THE EURO AND MONETARY POLICY TRANSPARENCY

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Over the last two years the external value of the euro has attracted considerable attention—not surprisingly, given the potential economic and politic repercussions of its steady decline. By November 2000, the value of the European single currency had fallen by 30 percent against the dollar compared to its value at the date of its launch on 1 January 1999, though it has most recently staged a recovery, stabilizing at a higher level. Various reasons for its weakness have been cited. For instance, it has been pointed out that real growth and interest rates differentials were in favor of the United States, which led to significant capital flows from Europe to the United States. Further, it has been argued that the sharp increase in the issuance of euro-denominated bonds and the relative attractiveness of the U.S. equity markets may account for the depreciation of the euro. Its decline has also been attributed to the monetary-fiscal policy mix adopted in Euroland, which, it is argued, might lead to free-riding behavior of fiscal authorities in any particular country. In essence, the low interest rates prevailing in the euro area could result in overborrowing to finance budget deficits, thereby increasing the risk of fiscal unsustainability [Cohen and Loisel, 2000].

This paper focuses on another possible explanation for the weakness of the euro, namely the lack of transparency of the European Central Bank's (ECB) monetary policy. Recently, both the IMF's Economic Outlook [2000] and the Economist [2001] have stressed that, notwithstanding its regular press briefings, there is a widespread perception that the ECB's communication strategy has so far lacked clarity. As argued by Cuckierman and Meltzer [1986], some "creative" ambiguity may be useful in a few instances, but it must be weighed against the uncertainty that it generates, which translates into higher and more volatile borrowing costs. Faust and Svensson [1999] and Geerats [2000] have shown that transparency can act as an implicit commitment mechanism and help to build an institution's reputation. Therefore, as Favero et al. [2000] point out, what has worked well in terms of secrecy for the Bundesbank and other central banks (under different circumstances) may not be the right approach for the ECB.

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Eastern Economic Journal, Vol. 28, No. 1, Winter 2002

This paper provides some empirical evidence on the extent to which the communication strategy chosen by the ECB has resulted in uncertainty about its monetary policy objectives, thereby weakening the euro. In particular, an increase in this source of risk might be the reason for the observed capital outflows from the euro area to the United States, with their obvious consequences for the exchange rate. Since we are interested in market uncertainty about monetary policy, we focus on short-term interest rates. Although other factors could affect their volatility, undoubtedly the lack of monetary policy transparency is one of the most important ones, as argued by various authors. For instance, Dotsey [1987] shows that secrecy shrinks the feasible information set of private agents on monetary policy operating procedures. Consequently, the interest rate forecasting error and the interest rate conditional variance tend to increase.

Options prices are being increasingly employed to extract market expectations and views about monetary policy. For this purpose, Gros et al. [2000] employ risk-neutral probability functions to synopsize the information contained in the prices of short-term futures options. They pay particular attention to the second moment of these distributions, to extract the so-called implied volatility. This can be seen as a measure of the uncertainty in the underlying asset price (money market rates, in this context). However, since estimating risk-neutral probability functions is computationally burdensome, they focus only on a few of the several days (over the period 1999-2000) surrounding the Federal Open Market Committee (FOMC) or the ECB's Governing Council meetings [Gros et al., 2000]. It is standard practice to use the Black-Scholes [1973] formula for option pricing to obtain a time-varying measure of the implied volatility [Gros et al., 2000]. However, it should be noted that the Black-Scholes formula predicts a constant volatility across time-to-maturity and strike prices, which is not consistent with the empirical evidence.

The contribution of this paper is twofold. First, we take an alternative approach to measuring uncertainty, and estimate a Stochastic Volatility model [Ghysel et al., 1996] to obtain a time-varying variance from the unpredictable innovations. This, rather than the implied volatility calculated in the standard way, is used as our measure of monetary policy uncertainty. To be more specific, we focus on the deviations of the spot level of short-term interest rates from policy-determined, "official rates." These differences, we argue, are more representative of market-determined interest rates. Secondly, we estimate directly the impact of monetary policy uncertainty on the euro-dollar exchange rate. The paper is organized as follows: we begin by reviewing a number of theoretical studies on monetary policy transparency and continue by summarizing the available empirical evidence. We then explain the empirical methodology and describe the empirical findings, specifically the implications for the euro-dollar exchange rate.

MONETARY POLICY AND TRANSPARENCY

Previous studies on monetary policy transparency are not always in agreement. While a majority emphasize the reasons for secrecy, a few recent ones advocate openness, by showing that it provides an implicit commitment mechanism, and it can help

a central bank build its reputation. Research has focused on five different aspects of monetary policy transparency [Geerats, 2000]. These are:

- openness about policy objectives, such as explicit inflation targets (political transparency)
- disclosure of economic data, models, and a central bank's forecasts (economic transparency)
- information about the monetary policy strategy and internal policy deliberations, for instance through the release of minutes and voting records (procedural transparency)
- communication of policy decisions and announcements (policy transparency)
- openness about the implementation of policy decisions, market interventions and control errors (operational transparency, market transparency)

Political transparency is analyzed by Nolan and Schaling [1996], who show that less uncertainty about the central bank's preferences is beneficial and reduces the inflation bias.

As for economic transparency, Gersbach [1998] and Cuckierman [1999] focus on the publication of the central bank's forecasts, which removes an information asymmetry about economic shocks. They show that disclosing the forecasts to the public reduces welfare. The reason is that the central bank loses its ability to stabilize output because supply shocks revealed by the forecasts are incorporated in inflation expectations. Both models assume that there is perfect information about the central bank's preferences. Tarkka and Mayes [1999] consider economic transparency in the form of mutual uncertainty about expectations. Specifically, the public is assumed to be uncertain about the central bank's preferences and its assessment of the public's inflation expectations. The publication of the central bank's forecasts removes these uncertainties and leads to greater predictability of monetary policy. Geerats [2000] also analyzes the case of asymmetric information between the central bank and the public, where it is assumed that the central bank has additional economic information, and the public does not know the central bank's preferences. Concerning the first assumption, the argument is that central banks have an informational advantage in the interpretation of the available information; they are likely to have different (and often better) forecasts than the market. Romer and Romer [1996] provide evidence of such asymmetric information. The second assumption is claimed not to be a contentious one, since many central banks have adopted explicit target ranges for inflation. Geerats [2000] shows that transparency enhances the central bank's ability to build a reputation, reduces the inflation bias, and gives monetary authorities greater flexibility to respond to shocks to the economy. These advantages can be achieved through the publication of the conditional central bank's forecasts of both inflation and output.

Procedural and policy transparency (in particular the publication of minutes, voting records, and policy directives) are considered in Goodfriend [1986], Buiter [1999] and Issing [1999]. The implications of disclosing individual voting records are formally analyzed by Gersbach and Hahn [2000].

There are several models of operational transparency. In their seminal paper, Cuckierman and Meltzer [1986], who build on the optimal policy models of Kydland and Prescott [1977] and Barro and Gordon [1983], provide a motivation for secrecy. They show that a central bank, through control errors, can mask its true intentions, and then use inflation surprises to increase output during periods when it is most valuable to do so. Because in their model the loss function is linear in output, the central bank is willing to accept arbitrary increases in the variance of employment to achieve tiny reductions in inflation. Consequently, monetary authorities behave in the same way regardless of whether credibility is low or high. Because monetary policy does not depend on the reputation and credibility of the central bank, less secrecy represents a cost to the central bank only to the extent that it reduces its ability to engineer inflation surprises.

Faust and Svensson [1998] extend the Cuckierman and Meltzer analysis in two ways. First, they consider a more realistic loss function for the central bank (quadratic in both arguments: inflation and employment variability). Secondly, they explicitly distinguish between operational transparency and imperfect monetary control. In their model the central bank is tempted to deviate from an announced inflation target due to fluctuations in an idiosyncratic employment target, which represents information exclusive to the central bank and unobservable to the private sector. Increased transparency allows the private sector to infer the central bank's employment target with greater precision, which makes both the central bank's reputation and inflation expectations more sensitive to the actions of the monetary authorities. This, in turn, increases the cost of the central bank's deviating from the announced inflation target, and hence deters it further from attempting to achieve its idiosyncratic employment target. As a result, the variability of both inflation and employment falls, and the inflation bias is reduced. Consequently, increased transparency gives the central bank the incentive to build its reputation, and, generally, it increases social welfare.

More recently, Faust and Svensson [1999] endogenize the choice of control and transparency, and show that a minimum degree of transparency can be preferable. The evidence pertaining to the Bundesbank and the U.S. Federal Reserve Board (Fed) appears to be consistent with this view, while the recent experience of high central bank transparency in inflation targeting countries is clearly not. In a model similar to Faust and Svensson [1998] but with a New Keynesian Philips curve, Jensen [2000] finds that greater transparency could actually reduce social welfare.

EARLIER EMPIRICAL STUDIES

As already mentioned, the ECB's monetary policy, especially when compared with the Fed's operating strategy, has attracted criticism from the media, market participants, and international organizations. Several empirical studies have tried to demonstrate that faults in a central bank's communication strategy can cause considerable uncertainty over the future course of monetary policy.

Poole and Rasche [2000] analyze daily data on the Fed funds futures, and find that over the last few years the accuracy of market forecasts of the Fed's policy decisions has increased. They argue that the improved market understanding of monetary policy is due to the adoption of a better communication strategy, which includes immediate announcements of policy decisions following the Federal Open Market Committee (FOMC) meetings, and confining most policy actions to the time of regularly scheduled FOMC meetings. Two surveys, one from Goldman and Sachs [2000] and another from the Center for European Economic Research (ZEW) in Germany [1999], criticize the ECB for its lack of transparency. Following Soderlind and Svensson [1997], Gros et al. [2000] use the volatility of 3-month money market rates (in both Euroland and the United States) implied by option prices as a measure of monetary policy uncertainty. They show, using cross sections of different strike prices, how to derive the (risk-neutral) probability distribution of option prices on a daily basis. Once this has been estimated, the moments of the distribution (in particular, the variance) can be computed. Volatility levels are normalized to make them comparable, given the different mean levels. The analysis focuses on some crucial dates when monetary policy decisions were expected in the United States and Euroland, between September 1999 and March 2000. The empirical results show that there is no clear ranking: implied volatility is sometimes higher in the United States, and sometimes higher in Euroland. To check the robustness of their results to the dates chosen, the authors also examine the daily implied volatilities estimated by Bloomberg, which are based on the same option prices using the traditional Black-Scholes [1973] formula. The findings confirm that there is no clear ranking: towards the end of the sample, Euroland volatilities seem to be higher, while the opposite is true at the beginning of the sample. In particular, they report that Euroland's volatility drops after the interest rate hike decisions in November and February, while it is high (and higher than in the United States) before such decisions.

As already mentioned, the Black-Scholes [1973] formula implies a constant volatility, while the evidence based on observed option prices indicates that volatility varies across time-to-maturity and strike prices. Therefore, in contrast to the existing literature [Gros et al., 2000], we measure the uncertainty surrounding expectations on the ECB's and Fed's monetary policy by using the variance of the stochastic, or unpredictable component of the spot money market rates. This is modelled adopting a stochastic volatility framework [Harvey et al., 1994], which allows the estimation of a time-varying variance, using an unobserved component model, as explained in the following section.

EMPIRICAL METHODOLOGY

Measuring the implied volatility from option prices is one possible way to quantify the uncertainty in expectations about a financial variable. The cross-sectional dispersion of individual forecasts from surveys summarizes the range of disagreement among individual forecasters. However, it does not give any information regarding each individual's uncertainty about their own forecast. It is possible for each forecaster to be extremely uncertain about future events but to submit very similar estimates. Under these circumstances, survey measures would fail to capture the amount of existing uncertainty.

TABLE 1
Stochastic Volatility Model Diagnostics

	1-month EU	1-month US	3-month EU	3-month US
$\sigma_\eta/\sigma_\varepsilon$	0.42	1.71	0.89	0.43
LogL	−42.17	−19.31	302.94	479.19
Q(5)	5.81(0.12)	1.45(0.91)	5.09(0.16)	3.71(0.29)
DH	189.57(0.00)	235.05(0.00)	459.50(0.00)	711.75(0.00)

$\sigma_\eta/\sigma_\varepsilon$ are the ratios between the measurement and the transition equation variances. LogL is the maximized Log-Likelihood value, Q(5) is the Ljung-Box statistic to test the null of no autocorrelation (up to order 5). DH is the Doornik-Hansen [1994] normality test statistic. P-values are in brackets.

By contrast, to examine uncertainty we use a stochastic volatility model which yields estimates of the variance of the unpredictable innovations in a variable.[1] As argued by Grier and Perry [2000] [2], the estimates of a time-varying residual variance are a good proxy for the notion of uncertainty found, (for example, in the study due to Cuckierman and Meltzer [1986]. Given a time series y_t, the serial dependence in its variance is modelled as:

$$(1) \qquad y_t = \sigma_t \varepsilon_t = \sigma \varepsilon_t \, h_t/2 \qquad \varepsilon_t \sim IID(0,1) \qquad t = 1,\ldots, T$$

where:

$$(2) \qquad h_{t+1} = h_t + \eta_t \qquad \eta_t \sim NID\,(0,\sigma_\eta^2)$$

the term σ^2 being a scale factor, and η_t being a disturbance term which is uncorrelated with ε_t. Taking logs, from equation (1) we obtain:

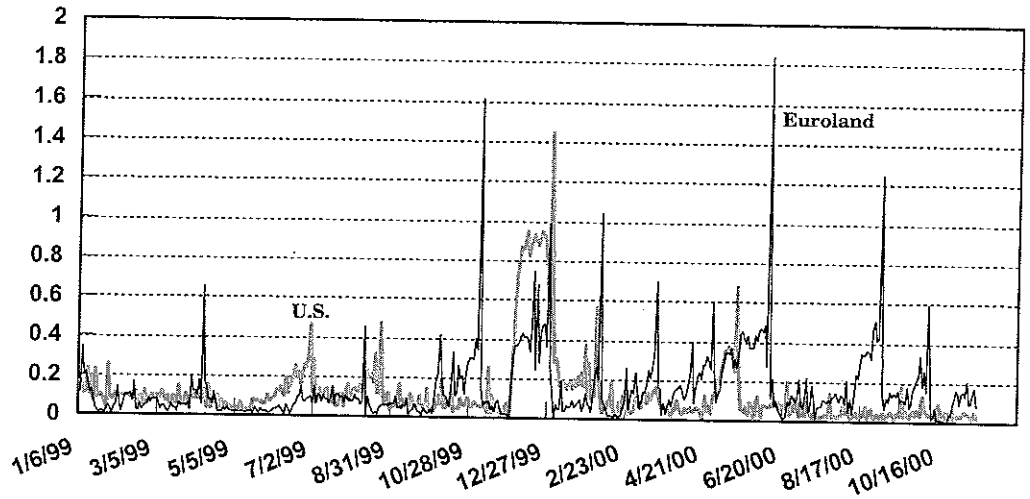
$$(3) \qquad \log y_t^2 = h_t + \log \varepsilon_t^2 \qquad t = 1,\ldots, T$$

The mean and the variance of ε_t^2 are known to be −1.27 and $\pi^2/2 = 4.93$, respectively [[Abramovitz and Stegun, 1970]. A practical problem arises if some of the observations are zero, because in this case the logarithm cannot be taken. The solution put forward by Breidt and Carriquiry [1996] is to make the following transformation based on a Taylor series:

$$\log y_t^2 \cong \log (y_t^2 + cs_y^2) - cs_y^2/(y_t^2 + cs_y^2) \qquad t = 1,\ldots,T$$

where s_y^2 is the sample variance of y_t, and c is a small number, the suggested value being 0.02. To compute the optimal estimate of the unobserved state vector h_t, for t = 1,2,…,T, we used a recursive procedure—the Kalman filter.[3] When applied to the model given by equations (2) and (3), this will yield the minimum mean square linear estimates (MMSLEs) of the state and future observations. It is important to note that, because the model is not conditionally Gaussian, the exact likelihood cannot be obtained from the resulting prediction errors. Therefore, as suggested by Harvey et al.

FIGURE 1
Stochastic Volatility of 1-Month Interest Rates in the United States and Euroland



[1994], we used a Quasi Maximum Likelihood (QML) method, which is robust to non-normal residuals.

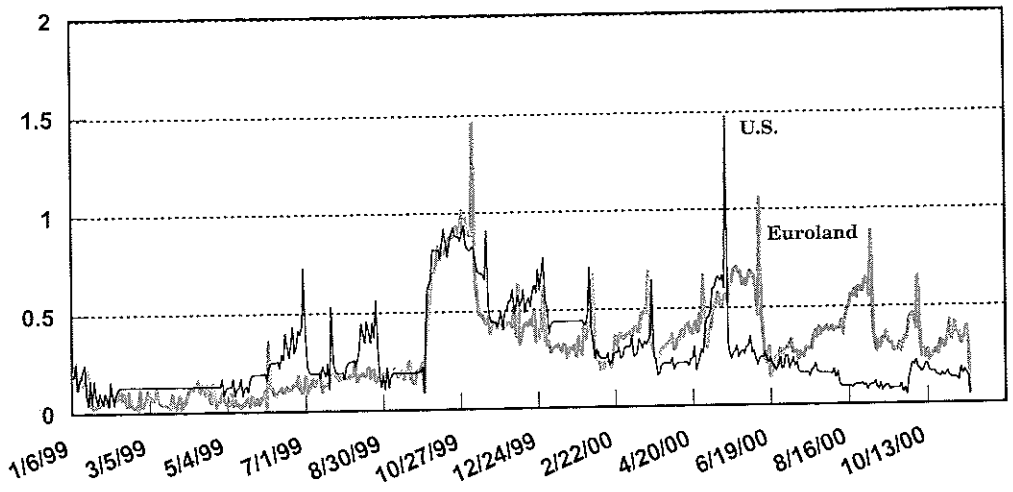
EMPIRICAL ANALYSIS

The empirical methodology is applied to the 1-month and 3-month Euribor and U.S. dollar Libor rates. Specifically we consider the deviations of these money market rates from the corresponding "official rates", which are the repo rate (that is, the rate of the open market operations) for the ECB, and the fed funds target rate for the U.S. Fed. The constructed series can be interpreted as the proportion of the daily rate, which is driven by market forces. (For a similar analysis, see Hamilton [1996], Quiros and Mendizabal [2000], and Panigirtzoglou et al. [2000].) The sample period runs from 5 January 1999 to 14 November 2000, for a total of 486 observations. All data series were taken from Datastream. Diagnostic tests on the standardized residuals show that the model is reasonably well specified (see Table 1).

Figure 1 plots the normalized stochastic volatility for the 1-month interest rates in the United States and in Euroland.[4] In the early part of the sample interest rate volatility is higher in the United States than in Euroland, while the opposite is true towards the end of the sample. Volatility appears to rise just before the interest rate decisions taken at official meetings of the U.S. Fed and of the ECB, and drops afterwards.[5] Also, Euroland money market volatility hikes are comparatively higher than those for the United States.

Figure 2 plots the normalized stochastic volatility for the 3-month interest rates in the United States and in Euroland.[6] Similarly to Gros et al. [2000], we find few differences between the two regions. Towards the end of the sample, Euroland volatility is higher, while the opposite is true in the early period.[7] Further, as reported by

FIGURE 2
Stochastic Volatility of 3-Month Interest Rates in the United States and Euroland



Gros et al. and by ourselves for the 1-month contracts, volatility in both the United States and Euroland drops after interest rate changes decided by the central banks, and is high before such decisions.[8]

It is important to note that volatility can be high because of market uncertainty about either future economic developments or monetary policy strategy [Gros et al., ibid.]. Forecasts from Consensus Economics and those published in *The Economist* clearly show a higher degree of market uncertainty about future GDP growth and inflation in the United States. Finding similar volatility in the United States and Euroland, in the presence of a more turbulent economic environment in the United States, can therefore be interpreted as evidence that there is a higher degree of market uncertainty about monetary policy strategies in Euroland [Gros et al., ibid.]. We would argue that this difficulty in understanding the ECB's operating strategy (relative to the Fed's) might have made the United States a more attractive market for investors, thereby generating capital outflows from the euro area to the United States and weakening the euro relative to the dollar.

In the second stage of the analysis, we examine directly the influence of market uncertainty on the euro-dollar exchange rate (the series used is the spot rate, also taken from Datastream). For this purpose we use the fully-modified ordinary least-squares estimator [Phillips and Hansen, 1990] to obtain standard errors robust to the non-stationary properties of the data. For the 1-month rates, the estimated equation is (t-ratios in brackets):

$$xr = \underset{(94.37)}{1.01} + \underset{(2.48)}{0.11}\, svus1m - \underset{(4.59)}{0.19} sveu1m$$

where xr is the euro-dollar exchange rate, and *svus1m* and *sveu1m* are the stochastic volatilities for the one-month interest rates in the United States and in Euroland,

respectively. For the three-month rates, the corresponding estimates are the following (t-ratios in brackets):

$$xr = \underset{(82.25)}{1.02} + \underset{(7.26)}{0.27}\, svus3m - \underset{(9.07)}{0.33}\, sveu3m$$

where *svus3m* and *sveu3m* stand for the stochastic volatilities of the three-month interest rates in the United States and in Euroland, respectively. Given the fact that the economic environment seems to be characterized by a higher degree of uncertainty in the United States than in Euroland, the estimation results can be interpreted as evidence that monetary policy uncertainty plays an important role in exchange rate determination. Specifically, they indicate that the lack of transparency in the ECB's operating procedures relative to the Fed's has a (statistically significant) negative effect on the euro-dollar exchange rate, which is even stronger in the case of the three-month rates. This can be seen simply as a consequence of the uncovered interest parity relationship (UIP), with imperfect substitutability between domestic and foreign assets: UIP predicts that, for given interest rates, an increase in the country risk premium (which, in our case, reflects higher monetary policy uncertainty) leads to a capital outflow and a nominal exchange rate depreciation [Isard, 1978; Dornbusch and Fischer, 1980].

CONCLUSIONS

As pointed out in a number of studies [Faust and Svensson, 1998; Geerats, 2000], transparency can help central banks to build their reputations, thereby enabling monetary authorities to conduct their policies more successfully. This paper has addressed the issue of monetary policy uncertainty in both the United States and Euroland, and it has improved upon the existing literature [Gros et al., 2000] in two ways. First, we have estimated a stochastic volatility model to obtain a time-varying measure of uncertainty. This is in contrast to earlier studies relying on the Black-Scholes [1973] formula, which, implausibly, implies constant volatility. Furthermore, we have used policy-adjusted short-term interest rates, which has enabled us to focus on the component of interest rates which is market-driven. Secondly, we have analyzed directly the impact of monetary policy uncertainty on the euro-dollar exchange rate. Our empirical findings (which are consistent with those of Gros et al.) appear to confirm that the ECB's communication strategy has not been very successful. In other words, the ECB's actions and motivations are not well understood by the markets, and this lack of transparency (relative to the U.S. Fed) has been perceived as an additional source of risk by investors, with consequent capital outflows and a weakening of the euro relative to the dollar. Such a view has been receiving increasing support among foreign exchange dealers, media analysts and academic economists.

The ECB's communication strategy undoubtedly plays a crucial role in the pursuit of its policy objectives. As suggested, for instance, by the IMF [1999], and also by Gros et al. [2000], a number of measures could be taken to improve it. For a start, publications of the inflation forecasts (as in inflation targeting countries, such as New Zealand, the UK and Sweden) and of the models used to produce such forecasts could

lead to a better understanding of European monetary policy. For instance, reporting the conditional inflation (and output) forecast allows outsiders to monitor and scrutinize it. Hence, the evaluation of monetary policy does not have to be postponed some two years until actual inflation is observed. The more explicit a central bank is about its targeting rule, the easier it is for outsiders to monitor the extent to which this is adhered to, and to learn how to accurately predict the behavior of the central bank. This implies that the incentives for the central bank to build a reputation become stronger. In the last few months promising signals have emerged that the ECB is changing its attitude. Following an announcement made in November 2000 by its president, Mr. Wim Duisenberg, on 21 December the ECB published for the first time its economic projections (rather than forecasts) for the euro area in the form of ranges of prospective economic growth and inflation over a two-year horizon. However, Mr. Duisenberg stressed that they are "produced by staff experts and do not embody the policy judgments of the Governing Council" [*Financial Times*, 24 November 2000], and that they are simply one of various inputs into the policy-making process which is the responsibility of the ECB's Governing Council.

Another important issue is whether the two-pillar strategy adopted by the ECB is the most effective one. The first pillar is targeting the M3 monetary aggregate. However, the ECB does not seem to have paid much attention to its first pillar. Svensson [2000] has pointed out that the emphasis on monetary aggregates is misplaced and confuses financial markets. Therefore, a strategy based only on an inflation target would make it easier for financial markets to understand the motives behind the ECB's decisions. Improved communication could also be achieved by clarifying the meaning of the general goal of keeping inflation below 2 percent in the medium run. This could be done by specifying a target in terms of "core" inflation, defined as the Harmonized Consumer Price Index minus the more volatile components, such as energy and food. This would enable the ECB to ignore temporary deviation from the target driven by changes in the oil price or shifts in indirect taxes. An explicit distinction between direct and second-round inflationary effects has already been adopted in a number of inflation targeting countries, such as Canada and Sweden.

Finally, at present the communication and explanation of the ECB's operating decisions takes place through a press conference and not through the publication of the minutes of the ECB meetings. The main reason given against their publication is that they would expose disagreements within the Governing Council, which might confuse rather than help outside observers in their attempts to understand the ECB's policy. However, occasional comments made informally after an official press conference can be at times equally if not more confusing, especially when they offer conflicting views of the policy outlook and policy priorities. To avoid sending confusing signals to the markets, the EBC should indicate clearly which sources are authorized to make major policy pronouncements.

The costs of adopting such measures would be minimal, because none of them would require amending the Amsterdam Treaty defining the ECB's institutional setup. By contrast, as our analysis appears to confirm, the benefits could be significant. It is to be hoped that the ECB will be responsive to the suggestions being made in many quarters.

NOTES

We are grateful to participants at the 2001 Eastern Economic Association Annual Conference, New York, February 23-25, 2001 for useful comments, and to Fabio Fraschetti for assistance with the data and helpful conversations.

1. Chadha and Nolan [1999] take the same approach to assess whether, in a regime of increased transparency in the UK, there has been a rise in the volatility of the 3-month Sterling Libor. Their results indicate that, contrary to their theoretical prior, higher transparency has been associated with less volatile interest rates in the UK.
2. Grier and Perry [2000] use GARCH models to estimate time-varying conditional variances of inflation and output growth. In a GARCH models, the conditional volatility follows a deterministic process, whereas in a stochastic volatility model, it follows a stochastic process. Recently, Panigiritzoglou et al. [2000] have applied GARCH models to policy-adjusted interest rates without obtaining significant coefficient estimates. We found equally unsatisfactory results (not reported) when applying the same framework to our data series.
3. Depending on the information set used, one can have a basic filter or a smoothing filter. The basic filter refers to an estimate of h_t based on the information available up to time t, and the smoothing filter refers to an estimate of h_t based on all the available information in the sample up to time T. In this paper we used the smoothing filter.
4. We first take the anti-log of the stochastic volatility unobserved component, h_t, and then divide it by the absolute levels of the policy-adjusted rates.
5. The focus is on the dates of central bank meetings producing official interest rate variations. For the Federal Reserve, these dates are: 30 June 1999, 24 August 1999, 16 November 1999, 2 February 2000, 21 March 2000, and 19 May 2000. For the ECB, they are: 9 April 1999, 5 November 1999, 4 February 2000, 17 March 2000, 28/ April 2000, 9 June 2000, 1/ September 2000, and 6 October 2000.
6. See footnote 4.
7. The observed volatility pattern, for both 1 and 3-month rates, might reflect, to some extent, changes in the relative degree of policy activism in Euroland and the United States.
8. See footnote 5.

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