

Does it pay to be transparent?
International evidence from central bank forecasts

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Abstract

Is central bank transparency associated with variation in macroeconomic outcomes? We use cross-country data covering 87 countries and construct an index for transparency based upon the detail in central banks' published forecasts. After controlling for a number of other institutional and macroeconomic variables we find that an increase in the detail that central banks include in their published forecasts is associated with lower average inflation. The result holds regardless of whether the domestic nominal anchor is based more on an inflation or money target, but not for exchange rate targeting countries. Furthermore, we do not find evidence that the publication of forecasts is associated with greater output volatility.

JEL Classification: D72, E42, E52, E58.

Summary

Is central bank transparency associated with lower inflation? This paper provides the first international evidence on if and how the degree of transparency in monetary policy affects policy outcomes. We focus on one particular form of transparency, namely the publication of inflation forecasts and forward-looking analysis. The recent theoretical literature suggests that transparency in publishing forecasts will reduce inflation to the extent that it makes central bank credibility more sensitive to policy actions. Recent policy debates have also highlighted the potential importance of the publication of the central bank's inflation forecasts.

We use a unique cross-country data set covering the detail with which central banks explain forecasts in 87 countries and we construct an index for transparency based on the publication of forecasts by central banks. We then assess how our index of transparency is related to inflation, inflation variability, output, and output variability. After controlling for a number of other institutional and macroeconomic variables we find that an increase in the detail with which central banks publish forecasts is associated with lower average inflation. The result holds regardless of whether the domestic nominal anchor is based more on an inflation or money target. Furthermore, we do not find evidence that the publication of forecasts is associated with greater output volatility.

One conundrum emerges, however: why, given the apparent benefits, do not more central banks publish forecasts in greater detail? We base a detailed discussion of the robustness of our results around this question. The discussion blends extensive econometric testing with a detailed assessment of how such tests relate to theory and practice of monetary frameworks. We offer three main explanations:

First, theory asserts the publication of forecasts will have a smaller impact on inflation when credibility is secured by other means, a prediction that is supported by the results in the paper. We do not detect a significant impact of transparency on inflation for those countries with exchange rate targets, and the effects are smaller for lower inflation countries whose credibility may be relatively strong.

Second, the result may have been biased by reverse causality, ie it is the attainment of low inflation that leads central banks to become more transparent, and not the other way round. Our statistical tests cannot completely reject such a possibility but demonstrate that it is unlikely to undermine the results. Furthermore, there are few if any examples of either (a) a framework in which policy-makers have reduced transparency in response to an increase in inflation, or (b) a transparent framework in which inflation has markedly increased.

Finally, we argue that many central banks have not yet completed the transition to greater transparency. The theoretical and empirical evidence on the effects of transparency is relatively new.

And the practical precedents of frameworks in which published forecasts made important contributions to credibility-building emerged only in the 1990s.

In summary, we argue that the robustness tests have gone far enough to make us confident that we have identified empirically a channel for reducing and maintaining low inflation. Furthermore, there are global policy implications: there remain many central banks around the world that may achieve lower average inflation by publishing their forecasts in greater detail.

1. Introduction

The past decade witnessed an increased interest in the institutional framework of monetary policy. The benefits of central bank independence have been demonstrated in much academic research and have become conventional wisdom among policy-makers.¹ New questions have emerged, however, about the institutional characteristics of central banks and their effect on economic performance; recent analyses have attempted to identify optimal degrees of independence, accountability and transparency in monetary policy.

Relative to the abundant literature on the effects of central bank independence, only limited research exists so far on the issues of transparency and accountability in monetary policy. Furthermore, empirical analyses have mostly focused on financial markets and used time series data.² In this paper we examine how monetary policy transparency is associated with inflation and output in a cross-section of 87 countries. We use a particular concept of transparency that relates to the detail in which central banks publish economic forecasts (henceforth ‘transparency in forecasting’). We employ a new data set based on a survey conducted by Fry, Julius, Mahadeva, Roger and Sterne (henceforth FJMRS). To our knowledge these are the only data covering transparency in monetary policy across such a wide cross-section of countries.

Our results show that a higher degree of transparency in monetary policy is associated with lower inflation. The relationship is robust to various econometric specifications, and holds whether the domestic nominal anchor is based more on an inflation or a money target. In contrast, our results suggest that the publication of forecasts has no significant impact on inflation in countries that target the exchange rate. In addition, we do not find evidence to support the proposition that a high degree of transparency is associated with higher output volatility.

⁽¹⁾ See Blinder (2000).

⁽²⁾ Some exceptions are the papers by Briault, Haldane and King (1996) and Nolan and Schaling (1996). Their focus, however, is on accountability rather than on transparency, and these accountability measures involve only a limited number of countries (14 countries).

The rest of this paper is organised as follows. The next section reviews the relevant empirical and theoretical literature. Section 3 provides a discussion of our survey data set. The econometric analysis and the discussion of our results are contained in Section 4. Section 5 assesses the robustness of our results, and Section 6 concludes.

2. Review of the literature

The currently expanding theoretical literature on central bank transparency identifies various channels through which increased transparency may affect economic policy outcomes. Not all of these move in the same direction. And neither is there a universally accepted definition of central bank transparency.³ Various authors conceptualise transparency in different ways, focusing either on preferences, models, knowledge about the shocks hitting the economy, the decision-making process, or the implementation of policy decisions.⁴ The models by Faust and Svensson (2000, 2001), Jensen (2000), Geraats (2001a), and Tarkka and Mayes (1999) all assume private information about the central bank's objectives/intentions. Transparency is modeled as the degree of asymmetric information about control errors (Faust and Svensson (2001) and Jensen (2000)) or (anticipated) economic shocks reflected in the policy instrument (Cukierman (2000a,b) and Tarkka and Mayes (1999)).

In this paper we focus on the detail in which central banks publish forecasts, since this variable is of common interest both in theoretical models of transparency and in related policy debates.⁵ Furthermore, publication of forecasts may allow dissemination of information relating to the central bank's view of the world (economic models), stochastic shocks, or preferences.

For any form of central bank transparency to be relevant some asymmetry of information in monetary policy must exist. Recent empirical work provides evidence confirming that central banks

⁽³⁾ Blinder, Goodhart, Hildebrand, Lipton and Wyplosz (2001) assess why, how, and what central banks do and should talk about. Winkler (2000) discusses issues related to the definition of transparency.

⁽⁴⁾ For example, see Geraats (2001a) for a classification.

⁽⁵⁾ See, for example, Buiters (1999) and Issing (1999) for a lively debate about transparency and accountability among central bankers.

may possess superior information. Romer and Romer (2000), for example, show that if commercial forecasters had access to the Federal Reserve's inflation forecasts, they would generally find it optimal to adopt them, discarding their own forecasts. Peek *et al* (1998, 1999) also find that the Fed's forecasts benefit from an informational advantage over the public that assists the Fed in conducting monetary policy. Superior information here is a product of the Fed's supervisory function and includes information about non-publicly traded banks.

Increased central bank transparency may reduce uncertainty in financial markets. Studies employing various methodologies provide evidence that market participants react to the dissemination of macroeconomic information by the central bank. For example, Clare and Courtenay (2001) employ an event study methodology and use tick-by-tick exchange rate data from LIFFE futures contracts, finding that the publication of forecasts in the form of the *Inflation Report* has an information content for UK market participants. Kuttner and Posen (2000) examine how shifts in the Federal Reserve's and the Bank of Japan's degrees of transparency over time contributed to the reduction of exchange rate volatility.⁶ Additional arguments in favour of transparency in monetary policy include the insulation of monetary policy from political pressures, increased accountability, facilitation of fiscal and monetary policy co-ordination, and improved internal organisation of central bank analysis.⁷

In Faust and Svensson (2001) a high degree of transparency in monetary policy is in general welfare-improving. Increased transparency reduces each of the inflation bias, inflation variability and employment variability. Faust and Svensson (2001) use a modified Barro-Gordon model. The central bank's employment target is not announced and varies over time according to an idiosyncratic component. Fluctuations in this component of the employment target tempt the central bank to deviate from an announced inflation target. The central bank controls inflation imperfectly and the inflation outcome has two components; the central bank's intentions and a control error. The central bank decides upon the extent to which it will reveal its knowledge of the control error to

⁽⁶⁾ Other relevant studies include Dotsey (1987) and Haldane and Read (2000). Thornton (1999) provides evidence on whether the Fed controls the funds rate primarily through open market or 'open mouth' operations.

⁽⁷⁾ These views were expressed by Josef Tošovský, who was at that time Governor of the Czech National Bank. His views, and those of various other central bank governors are contained in Mahadeva and Sterne (2000, pages 186-205). For a discussion of policy-related arguments for transparency in monetary policy, see Blinder *et al* (2001).

the public. By revealing the control error the central bank renders its intentions for inflation observable and enables the public to infer the central bank's employment goal. Thus the degree of central bank transparency increases as the central bank reveals a greater proportion of the observable component of the control error.

Analytically, Faust and Svensson (2001) distinguish between three different regimes of transparency. In the first (least transparent) regime neither the employment objective nor the intentions of the central bank are observable by the public. In the second regime with a high degree of transparency the inflation intentions of the central bank become observable. Increased transparency in inflation intentions results in lower inflation because it increases the sensitivity of a central bank's reputation to its actions, making it more costly for the central bank to pursue a high-inflation policy. The third regime is one the authors classify as 'extreme' transparency where both the employment goal and the intentions of the central bank are observable. The central bank's actions no longer convey additional information about the inflation bias, and its reputation is no longer affected by its actions. An inflationary bias re-emerges resulting in higher inflation, inflation volatility, and unemployment variability.⁸

Jensen (2000) adopts a similar informational structure to Faust and Svensson (2001), assuming that the output target is private information to the central bank and that the public's capacity to deduce it increases as the central bank publishes a greater percentage of the inflation control error. In contrast to Faust and Svensson (2001), who focus on the credibility effects of central bank actions in the future, Jensen (2000) uses a model with new Keynesian elements (staggered price-setting and monopolistic competition) and focuses on the marginal costs of inflation within the current period. More transparency increases the reputational costs of deviations from the inflation target and therefore increases its discipline and credibility.

The literature does not suggest that a high degree of transparency is unconditionally desirable. In Jensen's model, when central bank preferences are already public information, the

⁽⁸⁾ This result is consistent with the results of the more general model of policy-making by Morris and Shin (2001).

credibility-enhancing effect of increased transparency becomes redundant. Furthermore, in the presence of a shock that requires counter-cyclical monetary policy, transparency becomes a straightjacket. Thus the choice of the optimal degree of transparency is related to the trade-off between flexibility and credibility. A high degree of transparency is desirable for central banks with poor credibility but may be costly in terms of flexibility for high-credibility central banks.

Increased transparency may have the disadvantage of eliminating the central bank's strategic advantage, thereby reducing its capacity to stabilise the economy. 'Cheap talk' and 'optimal ambiguity' arguments are characteristic expressions of this view.⁹ Other papers focus less on the reputational aspects of transparency and more on the consequences of the central bank releasing information about stochastic shocks. In Cukierman's (2000b) one-period model the central bank's private information is about an upcoming shock. He uses each of a neoclassical transmission mechanism, relying on an expectations-augmented Phillips curve (ie a standard Barro-Gordon model), and a model along the most recent neo-Keynesian lines that focuses on the interest rate instrument. He examines the welfare implications of different degrees of transparency in each model. Under a regime of 'limited' transparency the central bank reveals its information about the upcoming shock after the public's inflation expectations have been set, while under 'full' transparency this information is released before the public forms its expectations.

Different degrees of transparency in the neoclassical version of the model merely affect the variability of inflation and not its average level. This is because the public becomes aware of the supply shock so the central bank loses its informational advantage and cannot generate inflation surprises to stabilise the economy. Expected social welfare, however, is always higher under a limited transparency regime compared with the full transparency regime. This is because under full transparency unexpected inflation is always zero and therefore the central bank cannot affect employment. This result holds under assumptions of both perfect and imperfect (noisy) central bank

⁽⁹⁾ For example in the 'cheap talk' model of Stein (1989) the central bank can generate inflation surprises. In the 'optimal ambiguity' model of Cukierman and Meltzer (1986) imprecise control of money supply allows the central bank to generate inflation surprises according to its time-varying preferences.

forecasts. Under perfect central bank forecasts, however, only the variance of the policy outcomes is affected while under noisy forecasts the average policy outcomes are affected as well.¹⁰

In the neo-Keynesian model of Cukierman (2000b) society is indifferent between the two regimes provided that interest rate variability does not enter its loss function. When the social loss function includes interest rate variability, however, the limited transparency regime is superior to the full transparency regime. Since the model incorporates a typical instrument rule, premature forecast publication requires more nominal interest rate variability in order to stabilise the *ex ante* real rate and through it the output gap and inflation.

Geraats (2001a) uses a two-period Barro-Gordon model with a real-interest-rate transmission mechanism and focuses explicitly on the publication of central bank forecasts. The central bank has private information about both demand and supply shocks and does not publish its inflation target. More transparency in the first period allows the private sector to observe the first period's demand and supply shocks and make inferences about the central bank's inflation target. More transparency therefore makes the central bank's reputation more sensitive to its actions, so an 'opaque' monetary policy regime is characterised by higher inflation in the first period. This is because the non-publication of the central bank's forecasts implies a reputation loss. Given the uncertainty about the central banker's type, the public tends to interpret the non-publication as an indication that the central bank is 'weak'. Transparency reduces the variability of inflation, but the effect on output is ambiguous. More precisely, under transparency supply shocks lead to greater variability of output, whereas demand shocks lead to less. The reason is that under opacity, the central bank has less flexibility to adjust the interest rate in response to shocks. So under opacity, supply shocks lead to more variability in inflation and less in output; thus the demand shocks are no longer completely offset, leading to greater variability of both inflation and output.

Tarkka and Mayes (1999) suggest that publishing the central bank's forecasts leads to better macroeconomic performance because the released information reduces the private sector's

⁽¹⁰⁾ Cukierman's (2000b) model does not include an explicit inflation bias, but our analysis shows that the results are similar when the model is extended to incorporate such a bias in central bank's objective function.

uncertainty about the central bank's intentions. The authors use a Barro-Gordon model and assume that the central bank does not publish its inflation target.

Our assessment of the literature points towards appropriate measures of transparency for empirical tests, possible implications for the macroeconomy and channels through which transparency may affect inflation:

- Transparency is generally conceptualised as the publication of central bank forecasts, since this allows the public to observe the control error.¹¹
- The literature identifies a number of channels by which transparency affects the macroeconomy. These are conditional on model choice and specification (eg neoclassical versus neo-Keynesian models, presence of inflation bias), and assumptions such as the initial degree of credibility enjoyed by the central bank, the precise degree of transparency, and whether the models are specified over one or more periods.
- The effects of increased monetary policy transparency in the existing theoretical models are associated with variables such as average inflation, output, inflation volatility, output volatility, and interest rate volatility. Thus the hypotheses we test in this paper are in general consistent with the theoretical propositions of the recent literature.
- A common element in the majority of the models is that increasing transparency makes the central bank's reputation more sensitive to its actions, and therefore reduces the incentive to pursue inflationary policies. Transparency has less impact on the sensitivity of reputation to the actions of the central bank when its preferences are already known. Regardless of the different implications of increased transparency about social welfare in the above models, more transparency never results in higher inflation outcomes.
- Another common element is that the improvement in inflation performance may be offset by a reduction in the capacity of the central bank to stabilise the economy by surprising the private sector with a policy-induced demand shock.

⁽¹¹⁾ An exception in the recent theoretical literature is Cukierman (2000a), who focuses on the economic model and the operational objectives of the central bank rather than central bank forecasts and votes.

3. A new data set on central banking institutions

In measuring transparency of central bank forecasts, we seek to establish the scope and coverage of macro-forecasts published by central banks. Data are taken from a survey of central banks contained in FJMRS (2000).¹² They provide estimates of many transparency characteristics. We focus on central bank publication and explanation of macroeconomic forecasts, since this emphasis is closest to that of both theoretical and policy-oriented work on transparency in monetary policy.

The great majority of central banks in our sample publish some form of forward-looking analysis – 79% of the 94 covered in the FJMRS survey.¹³ Forward-looking analysis may, of course, take many forms, some of which may help to guide expectations more than others. For some central banks, the publication of a money target is in itself a form of forward-looking analysis, since such targets are often more benchmarks rather than rules, and other forecasts must underpin the target. Other central banks have gone further in the way forecasts are presented in attempting to guide inflation expectations.

The questions in the survey ask not just whether or not the central bank provides forward-looking analysis. They also consider the quality, scope and frequency of forecasts, and the extent to which forecast errors are monitored and publicly discussed. The exact wording of the questions is provided in Table A, and the distribution of the results to each question are shown in Table A. The questions are:

- *What is the form of publication of forecasts? Is it in words only, or is it also presented formally in terms of numbers?*¹⁴

Motivation: The ‘bottom line’ of a forecast is usually presented in a numerical or graphical format, which may help to influence expectations and discipline policy, since the forecast may

⁽¹²⁾ The characteristics covered in the FJMRS survey include numerical measures of how policy decisions are explained; the quantity of current analysis, research and speeches provided by the central bank. They also assess and provide scores for various aspects of accountability, independence and target-setting, each of which may contribute to transparency and clarity in the monetary framework.

⁽¹³⁾ 82 of these observations are included in our estimates. The other 12 are excluded because other data do not match up with them.

⁽¹⁴⁾ Graphs are treated as identical to numbers in this analysis.

then be directly compared to a target, and subsequently outcomes may be compared to the forecast. The analysis underpinning the forecast may, however, be more important than the precise number, since the accuracy of numerical forecasts may sometimes be attributable to luck as well as judgment. The questionnaire distinguishes between those central banks that publish forecasts: (1) using both words and numbers, (2) using one of words or numbers, and (3) using neither.

- *With what frequency does the central bank publish forward-looking analysis in standard bulletins and reports?*

Motivation: Published annual targets for money and inflation may help to guide expectations, but they only do so over a particular horizon. Forecasts published more frequently will guide/anchor expectations and may discipline policy over different forecast horizons.

- *Are risks to the forecast published, and if so in what form?*

Motivation: A number of central banks use their forecast as a vehicle for highlighting the relative likelihood of various outcomes, rather than to focus on a particular number. The argument for publishing risks to forecast is that a forecast that rests on a single number for each time period may be accurate for spurious reasons. An assessment of risks can convey a more accurate representation of the forecasters' subjective assessment of monetary conditions. As with the first question, the quality of risk assessment is judged according to whether both numbers and words are used.

- *Is there a discussion of past forecast errors, and if so is this a standard feature of discussion?*

Motivation: Attempts to build credibility may rest on becoming more open about the capacity of the central bank (and other institutions) to forecast accurately. An open assessment of forecast errors may also reinforce the quality of future forecasts.

Data reliability

The FJMRS survey data are the most comprehensive description available of central bank efforts to explain policy. The questions are worded objectively and cover a number of aspects of forecasting whose publication could enhance transparency to varying degrees, yet there are a number of reasons

that might suggest caution in interpreting and using the data. We assess the implications of each in turn.

First, there could be a problem of sample selection bias to the extent that only the ‘best performers’ respond. We are confident that the FJMRS survey is largely immune to this problem, because of the very high response rate. 94 out of 114 questionnaires were completed, and the survey covers over 95% of world GDP. Furthermore, as the discussion of forecasts was only one facet of a broad survey, it is less likely that central banks were deterred by this particular part of the questionnaire.

Table A: Measure of explanations of forecasts and forward-looking analysis: questions and distributions of responses

Questions	Categories of answers, distribution of results	All	Industrial	Transitional	Developing
1. Form of publication of forecasts	Words and numbers	35	16	5	14
	One of words or numbers	25	8	6	11
	Unspecified	13	0	4	9
	None	21	4	7	10
2. Forward-looking analysis in standard bulletins and reports	More than annually	39	18	7	14
	At least annually	24	4	4	16
	Unspecified	10	2	4	4
	Otherwise	21	4	7	10
3. Discussion of past forecast errors	Yes	21	8	3	10
	Sometimes	9	7	2	0
	No	64	13	17	34
4. Risks to forecast published	Words and numbers	9	7	2	0
	One of words and numbers	23	9	4	10
	None	62	12	16	34

Second, there could be problems with the subjective nature of the responses. For example, the distinction between publishing regular targets and forecasts may become blurred in some cases. Some respondents may have interpreted publishing an intermediate money target as providing forward-looking analysis. Such a target, after all, must be based upon output and inflation projections. Other countries, however, interpreted the publication of an intermediate target as

distinct from publishing a forecast. This potential subjectivity bias may not be serious, however, since the questionnaire asked about the nature of publication, its frequency, and the discussion of risks and forecast errors.

A third problem is that it may be relatively easy to change some transparency characteristics. Some of the transparency measures in the survey have been implemented only recently, and so they may not have had an impact on inflation in the sample. If the impact of these measures represents a significant change in central bank behaviour, the effect may also take some time to influence inflation expectations. We consider this problem in the discussion of the robustness of our empirical results.

4. Empirical methods and results

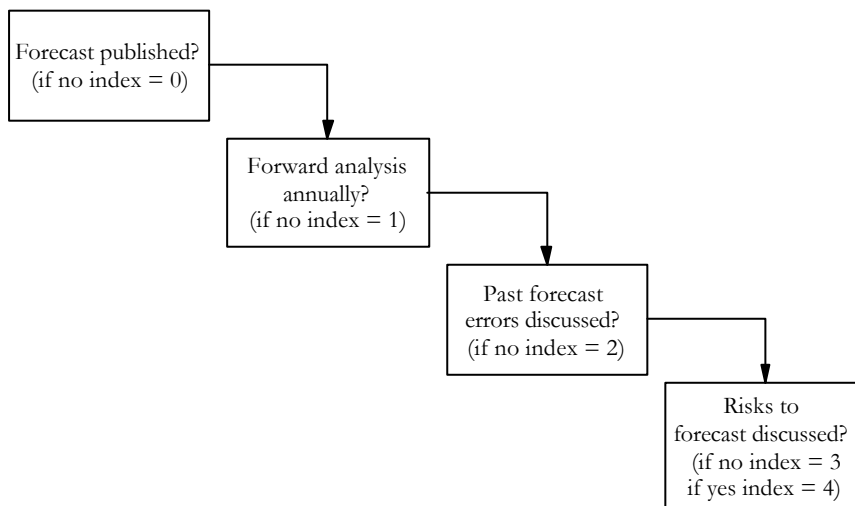
As noted above, theoretical work on transparency has generated a number of different propositions about the effect of publishing central bank forecasts. In order to evaluate these alternative models, in this section we provide empirical tests of the effect of transparency on inflation and on the volatility of output, using a cross-section of 87 countries over the period 1995-99. Our results show that there is a statistically significant negative correlation between transparency and inflation, and in particular in countries with flexible exchange rate regimes. At the same time, there is no evidence of a cost of transparency in terms of increased output volatility.

Constructing an index for transparency of forecasts

The FJMRS data set provides four separate indicators that can be used to assess the detail in which a central bank publishes its inflation forecasts. These include the frequency with which forecasts are published, and whether or not past forecast errors and risks to the forecast are discussed in publications. These indicators are highly correlated, implying that any regression that included each would exhibit multicollinearity. This argues in favour of aggregating the four to produce a composite measure of transparency.

Rather than creating an aggregate measure by simply taking the average of the different transparency measures in the FJMRS data set, we considered to what extent the FJMRS indicators can be arranged to form a Guttman scale. Its major advantage is that unlike an average of several variables, a Guttman scale constructed from several indicators does not result in a loss of information through aggregation. A Guttman scale is constructed by arranging binary variables in a sequence such that a positive value for one indicator implies a positive value for all previous variables in the sequence. To construct a Guttman scale for transparency, we have ordered our variables according to the decision tree in Chart 1 below. Although a few of the central banks in our sample do not fit this pattern (for example they discuss risks to their forecast but not past forecast errors), the vast majority did. A common criterion for judging whether data can be ordered in a Guttman scale is if the ‘coefficient of reproducibility’, defined as number of errors/total responses is less than 0.10 (‘errors’ are cases where ordering according to a Guttman scale results in a false prediction for a response). Our transparency data set easily satisfies this criterion, with a ratio of errors to total responses of 0.08.¹⁵

Chart 1: A Guttman scale of transparency in forecasting



¹⁵ Alternative orderings, such as scaling in the following order: (1) forecasting, (2) forward analysis, (3) risks to forecast, (4) past forecast errors, generate virtually identical results for the 82-observation sample that we use in our regression.

The advantage of Guttman scaling is that based on the aggregate index, one can determine exactly how a central bank scores on each of the four separate sub-indicators. So, for example, a score of 2 on our transparency index implies that a central bank publishes forecasts and that it does so on at least an annual basis, but it does not discuss either past forecast errors or risks to the current forecast.¹⁶ In contrast, if we took the simple average of the four indicators, then a score of 2 could imply a positive response on any two of the four sub-indicators. Furthermore, we later show that our results are robust to the use of either a Guttman scale or the simple average of our four sub-indicators of transparency in forecasting.

Transparency and inflation

As a first step towards investigating the effect of transparency in forecasting in monetary policy, we examined whether our index is negatively correlated with average inflation across our 87-country sample. Because the FJMRS data set examined transparency at one specific point in time (1998), we are limited to tests that consider only cross-country variation in inflation, rather than variation over time. Given that many reforms to increase central bank transparency are quite recent, we also chose to use a brief period for calculating average inflation (1995-99). This is based on CPI data from the IMF's *International Financial Statistics*. As discussed later, our results are nonetheless robust to using different time periods and to running regressions based on data from individual years.

Table B, below, presents pairwise correlations between levels of transparency and average inflation. We use both our overall index and individual measures from the FJMRS data set. There is a significant negative correlation between all of these indicators and both the level and the variability of inflation, and this correlation is significant for the Guttman index in both cases.

As a next step we examined whether or not this relationship holds when controlling for other determinants of average inflation.¹⁷ To do this we followed existing cross-country empirical literature on inflation including Campillo and Miron (1996), Lane (1997), Bleaney (1999), Romer

⁽¹⁶⁾ This highlights the importance of having the overall data set closely approximate a perfect Guttman scale, in order to be able to make this inference.

⁽¹⁷⁾ We restrict our attention to average inflation here because existing empirical work focuses on this variable.

(1993), and Ghosh *et al* (1995). First, we included the log of real GDP per capita, based on the possibility that lower-income countries may rely more heavily on the inflation tax to finance government expenditures. Second, we included a measure of openness,¹⁸ following Romer (1993) and Lane (1997) who argue that incentives for policy-makers to generate ‘surprise’ inflation are weaker in more open economies. We also included a measure of political instability as a control variable, based on the prediction from a number of different political economy models that a high frequency of government turnover may shorten the time horizons of politicians, prompting them to adopt more inflationary macroeconomic policies.¹⁹ Finally, we added a dummy variable to control for a country’s exchange rate regime (Fixed=1).²⁰ This follows the theoretical arguments that emphasise how pegging can serve as a commitment device. It also follows empirical findings of Ghosh *et al* (1995), Bleaney (1999), and others who show that there is a clear negative correlation between exchange rate pegs and average inflation.

Table B: Transparency and inflation
(pairwise correlations)

	Log inflation
Guttman scale	-0.37 (p<0.01)
Publication?	-0.29 (p=0.01)
Forward analysis annually?	-0.15 (p=0.15)
Past forecast errors discussed?	-0.21 (p=0.05)
Risks to forecast considered?	-0.28 (p=0.01)
Number of observations	87

Table C (below) reports the results of four cross-country regressions. Regression 1 includes each of our control variables in addition to our Guttman scale for transparency in forecasting. The coefficient on the scale is negative and highly significant. Our second regression adds an interaction term, which allows the effect of transparency to vary between countries with fixed exchange rates and those with flexible exchange rate regimes. This tests our hypotheses about transparency in

⁽¹⁸⁾ We define openness as $(x+m)/GDP$, where x and m stand for exports and imports respectively.

⁽¹⁹⁾ Drawn from a database created by Beck *et al* (1999) this variable measures the percentage of key decision-makers (executive, legislative majority(ies), coalition members) which change in a given year.

⁽²⁰⁾ Based on the classifications in the IMF’s *Annual Report on exchange arrangements and exchange restrictions*.

forecasting with greater precision, because arguments in favour of publishing inflation forecasts apply above all to economies with floating exchange rates where the monetary authorities have greater control over the domestic money supply. In small open economies with a fully credible fixed exchange rate regime and with full convertibility, publishing forecasts should have no effect on average inflation since the central bank has little or no control over domestic interest rates or the money supply. Following Canavan and Tommasi (1997) and Herrendorf (1999), exchange rate pegs can be seen as an alternative strategy for establishing transparency, since they provide the public with an easily observable indicator over which the government has direct control.

The results of regression 2 in Table C correspond to those predicted by theory. In countries with floating exchange rates, transparency in forecasting is negatively correlated with average inflation. The coefficient on our transparency index is highly significant and becomes more negative when compared with the result from regression 1.²¹ The significance is accounted for by a high-point estimate of the effect of transparency in inflation coupled with relatively wide error bands. In a country with a floating exchange rate which began with an inflation rate of 12% per annum, we estimate that a decision by the central bank to begin publishing regular inflation forecasts (a move on the index from 0 to 2) would lead to a reduction in inflation of between 1.8% and 7% per annum (the 95% confidence interval). In contrast, in countries with fixed exchange rates, transparency in forecasting has less effect on inflation. According to our estimates, the effect of a similar increase in transparency in forecasting in a fixed exchange rate country would be much smaller (reducing inflation from 12% to 11.8% per annum).

We also investigated if the effect of transparency in forecasting on inflation might depend on whether countries are inflation targeters, or whether they target monetary aggregates. The two variables *Inflation target* and *Money target* presented in regressions 3 and 4 are binary variables compiled from several different indicators in the FJMRS data set.²² A number of authors have

⁽²¹⁾ The results are very simple from a regression that excludes countries with pegged exchange rates.

⁽²²⁾ The questions ask central banks (i) to classify their regime, (ii) to report if an explicit target was published for each variable, (iii) to rank objectives in practice, and (iv) which variable prevails in policy conflicts? Each country was allocated a score for each of the exchange rate, money and inflation focus, and discretion. The maximum of these scores was classified as the 'targeted' variable. This definition is broader than that used in other papers (eg Mishkin and Schmidt-Hebbel (2000)).

defined transparency as a key ingredient of inflation targeting (eg Mishkin (2000)) while some have gone further by arguing that transparency is a prerequisite to inflation targeting (Masson *et al* (1997)). The latter argument would suggest that transparency should have a greater impact on the credibility of monetary policy when adopted in conjunction with the use of an inflation target. The results of regressions 3 and 4 suggest that the effect of transparency in forecasting on inflation does not depend on whether a central bank has an inflation-targeting regime in place or on whether it targets monetary aggregates.

Our estimates of the effects of our control variables on inflation are consistent with previous studies. Income per capita is negatively correlated with inflation while political instability tends to be associated with higher inflation. As in previous studies, there is a very large and very significant negative correlation between exchange rate pegs and inflation. One finding which may appear surprising is the result that greater openness of an economy to trade is not associated with lower inflation. Earlier studies by both Romer (1993) and Lane (1997) using data covering the 1970s and 1980s found evidence of a negative openness-inflation correlation. More recently Bleaney (1999) has reproduced earlier findings with regard to the 1970s and 1980s, while also concluding that there is no significant correlation between openness and inflation in data from the 1990s. Given that our data cover the period 1995-99, our results are consistent with those obtained by Bleaney. We also investigated whether these results with regard to openness were attributable to outliers with very high levels of openness but concluded against this possibility.

Table C: Transparency in forecasting and average inflation

Dependent variable:	(1)	(2)	(3)	(4)
Log inflation				
Log GDP per capita	-	-0.45***	-0.46***	-0.48***
	0.47***	(0.07)	(0.07)	(0.07)
	(0.07)			
Openness	-0.001	-0.001	0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Political instability	1.13*	0.97	1.05*	1.06*
	(0.63)	(0.64)	(0.62)	(0.62)
Exchange rate peg (peg=1)	-0.47**	-0.95**	-0.47**	-0.50*
	(0.23)	(0.43)	(0.23)	(0.26)
Transparency in forecasting index	-0.16**	-0.26***	-0.19**	-0.13*
Peg x transparency		0.25*		
		(0.13)		
Inflation target (target=1)			-0.13	
			(0.46)	
Inflation target x transparency			0.19	
			(0.19)	
Money target (target=1)				0.19
				(0.43)
Money target x transparency				-0.14
				(0.15)
Constant	6.04***	6.11***	5.94***	6.05***
	(0.54)	(0.51)	(0.60)	(0.59)
R ²	0.52	0.54	0.53	0.53
N	82	82	82	82

Heteroskedastic consistent standard errors in parentheses. ***, **, and * indicate significance at the 1, 5, and 10% levels respectively.

Transparency and output volatility

In addition to making predictions about the effect of transparency on average inflation, models of transparency in monetary policy also produce comparative statics about volatility of output.²³ As noted, one's prediction here depends heavily on underlying assumptions. Our empirical investigation of the effect of transparency on output volatility is limited by the lack of obvious controls to be used in estimating cross-country differences in output volatility. To construct measures of output volatility (based on the standard deviation of GDP growth), annual data were

⁽²³⁾ We also tested for the effects of transparency on the volatility of inflation and our tentative results showed no significant positive or negative impact.

available for our entire sample (1993-99), while quarterly GDP data were available for 30 of our sample countries (also 1993-99).

Table D reports the results of pairwise correlations, using both the Guttman scale for transparency and the individual indicators from the FJMRS data set. There are several extreme outliers in our output volatility data, and in order to obtain more robust results we have excluded these countries from the correlations reported below.²⁴ The results show that the correlation between transparency and output volatility is often negative, and especially in the sample using quarterly data, but in only one case is a correlation significant at conventional levels. While this evidence certainly does not suffice to demonstrate that publishing inflation forecasts reduces output volatility, it does appear to be fairly strong *prima facie* evidence against claims that increasing transparency would increase output volatility. Results obtained before outliers were excluded were also consistent with this finding.²⁵

Table D: Transparency and output volatility

(Pairwise correlations)

	Std. dev. annual GDP growth	Std. dev. quarterly GDP growth
Guttman scale of transparency	-0.08 (p=0.47)	-0.29 (p=0.13)
Publication?	0.06 (p=0.59)	-0.10 (p=0.60)
Forward analysis at least annually?	0.02 (p=0.86)	-0.25 (p=0.19)
Past forecast errors discussed?	-0.22 (p=0.06)	-0.20 (p=0.29)
Risks to forecast considered?	0.09 (p=0.43)	0.16 (p=0.40)
Number of observations	76	29

⁽²⁴⁾ In the sample based on annual data, Kuwait and the Kyrgyz Republic were outliers in terms of having very high standard deviations of GDP growth, while in the quarterly data Turkey was the only severe outlier. We defined a 'severe' outlier, x , using the following formula where 'pctile' refers to the percentiles of the entire sample : $x < 25\text{pctile} - 3(75\text{pctile} - 25\text{pctile})$ or $x > 75\text{pctile} + 3(75\text{pctile} - 25\text{pctile})$.

⁽²⁵⁾ Before exclusion of outliers all correlations were negative, and 7 out of 10 were significant at conventional levels.

We also estimated several OLS regressions of output volatility on the Guttman scale of transparency, controlling for the variance of terms of trade shocks.²⁶ The results, which are reported in Table E, show no significant effect of increased transparency on output volatility.

Table E: Transparency and output volatility
(controlling for terms of trade variability)

Dependent variable	Standard deviation annual GDP growth	Standard deviation quarterly GDP growth
Guttman scale of transparency	-0.03 (0.12)	-0.005 (0.004)
Standard deviation ToT shocks	0.53*** (0.14)	0.23 (0.29)
Number of observations	71	28

Heteroskedastic consistent standard errors in parentheses. ***, **, and * indicate significance at the 1, 5, and 10% levels respectively.

5. Interpreting the robustness of our results

The effort required for a central bank to publish detailed forecasts may not appear to be particularly arduous relative to the benefits of securing lower inflation. Why, then do many more central banks not introduce detailed forecasts?²⁷ We base our detailed discussion of the robustness of our results on five complementary explanations of this empirical conundrum:

- The result (that greater transparency in forecasting leads to lower inflation) is valid and could be exploited by more central banks than at present, but some central banks have not yet completed the transition to greater transparency.
- The result is valid overall but may not be true of all frameworks.
- The result is valid but there may be offsetting costs to transparency, which deter some central banks from introducing it.
- The results may be overstated or invalid, because of endogeneity and reverse causality.
- There may be other statistical biases.

⁽²⁶⁾ This was based on a variable from the World Bank's *World Development Indicators*, which for each year measures the change in capacity to import less exports in constant prices. We then calculated this effect as a share of GDP and took the standard deviation of this indicator over the period 1992-97.

⁽²⁷⁾ In the FJMRS survey, only three central banks (Norway, Sweden and the United Kingdom) satisfy every criterion by which the authors judged the detail in which central banks explain forecasts.

Econometric techniques are necessary but insufficient for judging the robustness of our results. In this section we also include a detailed discussion of how such tests relate to theory and practice of monetary frameworks.

A transition to greater global transparency in monetary policy?

One possible reason why only a relatively small number of central banks publish detailed forecasts may be that policy-makers have not yet fully acted upon the evidence that transparency can contribute to lower inflation. The theoretical and empirical evidence on the effects of transparency is relatively new. Goodfriend's (1986) landmark paper was amongst the first to discuss the costs and benefits of secrecy in monetary policy, in the context of the Merrill vs FOMC case.²⁸ A context for his paper were questions relating to how central banks might respond to increasing evidence of the importance of expectations in economic decision-making. The theoretical literature began to increase rapidly only at the end of the 1990s, and this paper represents the first cross-country empirical evidence using macroeconomic data. Similarly, the practical precedents of frameworks in which published forecasts made important contributions to credibility-building emerged only in the 1990s.²⁹

Framework designers have not always been quick to adjust their frameworks quickly in response to new framework innovations,³⁰ yet recent developments in global framework design suggest that central banks are on a transition path towards much higher average levels of transparency. Even after FJMRS (2000) constructed their data, several countries have markedly increased the information about their forecasts.³¹ And the rapid global proliferation of explicit money and inflation targets in the 1990s is, according to Mahadeva and Sterne (2001), part of a global trend whereby disinflating countries use targets more as a forecasting device than as a policy rule.

⁽²⁸⁾ One of the Fed's arguments for resisting greater transparency, that it was difficult in the early 1980s to provide information evenly to all market participants, has been eroded over time by advances in information technology.

⁽²⁹⁾ The discussion of central bank governors in Mahadeva and Sterne (2000, pages 182-205) illustrates that inflation-targeting countries have stressed transparency to be a key aspect of their framework. The Bundesbank has, according to Posen (2000), a long history of explaining its policies well, yet its independence is more widely perceived as contributing more strongly to its credibility.

⁽³⁰⁾ For example, if regimes are classified according to money targeting, exchange rate targeting, inflation targeting and discretion then only three countries (Australia, the United Kingdom and Uruguay) have changed their regime as much as four times since the breakdown of the Bretton Woods agreement.

⁽³¹⁾ Each of Brazil, Chile, South Africa and Thailand now publish fan charts for inflation and provide explicit discussion of risks to inflation forecasts in regular inflation reports.

Transparency may have significantly differential effects on inflation across frameworks

Our discussion suggests that more explanation of policy does not significantly reduce inflation under all circumstances. Moreover, our point estimates of the overall effect, though large, were surrounded by relatively wide error bands, suggesting that there are a number of frameworks that are exceptions to the overall result. The governance structure of the central bank may affect the willingness of the central bank to publish forecasts. In some central banks senior policy-makers are responsible for the published forecast; in others the central bank's staff are the sole authors.³² Such differential arrangements may affect the perceptions of policy-makers and the public alike regarding the closeness of the link between published forecasts and policy decisions, and this in turn may affect the transmission channels between transparency and inflation outcomes. To the extent that transparency operates by enhancing credibility, as is predicted by a number of the models we have discussed, the effect of transparency on inflation may be smaller when credibility has been secured by actions rather than words. This applies to exchange rate targeters (see results above) and may also apply to countries with low inflation.³³

Given that our sample includes countries both with very low and very high average rates of inflation, we examine the extent to which our results are stable when we exclude high-inflation countries from the sample. As a first step, we used a standard procedure to determine whether the coefficient on the Guttman scale was influenced by outliers. This resulted in the exclusion of five observations, after which the coefficient on the Guttman scale remained significant.³⁴ We then used a recursive estimation procedure to examine how our results changed as we progressively excluded high-inflation observations from the remaining sample. This was an iterative procedure which involved: (1) estimating regression 2 in Table C using a sample of the 50 countries with the lowest average rates of inflation, (2) adding the observation with the next highest rate of inflation and (3)

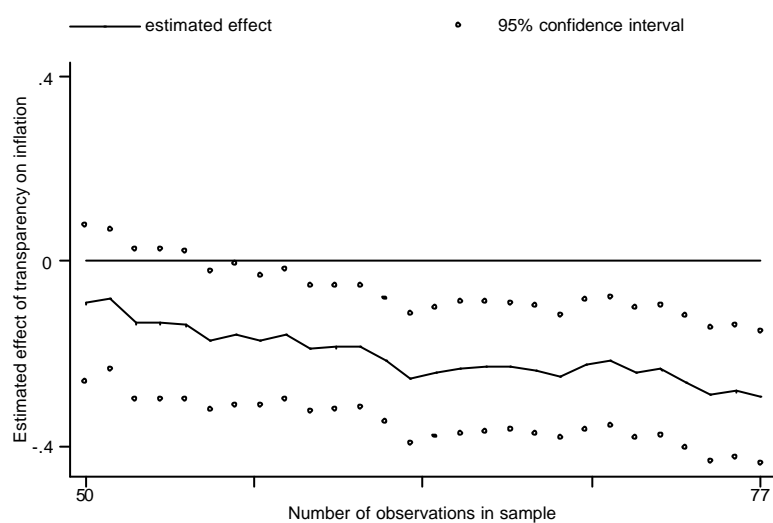
⁽³²⁾ Kohn (2001) and Svensson (2001) include discussions on ownership of the forecast in their respective reports.

⁽³³⁾ A related issue is the optimal degree of transparency. It is conceivable that there exist circumstances when increased transparency might lead to a deterioration in welfare or an increase in inflation. Telling the public about a likely financial or exchange rate crisis might precipitate the crisis. And many central banks have developed well-resourced press offices to manage the clarity of published information.

⁽³⁴⁾ The countries excluded were Bahrain, Indonesia, Mauritius, Turkey and Russia. We tested for outliers based on the *dfbeta* statistic, which measures the impact of an individual observation on a specific coefficient. Following standard practice, we excluded observations for which the absolute value of the *dfbeta* statistic was greater than $(2/\sqrt{n})$, where n is the number of observations. The coefficient on the Guttman scale was -0.29 (0.08) $p < 0.01$ after five outliers were eliminated (based on regression 2).

re-estimating the regression, and then repeating the process until we reached maximum sample size. Chart 2 below plots the estimated coefficient on the Guttman scale, together with bounds for the 95% confidence interval according to sample size. The coefficient becomes progressively more negative as we include high-inflation countries in the sample, suggesting that the estimated anti-inflationary effect of publishing a forecast in our Table C regressions may be somewhat inflated by the inclusion of high-inflation countries.

Chart 2: Results of recursive estimation



Costs to publishing forecasts

There may be political and economic costs associated with a central bank publishing forecasts, and these may offset the benefits of potential reductions in inflation. To the extent that fiscal policy may in some circumstances be the root of high inflation, detailed forecasts are likely to pinpoint the source of the problem, and could in some cases lead to tensions between the central bank and the government. Transparency may, in such circumstances, also be proxying for a degree of central bank independence that may be very difficult to measure in conventional surveys.³⁵

There may also be economic costs to introducing transparency that prevent central banks from publishing forecasts. The theoretical discussion pointed to circumstances in which greater

⁽³⁵⁾ Fry (1998) questions the extent to which survey measures are capable of fully capturing central bank independence.

transparency may be associated with higher volatility in inflation and output. Where there is a risk of a banking or exchange rate crisis, for example, it is questionable whether or not a central bank should highlight such an issue by publishing forecasts. Cross-country evidence presented in Chortareas, Stasavage and Sterne (2001) does not support the view that increased transparency increases the costs of disinflation, though there may be particular circumstances when this is the case.

Endogeneity and reverse causality?

There is a possibility that the results may be affected by reverse causality whereby low inflation may lead to greater transparency as well as being caused by it. Similarly there may exist endogeneity caused by cross-country differences in institutional circumstances or macroeconomic conditions may imply systematic variation in each of transparency and inflation. In this section we seek to address these issues that have potentially serious implications for bias in our results.

Could it be the case that low inflation dissolves a central bank's preference for secrecy? Geraats (2001a) models the effect of transparency on the utility of both strong and weak central banks. Strong central banks are defined as having lower (unpublished) inflation targets than weak ones. She considers two alternative scenarios that shed light on the issue of endogeneity. In the first, transparency is exogenous, being imposed by the public. Weak central banks prefer secrecy since it affords them an opportunity to conduct stabilisation policies with a lower probability of their preferences for relatively high inflation being revealed. In the case of transparency being an endogenous choice of the central bank, however, weak central banks also choose greater transparency. They overcome an inclination towards secrecy because they appreciate that secrecy will itself be interpreted by rational agents as a sign of weakness.³⁶

We attempt to assess empirically the extent of any endogeneity. First, we can demonstrate that although transparency is positively correlated with other measurable characteristics of a country's

⁽³⁶⁾ Geraats qualifies this channel in her paper and provides possible reasons why, in spite of her results under endogenous choice of transparency, not all central banks are transparent. Furthermore, in Geraats (2001b) the author shows that the desirability of transparency depends critically on the institutional framework. In this model, when the central bank has limited independence, less transparency reduces the government's information about the economy, which discourages it from overriding the central bank.

economic, legal, and political environment, our results remain robust even when we control for the fact that transparency might be endogenous to these other factors. The second column in Table F, below, shows simple correlation coefficients between our Guttman scale of transparency and other variables to which it might arguably be endogenous. These include measures of development (per capita GDP, OECD membership), other features of monetary policy (a focus on inflation objectives, legal central bank independence, quality of central bank analysis³⁷), and measures for the political environment (democracy, political instability, political polarisation, type of legal system³⁸). As one might expect, transparency is positively correlated with a number of these variables, but in no case is the correlation high enough to suggest that transparency is perfectly correlated with another variable. Two of these variables, per capita GDP and political instability are already included in our Table C regressions. As a next step, we re-estimated regression 2 from Table C while adding one of the variables which may affect transparency. We repeated this procedure for each variable.

Table F: Correlation of transparency to economic, political, and legal variables

	Correlation with Guttman	Coefficient on Guttman after inclusion*	Nobs
Democracy	0.23	-0.34 (0.10)	64
GDP per capita	0.34	-0.26 (0.09)	82
OECD member	0.39	-0.21 (0.09)	82
Inflation target	0.17	-0.26 (0.10)	82
Central bank ind. (FJMRS)	0.32	-0.28 (0.10)	82
Central bank ind. (Cukierman ³⁹)	-0.10	-0.39 (0.12)	47
Type of legal system	0.15	-0.26 (0.10)	82
Quality of CB analysis	0.44	-0.32 (0.09)	82
Political instability	0.07	-0.26 (0.09)	82
Political polarisation	0.02	-0.24 (0.09)	82

Notes: *Each coefficient may be compared to -0.26, the result from regression (3) in Table C. Democracy from Polity III data set. Inflation target, central bank independence, and quality of analysis from FJMRS data set. Political instability and polarisation from Beck *et al* (1999).

⁽³⁷⁾ The FJMRS study collected data on the extent to which central banks conduct detailed analysis of inflation expectations (based on market information), and on the sophistication of the models used to generate forecasts.

⁽³⁸⁾ The type of legal system is a dummy variable distinguishing whether countries have a common legal system. Data are taken from La Porta, Lopez-de-Silanes, Shleifer and Vishny (1998).

⁽³⁹⁾ Cukierman's central bank independence measure for 1980-89. A number of smaller countries in Cukierman's data set were not included in the FJMRS survey.

In every single case, the coefficient on the Guttman scale remains negative, significant, and of roughly the same magnitude as in the original regression. The Guttman scale coefficient also remained significant when we included all variables in Table F simultaneously.

Although we can demonstrate that our transparency index is not merely proxying for levels of income or the level of democracy, it remains possible that our index may to some extent be influenced by some other political or economic variable x which may be difficult to measure directly. It may be possible to investigate this indirectly, though. If this unmeasurable variable x involves some broad change in the economic or political conditions that leads to both increased transparency and lower average inflation, then we might expect it to lead also to improvements in other policy outcomes that are exogenous to inflation. For example, in many countries dramatic turnarounds in economic policy often involve both reductions in inflation and improvements in a government's fiscal balance, to the extent that fiscal balance can be seen as being exogenous to inflation. Likewise, a policy turnaround is also likely to lead to an improvement in the rating on a government's foreign currency bonds, which should be independent of domestic inflation. This suggests using the fiscal balance and the rating on foreign currency denominated bonds in order to proxy for x . We can then perform the same test that we performed for variables such as democracy. Table G shows the results, while also showing the simple correlation of each variable with the Guttman. The results strongly suggest that our original results with respect to transparency and inflation cannot be attributed entirely to more broader policy improvements.

Table G: Endogeneity of transparency to broader policy measures

	Correlation with Guttman	Coefficient on Guttman after inclusion	Nobs
Fiscal surplus	0.30	-0.25 (0.11)	59
Foreign currency bond rating	0.37	-0.20 (0.08)	58

Notes: Foreign currency bond rating, Standard & Poor's January 2000. Fiscal surplus from *International Financial Statistics*.

We also considered directly the possibility of reverse causality, whereby the negative correlation between transparency and inflation could reflect the fact that central banks are more likely to publish forecasts when they have greater control over macroeconomic outcomes. If this assessment is accurate, one would expect central banks to decide whether to make their forecast public based on the level and the volatility of past inflation (and potentially output). A bias would be introduced in our results, then, to the extent that lagged inflation or lagged inflation volatility is correlated with the current level of inflation.

We investigated this possibility with the same procedure used to assess whether transparency is influenced by other variables, such as the quality of internal analysis of the central bank. For each of our sample countries using the five years preceding our sample period (1990-94) we calculated the mean absolute deviation of inflation and output from their desirable levels during this same period (2% inflation and 2.5% annual output growth). We also calculated the mean absolute deviation of inflation and output from their average level for the period, in order to measure volatility. As the endogeneity critique would suggest, our Guttman scale for transparency is in fact negatively correlated with lagged inflation outcomes over the 1990-94 period (see Table H below). We then included each of these four measures as control variables in regressions using the specification from regression 3 in Table H. As can be seen in Table H, the coefficient on the Guttman scale is essentially unchanged when we control for both lagged output and lagged output volatility. However, when we control for lagged inflation and lagged inflation volatility, the coefficient on the Guttman scale is less negative and somewhat less significant in each case ($p=0.10$ and $p=0.07$). So although we acknowledge that it is difficult to be certain that there is not some endogeneity between transparency and inflation, we are reassured that the association is clearly detectable even when we control for the effect of the average rate or volatility in past output and inflation.

Table H: Endogeneity of transparency to past inflation and output outcomes

	Correlation with Guttman	Coefficient on Guttman after inclusion
Past deviation of output from desirable	-0.16	-0.24 (0.10)**
Past output volatility	-0.26	-0.23 (0.09)***
Past deviation of inflation from desirable	-0.42	-0.16 (0.10)*
Past inflation volatility	-0.43	-0.20 (0.11)*

Notes: ‘Past deviation of output from desirable’ is average absolute deviation from 2.5% inflation over 1990-94. ‘Past deviation of output from desirable’ is average absolute deviation from 2% real GDP growth over 1990-94. Past inflation volatility is the log of the mean deviation of inflation 1990-94 with respect to the average level of inflation for the same period. Past output volatility is the mean deviation of real GDP growth with respect to the average level of GDP growth. Standard errors are in brackets. ***, **, and * indicate significance at the 1, 5, and 10% levels respectively.

Other robustness issues

We also considered several other robustness issues, including whether or not our results are stable when we consider sub-samples of low-inflation countries, whether changes in the time period affect the results, and whether modifications in the Guttman scale lead to significantly different inferences.

In addition to investigating outliers, we also determined the extent to which our results are robust to modification of the time period considered. When we performed regressions based on inflation data for individual years between 1995 and 1999, the coefficient on our transparency index was always negative and generally statistically significant at conventional levels.⁴⁰

We also examined the possibility that the Guttman scale might not be the most appropriate technique for examining the relationship between average inflation and the transparency indicators collected as part of the FJMRS survey. We compared the results of our regressions using a Guttman scale with two alternative specifications. The first alternative was to take the simple average of the four indicators. To test which of the two specifications (Guttman vs average) provided more explanatory

⁽⁴⁰⁾ Coefficients and standard errors for each successive year were -0.29 (0.10) for 1995, -0.15 (0.17) for 1996, -0.30 (0.09) for 1997, -0.28 (0.21) for 1998, and -0.41 (0.20) for 1999.

power, we used a simple non-nested test developed by Davidson and MacKinnon (1981), and the test results supported using the Guttman scale.⁴¹

The second alternative to the existing Guttman scale involved creating a matrix of dummy variables, each of which takes a value of 1 for particular range of values of the Guttman scale. This method allows the estimated effect of each step on the Guttman scale to vary, whereas introducing the Guttman scale as a single variable constrains the estimated effect of each successive step upwards on the Guttman scale to be constant. Our sample countries can be divided into three groups of roughly equal size for this purpose. First, there are 25 countries that do not publish any form of inflation forecast (Guttman = 0). Second, there are 32 countries that publish a basic forecast that in most cases includes forward analysis on at least an annual basis (Guttman = 1-2). Finally, there is a third group of 25 countries that publish an inflation forecast including a discussion of previous forecast errors and in most cases, a discussion of risks to the forecast (Guttman = 3-4).

We repeated regression 2 from Table C, while substituting two dummy variables for the Guttman scale: one for countries with Guttman values of 1 and 2, and the second for countries with Guttman values of 3 and 4. Both dummy variables had the expected negative sign, and the dummy for Guttman values of 3 and 4 was both more negative and more statistically significant than the dummy for Guttman values of 1 and 2.⁴² These results suggest that while there may be significant gains from publishing a basic inflation forecast, the marginal gain in terms of inflation performance from publishing a more detailed forecast may be even larger. It should be noted, though, that because the coefficient on the dummy for Guttman values of 1 and 2 was not highly significant, using a standard F-test, we were unable to reject the null that the coefficients on the two dummies were equal.

⁽⁴¹⁾ The J-test involves estimating each specification and saving the fitted values as a first step. Then, in the second step the fitted values from each specification are included as an additional explanatory variable in the alternative specification. The t-statistic on the coefficient for the fitted values can then be used as a test of the null that the alternative specification *does not* add any explanatory power. Using this test we rejected the null that the Guttman specification did not add explanatory power to the ‘average’ specification. In contrast, we could not reject the null that the ‘average’ specification does not add explanatory power to the Guttman specification.

⁽⁴²⁾ The coefficient and standard error for the dummy Guttman12 were -0.48 (0.38). The coefficient for the dummy Guttman34 was both larger and highly statistically significant -0.98 (0.37) $p < 0.01$. In this specification, each dummy was also interacted with the exchange rate peg dummy.

A final potential robustness issue involves the measurement of our dependent variable. While much of the cross-country literature on determinants estimates a semi-log model which minimises the effect of high-inflation outliers, Bleaney (1999) argues that using log inflation as dependent variable results in too much weight being given to very low inflation countries. As an alternative, he suggests estimating an equation where the dependent variable is $(p_i)/(1+(p_i))$, where p_i is inflation in the i th country. All of our results from Table C remain robust when we use transformed inflation instead of log inflation as our dependent variable. As a further alternative, we also repeated our Table C regressions using a Box-Cox model, and the results of this estimation were nearly identical to our original semi-log specification.

Our bottom line on robustness

We have subjected our results to numerous econometric tests and they remain reassuringly robust. But how far have we gone to explaining the apparent empirical conundrum we highlighted at the start of the section; that few central banks publish forecasts in full detail in spite of the evidence that such acts would facilitate lower inflation? Although we have controlled for a number of additional variables in this section, it remains possible that the negative correlation we observe between transparency and inflation is biased by our inability to control for unobserved country effects.

To be absolutely confident that our results are subject to zero econometric bias we would need more data. To eliminate the possibility of reverse causality affecting our results, for example, we would need to distinguish those central banks that were publishing forecasts merely to rubber-stamp their reputation, and those that were reluctant to publish because inflation was high. Such causality analysis would benefit from a time series or panel data on transparency, yet these data are so far unavailable. We feel comforted, however, that we know of no example of a framework in which policy-makers have reduced transparency in response to an increase in inflation. Furthermore, to the extent that transparency locks in low-inflation policies even if it is introduced when inflation is already low, then the issue of reverse causality becomes less important, since transparency may be effective in reducing and maintaining low inflation.

Of greater practical relevance could be the possibility that some central banks have attempted to improve macroeconomic policy both by simultaneously altering policy preferences, transparency and

other aspects of the institutional framework, which could be argued to be the case in some inflation-targeting countries.⁴³ Even with good time series data, it would be difficult to identify the precise empirical role of transparency in such circumstances, yet our conclusion that publishing forecasts can lead to lower inflation is unaffected by this sort of endogeneity.

Overall, we acknowledge that in spite of the battery of tests we employ, we cannot be sure that our tests using cross-section data eliminate all possible biases. Yet our existing tests have gone far enough to make us confident that we have identified empirically an established theoretical channel for reducing and maintaining low inflation. Furthermore, there are important global policy implications: many central banks around the world could secure improved credibility and lower inflation by publishing their forecasts in greater detail.

6. Conclusions

There are a number of aspects to central bank transparency, yet recent theoretical models and much of the policy debate focus on the role of publication of central bank forecasts. The existing literature provides mixed suggestions and evidence on the welfare effects of monetary policy transparency. It is virtually unanimous, however, about the main proposition tested in this paper: greater transparency in monetary policy leads to lower inflation. Furthermore, one of the most important channels identified by the theoretical literature is entirely consistent with the practical experiences of the numerous central bank's that have chosen to explain policy more thoroughly: transparency makes a central bank's credibility more sensitive to its actions.

This paper is the first to consider detailed cross-country evidence for a wide range of countries covering the effects of central bank transparency on monetary policy outcomes. We construct an index of central bank transparency based on forecast publications by central banks. The main empirical result is that greater transparency in publishing forecasts is associated with lower inflation. We acknowledge that it is difficult to be certain that there is not some endogeneity between

⁽⁴³⁾ See Schaecter, Stone and Zelmer (2000).

transparency and inflation. We are, however, reassured that the result is robust to a comprehensive set of econometric specifications and robustness checks, and the association between transparency and inflation is detectable even when we control for the effect of the average rate or volatility in past output and inflation.

Our results suggest that transparency contributes to lower inflation whether or not policy is based more on an inflation-targeting or money-targeting anchor for policy. In countries that target the exchange rate the publication of forecasts does not appear to have a significant impact on inflation. Finally, we do not find evidence supporting the proposition that a high degree of transparency is associated with higher output volatility.

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