

Summary

Monetary analysis: tools and applications

Huw Pill*

European Central Bank

1. Introduction

“We did not abandon M1. M1 abandoned us.”

Gerald Bouey, former Governor of the Bank of Canada, March 1983.¹

“Inflation is ultimately a monetary phenomenon. The Governing Council therefore recognised that giving money a prominent role in the Eurosystem’s strategy was important.”

ECB Monthly Bulletin, January 1999, p. 47.

These two quotations illustrate the breadth of central bank opinion on the role of money in monetary policy-making. On the basis of a central bank workshop held in Frankfurt during November 2000, this paper goes behind such rhetoric to consider the role monetary analysis plays in monetary policy.

On the one hand, Mr. Bouey’s above oft-quoted remark is indicative of the frustration felt by many central banks pursuing monetary targets in the early 1980s. The considerable challenges faced by intermediate monetary targeting strategies during this period have been well documented in the academic literature, particularly for the Anglo-Saxon countries (e.g. Goodhart, 1989). In an environment of financial innovation and structural change, changes in financial structure created instabilities in money demand which rendered developments in the monetary aggregates difficult for policy makers to interpret, let alone explain coherently and consistently to the public. These practical difficulties led several Anglo-Saxon central banks to abandon formal monetary targets in the mid and late 1980s. Furthermore, in many countries – regardless of whether formal targets had been announced – the importance attached to monetary indicators as a guide to monetary policy decisions progressively diminished. The British experience in this regard, culminating in the abolition of the remaining “monitoring ranges” for the growth of monetary aggregates in 1997, is instructive, but by no means unique. For example, the US Federal Reserve, while still announcing ranges for monetary and credit

* This paper summarises the proceedings of the ECB central bank workshop “Monetary analysis: tools and applications” held at the ECB in Frankfurt on 20–21 November 2000. It has benefited from the comments and suggestions of Hans-Joachim Klöckers, Klaus Masuch, José-Luis Escrivá, Caroline Willeke, Livio Stracca, Dieter Gerdesmeier and other colleagues in the ECB’s Directorate Monetary Policy. The views expressed in the paper are those of the authors and do not necessarily reflect the views of the ECB or the Eurosystem.

¹ Quoted from the Minutes of Proceedings and Evidence of the Canadian House of Commons Standing Committee on Finance, Trade and Economic Affairs, No. 134, 28 March 1983, p. 12.

growth as required by legislation, also assigned monetary developments a lesser role in policy decisions, especially from the early 1990s onwards, and eventually abolished the announcement of the ranges in July 2000.²

On the other hand, the European Central Bank (ECB) statement quoted above is a reflection of a different experience. In continental Europe monetary and credit aggregates continued to play an important role in the conduct of monetary policy throughout the 1980s and 1990s. In particular, the Deutsche Bundesbank – maintaining the intermediate monetary targeting strategy which it had pursued with success since the mid-1970s – continued to announce a target for the growth rate of its broad monetary aggregate M3 until the end of 1998 (when the responsibility for monetary policy passed to the ECB). Other continental European central banks (including the Banque de France, the Banca d'Italia and the Banco de España) also announced monetary targets or reference ranges which complemented and supported other aspects of their monetary policy strategies, such as exchange rate targets and/or direct inflation targets.

The continued prominence of money and monetary aggregates in the monetary policy strategies of continental European central banks was a reflection of the empirical properties demonstrated by the monetary aggregates – in particular, the continued stability of money demand and the leading indicator properties of monetary developments for future inflation. These empirical characteristics were markedly different from those observed in many Anglo-Saxon countries. In the latter, it became almost “conventional wisdom” (at least in the journalistic and academic discussion) that monetary developments were largely “noise”, which was naturally of little relevance for monetary policy decisions aimed at price stability. In this light, several countries – notably the United Kingdom and Canada – adopted direct inflation targeting strategies in the early 1990s, since monetary aggregates and other indicators no longer appeared to constitute plausible or meaningful intermediate targets.

It was against this background that, first, the Committee of Governors of the Central Banks of the Member States of the European Community and, later, the European Monetary Institute (EMI) undertook the preparatory work required for the introduction of the euro and the creation of the single European monetary policy. Naturally, one aspect of this preparatory work was an analysis of the pros and cons of various monetary policy strategies which could form the basis of the ECB's approach to monetary policy. Attention focused on the relative merits of direct inflation targeting and intermediate monetary targeting, which were widely viewed as the two plausible candidate strategies for the ECB.

However, in comparing the relative merits of inflation and monetary targeting, the EMI (1997) recognised that the sharp distinction drawn in the academic literature was misleading. This conclusion followed from the observation that central banks targeting inflation, at least in their internal analyses, devote considerable resources to monitoring

² Quoting from the U.S. Federal Reserve Board of Governors July 2000 *Report to Congress*: “At its June meeting, the FOMC did not establish ranges for growth of money and debt in 2000 and 2001. The legal requirement to establish and to announce such ranges had expired, and owing to uncertainties about the behavior of the velocities of debt and money, these ranges for many years have not provided useful benchmarks for the conduct of monetary policy. Nevertheless, the FOMC believes that the behavior of money and credit will continue to have value for gauging economic and financial conditions, and this report discusses recent developments in money and credit in some detail.”

and analysing monetary developments. At the same time (as illustrated by Reischle (Deutsche Bundesbank) in this volume for the case of the Bundesbank), central banks pursuing intermediate monetary targets also evaluated a very broad range of economic and financial indicators beyond the key monetary aggregate in coming to their monetary policy decisions.

Against this background, in October 1998 – after a comprehensive evaluation of central bank experience and an assessment of the particular circumstances of the euro area – the Governing Council of the ECB decided to adopt neither monetary targeting nor inflation targeting, but rather its own stability-oriented monetary policy strategy (ECB, 1999a). The primary and overriding objective of the single monetary policy is the maintenance of price stability in accordance with a definition published by the ECB. Within the two-pillar framework created by the ECB's strategy, risks to price stability are assessed, on the one hand, on the basis of an analysis of monetary developments (the first pillar of the strategy) and, on the other hand, by an assessment of other economic and financial indicators (the second pillar). The prominent role of money in the ECB's strategy is signaled by the announcement of a quantitative reference value for the growth rate of the broad monetary aggregate M3.

In their public presentation of monetary policy, most central banks currently assign monetary aggregates a less important role in the explanation of monetary policy decisions than does the ECB. In particular, they neither officially accord money a prominent role nor publicly announce a reference value for monetary growth. Nevertheless, a broad spectrum of approaches exists.

On the one hand, the Swiss National Bank (SNB) gives the broad monetary aggregate M3 “a major role as a monetary policy indicator”³, and is therefore perhaps closest in approach to the ECB. On the other hand, many other central banks do not accord a prominent role to money, focusing at least in their public statements almost exclusively on an analysis of the interaction of demand and supply and cost pressures in the real economy and/or a published inflation forecast based on such analysis.

Against this background, the ECB's Directorate Monetary Policy in the Directorate General Economics organised a central bank workshop in November 2000 to discuss the role of monetary analysis in the monetary policy making processes of central banks. Staff members from each of the EU central banks, the U.S. Board of Governors of the Federal Reserve System, the Bank of Canada, the Bank of Japan and the SNB were invited. The purpose of the workshop was twofold. First, it encouraged comparison of the tools and techniques of monetary analysis employed at various central banks, permitting an exchange of views and ideas of mutual benefit. Second, the workshop was intended to provide a platform for discussing the role of monetary analysis in monetary policy strategies in general, and in the ECB's strategy in particular.

One purpose of this paper – and the accompanying papers contained in this volume – is to extend this clarification of the role and nature of monetary analysis to a broader audience, encompassing those outside the central banking community. It therefore summarises the proceedings of the workshop and comments on them from the perspective of an ECB staff member.

³ Statement of the monetary policy strategy of the SNB, available at <http://www.snb.ch/e/geldpolitik/geldpol.html>.

The remainder of the paper is organised as follows. Section 2 notes that there are many similarities among central banks in their internal work. In particular, a broad consensus exists that monetary developments reveal relevant information for monetary policy decisions aimed at price stability (or inflation) objectives. In addition, it suggests that extracting the relevant information requires the adoption of relatively sophisticated techniques. Section 3 focuses on differences between central banks, relating in particular to the way monetary analysis is combined with analyses of other economic and financial indicators, and to how monetary analysis and its role in the policy process is presented to the public. Section 4 briefly concludes.

2. Similarities across central banks: the importance and complexity of monetary analysis

2.1. All central banks monitor monetary developments closely

All the central banks participating in the workshop – regardless of the monetary policy strategy that they formally pursue – recognise that *monetary developments contain information which is potentially important for taking monetary policy decisions aimed at the maintenance of price stability*. All central banks therefore closely analyse monetary developments on a regular basis. In particular, contrary to characterisations typical of the academic literature, central banks targeting inflation (e.g. the Bank of England, the Bank of Canada) analyse monetary developments thoroughly.

2.2. ... but the approach to monetary analysis can differ ...

The type of information contained in monetary developments can be seen as lying along a spectrum, ranging from, on the one hand, a structural explanation of the inflation process where money plays an active and dominant part, to, on the other hand, a treatment of money as, at most, a summary indicator with little or no causal role in the determination of price developments.

As recognised by Friedman (1984), monetary aggregates can play an important role as indicators even if they play no structural or causal role in the inflation process or the transmission mechanism for monetary policy. Even if inflation is regarded solely as the result of excess demand or cost pressures, monetary developments can still provide information for monetary policymaking if they allow central banks to identify better the nature of shocks hitting the economy, and/or to predict trends in future price developments and thus identify emerging risks to price stability.

One explanation of the leading indicator properties of money for future inflation is that monetary indicators may be related to observable macroeconomic variables that play an important role in the transmission mechanism, such as real economic activity or interest rates. For example, money demand studies suggest that monetary growth is related (positively) to real GDP growth and (negatively) to interest rates. In this context, GDP growth above sustainable rates will typically increase both monetary growth and inflationary pressures. Similarly, inappropriately low levels of interest rates may both spur monetary growth and lead to risks to price stability. Viewed in this light, monetary growth *summarises* information about developments in the determinants of money demand, which also influence future price developments. Such a summary variable can therefore be a useful indicator for monetary policy.

While such a summary statistic role is useful, monetary developments may also possess *additional* information about future price developments beyond that which is contained in other macroeconomic indicators. In this volume, this approach is adopted by Orphanides and Porter (Federal Reserve Board), Jordan, Peytrignet and Rich (Swiss National Bank) and Altissimo, Gaiotti and Locarno (Banca d'Italia). These papers highlight the role of monetary aggregates as *informational variables*, which can provide additional or complementary information to that derived from conventional macroeconomic models.

One approach to investigating this role for money is pursued by Altissimo et al. for the case of Italy. Following a suggestion by Friedman (1984), they investigate whether the residuals from money and credit demand equations embedded in the Banca d'Italia's large macroeconomic model of the Italian economy are correlated with forecast errors for key macroeconomic variables, such as inflation and GDP growth. Such correlations are found. Therefore, although the Banca d'Italia model does not accord monetary variables an "active" causal role in the transmission mechanism, this exercise nevertheless suggests that there is information in monetary developments beyond that in the determinants of money which helps to forecast macroeconomic variables of interest to central banks.

The results reported by Altissimo et al. can be interpreted as suggesting that monetary and credit developments reveal information about factors which are important for the transmission mechanism – such as interest rate spreads or non-price rationing of credit – yet are neither easily measured (and thus for which statistics are typically not available) nor captured by conventional macroeconomic models. In such circumstances, residuals to money demand equations provide relevant "news" to policy makers.

Monetary and credit variables may also play an active role in the inflation process and/or the transmission mechanism for monetary policy. In this context, central banks are likely to find it important to monitor monetary variables in order to obtain a better insight into the *structural* and behavioural relationships underlying these processes. For example, if bank credit is sometimes rationed using non-price mechanisms (e.g. as investigated in the credit rationing literature following from Stiglitz and Weiss (1981)), monitoring credit aggregates should help to develop a better understanding of the economic situation and the likely impact of monetary policy actions, both of which are, of course, crucial to well-designed policy decisions aimed at the maintenance of price stability.

Some approaches to extracting the information in money represent an amalgam of the "summary statistic" and "additional information" views. The indicator properties of monetary growth for price developments in the euro area are investigated by Nicoletti Altimari (2001) in a simulated out-of-sample forecasting exercise. His results are reported in this volume by Masuch, Pill and Willeke (ECB). They suggest that euro area M3 growth is one of the best predictors of cumulative inflation over the coming three years, out-performing cost and demand indicators (such as unit labour costs and estimates of the output gap), as well as a variety of other monetary indicators. The study therefore supports the view that price developments over the medium term can be predicted on the basis of monetary indicators. Evaluating the indicator properties of headline monetary growth, e.g. in the manner of Nicoletti Altimari (2001), may capture both the summary statistic and additional information contained in M3 growth.

2.3. ... and a variety of relatively complex approaches are employed ...

In practice, central banks adopt a pragmatic approach to monetary analysis, encompassing both the structural and informational variable views. The range of approaches employed within a single central bank is therefore typically rather large. On the basis of experience at the Bank of England and the ECB respectively, the papers presented by Hauser (Bank of England) and Masuch, et al (ECB) describe a broad variety of time series models which use money to help predict the path of future inflation, GDP growth and other important macroeconomic variables. While this eclectic approach falls short of providing a single framework for monetary analysis, it helps to ensure that as much relevant information as possible is extracted from monetary developments.

2.4. ... which embody a judicious mixture of econometric techniques ...

The range of analytical tools and techniques available for monetary analysis is potentially extremely broad. Several papers presented at the workshop illustrated specific model applications, while others gave a wider overview of the type of models used in the analyses underlying monetary policy decisions.

A natural starting point for econometric modeling of monetary developments is the estimation of *money demand equations*. An enormous academic literature now exists (Goldfeld and Sichel (1990) and Laidler (1993) provide general surveys; Browne, et al. (1997) review the literature relating to EU countries). Central banks have made many important contributions to this literature. Recent papers have almost ubiquitously relied on error correction specifications and used time series modeling techniques based on cointegration.

Kimura's (Bank of Japan) paper in this volume provides an elegant example of this approach in an investigation of the stability of money demand in Japan during the 1990s. Consistent with the results described by other participants in the workshop, he demonstrates that an "intelligent interpretation" of monetary developments in Japan – which in this case accords an important role to the impact of financial volatility on the precautionary demand for money – can account for the evolution of M2 + CDs (the key aggregate monitored by the Bank of Japan) over the last decade. This result overturns the finding (based on more conventional specifications) that money demand in Japan has been unstable in recent years.

As noted above, the Hauser and Masuch, et al. papers provide a broad overview of the econometric techniques developed and used for monetary analysis by staff at the Bank of England and the ECB respectively. The techniques employed are revealed to be very similar. Both the Bank of England and the ECB use a variety of money-based time series indicator models for inflation and other macroeconomic variables. Consistent with the mainstream academic literature, the two main econometric frameworks discussed are vector autoregressions (VARs) and vector error corrections models (VECMs) (Dhar, et al., 2000; Brand and Cassola, 2000). Both these approaches are used to investigate the indicator properties of monetary and credit aggregates for macroeconomic developments, typically in conjunction with developments in other indicators. The main difference between the two types of model is that VECMs impose long-run relationships between the money stock, prices and other key economic variables (e.g. in the form of a money demand equation), whereas VARs focus on shorter-term dynamic interactions.

While the techniques employed are similar, some nuances emerge. On the one hand, the Bank of England places greater emphasis on analysis and modeling of sectoral aggregates. (For the time being, the scope for such analysis at the ECB for the euro area remains restricted by the lack of long-run time series for sectoral money and credit at the area-wide level.) On the other hand, the ECB has placed greater emphasis on evaluating the leading indicator properties of a wide variety of monetary and credit indicators in simulated out-of-sample exercises, as proposed by Stock and Watson (1999) (Nicoletti Altimari, 2001).

One prominent variant of the VECM approach is the so-called *P-star model of inflation* (Hallman, et al., 1991). As illustrated in several papers presented at the workshop, such models use the deviation of the money stock from a level deemed consistent with equilibrium as a leading indicator of future inflation. The P-star model is used at several central banks, including the Federal Reserve System, the ECB, the SNB and the Bank of Japan.

For example, Kimura uses his money demand results to derive a measure of the equilibrium money stock and thus a P-star indicator for Japanese inflation. On the basis of this indicator, he demonstrates that monetary developments, appropriately corrected for the impact of financial volatility, are a leading indicator of inflation in Japan. Similarly, in their study of Swiss data, Jordan, et al. show that a P-star model can forecast price developments at a one to two-year horizon, a result confirmed for the euro area by Gerlach and Svensson (2000), Trecroci and Vega (2000) and Nicoletti Altimari (2001).

In illustrating the performance of the P-star model in the United States, Orphanides and Porter make two important points.

First, they demonstrate that, in order to obtain good forecasts of inflation, the equilibrium level of M2 income velocity has to be modeled in a time-varying manner, rather than be treated as a constant as in the original P-star model (Hallman, et al., 1991). This is consistent with the results obtained by other central banks, which use money demand equations to predict developments in the equilibrium velocity concept underlying the P-star approach.

Orphanides and Porter show that a shift in M2 income velocity in the early 1990s – associated with innovations in the financial and banking sector – severely disrupts the simple P-star model's forecasting performance. This basic story is a familiar one: financial innovation can lead to changes in equilibrium money demand if, for example, they permit some economisation in the money holdings required to undertake a certain level of nominal transactions. If the impact of such structural velocity shifts can be modeled successfully, then the indicator properties of money for future price developments – which would otherwise suffer significantly – can be restored.

Velocity shifts can often be captured by statistical methods *ex post*. From the policy-making perspective, however, the ability to predict such shifts *ex ante*, or at least in real time, is of greater importance. Only if shifts in velocity can be predicted contemporaneously or in advance will policy-makers be able to calibrate their assessment of the economic situation accordingly and thus take appropriate monetary policy decisions. This leads to Orphanides and Porter's second – and more striking – result. On the basis of internal Federal Reserve analysis undertaken at the time, they suggest that the structural shift in M2 income velocity which took place in the early 1990s could have been detected “in real time”. Specifically, the detailed institutional analysis by monetary

experts at the Federal Reserve allowed, only one year after the structural shift in M2 velocity, M2 growth to be predicted as accurately as it had been prior to the shift. By implication, within one year of the incidence of the velocity shift, the P-star model could have been amended on the basis of such expert assessment so as to provide useful guidance to policy-makers.

This result illustrates the importance of institutional and judgmental forms of monetary analysis to complement and explain the results of analysis based on explicit empirical models. In particular, in an environment of ongoing financial innovation (as observed in the United States in the early 1990s), it is crucial that central banks closely monitor the substitution between monetary assets and other financial instruments which are close substitutes.

2.5. ... and institutional and judgmental methods

Several of the presentations at the workshop discussed frameworks within which some approaches to this detailed *institutional analysis* could be organised.

For example, Reischle (Deutsche Bundesbank) describes the important role of the consolidated banking sector balance sheet in the Bundesbank's monetary analysis. In the context of the Bundesbank announcement of an intermediate target for broad money, monetary analysis naturally focused on understanding of developments in the key aggregate M3. Using a number of case studies (e.g. the large capital inflows to Germany in 1992–93, associated with the exchange rate mechanism (ERM) crises of that period), Reischle describes how analysis of the consolidated bank balance sheet helped to shed light on developments in M3 that were otherwise rather difficult to explain. Reischle argues that when analysis of the consolidated banking sector balance sheet pointed to caution in the interpretation of M3 growth, on occasion, it exerted an important influence on the Bundesbank's monetary policy decisions. In his view, monetary analysis in the context of the consolidated banking sector balance sheet was a central element of the "pragmatic monetarism" practised by the Bundesbank.

Reischle's discussion should be seen in the broader German context. In comparison with the situation in other countries, the Bundesbank was relatively successful in maintaining price stability during the 1970s and 1980s. Moreover, the German financial sector (e.g. the capital account of the balance of payments) had been liberalised at a relatively early stage. Taken together, these two factors implied smaller incentives for the private sector to introduce the financial innovations seen in many other countries. As a consequence, money demand remained more stable in Germany and money developments thus provided more useful guidance for monetary policy decisions, thereby facilitating the maintenance of price stability. In other words, in contrast to the experience of the Anglo-Saxon countries, a virtuous circle of price stability and money demand stability was created (Issing, 1997).

Reischle's paper focuses on the consolidated banking sector balance sheet. However, in an environment of extensive financial innovation, substitution between bank and non-bank liabilities may be more important than substitution between monetary and non-monetary bank liabilities. In other words, the distinction between monetary and non-monetary instruments is becoming increasingly blurred as disintermediation away from the banking sector becomes more pronounced.

Such experiences have been characteristic of the monetary developments in France over the last fifteen years. The paper by Drumetz and Odonnat (Banque de France) describes how the Banque de France responded by constructing and monitoring extended monetary and credit aggregates. These aggregates encompass instruments with similar economic characteristics regardless of whether they appear on the consolidated banking sector balance sheet. These extended aggregates therefore internalise substitution between monetary and non-monetary instruments and, on occasion, may be economically more meaningful than aggregates which distinguish between instruments, which are otherwise essentially identical, solely on the basis of the issuing sector. In the context of a case study, Drumetz and Odonnat illustrate how monitoring such extended aggregates during a major episode of financial innovation in France in 1993 ensured that developments in M3 (the key monetary aggregate then monitored by the Banque de France) could be interpreted and assessed correctly, thereby avoiding misguided policy advice.

Taking the approach pursued by Drumetz and Odonnat to its logical conclusion, all sectoral balance sheets should be evaluated simultaneously. (In flow terms, this would imply evaluating the flow of funds between all sectors.) In this context, monetary aggregates might then simply constitute one component of a broader system of financial accounts, rather than having a special, distinctive status. Such an approach would be consistent with the view that ongoing financial innovation in France rendered any specific definition of money vulnerable to instabilities and thus potentially less meaningful from an economic point of view.

Analysis of the financial accounts has also been given prominence at the Banco de España, as described in the paper by Peñalosa and Sastre (Banco de España). They note that constructing the financial accounts is, by their nature, very data and resource-intensive. In consequence, the financial accounts are typically available with a considerable time lag and the quality of some of the data is questionable. These shortcomings inevitably restrict the use of the financial accounts for policy purposes. Moreover, despite ongoing financial innovations, monetary instruments retain some distinctiveness (e.g. as the economy's main medium of exchange) and therefore deserve a special status. For these two reasons, analysis of the financial accounts should be seen as a complement to, rather than a substitute for, conventional monetary analysis. Nonetheless, the interpretation of monetary developments can be enhanced considerably by placing them in the broader context of the financial accounts. In particular, substitution between monetary and non-monetary/non-bank instruments can be monitored and evaluated in a systematic manner within this framework.

Analysis of the financial accounts emphasises sectoral financial flows and therefore is a natural complement to analysis of sectoral money and credit. As Hauser describes, sectoral analysis of money and, in particular, credit has been given prominence at the Bank of England. Indeed, such sectoral analyses are considered to provide most of the money-based information that is relevant for policy decisions. In particular, the Bank of England uses sectoral money and credit to forecast developments in the components of aggregate demand.

2.6. A more structural interpretation of monetary developments may be desirable

The discussion at the workshop showed that further progress may be desirable in *developing structural economic and econometric models which accord a role to monetary variables in the inflation process.*

The need for such progress can be viewed from two perspectives.

From the perspective of the macroeconomic modeling literature, it can be argued that the considerable progress made in recent decades with regard to structural modeling of the real side of the economy (e.g. the development of so-called “new neo-classical synthesis” models, such as those proposed by Goodfriend and King (1997) and Rotemberg and Woodford (1997)) has not been matched in the modeling of the monetary and financial sectors. Conventional macroeconomic models therefore suffer from the shortcoming that they neglect financial interactions and thus given an incomplete picture of economic developments.

Alternatively, from the perspective of monetary analyses, the development of structural models can be seen as a prerequisite for exploiting the information in monetary developments more efficiently. The appropriate monetary policy response to an innovation in monetary growth should depend on, *inter alia*, the cause of that innovation, i.e. the underlying structural economic shock. Non-structural indicator models involving money – while able to provide a broad “warning signal” of the possible emergence of risks to price stability – do not permit the nature of the underlying threat to price stability to be identified and thus the monetary policy response to be calibrated accordingly.

For example, an increase in monetary growth coming from a decline in the velocity of circulation caused by financial innovation might be benign with regard to the outlook for price stability and therefore not require a monetary policy response. In contrast, stronger monetary growth stemming from a positive demand or wealth shock could be a signal of emerging risks to price stability, which would require monetary policy action. Policy advice therefore needs to distinguish (or at a minimum, include a view regarding) the source of the underlying economic shock (see Masuch, *et al.*). Distinguishing between such shocks requires (at least implicitly) a structural model. Non-structural indicator models treat all innovations in monetary dynamics the same, whereas, in practice, it is intuitively obvious that some innovations matter more for monetary policy decisions than others.

A number of papers presented at the workshop suggested starting points for attempting to develop a more structural view of monetary developments.

For example, much of the institutional and judgmental analysis outlined in Section 2.4 can be viewed (in econometric terms) as attempts to identify “pure” velocity shocks which are seen as benign regarding the outlook for price stability. As noted by Masuch, *et al.*, this approach points towards the construction of corrected monetary series, adjusted for the “special factors” identified by such judgmental methods. However, the practical problems of constructing such series remain formidable. Furthermore, the identification achieved by such an approach is incomplete. Even if applied successfully (something that will always remain difficult to assess given the inevitably judgmental nature of the technique), this approach will only distinguish benign innovations in money from those which may be associated with the emergence of risks to price stability. It will not allow the precise nature of the risk to price stability to be ascertained.

At a more sophisticated level, it was mentioned that the Bank of Canada had undertaken some analysis in the context of various dynamic stochastic general equilibrium models including money, such as the limited participation model proposed by Christiano, *et al.* (2000). Like the benchmark new neo-classical synthesis models widely adopted in the academic literature, these models are based on microeconomic foundations

incorporating fully optimising behaviour by firms, households and banks. However, rather than assuming that the non-neutrality of money results from nominal rigidities in the goods and labour markets, limited participation models assume that frictions exist in the financial sector. The latter assumption naturally gives money a more active role in the transmission mechanism for monetary policy and the inflation process.

However, participants cautioned against believing such limited participation models would provide an adequate solution to the lack of structural monetary frameworks. First, the methodological assumptions underlying such models – such as “cash-in-advance” constraints on households’ spending decisions – remained rather artificial and thus unconvincing. Second, simulation exercises conducted using calibrated versions of such models sometimes produced results that were at odds with well-established empirical regularities on which practical monetary analysis relies, e.g. conventional specifications of money demand. Nonetheless, it transpired that the construction of similar models was envisaged at several other central banks.

Viewing the issue from a more empirical perspective, Hauser described how identifying restrictions had been introduced into a VECM system for United Kingdom M4 estimated at the Bank of England by Dhar, et al. (2000). Using these restrictions, a variety of economic shocks can be separately identified, although their economic meaning is not always clear. However, as is widely recognised in the academic literature, the results obtained in such “structural VECMs” are often sensitive to the choice of identification scheme, which is itself inevitably somewhat ad hoc. This renders the results of such an exercise potentially difficult to interpret and thus not straightforward to use for policy advice. This notwithstanding, similar approaches are being used or envisaged at other central banks.

Recognising the difficulties in achieving identification in econometric models of money, Masuch, et al. also present a so-called “semi-structural approach”. Such an approach takes an econometric model (in practice, a money demand specification) as its starting point, since this provides a clear framework within which to conduct analysis. Using this framework, actual monetary developments can be decomposed in various ways. While such decompositions are purely accounting exercises and thus do not, in themselves, identify the underlying economic behaviour, they may nevertheless provide a good starting point for attempts to understand the causes of monetary developments. For example, they can illustrate the relative contributions of output growth or interest rates to developments in observed monetary dynamics. While this clearly falls well short of a fully structural interpretation of money and credit, it at least represents an advance compared with simply looking at entirely non-structural indicators.

As this discussion illustrates, while the desirability of a more structural economic framework for monetary analysis was recognised by many workshop participants, it was widely acknowledged that progress in this regard has, thus far, proved modest. Considerable scope (and need) for further work remains.

2.7. In sum, money matters

The papers presented at the workshop show that *all central banks represented at the workshop – regardless of the formal monetary policy strategy they pursue (or pursued in the past) – incorporate monetary analysis into their policy-making process and, at least in some circumstances, may accord it an important role.*

Against this background, the main lessons from the workshop and the papers contained in this volume can be summarised as follows. If monetary developments are interpreted in a way which efficiently combines econometric techniques and judgmental and institutional analysis, they can provide relevant and important information for monetary policy decisions aimed at the maintenance of price stability.

The need for a judicious mix of econometric results and expert assessments would be considered mainstream in the context of conventional macroeconomic forecasting or simulation exercises. Yet, at least outside the central banking community, the same approach is often not applied to monetary analysis. One key message of the workshop was that central banks should (and, in practice, do) employ econometric and judgmental analysis in parallel when monitoring and evaluating monetary developments. By doing so, they are able to extract information that is relevant for monetary policy-making and which can thus improve policy decisions.

3. Differences across central banks: presenting monetary analysis internally and externally

While recognising the potential importance of monetary developments as a guide to policy decisions, the workshop also led to the identification of a number of challenges for monetary analysis. The response to these challenges differed across the participating central banks. Although there is consensus about the importance of monetary analysis, a broad spectrum of opinions exists concerning how this analysis should be communicated and presented, both internally (by the central bank staff to the monetary policy-making body) and externally (by the central bank as an institution to the public).

At the heart of this discussion was the relationship between monetary analysis and the analyses of other economic and financial indicator variables.⁴ If monetary-policy makers are to identify the nature of underlying economic shocks which pose a threat to price stability (and thereby be able to react in an appropriate manner), they cannot rely solely on money (or indeed any other single indicator). Therefore monetary variables must always be analysed in conjunction with other economic variables, such as output, interest rates, wealth and prices. Unsurprisingly, this view proved uncontroversial at the workshop and is reflected implicitly in the analyses described in Section 2 (e.g. money demand equations, P-star models, VARs and VECMs all evaluate money within a broader macroeconomic context).

It is uncontroversial to state that monetary policy decisions should be based on analysis of a range of indicators in addition to money. However, *the issue of whether and, if so, how monetary analysis should be integrated with analyses of these other economic and financial indicators remains open*. A very broad spectrum of practices exists.

⁴ This can be related to the need to develop structural economic models of monetary developments, as discussed in Section 2. In order to identify the different underlying economic shocks affecting both monetary dynamics and future price developments, money must necessarily be analysed in the context of other macroeconomic variables. Expressed simply, if money is evaluated in isolation, only one type of “shock” can be identified (namely innovations in money relative to some univariate time series model). This is the approach implicit in univariate, non-structural money-based indicator models. In order to distinguish between two different types of economic shock, at least two variables (which respond in different ways to the shocks) must be monitored. Similarly, to identify three different types of shock, at least three variables must be monitored, and so forth.

It is helpful to distinguish between two aspects of this issue, which correspond to the two distinct roles played by a monetary policy strategy.

First, the strategy should ensure that the relevant decision-making body (e.g. in the ECB context, the Governing Council of the ECB, which is charged by the Maastricht Treaty with determining monetary policy for the euro area) receives, in a timely and structured manner, all the information and analysis it requires to take monetary policy decisions which maintain price stability. In other words, the strategy should provide for an *efficient internal policy-making process* within the central bank. As regards the discussion in this paper, the internal role of the strategy is primarily concerned with how monetary analysis is presented to policy makers and the weight they should assign it in reaching their final policy decision. This question is taken up in Section 3.1 below.

Second, the strategy should provide a clear, consistent and coherent framework for the *presentation and explanation of monetary policy decisions* to the public. This external role should aim to build up the credibility – and thereby the effectiveness – of monetary policy. Several considerations arise: (inter alia) the need for democratic accountability of an independent central bank; the need for transparency of the procedures of the central bank; and the need for clarity regarding the objective of monetary policy (Winkler, 2000). As regards monetary analysis, the key question is whether and, if so, how such analysis and its implications for monetary policy decisions should be presented to the public. This question is addressed in Section 3.2.

3.1. *Monetary analysis in the internal decision-making procedure*

There is a broad consensus that monetary policy decisions should be based on the widest possible set of indicators and models, i.e. that no data or analyses should be arbitrarily excluded from the policy-making process.

However, practices differ regarding how such a “full information” approach is to be implemented.

On the one hand, monetary analysis is seen in some central banks as providing input into a single analytical framework which is used to assess the economic situation and identify emerging risks to price stability. This unified framework – within which monetary analysis is only one component among potentially many others – would ultimately provide a single set of advice and guidance results to policy-makers.

As discussed by Hauser, this description captures – albeit inevitably in a rather stylised manner – the approach adopted at the Bank of England. Monetary analysis undertaken by Bank of England staff is presented at an early stage of, and is incorporated into, the regular quarterly forecasting exercise (which constitutes the core of the internal decision-making process).

In other central banks, on the other hand, a diverse set of competing analyses and advice from fundamentally different perspectives is provided, this being seen as necessary for robust (and thus useful) policy guidance. The adoption of such an approach is based on the conviction that only then can policy-makers make a well-informed assessment of the risks and uncertainties they are facing and thereby reach their own conclusions about the appropriate monetary policy stance.

In his paper contained in this volume, Selody emphasises this latter role for monetary analysis. Given uncertainties regarding the true structure of the economy and the transmission mechanism for monetary policy, Selody argues that central banks should adopt

a diversified approach to the analysis of economic information, rather than relying on a single – and inevitably incomplete – analytical framework. Such an approach – which has been adopted at the Bank of Canada – should enhance the robustness of monetary policy decisions. Policy-makers receiving diversified policy advice can choose policy actions which preserve price stability in the range of plausible settings defined by this broad span of advice. They are thus less likely to make large policy errors in the face of an uncertain world.

On this basis, Selody argues that the analysis underlying monetary policy decisions should be based on “multiple paradigms” of the monetary transmission mechanism, i.e. a broad range of economic models of the inflation process which differ from one another in some fundamental respect. Among macroeconomic models, a distinction can be drawn between those which assign an important role to money in the inflation process and those which view inflation as the outcome of excess demand or cost pressures (proxied by developments in estimates of the output gap).

Selody argues that undertaking monetary analysis ensures that money-based models of price developments are encompassed in the analysis underlying policy decisions. Monetary analysis is therefore crucial to spanning the range of plausible models of inflation and providing genuinely diverse policy advice from a range of approaches.

Against this background, Selody’s paper describes the internal procedures currently in place at the Bank of Canada. Monetary analysis is presented to the Governor *in parallel* with a conventional macroeconomic forecast, rather than as an *input* to it. Thus monetary analysis provides a different and, in some senses, competing view of the economic situation to that supplied by conventional macroeconomic models and forecasts. This competition between fundamentally different “views of the world” or “paradigms” is seen as strength, rather than as a weakness of the approach (Engert and Selody, 1998). Broadly speaking, the approach advocated by Selody and adopted at the Bank of Canada parallels the two-pillar structure of the ECB’s monetary policy strategy (discussed briefly in Section 1), where the two pillars are implicitly interpreted as representing different monetary and non-monetary paradigms of the inflation process (cf. Masuch, et al. in this volume; ECB, 2000).

While important, the distinction between presenting monetary analysis in parallel or using it as an input to a single, unified exercise should not be over-emphasised. Ultimately the policy-making body must take a single decision regarding the level of interest rates on the basis of all available information. In that sense, a unified framework is always in place, at the latest at the level of the highest decision-making body.

The above differences in practices demonstrate that important procedural questions arise when considering how monetary and other analyses should be combined in coming to an interest rate decision. These *procedural* issues are at the heart of practical monetary policy-making and thus at the core of the internal role of a monetary policy strategy. In particular, central banks must resolve the question of whether, on the one hand, staff members should take responsibility for integrating monetary and other analyses or, on the other hand, the responsibility for making an overall assessment should be left to policy-makers.

Yet even framing this question is often difficult. Some central banks (e.g. the ECB) draw a relatively sharp distinction between staff policy advice (which is treated as an input to the decision-making process) and the policy decision itself (which is left to the decision-making body responsible). However, as noted by Kohn (2000), in other central

banks the distinction between the inputs to the monetary policy decision and the decision itself is less clear cut (e.g. the Bank of England, where policy-makers are closely involved in the production of the quarterly inflation forecast, which is seen as the key analytical tool for guiding policy decisions, as well as in the decisions themselves).

Another aspect of this question is the role played by large macroeconomic models in the formulation of monetary policy guidance. On the one hand, some workshop participants were sceptical of the benefits of attempting to build a single, large “eclectic” economic model which encompasses the essence of both monetary and non-monetary paradigms of the inflation process. In their view, such an eclectic model would lack the simplicity, internal consistency and intuitive appeal which are prerequisites for providing good policy advice. On the other hand, others – drawing in part on Altissimo, et al.’s description of the role played by the Banca d’Italia’s large macroeconomic model in Italian monetary policy-making prior to the introduction of the euro – suggested that preparing policy guidance in the context of a single model allowed a holistic and rich picture of the economic situation to be obtained. Underlying these two contrasting views was a disagreement on the prior question, namely whether the staff or policy-makers should be responsible for integrating analyses within the overall policy-making process.

However, the appropriate role of large macroeconomic models does not need to be viewed in black and white terms. Giving greater prominence to the analysis of sectoral financial accounts constitutes an intermediate way between the two approaches outlined above. The financial accounts allow balance sheet developments, including developments in the monetary aggregates, to be evaluated together with real economic variables such as the savings rate within a consistent accounting framework. Such an approach permits cross-checking and some integration of monetary and other economic analyses. However, it falls well short of providing a behavioural explanation of the relationships between financial and real variables.

Several participants offered more theoretical comments on this theme. For example, consideration was given to Bayesian approaches – which assign subjective weights to the various paradigms of the inflation process – as a way of combining the production of a diversified set of underlying analyses with the creation of a single, unified view of the economy.

In the academic literature, such a Bayesian approach has been advocated by Sims (2001). He contrasts this framework favourably with an emerging literature applying “robust control” methods to monetary policy models (Hansen and Sargent, 2000; Onatski and Stock, 2000). The latter technique has some parallels with the diversified, multiple paradigm approach to policy advice advocated by Selody. It leads to the formulation of robust monetary policy rules, which map out a path for short-term interest rates on the basis of current and lagged values of macroeconomic indicators (potentially including money). The intense and, as yet, unresolved debate in the academic literature on these issues clearly signals that this is a field of potentially fruitful further work at both the conceptual and practical level and represents one of the bigger challenges facing the conduct of monetary analysis by central bank staff.

3.2. Presenting monetary analysis and its implications for monetary policy to the public

A final – and closely related – challenge facing central banks is *the presentation of the analysis of monetary developments and their impact on monetary policy decisions to the*

public. Of course, the presentation of monetary analysis is only one part of the external aspect of a monetary policy strategy, and should be seen in the wider context. Broadly speaking, one can identify a trade-off between, on the one hand, a simple and accessible presentation of the rationale behind monetary policy decisions and, on the other hand, a more honest and open approach which reveals the underlying complexity and uncertainty surrounding the analyses on which monetary policy decisions are based (ECB, 2000).

3.2.1. Should monetary analysis be presented independently?

Central bank communications should foster the credibility and thereby the effectiveness of monetary policy. Considerable controversy exists over how this is best achieved. A spectrum of approaches can be identified, defined by two extremes.

One approach to presenting monetary analysis to the public is to subsume the information derived from it into a single presentational device, such as a published inflation forecast, projection or fan chart. This approach can be justified on the grounds that emphasising developments in individual indicators (possibly including monetary variables) only adds unnecessary complexity to the presentation of monetary policy and potentially distracts the public from the central bank's primary objective. While subsuming the information from monetary analysis into an inflation forecast may help to focus the public's attention on the maintenance of price stability, it inevitably makes the impact of various forms of analysis, including monetary analysis, on policy decisions difficult to see. Thus greater clarity about the objective of monetary policy is achieved only at the expense of reduced transparency about the role of individual variables – including monetary aggregates – in monetary policy decisions.

These shortcomings notwithstanding, there are some reasons to favour this approach to presenting monetary analysis to the public. For example, Selody describes how – despite its commitment to maintaining a distinct role for monetary analysis in internal policy discussions – the Bank of Canada presents policy decisions to the public *as if* they were determined on the basis of a single, unified assessment. As Selody reports, this choice was taken for two reasons. First, the Bank of Canada took the view that it was crucial to adopt a simple framework for the presentation of policy decisions to the general public – the multiple paradigm approach was considered too complex. Second, it was felt that revealing the extent of the uncertainty surrounding policy decisions by discussing the various paradigms underlying policy analysis might trigger undue public concern about the direction and formulation of monetary policy and thereby undermine credibility.

The Bank of Canada's decision throws into sharp relief the trade-off between, on the one hand, presenting monetary policy in a clear, simple and reassuring way and, on the other hand, revealing the underlying internal decision-making process and the way in which it addresses the pervasive complexities faced by policy-makers.

The ECB's monetary policy strategy adopts a different view, namely that the presentation of monetary policy decisions to the public should closely reflect the internal decision-making process, i.e. the internal and external aspects of the strategy correspond closely (ECB, 2000). Keeping this approach in mind, it should be noted that monetary analysis prepared by ECB staff is presented to the policy-making Governing Council *in parallel* with analyses of other economic and financial indicators (including macroeco-

nomics forecasts and projections). This is the essence of the two-pillar structure used to organise the internal policy-making process. As such, monetary analysis is not viewed as input into a single framework for staff policy advice (such as a forecasting exercise). Rather, policy-makers are provided with a diversified set of policy guidance results and are thereby prompted to cross-check among the various analyses.

Given this approach, monetary analysis is presented to the public by the ECB in the context of a distinct pillar of the strategy, rather than integrated or subsumed within a single overarching analytical framework.

Against this background, Masuch, et al. suggest that the first pillar of the ECB's strategy constitutes a visible and public commitment to undertake monetary analysis and present its implications for monetary policy decisions to the public. The first pillar thereby helps to ensure that the important information in monetary developments is not neglected either in the internal decision-making process or in the presentation of decisions to the public. Experience with the conduct and presentation of the single monetary policy since the introduction of the euro supports the view that the separation of the two pillars has helped to maintain an important role for money in the public discussion of monetary policy – reflecting its important role in the internal ECB policy-making process – and has thus added to the transparency and effectiveness of the ECB's strategy and policy decisions.

3.2.2. How shall monetary analysis be presented to the public?

At the ECB, the announcement of a quantitative reference value for monetary growth is viewed as a *signal* of the prominent role of money in the ECB's strategy, not as a comprehensive description of that prominent role. As Masuch, et al. demonstrate, monetary analysis undertaken by staff at the ECB – while taking deviations of M3 growth from the reference value as one natural starting point – extends to a much broader and more complex range of tools and techniques. The reference value should therefore be seen as a simple and intuitive presentational device for the general public, which inevitably obscures some of the necessary complexity of the underlying detailed monetary analysis.

This notwithstanding, it should also be recognised that empirical studies of the euro area support the view that headline annual monetary growth – appropriately interpreted – can be a good leading indicator for price developments over longer horizons. As mentioned in Section 2.2, Nicoletti Altamari (2001) demonstrates that a simple time series model of inflation and M3 growth provides better forecasts of cumulative euro area inflation over the next three years than alternative models.⁵

As described by Jordan, et al., the approach adopted at the Swiss National Bank differs from that pursued by the ECB. Given the results of their econometric study presented in this volume, Jordan, et al. are sceptical of the benefits of announcing a reference value for M3 growth in Switzerland. They show that indicator models for future inflation based on M3 growth alone do not perform particularly well in Swiss data, especially at the one

⁵ An important aspect of this result is that the leading indicator properties of headline annual M3 growth are for low frequency price developments. In other words (and speaking loosely), monetary growth is an indicator of the medium-term trend in inflation, not of high frequency (e.g. quarter-to-quarter) developments. When interpreting headline annual euro area M3 growth relative to the ECB's reference value, the medium-term nature of the information provided always needs to be kept in mind.

to two-year horizon that is typically the focus of monetary policy discussions. Rather, they are able to demonstrate that more sophisticated money-based indicator models for inflation, which incorporate both a P-star measure of excess liquidity and a measure of monetary growth, can predict inflation relatively well at these horizons.

On the basis of these empirical results, Jordan, et al. suggest that the announcement of a reference value in the Swiss context would focus public attention on headline annual monetary growth and thus on a too narrow and flawed indicator of emerging risks to price stability. The danger therefore exists that the public could be misled about the future course of monetary policy decisions, threatening the reputation and credibility of the central bank.

In Jordan, et al.'s view, the favoured monetary indicator for Switzerland – essentially a weighted average of a P-star measure of excess liquidity and monetary growth – is too complex to constitute a useful communication vehicle. As mentioned in Section 2.3, if the information relevant for monetary policy decisions can only be extracted from monetary variables using relatively complex techniques, this inevitably complicates the presentation of that information to the public. Against this background – and consistent with the SNB's strategy – Jordan, et al. therefore suggest that monetary analysis be presented to the public largely in the form of inflation projections which also include the information content of money. In their view, such an approach combines the simplicity of the inflation targeting approach adopted by the Bank of Canada (inter alia) with a clear public commitment to monetary analysis.

The argumentation of Jordan, et al. reflects the widespread view that *extracting the information relevant for monetary policy decisions from observed monetary developments is not a trivial task*. In fact, the workshop demonstrated that a wide variety of analytical tools and frameworks are required to extract the information in monetary developments which is relevant for monetary policy-making. The potential sophistication and complexity of such tools – while ensuring that policy-makers are provided with the best possible policy guidance – can complicate the presentation of the role of monetary developments in policy decisions to the public.

4. Concluding remarks

A number of conclusions can be drawn from the workshop proceedings, from the perspective of the ECB's monetary policy strategy.

First, almost all central banks analyse monetary developments closely, using similar tools and techniques.

Second, while the importance of monetary analysis was unanimously recognised, two questions remained open, namely: how monetary analysis conducted by central bank staff should be presented to policy-makers; and how this analysis should be presented to the public. A wide range of possibilities exists with regard to both issues. The approaches pursued by the ECB fall within the broad spectrum of opinions expressed by workshop participants, which itself reflects the range of approaches currently taken by central banks. Nevertheless, given the lack of consensus on these questions, one should anticipate a continued debate in the future.

Finally, the workshop made clear that further work is required at the technical level to develop tools for more effective monetary analysis. Developing structural models of the inflation process which accord a role to monetary variables is one of the key issues.

An exercise from which two lessons were drawn but an equal number of challenges identified is a recipe for further work. The November 2000 monetary analysis workshop should therefore be seen as a beginning, not as an end. As Hauser concludes in his contribution to this volume, a challenging agenda has been drawn up. What remains now is to address this agenda successfully.

References

- Brand, C. and N. Cassola (2000), "A money demand system for euro area M3", ECB working paper No. 39.
- Browne, F., G. Fagan and J. Henry (1997), "Money demand in EU countries: A survey", EMI staff papers No. 7.
- Christiano, L., M. Eichenbaum and C. Evans (2000), "Sticky price and limited participation models of money: A comparison", mimeo, Northwestern University.
- Dhar, S., D. Payne and R. Thomas (2000), "A small structural empirical model of the UK monetary transmission mechanism", Bank of England working paper No. 113.
- ECB (1999a), "The stability-oriented monetary policy strategy of the Eurosystem", ECB Monthly Bulletin (January).
- ECB (1999b), "Euro area monetary aggregates and their role in the Eurosystem's monetary policy strategy", ECB Monthly Bulletin (February).
- ECB (2000), "The two pillars of the ECB's monetary policy strategy", ECB Monthly Bulletin (November).
- EMI (1997), *The single monetary policy in Stage Three: Elements of a monetary policy strategy for the ECB*. Frankfurt am Main.
- Engert, W. and J. Selody (1998), "Uncertainty and multiple paradigms of the transmission mechanism", Bank of Canada working paper No. 98/7.
- Fagan, G. and J. Henry (1999), "Long-run money demand in the EU: Evidence for area-wide aggregates" in H. Lütkepohl and J. Wolters (eds.), *Money demand in Europe*, Physica Verlag: Heidelberg, pp. 217–240.
- Friedman, B.M. (1984), "The value of intermediate targets in implementing monetary policy" in FRB Kansas City (ed.), *Price stability and public policy*.
- Gerlach, S. and L.E.O. Svensson (2000), "Money and inflation in the euro area: A case for monetary indicators?", mimeo, Institute for International Economic Studies, Stockholm.
- Goldfeld, S.M. (1984), "Comment on Friedman" in FRB Kansas City (ed.), *Price stability and public policy*.
- Goldfeld, S.M. and D.E. Sichel (1990), "The demand for money" in B.M. Friedman and F.H. Hahn (eds.), *Handbook of monetary economics*, Vol. 1, North Holland: Amsterdam, pp. 299–356.
- Goodfriend, M. and R.G. King (1997), "The new neo-classical synthesis and the role of monetary policy" in B. Bernanke and J.J. Rotemberg (eds.), *NBER Macroeconomics Annual 1997*, MIT Press, Cambridge, MA.
- Goodhart, C.A.E. (1989), "The conduct of monetary policy", *Economic Journal*, Vol. 99, pp. 293–346.
- Hallman, J.J., R.D. Porter and D.H. Small (1991), "Is the price level tied to the M2 monetary aggregate in the long run?", *American Economic Review*, vol. 81, no. 4, pp. 841–858.
- Hansen, L. and T.J. Sargent (2000), "Wanting robustness in macroeconomics", mimeo, Stanford University.
- Issing, O. (1997), "Monetary targeting in Germany: The stability of monetary policy and of the monetary system.", *Journal of Monetary Economics*, Vol. 39, No. 1, pp. 67–79.
- Kohn, D. (2000), "Report to the non-executive directors of the court of the Bank of England on monetary policy processes and the work of monetary analysis", <http://www.bankofengland.co.uk/kohn.pdf>
- Laidler, D.E.W. (1993), *The demand for money: Theories, evidence and problems*, Harper Collins, New York, NY.
- Nicoletti Altimari, S. (2001), "Does money lead inflation in the euro area?", ECB Working Paper No. 63.
- Onatski, A. and J. Stock (2000), "Robust monetary policy under model uncertainty in a small model of the US economy", NBER working paper No. 7490.

- Rotemberg, J.J. and M. Woodford (1997), "An optimisation-based econometric framework for the evaluation of monetary policy" in B. Bernanke and J.J. Rotemberg (eds.), *NBER Macroeconomics Annual 1997*, Cambridge, MA, MIT Press.
- Sims, C. (2001), "Pitfalls in a minmax approach to model uncertainty", Presentation at the AEA meetings in New Orleans, 5 January 2001.
- Stiglitz, J. and A. Weiss (1981), "Credit Rationing in Markets with Imperfect Information.", *American Economic Review*, Vol. 73, No. 3, pp. 393–410.
- Stock, J. and M. Watson (1999), "Forecasting Inflation", *Journal of Monetary Economics*, Vol. 44, pp. 293–335.
- Trecroci, C. and J.-L. Vega (2000), "The information content of M3 for future inflation". ECB working paper No. 33.
- Winkler, B. (2000), "Which kind of transparency? On the need for clarity in monetary policy-making", ECB Working Paper No. 26.