Monetary Policy-Making under Uncertainty

Conference organised jointly by the
European Central Bank (ECB)
and the Center for Financial Studies
of the University of Frankfurt
on 3 December 1999
in Frankfurt am Main

PROGRAMME

Editors Introduction

As a new central bank operating in a completely new environment, the European Central Bank (ECB) still faces greater-than-usual uncertainty about the state of the euro-area economy and the working of the monetary policy transmission mechanism. In addition, the ECB must establish a track record for maintaining price stability, and the gradual acquisition of that credibility can be an additional source of uncertainty.

Both forms of uncertainty have relevant implications for the design and framework of monetary policy and need to be better understood by both decision-makers and observers. For this reason, the European Central Bank and the Center for Financial Studies organised a conference on "Monetary Policy-Making under Uncertainty", which was held in Frankfurt on 3 and 4 December 1999, and featured contributions from high-level policy makers and top international academic experts in this field. This booklet contains the speeches delivered at the conference, the statements of the policy panel-lists, and a summary of the main papers presented and their discussions. The papers in their entirety can be downloaded from the ECB's webpage at http://www.ecb.int (Working Paper Series Section) as well as CFS' web-site at http://www.ifk-cfs.de.

The conference, which attracted more than 160 participants, was opened on Friday 3rd December with a welcoming address by the ECB President Wim Duisenberg. He stressed that this first, large, open conference, co-organised by the ECB, is yet another signal of the ECB's commitment to a continuous and active exchange with the academic world.

The morning session, which was chaired by John Taylor (Stanford University), started with a panel of high level policy-makers. The experts on the panel were Steven Cecchetti (Ohio State University), Charles Freedman (Bank of Canada), Otmar Issing (ECB), Leonardo Leiderman (Bank of Israel), and Lucas Papa-demos (Bank of Greece). The panel discussed the implications of different forms of uncertainty for the design and framework of monetary policy from the specific angle provided by their own policy experience.

The qualitative and quantitative impact of various forms of uncertainty (measurement error, forecast error, parameter uncertainty, model uncertainty) on how central banks should respond to developments in the state of the economy were analysed in the more scientific-oriented sessions.

The first academic presentation was a paper on "Indicator Variables for Optimal Policy" by Lars Svensson (Stockholm University) and Michael Woodford (Princeton University), and it was discussed by José Viñals (Banco de España) and Guido Tabellini (Bocconi University). Svensson and Woodford derive the optimal weights on monetary policy indicators in models with forward-looking variables and only partial information about the state of the economy. To demonstrate the properties of their model, they discuss an example of optimal monetary policy with unobservable potential output and a partially observed cost-push shock.

In the second session, Thomas Sargent (Stanford University and Hoover Institution) and Ju-Koo Cho (University of Illinois, Urbana-Champaign) presented their paper on "Escaping Nash Inflation", which was discussed by Ramon Marimon (European University Institute) and James Stock (Harvard University). The Sargent and Cho model assumes that the monetary authority controls the inflation rate up to a random disturbance, but does not know the true data-generating mechanism. Instead it uses a good fitting approximating learning model. The authors show that in such a framework least squares learning ensures convergence to rational expectations equilibrium. But, under fixed-gain recursive learning schemes that discount past observations, the so-called "escape dynamics" can drive the economy away from a rational expectations equilibrium. The authors argue that such dynamics could explain the great inflation experience of the 1970s.

The third paper on "The Performance of Forward-looking Monetary Policy Rules under Model Uncertainty" was delivered by Andrew Levin, Volker Wieland and John Williams (Federal Reserve Board) and was discussed by Charles Bean (London School of Economics) and Stefan Gerlach (Bank for International Settlements). Levin, Wieland and Williams compare the performance of outcome- and forecast-based rules in four different macro-econometric models of the U.S.

economy. They also investigate how robust these rules are with respect to model uncertainty. The paper shows that in all four models forecast-based rules yield at best only small benefits in stabilising inflation, output, and interest rates relative to optimised outcome-based rules that respond to inflation, the output gap, and the lagged interest rate. This is even true in the two large-scale models which contain literally hundreds of state variables and allow for significant lags until the maximum effect of a policy change on the economy is felt. Moreover, forecast-based rules may induce multiple equilibria with self-fulfilling expectations, if the forecast horizon is sufficiently long.

The paper by ATHANASIOS ORPHANIDES (Federal Reserve Board) on "The Quest for Prosperity without Inflation", which JORDI GALÍ (Pompeu Fabra and New York University) and PAUL DE GRAUWE (Leuven University) commented on, also dealt with activist monetary policy rules in which the central bank responds to inflation and the level of economic activity. Orphanides reconstructs real-time data that was available to U.S. policymakers from 1965 to 1993. Using an estimated model, he then per-forms counterfactual simulations under alternative informational assumptions regarding the knowledge policymakers can reasonably have had about the state of the economy when policy decisions were made. When realistic informational assumptions are used, findings favoring activist policies are overturned in favour of prudent policies that ignore short-run stabilization concerns altogether. The evidence points to misperceptions of the economy's productive capacity as the primary underlying cause of the 1970s inflation and suggests that apparent differences in the framework governing monetary policy decisions during the 1970s, compared to the more recent past, have been greatly exaggerated.

A highlight of the conference was the dinner speech given by ALAN BLINDER (Princeton University). After noting that the notion of monetary policy under uncertainty is somewhat redundant ("was there ever such a thing as monetary policy-making under certainty?"), Blinder listed 15 issues that he considers central to modern central banking. The issues can be grouped into three categories: 1) institutional design; 2) tactics for operating in the markets; 3) the model of the transmission mechanism. On each of them, Blinder gives his views based on his combined academic and policy-making perspective.

The paper by GLENN RUDEBUSCH (Federal Reserve Bank of San Francisco) on "Assessing Nominal Income Rules for Monetary Policy with Model and Data Uncertainty" was discussed by BEN MC-CALLUM (Carnegie Mellon University) and HENRIK JENSEN (University of Copenhagen). Rudebusch analyses two issues concerning nominal income targeting rules for monetary policy. First, he examines the performance of such rules over a range of plausible empirical models – especially models with and without rational inflation expectations. Second, he analyses the performance of these rules, in real time, using the type of data that is actually available to policy-makers rather than final revised data. The paper compares optimal monetary policy rules in the presence of such model uncertainty and real-time data uncertainty and finds only a limited role for nominal output growth.

The conference concluded with a series of five shorter presentations, which were jointly discussed by ALEX CUKIERMAN (Tel Aviv University), MARVIN GOODFRIEND (Federal Reserve Bank of Richmond), and CARL WALSH (University of California at Santa Cruz).

The paper by MARTIN ELLISON and NATACHA VALLA (European University Institute) on "Learning, Uncertainty and Central Bank Activism in an Economy with Strategic Interactions" presents a stylised model in which learning, uncertainty and strategic behaviour play a role. The model is estimated with G7 data and used to examine the optimal degree of activism of a central bank. The authors show that a central bank which takes into account that its actions could affect learning, may choose to be less active than a central bank that ignores learning effects.

The paper by ULF SÖDERSTRÖM (Sveriges Riksbank) on "Monetary Policy with Uncertain Parameters" presents a simple dynamic macroeconomic model and shows that uncertainty about structural parameters does not necessarily lead to a more cautious monetary policy. In particular, when there is uncertainty about the persistence of inflation, it is optimal for the central bank to respond more aggressively

to shocks than under certainty equivalence, since the central bank this way reduces uncertainty about the future development of inflation. Uncertainty about other parameters, in contrast, acts to dampen the policy response.

In his contribution "Caution and Conservatism in the Making of Monetary Policy" PHILIP SCHELLEKENS (London School of Economics) asks whether or not caution and conservatism improve the conduct of monetary policy-making. In his model he examines the implications of caution for the credibility and flexibility of monetary policy and suggests a reconsideration of the role for conservatism as an element of delegation. The key finding of the paper is that the conservative-central-banker approach need not imply sub-optimal output stabilisation.

The paper by PETRA GERAATS (University of California at Berkeley) on "Transparency and Reputation: Should the ECB Publish its Inflation Forecast?" aims at explaining why central banks may want to abandon secrecy in monetary policy and become very transparent by focussing on the disclosure of central bank forecasts. The model shows that transparency leads to lower inflation and gives the central bank greater flexibility to respond to shocks in the economy. Furthermore, transparency makes it easier for a central bank to build reputation and in order to achieve such benefits from transparency it is shown to be necessary to publish the conditional central bank forecasts for both inflation and output.

Finally, the paper by BERNHARD WINKLER (ECB) entitled "On the Need for Clarity in Monetary Policy Making" states that greater transparency about the policy-making process is one way of minimising the potential for misunderstanding between the ESCB and financial markets and the public. He proposes distinguishing between different aspects of transparency, and emphasises the particular importance of "clarity" in communicating central bank policy. "Clarity" means that information needs to be simplified, packaged, processed and interpreted in order to be understood. In this context, it is pointed out that the ECB faces an extraordinary communication challenge due to it being both a new and a supranational institution which must make itself understood vis-à-vis a fragmented set of audiences in a multi-cultural environment.

The conference organisers
Ignazio Angeloni (ECB),
Frank Smets (ECB) and
Axel A. Weber (CFS and Goethe-University)

Introductory Statement

Willem F. Duisenberg,
President of the
European Central Bank

Ladies and gentlemen,

It is a great pleasure to welcome you here to Frankfurt on the occasion of the conference entitled "Monetary policy-making under uncertainty", organised jointly by the European Central Bank (ECB) and the Center for Financial Studies of the University of Frankfurt.

As you can imagine, I have had the opportunity to live through many "firsts" in recent times. It all started on 9 June 1998, when the Governing Council of the ECB met for the first time. Then, on 4 January this year, the first transactions in euro were conducted in the money and foreign exchange markets and the first payments in euro were settled in the new TARGET system. Three months later, the first decision to change official interest rates was adopted by the Governing Council on 8 April. And I could continue. In the light of the unique historical journey upon which we embarked as a consequence of the establishment of a single currency in 11 sovereign countries, the smooth and successful start of Stage Three is a tribute to the dedication and relentless efforts of many of my colleagues at the ECB, at its precursor, the European Monetary Institute, and at the national central banks, and of many others involved outside the central banking community.

This event is another important "first" that is worth celebrating: the first, large, open conference organised by the ECB. I should like to use this occasion to thank Professor Weber from the Center for Financial Studies for co-organising this event with us. This conference – and I am sure there will be many more to follow – is yet another signal of our commitment to a continuous and active exchange between the ECB and the academic world. As many of you know, such conferences are not the only way in which we interact with academics. Many of you have already visited the ECB to present your views and discuss issues of policy interest with our economists. This year alone we have hosted around 50 presentations in the context of our Invited Speaker and Lunchtime Workshop programmes. In spite of the heavy workload faced by the ECB staff, such presentations are generally well attended and very much appreciated.

In addition, ECB economists present their work at academic conferences on a regular basis. The ECB has also launched a Working Paper Series via which our research is disseminated and to which the speakers at this conference will also contribute. Finally, this summer we started a new Graduate Research Programme in which students are expected to pursue part of their dissertation, work here at our headquarters, on topics that are relevant from the viewpoint of ECB policies. One such student, Petra Geraats, will tomorrow present her work at this conference.

Why do we invest so much time and resources in this exchange with the academic world? After all, as an independent pan-European institution, the ECB is, in the first place, accountable to the public at large, not to the limited circle of academic economists. I should imagine that the answer is obvious to most of you. Let me, nevertheless, expand somewhat on the most important reason, and this relates to what Alan Blinder, who will be the speaker at tonight's dinner, called the large, and sometimes unexploited, potential gains from trade in ideas between practitioners and academics.

Central banks are among the most intensive users of economic research. It is therefore of utmost importance that the ECB should continuously update its knowledge of, and expertise in, the most recent theoretical and empirical research findings. We should never be, as Keynes put it, unwitting "slaves of some defunct economist", while pretending to be exempt from intellectual influences. Just as most firms need to update regularly their computer and software systems in order to remain competitive, a central bank needs to ensure that it understands and can implement recent economic research in order to achieve its primary goal of price stability, in the most efficient way. Of course, just as most firms would not abandon their old time-honoured systems for new, untested ones without gathering evidence of their benefits and reliability, central banks need to be very cautious about jumping on the bandwagon of any new paradigm that academic researchers or other observers may provide.

The usefulness of economic research in monetary policy-making is very clear at all levels, from the institutional design of central banks to the details of day-to-day monitoring. We do not need reminding that it was the revolution in rational expectations and the results concerning the time inconsistency of optimal policies, together with the experience of the great inflation of the 1960s and 1970s and its associated costs, that contributed to a wave of changes in central bank charters based on the principle of independence and a clear focus on price stability. These principles also represent the foundations of the Treaty on European Union, which established the European System of Central Banks. With this in mind, it was, for example, decided right from the outset that the Eurosystem should clearly define its primary objective of price stability as an increase in the Harmonised Index of Consumer Prices of below 2%.

A similar mixture of sound theoretical and empirical research, and practical experience underpins the Eurosystem's monetary policy strategy, which, as you are aware, is based on a prominent role for money (in the form of a reference value for the growth of M3 of 4½%) and a broadly based assessment of the outlook for price developments. The money indicator provides a reference point for the evaluation of the prospects for price stability. Its usefulness is based on the long-term relationship between money and prices, which characterises virtually all economic models and which has been extensively illustrated in empirical studies. This relationship reflects the fact that inflation is ultimately a monetary phenomenon.

While the reference value for monetary growth is a useful and robust policy guide in many ways, and ensures that the ECB maintains a medium-term perspective, it is clear that the ECB, like any other central bank, needs to take into account all the information it has at its disposal. No central bank can afford to rely on a single indicator or a single rule. The second pillar of our stability-oriented monetary policy strategy provides a framework in which that information can be processed and presented. The most important guiding principle is that information should be used to the extent that it is relevant for the assessment of future price developments and the risks to price stability.

And this brings me to a third area in which economic research has an important role to play: the monitoring of indicators and of their implications for the outlook for price developments. Let me focus on model-based analysis. Clearly, such analysis, including model-based forecasts, can be a useful tool for interpreting the available information in a consistent and coherent framework. However, these forecasts are only as good as the underlying models that are used. Moreover, different models may be used to answer different questions. We, at the ECB, are committed to developing and maintaining a set of tools that are useful for analysing the euroarea economy, and examining the implications for future inflation. This is, however, not a trivial task given the large uncertainties that we are facing due to the establishment of a multi-country monetary union. Not only can we expect some of the historical relationships to change due to this shift in regime, but also, in many cases, there is a lack of comparable historical and cross-country data series that can be used to estimate such relationships. We are availing ourselves of some of you as consultants in this difficult process. However, the bottom line is that, in spite of all the progress made, it takes time to develop such tools, and that some of these uncertainties will never disappear.

I have mainly spoken to you about the important input that economic research provides in central banking. Let me briefly touch upon the other leg of this exchange. How can central bankers contribute to the academic world? Again the answer seems obvious. By bringing together researchers and central bankers in conferences like this, by inviting academics to give presentations at our central bank and engage in discussions with our economists, by bringing academics from their ivory towers into the hustle and bustle of real-world policy-making, we hope that we can inspire them to go back to their universities and research institutes and work on the issues that confront us in our daily policy-making process. Some of these issues are very practical, like devising new econometric techniques to detect structural change. Others are empirical, like understanding movements in volatile asset prices, or examining the implications of much-needed structural reforms in labour and goods markets. Finally, some of the most important issues for central banks are analytical: for example, understanding the role of money and credit in the transmission mechanism of monetary policy, or the issues arising in conducting monetary policy in conditions of low inflation. All these issues show that whoever thought monetary policy would become boring once price stability was achieved, was clearly way off the mark.

After all, one of the few things we economists know with certainty, is that we know little without uncertainty. It is, therefore, entirely appropriate that the first academic conference organised by the ECB should deal with the topic of "Monetary policy-making under uncertainty". I wish you very interesting and stimulating discussions and I look forward to witnessing the results.

Opening Remarks

John B. Taylor,
Stanford University

Thank you very much for an excellent beginning to this conference on Policy Making Under Uncertainty. I want to thank the European Central Bank and the Center for Financial Studies for organizing a really very interesting conference – and for inviting me to it.

The first session of the conference is a panel of policy makers discussing the subject of Monetary Policy Under Uncertainty. It is an honor for me to chair this opening panel with such a distinguished group of policy makers.

I think it is an excellent idea to start a conference on research on policy uncertainty by hearing from the policy makers who actually have to make decisions under uncertainty. There is nothing like having to make a decision about whether to raise or lower an interest rate – an action that affects many people's lives – to focus one's mind on the importance of uncertainty. And so,

we will begin by hearing about what it is like to make decisions under uncertainty.

Another reason that it is an excellent idea to start the conference by hearing from policy makers is that the ultimate goal of the policy research to be presented later is to help inform policy makers and to help them make better policy decisions. So, in my view, this beginning puts the emphasis on the right priorities.

We have a panel of five experienced policy makers: Prof. Otmar Issing from the European Central Bank, Prof. Steven Cecchetti who has just stepped down as Research Director at the Federal Reserve Bank in New York and is now at Ohio State, Dr. Charles Freedman of the Bank of Canada, Dr. Leo Liederman from the Bank of Israel, and Governor Lucas Papademos from the Bank of Greece.
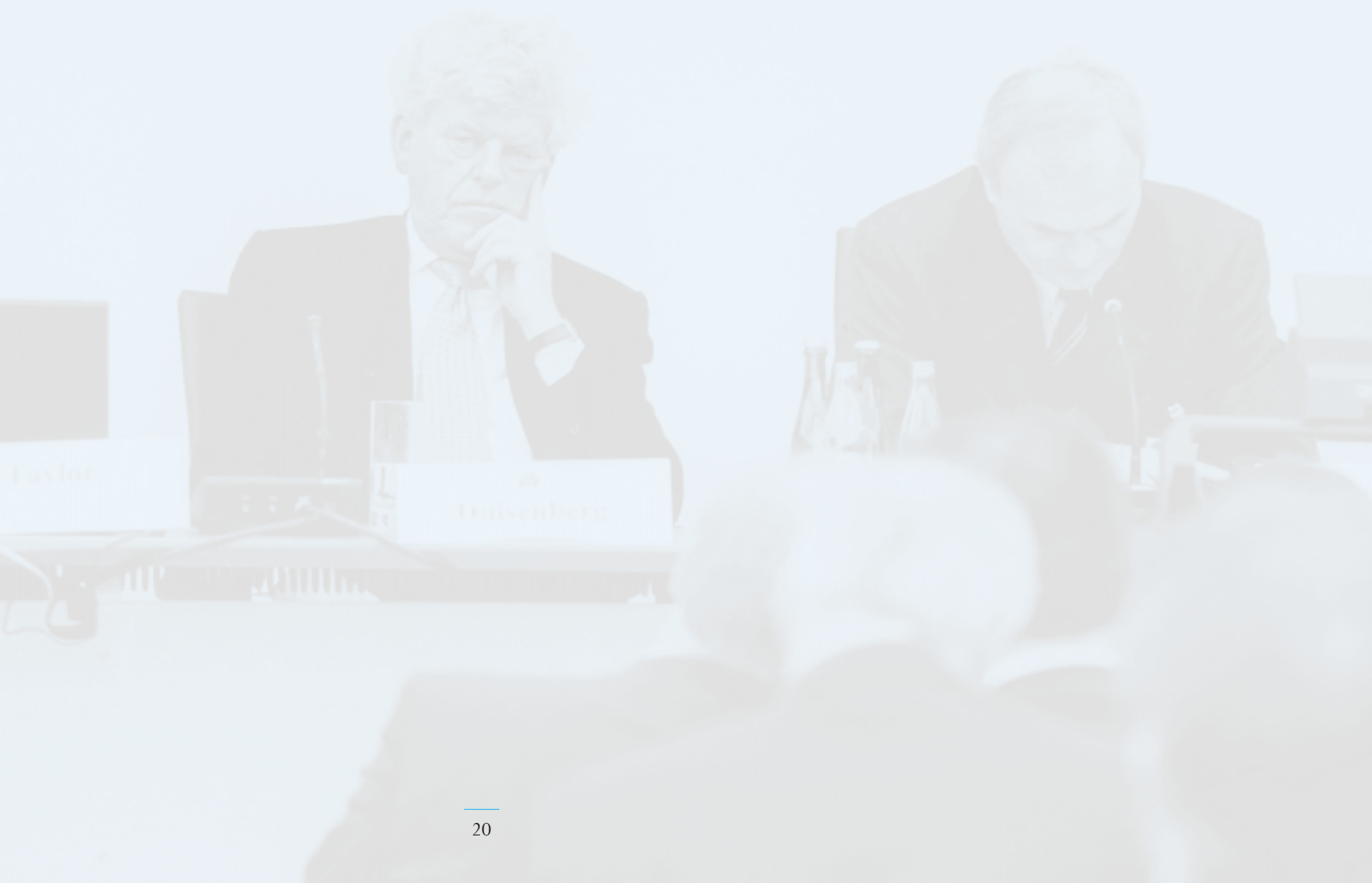And we are going to begin with Professor Issing.

The monetary policy of the ECB in a world of uncertainty

Otmar Issing,
Member of the Executive Board of the
European Central Bank

1. Introduction

As a central banker directly involved in monetary policy-making, I have been dealing with uncertainty and its consequences for a large part of my professional life. From my experience as a member of the Board of the Bundesbank, I have vivid memories of the challenges posed by German reunification and the turbulence surrounding the ERM crises. But never have I felt the impact of uncertainty so acutely as in the weeks that preceded and followed the introduction of the euro and the birth of the single monetary policy. Now, after almost a year, we feel more comforta-

ble: we have learned a lot from that experience. But exactly one year ago this week, when the Governing Council made its final announcements on the monetary policy strategy and was getting ready for the Changeover Weekend, the uncertainty was at its peak. Nothing could be taken for granted, no matter how careful had the preparatory work been.

It was precisely in those weeks, and for these reasons that the idea of hosting an academic conference on "Monetary policy-making under uncertainty" came to our minds. No other subject seemed to us, at

the same time, so close to the frontier of academic research and so relevant for our direct concerns. Our desire was, and still is today and tomorrow, to give an opportunity to central bankers to learn from recent academic research on this issue and, vice versa, to enable academic economists to benefit from the awareness of the practical concerns of central bankers.

2. The many aspects of uncertainty in monetary policy-making

Academic economists hardly need any reminding that central bankers have to make decisions in a world of pervasive uncertainty. However, while the academic profession has made tremendous progress in analysing risk in well-defined stochastic economies, the "Knightian" uncertainty that confronts central bankers is altogether of another dimension. Among the various forms of uncertainty that central bankers face, the uncertainty about how the policy instrument affects inflation and economic activity – the monetary transmission mechanism – and the uncertainty about the current state of the economy – the data – appear to weigh particularly heavily.

Central bankers need to have a good understanding of the timing and the ultimate effects of changes in the monetary policy instruments on inflation and economic activity in order to be successful in conducting monetary policy. For this purpose, monetary policy-making requires more than just the qualitative information that theory provides. They must have quantitative information about magnitudes and lags,

even if that information is imperfect. However, within the profession of central bankers – probably even within a particular institution – there is no common view on the appropriate specification of a model suitable for the analysis of monetary policy issues.

Given the high degree of model uncertainty, central bankers highly welcome the recent academic research on the robustness of monetary policy rules across a suite of different models. Some of that research will be presented at this conference.

Even if there were a consensus on an appropriate model, there would remain considerable uncertainty about the model's parameters. Since Brainard (1967) it is well known, that this form of uncertainty provides a rationale for a prudent, gradualist approach to monetary policy-making. The policy relevance of this result has nicely been reiterated by the former Vice-Chairman of the Board of Governors of the Federal Reserve System Alan Blinder (1999) who concludes that "a little stodginess at the central bank is entirely appropriate."

However, research, which will be presented tomorrow, shows that this result depends on the exact source of parameter uncertainty. In particular, if the uncertainty concerns the persistence of inflationary developments, central banks may be well advised to be firmer in their policy response. Similarly, adopting robust control theory Sargent (1999) finds that parameter uncertainty does not necessarily imply a

reduction in the responsiveness of monetary policy.

Beyond the need of a suitable model, a thorough assessment of the current state of the economy is central to the formulation of monetary policy. Among the multitude of useful indicators the concept of the output gap and, intimately related, that of potential output, plays an important role in measuring future inflationary pressures. Unfortunately, potential output is unobserved and, as with estimates of other unobserved variables such as the NAIRU or the equilibrium real interest rate, there is no obvious way in which it can be defined and estimated.

Moreover, since central banks need to operate in real time, the data used in the assessment of the current state of the economy are incomplete and sometimes subject to substantial revision. For the U.S., Orphanides and van Norden (1999) have conducted a comparative study of alternative methods for estimating the output gap in real time. Research presented later today shows that taking into account the sizeable measurement error derived from these real-time estimates leads to a significant deterioration of feasible policy outcomes and causes efficient policies to be less activist.

All in all, academic research as well as the practice of central banking seem to reaffirm the famous dictum by Milton Friedman (1968) questioning activist monetary policy. This dictum seems true, even more for the ECB's monetary policy, since the level of uncertainty which the ECB faces on account of the transition to Stage Three of EMU is even higher than the level of uncertainty which central banks face in normal times. The ECB is confronted with a historically almost unique regime shift accompanying the introduction of the single currency.

With regard to the operation of the single monetary policy, we can only safely say that we know, at best, the broad contours of the euro-area transmission mechanism right now. What we can say for sure, however, is that there is a considerable likelihood that the way monetary policy is transmitted may change, making the task of the ECB even more difficult. For example, the restructuring and the intensification of the competition within the banking system will deeply affect the interest rate channel given the dominant role it plays for financial intermediation in the euro area. The uncertainties surrounding the data are magnified by a lack of area-wide time series. Therefore, econometric analysis has to make inferences on the basis of "fictitious", aggregated time series that pre-date the formation of EMU, and the way in which these time series are constructed is not beyond dispute.

Given this uncertain environment, however, the ECB did not have the option to wait for even some of the uncertainties to resolve. Instead, the ECB designed its monetary policy strategy to guide monetary policy in the best possible way through all the deep waters that inevitably surround the transition to the single currency.

Dealing with these deep waters had at least three important implications for formulating the strategy. Let me turn briefly to them.

3. Credibility

First, in an environment of uncertainty it is important to establish and maintain the credibility of the central bank for achieving price stability. High credibility will reduce the probability that unexpected deviations in inflation from price stability will be interpreted as a change in objectives rather than the result of shifts in the underlying relationships. Although, in the end, it is the central bank's actions and performance that will determine its reputation, the mandate of the Treaty – to maintain price stability as the primary objective – and its institutional set-up provide a solid foundation for building such a reputation for the newly established ECB.

Moreover, the pre-commitment expressed through the announcement of the stability-oriented strategy helps to preserve the anti-inflationary reputation from its precursors, the national central banks. For this, and the previous reason, it was also important that the ECB clearly defined what it means by price stability. Some observers have criticised this definition for not being precise enough. The definition, however, contains two very precise statements. The ECB does not consider inflation above 2% as price stability; and the ECB does not consider deflation as price stability. Being more precise, in the form of a point target, is likely to be counterproductive, exactly because of some of the uncertainties we will discuss at this conference, such as measurement bias in the price index.

A measure of the credibility the ECB enjoys in the markets can be extracted from the yields on long-term bonds. If one takes a look far enough ahead, beyond the horizon of business cycles, changes in long-term nominal interest rates typically reflect markets' perceptions of long-term inflation risks. If the central bank is credible, long term rates will not move very far away from levels consistent with maintained prospects of price stability; they will quickly jump to higher levels if credibility is lost. If I take a look at long-term bonds denominated in euro, I can conclude that the ECB has already earned a considerable level of credibility given the particularly high degree of uncertainty it faces.

Despite the increase over the course of this year, which seems to reflect mainly global factors, long-term interest rates in the euro area appear fully consistent with a prolonged period of price stability. In fact, the most recent decrease in connection with the Governing Council's interest rate decision on 4 November confirms this view.

4. Flexibility

Second, in an environment of high uncertainty about the economy, flexibility – some would call it discretion – is important. Monetary policy decisions must always remain a valid option which results from a complex evaluation of empirical results, theoretical reasoning, and judgmental inputs. This is why central banking has sometimes been described as an art, and this is why a central bank cannot afford to be strictly bound by any simple policy rule which may be optimal for a given structure of the economy, but breaks down as soon as the structure changes.

More generally, no central bank can afford to disregard information. That is, no central bank can escape the need to continually assess the state and the operation of the economy using a multitude of indicators and information variables, and base their policy decisions on the comprehensive assessment of that information for the risks to price stability. The second pillar of our strategy ensures that the ECB takes all this information into account with its relevance for future inflation as guiding principle. At the same time, however, a prudent central bank should recognise that much of the information at its disposal is fraught with considerable noise. As we learned from Friedman, it does not pay to be too activist in a very uncertain world (and various papers in this conference will illustrate this point).

Once we recognise that informational problems, among others, limit the scope for activist policy, a robust policy guide with a

medium-term orientation would be a useful tool. In the Eurosystem's strategy the reference value for the growth of the broad monetary aggregate M3 plays such a role. It is based on a simple framework, which is robust to important forms of data uncertainty (though not all of them). It is intended to help analyse and present the information contained in M3 in a manner that offers a coherent and credible guide for monetary policy aimed at price stability over the medium term. More basically, monetary growth in line with the reference value should be consistent with the maintenance of price stability at that horizon.

Of course, the practical usefulness of money growth as a medium-term policy guide will also depend on the existence and the stability of a long-run relationship between money and prices as typically embodied in structural models of long-run money demand. Recent empirical studies at the ECB have provided evidence on the existence and the stability of the latter. More recent academic research tends to show that the real money gap, i.e. the difference between current real money holdings and its long-run level, is a good predictor of future inflation.

We have fairly good reasons to be confident that the long-run relationship between money and prices is not significantly affected by the transition to Stage Three of EMU, i.e., that it is robust as it has proved, ubiquitously, to be in the past. However, we must also be aware of possible structural shifts in the future. This form of uncertainty,

and also a lack of strong empirical evidence at the time when the decision was taken, explains why the Eurosystem decided not to adopt a monetary targeting framework.

But, the Eurosystem decided also against adopting an inflation-targeting framework. Instead, by introducing a reference value for the growth of a broad monetary aggregate – not a target in the traditional sense –, the two-pillar strategy is designed to ensure that a balance is reached between the information which is provided by the broadly-based assessment of the prospects for price stability, and the medium-term information which is contained in the monetary aggregate.

Not surprisingly, it takes some time until it is widely recognised that the strategy chosen by the ECB is neither monetary targeting nor inflation targeting, nor even a mixture of these two approaches well known to observers. It is a new strategy designed for a unique situation with which the ECB was confronted before the start of Stage Three.

Nevertheless, I found recent critique of not having adopted either a monetary or an inflation targeting strategy not very convincing since it was not accompanied by any evidence of why the reason for the cautious two-pillar approach of the ECB were not justified.

5. Communication

I have so far emphasised the virtues of flexibility. But there is a clear limit – or

counterbalance – to it: flexibility must be accompanied by a continuous effort towards openness and clarity in communication.

High uncertainty complicates communication with the public and the financial markets. As a result, one cannot rely on simple communication devices, but needs to tell the full story. Some observers have wrongly taken the comprehensive assessment of the prospects for, and risks to, price stability to be synonymous with an inflation forecast, which is customarily at the centre of direct inflation targeting strategies. However, the broadly-based assessment comprises an analysis of such a wide range of indicators and information variables – including various internal and external forecasts – that it cannot be reasonably summarised in a single number or chart.

Instead, the Eurosystem's strategy provides an honest account of all the pieces of information that have been taken into account in the decision-making process. The ECB's Monthly Bulletin summarises the analysis of the information leading to the decisions of the Governing Council, and provides the most recent statistical information on the euro-area economy. Moreover, immediately after the first Governing Council meeting of each month, the ECB's President and Vice-President together hold a press conference where they comment on the meeting, explain the decisions taken, and then answer questions.

The two-pillar strategy of the Eurosystem helps organising all the available in-

formation in a way which permits both to more efficiently structure the internal decision-making process and to communicate these decisions to the public. The monetary policy strategy is thus an important vehicle to explain policy decisions and thereby to also affect market expectations and, indirectly, economic behaviour and outcomes.

To stabilise market expectations and thereby increase the effectiveness of its monetary policy actions, the ECB should do nothing to add to the level of uncertainty confronting the private sector of the economy. More precisely, the ECB needs to act and to convey its actions to the public in such a way that errors in the market expectations of what the ECB is going to do are minimised.

6. Conclusion

To conclude, in dealing with the pervasive uncertainties that surround the introduction of the single currency, the Eurosystem's strategy is able to combine the sophisticated demands to modern central banks with the traditional prudence that central banks need to adhere to in order to avoid being themselves a source of monetary instability.

Our strategy is credible and flexible at the same time and allows for a timely response to a changing environment while keeping the objective of price stability in clear focus. It communicates the commitment to price stability by providing a clear definition. This helps to anchor inflation expectations and also preserves the anti-inflationary reputation inherited from its precursors, the national central banks.

The two pillars – a reference value for the growth of a broad money aggregate and a broad based assessment of the outlook for inflation – are used to explain monetary policy decisions necessary to maintain price stability. The prominent role of money – as signalled by the announcement of the reference value – is rooted in robust theoretical and empirical arguments accumulated over many decades of research.

Of course, in the uncertain circumstances surrounding the early years of Stage Three, the ECB is particularly aware of the challenges posed by a changing environment. In this regard, without losing sight of a few fundamental principles that have been known for a long time in the discipline, the ECB is looking forward to a fruitful discussion about the advances of research on the optimal design of monetary policy under uncertainty which will be presented at this conference.

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Monetary Policy Making and Uncertainty

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Most uncertainty is unavoidable. For instance, we know that the current, extraordinary, boom in the U.S. will eventually come to end, we just don't know when. We know that the sustainable growth rate of the U.S. economy has increased over the past five years, we just don't know how much. The list goes on. The job of central bankers is to conduct monetary policy in order to promote price stability, stable growth, and a stable financial system. They do this in an environment fraught with such unavoidable uncertainties. But in conducting policy, there is one uncertainty that policy makers can reduce: the uncertainty they themselves create. Everyone agrees that monetary policy makers should do their best to minimize the noise their actions add to the environment. The essence of good, transparent, policy is that the economy and the markets respond to the data, not to the policy makers. Does the U.S. Federal Reserve's Federal Open Market Committee (FOMC) meet this test? Or, do the current FOMC practices add noise to the economic environment? These are the questions faced by the committee chaired by Federal Reserve Board Governor Roger Ferguson, that is due to recommend possible changes as early as the next FOMC meeting on 21 December 1999.

Current practices were put in place on 22 December 1998, when the FOMC announced that it would periodically release statements explaining some of its policy actions, and clarifying the committee's thinking about likely future events. Beginning with the announcement on 18 May 1999, there have now been 5 such statements, one following each of the FOMC meetings between May and November. To understand the history of these statements, it is important to begin with the FOMC's policy directive. The directive has two parts, the first is a brief description of the current state of the economy, and the second sets the target for the federal funds rate and 1 Cecchetti is Professor of Economics, Ohio State University, and former Director of Research at the Federal Reserve Bank of New York. This essay is based on a remarks prepared for the policy panel at the joint European Central Bank/Center for Financial Studies conference on "Monetary Policy-Making under Uncertainty," Frankfurt, Germany, 3-4 December 1999.

1. then describes the committee's consensus about the likely future course of interest rates. This last portion of the directive has become known as the "tilt" or "bias".

The directive agreed to on 5 October 1999 contained an upward bias, stating that: "In view of the evidence currently available, the Committee believes that prospective developments are more likely to warrant an increase than a decrease in the federal funds rate operating objective during the inter-meeting period."

While the minutes of this meeting became publicly available only on 18 November 1999, and so the exact wording of the directive was only known 6 weeks plus two days later, a brief statement released the day of the meeting making it clear that, this language had been adopted. Following a brief comment about how "a decreasing pool of available workers willing to take jobs" posed risks to the inflation outlook, the statement closed with the following remarks: "Against this background, the Committee adopted a directive that was biased toward a possible firming of policy going forward. Committee members emphasized that such a directive did not signify a commitment to near-term action. The Committee will need to evaluate additional in-formation on the balance of aggregate supply and demand and conditions in financial markets."

Following the most recent meeting on 16 November, when the FOMC raised the federal funds rate target by 1/4 percentage points to 5 1/2 percent, the announcement of the interest rate change was accompanied by a comment that the bias had been returned to neutral. That is, the final sentence of the directive in place today reads: "In view of the evidence currently available, the Committee believes that prospective developments are equally likely to warrant an increase or a decrease in the federal funds rate operating objective during the inter-meeting period."

Does the FOMC's current announcement policy clarify policy maker's intentions, reducing the uncertainties in the environment? Or, does this scheme actually obfuscate the FOMC's intentions, making policies more opaque and increase risks surrounding future policy actions? There are numerous difficulties with the current disclosure procedures. Primary among them is that the statements clearly mean different things to different people.

A primary reason for this is that the FOMC is actually not clear about its own objectives. Unlike the European Central

Bank, whose primary objective is price stability, defined as inflation in the Harmonized Index of Consumer Prices of less than two percent, or the Bank of England, where the Monetary Policy Committee is charged with maintaining inflation of 2 1/2 percent in the Retail Price Index, the Federal Reserve has no publicly stated objectives. The language of the Humphrey-Hawkins Act, which is very long on goals and very short on details, is all that we have. As a result, not even the members of the committee seem to agree on the specific goals they are striving to achieve. Is current policy targeting inflation? If so, at what level? Using what measure? Some articulation of these goals seems essential if we can ever hope for clarity and transparency from the FOMC.

A second problem is that the bias in the directive has no agreed upon interpretation, even within the FOMC. Taken literally, the second sentence of the final paragraph of the directive is a statement about the intermeeting period. That is, about likely interest rate actions prior to the next formally scheduled FOMC meeting. Within this context, some people seem to think that the bias gives discretionary authority to Alan Greenspan, as the Chairman of the FOMC, to change interest rates on his own. This interpretation has it that if the bias is neutral, as it is today, then the Chairman can move the federal funds rate by 1/4 per-

centage points in either direction. With a bias, he would be able to go 1/2 percentage points in the direction of the tilt, but not the other way. Even if there were an understanding that this were the case, and there is not, it is inconceivable that any Chairman would use such power without extensive consultation with the members of the committee.

On a practical level, the tilt has been used as a consensus building device. The FOMC is unlike both the ECB council, whose votes are never published, and the Bank of England's Monetary Policy Committee, who have a clear willingness to disagree publicly on the current stance of policy. In contrast, the FOMC both publishes its votes (in minutes released two days following the next meeting), and has a tradition of public consensus. For there to be more than two dissenting votes, out of the twelve voting members (when there is a full complement), is nearly unheard of. Dissents, particularly by the Governors or the President of the Federal Reserve Bank of New York, would be viewed by many observes as a revolt against the Chairman. The bias in the directive acts as mechanism whereby the Chairman insures that there is not significant dissent. When there is significant disagreement on the committee, the Chairman will offer those with only mild differences of views a biased directive as a

way of expressing themselves without actually voting against his position.

The history of the statement is that, after a newspaper story disclosed the directive soon after the May 1998 meeting, triggering a sharp drop in stock prices, a number of the participants in the FOMC process expressed their dissatisfaction.

While some people approved of the policy of disclosing the directive with a substantial lag, when it had become essentially irrelevant, others thought it best to announce the bias immediately after it was adopted. The current selective release of the bias and the statement is a result of the discussions that ensued during that year. The intention was to reduce the speculation about the committee's position, and increase the transparency of policy making.

My view is that the current strategy has been increasing the uncertainty created by the FOMC, not decreasing it, as had been hoped. There are several difficulties. First, the bias refers only to the intermeeting period, while the statements that have been released thus far use wording like "policy going forward," implying a longer horizon.

Furthermore, by referring to selective concerns in the outlook, such as the recent focus on labor productivity and the pool of available workers, the statement suggests that future actions are predicated largely on the data that is in a small subset of what will become known before the next meeting. Finally, the statement gives the impression

that the committee has been able to summarize its likely reaction to future events in a few sentences (the statements have been between 3 and 6 sentences). Surely none of these is either accurate or possible.

As for the tilt itself, it is important to ask whether it serves any useful purpose at all. In the absence of a more detailed description of the sense of the committee, the bias is very difficult to interpret. It is not, as some market participants seem to believe, a conditional vote about the next meeting. That is to say, when the committee sets a biased directive, it is not voting to change interest rates in the future. This would be very bad practice, and no one should be advocating it.

I have tried to argue that the current policy of including a bias in the FOMC directive, with selective public release of the bias and an accompanying statement on the day of the meeting, increases confusion. Where should we go from here? First, I propose the elimination of both the bias and the statement as they are currently constituted. The statement is too short to properly convey the sense of the committee, and the only purpose the bias serves is internal consensus building. If there is a bias, the market participants will speculate about it, and try to figure out what it is, and so there is little justification for not announcing it.

Looking to other central banks, we see several alternatives. The first is the ECB's approach, following that of the Bundesbank, where the President holds a press

conference at the conclusion of each council meeting. This promotes transparency and enhances understanding. The give and take of a news conference allows for a description and justification of the decision that has been taken, and its accompanying subtleties. I am in favor of the Chairman holding a news conference following each FOMC meeting.

My preferred solution, and my recommendation to the Ferguson Committee, is the publication of the minutes of the meeting be moved forward. The Bank of England publishes detailed minutes of the Monetary Policy Committee's deliberations two weeks following each meeting. This is an excellent communications device, as it contains details that make policy decisions much easier to understand, with the concluding section of the minutes would contain a clear synopsis of the committee's views on the future. The two week lag may seem like an eternity to financial market participants, where two minutes can be a long time, but it is the minimum that is physically possible. This short wait is likely to be worth the overall reduction in the uncertainty of monetary policy.

Monetary Policy Making and Uncertainty

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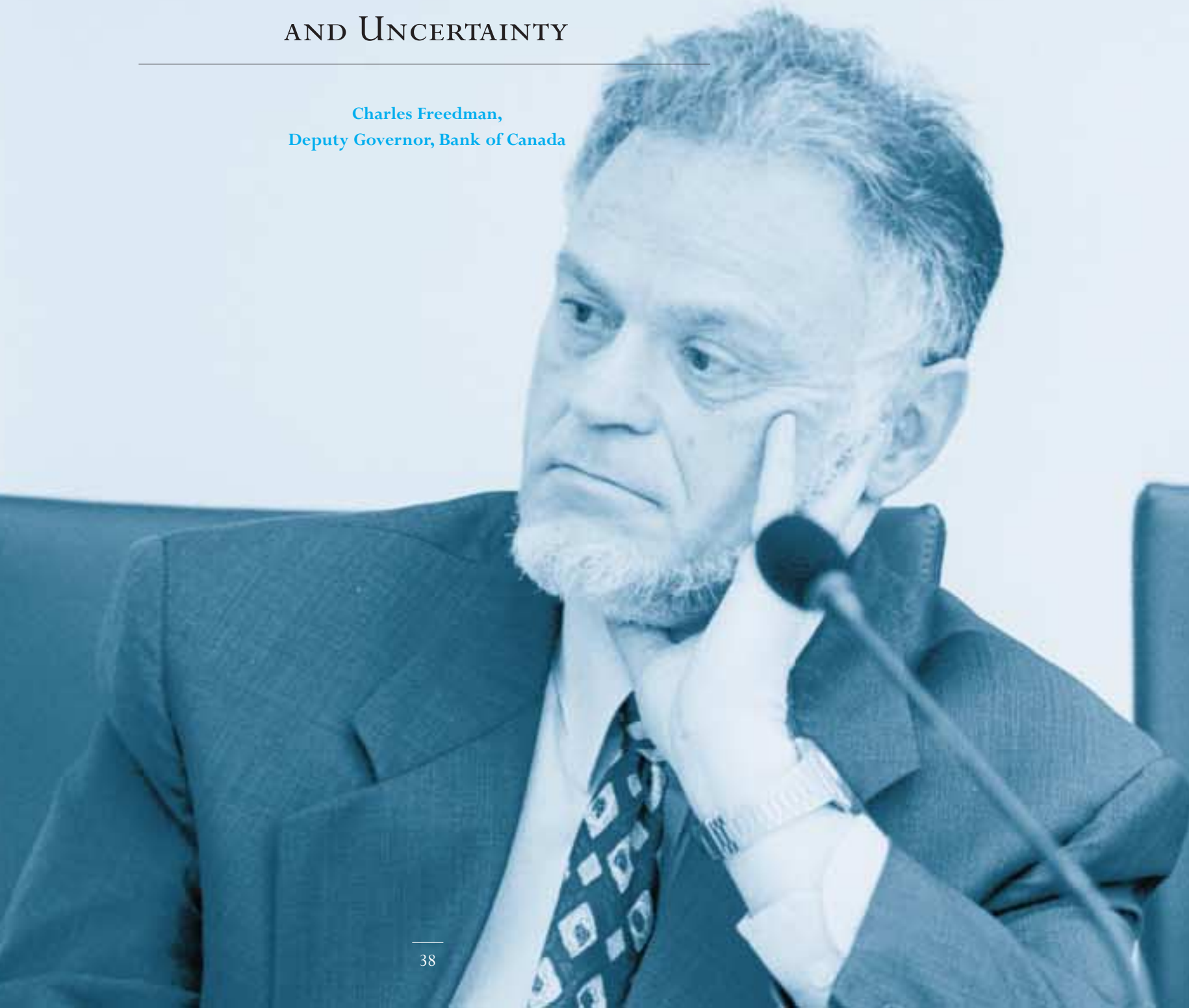
In my remarks, I will focus on how various forms of uncertainty have affected the practical aspects of monetary policy-making in Canada. The discussion, of course, reflects the large and growing body of theoretical literature on policy-making under uncertainty, since the way policy-makers interpret the reality that they face is strongly influenced by how that reality is characterized in theoretical models. I will also be emphasizing some of the issues that face a central bank in a small open economy with flexible exchange rates. This approach contrasts with most of the literature, which focuses on models of closed economies.

I should note, by way of introduction, that the policy-maker's role is not just to assess the economic situation and then take "appropriate" action. It is also to explain the reasons for the action, and, indeed, for the whole policy approach, to the public and to the markets in a convincing manner. The importance of communication cannot be overstated. Public support for the broad approach to policy is essential in a democracy. And the effectiveness of monetary policy is appreciably increased if the expectations of the markets and of the public are in line with those of the authorities. But, as we shall see, it is precisely the various forms

of uncertainty – additive uncertainty, multiplicative uncertainty, data uncertainty, and model uncertainty – that make it difficult to decide on the need for action and the magnitude of that action, and then to convince markets and the public that the action is appropriate.

Let me begin with a framework, like the one in place in Canada, in which the central bank has a target for the rate of inflation and responds to deviations of the forecast rate of inflation from that target six to eight quarters in the future. The focus on forecasts of inflation six to eight quarters in the future takes into account the lags between monetary policy actions and their effects on inflation. This forward-looking approach allows policy-makers to move in a timely manner and thus to avoid generating excessively sharp movements in output by their actions. Of course, using an inflation target as the nominal anchor entails operating under a regime of flexible exchange rates.

The inflation-targeting framework clearly places a great deal of emphasis on the central bank's forecast of inflation and on its model of the transmission mechanism between its actions and their eventual effect on inflation. Both of these involve considerable uncertainty.

Let me begin with the inflation forecast. In a small economy like Canada's, the starting point for the forecast is an assessment of developments in the world economy, and we pay particular attention to

developments in the United States, which is by far our largest trading partner. Given the external forecast, we then assess future developments in the Canadian economy, most notably in aggregate demand and inflation. The forecast of inflationary pressures, in turn, indicates the monetary policy actions required to bring inflation to the target rate or to hold it there. In this context, we are faced with additive, multiplicative, data, and model uncertainty.

Additive uncertainty comes from the projections of external and domestic demand and supply developments, or shocks. In particular, are recent demand shocks likely to be long-lasting or transitory? Or, put another way, is the momentum in the economy likely to persist or to fade? An example from the recent past might be instructive. When the Asian crisis first broke out, our interpretation was that it would have relatively little direct effect on the Canadian economy because our trade with that region of the world was so small. While we recognized that the Asian crisis might have indirect effects on Canada through its possible impact on the U.S. economy and on the prices of raw materials, we initially did not expect these factors to be very important. But as the full magnitude of the decline in the Japanese economy became apparent and as the prices of raw materials were increasingly affected by the global slowdown, our views concerning the impact of the developing crisis on the demand for Canadian goods and services and on the future rate of inflation changed considerably.

Additive uncertainty is the simplest form of uncertainty, and it typically requires the central bank to take action based on certainty equivalence. In practice, however, interpreting whether an unexpected outcome is the result of a demand shock, a supply shock, or both; deciding whether the shocks are likely to be transitory or long-lasting; and making clear the degree of uncertainty associated with the interpretation of such shocks when communicating with the public and with markets are not easy tasks. They are central to the forecasting process and take considerable time and effort on the part of policy-makers.

Consider, for example, a demand shock that has typically been autocorrelated in the past but for which, in the current circumstances, no information is available regarding the likely degree of autocorrelation. More concretely, suppose that on one-half of the occasions when the shock occurs it lasts two quarters, while for the other half it lasts only one quarter. The certainty-equivalent optimal policy is always to act as if the shock will continue into the second quarter but with a weight of one-half. On one-half of the occasions, the central bank will therefore underreact, and inflation will rise above the target, and on one-half of the occasions, it will overreact and inflation will fall below the target.

At times in the past, in the face of this kind of uncertainty, central banks have chosen to underreact and to wait and see whether the shock actually persisted into the second quarter. In circumstances where

expectations were not well anchored, this could prove to be a recipe for actions being "too little, too late." However, following the deleterious experience of the "great inflation," central banks have recognized the importance of pre-emptive action to prevent inflation from re-emerging. Pre-emptive action is especially important when inflation expectations are not well anchored and can easily be unhinged. under such circumstances, even a temporary demand shock could result in a rise in inflation expectations because of past experience and the uncertainty regarding the duration of the shock. Thus, it could affect the rate of inflation.

In recent years, an important development that makes it somewhat easier for the central bank to cope with the kind of demand shocks that I have been describing has been the success of policies aimed at achieving low inflation. The increased credibility of these policies has provided an anchor for inflation expectations. In many countries with inflation targets, longer-term inflation expectations have come to settle on the centre of the inflation-control target range. This has allowed the central bank an increased margin for manoeuvre when responding to demand shocks. Whereas, in the past, an upward movement in prices resulting from a demand shock would have fed into inflation expectations fairly rapidly, in today's circumstances central banks have the luxury of taking more of a wait-and-see attitude because the shock-induced increase in prices would not immediately affect inflation expectations. Put

another way, the reduction in both the market's and the public's uncertainty about the central bank's commitment to containing inflation has anchored longer-run inflation expectations. This has made it easier for a central bank to deal with its own uncertainty about whether a demand shock is transitory or longer-lasting by waiting before taking policy action; i.e., it need not be quite so pre-emptive. That said, waiting too long before acting could be risky (especially if the shock occurred when the rate of inflation was already at or above its target) since credibility, and the associated anchor for inflation expectations, could be lost if the central bank was perceived not to be reacting appropriately to the inflation pressures from a longer-lasting demand shock.

A similar story can be told about supply shocks, including the price-level increases resulting from a currency depreciation. In the past, with uncertainty about the central bank's commitment to keeping inflation low and, hence, little or no anchor for inflation expectations, an increase in the price level induced by a supply shock or by a currency depreciation would rapidly feed into inflation expectations. Hence, the central bank would have to react quickly to such a shock to prevent, or at least minimize, the extent of a resulting wage-price spiral. In the 1990s, with inflation expectations more firmly anchored, the public and the markets are better able to differentiate between price-level movements and inflation pressures, with the former requiring less of a monetary policy response than the latter.

Market uncertainty regarding the type and duration of shocks affecting the economy could cause difficulties for the central bank in its conduct of monetary policy. To lessen these difficulties, the central bank should be as transparent as possible about the uncertainties surrounding its outlook for the economy and its assessment of inflationary or disinflationary pressures.

How can a central bank communicate the nature and extent of the uncertainty it faces to the public and to the markets? One way is to formally set out the probability distribution of the forecast path for inflation, as is done, for example, in the fan chart in the Bank of England's Inflation Report. Less formally, the central bank can talk about a range for output growth and inflation, thereby giving the public and the markets some indication of the degree of uncertainty around the forecast. Moreover, it can describe the kinds of risks surrounding the forecast to draw attention to the conditionality of any forecast and to the uncertainty about the assumptions that underlie the base case. It can also present alternative scenarios based on different paths for exogenous variables, such as demand growth in the country's trading partners. That said, there can be a tendency at times on the part of markets to view forecasts as being more precise than the central bank intends. Therefore, no opportunity should be lost to emphasize the nature and extent of the uncertainties surrounding forecasts and, hence, policy decisions, and the particular sources of those uncertainties.

In summary, while dealing with additive uncertainty is simple in theory, in practice the difficulty of interpreting the type of shocks, drawing the appropriate conclusion for the required policy action, and explaining the uncertainty to the markets and to the public all pose significant challenges for the central bank.

Let me now turn to uncertainty about the output gap. In its simplest form, this type of uncertainty involves additive uncertainty, and the policy prescription from the standard framework with a quadratic loss function is to make one's best guess of output potential and to ignore the uncertainty surrounding this guess. In practice, this can be difficult, as I have discussed above. But there are also other factors that complicate both theory and practice. As Orphanides (1999) has shown, errors in the estimates of the output gap can be highly autocorrelated, and this can lead to major errors in policy-making. Overestimates of productivity growth and underestimates of the degree of tightness in labour markets in the early to mid–1970s were important elements in the outbreak of inflation in a number of countries. In addition, the use of filters to estimate potential output is backward looking, and there can therefore be major problems at the end of the sample. Moreover, parameter estimates of such key elasticities as the slope of the (inflation-augmented) Phillips curve are conditional on the measures of the output gap. So, if there is uncertainty about the output gap, there is also uncertainty about these elasticities, which introduces multiplicative uncertain-

ty. And the standard Brainard result is that multiplicative uncertainty calls for a more cautious response than would otherwise have been the case.

The current situation facing Canada involves output near or at measured capacity. But there is considerable uncertainty as to whether the conventional measure of capacity reflects reality, given all the policy changes and restructuring of the 1990s, and given the recent U.S. experience in which unemployment moved well below traditional measures of NAIRU without, thus far, leading to significant inflation pressures. In assessing future developments, the Bank of Canada's response to this uncertainty has been to put less emphasis on the measured output gap and more emphasis on other leading indicators of inflation.

We can interpret the U.S. experience and the recent Canadian experience as a form of "probing," in which the central bank acts in a less pre-emptive manner than otherwise when responding to a shock that would seem to test the limits of previous estimates of capacity. Nonetheless, in such circumstances, the central bank must be especially vigilant for signs of pressures on capacity (e.g., delivery delays or bottlenecks) and pressures on inflation (e.g., wage settlements or acceleration of money growth).

More generally, multiplicative uncertainty applies to virtually all coefficients in estimated models. From a central bank's point of view, the most important is proba-

bly the considerable uncertainty attached to every element of the transmission mechanism. This includes the effect of the central bank's action in changing the overnight interest rate on money market rates, on longer-term rates, on administered rates, and on the exchange rate, as well as the effect of changes in interest rates and the exchange rate on spending, and the effect of changes in spending on the future rate of inflation and on expected inflation. At every stage of the process there is considerable uncertainty, and at every stage, changes in expectations play a critical role in determining the outcome. In line with the literature, this type of uncertainty leads the central bank to be somewhat more cautious than would otherwise have been the case when taking action, and is probably one of the factors that leads to the "successive approximation" approach to decision-making.

Let me now turn to model uncertainty. One important way in which this type of uncertainty fits into the decision-making process relates to the role that monetary aggregates play in the transmission mechanism. Are they simply passive elements in a world in which financial prices are the key drivers, or do they play an active role in the transmission of central bank actions to demand and inflation? At the Bank of Canada, there are competing views on this issue and on how uncertainty about the correct model should influence the analysis leading up to policy decisions. In response to this particular uncertainty about the correct model, the Bank of Canada recently formalized the role of monetary aggregates

in the forecast process by adding to the traditional staff forecast of output and inflation (based on a forecasting model adjusted to incorporate the judgment of the staff) a companion projection that is based on movements of the financial variables (also adjusted for staff judgment). In addition to the implications that movements in the money and credit aggregates have for output and inflation, this companion projection includes an assessment of the implications of such financial measures as the term spread and the spread between conventional and indexed bonds. The weight that policy-makers will place on the various inputs into the forecasting process will clearly depend on the track record that they generate over time in forecasting future developments. We are also examining alternative reaction functions to see how robust they are across different models.

I would now like to discuss how the exchange rate enters the policy process in Canada – another area where uncertainty seems to have played an especially important role. A few years ago, the Bank of Canada developed the concept of the monetary conditions index (or MCI) as a policy guide for a central bank in a small open economy. This concept was intended to capture in one measure both of the channels through which monetary policy actions affect the economy; namely, interest rates and the exchange rate. Thus, for example, if a 25-basis-point increase in the central bank's benchmark interest rate led to a significant appreciation in the value of the currency, this would imply much more tigh-

tening overall than if the value of the currency remained unchanged or appreciated only a little in response to the policy action. Or, to put it slightly differently, the size of an interest rate increase required to achieve a desired amount of tightening in monetary conditions would depend on the extent of the currency appreciation that accompanied the interest rate increase.

One implication of this approach is that an exchange rate movement resulting solely from portfolio adjustments on the part of international or domestic investors would require an offsetting interest rate adjustment to keep monetary conditions unchanged. Now, it was made very clear in the original analysis that other kinds of shocks that affected the exchange rate, such as a terms-of-trade shock, would require a different kind of response. For example, a significant decline in the prices of raw materials, such as Canada experienced during the Asian crisis, would lead to both a weaker economy and a depreciation of the Canadian dollar. In this case, the currency depreciation would be appropriate for the weakening economic and inflation situation, and there would be no reason to adjust interest rates in an offsetting manner.

Use of the MCI as a policy guide, while appealing, had two basic difficulties associated with it. First, the markets started to treat all exchange rate movements as portfolio shocks and therefore came to expect an offsetting interest rate adjustment every time there was a movement in the exchange rate, whether or not such an

adjustment was appropriate. Second, and this difficulty faces all central banks in a floating exchange rate regime, the central bank itself had to make a judgment on the source of the shock to the exchange rate and the likely persistence of the shock in order to decide on the appropriate response.

There are, of course, circumstances in which the source of the shock is evident. Terms-of-trade shocks or asynchronous business cycle movements in Canada and the United States are obvious examples. But when the origin of an exchange rate movement is uncertain, how should the central bank react? Should such a depreciation of the Canadian dollar be interpreted as the result of the market anticipating a future weakening in raw materials prices or a slowing in the growth of Canadian domestic demand, or simply as the outcome of a portfolio readjustment by investors that is unrelated to the fundamental factors that influence economic developments? An off-setting interest rate response would be appropriate in the portfolio-readjustment case but not in the case of a shock to fundamentals (or what could be termed a "real" shock).

In the first half of the 1990s, the portfolio shock was the more prominent source of shocks to the Canadian dollar, while in the latter part of the decade real shocks seemed to predominate. Therefore, our view of the "default" interpretation for cases in which the source of the shock was uncertain, which is often the case, moved away from a portfolio adjustment towards a real

shock. Indeed, Smets (1997) has argued that the reason Canada chose to use the MCI (which is particularly helpful in explaining the response to a portfolio shock) and Australia did not, is that the typical shock affecting the Canadian dollar at the time the MCI was adopted was a portfolio shock and the typical shock affecting the Australian dollar was a real shock. And with the increased importance of real shocks for the Canadian dollar in the later 1990s, the role of the MCI has diminished in Canada.

There is one other issue relating to monetary policy-making under uncertainty to which I would briefly like to draw attention and that is the notion that there might be limits to transparency. In practical terms, this shows up in debates among central banks regarding the publication of their forecasts. More broadly, one can question the extent to which central banks should explicitly or implicitly signal either their forthcoming actions or their tendencies with regard to official interest rates. For example, the recent U.S. discussion about the usefulness of the Fed's announcement of a "bias" focused on whether it helps markets understand the Fed's stance or simply causes confusion. In Canada, conditional statements by the Bank of Canada about the future path of monetary conditions made in the spring of 1998 ended up being undermined by the impact on Canada of the surprising size and degree of contagion associated with the Asian crisis. Markets became unsettled in the aftermath of these developments. Part of the problem seems to have arisen from the market's interpretation of

these conditional statements as a form of commitment. Following discussions with market participants, the Bank decided to focus its discussion of future developments on aggregate demand and inflation pressures and to leave it to the financial markets to draw their own conclusions about the likely future path of monetary conditions.

This issue of possible limits to transparency deserves further attention from academics and policy-makers. And the best way to address it would seem to be in the context of models that deal with the effect of uncertainty both on optimal ways of making policy and on the best ways of communicating with markets and with the public.

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Some Lessons from Israel

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In the comments that follow, I elaborate on what, in my view, is the main lesson on the impact of uncertainty on monetary policy-making based on Israel's experience with inflation targets in the 1990s. This main lesson is as follows: in an economy where there is considerable uncertainty about the persistence of inflation shocks, and in which there is only partial credibility of monetary policy in its attempt to achieve inflation targets – both these phenomena reflecting a history of high and volatile inflation-relatively aggressive policy responses to deviations of inflation from target can have – especially when unanticipated – a stronger and more effective impact in bringing inflation back to the target, than smaller and gradual policy actions. I have no general theorem to support this proposition at this time. However, it is claimed below that a plausible interpretation of the evidence, points in that direction.

In spite of recent rapid convergence to single-digit rates of inflation, many key transmission mechanisms that were introduced previously in Israel under double- and triple-digit inflation are still here. Leading examples are the existence of widespread wage- and financial-markets indexation to the consumer price index and to the exchange rate, and a relatively quick passthrough from nominal exchange rates to prices. In addition, the history of high and volatile inflation left its mark, in a considerable degree of ambiguity, about the compatibility of fiscal policy and wage policy with the inflation targets set by

government, and about the degree of commitment of monetary policy to achieving these targets. Taken together, these features formed some of the key 'initial' conditions for disinflation in the 1990s, and as such, they play a central role in assessing the impact of uncertainty on monetary policy-making in Israel, or in any other country where present economic institutions and the credibility of anti-inflation policies are still influenced by a history of high inflation.

As also indicated by other participants in this panel, and as documented in several of the research contributions in this conference, economic theory does not yield unambiguous implications regarding the effects of uncertainty on monetary policy making. Brainard's (1967) original contribution showed that uncertainty about the impact of interest rate changes on inflation and output gives rise to more cautious, and less aggressive, monetary policy responses than would be the case under certainty equivalence. Yet more recent analysis, by various authors, has questioned this result and has pointed to a-priori ambiguity about the impact of uncertainty. That is, once Brainard's one-period framework is extended to a multi period dynamic setup, and once various forms of uncertainty are considered, various relations may emerge, including that which suggests that uncertainty should lead to more aggressive monetary policy responses quite in contrast to Brainard's result.

That this is the case has been stressed e.g. by Sodertrom's (1999) research contri-
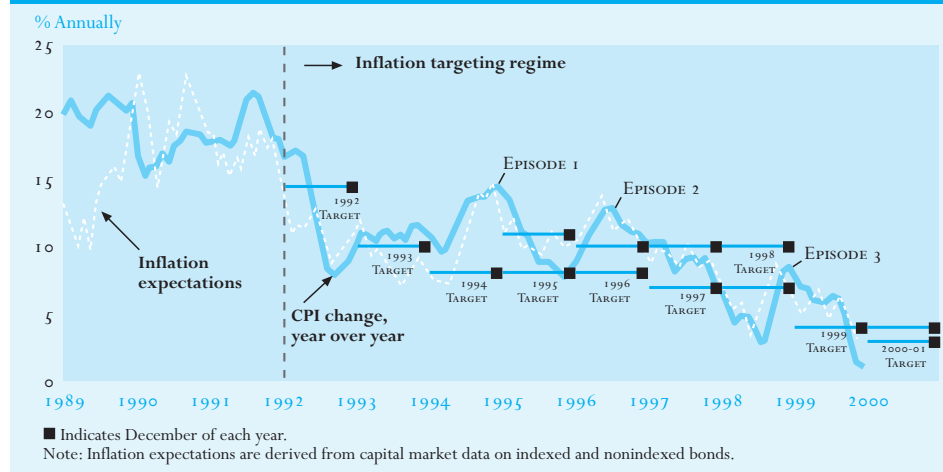
bution to this conference. Using an extended version of Svensson's small-scale macroeconomic model of inflation targets, the author shows that parameter uncertainty acts to dampen current policy responses, much in the flavor of Brainard's result. To the contrary, however, uncertainty about the degree of inflation persistence results in more aggressive policy responses than under certainty equivalence. This is the case because as the dynamics of inflation become more uncertain, strong policy actions can help reduce the uncertainty about the future course of inflation and can shift inflation closer to target. It turns out that, as indicated by the author, previous analytical work of Craine, Sargent, and Onatski and Stock produced similar results about the policy effects of uncertainty about the dynamics of the economy.

In reality, policymakers face of mix of these and other sources of uncertainty. While it seems that in many circumstances in Israel – especially at relatively tranquil times--Brainard-type considerations have led, in fact, to relatively smooth interest rate policy responses in reaction to shocks, policy in more turbulent recent inflationary episodes provides substantial support to these relatively new ideas.

Before we turn to some details on those episodes, in Israel's case, that seem to support non-Brainard type reactions by policymakers, it is well to briefly describe the current monetary policy regime. Broadly speaking, inflation targeting has played a key role in the disinflation in the

1990s. Following the well known inflation stabilization program of mid 1985, there has been a double-digit rate of inflation in the range from 10 to 20 percent in the late 1980s and early 1990s, and recently inflation has been reduced to about 3-4 percent per year. The inflation target for 1999 was 4 percent and the rate of inflation was actually much lower than that (i.e., about 1.3 percent), and the targets for the years 2000 and 2001 have been set as the range of 3 to 4 percent. For the first time since the 1960s, there is a good chance that Israel's inflation rate in the near future will not differ much from that of advanced western economies. While policymakers have been operating under inflation targets since 1992, there has been a considerable degree of ambiguity about the nature of these targets, about the conduct of monetary policy, and about the fact that the inflation target has also key implications for the stance of fiscal policy and wage policy. A key difficulty has been the coexistence of inflation targets with nominal exchange-rate targeting, in the form of a currency band, and the lack of a well specified preference ordering between the inflation target and the nominal exchange rate target . Another difficulty has emerged in the mid 1990s, when there was a considerable degree of monetary policy overburdening aimed at offsetting, at least partially, the inflationary impacts of a relatively expansionary fiscal policy that was not compatible with the inflation target. If anything, these conditions have prompted the central bank to maintain a more 'conservative' stance than otherwise, in order to build up anti-

% Annually

Inflation targeting regime

EPISODE 1

EPISODE 2

1992 TARGET

1993 TARGET

1994 TARGET 1995 TARGET 1996 TARGET 1997 TARGET

1998 TARGET

EPISODE 3

Inflation expectations

CPI change, year over year

1999 TARGET 2000-01 TARGET

1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000

■ Indicates December of each year.
Note: Inflation expectations are derived from capital market data on indexed and nonindexed bonds.

% (Daily data) NIS

+2.0% +2.0%

-0.5%

-0.5%

Russian crisis

LTCM

Dollar

Expectations

8/98 9/98 10/98 11/98 12/98 1/99 2/99 3/99

X% Indicates a change in BoI interest rate by X%.

inflation reputation and credibility and to ensure the achievement of the targets, and this more 'conservative' stance showed up in several quite aggressive policy responses to potentially destabilizing shocks.

To illustrate this, I rely on three salient episodes in which there were growing risks that inflation might end up well above target: in late 1994, mid 1996, and late 1998. These appear in Figure 1, which depicts the evolution of yearly inflation, market-based, one-year-ahead inflation expectations (derived from the yields on CPI-indexed bonds and non indexed bonds), and inflation targets. In the first two cases, a combination of expansionary fiscal policy and other factors created inflationary pressures which resulted in within-the-year marked deviations of forward-looking inflation expectations from the inflation target. Accordingly, in the last quarter of 1994 — i.e., the first episode — inflation expectations (as well as inflation forecasts) reached the high level of about 14 percent from a

level of about 7 percent in the first quarter of the year, while the underlying inflation target was 8 percent for the whole year. Similarly, in the second episode, toward the middle of 1996 inflation expectations accelerated to a level of about 13 percent while the official target was the range 8-10 percent.

What was the monetary policy response to these marked deviations of inflation from target? It turns out that throughout the year 1994 there were gradual increases in the central bank interest rate, in response to a gradual increase in inflation expectations over the year. The central bank rate was raised from about 10 percent at the start of the year to 12.5 percent in August. Yet, since these measures did not succeed in reducing the acceleration of inflation and of inflation expectations, the central bank — in a somewhat unexpected action — raised the interest rate in October by 150 basis points, and then again in December by the same amount, to reach a level of 17 percent at the
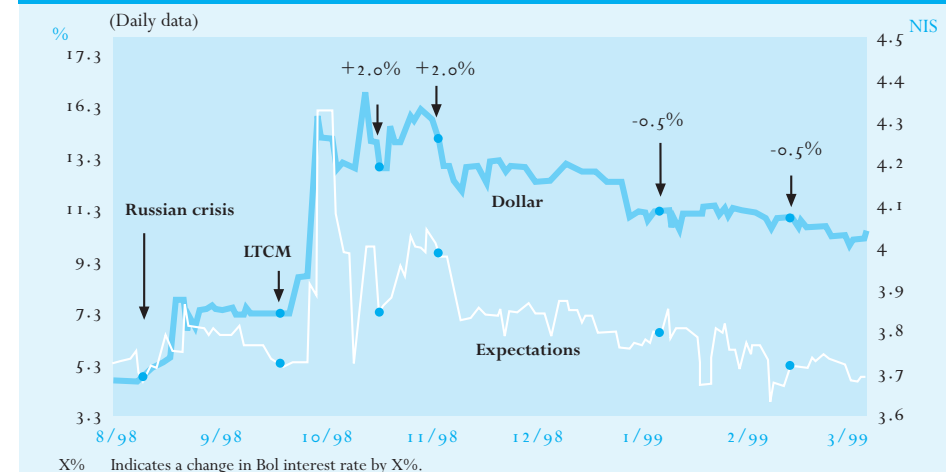
end of the year. It seems that both these unanticipated relatively aggressive policy actions had a major impact in reducing the rate of inflation in later months. Subsequently, in a matter of four to five months, there was a drop of 500 basis points in inflation expectations, well into the target range. In 1995, three consecutive raises in the central bank rate, of 80 basis points in May, 50 basis points in June, and 150 basis points in July (the latter order of magnitude came as a surprise to the markets) contributed to bring about a drop in inflation expectations which reached below 10 percent at the end of that year.

The third illustrative episode has to do with the period immediately following the Russian crisis and the LTCM failure in the second half of 1998. In Israel, the impact of the reduction in overall capital inflows to emerging economies resulted in a depreciation of about 15 percent of the domestic currency against the US dollar, from August to October of that year.

The main concern for monetary policy was that what in other economies could have been a one-time jump in the nominal exchange rate and in the price level, could become in Israel a permanent rise in the rate of inflation. In the high-inflation past, currency devaluations had typically a strong impact on inflation expectations and on the rate of inflation. The quick passthrough from the exchange rate to prices, and to the level of inflation, reflected the existence of widespread wage- and financial indexation mechanisms, together with a high degree of monetary accommodation, all of which gave rise to strong inflation persistence. Although these elements of the past were eliminated to a great extent during inflation targeting in the 1990s, the size of exchange rate depreciation this time — especially the fact that in about three days, from October 6 to 8, 1998, there was a nominal exchange rate depreciation of about 10 percent — probably brought back some of the memories from the earlier high-inflation period. That this is probably the case, is evident

from the daily data in Figure 2, where it can be seen that the sharp currency depreciation was accompanied by a marked rise in one-year-ahead inflation expectations, which reached levels well above target. That is, marked exchange rate depreciation in two to three days had a strong impact on one-year-ahead inflation expectations!

The central bank's initial policy response to these events included no intervention in the foreign exchange market and no raise in the interest rate for September and October, on the 'hope' that under the inflation targeting regime this episode represented more of a price level jump than of a permanent rise in the rate of inflation. However, as inflation risks could not be ruled out, and as inflation expectations exhibited some inertia at previous levels, the central bank rate was raised at the end of October by 200 basis points, and in the face of a lack of a considerable downward adjustment of inflation expectations the rate was increased again by the same amount in two weeks, at an unexpected time, and this was perceived as 'news' by the markets. It was only after this second, strong and unanticipated rise in the central bank interest rate that inflation expectations and the rate of inflation began to converge back to target.

Although these are episodes from Israel, the lessons that can be derived from them have wide applicability. To generalize, in economies where there is considerable uncertainty about the persistence of inflation shocks – especially because of a history of high and volatile inflation, whose impact on economic agents and institutions lasts for a long period – and in which there is only partial credibility of monetary policy in its attempt to achieve inflation targets, relatively aggressive policy responses to deviations of inflation from target can have--especially when unanticipated – a stronger and more effective impact in bringing back inflation to the target, than smaller and gradual policy shifts. This is in line with the theoretical work discussed at the start of this discussion. This does not mean that Brainard-type considerations have not influenced monetary policy in Israel. In fact, in many occasions the monetary authority opted for cautious and gradual responses to what were relatively small shocks in tranquil circumstances, in an attempt to learn more, over time, about the nature of the shocks and their effects on the economy. Yet, when major risks to the inflation targeting regime emerged – of a nature quite analogue to what a speculative attack does to an exchange rate regime – more aggressive policies had an effective impact in avoiding transmission of one-time shocks to a permanent rise in the rate of inflation, and in strengthening the anti-inflation credibility of the central bank. This relation, between uncertainty, credibility, and policy responses is central to current monetary policy across many countries and regions, including that of the ECB, and is certainly worthy of future theoretical and empirical research.

Central Bank Strategy and Credibility

Lucas Papademos,
Governor, Bank of Greece

The theme of this conference might be interpreted by some as suggesting that central bankers occasionally have the luxury of formulating and implementing policy under conditions of certainty. Of course, the only certainty in central banking is the uncertainty surrounding it. In fact, uncertainty is the salient feature of the science and art of monetary policy-making. There are several types of uncertainty which complicate a central banker's task:

- uncertainty associated with the impact of exogenous variables or of non-monetary policies on the economy;
- uncertainty regarding market behaviour as well as the impact of technological and institutional change;
- uncertainty relating to the role and nature of expectations of future developments and policies, which crucially influence the transmission of monetary policy to the economy; and, consequently,
- uncertainty about market perceptions of the effectiveness of the central bank in performing its monetary policy function.

I would like to focus on two related aspects of this theme:
- the implications of the nature and relative magnitude of different types of uncertainty for the optimal choice of monetary policy strategy (which should be distinguished from the concept of a monetary policy rule);
- the importance of credibility in enhancing the effectiveness of monetary policy and the role of the institutional framework (for example, central bank independence and accountability) in increasing credibility.

Although I will illustrate my remarks by drawing upon the experience of Greece, I believe that the general conclusions are not country-specific.

In recent years, the monetary policy strategy adopted by the majority of central banks has involved some form of inflation targeting, in the sense that the primary policy objective is to maintain price stability or reduce inflation, depending upon initial conditions. This is fundamentally the consequence of a widespread consensus among economists, as well as among policymakers, that long-term GDP growth cannot be influenced significantly by monetary policy and that there is no trade-off between inflation and unemployment in the long run. Furthermore, although an inflation-unemployment trade-off may exist in the short run, theory and evidence suggest that it is likely to be rather unstable so that it cannot be exploited in a systematic way by monetary policy. These propositions, regarding the nature of the inflation-unemployment trade-off in both the short and the long run, are supported by the Greek experience over the past twenty years.

The consensus which has emerged regarding the primacy of price stability as the monetary policy objective has not been accompanied by a consensus on the appropriate strategy for achieving it. Several approaches have been adopted, of which the most common are: direct targeting of future (or forecasted) inflation, and indirect targeting of inflation, either by aiming to control the growth rate of money suitably defi-

ned, or by stabilizing the exchange rate against the currency of a low inflation country. The popularity of these strategies has varied over space and time. There are also other, more synthetic, approaches which involve elements or variations of the above, such as the one pursued by the ECB.

We should neither expect nor perhaps even aim at reaching a consensus on the appropriate strategy which is likely to be superior under all "circumstances", that is, for all countries independently of their market or institutional structure and of the state of their economy. This is because the optimal strategy partly depends on the economic, financial and institutional structure, the likely stance of other policies, initial conditions, as well as the dominant sources of uncertainty facing a central bank over the relevant time horizon in which it formulates and implements policy. Of course, some of these determining factors may not be exogenous and may be altered by policies and institutional changes to improve the effectiveness of monetary policy. Let me illustrate this point with reference to the Greek experience.

Over the last ten years, the Bank of Greece has adopted three different strategies in its attempt to disinflate the economy and achieve the necessary inflation convergence for joining EMU. During this period

inflation declined from an average rate of around 20% in the late eighties to about 2% today. In the late eighties and until 1993, the Bank employed a monetary targeting strategy. The target range for broad money growth was chosen to be consistent with the inflation objective and projected real GDP growth. The choice of a monetary targeting strategy was justified by: (i) a fairly stable relationship between broad money growth and nominal GDP growth, and (ii) the ability of the Bank to control reasonably well, though not perfectly, the evolution of the money stock. These two prerequisites for effective monetary targeting were partly met because of the financial structure prevailing at the time: a banking system not fully liberalized, a relatively underdeveloped financial sector, and extensive capital controls.

But, the adoption of monetary targeting was also a consequence of additional considerations. Although the Bank had a high degree of operational autonomy to set and achieve intermediate monetary objectives, it had to accept the government's inflation objective and, more generally, the orientation of monetary policy had to be broadly in line with the overall objectives of

government policy. Fiscal and income policies, however, were not always compatible with the inflation objective (either ex-ante or ex-post), while the system of wage indexation inhibited inflation control. To put it simply, and in the present context, the cumulative uncertainty regarding the relationship between the ultimate inflation goal and the monetary policy instruments was perceived to be far greater than that concerning the relationship between these instruments and the intermediate monetary target. Thus, direct inflation targeting was not only more difficult to implement, but it also involved risks for the credibility of the central bank within the prevailing institutional framework and in view of the uncertainty about the stance of economic policies.

By mid-1994, the deregulation of the banking system, financial innovation and the full liberalization of capital movements had impaired the stability of the relationship between monetary aggregates and nominal GDP, and had undermined the ability of the central bank to control broad money effectively. Consequently, monetary targeting was gradually abandoned and, between mid-1994 and spring 1998, the exchange rate of the drachma against a basket of European currencies became the intermediate objective of monetary policy. The choice of this strategy was not only a consequence of the increased uncertainty associated with the links between inflation, money growth and interest rates. It was also influenced by uncertainties regarding the magnitude and evolution of the output gap

and, more importantly, expectations about the stance of economic policies as well as about the future behaviour of the exchange rate following the lifting of all capital controls. These uncertainties raised serious doubts about the effectiveness of direct inflation targeting, and underlined the importance of employing the exchange rate, both as a means of stabilizing expectations (about the exchange rate and the monetary policy stance) and as a device which could help impose greater discipline on economic policy. The choice of the exchange rate as an intermediate objective was also affected by the prospective participation of the drachma in the ERM, which was a precondition for joining EMU. In 1994, however, inflation was too high and fiscal policy too slack for ERM participation to be considered a viable option.

The strategy of employing the exchange rate as an intermediate target proved quite effective in reducing inflation, and increased the credibility of monetary policy, which became more transparent. The credibility of the central bank was enhanced because exchange rate targets were met over a period of almost four years, during which the exchange rate was defended vigorously and successfully on a number of occasions. Although this strategy increased public confidence in the currency, accelerated the pace of disinflation, and promoted the fiscal consolidation process, it did not succeed in imposing the necessary degree of discipline on the labour market. Consequently, international competitiveness was eroded and the current account

deficit widened. Uncertainty about the sustainability of the exchange rate target and "rational" expectations about the need to maintain exchange rate stability within the ERM for at least two years before joining EMU precipitated the entry of the drachma into the ERM in March 1998.

The participation of the drachma in the ERM led to a change not only in the institutional framework but also in the monetary policy strategy. Following ERM entry, monetary policy, although paying attention to the volatility of the exchange rate, has focused more on achieving the final policy objective of price stability, as explicitly specified by the law which formally granted independence to the Bank of Greece in December 1997. Thus, policy instruments have been adjusting relatively more directly to the future path of inflation, which is forecast by employing various economic and financial indicators, including the output gap, as well as a monitoring range for the rate of growth of broad money. The latter serves not as an intermediate target but as an indicator of the monetary policy stance because of the considerable uncertainty surrounding the size of the output gap and the non-inflationary rate of unemployment. The main reason, however, underlying the adoption of such a strategy was another type of uncertainty facing policy-makers. It related to the fact that the drachma's ERM entry was accompanied by a devaluation, which entailed a "shock" to the price level and adversely affected expectations about the future course of inflation and the exchange rate. It was the-

refore deemed necessary to pursue a more restrictive monetary policy than that implied by targeting the central parity of the drachma within the ERM, in order to help absorb the inflationary effect of the "devaluation shock" and achieve price stability as quickly as possible, thus maintaining confidence in the sustainability of the central parity. The greater flexibility for monetary policy allowed by the standard fluctuation band of + 15% in the ERM was therefore considered useful, and was exploited. This strategy was also appropriate for controlling liquidity growth generated partly by substantial capital inflows, induced by high domestic interest rates and a favourable outlook for nominal convergence, and the country's eventual participation in the euro area.

The effectiveness of the monetary policy, pursued in Greece in recent years, to reduce inflation and achieve price stability, reflects a number of factors. First, the adoption of the appropriate strategy given the structural and institutional constraints and the dominant sources of uncertainty affecting the economy over the relevant period. Second, the flexible and resolute use of policy instruments to offset the impact of external disturbances as well as internally-generated inflationary pressures, favourably influencing expectations about the prospects for price stability. Third, the enhanced credibility of monetary policy, following the successful implementation of an exchange rate targeting strategy in previous years, and the adoption of a new institutional framework which not only granted

the Bank independence in pursuing price stability, but also made it accountable for achieving it. Fourth, an improved macroeconomic policy mix, which resulted in fiscal and labour market policies becoming progressively more supportive of monetary policy. These factors contributed to reducing uncertainty about the orientation and implementation of monetary policy, thereby increasing its effectiveness. I believe that the Greek experience is of broader relevance and I would like to draw some general conclusions regarding (i) the choice of an effective monetary policy strategy, and (ii) the role and determinants of central bank credibility in achieving the final policy objective.

The review of the three monetary policy strategies pursued during different phases of the disinflation process in Greece illustrates how the choice of the appropriate strategy depends upon the relative importance of different types of uncertainty facing policy-makers, including uncertainty regarding financial market behaviour and structure, the size of the output gap, the stance of non-monetary policies, and expectations about the future path of key variables. However, the choice and effectiveness of a strategy depends on other factors as well, such as the economy's financial structure, its degree of openness, labour-market characteristics, and the institutional framework of monetary policy. The various strategies pursued during the convergence process of the Greek economy reflected, as I have argued above, the substantial change in these economic, structural, and institutio-

nal factors, as well as the relative magnitude of different types of uncertainty. These conclusions were derived from the experience of a given country in different periods. But, similar conclusions could be obtained by comparing the alternative strategies pursued by different central banks in a given period.

This leads me to express the view that the strategy of the ECB is the most appropriate one for the euro area under the present circumstances. Pure monetary targeting could be subject to a high degree of uncertainty in the new environment of monetary union, which may induce shifts in behavioral patterns and/or the restructuring of the financial system. At the same time, pure inflation targeting could be difficult to implement credibly in view of increased uncertainty regarding the monetary transmission mechanism in the euro area, and the expected impact of decentralised national non-monetary policies. The strategy adopted by the ECB is likely to be superior to these two alternatives. It may appear relatively complex, but this does not imply that simpler alternatives would be more effective in attaining the final objective. We should not overlook the fact that a chosen strategy, which is indeed superior to other possible alternatives, may still appear insufficiently effective because of the influence of economic and institutional factors which would also constrain the effectiveness of other monetary policy strategies as well. These points should be taken into account in the current debate on this issue.

The credibility of a central bank is an important determinant of policy effectiveness because of its influence on market expectations, and thus on the dynamics of the transmission process. The Greek experience suggests the following about the determinants of central bank credibility. The legal framework of a central bank, which safeguards its independence in achieving well-defined and feasible objectives for which it is accountable, is a necessary and essential determinant of its credibility. Nevertheless, the legal framework is not sufficient to ensure credibility and effective performance. Another necessary ingredient is the implementation of economic and structural policies which are compatible with the attainment of the monetary policy objective. And, of course, a central bank must be able to implement its strategy consistently, and use its policy instruments with flexibility and resolve. It must also employ a communications policy which can enhance public understanding of its objectives, commitment, and strategy. In this way, informational uncertainty can be reduced, and expectations about the prospects for price stability can be influenced so as to speed up the attainment of the ultimate policy goal.

In the final analysis, however, the credibility and effectiveness of monetary policy can only be established over time on the basis of a central bank's performance in an uncertain world, or, as a famous ancient Greek philosopher remarked more than two thousand years ago: "the proof of the pudding is in the eating". Conferences such as this one can help central bankers to improve their recipes for their puddings.

CRITICAL ISSUES FOR MODERN MAJOR CENTRAL BANKERS

Alan S. Blinder
Princeton University and the Brookings Institution

This conference is entitled "Monetary Policy-Making under Uncertainty." But that title seems redundant to me – was there ever such a thing as monetary policymaking under certainty? So I will adopt a different topic for this talk. With due apologies to Gilbert and Sullivan, my focus is on what it takes to be "the very model of a modern major central bank." I will raise a host of questions, 15 in all, that would have to be answered by a central bank starting do novo in the year 1999 – a situation that may perhaps sound less than hypothetical here in Frankfurt. My emphasis is on how both the questions and the answers differ from what people might have thought ten or twenty years ago – hence the adjective "modern." The questions divide themselves into three categories:

1. issues of institutional design, or what might be called "setting up shop" (seven issues);

2. tactics for operating in the markets (four issues)

3. issues pertaining to the bank's model of the transmission mechanism (four issues).

I. Institutional Design

Issue No. 1, both literally and, I think, figuratively, is the central bank's ultimate goal or goals for monetary policy – the arguments of its loss function. Almost all recent academic research and thinking presumes that the objective function of the central bank is some weighted average of the expected squared deviations of output and inflation from their respective targets. But that raises several subsidiary questions:

(a) What are the weights? Just how much should the central bank care about output (employment) deviations relative to inflation deviations? This choice is crucial, but underemphasized. It can exercise substantial influence over actual policy decisions. For example, it may be one of the key points of difference between the ECB and the Fed today.

(b) Around what targets? The choice of the targets is probably more important than the choice of the weights. The inflation target has been extensively examined both in academic literature and in central bank discussions. But what about the output target? Athanasios Orphanides' paper for this conference suggests that specifying an output target in a sensible way can be quite difficult in real time.

In addition, a deep question arises if the economy displays hysteresis: Does it then even make sense to specify an output target a priori, when doing so might lead the central bank to settle for a local optimum even though there may be a superior global optimum available? As a concrete example, think about how much worse off the United States (and, indeed, the entire world) would be today if the Fed had decided in 1995 that the U.S. economy could not sustain an unemployment rate below 6% – and had acted on that belief.

(c) What about financial stability? Real central bankers care about more than just the variances of inflation and output. They also bear a responsibility for financial stability, which, while related to the other two goals, is not entirely subsumed in them. In my view, concern over financial stability is the best rationale there is for including something like the change in interest rates directly in the loss function – wholly apart from any other reasons for doing so.

Issue No. 2 is whether the central bank should be an inflation targetter. This, of course, is a relatively new issue. A decade ago, it was not even on the radar screen; nowadays, no modern central banker can avoid it. I must admit that my initial reactions to inflation targeting, while Vice Chairman of the Fed, were quite negative. That was because I wrongly associated inflation targeting with placing zero weight on output stabilization – what Mervyn King has called "inflation nuttery" – at a time when I was arguing strongly for just the reverse (Blinder, 1994). But I have learned something since then. As Lars Svensson (1997) and others have shown, the weight the central bank places on output stabilization maps directly into the speed with which the inflation target should be approached. A central bank that places a high weight on output stabilization can be a gradualist inflation targetter. A second piece of research that has made me more sympathetic to inflation targeting is Orphanides' finding, mentioned earlier, that large errors in estimating the output gap can lead (and have led) to egregious errors in monetary policy. If an inflation targeting central bank starts out underestimating (overestimating) the economy's potential, it will see inflation falling (rising), and therefore be induced to ease (tighten) policy. That is an important virtue. A yet-newer literature, spawned by Japan's problems with deflation and the zero bound on nominal interest rates, calls into question the previous professional consensus that inflation targeting is superior to price-level targeting. In fact, this literature suggests that a price-level target might be preferred when deflation is a danger. The reason is simple: to get real interest rates negative when the zero bound on nominal rates is binding, the central bank needs to engender expectations of positive inflation even though prices are falling. A credible price level target accomplishes that by pledging the central bank to offset episodes of deflation with subsequent periods of inflation, to get the price level back on its predetermined path. (The trick, of course, is to make the pledge credible.)

More generally, central bankers must now pay attention to an issue that their older brethren (they were all men then!) could safely ignore: the costs of deflation, which most economists reckon to be greater than the costs of inflation. Just like modern major generals, modern central bankers must prepare to fight the next war rather than continue fighting the last one.

Issue No. 3 pertains to transparency: How open should a modern central bank be, and about what? Qualitatively, the answer is simple: A modern central bank must be a good deal more transparent than its ancestors. There seems now to be something approaching a consensus on this point – the consensus itself signifies a sea change in central banking attitudes. Among the logical candidates for greater transparency are the bank's ultimate goals (Issue No. 1 above), its basic model of the economy (even if only informally), and its internal forecasts.

As many of you know, I have long been a hawk on transparency – on both economic and political grounds. Economically, I believe greater transparency makes monetary policy easier by anchoring expectations better to the realities underlying policy. Financial markets that are better attuned to the central bank's thinking are better able to anticipate its actions. And, anticipatory movements in interest rates, if correct, shorten the lag in monetary policy – a lag that has long bedeviled attempts to stabilize the economy. Politically, democratic theory strongly suggests that, in return for its broad grant of authority, the central bank is obliged to keep the public and their elected representatives well informed. To do otherwise would be imperious. (Remember the etymology of that word!)

Issue No. 4 is rarely discussed, but must be considered at the design stage: Should monetary policy decisions be made by an individual or by a committee? I am currently engaged in some experimental laboratory research at Princeton to test two hypotheses: that, compared to individuals, H1: committees react more slowly to the same stimulus.

H2: committees nonetheless make better decisions.

It is a bit too early for definitive results, but the early returns dispute H1 while supporting H2. More generally, I want to take note of a small academic literature that is developing around the question of whether, and how, monetary policy decisions made by committee differ from monetary policy decisions made by individuals.

The Federal Reserve offers an interesting, and apparently highly successful, hybrid model. The Federal Open Market Committee (FOMC) in a formal sense makes decisions by majority rule with a recorded vote. But, in fact, it is dominated by its chairman. Much of the outside world is watching to see whether the ECB will develop into an FOMC-style faux committee, or into a genuine committee organized on the "one person, one vote" principle (like the Bank of England's Monetary Policy Committee).

Issue No. 5 is whether a central bank operating in a floating exchange rate regime should forsake foreign currency intervention as a policy tool – even though the exchange rate is an important part of the monetary transmission mechanism.

The conventional wisdom nowadays seems to be that central banks should forget about intervention, mainly on the grounds that sterilized intervention doesn't work. But I wonder if this is always right. Certainly, foreign exchange interventions that oppose major market trends stand little chance of success; the old market wisdom, "don't stand in front of a freight train," applies to central banks as well. But there are times when markets have no particular conviction about which way the exchange rate will go next, or are thin, or have lots of nervous short-sellers. At such times, the markets are susceptible to being pushed around (within limits) by the central bank – if it is willing to commit substantial sums to the effort. It could be that the current consensus against sterilized intervention stems, in part, from

central banks' unwillingness to intervene with large amounts of money.

Issue No. 6 is whether the monetary authority should also regulate and supervise banks. This issue is very much up in the air right now. The U.K. has explicitly separated monetary policy from bank supervision, as you know, and the ECB is not a bank supervisor. (But several central banks within the ESCB are.) In the U.S., we have just concluded a multi-year turf war between the Federal Reserve and the Treasury Department over the Fed's role in bank supervision. Throughout, the Fed has steadfastly insisted that the information it routinely receives in its supervisory role, is vital to the performance of its monetary-policy duties. Is that true?

My personal view is that the Fed has taken a grain of truth and greatly exaggerated its importance. Proprietary information that the central bank receives in bank examinations is of some, limited use in formulating monetary policy – and is on rare occasions very important. So, on balance, it is probably better to have it than not. On the other hand, a bank supervisor may sometimes have to be a protector of banks and sometimes a stern disciplinarian – and either

stance may conflict with monetary policy. In the United States, there is yet another conflict of interest, which is currently under study by the General Accounting Office: The Federal Reserve not only supervises banks, it also sells them priced services in competition with private vendors of the same services.

Finally, two other questions are worth raising in this context. First, as the lines separating banks from other financial institutions blur and disappear in the modern world, must central banks that serve as bank supervisors be morphed into general-purpose financial supervisors – and do they have the expertise to do this broader job? Second, even if we decide that central banks should be bank supervisors, why should they also be bank regulators, that is, rule-makers (as the Federal Reserve is)? Shouldn't that function remain in the political domain?

Issue No. 7 is genuinely novel – central bankers of a generation ago certainly did not think about it. The question is this: Do various (actual and incipient) forms of electronic money pose a threat to central banks? Two distinct sorts of threats can be imagined; both arise from the possible erosion of

the bank's monopoly over the issuance of the medium of exchange. The first threat is to central bank independence: If seignorage revenue shrinks enough, the central bank will become beholden to the legislature for its annual budget, and that could make it more susceptible to political influence. Loss of seignorage revenue is probably not much of a threat to the big three (Fed, ECB, BOJ), but it could be a more serious matter for smaller central banks whose expenses more nearly exhaust their revenue. The second threat is to monetary policy itself: If Microsoft-money and the like come to be used for settlements on a grand scale, banks will no longer need reserves at the central bank for clearing purposes. Indeed, the banking system might be bypassed entirely if buyers and sellers settle accounts directly with e-cash. Similarly, electronic transfers of all sorts make it increasingly easy for banks to avoid the implicit tax on required reserves — as sweep accounts have been doing in the U.S. for years. In combination, these two developments will weaken — and may eventually even destroy — the main lever that central banks have traditionally used to manage their economies: control over base money. What's a central banker to do? For now, I think, the answer is: nothing. But sometime, in the near future, these hypothetical questions may become real ones which modern central bankers will be forced to confront.

II. Tactics for Operating in the Money Market

My next four questions relate to how the central bank operates in the financial markets.

Issue No. 8 is a broad question of strategy rather than a narrow tactical one. If I may be forgiven for indulging in stereotypes for a moment, some years ago, central bankers saw their proper role as surprising and bullying the markets. Central bankers were (they thought) in control; markets were meant to be pushed around. No longer. Nowadays, a thoroughly modern central banker is more likely to respect markets and keep them well informed. That is a healthy development, but it can be taken too far.

As I emphasized in my Robbins Lectures (Blinder, 1998), central bankers are often tempted to "follow the markets" — that is, to deliver the monetary policy the markets are expecting or, indeed, demanding. At times, that might be precisely the right thing to do — especially if the bank has conditioned market expectations properly. But not always. Many of us believe that markets tend to go to extremes, to overreact to stimuli, and to be stunningly shortsighted. A good monetary policymaker must succumb to none of these temptations.

Issue No. 9 concerns the implications of high-tech finance for the conduct of monetary policy. A host of questions for modern central bankers arise here. How should monetary policy adapt to the explosion of derivatives and financial exotica of all kinds — instruments that central bankers never dreamed of a decade or two ago? Some of these markets are extremely deep and liquid; some contain a great deal of information; many of them create extremely high leverage — sometimes in non-trans-

parent ways. Should monetary policy just proceed as if none of this had ever happened? I think not. At a minimum, a modern central bank must make use of the information found in these new markets. For example, the Fed has for years used the Federal funds futures market in Chicago as its primary window into what the markets are thinking about future monetary policy. In addition, high-tech financial instruments almost certainly affect the monetary transmission mechanism — especially the linkages from short rates to long rates and other financial market prices. And, central bankers ignore this at their peril. My own hunch — but it's just a hunch — is that derivatives have shortened the lag in monetary policy.

There are still more questions. Should a modern central bank operate in some of these more exotic markets, rather than restrict itself to conventional open-market operations in government securities? A conservative central banker's reflexive answer is no, and I must admit this is my own reaction to date. But perhaps the idea should not be dismissed out of hand. After all, derivatives can enhance the power of the central bank to push interest rates (or even exchange rates) around, just as they do for private market participants. A modern central banker needs to give this issue serious thought.

Issue No. 10 pertains to what I call the Brainard (1967) conservatism principle: the idea that multiplier uncertainty should make the central bank more conservative, in the sense of using its policy instrument less vigorously. In Blinder (1998), I opinioned that, while the conservatism principle is not

very robust mathematically, "My intuition tells me that [it]… is more general — or at least more wise — in the real world than the mathematics will support." (p. 12)

This remark seems to have touched off a fair amount of quite interesting academic work, and I have been surprised at how little support Brainard's principle has received. There are, by now, a number of examples in which multiplier uncertainty, in conjunction with something else, leads an optimizing central bank to vary its instrument more than it would under certainty. The Brainard result is indeed fragile. Still, I find these new anti-Brainard results both puzzling and troubling. Though my confidence in the conclusion has been shaken by recent research, my gut still tells me that Brainard was right in practice. In any case, it's certainly an intellectual question that should engage modern central bankers.

Issue No. 11 is related: When a central bank decides to change monetary policy, should it move its interest rate by large or small amounts? Under Alan Greenspan's stewardship, the Federal Reserve has shown a clear preference for frequent, small moves — usually 25 basis points. And who would argue that the Greenspan Fed has not been successful? Yet, I suspect that this style of policy is not what dynamic optimization calls for. Why not? The argument for larger moves is predicated, in part, on the unit root in the inflation process: If inflation can random-walk away from you, the central bank will want to make sure to step on the brakes hard enough. But what if the unit root in the inflation time series is a bypro-

duct of a particular policy regime that let inflation ratchet up from the 1950s to the 1960s to the 1970s? As more recent data are added to the sample, the evidence for a unit root weakens. In other words, an appropriate monetary policy — one that approximates a Taylor rule, say — can remove the unit root from the inflation process. In that case, a more gradualist approach to monetary policy might make sense. It's something for a modern central banker to think about.

The ECB, according to current market lore, prefers larger, less frequent moves — say, 50 basis points. But I caution you that such a deduction is based on a rather thin data base – precisely two observations!

III. Questions about the Monetary Transmission Mechanism

My final four questions pertain to the central bank's model of the economy.

Issue No. 12 should be an easy one, although the ECB seems not to agree. In this case, I will state an answer rather than pose a question: A modern central bank should think of its overnight interest rate, not any monetary aggregate, as its principal policy instrument. My reason is simple and well known. As Gerry Bouey, a former Governor of the Bank of Canada, aptly put it, "We didn't abandon the monetary aggregates, they abandoned us." With financial innovation virtually certain to continue, and with the lines between banks and other types of financial institutions blurry and getting blurrier, I see no reason to suspect that this abandonment will end soon. A cen-

tral bank that relies on a monetary aggregate may trap itself in vestigial thinking – and may therefore put its economy in harm's way. Indeed, modern financial arrangements are rapidly eroding the primacy of banks, which are the source of the money supply as conventionally defined. Such developments scream out to central banks to stop focussing on the textbook link from bank reserves to bank lending to aggregate demand. Instead, a modern central bank should think of the main linkages in the transmission mechanism as running from its policy rate to other interest rates and financial prices (such as longer-term interest rates, exchange rates, and stock market values), and then on to aggregate demand. The Ms are byproducts of this process, but of no great intrinsic interest.

The next two issues follow directly from this point of view, and are vexing ones. But since they are also familiar, I will deal with them briefly.

Issue No. 13 observes that the standard model linking short- and long-term interest rates — the so-called expectations theory of the term structure — is dead wrong, in the sense that long rates are terrible predictors of future short rates. This fact seems to be well-known in academia, in the markets, and in central banking circles. But, its resolution remains a mystery. Given the importance of long-term interest rates to the monetary transmission mechanism, this may be the single most important intellectual issue with which modern central bankers must grapple. I wish I could tell you the answer, but I can't.

Issue No. 14 is a closely-related paradox in the international arena. Uncovered interest parity is supposed to tie current and expected future exchange rates to the interest-rate differential between any two countries. Yet it fails miserably as a forecaster of future exchange rates. Once again, everybody knows this, but no one (myself included) seems to know what to do about it. Since interest parity is an essential link in the monetary transmission mechanism for open economies, and since all economies are open, this is not only an intellectual embarrassment but a major impediment to successful monetary policy. It must rank high on the work list for modern central bankers.

Last, but certainly not least, I come to Issue No. 15: How does a central bank conduct monetary policy in the absence of a Phillips curve it can trust? For years, I used to gloat that the Federal Reserve had an important advantage over the other G7 central banks: We had a reliable statistical Phillips curve to use, they did not. But nowadays we all seem to be in the same boat. As is well-known, the traditional U.S. Phillips curve, which worked so well for decades, has been malfunctioning of late. Today the Fed finds itself up the creek without a Phillips-curve paddle, just like other central banks. This is a serious handicap. Given the long lags in monetary policy, it is generally agreed that the authorities need to conduct a "preemptive" monetary policy. That means moving on the basis of inflation forecasts. But, the collapse of the Phillips curve leaves us without a reliable way to anticipate the impacts of economic activity

on inflation. And that, in turn, raises a serious intellectual question: When is it better to wait for an actual upturn in inflation rather to act preemptively, on the basis of a forecast? Both Orphanides' paper and the Brainard uncertainty principle suggest that the current preference for preemption may need reexamination.

IV. in Conclusion

So, that is my highly-selective list of 15 critical issues. Rather than try to sum up, I will again beg the indulgence of Gilbert and Sullivan, and conclude in verse:

I am the very model of a modern central bank for all.

I've information national, financial, international.

I know the Bank of England, and I quote the minutes of the Fed.

I mimic every syllable that Alan Greenspan ever said.

I'm very well acquainted, too, with matters mathematical.

I understand equations, both the simple and quadratical.

Of standard deviations, I am teeming with a lot o'news,

With many useful facts about the square of the hypotenuse.

I'm very good at integral and differential calculus.

My staff provides me models that are really quite miraculous

In short, in matters national, financial, international,

I am the very model of a modern central bank for all.

I know central banking history from Lombard Street to ECB.

I speak in cryptic phrases whose intent is rather hard to see.

With repos, I can push the rates from floor to ceiling flawlessly.

And seignorage enables me to prosper rather nice-a-ly

My monetary knowledge is extensive and adventury.

It's based on all the wisdom handed down across the centuries.

And so, in matters national, financial, international,

I am the very model of a modern central bank for all.

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Indicator Variables for Optimal Policy

Summary of the Paper

The paper by Svensson and Woodford aims at clarifying the principles of deriving the optimal weights on indicators for optimal policies in models with partial information about the state of the economy and forward-looking variables. As a challenge for deriving the optimal weights, forward-looking variables complicate both the problem of estimating the partially observable state of the economy, as well as the determination of optimal policies. This challenge arises because forward-looking variables depend, per definition, on current expectations of future endogenous variables and the current setting of the policy instrument. Current expectations and the current instrument setting depend on the estimate of the current state of the economy. This state, in turn, depends on the current realisation of the forward-looking variables, thereby causing a simultaneity problem.

In addressing this simultaneity problem, Svensson and Woodford first re-establish the important result that, under symmetric partial information, certainty equivalence and the separation principle continue to hold in the case of linear rational-expectations models and a quadratic loss function. Thus, the determination of optimal policies, given an estimate of the partially observable state, and the estimation of

Lars E.O. Svensson (Stockholm University and Princeton University) **and Michael Woodford** (Princeton University)

the state, can be treated as separate problems and optimal policies, as a function of the estimate of the current state of the economy, act as if the state were observed. With regard to the problem of estimating the partially observable state, they show that the estimation problem becomes a simpler variant of the estimation problem with forward-looking variables which was previously solved in Pearlman, Currie and Levine (1986) by transforming the original problem to a problem without forward-looking variables. In dealing with the optimisation problem, they provide the optimal policies under discretion as well as under commitment, building on Pearlman (1992). The most fundamental difference with respect to the discretion case is that optimal monetary policy under commitment depends on the history of the economy, and thus displays inertia.

For both the discretion case and the commitment case, Svensson and Woodford provide some general results on how the observable variables – the indicators – are used to estimate the current state of the economy. The solution to the estimation problem with forward-looking variables is expressed in terms of an appropriately modified Kalman filter in which the Kalman gain matrix gives the optimal weights on the observable variables for estimating the state. Since the estimate of the state is a

distributed lag of the observable variables, the estimate is updated only gradually. Therefore, even under discretion, the observed optimal policy will display considerable inertia as a consequence of partial information. The degree of inertia is higher, the noisier the current observations, and the less the weight on current observations is relative to previous estimates.

Svensson and Woodford illustrate the use of the modified Kalman filter formulae for deriving the optimal weights of indicator variables by analysing a simple New-Keynesian model of monetary policy, which comprises a forward-looking aggregate supply relation and a forward-looking IS relation. Potential output is assumed to be unobservable, and the supply shock is measured only with error. The vector of observable variables includes the forward-looking inflation rate which both affects and depends on the current estimates of potential output and the supply shock. By applying the modified Kalman filter, Svensson and Woodford show that the usefulness of the observable variables for optimal policy, i.e. their optimal indicator weight, depends on the noise surrounding their measurement. Due to the separation of estimation and control, however, the weight to be put, on the resulting estimate of potential output under an optimal policy is unaffected by the amount of noise involved. Svensson

and Woodford therefore conclude that the lack of a more accurate estimate of the output gap itself is not a reason for policy to be less responsive to perceived fluctuations in the output gap.

Summary of the Discussion

Jose′ Vinãls' discussion of the paper mapped it from its technical insights to the practical problems of monetary policy-making under uncertainty. He welcomed the setting of the technical analysis addressing the real world complexities which arise due to partial information about the state of the economy, and the non-resolvable link between monetary policy actions and the forward-looking expectations of the private sector. He appreciated the authors' message to central bankers that such circumstances should not worry them. Given the presumptions of the analysis, central bankers should conclude that monetary policy can be simplified. First, central bankers can act as if the partially observable variables were known (due to certainty equivalence and, thus, the separation of estimation and optimisation). Second, optimal policy under commitment is superior to discretionary policy, even in an environment of uncertainty about the state of the economy. Third, optimal policy, both under commitment and under discretion, is characterised by inertia. This inertia may increase the effectiveness of monetary policy actions by

exploiting the leverage of the expectation channel. Last but not least, a modified Kalman filter gives the optimal weights of the multiplicity of indicator variables for monetary policy which, in practice, may often provide conflicting information on economic developments. The Kalman gain's dependence on the structure of the model demonstrates that it is crucial to know the properties of the monetary transmission mechanism in order to determine the weights of the available indicator variables. Therefore, a pure statistical horse race for the importance of indicators must be inappropriate. Vinãls thanked the authors for their valuable contribution but also stressed that reality is even more complex than presumed in the paper. A central bank, in fact, would have to rely on imprecisely estimated behavioural parameters which are assumed known in the paper. In the context of parameter uncertainty, however, certainty equivalence does not hold any longer, and the cautious recommendation of Brainard (1967) to follow a more gradualist approach to monetary policy would prevail. Moreover, the results by Svensson and Woodford would have to be reconciled with the recent findings based on the analysis of Taylor-type policy rules incorporating a feedback of the monetary policy instrument to an imprecisely measured output gap. In contrast to the conclusion by Svensson and Woodford, these latter findings recommend not responding aggressively to fluctuations of the imprecise gap measure.

The discussion by Tabellini started with a brief review of Svensson's previous work on the analysis of strict versus flexible inflation targeting in predominantly backward-looking models for which the principles of certainty equivalence and the separation of estimation and optimisation are well known. Against this background, Tabellini appreciated the extensions by Svensson and Woodford in re-establishing these principles for models with partially observable states in the presence of forward-looking variables, and for providing simplified filtering formulae. With regard to the derivation of optimal policies under discretion, Tabellini referred to the simple, static Barro and Gordon (1983) framework where the socially optimal monetary policy can be enforced by a linear inflation contract, or by appointing a conservative central banker. He emphasised Svensson's and Woodford's finding by that in dynamic models with forward-looking variables, the socially optimal monetary policy can similarly be enforced under discretion by appropriately adding lagged terms of the Lagrange multiplier associated with the forward-looking variables to the central bank's objective function. The question remains, however, whether these terms can be simplified, and which practical implications this finding may have for the institutional design of monetary policy. Since the assumption of symmetric partial information may be unrealistic for monetary policy, he welcomed ongoing work by Svensson and Woodford which aims at extending the results to the case of asymmetric information for which certainty equivalence does not hold. Though sympathetic with the outcome of the positive and normative analysis of

implementing inflation targeting in models with forward-looking variables and partial information, Tabellini criticised the simple structure of the New-Keynesian model used for illustrating the results. Since inflation is a leading indicator of the output gap within this class of models, he questioned the emphasis on the output gap as an information variable for monetary policy. Instead, referring to Galí and Gertler (1998), he suggested that marginal costs would be the more appropriate variable to focus on in the model's context.

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Escaping Nash Inflation

Summary of the Paper

Tom Sargent presented a paper co-authored with In-Koo Cho on "Escaping Nash Inflation." The paper aims at explaining the observed path in U.S. inflation, after World War II. Following a decade of relatively stable inflation, the US experienced an acceleration in inflation in the late '60s and '70s, a sharp stabilization in the '80s and a further slowdown in the '90s. Two alternative approaches have been used in the literature to explain the data. The first argues that movements in observed inflation reflected movements in the time-consistent inflation rate, due to changing fundamentals in the basic Kydland-Prescott model. The second argues that, after the early 1980's, the monetary authorities may have chosen inflation below the time-consistent rate.

Building upon the literature on least squares learning, Sargent and Cho contributes to the second approach. In his model fundamentals are fixed, while it is assumed that:

1) the authorities (imperfectly) control inflation, and the private sector forecasts inflation optimally;
2) the true data generation process embodies an expectational Phillips curve;
3) the authorities dislike inflation and unemployment;
4) the authorities do not know the true data generating process, but use an approxi-

Thomas Sargent (Stanford University and Hoover Institution) **and In-Koo Cho** (University of Illinois, Urbana Champaign)

mating model, where unemployment is regressed on a constant and on observed inflation.

Previous works have shown that an adaptive system with least squares learning is driven by a deterministic dynamics, known as 'mean dynamics', and that it converges to a self-confirming equilibrium. This is an equilibrium concept that is suited for approximating models. While it differs from a Nash equilibrium, it turns out that the self-confirming equilibrium is also time-consistent. In the paper presented, Sargent and Cho analyze the dynamics of the system when the authorities use an approximating model with a 'constant gain', recursive estimation algorithm, which discounts past observations. Under this new algorithm, there is another deterministic component governing the dynamics of the system, called 'escape dynamics.' This component drives the economy away from the sub-optimal time-consistent equilibrium and occasionally leads it towards the optimal time-inconsistent (Ramsey) outcome.

The intuition is the following. When the system is in the self-confirming equilibrium, the government is in an experimentation trap. Although the econometrician does not realize the role of private expectations in shifting the short-run Phillips curve, his approximating model is able to capture the true trade-off between inflation and unemployment at the self-confirming equilibrium. Would it be possible for the authorities to learn the natural rate hypothesis? Only in this case they would optimally set the systematic component of inflation to zero, leading the economy to the optimal Ramsey outcome. However, learning the natural rate hypothesis would require sufficient variation in private inflation expectations. This variation cannot arise, because in the self-confirming equilibrium, the government does not change the systematic component of inflation, so that inflation expectations also remain constant.

Experimentation can be started by a certain unusual shock pattern, which induces the authorities to randomize the systematic component of the inflation rate. This generates a data scatter that increases the slope of the estimated Phillips curve. The optimal reaction of the government is then to lower inflation, thus generating observations that make the estimated curve steeper. This process ends when the estimated Phillips curve is vertical, so that the economy is at the Ramsey optimal outcome. However, the economy cannot stay there forever. The government would soon discover and exploit the true short-run Phillips curve, moving back to the time-consistent self-confirming equilibrium.

Summary of the Discussion

In the first discussion, Ramon Marimon criticized the specification of the model perceived by the government, where the role of expectations is completely ignored. A more realistic setting would be one in which the authorities still use an approximating model, but where a measure of inflation expectations enters as a regressor, in addition to the constant and to realized inflation. Sargent's setup would then be a particular case in which the coefficient on inflation expectations is set at zero. Under this alternative model assumption, i) the government would also react optimally to changes in expectations; ii) the econometrician would be using a recursive algorithm to estimate a long-run Phillips curve; iii) under the natural rate hypothesis, the coefficients on realized inflation and on inflation expectations would be identical. This more realistic set-up might lead to different conclusions. First of all, multiple self-confirming equilibria might arise. Second, an alternative explanation of the US inflation pattern may emerge; Volker's and

Greespan's action may have been the outcome of a process in which they were learning the coefficient on inflation expectations, rather than the outcome of an escape dynamics.

In the second discussion, James Stock stressed four points. The first related to the role of the escape dynamics, which is triggered by the realization of a small number of unfrequent and highly influential observations. Stock noticed that, for the escape dynamics to prevail, it is important that the information set is restricted to a small number of observations. One could also carry the experiment of maximizing welfare with respect to the number of observations to be included in the estimation, and the result would be a peculiarly low number, around four or five. The second point was that, for Sargent's explanation to hold, the econometrician has to be rather mindless and certainly not rational, since it doesn't learn the true model. The third point related to the empirical evidence on the US inflation process. Estimating an auto-regressive process for inflation over the period following the stabilisation, Stock found evidence for the largest root being close to one. This finding is at odds with the evidence based on spectral analysis that Sargent presented, which pointed at stationarity over that period. The final point related to the theme of the conference. Stock noticed that, somehow paradoxically, uncertainty is beneficial in Sargent's model, because a lot of econometric uncertainty is needed to approach the optimal Ramsey equilibrium outcome.

Several questions and comments were raised from the floor. Bennett Mc Callum asked what type of dynamics emerges when the econometrician uses good econometric techniques to estimate an expectational Phillips curve. Tamim Bayoumi pointed out that in Sargent's explanation, as in the dynamic of scientific revolutions, some unlikely event would start a learning process. An important difference, however, is that in Sargent's model, the econometrician keeps estimating the same old model, even after being at the Ramsey equilibrium. Guido Tabellini objected that the idea of having sophisticated econometricians, who disregard available observations, is not very appealing. David Vines asked whether the recent US experience, where for some reason policy-makers started reducing inflation despite their belief of being close to the natural rate, could be seen as an example of the initial phase in the escape dynamics.

The Performance of Forecast-Based Monetary Policy Rules under Model Uncertainty

Summary of the Paper

Andrew Levine, Volker Wieland and John C. Williams, from the Board of Governors of the Federal Reserve System, jointly presented their paper on "The Performance of Forecast-Based Monetary Policy Rules under Model uncertainty". Their quantitative analysis compared forecast-based monetary policy rules with outcome-based policy rules in terms of output, inflation, and interest rate stabilization. Counterintuitively, their results promise only small benefits from the use of forecast-based rules versus outcome based rules.

Andrew Levine, Volker Wieland and John C. Williams (Federal Reserve Board)

The growing literature on the quantitative evaluation of monetary policy rules for various macro models includes the recent studies by Ball (1999), Batini and Haldane (1999), and Black et al. (1998), to mention a few. In a first approach, to compare alternative policy rules, Levine, Wieland and Williams (1999a) show that simple outcome-based policy rules perform well in stabilizing output, inflation, and nominal interest rate. The present analysis expands their previous work by focussing on the performance of instrumental forecast-based policy rules in four macro-economic models that differ along the dimensions of size, output and inflation dynamics, as well as lag-structure. The models under consideration are: the Fuhrer-Moore (FM) model (1995), the MSR model by Orphanides and Wieland (1998), Taylor's multicountry model (TAYMCM), and the Federal Reserve Board (FRB) staff model. The comparison of the results with the benchmark values of the previously analyzed outcome-based rules allow some conclusions to be drawn:

1.) The ouput-, information-, and lag-encompassing features of forecast-based rules – which were assumed to generate an advantage over outcome-based rules – turn out to be of minor quantitative importance. There is virtually no observable distinction in the optimal policy frontier amongst the forecast-based and output-based rules in the small scale models (FM and MSR). In the large scale models (TAYMCM and FRB), the forecast-based policy rule seems to perform only marginally better.

2.) If output stabilization is of minor importance in the policy objective function, the performance of forecast-based rules worsens. Instead, if minimizing inflation variability is the sole policy objective, inflation-forecast-based rules prove to be efficient.

3.) Whilst outcome-based rules are generally associated with stable and unique rational expectations equilbria, forecast-based policy rules, with forecast horizons longer than two years, often seem to generate multiple rational expectations equilibria.

4.) Forecast-based rules turn out to be reasonably robust to model uncertainty with the limitations that forecasts are consistent with the model and the rule itself , the policy rule does not require a forecast horizon beyond four quarters, and the inflation measure is a moving average over four quarters. The robustness of forecast-based policy rules to model uncertainty disappears when the policy rules respond to expectations in inflation more than a year in the future, which is a common feature of many rules proposed in the literature.

Summary of the Discussion

Charles Bean (London School of Economics) doubted the policy relevance of the multiplicity outcomes in forecast-based rules. Instead, he suggested distinguishing between expectations of private agents and central banks. If a central bank communicates publicly the way it forms expectations, and private agents follow the central bank's reasoning, they will settle at a unique equi-

libria and the multiplicity phenomena will disappear.

Stefan Gerlach (Bank for International Settlements) noted that the small benefits of forecast-based rules over outcome-based rules are not surprising. Many macroeconomic variables follow low-order AR-processes, which are also reasonablly good forecast rules. It is, however, not warranted to dismiss the forecast-based rules since their information-encompassing feature may become important should the low-order AR-structure of macroeconomic variables disappear.

David Vines (University of Oxford) commented on the advantage of forward control features in policy rules. The experience of current account balancing, and the existence of the J-curve has taught that feedback rules are misleading when a complicated lag-structure initially inverts the response of the target variables. The multiple equilibria problem led Roger Farmer (European University Institute) to propose that rational expectation monetary models be supplemented with mechanisms that define the way agents form their beliefs. These mechanisms work as selection devices to pick an equilibria out of a multiplicity. Whilst Roger Farmer assumed a multiplicity of equilibria, Bennett McCallum (Carnegie-Mellon University) raised the question whether the indeterminacy regions are characterized by no solution, or multiple solutions. Stephen Cechetti (Ohio State University) asked for a clarification of the definitions. Since forecasts depend on

past outcomes, it seemed that forecast-based and outcome-based rules were redundant. He also noted that forecasts need to take into account policy reaction functions, a feature that might render forecast-based rules trivial. The results are evidence for Glen Rudebusch (Federal Reserve Bank of San Francisco) that forecast-based policy rules with a complicated lag-structure in the state variables do not perform better than simple outcome-based policy rules.

The Quest for Prosperity without Inflation

Summary of the Paper

Athanasios Orphanides
(Federal Reserve Board)

In this paper, Athanasios Orphanides analyzes Taylor-type policy rules in which the central bank responds to inflation and the level of economic activity. In contrast to earlier studies which suggest that these rules provide a flexibility that yields substantial stabilization benefits, the paper aims at showing that the macroeconomic policy failure in the 1970s is due to an inappropriately activist monetary policy, much like a Taylor rule would have suggested at that time. The apparent improvement in economic performance that activist monetary policy rules suggest over alternative policies, which completely ignore short-run stabilization objectives, can be attributed to unrealistic informational assumptions regarding the knowledge policymakers can reasonably have about the state of the economy at the time when policy decisions are made. Relying on counterfactual simulations, the paper particularly points to misperceptions of the economy's productive capacity by policymakers as the underlying cause of the 1970s inflation.

As a first step in his analysis, Orphanides theoretically considers the problem of imperfect information by allowing for noise in the observation of the true rate of inflation and the true output gap. This setup, following the Taylor rule, leads to undesirable interest rate movements that could adversely influence macroeconomic performance. The author then re-establishes the stabilization promise of following activist policies by performing counterfactual simulations under the unrealistic assumption of perfect information. The results have the well-known implication that the inflation of the 1970s would have been avoided if activist rules had been followed. However, by constructing a database with data available to U.S. policymakers in real time from 1965 to 1993, it becomes evident that real-time estimates of potential output severely overstated the economy's capacity relative to the recent estimates in the sample. Realistic policy rule simulations, which are based on these real-time estimates, show that activist policies not only would have produced the inflation of the 1970s, but would have greatly inhibited the disinflation of the 1980s as well. Thus, the paper provides evidence that 1970s inflation was accelerated not because policy must have deviated from prescriptions suggested by the Taylor rule, but because policy must have actually followed a strategy indistinguishable from the Taylor rule.

Orphanides concludes that apparent differences in the framework governing monetary policy decisions during the 1970s, as compared to the more recent past, have been greatly exaggerated. To avoid policy disasters in the future, prudent policies like inflation targeting, or natural growth targeting that ignore short-run stabilization concerns altogether, should be applied.

Summary of the Discussion

At the beginning of his discussion, Jordi Gali summarized the main findings of the paper. First, a simple Taylor rule based on real-time estimates of inflation and output is able to characterize the behavior of the federal funds rate in the late 1960s and the 1970s. Second, a persistent negative bias in output gap estimates can explain a historical interest rate level which was persistently below the level corresponding to price stability. Third, a poor assessment of macroeconomic conditions by policymakers is responsible for over-expansionary monetary policy in the past. The general lesson of these findings is that, because of severe data limitations, simple monetary policy rules do work well in theory but are not appropriate for the conduct of monetary policy in practice. As a consequence, policy should rely on variables which could be measured relatively exactly. Though welcoming the paper as a provocative study which will be widely cited, Gali addressed two specific issues with which he feels unhappy, with regard to recent literature. The first issue refers to the notion of the output gap whose measurement is a key factor. Gali noticed that though empirical researchers have not yet resolved conceptual problems measuring potential GDP, the paper is silent about this issue. While all available empirical concepts have the common feature of modeling potential output as a smooth time series, optimizing models with sticky prizes do not imply potential GDP, defined as the natural output level when prices are flexible, to be smooth. Referring to his own recent research, Gali suggested to couple micro foundations and empirical analyses by constructing a model-based measure of the output gap, using real marginal costs. The performance of this approach in explaining inflation has been shown to be very good. Regarding the second issue, Gali discussed the evolution of monetary policy rules over time. He stressed that monetary policy improved in the 1970s and 1980s, which is supported by recent empirical studies showing monetary response to inflationary pressures to be varying over time. Since its focus is on interest rate levels, the paper does not dis-

cuss this topic. This can be regarded as a shortcoming.

In the second discussion, Paul De Grauwe characterized the paper as a fascinating study which shows how incomplete information can complicate monetary policy or even might lead to large policy errors. After reconsidering the basic strategy of the paper as simulating monetary activism, with and without perfect information, De Grauwe criticized that inflation and the output gap are the only two sources of noise to which an activist strategy, with imperfect information, is subjected. This, however, would imply that the remaining data are perfectly known, which does not appropriately describe macroeconomic reality. An important example for other sources of noise is the inflation equation including cost push factors unobservable to policymakers. Since the paper does not account for this kind of uncertainty, the reported results are biased against Taylor-type rules. De Grauwe further criticized that the simulation results rely on mindless activism, defined by him as mechanically applying the Taylor rule over time, even after realizing large estimation and policy errors. As an alternative, he suggested looking at additional indicators in order to simulate intelligent activism, which might lead to very different outcomes. De Grauwe therefore concludes that the paper has gone too far in criticizing activist monetary policy.

Referring to his own conference paper, Lars Svensson questioned what hap-

pened to certainty equivalence. He argued that a comparison which relies on expost data is not fair. He emphasized that poor measurement of potential output can be either explained by a wrong concept, or can be biased because of real data. A late revision could be interpreted as a signal for a wrong concept. Vitor Gaspar pointed to the significant output gap in the second period of the analysis, which supports the main results of the paper. In his reply to Jordi Gali, Athanasios Orphanides welcomes more research on estimating the output gap. He also noted that the Taylor rule is a sensible concept which does not describe mindless activism. Bennett McCallum stated that he has undertaken similar studies using the same approach. A central finding was the importance of measurement revisions. John Taylor disagreed with this point of view.

Assessing Nominal Income Rules for Monetary Policy with Model and Data Uncertainty

Summary of the Paper

The objective of the paper by Rudebusch is to show how nominal income rules for monetary policy conduct themselves under uncertainty. The advent of the European Monetary Union has again awakened interest in monetary policy strategies. The pillar of the ECB's monetary strategy shares some common features with nominal income rules. Any insights into the performance of nominal income rules may therefore be of interest to monetary policy makers inside the ECB.

Another source of the growing interest in nominal income rules is the outstanding performance of the US economy. The long-lasting boom suggests, to some pundits, that a structural shift may have occurred. According to McCallum and Orphanides, it is the uncertainty surrounding the possible occurrence of a structural shift that constitutes the argument for conducting monetary policy within a framework of nominal income targeting. The reason for this being that such a policy would not need to rely on estimations of the output gap, which are notoriously disputable.

However, the advantages of nominal income targeting must be weighed against its disadvantages. Ignoring nominal income

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rules when dealing with the different time lags of monetary policy actions on inflation and output must be seen as the main disadvantage. As Ball and Svensson have shown in a simple backward-looking aggregate demand and supply macro-model, the performance of a nominal income rule is somewhat poor, that is, the conduct of monetary policy following such a rule leads to destabilization. McCallum criticized the results of Ball and Svensson on the grounds that their inflation specification was backward-looking. In a setting with forward-looking specifications, McCallum finds nominal income targeting to be output stabilizing.

The controversy between McCallum and Ball/Svensson critically hinges on the question of model and parameter uncertainty. Rudebusch's paper attempts to shed some light on how nominal income rules perform under uncertainty. In his simulations he allows for uncertainty with regard to the real output gap and the appropriate model. His different models are nested within a New Keynesian setting which allows for both forward and backward-looking inflation specifications.

Rudebusch compares the performance of three different monetary policy rules:

two nominal income rules based on McCallum and Orphanides and one simple Taylor rule are the benchmarks. To derive the optimal policy rule, he uses a standard objective function which minimizes variations in inflation and the output gap.

To achieve robust results regarding the performance of each policy rule, Rudebusch calculates the objective functions over a range of different model specifications and data uncertainties. The assumed models thereby differ in the way inflation expectations are incorporated. Each model specification is weighted with its appropriate probability. Data uncertainty comes into play through uncertainty regarding the output gap. The result of his simulation shows a rather poor performance by the nominal income rules of Orphanides and McCallum as compared to the simple Taylor rule. This result holds for uncertainty concerning model specification, as well as data uncertainty.

Summary of the Discussion
Bennett McCallum voiced strong reservations in his discussion about the conclusions drawn in Rudebusch's paper. First, he stated that the results of his paper are more general than stated by Rudebusch. Instead of just one inflation specification, his results were derived for 7 different price adjustment specifications. Furthermore, he disagreed with Rudebusch's claim that nominal income rules show a disastrous performance. Should this attribute be given to the two proposed nominal income rules, it should be assigned to actual

monetary policy in the United States as well. The reason for this is that actual data perform worse than both nominal income rules when applied to Rudebusch's loss function. Finally, McCallum criticized the range of parameters Rudebusch had chosen to specify price setting. He points to a paper by Gali and Gertler which suggested that Rudebusch's set of admissible parameters were too narrow. Further model specifications, like forward-looking demand or an open-economy setting, should have been chosen as well.

Henrik Jensen, the second discussant, appreciated Rudebusch's paper as an "excellent, clear, and interesting paper". Jensen sees particular merits in the robustness analysis since it shows that an optimal Taylor-rule dominates both proposed nominal income rules under output-gap and model uncertainty. Nevertheless, he sees the robustness analysis as being incomplete and too favorable towards the Taylor-rule. The intuition behind Rudebusch's results can be explained by the fact that the Taylor-rule contains the output-gap as a welfare relevant variable, whereas both nominal income rules contain "almost" no welfare-relevant variable. Nonetheless, both nominal income rules perform well as long as forward-looking behavior in price-setting reaches a certain level. This lead Jensen to propose a "flexible" nominal income rule.

During the open discussion afterwards, Orphanides stressed the importance of learning, whether to incorporate the output level or the growth rate, when assessing

the performance of policy rules. Vines mentioned that nominal income rules do not have a good dynamic performance. To improve the robustness analysis, performance under the occurrence of supply and trade shocks should be investigated as well. Svennson mentioned that two interpretations of nominal income targeting exist. He therefore asked the proponents of nominal income rules which of these concepts was actually meant. Taylor highlighted the importance of potential output uncertainty whether monetary policy is conducted on a day-to-day basis, or rule-based. Levin questioned the justification of the restriction of parameter equality which nominal income rules impose on the output growth and inflation coefficient. Nelson criticized the New-Keynesian setting in Rudebusch's paper. He claimed that in a setting with capacity being time-varying, nominal income rules would outperform a simple Taylor-rule.

Summary of the Presentations and Discussions during the Short Papers Session

Summary of the Paper "Learning, uncertainty and Central Bank Activism in an economy with Strategic interactions", Martin Ellison and Natacha Valla

In this paper the authors construct a stylised model of monetary policy in which there are roles for uncertainty, learning, and strategy. The model they construct is characterised by an expectations-augmented Phillips curve between inflation surprises and output deviations from trend. Inflation is assumed to be completely under the control of the central bank, and is the instrument of monetary policy.

Uncertainty in the model takes the form of a two state Markov-switching process for the monetary policy effectiveness. Monetary policy switches between high and low policy effectiveness. The central bank has an informational advantage in the form of receiving a signal of the output shock. This informational asymmetry creates a basis for stabilisation actions.

The actions of the central bank lead to outcomes from which the central bank updates its beliefs about the state of monetary policy effectiveness. The same learning process that takes place in central banks also goes on at private agencies. Since private agents can deduce from the policy actions the output signal the central bank received,

learning is symmetric. Private agents and central banks have identical beliefs.

The authors then consider two equilibrium concepts. In the first one, the central bank is a passive learner. A central bank that is passively learning will optimally take into account current uncertainty but does not make any conscious attempt to influence such uncertainty in the future. It does not consider that policy actions can be used to update beliefs. The second equilibrium concept considers the central bank to be an active learner. The central bank takes into account current uncertainty and is aware that actions taken today generate information which affects future uncertainty. After estimating the model for the G7 countries, the authors calibrate the model to perform simulations. The main result is that an actively learning central bank reacts less to an output signal than a passively learning central bank would. The reason for this result is that the degree of central bank activism directly determines the degree of learning, in both central bank and private agencies, Due to strategic interaction between the central bank and private agents, the central bank has an incentive to speed up or slow down the learning of private agents. When monetary policy is effective, the central bank prefers slower learning to avoid agents adjusting their inflation expectations.

Summary of the Discussion

Alex Cukierman argued that this was an interesting as well as thought-provoking paper. The central bank not only faces the usual uncertainty, but also uncertainty about the effectiveness of its policy. Crucial is the question of how much the central bank is able to learn. A central bank must experiment. This leads to the notion that keeping the actions of the central bank stable, allows it to have more sample points for the central bank. However, because of strategic interaction, this is not necessarily the case. In periods of low policy effectiveness, the inflation bias will be small and the policy-maker has an interest in revealing this. In periods of high policy effectiveness, the inflation bias will be high in which case the policy-maker has an interest in keeping this undisclosed. If the latter effect is stronger, the hiding mechanism, dominates. The main result of this paper is, therefore, that an additional mechanism apart from the Brainard conservatism principle, exists which leads to fewer actions by the central bank.

Summary of the Paper "Transparency and reputation: Should the ECB publish its inflation forecast?", Petra Geraats.

Before presenting the model developed in the paper, Petra Geraats introduced a framework to identify the different dimensions of transparency that are relevant for monetary policy. Political transparency refers to the openness about policy objectives, economic transparency on the disclosure of economic data, procedural

transparency on the policy decision-making process, policy transparency on the communication of present and future decisions, while operational transparency touches upon the implementation of policy and market interventions.

The paper addresses the issue of economic transparency, and more specifically the advantages and disadvantages for a central bank should it release its own inflation forecasts. To do so, Geraats has elaborated a two-period, Barro-Gordon model, in which the public interprets the interest rate setting by the central bank as a signal of its commitment to control inflation. In the «transparency»-dominated setting, the first period interest rate is a less noisy signal than in a setting of «opaqueness». As a result, markets respond more to the interest rate signal if the central bank is transparent. In the latter case, the incentive for the central bank to invest in reputation, by targeting lower inflation in the first period, is relatively smaller, and the realised first period inflation is higher than in the regime of transparency. The model also shows that, in addition to the reduction of the inflation bias, transparency increases the leeway for the central bank to stabilise the economy.

Finally, as the result of the model relies on the ability of the central bank to reveal what is the structure of shocks affecting the economy, the paper shows that this can better be achieved through the publication of conditional, rather than unconditional, forecasts.

Summary of the Discussion

Alex Cukierman began his discussion of the paper by summarising the key features of the model, such as: the public ignores the true inflation target of the central bank and knows that its policy will not be time-consistent. In this context of asymmetric information, there is an incentive to be transparent so as to improve the ability to stabilise the economy. Cukierman asked about the relevance of assuming that the public ignores the inflation target of the central bank.

The second discussant, Marvin Goodfriend, broadened the debate by putting the paper in the perspective of central bank practice in the real world. He first questioned the relevance of models relying on output inflation trade-off for central banks, such as the ECB, with a lexicographic preference for inflation. He then concentrated on the drawbacks of publishing forecasts. To start with, unconditional inflation forecasts by central banks who target inflation are constant so that it would be meaningless to publish them on a regular basis. The uncertainty of the forecast may then confuse the market. The market expectation of future inflation, which should be as good as the one elaborated by central bank economists, is readily available in the yield curve.

In the general discussion, Adam Posen criticised Geraats' model, and more generally models of time inconsistency, on the basis of empirical evidence that shows the central banks' ability to reveal their preference to the public.

Summary of the Paper: "Which kind of transparency?", Bernhard Winkler

In this paper, Bernhard Winkler develops a language in which central bank communication can be meaningfully discussed. He develops a theory on the meaning of the different uses of the word 'transparency'.

The paper first surveys the literature on transparency in monetary policy-making. This literature has given precise meaning to the term 'transparency' in the context of models, which do not analyse the critical issue of how to best communicate monetary policy. Winkler questions the assumptions of perfect information processing by individuals, common knowledge in game situations, and perfectly efficient markets.

In his paper, Winkler proposes to distinguish different aspects of transparency. The first aspect, clarity, refers to the fact that information needs to be simplified, processed and interpreted, in order to be understood. The second aspect, honesty, requires that communication correspond to the true intended meaning of the sender, and this is independent of whether it is clear or understood by the receiver. The third aspect of common understanding refers to the need for the sender and receiver in the monetary policy game to share a common perspective and have sufficient knowledge of each other's information.

Winkler further develops a transparency triangle consisting of honesty, clarity, and information efficiency. He argues that

those aspects of transparency are sometimes in conflict with each other. One corollary is that, in general, it will no longer be possible to rank different monetary policy strategies and communication policies in any meaningful way.

The paper also discusses the persistent controversy over ECB transparency. It explains it by the extraordinary communication challenges faced by the ECB, which must communicate to fragmented audiences in a multi-cultural environment.

Summary of the Discussion

Marvin Goodfriend argues that this paper is about the economics of conversation with various audiences. Central to the issue is the fact that the central bank has to communicate with different market participants: financial markets, price-wage setters, households, foreign investors, etc. The central bank cannot informationally discriminate in the same sense a price setter would price discriminate. Therefore, communication becomes a very difficult job. Sustaining a conversation is further hampered by the fact that the current economic situation continuously changes. In addition, historically the public at large and the press have come to know and understand more, which requires more from the central bank. He concludes that there is a role for the central bank in educating and teaching the public.

Charles Freedman elaborated further on the limits of transparency. He questioned which type of statements actually revealed information and which ones mere-

ly added noise. He also posed the question of what to publish: conditional versus unconditional forecasts. He referred to the Bank of Canada experience in which the market interpreted forecast conditioning as an intent on the part of the central bank. Problems may arise if the central bank then has to deviate from the forecasts when conditions change. He also pointed to the fact that different audiences have different understandings.

David Vines argued that the paper was not only about conversation, but also about central bank action. He pointed towards the inescapable conflict between openness and clarity. The actions of the central bank could never be fully described by an algorithm. He pointed out that there will always be an unexplainable epsilon.

Summary of the Paper "Caution and Conservatism in the making of Monetary Policy", Philip Schellekens.

The paper explores the robustness of the key results of the credibility literature, from time inconsistency inflation bias to delegation, with multiplicative uncertainty and generalised quadratic central bank objectives. In the model, the supply curve takes the traditional Lucas form and the transmission process, from policy instrument, to realised inflation is given by a stochastic multiplicative factor. In addition, the quadratic loss function of the central bank departs from the one used in the credibility literature by admitting different weights for missing inflation or output targets and for their variability. This allows the aversion for

missing targets to be separated from the one relating to macro-economic instability.

First, Schellekens shows that multiplicative uncertainty introduces an incentive for the central bank to be cautious and that delegation to a conservative central banker improves general welfare. Second, he offers a new way to approach conservatism in the delegation of monetary policy. He finds that a more flexible definition of central bank preferences helps to release the trade-off between flexibility and credibility. In other words, the appointment of a conservative central banker does not imply relinquishing the ability to stabilise output.

Summary of the Paper "Monetary Policy with Uncertain Parameters", Ulf Soderstrom

Soderstrom develops a dynamic macro-economic model in which there is uncertainty about structural parameters. He shows that this uncertainty does not necessarily lead to more cautious monetary policy, contrary to the current wisdom of the Brainard conservatism principle. In particular, when there is uncertainty about the persistence of inflation, it is optimal for the central bank to respond more aggressively to shocks than under certainty equivalence. This is so because this way the central bank reduces uncertainty about the future development of inflation. Uncertainty about other parameters acts to dampen the policy response.

For his analysis, Soderstrom uses the dynamic aggregate-supply, aggregate-demand framework developed by Lars Svensson. The model consists of two equations relating the output gap and the inflation rate to each other, and to a monetary policy instrument. The central bank has the traditional quadratic objective function. Monetary policy is assumed to affect the output gap with a lag of one period which, in turn, affects inflation in the subsequent period. Soderstrom modifies the Svennsson framework by assuming multiplicative uncertainty. The parameters of the model are assumed to be time varying. They are random variables with time invariant means. In this model, certainty equivalence ceases to hold, and the variances of the state variables affect the optimal policy rule.

Soderstrom solves the model numerically. He then analyses how the resulting path of the monetary policy instrument depends on the degree of uncertainty of the model. To analyse this, he considers first uncertainty about the model parameters separately. In a second stage he combines uncertainty of more than one parameter. In the case of impact uncertainty, the uncertainty about the parameters in the transmission mechanism, the Brainard conservatism principle still holds. This is also the case for uncertainty about the persistence of output.

However, uncertainty about the persistence of inflation, causes the central bank to act more aggressively. One reason for this result is that under multiplicative uncertainty, the variance of the model variables increases with the distance from target. When inflation and output are further away from the target, the uncertainty about their future development is greater. Since the persistence of inflation only affects the dynamics of the economy, optimal policy reduces the amount of uncertainty about future inflation by acting more aggressively to push inflation closer to target.

A further result, so the paper, is that parameter uncertainty can lead to smoother paths of the interest rate than under certainty equivalence. This mitigates the need to explicitly enter a smoothing objective into the central bank's loss function.

Summary of the Discussion

Carl Walsh compared the paper by Soderstrom to the one by Schellekens. He discussed what one can learn from those papers regarding uncertainty, learning, and strategy. He stated that Soderstom had a wider set of parameter uncertainty than Schellekens, where only one parameter was uncertain. He argued that the exogeneity assumption of the uncertainty might not be completely revealing. In the real world, much of the parameter relates instead to the lag of the transmission mechanism. More interestingly, the comparison of the U.S. disinflation in the early 1980's, and the ongoing 1990's disinflation suggests that this lag is, itself, an endogenous response by the private sector to the monetary policy-makers. One may then regret that the models of Schellekens do not tackle the learning mechanism.

He argued that monetary policy itself plays a role in creating parameter uncertainty. There is nothing to learn about learning itself in the models of Soderstrom and Schellekens. Because of the backward-looking features of the Soderstrom model there is no role for strategic interaction. Ideally, expectations should be incorporated in the model. He further argued that the paper did show that uncertainty in model dynamics removes the presumption that caution is optimal. However, the real net effect of overall parameter uncertainty might not be that large.