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Monetary analysis and monetary policy in the euro area 1999–2006

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A B S T R A C T

This paper assesses the practical experience of monetary analysis at the ECB from the introduction of the euro in 1999 through 2006. The paper exploits a unique and rich real-time data set, containing both the vintages of data and the economic models that have been employed in the ECB's monetary analysis during the first eight years of Monetary Union. It embodies both a description of how monetary analysis was conducted over this period and a quantitative evaluation of the indicators of risks to price stability that derived from this analysis. A close investigation of this material is used to evaluate the role monetary analysis has played in the evolution of monetary policy in the euro area.

1. Introduction

Since the announcement of the ECB's monetary policy strategy in October 1998, the "prominent role" assigned to money within it has been the subject of an intense debate.

To place this debate in context, it is useful to recall the broader framework for monetary policy making in the euro area. When taking interest rate decisions aimed at the maintenance of price stability, the Governing Council of the ECB draws on both economic analysis and monetary analysis (ECB, 1999b, 2003). The former attempts to identify the economic shocks driving the business cycle and thus embodies a thorough assessment of the cyclical dynamics of inflation. The latter analyzes the monetary trends associated with price developments over the medium to longer-term. While, in principle, there is no arbitrary segregation of the available data between the two forms of analysis, in

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practice the economic analysis is largely focused on developments in economic activity and price and cost indicators, whereas the monetary analysis relies on a close scrutiny of the monetary aggregates, their components and counterparts, as recorded in the consolidated balance sheet of the euro area monetary financial institutions (MFI) sector (ECB, 1999a, 2000a).[1]

In contributing to this rich debate, this paper adopts a different approach from the existing literature. Rather than attempting to motivate or criticize the role played by monetary analysis in the abstract, it focuses on how monetary analysis has been conducted in practice. More specifically, the paper presents: a narrative history of the ECB's monetary analysis from the introduction of the euro in 1999 until the end of 2006; a quantitative evaluation of models used to produce money-based indicators of risks to price stability[2]; and an assessment of the impact of the signals drawn from the monetary analysis on monetary policy decisions in the euro area.[3]

From a methodological perspective, another novel and distinctive feature of the paper is the close attention it pays to maintaining a "real time" perspective when describing and evaluating the ECB's monetary analysis. In other words, the paper attempts to characterize and evaluate the monetary analysis and its impact on interest rate decisions on the basis of the information that was available at the time the analysis was conducted and the policy decisions were taken. In both the simulated out-of-sample evaluation of money-based inflation indicators and in the narrative history, the paper pays close attention to ensuring that the correct vintages of the monetary time series and analytical models are used.

The remainder of the paper is organized as follows. Section 2 provides an overview of the tools used in the ECB's monetary analysis and how they have evolved over time. Section 3 conducts a thorough evaluation of a money-based indicator of risks to price stability (which is identified in Section 2 as a "summary – but not sufficient – statistic" for the monetary analysis as a whole), addressing the real time issue carefully. On the basis of this investigation, Section 4 presents a series of event studies illustrating how the monetary analysis has influenced interest rate decisions. Section 5 presents some brief concluding remarks.

2. Conducting monetary analysis at the ECB

2.1. The structure of the briefing material

Although complemented by a large body of higher frequency material, on a quarterly basis the economic and monetary analyses take concrete form in two key exercises, the results of which are ultimately presented to the Governing Council.

The Broad Macroeconomic Projections Exercise (BMPE) is conducted by Eurosystem[4] staff twice a year (for the June and December Governing Council meetings), with the ECB staff repeating the exercise in the intervening quarters.[5] The exercise uses conventional macroeconometric tools

[1] The MFI sector consists mainly of credit institutions and money market funds resident in the euro area as well as National Central Banks and the ECB. Broadly speaking, one can identify it with "banks".

[2] To deepen the narrative assessment, we have also constructed a number of qualitative indicators of the monetary analysis: an indicator of the input to the policy-making process made by the monetary analysis, derived from a coding of words used in briefing material provided by staff (viz., the quarterly monetary assessment discussed in Section 2); and two indicators of the impact monetary analysis had on the output of monetary policy deliberations, deriving from a coding of words used in the President's introductory statement at the press conference following the interest rate decision. (These indicators of the impact of monetary analysis on the output of monetary policy deliberations are similar to those developed by Gerlach, 2004.)

[3] More information can be found in a number of appendices to the paper that are available in the version published in the proceedings of the fourth ECB central banking conference, "The role of money: Money and monetary policy in the twenty-first century" at http://www.ecb.int/pub/pubbydate/2008/html/index.en.html. These appendices offer more detailed descriptions of the tools and methods used to assess monetary developments from the introduction of the euro in January 1999 until the end of 2006.

[4] The Eurosystem consists of the ECB and the (now sixteen) national central banks of the countries that have adopted the euro as their currency.

[5] The exercises conducted by ECB staff in the intervening quarters are labeled as the Macroeconomic Projections Exercises (MPE). In the following, we will refer to BMPE to indicate both MPE and BMPE outcomes, without distinguishing between the two.

(including area-wide and multi-country models of the euro area), augmented by the judgmental input of sectoral and country experts, to produce projections of inflation and economic activity for the coming two to three years (ECB, 2000b). These projections are published, in the form of ranges, on the day the Governing Council discusses them and subsequently in the ECB Monthly Bulletin.

The Quarterly Monetary Assessment (QMA) is undertaken primarily by ECB staff, drawing on the expertise of NCB staff as necessary. Three aspects of the assessment are particularly noteworthy. First, the analysis of monetary data contained in the QMA is instrumental, in the sense that it is intended to shed light on the outlook for price developments and the implications for monetary policy rather than simply to explain monetary developments in their own right. Second, consistent with the view that the policy-relevant information in money is in its lower frequency or trend-like developments (see, for example Benati, 2009), the focus of this assessment is on identifying the underlying rate of monetary expansion that is related to inflation dynamics over the medium to longer-term. Seen in this light, the analysis is intended to look through the often erratic month-to-month variations in monetary growth.[6] Third, the analysis does not rely solely on developments in the key broad monetary aggregate M3. Rather a holistic assessment of the monetary data is made, encompassing the analysis of components, counterparts, sectoral contributions, financial accounts, financial prices and yields and other data sources as necessary.

2.2. The quarterly monetary assessment

While the QMA has not been published in a systematic manner by the ECB, the analysis contained therein underpins the description and assessment of monetary developments regularly presented in the ECB's Monthly Bulletin, especially in the longer quarterly format of the commentary section. Moreover, many of the tools used in the QMA have been described in papers and articles produced by ECB staff (e.g. Masuch et al., 2001; ECB, 2004). A quantitative outlook for price developments derived from the monetary data in the QMA (so-called "money-based indicators of risks to price stability", as analyzed in detail in subsequent sections of this paper) has been published on several occasions in the Monthly Bulletin (ECB, 2005, 2006a, 2007).

The first QMA was produced in December 1999 and analyzed data through the third quarter of 1999. Although the monetary analysis has faced several significant challenges in the ensuing years, the basic structure of the QMA has proved remarkably stable over this period. A first section simply describes the latest monetary data, placing them in the context of longer-term trends. A second section attempts to explain recent monetary dynamics, drawing on various interrelated tools (including econometric and statistical models, a thorough analysis of the components and counterparts of M3, and a detailed investigation of "special factors" influencing monetary developments), so as to recover a quantitative proxy for the prevailing underlying rate of monetary expansion corrected for shorter-term distortions. The final section transforms the appropriately filtered monetary series into an outlook for price developments, so as to permit an assessment of the risks to price stability implied by the monetary analysis.

2.3. Analytical tools used in the QMA

While the basic structure of the QMA has remained stable over time, the nature of the analysis conducted has evolved through several phases, reflecting the successive challenges faced in interpreting the monetary data since 1999. With this in mind, when presenting the ECB's monetary analysis, it is useful to distinguish three broad sets of tools that have been employed, namely: (i) money demand equations; (ii) judgmental analysis, drawing on a broad set of monetary and financial data and a deep expert knowledge of institutional structure; and (iii) reduced-form money-based indicator models for inflation. The three types of tool have been in the preparation of the monetary analysis since the

[6] The monthly data are analyzed in order to help identify specific "special factors" that may distort the data, but which are not reflective of underlying monetary dynamics. Monthly money data are not used to assess contemporaneous short-term inflation developments ("now-casting").

introduction of the euro, although their relative importance and the interrelationships among them have evolved over time as circumstances dictated.

2.4. Money demand equations: specification and uses

In December 1998, the ECB announced a reference value for the annual growth rate of the broad monetary aggregate M3. The reference value was defined as the rate of money growth over the medium term that would be consistent with the maintenance of price stability at that horizon. In line with the ECB's strategy, deviations of M3 growth from the reference value were viewed as triggers for further analysis to identify the cause of the deviation and assess its implications for the outlook for price developments (ECB, 1999a).[7]

Against this background, the assessment of monetary developments initially focused on an analysis of deviations of M3 growth from the ECB's reference value of $4^1/_2$ %. Money demand equations constituted a natural starting point for this analysis.[8]

Money demand models were seen as providing a semi-structural framework that allowed judgement deriving from a comprehensive analysis of monetary data and expert institutional knowledge to be combined with the results of standard money demand equations, as presented in Masuch et al. (2001). Such an approach relied on the assumption that a long-run money demand relation existed, but that the short-run relationships between money and its economic determinants were sufficiently complex and shifting that it was difficult to model in a single, consistent framework over time.

In practical terms, this approach took concrete form in the use of Vector Error Correction (VEC) models to analyze and explain the evolution of M3. For example, the Calza et al. (2001) specification (henceforth CGL) – which was the workhorse M3 money demand equation used in the QMA from 2001 to 2006 – is a VEC model of order 2 (meaning that two lags of each variable modeled in the system are included). The CGL model embodies one stationary co-integration relation that is interpreted as the long-run demand for real money (m–p). This relationship takes a semi log-linear functional form, relating money demand to real GDP (y) and the spread between the short-term market interest (s) rate and the own rate of return on M3 (OWN):

$$m_t - p_t = k + 1.31y_t - 1.1(s_t - OWN_t) \tag{1}$$

Using such a money demand framework in the QMA led to three types of conclusion. First, monetary dynamics were seen as complementing the information coming from the economic analysis. For example, money demand equations might suggest that strong monetary growth was a result of strong real income growth and/or a low level of interest rates in the economy. Strong monetary dynamics would thus be seen as confirmation of signals coming from conjunctural indicators.[9]

Second, money demand equations provided a vehicle to distinguish between monetary dynamics that were more transitory in nature and those which were more persistent. For example, in the Brand and Cassola (2004) specification of money demand, the relatively steep euro area yield curve observed in late 1999 was viewed as implying a temporary dampening effect on monetary growth, such that the headline annual growth rate of M3 understated the underlying rate of monetary expansion relevant for comparison with the reference value.[10] Money demand equations were thus seen as offering a framework for translating the observed rate of M3 growth into an indicator that could be more meaningfully compared to the reference value.

[7] The ECB emphasized that the reference value should not be seen as an intermediate monetary target, since interest rate decisions would not be geared to keeping monetary growth close to the reference value in a mechanical fashion.

[8] Appendix C to the paper, available in the version published in the proceedings of the fourth ECB central banking conference, "The role of money: Money and monetary policy in the twenty-first century" at http://www.ecb.int/pub/pubbydate/2008/html/index.en.html describes the evolution of the specification and use of money demand models at the ECB in greater detail.

[9] Indeed, some suggested that monetary data would be available sooner and may be more reliable than alternative indicators (Coenen and Wieland, 2001), although in practice this argument has played a modest role in the ECB analysis.

[10] Note that the derivation of the reference value implicitly assumed that the slope of the yield curve would be at its steady-state level, since it focused on the medium to longer-term relationship among money and other macroeconomic variables.

Third, by identifying an equilibrium level of money holdings, money demand equations gave a benchmark for assessing the liquidity situation. Given that the policy-relevant signal in monetary developments was of a longer-term or lower frequency nature, measures of excess liquidity (rather than the current rate of M3 growth) could be viewed as more meaningful indicators of risks to price stability since they accumulated past deviations of monetary dynamics from the rate consistent with price stability over the medium term. For example, if the money demand equation suggested that M3 growth was subdued because of a correction of excess liquidity accumulated in the past (other things equal), this would be viewed less benignly in terms of inflationary pressures than the same subdued rate of monetary growth stemming from other determinants.

2.5. Judgmental analysis and the development and quantification of corrections to M3

From the outset, it was clear that money demand equations alone would not be able to account for all the identifiable movements in M3. As a result – and as is the case with other macroeconomic models used in a policy context – the analysis based on money demand has always been complemented by and integrated with a broad judgmental investigation of monetary developments.

The quantification of this judgement has led to production of a (real time) corrected M3 series, which has been used as an input to the reduced-form money-based indicator models that have been employed in the QMA (and which are discussed in greater detail in the next Subsection).[11]

Broadly speaking, three forms of judgement have been incorporated into the ECB's analysis, with the relative importance of each type having varied over time as conditions dictated.

First, judgmental adjustments to the monetary series used in the internal analysis have been made for various technical factors. One example is the adjustment made to M3 to account for the impact of the introduction of a new system of required reserves when the euro was created, which removed an implicit tax on banking intermediation (in at least some countries, which had imposed unremunerated minimum reserve requirements prior to January 1999). This change led to a repatriation of deposits, including from "offshore accounts" from the perspective of the euro area (such as those held in London). Such behavior raised M3 growth, but was deemed unlikely to represent a risk to price stability as it simply represented a transfer of existing deposits from offshore to onshore accounts.

Second, judgmental adjustments have been made to address specific statistical problems that have arisen in the data, in part because the statistical infrastructure needed to produce monetary aggregates for the new euro area had to be developed and refined over time. Most important among such adjustments is the treatment of non-resident holdings of various marketable instruments issued by MFIs (on this point see ECB, 2001a,b).

Third, judgmental adjustments have also been introduced to account for economic behavior that was not captured by the conventional determinants of money demand included in the standard econometric models estimated and employed from 1999 onwards. The most prominent example of such adjustments concerns the portfolio shifts into monetary assets that took place between late 2000 and mid-2003, as a result of the heightened economic and financial uncertainty prevailing at that time.

In the interests of brevity, a description of how the adjustment for portfolio shifts during the period 2001–2003 was constructed in real time is not reproduced here.[12] Suffice to say that a rich internal analysis – encompassing evaluation of a broad set of monetary, financial and economic data and employment of a variety of econometric and time series models – underpinned the identification and, most importantly, the quantification of these portfolio shifts. Ultimately, this thorough process took concrete form in the construction of an adjustment factor, which was used to adjust the level of headline M3 and produce a series corrected in real time for the estimated impact of portfolio shifts.

[11] Judgement has been introduced by making an adjustment to the M3 series. Note that this represents a presentational choice; in substance, it is equivalent to introducing a velocity shift in the quantity equation and/or a dummy variable into a money demand equation.

[12] A detailed description is provided in appendix B in the version of the paper published in the proceedings of the fourth ECB central banking conference, "The role of money: Money and monetary policy in the twenty-first century" at http://www.ecb.int/pub/pubbydate/2008/html/index.en.html, to which interested readers are referred.

Fig. 1 reports the various vintages of the portfolio shift adjustment itself, reflecting the real-time approach highlighted in the introduction to this paper.

A number of important conclusions can be drawn from Fig. 1. First, it is apparent that the adjustment was timely, in the sense that the first adjustment for portfolio shifts (made to the data for 1) was introduced in 2001Q3. While no independent assessment of when portfolio shifts became important is available, the identification in mid-2001 is consistent with the policy assessment made at that time. Moreover, taking the adjustments themselves as a given, the introduction of the adjustment into the overall analysis occurred with a lag of only one quarter. Second, the adjustment made has been very significant in magnitude, peaking at over 5% of the stock of M3. This is also reflected in the evolution of the annual growth rates for the official M3 series and the M3 series corrected for the estimated impact of portfolio shifts (see Fig. 2).

It is important to note that introducing corrections to the M3 series was preferred to re-specifying and re-estimating money demand equations in order to account for various factors that were not embodied in the conventional specifications, including, in particular, portfolio shifts. This strategy was viewed as more reliable – indeed, necessary – in real time, so as to provide timely input to the policy assessment. The scope to estimate new specifications of money demand allowing for portfolio shifts rested on the availability of data covering the period when these portfolio shifts were taking place. By necessity, a time series of sufficient length to allow estimation was only available after several quarters in which portfolio shifts had proved important. Such an approach would inevitably be lagging from real-time policy-making perspective, whereas the real-time judgmental assessment of portfolio shifts was much more timely.

Nonetheless, the judgmental adjustments and the money demand models had to be reconciled to maintain the internal consistency of the analysis. In practice, two concrete measures were taken to achieve this.

First, from 2001Q4 onwards ECB staff fixed the parameters of the baseline money demand equation then used in the QMA (Calza et al., 2001) at the values estimated for the sample from 1980Q1 to 2001Q2. From that point, this model became a historical benchmark for the analysis, recognizing that the stability of the specification after 2001 (at least on the basis of standard econometric tests) was – at best – questionable. One could characterize this approach as a form of calibration, where the pre-portfolio shift period estimates are viewed as more representative of behavior during "normal times" and thus as more reliable calibrated values than empirical estimates that include the post-2001 data.

Second, instability of M3 demand relative to this historical benchmark was captured by a stochastic term in the money demand equation, which represented identifiable economic factors beyond the

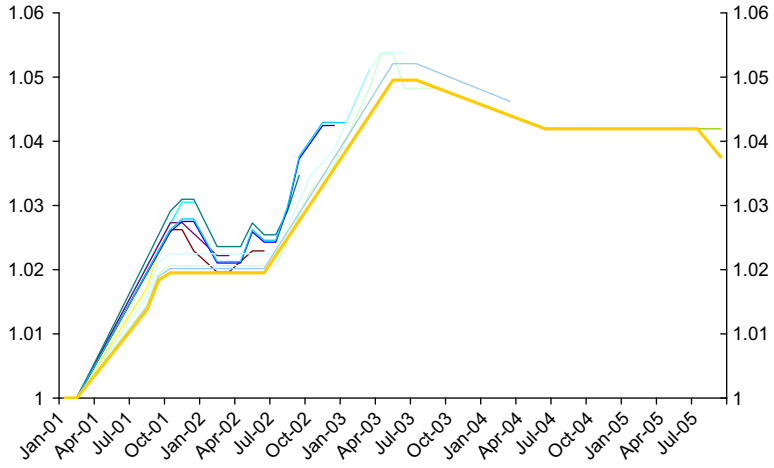


Fig. 1. Different vintages of real-time adjustment factors for portfolio shifts. Note: The figure shows the vintages of the adjustment factors as available in real time. A value of 1.05 indicates that the level of M3 is corrected by 5%.

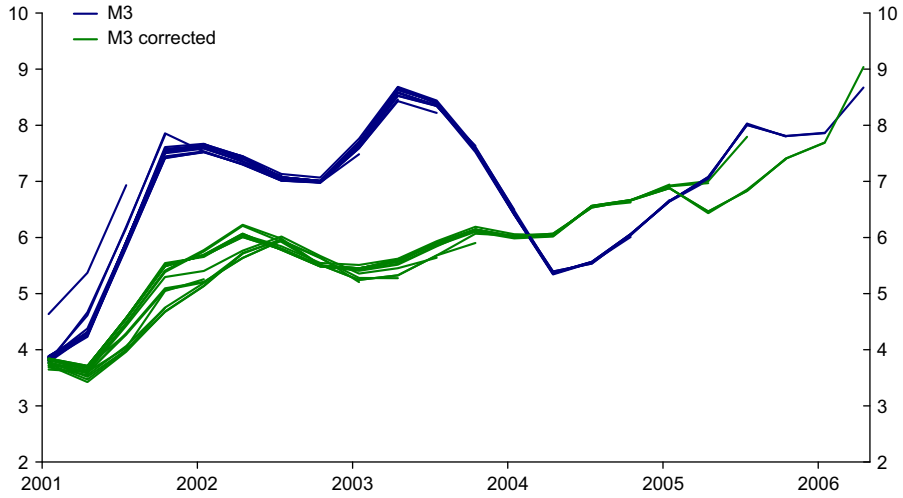


Fig. 2. Annual growth rates of M3 and M3 corrected. Real-time vintages.

conventional determinants of money demand, notably the judgmental assessment of portfolio shifts. Indeed, one method used to quantify the magnitude of portfolio shifts – in parallel with a eclectic variety of other approaches – was to consider the residuals to conventional specifications of money demand over the portfolio shifts episode.

Given this approach, the monetary analysis and its communication changed in nature. In particular, the instability of standard money demand specifications inevitably complicated the assessment, explanation and – above all – presentation of deviations of M3 growth from the ECB's reference value. The interpretation of such deviations – in particular, the identification of those which have implications for the outlook for price developments over the medium term – has become more difficult. For much of the 2001–2004 period, the main reason for deviations of M3 growth from the reference value was the impact of portfolio shifts, which were identified and quantified outside the money demand model. This led to greater emphasis being placed on the M3 series corrected for the estimated impact of portfolio shifts in both the internal and external communication of the monetary analysis.

2.6. Money-based indicators of risks to price stability

As a complement to the money demand equations and judgmental analysis, money-based indicators of risks to price stability have also been employed in the QMA. Over time, reduced-form money-based inflation indicator models (such as those proposed in Nicoletti-Altimari, 2001, based on the methodology outlined in Stock and Watson, 1999) have played a more prominent role. These are bivariate equations where an autoregressive equation for inflation is augmented by, respectively, the growth rate of M3 and the growth rate of M3 corrected for portfolio shifts. We will discuss the exact specification of these equations in the next Section. Here, we simply outline the indicator model.

Define HICP inflation at time t as π_t. The bivariate indicator model of inflation at time $t+h$ is then:

$$\pi_{t+h} = a + b_1\pi_{t-1} + \ldots b_p\pi_{t-p} + c_1x_{t-1} + \ldots + c_px_{t-p} + \varepsilon_{t+h} \quad (2)$$

where x_t denotes either the M3 or the M3 corrected growth rate. At each time t the parameters are estimated and the estimates are used to produce a forecast.

The use of such simple indicator models can be seen as a straightforward method of transforming – in a rather mechanical way – the detailed monetary analysis into an outlook for price developments.

The indicator thus represents a "summary statistic" for the monetary analysis, which can be discussed and digested both internally and externally.[13]

Such simple bivariate indicator models have increased in prominence over time at the expense of inflation indicators that were produced on the basis of money demand equations. Initially, the entire VEC system (of which the money demand equation was a part) was simulated to produce forward-looking paths of the key macroeconomic variables in the system, including inflation. Such an approach was discontinued from 2001, given that these models did not provide a satisfactory forecasting performance. Money demand equations continued to be used to provide a forecast of inflation based on the "real money gap" or P-star models (as in Hallman et al., 1991). The P-star approach, however, has never been prominent in the QMA, since by the time it was introduced, greater reliance was already being placed on the bivariate approach in a context where the specifications of money demand underlying the P-star model were of questionable stability. Indeed, the rising prominence of the bivariate approach can be interpreted as one practical response to a situation from 2001 onwards where growing questions emerged about the stability of money demand equations used in the QMA.

2.7. The QMA: summary indicators of the overall assessment

As we have seen, the overall evaluation of risks to price stability stemming from the monetary analysis that is reported in the QMA is rather complex, since it is based on a variety of approaches and models and relies on a significant degree of expert judgement. This raises the question of whether and how to characterize the "policy message" stemming from the monetary analysis. As suggested in the preceding Section, the simple transformation of M3 and M3 corrected into a quantitative outlook for price developments on the basis of bivariate indicator models is one approach. For establish the robustness of our conclusions, this Subsection explores other characterizations.

To obtain a synthetic indicator of the overall assessment stemming from the monetary analysis, we have coded the wording of the introduction to the QMA. The resulting indicator ranges from -2 (clear downward risks to price stability) to $+2$ (clear upward risks to price stability). Fig. 3 plots the qualitative indicators against the evolution of both the official M3 series and the M3 series corrected for the estimated impact of portfolio shifts and other distortions identified by the judgmental analysis, the inflation rate, measures of excess liquidity and bivariate money-based inflation indicators

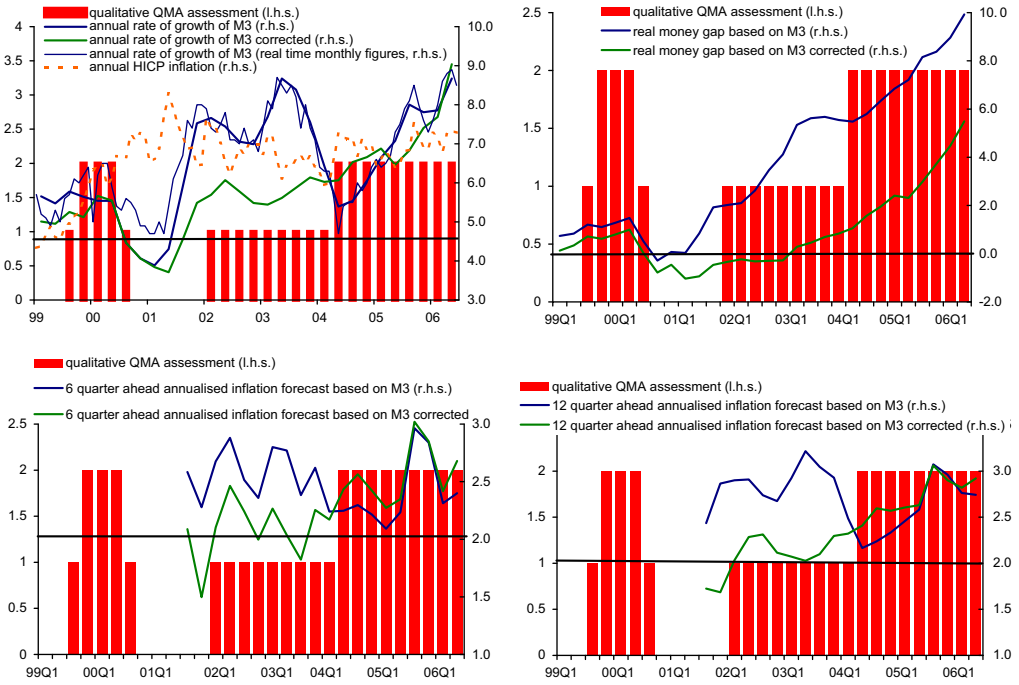
The figure shows that the growth rate of the M3 series corrected for portfolio shifts and the money-based inflation indicators based on this series have evolved in a similar manner to the qualitative indicator. In particular, the turning points in these series are aligned, implying that they can be used collectively to establish several distinct phases in the conclusion and signal to be drawn from the monetary analysis.[14]

More precisely, four phases are discernible from these summary indicators: early-1999 to mid-2000; mid-2000 to mid-2001; mid-2001 to mid-2004; and mid-2004 to end-2006 (the end of the sample considered in this paper). Using these dates as a starting point, a deeper analysis of the material presented in the QMA suggests that these phases can be distinguished along three dimensions: first, the signal offered by the baseline of the monetary analysis with regard to risks to price stability over the medium to longer-term (which is broadly captured by the money-based inflation indicators); second, the degree of uncertainty surrounding the interpretation of monetary developments, which governs the strength of the policy signal that can be drawn from the monetary analysis; and third, the risks to the baseline outlook derived from the monetary analysis.

The first phase lasted from early-1999 through mid-2000, during which the monetary analysis pointed to upside risks to price stability at medium to longer-term horizons. The strength of this signal increased over the course of the period, as uncertainties surrounding the monetary data associated

[13] By the same token, such indicators cannot be viewed as a "sufficient statistic" for the monetary analysis, given that they are too simple to encompass the richness and depth of the overall approach.

[14] The growth in the official M3 series and the resulting money-based inflation indicator series were used to make a risk assessment around the modal view captured by the corrected measures.



Source: ECB, own calculations.
Note: The horizontal line in the upper two charts represent the ECB's reference value for monetary growth. The horizontal linke in the bottom two charts represents the ceiling of the ECB's quantitative definition of price stability.
The qualitative coding goes from -2 (clear downward risks to price stability) to +2 (clear upward risks to price stability).

Fig. 3. Qualitative assessment of the QMA.

with the transition to Monetary Union (e.g. the impact of the change in the required reserves regime) receded.

The second phase lasted from mid-2000 until mid-2001. During this period, the monetary analysis pointed to a relatively benign outlook for price developments, with inflationary pressures at longer horizons diminishing over time. However, the monetary data published in real time (though not the more recent vintages of data) obscured this signal, due to the statistical distortions to the M3 series (note, however, that corrections based on expert judgement were available internally to overcome these statistical shortcomings.). In both the first two phases, the risks surrounding the signal offered by the monetary analysis were relatively balanced.

Between mid-2001 and mid-2004, the uncertainties surrounding the interpretation of monetary developments were multiplied by the incidence of portfolio shifts (first an inflow into monetary assets, and then an unwinding of those flows). The signal from the monetary analysis during this third phase was therefore blurred and thus weaker. While the baseline outlook for price developments constructed on the basis of the monetary analysis was rather benign in terms of implications for price stability, the risks to this outlook were viewed as skewed strongly to the upside, given the substantial accumulation of liquidity that was taking place. Nonetheless, signals from monetary analysis – among other sources – pointed against the emergence of persistent deflationary pressures in the period between late 2002 through the course of 2003, a time at which some commentators were concerned that the euro area might be heading into a deflationary spiral.

Finally, from mid-2004 through the end of 2006, the monetary analysis pointed to increasing upside risks to price stability at medium to longer-term horizons. Over the course of this fourth phase, the signal stemming from the monetary analysis strengthened for two reasons. First, the analysis pointed to a strengthening of the underlying rate of monetary expansion over time. Second, the view that this

strengthening of monetary dynamics was fundamentally different from the previous strengthening associated with portfolio shifts into money was progressively confirmed. This strengthening of the signal from the monetary analysis contrasts with the lack of clarity emerging in the real-time data from the economic analysis, against the background of the emerging gap between soft and hard data. At the same time, given the accumulation of liquidity remaining from the 2001–2003 period, the risks to this baseline view were also seen as skewed to the upside.

As shown in Fig. 3, the M3 corrected-based inflation forecasts capture the transition from the third to the fourth phase (unavailability of such real-time forecasts prior to 2002 limit the scope to assess other transitions). The next Section will evaluate the accuracy of such forecasts in tracking future inflation.

3. Forecasting evaluation

In order to provide a structured quantitative assessment of the ECB's monetary analysis, this Section describes a formal statistical evaluation of the money-based inflation indicators regularly presented in the QMA. Before describing the exercise in detail, a number of caveats need to be kept in mind, so as to avoid confusing this rather narrow technical evaluation of one tool with a comprehensive assessment of the worth of the monetary analysis.

In the previous Section, we have described the assessment of the outlook for price stability made in the QMA. As we have seen, this assessment embodies a rich set of quantitative and qualitative analyses, of which the money-based indicators are only one element. The money-based forecasts should be seen as "summary statistic" capturing the broad thrust of the assessment, not as a "sufficient statistic" providing an exhaustive summary of the information extracted from monetary developments. Moreover, the evaluation we discuss in this Section will focus only on the first moment of the forecast (i.e. the baseline outlook), which does not capture the higher moments (e.g. the risks surrounding the baseline), even though the latter are typically of great importance for monetary policy purposes. The question we will analyze is therefore narrower than establishing the role of the monetary analysis for the broad assessment of price stability.

More specifically, we will consider both the BMPE projections and the money-based inflation indicators and investigate how well they have each tracked future inflation. Moreover, we will consider how the BMPE projections and money-based indicators are related to each other, using other models to deepen our understanding and interpretation of the results. Such an approach has to be understood in light of the ECB's monetary policy strategy, where the BMPE projections and money-based inflation indicators are constructed on a largely independent basis, so as to allow the Governing Council to cross-check the results of the economic and monetary analyses in coming to an overall assessment of the risks to price stability and thus monetary policy decisions.

Our analysis will mainly concentrate on the six-quarter ahead horizon. This horizon was chosen to permit a comparison between the monetary analysis and the economic analysis[15] and because short-sample problems make longer horizon evaluations very unstable and therefore unreliable.

A number of caveats should be taken into account in focusing on the six-quarters horizon. First, since money is typically seen as containing information about the outlook for price developments over the medium to longer-term, one may question the appropriateness of this horizon. To partly address this problem we will focus on the annualized rate of HICP inflation over the next six quarters (which, as a moving average of quarterly inflation rates, serves to smooth the inflation series). Second, the economic analysis is meant to provide signals for the short/medium outlook for price stability and then focusing only on the six quarters horizon does not allow an evaluation of the analysis its relevant horizons. However, we only look at the BMPE projections to provide a benchmark for the money-based forecasts and a thorough evaluation of the BMPE is beyond the scope of this paper.

The evaluation of the money-based forecasts and the comparison of those forecasts with alternative benchmarks, is based on an out-of-sample exercise using data and models that were available to the forecasters in real time. To be able to conduct such analysis, we are exploiting a very rich database, containing all the vintages of data and models used at the ECB in the production of the QMA since 1999.

[15] The published Eurosystem – ECB staff macroeconomic projections (BMPE) have a maximum horizon of nine quarters.

The structure of the exercise is as follows. We estimate the models using the sample 1980Q1–2000Q3 and produce the first forecast for 2002Q1 (six-quarters ahead). The next quarter, 2000Q4, we will produce a new forecast, using data and models available up to then. For each subsequent quarter, we repeat this exercise so as to produce eighteen forecasts (corresponding to the period 2002Q1–2006Q2), which can then be compared with the realized inflation. Note that, as time progresses from 2000Q3 to 2004Q4 (the last vintage we evaluate), not only do we have new data points, but also new vintages of data reflecting revisions to the time series and to the model specifications. This is the essence of our real-time approach.

As has been observed in the literature, the historical evaluation of economic policy or, in our case, the evaluation of the analysis underlying monetary policy, is only possible if the informational assumptions are realistic in the sense of reflecting what people knew at the time the analysis was undertaken and policy decisions made. Based on this observation, a large literature in the US has evaluated the size of revision errors of variables and key indicators such as the output gap and the implications of those revisions for historical interpretation of monetary policy (e.g. Orphanides, 2001). Recently, revisions of the structural forecasting model at the Federal Reserve Board have also been analyzed (e.g. Ironside and Tetlow, 2005). The present paper is the first to conduct a fully real-time evaluation of the ECB money-based inflation indicator, which takes in consideration not only the evolution of the data but also of the models. In addition, it evaluates those forecasts against relevant internal and a theoretical real-time benchmarks.

In the next subsections, we provide details on the forecasting models, the procedures to prepare the forecasts and the statistics we use for the forecast evaluation. Finally we report the outcomes of the evaluation.

3.1. Models

We have seen that many models have been used to support the monetary analysis. However, only two money-based inflation indicator models have been used consistently throughout the period under consideration, namely bivariate models where an autoregressive equation for inflation has been augmented with, respectively, the growth rate of M3 and the growth rate of the M3 series corrected (inter alia) for the impact of portfolio shifts.

We will consider these equations in the exact specification used for the QMA. In addition, we will also consider 11 alternative bivariate forecasts with selected nominal and real variables: GDP, short and long-term nominal interest rates, the term spread, nominal wages, the unemployment rate, total employment, import prices, oil prices, the Euro-dollar exchange rate and unit labor costs. Bivariate equations including these variables constitute a useful benchmark for the money-based indicator models, since these variables are alternative indicators of real and nominal pressures on inflation and because of the availability of real-time data vintages for them.[16] To preserve comparability of results, the equation specification used for these other indicators is the same as that embodied in the money-based indicator models.

The variable we are interested in forecasting is the annualized h-period change in HICP. Defining HICP at time t as P_t, the h-period annualized change is given by:

$$\pi_{t+h} = 100 \times \left[\left(\frac{P_{t+h}}{P_t} \right)^{4/h} - 1 \right]$$

where, as noted above, h will be six quarters.

For each vintage of data v, the bivariate models are nested by the following equation

$$\pi_{v,t+h} = a_v + b_v(L)\tilde{\pi}_{v,t} + c_v(L)x_{v,t} + \varepsilon_{v,t+h} \tag{3}$$

[16] Precise definitions, sources and transformations are described in the Appendix A available in the version of the paper published in the proceedings of the fourth ECB central banking conference, "The role of money: Money and monetary policy in the twenty-first century" at http://www.ecb.int/pub/pubbydate/2008/html/index.en.html.

where $\tilde{\pi}_{v,t} = 100 \times [(P_t/P_{t-2})^{4/2} - 1]$[17] and $x_{v,t}$ denote the four-quarter moving average of the M3 or M3 corrected growth rate or one of the 11 alternative real and nominal variables and $b_v(L)$ and $c_v(L)$ are finite polynomial of order p in the lag operator L:

$$b_v(L) = 1 + b_{v1}L + \ldots + b_{vp}L^p$$

$$c_v(L) = 1 + c_{v1}L + \ldots + c_{vp}L^p.$$

We also present results from three benchmark models: a constant, set at 1.9% to reflect (albeit imperfectly) the ECB's definition of price stability as "annual HICP inflation of below, but close to, 2%"; a simple univariate autoregressive model (AR) defined as

$$\pi_{v,t+h} = f_v + g_v(L)\tilde{\pi}_{v,t} + \xi_{v,t+h} \tag{4}$$

and results from the random walk model computed in real time, defined as:

$$\pi_{v,t+h} = \pi_{v,t} + \varepsilon_{v,t+h}.$$

Clearly, if in our sample the random walk turned out to be the best predictor of inflation, this would imply that inflation realized six quarters ago was the best forecast of today's inflation. In the literature, such a situation is understood to imply that inflation is close to non-forecastable, since a naive forecast would perform better than supposedly more refined indicator models.

In addition to the bivariate models based on single variables and the three benchmarks, we also produce forecasts from combinations of individual indicators, where aggregation is achieved by simple averaging (equal weights). Formally,

$$\pi^{comb}_{v,t+h} = \frac{1}{N}\sum_{s=1}^{N} \pi^{\mathcal{M}\int}_{v,t+h}$$

where $\pi^{\mathcal{M}\int}_{v,t+h}$ denotes a generic individual forecast (produced by model $\mathcal{M}\int$) and N the number of forecasts being combined.

Finally, results are reported for the BMPE projections.[18] It should also be kept in mind that money-based inflation indicators are finalized about 36 working days after the end of the quarter, while the BMPE projections are finalized around seven working days later without, in practice, knowing or taking into account the outcome of the money-based exercise.

3.2. Procedures underlying the construction of inflation indicators

Our prediction sample for the $h = 6$ forecast horizon is 2002Q1–2006Q2 (18 observations), since money-based inflation indicators have only been included in the QMA as from 2000Q4, based on data through 2000Q3.

The indicators are constructed on the following lines, consistent with the approach underlying the preparation of the QMA.

3.2.1. Model specification

Lags for the dependent variables are chosen in each exercise by minimizing the Schwartz information criterion. The maximum allowed lag for inflation and the independent variables is 5. Owing to the choice of maximum lag and because dependent and independent variables enter the indicator

[17] A two-quarter moving average has been used for the money-based inflation indicator in order to reduce the volatility of the indicator.

[18] For the sake of simplicity and to allow the construction of the statistics underpinning the evaluation, we use throughout the paper the mid-points of the published BMPE ranges. These mid-points are calculated in an entirely mechanical manner and should not be understood as implying any view regarding the distribution of possible outcomes within this range.

models, respectively, in the form of six and four-quarter moving averages, 14 data points are lost at the beginning of the sample. Thereby, the first observation for the dependent variable in the regressions is 1983Q3 in each exercise.

3.2.2. Estimation of models and construction of indicators

The indicator models are estimated by simple OLS. For each exercise, we estimate in sample the relationship between annualized inflation over the next h quarters, inflation lags and those of the monetary or non-monetary variables. The estimated OLS coefficients are then applied to the last available observations in sample to construct an indicator of inflation six periods ahead. More formally, defining a_v^{ols}, $b_v(L)^{\text{ols}}$ and $c_v(L)^{\text{ols}}$ as the filters (with the implied coefficients) for the bivariate models estimated with data relative to vintage v and up to time t, the inflation indicator is defined as

$$\pi^{x}_{v,t+h} = a_v^{ols} + b_v(L)^{ols}\tilde{\pi}_{v,t} + c_v(L)^{ols}x_{v,t}.$$

The same procedure is adopted to produce the autoregressive indicator.

Errors e_t for the generic indicator model $\mathcal{M}$ are defined as

$$e_{t+h} = \pi^{\mathcal{M}}_{v,t+h} - \pi_{t+h}$$

where actual inflation π_{t+h} is defined as that observed at the time of the last available vintage (i.e. 2006Q2).

Finally, the random walk forecast, which we use as one of our naive benchmarks, is defined as

$$\pi^{RW}_{v,t+h} = \pi_{v,t}.$$

3.2.3. Update

After an indicator based on vintage v has been constructed, the database is updated to vintage $v+1$. The new indicator, based on the new data, takes into account not only one more data point, but also revisions in the history of the variables. The last vintage used for the current evaluation is 1980Q1–2004Q4, related to the exercise performed in 2005Q1.

3.3. Statistics of forecasting evaluation

The statistics used in the evaluation exercise are: the mean squared forecast error (MSFE $= 1/T\sum_{t=1}^{T} e_{t+h}^2$, where $T=18$ in our case); the bias (Bias $= 1/T\sum_{t=1}^{T} e_{t+h}$); the standard deviation of the forecast (SDF $= \sqrt{1/T\sum_{t=1}^{T}(\pi^{\mathcal{M}}_{v,t+h} - 1/T\sum_{t=1}^{T}\pi^{\mathcal{M}}_{v,t+h})^2}$); and the relative mean squared errors

$$Rel.MSFE = \frac{MSFE^{\mathcal{M}}}{MSFE^{uni}}$$

where $\text{MSFE}^{\mathcal{M}}$ and MSFE^{uni} are, respectively, the mean squared errors of forecast of the generic model $\mathcal{M}$ and of a univariate benchmark (autoregressive or random walk in this paper).

Finally, since the MSFE is affected by both the variance of the errors and the bias, that is

$$MSFE = \frac{1}{T}\sum_{t=1}^{T}\left[e_{t+h} - \frac{1}{T}\sum_{t=1}^{T} e_{t+h}\right]^2 + Bias^2$$

we will report results for both components.

3.4. Exercises and results

3.4.1. Exercise 1: BMPE projections and money-based indicator models

Table 1 illustrates the results for seven alternative models (indicated in column one): the AR model, the random walk, the BMPE projections, the two money-based indicator models and the simple

Table 1
Internal indicator models.

Model	MSFE	MSFE/RW	MSFE/AR	Bias	SD fore.	Var. f.e.	$Bias^2$
AR	0.18	1.76	1	0.16	0.48	0.15	0.03
RW	0.10	1	0.57	0.12	0.25	0.09	0.01
1.9%	0.09	0.92	0.52	−0.27	0	0.02	0.07
BMPE	0.24	2.40	1.37	−0.45	0.20	0.04	0.20
M3	0.19	1.86	1.06	0.28	0.23	0.11	0.08
M3c	0.11	1.04	0.59	0.01	0.27	0.11	0
BMPEM3	0.05	0.48	0.28	−0.08	0.10	0.04	0.01

average between the BMPE inflation projection and the money-based inflation indicator based on official (i.e. uncorrected) M3 (labeled BMPEM3).

Column two indicates the mean square forecast error (MSFE) and columns three and four the ratio between the MSFE of the model relative to, respectively, the random walk (RW) and the univariate AR. The following columns report bias, standard deviation of the forecast error, variance of the forecast error and bias squared.

Results can be summarized as follows.

1. Both the official M3-based inflation indicator and the BMPE inflation projections are outperformed by the random walk and naive models. Moreover, both the official M3-based and BMPE models are biased.
2. The M3 corrected-based indicator model corrects the bias, but induces excess volatility, as revealed by the relative high variance of the forecast and the forecast error relative to those of the BMPE. As a result of this volatility, the M3 corrected-based indicator is also outperformed by the random walk.
3. The random walk outperforms all models except: the constant (1.9% inflation rate); and, most strikingly, the simple average of official M3-based indicator and BMPE inflation projection. This combination model achieves an improvement of over 50% with respect to the random walk.

That simple statistical benchmarks such as the random walk outperform the indicator models over this sample period is not a surprising result. Similar findings have been produced for the US (see, for example, Atkeson and Ohanian, 2001; Giannone et al., 2004). It should also be noted that inflation forecasts for the euro area produced by other institutions, such as the IMF and the OECD, are very correlated with the BMPE projections and would therefore show similar performance.[19] What is more interesting for the purposes of this paper is the large and systematic biases – with opposite sign – demonstrated by the official M3-based indicator model and the BMPE projections.

Fig. 4 reports the forecast errors of the official M3 and M3 corrected-based indicator models. The indicator based on M3 has systematically over-predicted inflation over the relevant sample period. This bias is eliminated by the M3 corrected-based indicator which, although very volatile, is centered around actual inflation. The latter result suggests that the judgmental analysis of risks to price stability stemming from monetary developments succeeded in capturing developments in average inflation over the period reviewed here, although without reducing the excessive quarter-to-quarter volatility in the assessment.

Moreover, Table 1 shows that the mean squared forecast error of the BMPE inflation projections is, to a very significant extent, owes largely to the (negative) bias exhibited by these projections. Coupled with the low volatility of the BMPE forecast errors, this implies that the BMPE projections have systematically under-predicted six-quarter ahead annualized inflation.[20]

[19] In the regular presentation of the BMPE in the Monthly Bulletin, the ECB also publishes forecasts from other public and private institutions for comparative purposes.

[20] For additional evidence on this point, see Pill and Rautanen (2006).

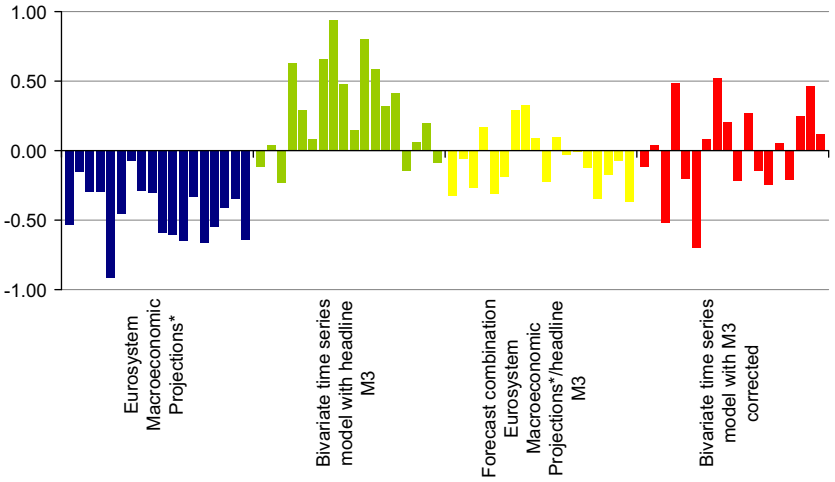


Fig. 4. Forecast errors of published ECB/Eurosystem forecasts. Note: for simplicity, the mid-points of the projections are taken for this exercise. The forecast errors include those of the Macroeconomic Projection exercises run by ECB staff in the intermediate periods.

The excessive volatility demonstrated by the M3 corrected-based inflation indicator is corrected by the BMPE–M3 combination. The latter indicator is not only smooth, but also unbiased. The bias correction is mechanically explained by the averaging of an indicator that is biased upwards and an indicator that is biased downwards. The reduction in the high volatility exhibited by the official M3-based indicator is achieved by the smoothing effect of averaging the two models.

Visual inspection of Fig. 4 and results in Table 1 suggest that, although the BMPE projections are strongly biased downward, they are better to track inflation dynamics. A formal way to assess whether M3 provides an improvement beyond what achieved by the BMPE for what concerns dynamics (i.e. after having netted out the bias), is to test whether the money-based inflation indicators are encompassed by the BMPE projection.

More precisely, the question we address is whether it is possible to find a convex linear combination of the BMPE inflation projections ($\pi^{B}_{v,t+h}$) and money-based inflation indicators ($\pi^{M}_{v,t+h}$) that *significantly* outperforms the BMPE projections. A simple regression procedure to address this question has been suggested by Harvey et al. (1998) and references in West (2006).

Assume that the relationship between realized inflation and the combination of inflation indicators is:

$$\pi_{t+h} = k + (1-\lambda)\pi^{B}_{v,t+h} + \lambda\pi^{M}_{v,t+h} + \eta_{t+h} \tag{5}$$

where we allow for a bias term k owing to the fact that the BMPE projections and the official M3-based inflation indicators are biased. The OLS estimate for λ in this equation minimizes the sum of the squared errors η_{t+h}, hence it provides the estimate of the optimal weights in the indicator combination. Moreover, if λ is significantly different from zero, the money-based indicator $\pi^{M}_{v,t+h}$ adds information to (i.e. it is not encompassed by) the BMPE projection $\pi^{B}_{v,t+h}$.

By subtracting $\pi^{B}_{v,t+h}$ from both sides of equation (5), we obtain:

$$u^{B}_{t+h} = k + \lambda\left(\pi^{M}_{v,t+h} - \pi^{B}_{v,t+h}\right) + \eta_{t+h} \tag{6}$$

where $u^{B}_{t+h} = (\pi_{t+h} - \pi^{B}_{v,t+h})$.

Table 2 shows results for both the official M3-based and the M3 corrected-based inflation indicators. Since long horizon forecast errors can be autocorrelated, the standard errors reported in parenthesis in Table 2 are corrected by the Newey–West procedure.

Table 2
Encompassing tests: results.

Parameter	k	λ
M3	0.27*** (0.06)	0.24** (0.09)
M3 corrected	0.35*** (0.04)	0.22** (0.08)

Newey–West corrected standard error in parenthesis. Three stars indicate the coefficients are significant at 1% level, two stars at 5% level, one at 10% level.

The results shown in Table 2 demonstrate that, at the 5% level of significance, we cannot reject the hypothesis that the money-based inflation indicators are not encompassed by the BMPE projections. This suggests that there is information in monetary developments beyond that embodied in the BMPE projections, which helps to forecast inflation at monetary policy-relevant horizons.

Notice also the value of λ which suggests that, after controlling for the constant (and therefore for the bias), the optimal combination between the official M3-based inflation indicator and the BMPE inflation projections should attribute a weight of around one quarter to the money-based model. How should we interpret this result? Notably, can we conclude that the optimal weight assigned to official M3-based indicators of inflation is invariably about one quarter?

The variance of the forecast errors reflects how well a forecast tracks the dynamics of the target variable while the bias how well a forecast captures the level of the target variable on average. Ideally, one wants low bias and variance of forecast errors. In practice, these goals may be conflicting.

In the encompassing test reported in Table 2, we control out the bias by specifying a constant in the regression. Hence, we can interpret the optimal combination suggested by the encompassing test as the optimal forecast combination for a policymaker that is not concerned about the bias.

More in general, how much weight one should assign to each of the two forecasts depends on the loss function of the forecaster and, in particular, on the relative weight given to the bias and the variance of inflation forecast errors in the policymaker's loss function. In order to illustrate this point, we can search for the forecast combination

$$\pi_{t+h}^{comb}(\gamma) = (1-\gamma)\pi_{v,t+h}^{B} + \gamma\pi_{v,t+h}^{M}$$

that minimizes the policymaker's loss function

$$\gamma^* = \text{argmin}L(\alpha,\gamma) = \alpha\frac{1}{T}\sum_{t=1}^{T}\left[e_{t+h}(\gamma) - \frac{1}{T}\sum_{t=1}^{T}e_{t+h}(\gamma)\right]^2 + (1-\alpha)Bias(\gamma)^2$$

where $e_{t+h}(\beta) = \pi_{t+h} - \pi_{t+h}^{\text{comb}}(\gamma)$ is the forecast error for $\pi_{t+h}^{\text{comb}}(\gamma)$ which depends on the weights β. The loss function is conditional on the value of α which captures the intensity of the policymaker's concern for the variance of the forecast error (i.e. how well the forecast combination tracks the dynamics of inflation). If we choose $\alpha = 0$, the solution of the minimization problem will deliver the optimal combination that minimizes bias, $\alpha = 0.5$ the optimal combination that minimizes the mean squared forecast error (i.e. the sum of variance and bias squared) while $\alpha = 1$ the optimal combination minimizing the variance of forecast errors.

Fig. 5 shows the policymaker's loss as a function of γ, the weight to the M3-based forecast in the forecast combination conditional to three different values of α (i.e. $\alpha = 0$, 0.5 and 1).

Fig. 5 shows that, when the policymaker is only concerned about tracking inflation dynamics ($\alpha = 1$), the optimal combination would assign a weight of about 1/4 to money-based inflation indicators. In fact, the BMPE projections track inflation dynamics better than M3-based inflation indicators. This result is, as mentioned above, the one we obtain in the encompassing test.

Instead, if the policymaker is only concerned about bias ($\alpha = 0$) then the optimal weight of the M3-based inflation indicator is about 2/3. Back of the envelope calculations from the results in Table 1 show that this combination would set the bias to zero. The high weight given to the M3-based forecast in the combination minimizing bias is explained by the fact that the official M3-based inflation indicator is better at capturing inflation on average over the period than the BMPE projections.

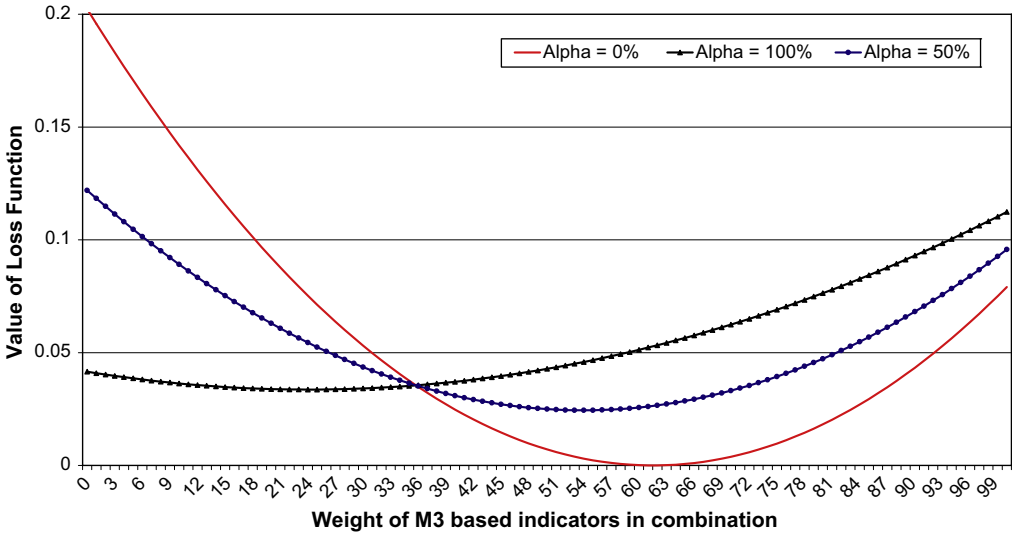


Fig. 5. Policymaker's loss functions.

Finally, when the loss function is the mean squared forecast error ($\alpha = 0.5$) – an approach which gives equal weight to the variance and the bias – the optimal combination would assign approximately equal weight to the official M3-based inflation indicator and the BMPE inflation projection. Hence, the equally weighted combination of the M3-based inflation indicator and the BMPE which was shown to provide the best performance in terms of mean squared errors in Table 1 is also approximately the best performing combination of money-based inflation indicators and BMPE forecasts.

3.4.2. Exercise 2: can we achieve the same reduction of the MSFE by combining the BMPE inflation projections with indicators other than money?

In this Section, we consider eleven bivariate indicator models (based on the other variables where real-time information is available), their combination, the combination of all nominal variables and the combination of real variables. (All combinations are computed as simple averages. The analysis based on principal components gives very similar results.)

The questions we address are: (i) can we identify one or a set of variables that scores better than the single indicators considered so far? (ii) can we assign a special role to M3 or there are other indicators that generate bias correction if combined with the BMPE projections?; (iii) does an average of nominal variables generate the same bias correction achieved by M3?

Here we simply summarize the main findings of our analysis.[21] We find that all bivariate models are outperformed by the random walk with the possible exception of nominal wage growth and no model produces the reduction of MSFE that we have seen for the M3-BMPE combination. Most models have a positive bias.

For what concerns the ability of tracking the dynamics of inflation, we find that inflation indicators based on wage growth and the exchange rate are not encompassed by the BMPE inflation projections at a 1% confidence level, while the growth rate of unit labor costs and import prices are not encompassed at the 5% confidence level. Note that, since all the variables considered in this exercise, unlike M3, do enter as input of the BMPE, these results might suggest that either the restrictions implied by the BMPE distort their signal or the assumptions embedded in the BMPE projections with regard to the future

[21] For the detailed set of results, please see the version of the paper published in the proceedings of the fourth ECB central banking conference, "The role of money: Money and monetary policy in the twenty-first century" available at http://www.ecb.int/pub/pubbydate/2008/html/index.en.html.

path of variables treated as exogenous (such as oil prices or short-term interest rates) hinder the accuracy of the projections.

Since there are indicator variables other than money that are biased upward and not encompassed by the BMPE, it appears that variables other than M3 could be used in combination with the BMPE inflation projections to provide accurate forecasts of inflation.

Indeed, we also find that models which combine nominal variables with the BMPE projections outperform the bivariate inflation indicator models both in terms of better tracking dynamics and bias correction. Nonetheless, all the combined indicators remain downwardly biased, like the BMPE. This suggests that the strong performance of the official M3-BMPE combination on this criterion largely owes to the large bias of opposite sign demonstrated by the official M3-based indicator model and BMPE inflation projection.

3.5. What can we conclude from the quantitative evaluation?

Overall, the results of the quantitative exercise can be summarized as follows.

- The combination of the official M3-based inflation indicator and the BMPE inflation projection produces a striking reduction of the MSFE for inflation relative to the random walk. This result has to be better understood. In particular, it should be evaluated whether the opposite sign of the systematic bias can be explained formally and exploited in future refinements of the monetary analysis.
- M3 is not encompassed by the BMPE, suggesting that money-based indicator models may have a role in helping to track the dynamics of inflation. Although encompassing tests show that other nominal variables replicate the improvement obtained by exploiting the information in money when explaining inflation dynamics, only combinations with official M3 can eliminate the downward bias in the BMPE inflation projection.[22]
- The M3 corrected-based inflation indicator model is dominated in terms of MSFE for inflation by the combination of the official M3-based indicator and the BMPE. Nonetheless, the M3 corrected-based indicator is unbiased. This suggests that the real-time analysis of monetary developments succeeded in obtaining a good estimate of average inflation, although this comes at the cost of an excessively volatile assessment of the quarter-to-quarter inflation outlook.

To sum up, the forecast evaluation suggests that monetary developments do contain information about the outlook for inflation (at least when focusing on the specific annualized HICP inflation over the next six quarters measure). Given the constraints surrounding and specificities of the exercise, drawing firm conclusions at this stage on the basis of such a short sample would be unwise. Certainly, the performance of the money-based inflation indicators needs to be monitored closely in the future and this Section can be seen as describing a framework within which to conduct such monitoring in a structured way, which over time will lead to more meaningful test of the validity of this aspect of the ECB's monetary analysis. In the meantime, we can conclude that, on the evidence provided by this evaluation exercise, one would not reject the hypothesis that there is information in monetary aggregates about the inflation outlook that is potentially relevant for monetary policy decisions.

4. Money and monetary policy: narrative evidence

4.1. Monetary analysis and monetary policy decisions

Sections 2 and 3 addressed the question of whether there is information in monetary developments that is relevant for monetary policy makers. Against this background, it is natural to assess how the

[22] Although we recognize that the combination of the BMPE projections and the bivariate forecast based on the nominal long-term interest rate achieves a result relatively close to that of the BMPE–M3 combination in terms of bias correction.

ECB's monetary analysis has, in practice, influenced monetary policy decisions since the introduction of the single monetary policy in 1999.

One way to confront this question is to adopt the narrative approach to identifying monetary policy actions, pioneered by Friedman and Schwartz (1969) and used more recently in a series of papers on the Federal Reserve by Romer and Romer (1989, 1994). Approached in this way, what relationship emerges between the monetary analysis and the ECB's interest rate decisions?

To address this key question, the remainder of this Section provides a relatively detailed narrative summary of developments in the monetary analysis over the period 1999–2006 and their relationship with the four distinct phases of the monetary analysis identified in Section 2. In support of the narrative, Fig. 6 shows the evolution of key macroeconomic time series since 1999.[23]

Given the objective of this paper, the discussion focuses rather narrowly on the impact of the monetary analysis on monetary policy decisions, thereby inevitably neglecting the important role of the economic analysis. Hence this discussion is not intended to offer a comprehensive description of how interest rate decisions have been made, but rather to identify more clearly what the input from the monetary analysis has been to that decision making process. Since there has been a high degree of correlation between the signal emanating from the monetary analysis and the economic analysis, from an analytical perspective identifying the distinct role of the former in interest rate decisions remains problematic.

One way to shed light on the key issue of how important a role monetary analysis has played in policy decisions is to compare how the staff analysis – as summarized by the various indicators evaluated above – has translated into the policy makers' assessment. To this end, an indicator has been constructed to capture the Governing Council's assessment of the intensity of the risks to price stability deriving from the monetary analysis, at least insofar as this is reflected in the language used in the President's Introductory Statement following the ECB's monetary policy meetings.[24] (A positive value of the index indicates an upside risk to price stability.) Of course, just as with the other synthetic quantitative indicators introduced in Section 2 and the money-based inflation indicator models evaluated in Section 3, such measures should be seen as a simple and imperfect summary of the information on monetary analysis in the Introductory Statement, not as a comprehensive assessment of the views expressed therein.

Fig. 7 shows the evolution of the qualitative indicator of the QMA's assessment of risks to price stability (which is one summary measure of the "input" to the policy discussion) against that of the qualitative indicator of how the monetary analysis was treated in the President's Introductory Statement (one measure of the "output" from the policy discussion).

Overall, the input and output series follow a very similar pattern. Although only tentative conclusions can be drawn, this would be consistent with the Governing Council assigning some significance to the monetary analysis in taking interest rate decisions for the bulk of the period since 1999. However, the generally high correlation between monetary analysis input and output to the Governing Council's discussion has not been uniform through the entire sample period. The exceptional episodes are treated in more detail in the narrative analysis below, since these offer the greatest scope to identify a distinct role for the monetary analysis in decision making.

4.1.1. Phase 1: early-1999–mid-2000

At the outset of Monetary Union, annual M3 growth rose from close to the $4^1/_2$ % reference value that had been announced in December 1998 to well above 5% (see Fig. 6). This strengthening of headline monetary dynamics took place in an environment where consumer price inflation was very low by historical standards and the economic outlook was uncertain (in the aftermath of the Asian and Russian economic crises of 1997–1998). At that time, the observed strengthening of monetary growth

[23] Note that the figures show the latest vintage of the data, which needs to be kept in mind when assessing some of the narrative discussion.

[24] Other authors, like Gerlach (2004), have also attempted to construct such indicators of the intensity of the risks to price stability stemming from the monetary analysis on the basis of the Introductory Statement. The indicator used in this paper (and shown in Fig. 7) is strongly correlated with similar indices reported elsewhere in the literature.

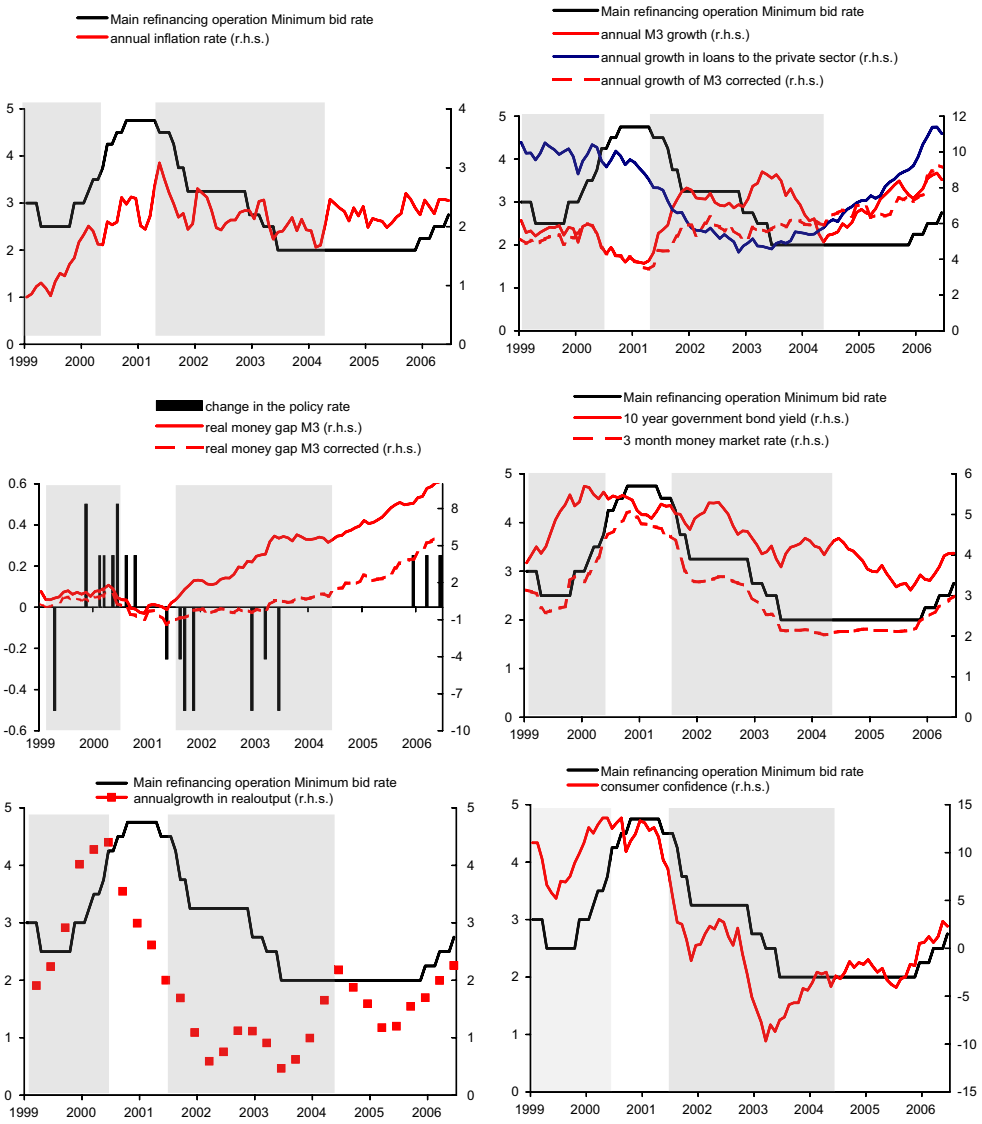


Fig. 6. Policy rate and main monetary and economic indicators.

was associated in part with a variety of technical factors (discussed in Section 2), notably the impact of the introduction of the remuneration of required reserves at essentially market rates. More generally, given the inevitable uncertainty introduced by the regime shift to Monetary Union, at that time all data were treated with some circumspection. In this context, higher monetary growth on the headline M3 definition was not necessarily seen as reflective of the underlying rate of monetary expansion and, as such, was not deemed an impediment to the decision to cut interest rates by 50 bp in April 1999. In the course of 1999, the reliability of the monetary data became better established. Moreover, the M3 data pointed to continued strength of monetary dynamics, which could no longer be accounted for on the basis of special factors associated with the start of Monetary Union. The view that monetary growth had strengthened was consistent with the signals identified from the economic analysis, with the

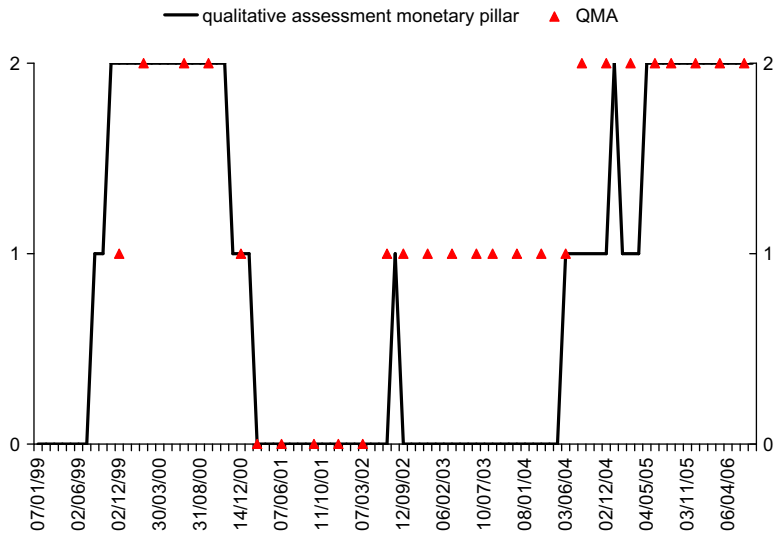


Fig. 7. QMA and Introductory Statement's assessment of risks to price stability stemming from monetary analysis.

outlook for economic activity in the euro area improving and inflation and inflationary pressures rising. Against this background, interest rates were raised by a total of 225 bp in a series of steps through mid-2000, starting with a 50 bp rise in November 1999.

With the benefit of hindsight, the narrative assessment of the monetary analysis during this period points to a number of issues. First, in general developments in the data were treated with some caution, as it was recognized that the start of Monetary Union and the introduction of new statistical systems had raised the uncertainty surrounding the published statistics. Second, broadly speaking, the signal extracted from monetary developments during this period was that of building inflationary pressures pointing overall towards a need to raise interest rates. This signal strengthened over the course of 1999 and into early 2000, both on account of stronger M3 growth and as the special uncertainties associated with the new policy regime and novel data series dissipated somewhat. Third, in retrospect, policy relevance was attached to developments in monetary growth which – by the standards of subsequent years – now look rather modest. Fourth, with the exception of the first few months of 1999, the signal stemming from the monetary analysis was broadly consistent with that derived from the economic analysis.

Overall, one can conclude that from mid-1999 through mid-2000 the monetary analysis pointed to inflationary pressures and a need to raise interest rates, which was reflected in monetary policy decisions. However, since a broadly similar signal was extracted from the economic analysis over this period, it remains difficult to identify the relative weights of the monetary and economic analysis on the decision making process.

4.1.2. Phase 2: mid-2000–mid-2001

By mid-2000 – and, in part, reflecting the increases in short-term interest rates – headline M3 growth showed some moderation, especially with regard to its shorter-term dynamics which, at annualized rate, fell below the reference value of $4^1/_2$ %. Translated into an outlook for price developments, the moderation in the rate of monetary expansion was seen as pointing to some easing of inflationary pressures at medium-term horizons. Although the changes in monetary dynamics on which this assessment was based look modest by the standards of subsequent developments, at the time they were interpreted as suggesting that the monetary policy actions from November 1999 had served to contain inflationary risks. The analysis thus pointed to a change in the broad outlook for monetary policy, implying first a stabilization of and then scope to lower the level of short-term interest rates. Again, with the benefit of hindsight, this narrative assessment suggests that the broad

signal from the monetary analysis is consistent with the actual path of interest rat decisions during this period, with the key rate in the Eurosystem's main refinancing operations peaking at 4.75% in October 2000. However, since the economic analysis provided a similar general message – notably with concerns of a slowdown in economic activity stemming from the sharp correction in global equity markets and weaker growth in the United States – the importance of the monetary information in driving policy decisions is difficult to identify separately ex post. Overall, in the first two years of Monetary Union, an ex post narrative assessment of the signal derived from the monetary analysis suggests that this was consistent with the broad thrust of interest rate decisions. However, from early 2001 onwards the situation is more complicated.

In early 2001, the economic analysis pointed to some deterioration in the outlook for economic activity. However, monetary growth on the headline M3 measure – at least on the basis of the data published at that time – strengthened relative to what had been previously expected. Prima facie, the two forms of analysis therefore appeared to give somewhat contradictory signals, with the economic analysis pointing to some moderation of inflationary pressures in the medium term,[25] whereas monetary developments suggested an intensification. In May 2001, interest rates were cut despite continued strong M3 growth (and publication of an annual growth rate of M3 for March 2001 at the end of April – just before the Governing Council meeting at which the decision was taken – that exceeded market expectations by 0.5 pp).[26]

Based on the reaction of market interest rates at the time of the policy announcement, the decision to cut key ECB interest rates in May 2001 came as a surprise to market participants. They appear to have concluded that the apparent strengthening of monetary dynamics relative to what had been originally anticipated strongly reduced the likelihood of an interest rate cut in May. However, the internal assessment of the underlying trend rate of monetary growth was quite different from that suggested by a naive mechanical inspection of the published headline M3 growth figures. Not only had the underlying rate of monetary expansion moderated since early 2000 (as was also apparent in the published figures), but the annual growth rate of M3 corrected for the internal estimate of non-resident holdings of marketable instruments issued by MFIs had fallen substantially below the ECB's reference value of $4^1/_2$ %. Thus, viewed in an encompassing manner and contrary to the naive signal offered by the published M3 data, the monetary analysis pointed to reasons to cut interest rates, in line with the signals stemming from the economic analysis.

To emphasize: the comprehensive internal monetary analysis undertaken at the ECB in early 2001 not only did not act as an impediment to the interest rate cuts observed from May 2001, but rather signaled the need for them, thereby supporting the conclusions of the economic analysis. Although the ECB publicly referred to the need for the crucial data correction in a qualitative way, external observers did not appreciate the significance of such guidance for the interpretation of monetary developments and appear to have concluded, at least in part, that the monetary analysis was being ignored in favor of the economic analysis.

4.1.3. Phase 3: mid-2001–mid-2004

From mid-2001, monetary developments were also influenced by the impact of portfolio shifts into safe and liquid monetary assets, in the environment of heightened economic and financial uncertainty that followed the global stock market correction and the terrorist attacks of 11 September 2001. Annual M3 growth started to rise more strongly from mid-2001 on account of these portfolio shifts. In the face of these developments, the internal analysis of monetary developments recognized three key issues.

First, the magnitude and causes of these portfolio shifts appeared to be unprecedented and, as such, analysis and interpretation of the monetary data was surrounded by more than usual uncertainty. In consequence, the signal stemming from the monetary analysis was more blurred – and thus weaker – than had been the case in preceding years.

[25] However, the economic analysis pointed to some short-term upside risks due to one-off shocks.

[26] Note that subsequent revisions to the M3 data deriving from a correction of the statistical issues discussed in Section 2 have reduced the strength of M3 growth during this period in the latest vintages of the data and are thus not visible in Fig. 6.

Second, the baseline or modal view developed by the monetary analysis treated the portfolio shifts as a temporary development, which would be reversed once financial market conditions normalized. As such, the strengthening of monetary growth associated with the portfolio shifts was not deemed to reflect a pick-up in the underlying rate of monetary expansion, which would signal inflationary pressures at medium to longer horizons. Rather it was seen as confirming the evidence from the economic analysis – apparent in the sharp decline in business and consumer sentiment surveys and measures of economic activity – that the private sector was retrenching in the face of the high degree of uncertainty.

Finally, although the baseline conclusions derived from the monetary analysis pointed to a rather benign interpretation of stronger M3 growth, the risks surrounding this baseline were viewed as heavily skewed towards upside risks to price stability. In particular, the accumulation of liquidity resulting from strong money growth was deemed to constitute a risk of inflationary pressures should it lead to stronger spending in a context where consumer and business sentiment were to recover as heightened uncertainties receded.

The signal drawn from the monetary analysis in the periods of strong portfolio shifts into money (late 2001 and late 2002 through early 2003) were therefore rather nuanced. On the one hand, strong M3 growth on the official headline measure was not seen as an impediment to the interest rate cuts that were prompted by the economic analysis. These cuts led to a progressive lowering of the minimum bid rate in the Eurosystem's main refinancing operations, which reached the historically low level of 2% in June 2003. On the other hand, growth in the internal M3 series corrected for the estimated impact of portfolio shifts (which was subsequently published in the Monthly Bulletin) remained quite sustained and, of itself, did not point to a need for interest rate cuts over this period. Both conclusions were viewed as rather tentative and thus did not provide a strong signal for monetary policy.

Overall, the monetary analysis appears to have played a more subdued role in guiding the broad outlook for short-term interest rate decisions in this period, although the upside risks to the modal rather benign view of strong M3 growth developed in the internal analysis may have acted as a break on more aggressive interest rate cuts in 2002–2003, when many commentators were calling for a substantial further easing of monetary policy at a time when deflationary risks were identified by some. Moreover, the portfolio shifts into money themselves demonstrated the confidence of the euro area private sector in the soundness of the European banking sector, which may have served to allay fears of debt deflation and financial crisis that some observers argued implied a need for more aggressive easing.

At this point, it is worth commenting further on Fig. 7 and the relationship between the input provided by the QMA to the Governing Council's discussions and the output of those discussions as reflected in the Introductory Statement. Indeed, the main exception to the generally strong correlation between the input and output measures of the monetary analysis is the period from mid-2002 through mid-2004. During this period, the staff assessment – while embodying a baseline view that strong monetary growth and the consequent accumulation of liquidity stemming from portfolio shifts was rather benign in terms of the outlook for price developments over the medium term – emphasized that the risks to this baseline view were heavily skewed to the upside. In other words, while the most likely outcome was that inflationary pressures coming from monetary dynamics were modest, it was hard to construct a scenario on the basis of the monetary data where deflationary risks would emerge, whereas there were scenarios where inflation could rise significantly. By contrast, output of the Governing Council's discussion as reflected in its communication via the Introductory Statement tended to downplay the role of the monetary analysis in general and, in particular, did not place such emphasis on the upside risks to the baseline interpretation of monetary dynamics.

This discussion sheds important light on the oft-repeated question of how much "weight" is assigned to the monetary analysis in the Governing Council's interest rate setting process. Two important points can be made. First, the weight assigned to the monetary analysis has varied over time, as the clarity and reliability of the policy-relevant signal coming from monetary developments (relative to those offered by the economic analysis) has fluctuated. It is clear that the Governing Council chose to discount some of the signals coming from monetary indicators at a time when portfolio shifts harder to interpret than usual. Second, the decision to form a somewhat different assessment from the input from the staff when communicating the monetary analysis suggests that the Governing Council

undertook an active discussion of how the analysis and monetary developments themselves should be interpreted.

As financial and economic uncertainty began to recede from mid-2003, portfolio allocation started to normalize. As had been anticipated in the baseline scenario of the monetary analysis, annual M3 growth moderated substantially between mid-2003 and mid-2004 as past portfolio shifts into monetary assets unwound. However, consistent with a symmetric interpretation of the impact of portfolio shifts on the policy-relevant signal in monetary developments, this fall in headline M3 growth was not interpreted as a signal that further interest rate cuts were warranted. Rather it was seen as providing evidence from the monetary side corroborating the view that the levels of uncertainty and risk aversion – which had proved to be a brake for consumption and investment spending during the economic slowdown – were returning to historical norms. Indeed, the internal M3 series corrected for the estimated impact of portfolio shifts continued to grow at a sustained (and slightly increasing) rate through this period, supporting the view that the underlying rate of monetary expansion was not being reflected in the substantially lower rate of headline M3 growth.

4.1.4. Phase 4: mid-2004 onwards

Through the course of 2004, the analysis of a broad set of indicators provided evidence of a further unwinding of portfolio shifts, albeit at a slower pace than would have been anticipated on the basis of historical experience regarding the elimination of accumulated liquidity holdings. Yet headline annual M3 growth increased from mid-2004 and remained on a sustained upward trend through 2006 (the end of the period considered in this paper).

The drivers of monetary dynamics during this period were judged to be quite different from those underlying strong monetary growth between 2001 and 2003 (ECB, 2006b). On the counterparts side, M3 growth was driven by strengthening credit expansion, in part driven by the growing employment of securitization techniques as a mechanism to ease credit supply constraints. On the components side, monetary growth has derived largely from the dynamism of the more liquid components of M3. Such characteristics led to the conclusion that the strengthening of monetary growth since mid-2004 reflected the then prevailing low level of interest rates in the euro area and, latterly, the recovery of economic activity and associated improvements in consumer and business sentiment. Moreover, the strengthening of headline M3 growth was seen as broadly representative of the underlying rate of monetary expansion and thus indicative of growing upside risks to price stability over time.

Given the uncertainties experienced in the preceding years and the low frequency nature of the information in money, the strengthening of monetary dynamics from mid-2004 did not have an immediate impact on interest rate decisions, but rather cumulated over time. Through the course of 2005, the interpretation of the strengthening of monetary growth and the accumulation of liquidity was viewed as progressively more reliable and thus offered an intensifying signal of the need for interest rate increases to address upside risks to price stability over medium to longer-term horizons. Interest rates were raised by 25 bp in December 2005 and a progressive withdrawal of monetary accommodation followed.

In December 2005, many observers viewed the decision to start raising interest rates as potentially premature, given that, in their view, the economic recovery in the euro area remained fragile and measures of so-called core inflation (such as HICP inflation excluding energy and unprocessed food prices) were low. In short, a degree of uncertainty surrounded the economic analysis, even if, on balance, it pointed to some modest upside risks to price stability over the medium term. In this context, the relatively strong and intensifying signal of longer-term inflation risks offered by the monetary analysis in the course of 2005 appears to have played an important role in the decision to raise interest rates in December of that year (Trichet, 2006).

4.2. The presentation of monetary analysis and its role in interest rate decisions

Another issue concerns the relative importance of the monetary analysis (as compared with the economic analysis) in explaining interest rate decisions. Using the same qualitative indicator of the language used in the Introductory Statement that underlies Fig. 7, Fig. 8 shows a comparison with an equivalent indicator (constructed using the same methodological approach) for the economic analysis.

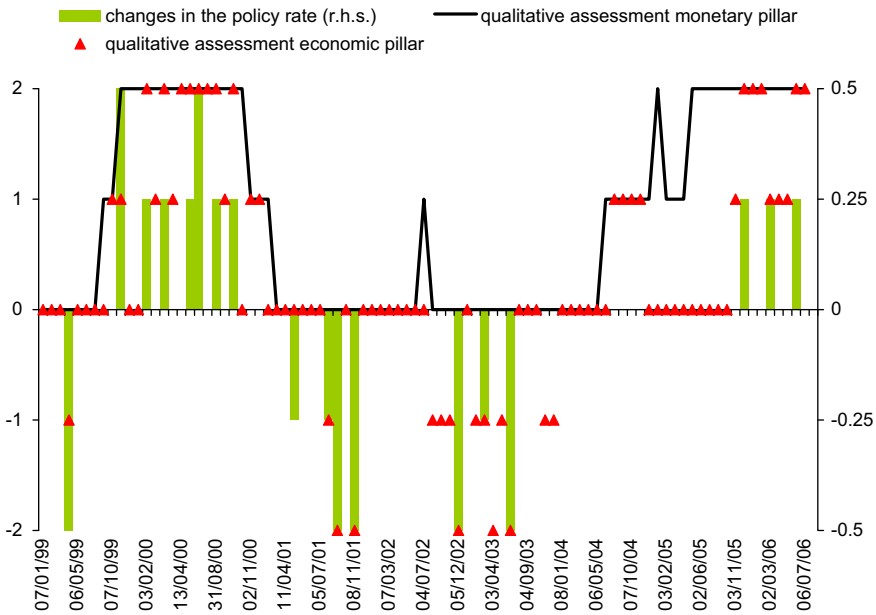


Fig. 8. Qualitative assessment of risks to price stability from monetary and economic pillar in Introductory statement.

For reference, the time series of changes in key ECB interest rates made since the introduction of the euro in January 1999 is also shown.

A number of observations can be made on the basis of Fig. 8.

First, as is reflected in the narrative discussion, there is a high degree of collinearity between the communication regarding the monetary and economic analyses, which presumably reflects the typically common thrust of the analyses themselves. This makes identifying the independent effect of monetary analysis – at least insofar as it is captured in the official communication – difficult to assess.

Second, there are two broad exceptions to this generally collinear picture. Between mid-2001 and mid-2003, the monetary analysis as described in the Introductory Statement pointed to relatively balanced risks to price stability, whereas the economic analysis saw risks on the downside. Overall, the successive cuts of interest rates of this period suggest that the economic analysis played the decisive role in explaining monetary policy decisions. The substantive reasons behind this approach, notably the high degree of uncertainty attached to the interpretation of monetary developments at that time, have been outlined in preceding sections.

The second exception concerns 2005, where for most of the year the monetary analysis pointed to upside risks, whereas the economic analysis suggested a more balanced outlook. Although with some lag, the progressive increase of official interest rates from December 2005 were – in real time – motivated to an important degree by the monetary analysis. Again the reasons for such communication – notably the uncertainties surrounding the interpretation of the economic analysis at a time when "soft" and "hard" data were giving somewhat contradictory signals – have been described in previous sections.

5. Conclusions

The paper has analyzed three issues. First, in the interests of transparency and to promote a better understanding of the ECB's approach over the first eight years of Monetary Union, the paper has provided a rich description of the ECB's monetary analysis, the tools on which it is based and the evolution of these tools over time. Second, the paper attempted to offer some evaluation of the

monetary analysis over this period. Finally, we assessed qualitatively the role played by monetary analysis in policy decisions.

As regards the first question, a number of points should be underlined. First, describing the ECB's framework for monetary analysis is complicated by the changing nature of that framework over time. The tools and methods used evolved significantly over the period 1999–2006, as practical solutions have been sought to the various challenges faced by monetary analysis in real time. Second, one important aspect of this evolution has been the rising importance of judgmental adjustments to the monetary series at the expense of a focus on conventional specifications of money demand. This shift of emphasis reflects both, on the one hand, the recognition that a structural or behavioral explanation of monetary developments is required in order to assess their possible implications for the outlook for price stability and, on the other hand, the failure of conventional money demand equations to offer convincing structural explanations of the monetary dynamics observed in the euro area, especially during the portfolio shifts phase. Third, in parallel with the rise of such adjustments, money-based inflation indicators have come to play a more prominent role in the presentation of the monetary analysis. In sum, the ECB's monetary analysis is much richer and broader than is sometimes recognized, drawing on a much broader set of monetary, financial and economic data to understand what implications monetary developments have for the outlook for price stability.

In this context, it is also important to emphasize two aspects of the ECB's monetary analysis that are not always well understood outside. First, money demand is no longer seen as the center-piece of the framework for monetary analysis. Conducting a rich monetary analysis is thus not contingent on the stability or otherwise of any single specification of money demand for a particular monetary aggregate. Second, the focus of the analysis is at the medium to longer-term horizon. The use of monetary aggregates to help forecast inflation or growth dynamics in the coming few months is not a core element of the ECB's monetary analysis.

Turning to the second question, it should be recognized from the start that the medium-term orientation of the monetary analysis complicates the assessment. By treating the real-time dimension of the evaluation seriously, the sample periods available for the evaluation conducted in this paper are short, the degrees of freedom for econometric work are thus not numerous and consequently the scope to draw strong, policy-relevant conclusions is limited. This having been said, what conclusions can be drawn?

First, the evaluation exercise suggests that there is information in monetary developments about future inflation dynamics beyond that which is contained in conventional macroeconomic forecasts or projections. Moreover, the fact the bias observed in the inflation indicators deriving from the economic analysis (notably the BMPE projections) can be largely eliminated by combining with money-based inflation indicators suggests (in line with Issing, 2006) that taking two complementary, but distinct, perspectives on the inflation outlook has made the ECB's analysis more robust and avoided the potentially the big mistakes that could have been made if an exclusive focus on either the monetary analysis or the economic analysis had been taken.

Second, the evaluation suggests that the ECB staff have been able to use judgement to identify and quantify in real-time various factors affecting monetary developments that were not captured in conventional money demand equations. Related to this, the evaluation exercise demonstrates that monetary aggregates corrected on the basis of the expert judgement have been used to produce inflation indicators that have proved to be unbiased, if excessively volatile. Of course, whether the use of judgement in this manner will continue to be successful in the future is an open question, and we certainly recognize that past success is not necessarily a guide to future performance. With this in mind, it will remain crucial to continuously evaluate and systemize the monetary analysis and, in particular, its judgmental element.

Finally, to evaluate the role of monetary analysis in interest rate decisions, we distinguish between phases in which the signal from monetary analysis was in line with that from economic analysis from those in which it was not. Clearly the latter periods are the most informative for our question. Moreover, we try to assess the degree of clarity of the two respective signals over time and link it to the policy decision. We conclude that, although, in general, there was a broad correspondence between the two analysis and it is therefore difficult to assess their separate role, it appears that the economic pillar prevailed in influencing the decision when the monetary pillar gave a blurred signal.

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