ A. Calza, D. Gerdesmeier and J. Levy (2001), op. cit.

²² The variant of the model used for this box is estimated conditionally on a restriction of weak exogeneity of real GDP to the system. In addition, the first difference in the annualised quarterly inflation rate (based on the GDP deflator) and the one-quarter lagged change in the "yield spread" (defined as the difference between the ten-year government bond yield and the three-month money market interest rate) have been included as exogenous variables.

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Source: ECB.
Note: Dashed lines denote the 95% confidence interval.
1) Based on the money demand model of A. Calza, D.
Gerdesmeier and J. Levy (2001); see notes to Chart 4 for details.

1994 1995 1996 1997 1998 1999 2000 2001 2002 2003

-0.5 -1.0 -1.5 -2.0 -2.5 -3.0 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 -3.0

Chart B Recursive estimates of the long-run coefficient of opportunity costs¹⁾

Source: ECB.
Note: Dashed lines denote the 95% confidence interval.
1) Based on the money demand model of A. Calza, D.
Gerdesmeier and J. Levy (2001); see notes to Chart 4 for details.

real money takes the following semi-log linear form (standard errors in parentheses):

$$(m-p)_t = 1.29 \cdot y_t - 1.82 \cdot (ST - OWN)_t$$

A conventional method of investigating the stability of the long-run coefficients consists of graphing recursive estimates of these coefficients. This procedure simply involves estimating the equation over a truncated sample and then repeatedly re-estimating the equation over extended samples until the full-sample estimate is reached. The exercise gives some insight into whether the estimates change over time. In particular, large fluctuations of the estimated coefficients are typically interpreted as indicating instability.

It should be noted from the outset that this method is rather informal and suffers from some serious econometric problems. Therefore, the results of applying this method should be interpreted with a significant degree of caution. They can only be used to collect preliminary evidence on the stability of the parameters of the model.

Charts A and B plot the time paths described by the recursive estimates of the coefficients of the long-run money demand equation, together with the corresponding 95% confidence bands. Both the income elasticity and the interest rate spread semi-elasticity (the two key long-run parameters of the model) seem to have been affected by perturbations in the last few quarters of the sample period, when monetary growth has been exceptionally strong. While the effect of these perturbations is particularly visible from the fluctuation of the coefficient of the opportunity cost, it can also be detected from the widening of the confidence bands surrounding the estimated income elasticity towards the end of the sample period.

Overall, this graphical analysis would suggest that the stability of the model could not be taken for granted in recent periods. This observation prompts the need for more formal investigation using methods, such as parameter constancy tests, that are not subject to the technical drawbacks associated with the recursive estimates. Such more sophisticated tests include the mean and supremum variants of the so-

Table A Nyblom parameter-constancy test 1)

Type of test	Statistic	P-value
Supremum	0.53	0.62
Mean	0.16	0.55

Note: The p-value is a measure of how much evidence there is against the null hypothesis (in these tests, joint stability of the parameters of the money demand equation). A large p-value indicates that there is little evidence against the null hypothesis. P-values are bootstrapped using 1,000 iterations.

1) Based on the money demand model of A. Calza, D. Gerdesmeier and J. Levy (2001); see notes to Chart 4 for details.

called Nyblom test of joint stability of the parameters of the cointegrating vector.²³ The results of such tests on euro area M3 demand are shown in Table A.

While these tests also suffer from various problems, such as small-sample size issues, the use of bootstrapping techniques as proposed by Bruggeman, Donati and Warne (2003) can mitigate at least some of them. As the relatively high level of the p-values show, the null hypothesis of the test (joint stability of the long-run parameters) cannot be rejected at conventional levels. This suggests that the long-run parameters of the model remain jointly stable, even when the sample period is extended up to the first quarter of 2004 and thus includes the recent period of strong monetary growth.

Overall, the two methods used to assess the stability of money demand yield somewhat conflicting signals. While the results of the recursive estimates suggest that the stability of the long-run coefficients of the model may have deteriorated towards the end of the sample period, the results of a formal parameterconstancy test fail to reveal major signs of parameter instability in the model. On balance, formal parameter-constancy tests should provide more reliable information than graphical analyses of recursive estimates and, therefore, their results should be given relatively higher weight. To sum up, this econometric exercise does not suggest that there are good reasons to believe that the estimated

long-run M3 demand relationship for the euro area has broken down.

²³ These tests have been extended to cointegrated VARs by B. Seo (1998), "Tests for structural changes in cointegrated systems", Econometric Theory 14, pp. 222-259, and H. Hansen and S. Johansen (1999), "Some tests for parameter constancy in cointegrated VAR-models", Econometric Journal 2, pp. 306-333.