Does Central Bank Transparency Reduce Interest Rates?*

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Abstract

Central banks have become increasingly transparent during the last decade. Theoretical models predict that monetary policy transparency enhances flexibility and reputation, which suggests that it should lead to lower short-term and long-term nominal interest rates. This paper exploits a detailed transparency data set to investigate this for eight major central banks. It appears that many transparency enhancements are associated with significant effects on interest rates, controlling for macroeconomic conditions. In most of these cases, interest rates are lower, often by over 50 basis points, although in some instances transparency appears to have had a detrimental effect on interest rates.

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1 Introduction

Central banks have become increasingly transparent and consider transparency a key feature of their monetary policy framework. Since central banks tend to be far more forthcoming than is needed to meet statutory accountability requirements, it is widely believed that transparency has considerable economic benefits. Theoretical models show that monetary policy transparency has the potential to enhance the credibility, reputation and flexibility of central banks, which should lead to lower interest rates. The contribution of this paper is to investigate this theoretical prediction using a unique transparency data set for major central banks from 1998 to 2002. We find that increases in transparency indeed tend to be associated with significant reductions in interest rates when controlling for macroeconomic conditions.

Intuitively, the advantages of transparency in the form of greater credibility, reputation and flexibility derive from the fact that transparency makes it easier for the private sector to infer the central bank's intentions from monetary policy decisions and outcomes. This allows a central bank to improve its credibility. It also gives the central bank a greater incentive to build reputation as private sector inflation expectations become more sensitive to monetary policy actions and outcomes that are not attributed to economic shocks. At the same time, transparency makes it clear when monetary policy decisions are intended to offset economic shocks, so it gives the central bank greater flexibility to stabilize the economy without affecting private sector inflation expectations.

These effects of transparency should influence the level of interest rates. In particular, enhanced flexibility would allow a reduction in policy and short-term interest rates without increasing long-term nominal interest rates, and improved reputation would reduce inflation expectations and thereby long-term nominal interest rates. This paper tests empirically for the presence of such flexibility and reputation effects on interest rates, exploiting changes in the degree of central bank transparency over time based on the index by Eijffinger and Geraats (2006).

In many instances, greater transparency tends to be accompanied by lower interest rates, when controlling for the macroeconomic situation using inflation and output. The empirical results show significant reductions in interest rates for all central banks in our sample: the Reserve Bank of Australia (RBA), the European Central Bank (ECB), the Bank of Japan (BoJ), the Reserve Bank of New Zealand (RBNZ), the Swedish Riksbank (SRB), the Swiss National Bank (SNB), the Bank of England (BoE) and the Federal Reserve (Fed). Some transparency events have not significantly influenced interest rates, whereas others have actually had a detrimental effect on flexibility and/or reputation. In a few cases, there appears to be a trade-off between flexibility and reputation.

There is an increasing number of empirical studies that analyze the effect of central bank transparency on interest rates. Most focus on the short-lived (daily or even intraday) effects of monetary policy decisions and communications. The move towards greater transparency during the last decade appears to have reduced the effect of monetary policy actions on financial markets in Canada (Muller and Zelmer, 1999), the UK (Haldane and Read, 2000; Clare and Courtenay, 2001) and Australia (Coppel and Connolly, 2003). A common finding is that the impact of monetary policy decisions on the short end of the yield curve has become smaller. In line with this, bond market volatility has declined (Rafferty and Tomljanovich, 2002) and monetary policy actions have become more predictable, as is shown for instance by Poole and Rasche (2003) and Swanson (2004) for the US.

There is also evidence that these benefits are directly related to central bank communication. Using data for 20 inflation targeters, Fracasso, Genberg and Wyplosz (2003) find that higher quality inflation reports are associated with smaller market interest rate surprises from monetary policy decisions. Gerlach-Kristen (2004) shows that the publication of the BoE's voting records in the UK has made it easier to predict future monetary policy decisions. In addition, Reeves and Sawicki (2005) find that UK financial markets react significantly to the minutes of the BoE's monetary policy meetings and to its Inflation Report. For the US, Kohn and Sack (2003) establish that market interest rates are significantly affected by the Fed's policy statements and Greenspan's congressional testimony. The latter two are not only the Fed communication tools with the largest market impact, but also the most accurate ones, as shown by Reinhart and Sack (2006). Although the importance of particular communications may differ across central banks, in a comparison of the Fed, ECB and BoE Ehrmann and Fratzscher (2005) argue that different central bank communication strategies can be equally effective in terms of monetary policy predictability.

In addition to these financial market effects, transparency of monetary policy also appears to have longer-lived, macroeconomic consequences. Using a panel of 11 countries, Siklos (2003) finds that inflation targeting and the release of an inflation report tend to significantly reduce inflation forecasts. Furthermore, relying on a cross-section of up to 87 countries, Chortareas, Stasavage and Sterne (2002a, 2002b, 2003) present evidence that the publication of forward-looking analysis by central banks reduces average inflation and diminishes the sacrifice ratio. Using data for 9 central banks, Van der Cruijsen and Demertzis (2006) find that greater monetary policy transparency reduces the sensitivity of inflation forecasts to inflation outcomes, which suggests that it helps to anchor inflation expectations.

The contribution of our paper is to analyze whether transparency has enduring effects on the level of interest rates. In particular, we investigate whether transparency has improved the flexibility and/or reputation of central banks by allowing for lower policy, short and/or long nominal interest rates.

The next section presents a simple model that captures the flexibility and reputation effects of transparency on short and long nominal interest rates. This is followed by a description of the data used in the empirical analysis, including the transparency data (section 3). Subsequently, the econometric methodology is presented (section 4) and the empirical results are discussed (section 5). The paper ends with some concluding remarks (section 6).

2 Stylized Model

We use a highly stylized model to illustrate the flexibility and reputation effects of central bank transparency on interest rates. Geraats (2000) shows how transparency enhances flexibility and reputation in a more sophisticated, dynamic model.[1] For a comprehensive survey of the literature on transparency of monetary policy, see Geraats (2002).

Suppose the central bank has an inflation target τ, about which the public has imperfect information. In particular, the public has a Bayesian prior on the inflation target such that $\tau \sim N\left(\bar{\tau}, \sigma_{\tau}^{2}\right)$. Uncertainty

[1] It should be noted that some theoretical papers, including Cukierman (2001) and Jensen (2002), find that transparency reduces flexibility. This occurs when the private sector learns about supply shocks before it forms its inflation expectations that affect the contemporaneous Phillips curve. This induces a worsening of the inflation-output tradeoff.

about the target, or imperfect credibility, is reflected by $\sigma_\tau^2 > 0$. In addition, suppose that the central bank suffers from a reputation problem in the sense that the prior mean exceeds the actual inflation target: $\bar{\tau} > \tau$. The monetary policy instrument set by the central bank is the short-term nominal interest rate s:

$$s = c - \tau + \varepsilon \tag{1}$$

where $c > 0$ is a constant reflecting the 'neutral' policy rate, and $\varepsilon \sim N\left(0, \sigma_\varepsilon^2\right)$ is an economic shock that the central bank decides to offset, which is independent of τ. In this short-term model, a higher inflation target τ leads to expansionary monetary policy and reduces the short-term interest rate s due to the liquidity effect. The long-term nominal interest rate is determined by the long real interest rate r and private sector inflation expectations z, so

$$l = r + z \tag{2}$$

A higher level of inflation z anticipated by the public increases the long-term nominal interest rate l due to the Fisher effect.[2] The public has rational expectations and uses the policy rate s as a signal of the central bank's inflation target τ, so that

$$z = \mathrm{E}_P\left[\tau | s\right] \tag{3}$$

where $\mathrm{E}_P\left[\tau | s\right]$ denotes the private sector's posterior mean of the inflation target.

In the case of transparency (denoted by subscript T), the central bank conveys to the private sector (e.g. by publishing forecasts, minutes or policy explanations) the economic shocks ε it is responding to. This means that the public can perfectly infer the central bank's intention τ from the policy instrument s, so that the long-term nominal interest rate equals

$$l_T = r + \tau \tag{4}$$

In the case of opacity (denoted by subscript O), the economic disturbance ε is not observed by the private sector. As a consequence, the public engages in Bayesian updating, or equivalently, solves a signal-extraction problem when it tries to infer the central bank's inflation target τ from the policy instrument s. So, the long-term nominal interest rate equals[3]

$$l_O = r + \frac{\sigma_\varepsilon^2}{\sigma_\tau^2 + \sigma_\varepsilon^2}\bar{\tau} - \frac{\sigma_\tau^2}{\sigma_\tau^2 + \sigma_\varepsilon^2}\left(s - c\right) \tag{5}$$

This shows that a change in the short interest rate affects the long interest rate in the opposite direction, thereby tilting the yield curve. Substituting (1) into (5) gives

$$l_O = r + \tau + \frac{\sigma_\varepsilon^2}{\sigma_\tau^2 + \sigma_\varepsilon^2}\left(\bar{\tau} - \tau\right) - \frac{\sigma_\tau^2}{\sigma_\tau^2 + \sigma_\varepsilon^2}\varepsilon \tag{6}$$

A comparison of the outcomes under transparency (4) and opacity (6) reveals two differences. First, under opacity, the stabilization of economic shocks is complicated by the effect on the long-term interest

[2] Note that over time, this also increases short term inflation expectations (which are fixed in the short term) and thereby raises the neutral policy rate c. Thus, the policy rate s would increase in the long run, which would make (1) and (2) consistent with the expectations theory of the term structure.

[3] Use the fact that for two jointly normal variables x and y, $\mathrm{E}\left[y|x\right] = \mathrm{E}\left[y\right] + \frac{\mathrm{Cov}\{y,x\}}{\mathrm{Var}[x]}\left(x - \mathrm{E}\left[x\right]\right)$.

rate. For instance, suppose the central bank would like to offset a negative demand shock $\varepsilon < 0$ by reducing the policy rate s. The lack of transparency causes the private sector to partly attribute the lower interest rate s to a higher inflation target τ. This increases the long-term nominal interest rate l, which hampers the central bank's ability to stimulate the economy. In contrast, in the presence of transparency, the long rate remains stable, thereby providing the central bank greater flexibility to offset economic disturbances without compromising its credibility.

Second, greater transparency allows the private sector to more accurately infer the central bank's inflation target τ from the policy rate s, which leads to lower inflation expectations z and reduces the long-term nominal rate l (as $\bar{\tau} > \tau$). However, under opacity, private sector expectations are less responsive to policy actions, so the central bank finds it much more difficult to improve its reputation. Similar in spirit, transparency could make it easier for the private sector to infer the inflation target τ from inflation outcomes (e.g. by publishing unanticipated transmission disturbances). This would also reduce private sector inflation expectations z and thereby the long nominal rate l.

To summarize, transparency could generate two beneficial effects. It could provide the central bank greater flexibility to stabilize economic shocks by reducing the short-term interest rate without risking a loss of reputation in the form of higher long-term nominal rates. In addition, it could have a desirable reputation effect that lowers inflation expectations and the long-term nominal interest rate. As a result, it is possible to distinguish between the flexibility and reputation effects of transparency.

3 Data

This paper exploits the rich transparency database collected by Eijffinger and Geraats (2006). In particular, changes in the Eijffinger and Geraats (2006) index are used to analyze the relation between transparency and interest rates over time. There are a few other measures of transparency of monetary policy: Fry, Julius, Mahadeva, Roger, and Sterne (2000) construct an index of 'policy explanations' based on a comprehensive survey of 94 central banks; Bini-Smaghi and Gros (2001) present an indicator of central bank transparency and accountability for six major central banks; and de Haan and Amtenbrink (2002) suggest a variation on this. However, these measures are all static, so they cannot be used for time series analysis.

The Eijffinger and Geraats (2006) index distinguishes five aspects of transparency relevant for monetary policymaking, each of which is quantified based on three criteria that refer to factual information disclosures.

1. Political (formal objectives, quantitative targets, and institutional arrangements).
2. Economic (data, models and internal forecasts used for policy decisions).
3. Procedural (strategy, minutes and voting records, capturing how policy decisions are made).
4. Policy (prompt announcement and explanation of policy actions, and policy inclination).
5. Operational (control errors, transmission disturbances, and formal evaluation of policy outcomes).

The index is constructed for nine major central banks (RBA, ECB, BoJ, RBNZ, SRB, SNB, BoE, Fed and Bank of Canada (BoC)) for the period 1998-2002.

The Eijffinger and Geraats (2006) index shows a great variety in the degree of transparency, both across central banks and over time. The most transparent central banks are the RBNZ, the SRB and the BoE, which are all inflation targeters. However, the adoption of inflation targeting does not guarantee a high degree of transparency, as is shown by the fact that the RBA gets one of the lowest scores in the sample. Furthermore, many central banks have experienced significant improvements in transparency over time. The SRB, which has been an inflation targeter since 1993, achieved the most impressive advance in the transparency index from 1998 to 2002. These examples also show that the adoption of inflation targeting can be a very poor proxy for the degree of central bank transparency.

The empirical analysis investigates how the level of interest rates is affected by changes in transparency over time, controlling for the macroeconomic situation in the form of inflation and output. Changes in the Eijffinger and Geraats (2006) index are used to construct transparency indicator variables $d_{MM/YY}$ for each central bank that switch from 0 to 1 on the date (coded as MM/YY) at which the change in the index took place. This leads to 15 indicators which are supplemented by 4 indicators that capture major transparency events that occurred before the sample of Eijffinger and Geraats (2006). The BoC was the only central bank that had no change in its transparency scores over the sample, so it was dropped. Appendix A.1 contains a list of all the transparency indicator variables, including a detailed description of the corresponding change in transparency and the aspect(s) it pertains to.

The analysis is performed for three different interest rates, policy, short and long. The policy rate i_p is the interest rate that the central bank employs as its policy instrument or operating target. The short interest rate i_s is the three-month deposit rate or the money market rate. And the long nominal rate i_l is the nominal yield on 10-year government bonds. End-of-quarter levels of the interest rate are used for the baseline results with quarterly data.

Two variables are used to control for macroeconomic conditions, inflation and the output gap. Inflation is measured as the annual percentage change in the Consumer Price Index (CPI). The measure for the output gap is the percentage deviation from the trend in Gross Domestic Product (GDP) computed using the Hodrick-Prescott (HP) filter. Further details about the quarterly data are in Appendix A.2.1.

To check the robustness of the results, estimations were also performed at monthly frequency. To compute the output gap, monthly production data is used, which is available for five out of the eight central banks: the ECB, BoJ, SRB, BoE and the Fed. In several cases, the interest rate data consists of monthly averages instead of end-of-month levels. Since changes in the interest rate take longer to affect average values, regressions with average rates use the one-month lagged value of the transparency indicator to facilitate comparability of the results across rates. So, for average interest rates, a transparency change in January effectively turns on an indicator variable in February. Further details about the quarterly and monthly macroeconomic data used for each central bank appear in Appendix A.2.1 and A.2.2, respectively.

4 Econometric Method

The empirical analysis of the effect of central bank transparency on the level of interest rates is complicated by two stylized facts: (i) interest rates tend to vary substantially over the business cycle by about 200-400 basis points; and (ii) the degree of central bank transparency has increased significantly over time but not uniformly across countries, as documented by Eijffinger and Geraats (2006). As a result, cross-section correlations between the (level or average of the) interest rate and transparency could be very misleading. Instead, we investigate how the level of the interest rate is affected by changes in transparency over time. Since the interest rate i depends on macroeconomic conditions, we include inflation (π) and the output gap (y) as control variables, as well as lagged interest rates to absorb serial correlation. The changes in transparency are captured by the indicator(s) $d_{MM/YY}$. This gives rise to the following backward-looking specification:

$$i_t = c_0 + \sum_{l=1}^{L_\pi} c_{\pi,l}\pi_{t-l} + \sum_{l=1}^{L_y} c_{y,l}y_{t-l} + \sum_{l=1}^{L_i} c_{i,l}i_{t-l} + \sum\nolimits_{MM/YY} c_{MM/YY}d_{MM/YY,t} + \varepsilon_t \quad (7)$$

where $i \in \{i_p, i_s, i_l\}$ and ε_t white noise. Although this resembles the so-called Taylor rule, which has a structural interpretation as a policy reaction function, we focus on the conditional expectations interpretation of (7). We focus in particular on the question whether improvements in transparency are associated with a reduction in interest rates, controlling for macroeconomic conditions.

To control for expected future conditions as well, an additional specification is considered that also includes current and forward-looking terms for inflation and output:

$$\begin{aligned} i_t \;=\; & c_0 + \sum_{l=1}^{L_\pi} c_{\pi,l}\pi_{t-l} + \sum_{l=1}^{L_y} c_{y,l}y_{t-l} + \sum_{l=1}^{L_i} c_{i,l}i_{t-l} \\ & + \sum_{k=0}^{K_\pi} c_{\pi,k}\pi_{t+k} + \sum_{n=0}^{K_y} c_{y,k}y_{t+n} + \sum\nolimits_{MM/YY} c_{MM/YY}d_{MM/YY,t} + \eta_t \end{aligned} \quad (8)$$

where $\eta_t \equiv \varepsilon_t + \sum_{k=0}^{K_\pi} c_{\pi,k}\left(\mathrm{E}_t\left[\pi_{t+k}\right] - \pi_{t+k}\right) + \sum_{k=0}^{K_y} c_{y,k}\left(\mathrm{E}_t\left[y_{t+k}\right] - y_{t+k}\right)$ is white noise. So, the forward-looking specification (8) encompasses the backward-looking model in (7).[4]

The main challenge in the estimation of (7) and (8) is to obtain results that pass the usual diagnostic tests (especially for autocorrelation). Instead of using a trial-and-error approach to try to find a suitable specification for each country and interest rate, we decided to adopt a more systematic method and used the automatic econometric model selection program PcGets, which is based on the *general-to-specific* methodology (Hendry, 1995). For all countries and interest rates, (7) and (8) are used as the so-called 'General Unrestricted Models' (GUMs), which are the starting point of the automatic selection of an undominated, congruent 'specific model' based on the results of diagnostic tests.[5]

The sample period runs from 1993 through 2002, covering the decade in which some of the most interesting changes in transparency practices have taken place. Ending the sample in 2002 allows for

[4]This makes (8) preferable to (7). However, when the current and forward-looking terms in (8) are not significant (which is sometimes the case for i_l), estimation of the backward-looking model (7) is more reliable.

[5]According to Hendry and Krolzig (2001, p. 3), "Monte Carlo experiments demonstrate that PcGets recovers the correct specification from a general model with size and power close to commencing from the data-generating process (DGP) itself."

the inclusion of forward-looking explanatory variables based on more recent data (2002-2004). For the backward-looking regressions with quarterly data (7), the number of lags in the GUM was set to $L_\pi = L_y = L_i = 5$. The same lags were used in the forward-looking regressions with quarterly data (8). For the latter, a selection of forward-looking terms had to be made because of the limited number of observations at our disposal. We decided to include the current, one-year ahead, and two-year ahead inflation rate, so $k \in \{0, 4, 8\}$, and the current and one-year ahead output gap, so $n \in \{0, 4\}$. These are treated as endogenous explanatory variables. For the estimations at monthly frequency, the lags and leads in the GUMs are adjusted correspondingly to make them comparable with the quarterly regression results, so $L_\pi = L_y = L_i = 15$, $k \in \{0, 12, 24\}$ and $n \in \{0, 12\}$.

For the endogenous inflation and output gap variables in the forward-looking regressions, several instruments were considered, namely lags up to two years of π, y, i_p, i_s, i_l, and, if available, also of the medium term interest rate i_m.[6] We experimented with the combination and lag lengths of the instruments in light of the following criteria: (i) the number of instruments is not too large, in the sense that they cause run time errors; (ii) the instruments are valid according to the Sargan test; (iii) the instruments have significant explanatory power for the endogenous explanatory variables; and (iv) if possible, other standard diagnostics tests pass as well (using the model selection thresholds). The Sargan test evaluates the null hypothesis that the instrumental variables are uncorrelated with the regression residuals. Since rejection of the Sargan test makes the coefficient estimates inconsistent, we used as selection criterion that this $\chi^2(q)$ test for q over-identifying instruments has a p-value of at least 0.10.

The backward-looking specifications are estimated by Ordinary Least Squares (using the model selection tool GETS in PcGets) based on the GUM in (7), the forward-looking specifications by Instrumental Variables (using GETSIVE) based on the GUM in (8). In our baseline results, all transparency indicators are forced to be included in the selected specific model. The selection strategy that is chosen is the built-in 'liberal' strategy, which minimizes the non-selection probability of variables that are relevant and employs sample size adjusted selection criteria.[7] To evaluate the robustness of the results, we consider a few variations on this baseline strategy with quarterly data. First, the 'liberal' strategy is replaced by the built-in 'conservative' selection strategy, which minimizes the non-deletion probability of nuisance variables. In the second variation on the baseline settings, the transparency indicators are no longer forced to be included in the specific model, which means that only highly significant transparency events tend to survive this 'non-forced' selection strategy. In addition, as mentioned above, the baseline estimations are also performed at monthly frequency for several central banks. The forward-looking estimations in the quarterly robustness checks were performed with the same instruments as in the baseline model, except when this violated the instrument selection criteria described above, in which case more suitable instruments were chosen.

The specific models selected by PcGets under the baseline settings are reported in Tables 1 and 2

[6] To prevent multicollinearity problems, i_p and i_s were not both included as instruments.

[7] Only two adjustments were made to this setting. In light of the relatively limited sample size, the loosest significance level for the diagnostic tests was increased from 0.01 to 0.025. In addition, a heteroskedasticity test was activated (in addition to the standard tests in PcGets, namely for structural breaks (Chow), normality, autocorrelation, and autoregressive conditional heteroskedasticity). If a diagnostic test is violated for the GUM at the set significance level, then PcGets discards this test and no longer reports it, in which case any missing diagnostics tests were obtained separately for each selected specific model.

for the ECB and Fed, respectively.[8] Columns 1-3 and 4-6 show the coefficient estimates (with p-values in brackets) for the backward-looking and forward-looking specifications, respectively. The reported Wald test is for the null hypothesis that the transparency indicators $d_{MM/YY}$ have no joint effect (H_0: $c_{MM/YY} = 0, \forall_{MM/YY}$). Indicator variables and Wald tests that are significant at the 10% level are printed bold. The outcomes of several diagnostic tests are reported as well (again with p-values in brackets), using the default settings of PcGets.[9] 'AR' refers to a Lagrange-multiplier (LM) test that evaluates the null hypothesis of no autocorrelation up to fourth order (for quarterly data). 'ARCH' denotes the standard Engle test for fourth-order autoregressive conditional heteroskedasticity in the residuals. 'Hetero' is the White test for heteroskedasticity that is quadratic in the regressors. 'Normality' refers to the Jarque-Bera normality test based on the skewness and kurtosis of the residuals. 'Sargan' denotes the Sargan test for instrument validity (described above) and it only applies to the forward-looking regressions. Finally, the standard error of the regression (s.e.e.) and the R^2 give an indication of the goodness of fit of the regressions.

The specifications selected by PcGets tend to have a pretty good fit with an R^2 of around 0.9, although it is sometimes lower for the long-term interest rate. The diagnostics look fine for the majority of our baseline specific models. However, in a considerable number of cases diagnostic tests yield p-values that are quite low ($<$0.05), which means that the results cannot be considered reliable.[10] Those instances are flagged in the presentation of the transparency estimates in Section 5.

For all central banks, the specific models for the policy and short rate are typically increasing in the lagged interest rate, inflation and the (change in the) output gap. For the long rate, there is more heterogeneity in the specific models across central banks, but there is always a strong autoregressive component. It should be noted that for many central banks the forward-looking model for the long rate shows a significant effect of expected future inflation. This means that the transparency indicator may no longer provide a good measure for the reputation effect which operates through inflation expectations. As a result, transparency estimates in forward-looking specifications for the long-term nominal interest rate should be interpreted with caution.

The focus in this paper is on the 19 transparency indicators $d_{MM/YY}$. Many of the transparency events exert a significant effect on the policy, short and/or long interest rate in the baseline results. For each central bank, the Wald test typically strongly rejects that the transparency indicators have no joint effect. This establishes that the changes in central bank transparency have significantly affected the level of interest rates.

[8] The detailed results for the other central banks are included in a separate Annex, which is available on request.

[9] Detailed information about the diagnostic tests is available in the PcGets manual (section 13.7). Note that the default in PcGets is to report the F-form of the χ^2 statistics for AR, ARCH and hetero, because it has better small-sample properties.

[10] The presence of problematic diagnostics may seem surprising since PcGets is supposed to select a specific model that passes the standard diagnostic tests at adjustable threshold significance levels. However, when a diagnostic test fails in the GUM even at the sharpest significance level (0.005), PcGets simply ignores that test altogether in its model selection. Of course, this could be a symptom of a misspecified GUM, which would also make the specific model unreliable.

5 Empirical Results

The empirical estimates for the indicator variables in the selected specific model are summarized in Table 3 and 4, based on the backward-looking GUM in (7) and the forward-looking GUM in (8), respectively. Our systematic econometric methodology ensures that the results in each of these Tables are comparable in the sense that they are based on exactly the same GUM and model selection settings for all central banks. The first three columns of the Tables show the coefficient estimates (with p-values in brackets) for the transparency indicators $d_{MM/YY}$ in the specific model with the policy rate i_p, short-term nominal interest rate i_s and long-term nominal interest rate i_l, respectively. Results in the Tables are flagged whenever the specific model fails to pass critical diagnostic tests with a p-value of at least 0.05. Nonnormality and/or heteroskedasticity, marked by †, make the p-values of the coefficient estimates unreliable. Autocorrelation, indicated by ‡, not only makes the p-values incorrect, but in the presence of a lagged dependent variable it also makes the coefficient estimates inconsistent. The final two columns show whether the transparency event appears to improve (+), reduce (–) or not significantly affect (0) the flexibility and reputation of the central bank.

The overview in Tables 3 and 4 reveals that most of the significant transparency coefficients (printed in bold) are negative. In fact, more than two-thirds of the significant transparency events are associated with a lower policy, short-term and/or long-term nominal interest rate. Interestingly, there are a few instances in which the effects on the policy/short rate and the long rate are significant but of opposite sign, which suggests a trade-off between flexibility and reputation.

These findings also hold for the 'conservative' and 'non-forced' robustness checks in Tables 5 and 6 (for the backward-looking GUM) and Tables 7 and 8 (for the forward-looking GUM). These robustness exercises often confirm the results based on the baseline settings. A large number of the significant transparency effects even survive the highly discriminating non-forced selection strategy. Although there are several cases in which a significant transparency effect in the baseline results is not corroborated by the robustness checks (or vice versa), it is very rare for the baseline estimates and robustness checks to actually yield contradictory significant effects.[11] This indicates that our findings are quite robust to changes in the model selection strategy.

The baseline econometric estimates of the transparency effects in Tables 3 and 4 are now discussed for each of the eight central banks. They are cross-checked against the estimates based on the 'conservative' and 'non-forced' model selection strategies in Tables 5-8. Whenever available, findings based on monthly data are taken into account as well.

5.1 Reserve Bank of Australia

The RBA experienced an increase in economic transparency when it clarified in October 2001 that it uses a particular macroeconometric model for policy analysis (indicated by $d_{10/01}$). This model had already been published by the RBA as a research discussion paper without receiving its formal endorsement.

The baseline estimates suggest that this transparency event ($d_{10/01}$) was associated with a significant decline in policy and short-term interest rates of over 50 basis points, which indicates increased flexi-

[11] Most differences occur for the (non-forced) forward-looking specifications, but these tend to be less comparable because the selection of instruments sometimes had to be changed to satisfy the instrument criteria described in section 4.

bility. Long-term interest rates did not change significantly, which suggests that the reputation of the RBA was not affected. These findings are supported by the robustness checks. Nevertheless, it seems surprising that such a minor transparency change would have such a strong effect. It is likely that the October 2001 transparency indicator is picking up the policy easing following the 9/11 terrorist attacks.

5.2 European Central Bank

The ECB has become more transparent in two respects. There was an increase in economic transparency in December 2000 (indicated by $d_{12/00}$) when it introduced the release of semiannual medium-term staff projections for inflation and output.[12] In the subsequent month, the ECB first published its structural macroeconomic model of the euro zone. In addition, policy transparency was effectively enhanced in November 2001 (indicated by $d_{11/01}$), when the ECB started to provide a policy explanation after each monetary policy meeting after the reduction in the frequency of policy meetings from twice to once a month. Since then, each monetary policy meeting has been followed by a press conference in which the President provides a statement and answers questions from journalists. Considering the major change that took place with the start of the European Monetary Union (EMU) in January 1999, we introduced an additional indicator variable EMU to investigate its effect.[13]

The baseline results show that the increase in economic transparency ($d_{12/00}$) has been followed by lower interest rates. The effect is only significant for the long rate in the backward-looking model, but this beneficial reputation effect of about 30 basis points is confirmed by the conservative robustness check. The latter also shows a significant decrease in the short rate of about 60 basis points. This advantageous flexibility effect also appears in the monthly results, both in the backward- and forward-looking model. So, greater economic transparency appears to have improved the flexibility and reputation of the ECB.

The increase in policy transparency ($d_{11/01}$) has also been accompanied by significantly lower interest rates, with reductions of more than 180 basis points for both the short and long rate. These large significant effects find support in the robustness checks. This suggests that the greater policy transparency has been very beneficial for both the flexibility and reputation of the ECB. However, it is likely that the sizeable decrease in the interest rate captured by the November 2001 transparency indicator is at least partly attributable to the policy easing after 9/11.

The start of EMU has been followed by a significant increase in the policy, short and long rate of up to 50 basis points in all the backward-looking regressions, including the highly selective non-forced robustness check. There is also evidence of significant positive coefficient estimates in the monthly forward-looking regressions. This indicates that EMU has had harmful flexibility and reputation effects.

All in all, the results suggest that the increase in economic and policy transparency have both been beneficial to the ECB, whereas EMU has exerted a detrimental effect on interest rates.

[12] This had been triggered by the Committee on Economic and Monetary Affairs of the European Parliament in its quarterly Monetary Dialogue with the ECB based on Article 113(3) of the Treaty on European Union and on the advice of its Panel of Experts in their quarterly Briefing Papers (see http://www.europarl.eu.int/comparl/econ/emu/default_en.htm)

[13] To ensure comparability before and after EMU, Eonia is used for the policy rate.

5.3 Bank of Japan

The BoJ experienced an increase in its political and procedural transparency when a new monetary policy framework was implemented in January 1998 (indicated by $d_{01/98}$), in anticipation of the entry into force of an amendment to the Bank of Japan Law on April 1, 1998. This amendment specified price stability as the explicit aim of monetary policy, increased the effective independence of the Bank, and required a semi-annual report on monetary policy to the Diet (parliament). Since January 1998, monetary policy decisions have been made at regular meetings of the newly autonomous Policy Board and the minutes of its policy meetings have been published. The BoJ also enhanced economic transparency in October 2000 (indicated by $d_{10/00}$) when it started publishing the Policy Board's semi-annual short-term forecasts for inflation and output. Finally, the BoJ actually suffered from a decrease in its transparency score in March 2001 (indicated by $d_{03/01}$ and coded as a change from 1 to 0) when it abandoned the use of the uncollateralized overnight call rate (which has been virtually zero since February 1999) as its main operating target. Instead, it adopted the outstanding balance of current accounts at the Bank, but this quantitative target proved quite loose and wide fluctuations within the target were not explained, thereby creating opacity about control errors.[14]

Nearly all backward-looking specifications for the BoJ turn out to have problematic diagnostics. Normality of the residuals is often strongly rejected, which is not surprising in light of the zero-interest-rate policy of the BoJ during the second half of the sample period. The baseline forward-looking model appears to be the most suitable specification since it is the only one to pass all diagnostic tests.

The implementation of the new monetary policy framework ($d_{01/98}$) has significantly reduced the short rate by about 20 basis points in the baseline forward-looking estimates. The non-forced forward-looking variation for the policy rate also shows a significant beneficial flexibility effect, but this should be interpreted with caution due to the presence of autocorrelation.[15] The estimates for the long rate show a decline of about 25 basis points in all the quarterly forward-looking regressions. This beneficial reputation effect is significant in the more selective non-forced variation, but this should be interpreted with care due to normality problems.

Higher economic transparency ($d_{10/00}$) has produced no significant effects on interest rates, except for an increase in the policy rate of about 70 basis points in the monthly forward-looking regression. But this sign of a detrimental flexibility effect may not be reliable due to the failure of normality.

The change in operational transparency ($d_{03/01}$) shows a significant negative effect on the policy rate of about 30 basis points in the baseline forward-looking model.[16] This corresponds to a beneficial flexibility effect from greater transparency, but it appears to be contradicted by a significant positive effect on the policy rate in the conservative forward-looking variation. However, the latter suffers from nonnormality, so its p-values are unreliable.

[14] The change in operating target has been reversed by the BoJ in March 2006, which marked the end of a five-year period of 'quantitative easing'.

[15] The monthly forward-looking estimates also yield significant, yet bewildering results, with a negative estimate for the short rate, but a large positive estimate for the policy rate. However, these are based on different instruments and suffer from nonnormality.

[16] Recall that $d_{03/01}$ captures a transparency decrease and that the indicator variable is turned off in March 2001. So, the results indicate that the prevailing zero interest rate was about 30 basis points higher than macroeconomic conditions would have warranted.

All in all, we only find tentative support that greater transparency may have increased the flexibility and perhaps also the reputation of the BoJ.

5.4 Reserve Bank of New Zealand

The RBNZ accomplished a major improvement in policy and operational transparency in March 1999 (indicated by $d_{03/99}$) when it abandoned the use of a target for the Monetary Conditions Index (MCI), which is a weighted average of the trade-weighted exchange rate and the 90-day interest rate, to convey its monetary policy stance. Instead, it introduced the Official Cash Rate, which is perfectly controlled and thereby eliminates operational uncertainty.[17] In addition, it started to release explanations of policy changes as well as quarterly, three-year ahead, unconditional forecasts for the 90-day interest rate. There was a further increase in policy transparency in December 2000 (indicated by $d_{12/00}$) when the RBNZ started to provide an explanation of policy decisions even when the Official Cash Rate was held constant.

The adoption of the Official Cash Rate ($d_{03/99}$) appears to have reduced policy/short rates by about 60 basis points in the backward-looking regressions, but this favorable flexibility effect is not statistically significant, although it should be noted that the reported p-values are not reliable due to nonnormality.

The further rise in policy transparency ($d_{12/00}$) has mostly lead to lower interest rates. The forward-looking estimates even show a significant decline in the policy/short rate of over 200 basis points. But this evidence of a large beneficial flexibility effect is tainted by the presence of autocorrelation. For the long rate, the backward-looking baseline model shows a significant decrease of about 60 basis points. This is confirmed by the non-forced backward-looking variation, although this should be treated with caution due to autocorrelation. On the other hand, the non-forced forward-looking specification contradicts this advantageous reputation effect and shows a significant increase in the long rate of about 55 basis points.

All in all, there are some indications that the increases in transparency may have been beneficial to flexibility but possibly harmful to the reputation of the RBNZ. However, the latter may be attributable to the gradual increase in the RBNZ's inflation target from 0-2% to 0-3% in 1997 and to 1-3% in 2002, which has probably raised the long-term nominal interest rate.

5.5 Swedish Riksbank

The SRB experienced the greatest number of transparency events in our sample. The SRB started publishing its inflation forecasts in the quarterly Inflation Report in March 1997 (indicated by $d_{03/97}$), which enhanced economic transparency. The Riksbank's institutional independence and main objective were clarified in amendments to the Constitution Act and Sveriges Riksbank Act, which entered into force in January 1999 and improved political transparency (indicated by $d_{01/99}$). The SRB introduced policy explanations for no-change decisions in October 1999 and later that quarter first released data on capacity utilization, which contributed to policy and economic transparency (indicated by $d_{10/99}$). Operational transparency was improved by an annual evaluation of past inflation forecast errors, which started in March 2000 (indicated by $d_{03/00}$). Finally, policy and procedural transparency increased when

[17] To ensure comparability before and after the adoption of the Official Cash Rate, the overnight interbank rate is used for the policy rate. Since it is essentially the same as the money market rate, the policy and short rate results are virtually identical.

a policy inclination was introduced in March 2002, followed by clarity about the attributed voting record in the minutes of the Executive Board's monetary policy meetings (indicated by $d_{03/02}$).

It should be noted up front that many of the backward-looking results for the SRB are marred by autocorrelation or nonnormality problems. But the forward-looking specifications, which often yield similar findings, appear more suitable and do not suffer from problematic diagnostics.

The increase in economic transparency ($d_{03/97}$) has significantly increased the policy and short rate by about 50 basis points in all quarterly specifications, including the highly demanding non-forced robustness checks. There are no significant effects for the long rate, except in the monthly forward-looking specification, which shows a decrease of about 35 basis points. This indicates that greater economic transparency has had a disadvantageous flexibility effect, while there is also some evidence of a beneficial reputation effect.

The advance in political transparency ($d_{01/99}$) appears to have reduced policy and short interest rates. This favorable flexibility effect is strongly supported by all the forward-looking estimates for the short rate, which show a significant decrease of about 100 basis points, also in the challenging non-forced robustness check.[18] At the same time, the long rate has significantly increased by about 100 basis points in the baseline forward-looking regression. The detrimental reputation effect is supported by the monthly results and even the non-forced backward-looking specification. Thus, this transparency event reveals a trade-off between flexibility and reputation.

The increase in policy and economic transparency ($d_{10/99}$) shows no significant effects in the quarterly models, but this may be due to collinearity with $d_{01/99}$ and $d_{03/00}$. The monthly specifications are more discriminating and detect a detrimental flexibility effect in the forward-looking regressions with a 20 basis point increase in the policy and short rate, although the latter suffers from autocorrelation and nonnormality. There is an indication of a possible beneficial reputation effect with a sizeable decline in the long rate of about 90 basis points in the baseline and conservative backward-looking models, but these estimates are not statistically significant, although it should be noted that the reported p-values of 0.13 are unreliable due to nonnormality.

The rise in operational transparency ($d_{03/00}$) did not generate any significant coefficient estimates in the quarterly models, again probably due to multicollinearity. Nevertheless, the results suggest a decline in the policy rate, up to about 50 basis points in the conservative specifications. The presence of an advantageous flexibility effect finds formal support in the monthly regressions, which reveal significant negative estimates in the backward- and forward-looking specifications.

Finally, the greater policy and procedural transparency ($d_{03/02}$) has significantly increased the short rate by nearly 50 basis points in all quarterly forward-looking specifications, including the highly selective non-forced variation. This strong finding of a detrimental flexibility effect appears to be contradicted by a significant decrease in the policy rate in the conservative forward-looking variation, but this estimate is only marginally significant with a p-value of 0.09.[19] Regarding the long rate, the esti-

[18] This appears to be contradicted by a significant increase in the short rate in the monthly forward-looking regressions, but this finding is unreliable due to autocorrelation and nonnormality.

[19] The monthly forward-looking regressions also yield opposite findings, with a significant positive estimate for the policy rate and negative estimate for the short rate, although the latter suffers from autocorrelation and nonnormality. Both contradictory findings may be related to the use of different instruments.

mates unambiguously point to a reduction. This beneficial reputation effect appears firmly supported by significant effects of up to 100 basis points in the baseline and conservative forward-looking specification as well as in the non-forced and monthly backward-looking variations. So, this transparency event provides another example of a trade-off between flexibility and reputation.

All in all, the increases in transparency have significantly affected the level of interest rates, although the benefits appear equivocal. In particular, the empirical results strongly suggest that the SRB has experienced trade-offs between flexibility and reputation.

5.6 Swiss National Bank

The SNB experienced a significant change in its monetary policy framework in December 1999 (indicated by $d_{12/99}$), with the announcement of a quantitative definition of price stability, quickly followed by the entry into force of a constitutional amendment that enshrined the Bank's independence. In addition, the SNB started to release three-year ahead inflation forecasts at semiannual frequency. On the downside, it introduced an operational target range for the LIBOR of 100 basis points, without accounting for significant fluctuations, thereby reducing operational transparency.

The change in the monetary policy framework ($d_{12/99}$) has been accompanied by significant effects on interest rates. Most specifications show a significant increase in the short rate of about 40 basis points. But this detrimental flexibility effect is contradicted by several significant declines of over 100 basis points in the forward-looking specifications.[20] While the effect on flexibility appears ambiguous, the baseline results show a significant decline in the long rate of about 40 basis points and this is confirmed by the backward-looking robustness checks. This indicates that the different monetary policy framework has boosted the reputation of the SNB.

5.7 Bank of England

The BoE was granted operational independence in 1997 and the first interest rate decision by the new Monetary Policy Committee (MPC) was made in June 1997 (indicated by $d_{06/97}$). This greatly reduced uncertainty about potential political influences on monetary policymaking. This transparency event resulted from the surprising move by the new Labor government to grant the BoE independence, so it can be considered as exogenous. In addition, in April 1999 the BoE increased its economic transparency by publishing extensive documentation about its policy models, even including the computer code of its macroeconometric model (indicated by $d_{04/99}$). And in August 1999, operational transparency was enhanced by the introduction of an annual evaluation of the MPC's forecasting record for inflation and output (indicated by $d_{08/99}$).

It should be noted that the BoE regressions for the policy rate raise red flags for nonnormality and autocorrelation. But the quarterly specifications for the short rate do not have diagnostic problems, so these are used to assess flexibility effects.

The operational independence of the BoE ($d_{06/97}$) has been followed by significantly higher short term interest rates of over 100 basis points in the baseline estimates. This detrimental flexibility effect is confirmed by the robustness checks, even by the non-forced variations. The long rate, however, has

[20] Again, the contradictory results may be related to the use of different instruments.

significantly declined by over 100 basis points in the baseline results. Although these are marred by heteroskedasticity, the advantageous reputation effect is strongly supported by the highly demanding non-forced robustness checks. So, empirical results indicate that the independence of the BoE has generated a trade-off between flexibility and reputation.

The rise in economic transparency ($d_{04/99}$) appears to have reduced short rates, but the effects are not statistically significant in the baseline regressions. The latter is probably due to collinearity with $d_{08/99}$, because the more discriminating non-forced backward-looking variation eliminates $d_{08/99}$ and shows a significant effect for $d_{04/99}$ with a 90 basis point reduction in the short rate. This points to a beneficial flexibility effect. The long rate seems higher in the quarterly results, but this is not significant. However, the monthly forward-looking regression, which suffers less from collinearity, detects a significant increase, so this suggests a detrimental reputation effect.

The increase in operational transparency ($d_{08/99}$) appears to have significantly increased the short rate by nearly 175 basis points in the baseline forward-looking regression. However, this detrimental flexibility effect is not supported by any of the robustness checks. In fact, it is contradicted by a significant decrease in the policy rate of about 50 basis points in the non-forced backward-looking variation, but this estimate is tainted by autocorrelation. The long rate seems lower in the quarterly results, though the effect is not statistically significant. However, similar to $d_{04/99}$, the monthly forward-looking regression again picks up a significant decrease, which indicates a beneficial reputation effect.

All in all, the transparency changes have had a mixed effect on interest rates and there is evidence that the BoE has experienced a trade-off between flexibility and credibility, especially after its independence in 1997.

5.8 Federal Reserve

The Fed introduced a prompt announcement of its Federal Funds rate decision in February 1994 (indicated by $d_{02/94}$), thereby contributing to greater policy transparency. In addition, it became more forthcoming about its policy stance in May 1999 when it started to provide a brief explanation of every policy decision at the time of announcement, as well as an explicit policy inclination (indicated by $d_{05/99}$).

The first increase in policy transparency ($d_{02/94}$) has lead to higher interest rates. There is a significant increase in the policy and short rate of about 50 basis points in the quarterly backward-looking models, including the non-forced specification. In addition, there is a significant rise in the long rate of up to 280 basis points in all the forward-looking estimates, including the non-forced robustness check. Although this seems detrimental to flexibility and reputation, the strong increase in interest rates was actually the Fed's intention. After a long 1.5 year spell of a constant Federal Funds rate target of 3%, the Fed decided on a 50 basis point hike in February 1994, accompanied by a prompt announcement to achieve maximum effect. So, this transparency event was endogenous to the interest rate decision. Nevertheless, it seems remarkable that the higher level of interest rates has been so persistent. However, an alternative interpretation of the significant positive effects of $d_{02/94}$ is that interest rates in 1993 (the first year of the sample) were relatively low compared to economic conditions.

The introduction of an explicit policy inclination in 1999 ($d_{05/99}$) has been followed by lower in-

terest rates. The policy and short rate are significantly reduced by about 50 basis points in the baseline estimates and in all the backward-looking variations, including the highly selective non-forced robustness check. The long rate has also significantly declined by 90 to 170 basis points, both in the baseline estimations and in the non-forced robustness exercises. These results point to a beneficial flexibility and reputation effect for the Fed.

All in all, the increases in policy transparency at the Fed have been associated with significant effects on interest rates, which appear to have been in a desired direction.

6 Concluding Remarks

Central bank transparency has become one of the key features of monetary policy frameworks during the last decade. Transparency is often alleged to provide monetary policymakers reputational advantages and greater flexibility to stabilize the economy. However, empirical evidence of such benefits has been sparse so far. This paper has systematically analyzed the relation between changes in transparency and the level of interest rates for eight major central banks from 1993 until 2002. It finds that greater transparency tends to be accompanied by persistently lower policy, short-term and/or long-term nominal interest rates, controlling for macroeconomic conditions.

To obtain a suitable econometric specification we have applied the same general-to-specific methodology to each central bank. Extensive robustness checks indicate that our findings are generally not affected by reasonable variations in the model selection criteria. The baseline forward-looking results in Table 4, which are the most encompassing, show that the majority of transparency events have been followed by significant changes in interest rates. In most of these cases, higher transparency is associated with a significant reduction in the policy, short and/or long rate, although sometimes there is a significant increase in the interest rate. In a few instances the effects on policy/short and long rates are of opposite sign, which suggests a trade-off between flexibility and reputation.

The negative relationship we find between transparency and interest rates should be interpreted with care since transparency changes could be endogenous. For instance, the greater policy transparency by the Federal Reserve in February 1994 appears to be motivated by the decision to suddenly raise the policy rate by 50 basis points. On the other hand, there are also transparency changes that are clearly triggered by external events, such as the surprise move by the new Labor government to grant the Bank of England operational independence in 1997. Such exogenous events provide a more reliable estimate of the effect of transparency on interest rates. When focusing on such increases in (political) transparency due to legal changes, there is clear evidence of a reduction in interest rates, although there tends to be a trade-off between greater flexibility through lower policy/short rates and higher reputation with a decline in the long rate.

All in all, this paper establishes that there tends to be a negative relationship between central bank transparency and the level of interest rates, controlling for macroeconomic conditions. It is remarkable that higher transparency is often accompanied by economically significant reductions in the interest rate, sometimes of over 100 basis points. Thus, our empirical findings suggest that central banks that become more transparent could benefit from sizeable flexibility and reputation effects.

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A Appendix

This appendix provides details about the variables used in the empirical analysis, namely the transparency indicators $d_{MM/YY}$ (in section A.1) and the macroeconomic data used for the interest rates i_p, i_s and i_l, inflation π, and the output gap y (in section A.2).

A.1 Transparency Indicators

This section contains a detailed description of the transparency indicators $d_{MM/YY}$ that represent changes in transparency according to the Eijffinger and Geraats (2006) index for each central bank from 1998 to 2002. In square brackets is (in reverse order) the date of change, the change in the index score, and the aspect it pertains to: (1) political, (2) economic, (3) procedural, (4) policy, and (5) operational.

In addition, a few events outside the 1998-2002 sample of Eijffinger and Geraats (2006) have been included (BoJ $d_{01/98}$, SRB $d_{03/97}$, BoE $d_{06/97}$, Fed $d_{02/94}$) as they would clearly effect transparency scores.

Finally, several transparency indicators (ECB $d_{12/00}$; RBNZ $d_{03/99}$; SRB $d_{10/99}$ and $d_{03/02}$; SNB $d_{12/99}$) capture multiple changes in the transparency scores to avoid exact multicollinearity.

Reserve Bank of Australia (RBA)

· $d_{10/01}$: [(2) **+1**, 10/2001] The speech "The Monetary Policy Process at the RBA" by Glenn Stevens, Assistant Governor, Melbourne, October 10, 2001 (available from http://www.rba.gov.au) clarifies that the Reserve Bank uses the following macroeconomic model for policy analysis: Meredith Beechey, Nargis Bharucha, Adam Cagliarini, David Gruen, Christopher Thompson, "A small model of the Australian macro economy", *Reserve Bank of Australia Research Discussion Paper* 2000-05.

European Central Bank (ECB)

· $d_{12/00}$: [(2) **+0.5**, 12/2000; and (2) **+1**, 1/2001] Since December 2000, conditional inflation and output projections for the medium term have been published twice a year in the June and December *Monthly Bulletin*. In addition, publication of a structural macroeconomic model used by the ECB for policy analysis: G. Fagan, J. Henry and R. Metez, "An Area-Wide Model (AWM) for the Euro Area", *European Central Bank Working Paper* 42, January 2001.

· $d_{11/01}$: [(4) **+0.5**, 11/2001] Since November 2001, monetary policy meetings of the Governing Council have taken place once a month, followed by a press conference in which the President provides an introductory statement with an explanation of the policy decision. Before that, there were two policy meetings every month, only the first of which was followed by such a press conference.

Bank of Japan (BoJ)

· $d_{01/98}$: [(1) and (3) **+?**, 01/1998] An amendment of the Bank of Japan Law specifies that monetary policy "shall be aimed at, through the pursuit of price stability, contributing to the sound development of the national economy" (Art. 2), it affirms the autonomy of the Bank of Japan over monetary policy (Art. 3.1) and increases its effective independence. In addition, the Bank is required to be transparent about "the content of its decisions, as well as its decision making process" (Art. 3.2), and in particular, publish the minutes and transcripts of the monetary policy meetings of the Policy Board (Art. 20) and

submit a semi-annual report on monetary policy to the Diet (Art. 54.1). The amendment entered into force April 1, 1998, but the regular monetary policy meetings by the Policy Board and the publication of minutes started in January 1998.

· $d_{10/00}$: [(2) **+0.5**, 10/2000] Since October 2000, the semiannual *Outlook and Risk Assessment of the Economy and Prices* has contained the Policy Board's short-term conditional forecasts for inflation and output.

· $d_{03/01}$: [(5) **-0.5**, 3/2001] On March 19, 2001 the main operating target was changed from the average uncollateralized overnight call rate (which had been effectively zero since February 12, 1999) to the outstanding balance of the current accounts at the Bank. In contrast to the previous target, it is a very rough range and the targeted variable shows significant fluctuations within it, but there are no explanations for these control errors.

Note that $d_{03/01}$ is the only indicator that solely pertains to a reduction in transparency. To facilitate the interpretation of the results, $d_{03/01}$ changes from 1 to 0 on $03/01$, so that $d_{03/01}$ still captures the effect associated with greater transparency.

Reserve Bank of New Zealand (RBNZ)

· $d_{03/99}$: [(4) **+1.5** and (5) **+1**, 3/1999] Before March 1999, the formal operating target was the daily settlement cash target, but there were no explanations of policy decisions on it and there was no evaluation of its achievement. Since the introduction of the Official Cash Rate in March 1999, explanations have been provided for formal policy changes (see http://www.rbnz.govt.nz). In addition, since March 1999 the quarterly *Monetary Policy Statement* has included three-year ahead unconditional projections for the 90-day bank bill rate, which is very closely related to the Official Cash Rate and therefore serves as a policy inclination. Also, the Official Cash Rate is nearly perfectly controlled (e.g. see Andy Brookes and Tim Hampton, 'The Official Cash Rate one year on', *Reserve Bank Bulletin*, June 2000), thereby yielding greater operational transparency.

· $d_{12/00}$: [(4) **+0.5**, 12/2000] Since December 2000, explanations for policy decisions have also been provided when it was decided not to adjust the Official Cash Rate (see http://www.rbnz.govt.nz).

Note that one event has not been included due to considerable uncertainty about the precise timing, namely: [(2) **+0.5**, 2002?] Data on capacity utilization have become publicly available in Excel spreadsheets that accompany the quarterly *Monetary Policy Statements* on the web site (http://www.rbnz.govt.nz), at least since June 2002.

Swedish Riksbank (SRB)

· $d_{03/97}$: [(2) **+?**, 03/1997] Publication of inflation forecasts in the quarterly Inflation Report since March 1997.

· $d_{01/99}$: [(1) **+1**, 1/1999] Amendments (effective from January 1999) to the *Constitution Act* and the *Sveriges Riksbank Act* clarify the Riksbank's institutional independence and main objective. In particular, "The Riksbank is responsible for monetary policy. No authority may determine the decisions made by the Riksbank on issues relating to monetary policy." *Constitution Act*, Chapter 9, Art. 12; "Members of the Executive Board may not seek nor take instructions when they are fulfilling their monetary policy duties." *Sveriges Riksbank Act*, Chapter 3, Art. 2; and, "The objective of the Riksbank's operations shall be to maintain price stability. In addition, the Riksbank shall promote a safe and efficient payment

system." *Sveriges Riksbank Act*, Chapter 1, Art. 2.

· $d_{10/99}$: [(4) **+0.5**, 10/1999; and (2) **+0.5**, 12/1999] Starting in October 1999, the announcement of every policy decision has been accompanied by an explanation, whereas previously this was only the case for adjustments in the policy instrument. And since December 1999, data on many economic variables, including capacity utilization (in the form of econometric estimates of the output gap), have become available for downloading from the Riksbank web site (http://www.riksbank.com) in Excel spreadsheets accompanying the quarterly *Inflation Report*.

· $d_{03/00}$: [(5) **+1**, 3/2000] Since 2000, the March *Inflation Report* has included a discussion of past inflation forecast errors, revealing macroeconomic transmission disturbances, and an evaluation of the inflation outcome over the last three years, including an account of the contribution of monetary policy.

· $d_{03/02}$: [(4) **+1**, 3/2002; and (3) **+1**, 5/2002] A policy inclination indicating the likely future adjustment of the policy rate was introduced in the policy decision statement in March 2002. In addition, the minutes sometimes noted attributed reservations against the policy decision, but it was not clear whether these were (the only) dissents. This was clarified in May 2002, so that the minutes now effectively provide attributed voting records.

Swiss National Bank (SNB)

· $d_{12/99}$: [(1) **+1,** (2) **+0.5** and (5) **-0.5**, 12/1999; and (1) **+0.5**, 1/2000] A quantitative definition of price stability was specified in December 1999, namely an inflation rate as measured by the national consumer price index of less than 2 % per annum. Furthermore, since December 1999, an inflation forecast for the three ensuing years has been presented in the June and December *Quarterly Bulletin* (in French and German only) and at the half-yearly media news conference (in English). In addition, since the introduction of an operational target range of 100 basis points for the three-month LIBOR rate in December 1999, the operating target has still been graphically evaluated in the *Annual Report*, but there are no longer explanations for control errors in the form of significant fluctuations within the wide target range. Finally, a constitutional amendment, effective from January 2000, enshrines the Bank's independence: "As an independent central bank, the Swiss National Bank shall pursue a monetary policy serving the interests of the country as a whole", *Federal Constitution* Art. 99(2).

Bank of England (BoE)

· $d_{06/97}$: [(1) **+?**, 1997] The Bank of England (BoE) was granted operational independence in May 1997 and the new Monetary Policy Committee (MPC) made its first interest rate decision in the next month.

· $d_{04/99}$: [(2) **+1**, 4/1999] Extensive documentation on the Bank's policy models is provided in *Economic Models at the Bank of England*, April 1999 (see also the September 2000 Update), and the computer code of the macroeconometric model is available from http://www.bankofengland.co.uk.

· $d_{08/99}$ [(5) **+0.5**, 8/1999)] Since 1999, there has been a discussion of the Monetary Policy Committee's forecasting record for inflation and output in the August *Inflation Report*.

Note that one event has not been included due to considerable uncertainty about the precise timing, namely: [(2) **+0.5**, 2002?] Time series for relevant macroeconomic variables, including the output gap have become available from the Bank of England web site.

Federal Reserve (Fed)

· $d_{02/94}$: [(4) **+?**, 1994] The Federal Reserve (Fed) first provided a prompt announcement of its Federal Funds rate decision in February 1994.
· $d_{05/99}$: [(4) **+1.5**, 5/1999] Since May 1999, an explanation of every policy decision has been provided at the time of announcement, instead of only in case of an adjustment of the policy instrument. Furthermore, an explicit phrase that describes the policy tilt has been included in the statement released after every policy meeting, which is further explained in the Federal Reserve Board Press Release "FOMC announced modifications of its disclosure procedures", January 19, 2000 (all available from http://www.federalreserve.gov).

A.2 Macroeconomic Data

This section gives a detailed description of the macroeconomic data that were used for each central bank. In particular, it lists the quarterly data (in section A.2.1) and the monthly data (in section A.2.2) that was used for the policy rate i_p, short nominal interest rate i_s, long nominal interest rate i_l, medium nominal interest rate i_m, inflation π, and the output gap y, for each of the eight central banks in the sample.

A.2.1 Quarterly data

Policy Rate (end of quarter values, in percent)
RBA: Cash rate target, end of the month (www.rba.gov.au)
ECB: Eonia, end of the month, 1994-1998; monthly averages, 1999-2002 (www.ecb.int)
BoJ: Uncollateralized overnight call rates, end of month (www.boj.or.jp)
RBNZ: Overnight inter-bank cash average, end of the month (www.rbnz.govt.nz)
SRB: Repo rate since June 1994, end of the month; marginal rate before June 1994, end of the month (www.riksbank.com)
SNB: Three month libor rate, end of the month (www.snb.ch)
BoE: Repo (base) rate, end of the month (www.bankofengland.co.uk)
Fed: Federal funds rate, end of the month (www.ny.frb.org/markets/statistics/dlyrates/fedrate.html)

Short Nominal Interest Rate (average over the last month of the quarter, in percent)
RBA: Average rate on money market (IMF, International Financial Statistics)
ECB: Three-month money market rate (Datastream)
BoJ: Call money rate (IMF, International Financial Statistics)
RBNZ: Money market rate (IMF, International Financial Statistics)
SRB: Call money rate (IMF, International Financial Statistics)
SNB: Money market rate (IMF, International Financial Statistics)
BoE: Overnight Interbank rate (IMF, International Financial Statistics)
Fed: Treasury bill rate (IMF, International Financial Statistics)

Long Nominal Interest Rate (end of quarter values, in percent)
RBA: 10-year Treasury bond, last month of the quarter (www.rba.gov.au)
ECB: 10-year Government bonds, monthly first day (www.ecb.int)

BoJ: 1992Q1-1998Q3, simple yield on 10-year TSE bonds with longest remaining maturity, end of the month; for 1998Q4-2003Q4, yield on newly issued 10-year government bonds, end of the month (www.boj.or.jp)
RBNZ: 10-year secondary market government bond yield, last day of the month (www.rbnz.govt.nz)
SRB: 10-year government bond yield, monthly average (www.riksbank.se)
SNB: CHF Obligationen der Eidgenossenschaft, last day of the month (www.snb.che)
BoE: Nominal 10-year yield on British government securities, end of the month (www.bankofengland.co.uk)
Fed: 10-year yield on treasury securities, last day of the month (www.ny.frb.org/markets/statistics/dlyrates/fedrate.html)

Medium Nominal Interest Rate (end of quarter values, in percent; utilized as instrument)
RBA: 3-year Treasury bond yield, last month of the quarter (IMF, International Financial Statistics)
RBNZ: 2-year secondary market government bond yield, last day of the month (www.rbnz.govt.nz)
BoE: short-term government bond yield, last month of the quarter (IMF, International Financial Statistics)
Fed: 3-year government bond yield, last month of the quarter (IMF, International Financial Statistics)

Inflation (annual inflation based on quarterly data)
Inflation is computed using the Consumer Price Index (IMF, International Financial Statistics), except for the ECB for which the HICP is used (Eurostat). To be precise: $\pi_t = (CPI_t/CPI_{t-4} - 1) \times 100$, using quarterly data.

Output Gap (based on quarterly GDP data)
The output gap is computed using quarterly data for Gross Domestic Product (OECD). To be precise: $y = (GDP/HPtrend - 1) \times 100$, where $HPtrend$ is the trend based on the Hodrick-Prescott filter, calculated with GDP data for the period 1960-2004 (using E-views).

A.2.2 Monthly data

The interest rate data is the same as the data used in the quarterly regressions. However, the output gap data are different as the quarterly GDP data are replaced by monthly production data for the central banks for which this information is available (ECB, BoJ, SRB, BoE and Fed).

Inflation (annual inflation based on monthly data)
Inflation is computed using the Consumer Price Index (IMF, International Financial Statistics), except for the ECB for which the HICP is used (Eurostat). To be precise: $\pi_t = (CPI_t/CPI_{t-12} - 1) \times 100$.

Output Gap (based on monthly production data)
The output gap is computed using monthly (seasonally adjusted) production data (IMF, International Financial Statistics), except for the ECB for which Eurostat data is used. To be precise:
$y = (production/HPtrend - 1) \times 100$, where $HPtrend$ is the trend based on the Hodrick-Prescott filter, calculated with production data for the period 1960-2004 (using E-views), except for the ECB for which production data was only available from 1985-2004.

Table 1: European Central Bank

	backward-looking								forward-looking			
	i_p (1)		i_s (2)		i_l (3)		i_p (4)		i_s (5)		i_l (6)	
i_{-1}	0.51	[0.00]	0.81	[0.00]	0.95	[0.00]	0.45	[0.00]				
y_{-1}	0.42	[0.00]	0.27	[0.05]								
y_{-2}							0.53	[0.00]				
y_{-4}							-0.64	[0.00]				
y_{-5}	-0.54	[0.00]	-0.21	[0.00]								
π_{-1}							-0.39	[0.06]				
π_{-3}	0.47	[0.00]										
π_{-4}	0.44	[0.03]					0.63	[0.02]				
π_{-5}			0.34	[0.08]								
y											-1.20	[0.00]
y_{+4}									-1.01	[0.00]	-1.69	[0.02]
π							0.62	[0.00]	0.75	[0.01]		
π_{+4}							0.33	[0.13]	1.18	[0.00]	3.32	[0.00]
π_{+8}									0.75	[0.00]		
$d_{12/00}$: econ.	-0.21	[0.44]	-0.40	[0.15]	**-0.31**	[0.07]	-0.02	[0.94]	-0.60	[0.14]	-0.51	[0.64]
$d_{11/01}$: policy	**-0.45**	[0.08]	-0.16	[0.58]	-0.03	[0.88]	**-0.57**	[0.05]	**-1.85**	[0.00]	**-2.81**	[0.00]
EMU	**0.49**	[0.00]	**0.36**	[0.01]	**0.48**	[0.00]	-0.04	[0.89]	-0.64	[0.14]	0.28	[0.83]
Wald	**17.38**	[0.00]	**6.84**	[0.08]	**19.66**	[0.00]	4.66	[0.20]	**160.1**	[0.00]	**28.15**	[0.00]
AR	1.37	[0.28]	0.51	[0.73]	1.16	[0.35]	2.30	[0.10]	1.77	[0.16]	1.00	[0.43]
ARCH	0.72	[0.59]	0.69	[0.60]	0.90	[0.48]	0.21	[0.93]	0.43	[0.79]	0.62	[0.65]
hetero	0.23	[0.99]	0.57	[0.83]	0.29	[0.92]	16.60	[0.48]	13.91	[0.24]	2.00	[0.11]
normality	0.85	[0.65]	1.77	[0.41]	0.48	[0.79]	0.37	[0.83]	2.64	[0.27]	1.97	[0.37]
Sargan							15.71	[0.15]	20.32	[0.32]	14.36	[0.50]
s.e.e.	0.24		0.31		0.26		0.23		0.48		1.05	
R^2	0.95		0.97		0.96		0.95		0.93		0.42	

Note: Coefficient estimates (with p-values in brackets) in the specific model selected under the baseline settings using the backward-looking and forward-looking GUM in equations (7) and (8), respectively. Data period: 1993Q1-2002Q4 for i_s; 1995Q2-2002Q4 for i_p and i_l. The indicator variable EMU takes on the value 1 from 1999Q1. Instruments for π, π_{+4}, π_{+8}, y and y_{+4} in addition to exogenous variables in GUM: $\sum_{t=-5}^{t=-1} i_{l,t}$ in (4); $\sum_{t=-8}^{t=-6} \pi_t$, $\sum_{t=-8}^{t=-6} y_t$, and $\sum_{t=-8}^{t=-6} i_{s,t}$ in (5); $\sum_{t=-5}^{t=-1} i_{p,t}$ in (6). Sources: Appendix A.2.1.

Table 2: Federal Reserve

	backward-looking						forward-looking					
	i_p (1)		i_s (2)		i_l (3)		i_p (4)		i_s (5)		i_l (6)	
c_0	1.08	[0.12]	1.77	[0.00]	4.47	[0.01]			0.87	[0.00]		
i_{-1}	1.19	[0.00]	0.96	[0.00]	0.62	[0.00]	0.89	[0.00]				
i_{-2}	-0.26	[0.42]										
i_{-3}	-0.12	[0.68]	-0.25	[0.01]							-0.31	[0.03]
i_{-4}	-0.27	[0.36]										
i_{-5}	0.27	[0.20]			-0.39	[0.03]					-0.98	[0.00]
y_{-1}	0.25	[0.12]	0.19	[0.10]								
y_{-2}	0.10	[0.62]									0.58	[0.05]
y_{-3}	-0.27	[0.15]							-0.21	[0.03]	0.60	[0.02]
y_{-4}	0.04	[0.82]					-0.37	[0.00]				
y_{-5}											-1.10	[0.00]
π_{-1}											-1.59	[0.03]
π_{-2}											1.20	[0.01]
π_{-3}	0.26	[0.30]			0.53	[0.02]						
π_{-4}	0.06	[0.86]									2.98	[0.00]
π_{-5}	-0.47	[0.09]	-0.26	[0.06]	-0.44	[0.04]					-0.93	[0.02]
y							0.47	[0.00]	0.38	[0.00]	-0.77	[0.02]
y_{+4}							-0.23	[0.00]			0.73	[0.00]
π											1.61	[0.00]
π_{+4}							0.22	[0.00]	0.19	[0.01]	1.30	[0.00]
$d_{02/94}$: policy	**0.50**	[0.08]	**0.42**	[0.06]	0.29	[0.33]	0.10	[0.57]	0.22	[0.29]	**2.83**	[0.00]
$d_{05/99}$: policy	**-0.53**	[0.06]	**-0.58**	[0.00]	**-0.90**	[0.01]	**-0.33**	[0.02]	**-0.38**	[0.02]	**-1.67**	[0.00]
Wald	**4.79**	[0.09]	**10.37**	[0.01]	**8.58**	[0.01]	**7.09**	[0.03]	**5.91**	[0.05]	**74.82**	[0.00]
AR	0.91	[0.48]	1.17	[0.35]	1.14	[0.36]	2.34	[0.08]	0.27	[0.89]	2.03	[0.13]
ARCH	0.35	[0.84]	0.60	[0.67]	1.41	[0.26]	0.31	[0.87]	1.52	[0.22]	0.11	[0.98]
hetero	29.98	[0.27]	13.99	[0.17]	8.26	[0.60]	1.22	[0.33]	0.93	[0.52]	29.89	[0.37]
normality	5.31	[0.07]	2.28	[0.32]	0.23	[0.89]	2.56	[0.28]	1.30	[0.52]	1.52	[0.47]
Sargan							23.69	[0.26]	21.26	[0.17]	4.65	[0.99]
s.e.e.	0.32		0.34		0.50		0.27		0.30		0.40	
R^2	0.97		0.95		0.76		0.97		0.95		0.88	

Note: Coefficient estimates (with p-values in brackets) in the specific model selected under the baseline settings using the backward-looking and forward-looking GUM in equations (7) and (8), respectively. Data period: 1993Q1-2002Q4. Instruments for π, π_{+4}, π_{+8}, y and y_{+4} in addition to exogenous variables in GUM: $\sum_{t=-8}^{t=-5} i_{p,t}$ and $\sum_{t=-8}^{t=-1} i_{l,t}$ in (4); $\sum_{t=-8}^{t=-6} i_{s,t}$ and $\sum_{t=-8}^{t=-6} \pi_t$ in (5); $\sum_{t=-8}^{t=-6} \pi_t$, $\sum_{t=-8}^{t=-6} y_t$, and $\sum_{t=-8}^{t=-1} i_{m,t}$ in (6). Sources: Appendix A.2.1.

Table 3: Summary of backward-looking results

	i_p		i_s		i_l		Flexibility	Reputation
RBA								
$d_{10/01}$: economic	**-0.94**	[0.01]	**-0.43**	[0.06]	0.46	[0.25]	+	0
ECB								
$d_{12/00}$: economic	-0.21	[0.44]	-0.40	[0.15]	**-0.31**	[0.07]	0	+
$d_{11/01}$: policy	**-0.45**	[0.08]	-0.16	[0.58]	-0.03	[0.88]	+	0
EMU	**0.49**	[0.00]	**0.36**	[0.01]	**0.48**	[0.00]	–	–
BoJ								
$d_{01/98}$: political/proc.	-0.14	[0.50]‡	0.02	[0.85]†	-0.05	[0.79]	0	0
$d_{10/00}$: economic	0.35	[0.19]‡	-0.03	[0.74]†	0.07	[0.80]	0	0
$d_{03/01}$: operational	0.00	[0.98]‡	-0.01	[0.90]†	0.18	[0.53]	0	0
RBNZ								
$d_{03/99}$: policy/oper.	-0.63	[0.18]†	-0.63	[0.18]†	0.13	[0.63]	0	0
$d_{12/00}$: policy	-0.13	[0.76]†	-0.13	[0.76]†	**-0.69**	[0.04]	0	+
SRB								
$d_{03/97}$: economic	**0.60**	[0.01]‡	**0.57**	[0.01]‡	0.30	[0.19]†	–	0
$d_{01/99}$: political	**-0.39**	[0.08]‡	**-0.38**	[0.06]‡	**0.82**	[0.02]†	+	–
$d_{10/99}$: econ/policy	0.11	[0.77]‡	0.09	[0.80]‡	-0.91	[0.13]†	0	0
$d_{03/00}$: operational	-0.13	[0.74]‡	-0.13	[0.72]‡	0.04	[0.95]†	0	0
$d_{03/02}$: proc/policy	-0.15	[0.52]‡	-0.07	[0.74]‡	**-0.60**	[0.09]†	0	+
SNB								
$d_{12/99}$: polit./econ./oper.	0.13	[0.46]	**0.38**	[0.01]	**-0.39**	[0.01]	–	+
BoE								
$d_{06/97}$: political	-0.02	[0.91]†	**1.37**	[0.00]	**-1.00**	[0.00]†	–	+
$d_{04/99}$: economic	-0.29	[0.40]†	-0.99	[0.16]	0.21	[0.68]†	0	0
$d_{08/99}$: operational	-0.21	[0.56]†	0.11	[0.88]	-0.44	[0.33]†	0	0
Fed								
$d_{02/94}$: policy	**0.50**	[0.08]	**0.42**	[0.06]	0.29	[0.33]	–	0
$d_{05/99}$: policy	**-0.53**	[0.06]	**-0.58**	[0.00]	**-0.90**	[0.01]	+	+

Note: Coefficient estimates (with p-values in brackets) for the transparency indicators $d_{MM/YY}$ in the specific model selected under the baseline settings using the backward-looking GUM in (7) for the sample period 1993Q1-2004Q4. Marked results indicate autocorrelation (‡) or only nonnormality/heteroskedasticity (†). The last two columns show whether the relation between transparency and flexibility and reputation is positive (+), negative (–) or not significant (0).

Table 4: Summary of forward-looking results

	i_p		i_s		i_l		Flexibility	Reputation
RBA								
$d_{10/01}$: economic	**-0.83**	[0.00]	**-0.54**	[0.00]	-0.25	[0.38]†	+	0
ECB								
$d_{12/00}$: economic	-0.02	[0.94]	-0.60	[0.14]	-0.51	[0.64]	0	0
$d_{11/01}$: policy	**-0.57**	[0.05]	**-1.85**	[0.00]	**-2.81**	[0.00]	+	+
EMU	-0.04	[0.89]	-0.64	[0.14]	0.28	[0.83]	0	0
BoJ								
$d_{01/98}$: political/proc.	-0.06	[0.78]	**-0.19**	[0.04]	-0.24	[0.23]	+	0
$d_{10/00}$: economic	0.32	[0.21]	-0.26	[0.14]	0.20	[0.47]	0	0
$d_{03/01}$: operational	**-0.31**	[0.09]	-0.17	[0.35]	0.11	[0.69]	+	0
RBNZ								
$d_{03/99}$: policy/oper.	-0.05	[0.92]‡	-0.05	[0.92]‡	0.33	[0.24]†	0	0
$d_{12/00}$: policy	**-2.10**	[0.00]‡	**-2.11**	[0.00]‡	-0.40	[0.16]†	+	0
SRB								
$d_{03/97}$: economic	**0.74**	[0.00]	**0.57**	[0.00]	0.19	[0.40]	–	0
$d_{01/99}$: political	**-0.75**	[0.00]	**-1.11**	[0.00]	**1.07**	[0.01]	+	–
$d_{10/99}$: econ/policy	-0.20	[0.57]	-0.02	[0.94]	0.09	[0.88]	0	0
$d_{03/00}$: operational	-0.33	[0.30]	0.13	[0.64]	-0.04	[0.95]	0	0
$d_{03/02}$: proc/policy	0.27	[0.16]	**0.48**	[0.01]	**-1.14**	[0.00]	–	+
SNB								
$d_{12/99}$: polit./econ./oper.	**-1.68**	[0.00]	**0.38**	[0.01]	**-0.50**	[0.01]	?	+
BoE								
$d_{06/97}$: political	0.16	[0.34]	**1.11**	[0.02]	**-1.34**	[0.00]†	–	+
$d_{04/99}$: economic	-0.32	[0.37]	-0.49	[0.63]	0.02	[0.97]†	0	0
$d_{08/99}$: operational	0.00	[0.99]	**1.73**	[0.04]	-0.21	[0.60]†	–	0
Fed								
$d_{02/94}$: policy	0.10	[0.57]	0.22	[0.29]	**2.83**	[0.00]	0	–
$d_{05/99}$: policy	**-0.33**	[0.02]	**-0.38**	[0.02]	**-1.67**	[0.00]	+	+

Note: Coefficient estimates (with p-values in brackets) for the transparency indicators $d_{MM/YY}$ in the specific model selected under the baseline settings using the forward-looking GUM in (8) for the sample period 1993Q1-2004Q4. Marked results indicate autocorrelation (‡) or only nonnormality/heteroskedasticity (†). The last two columns show whether the relation between transparency and flexibility and reputation is positive (+), negative (–), ambiguous (?) or not significant (0).

Table 5: Summary of backward-looking results (conservative)

	i_p		i_s		i_l		Flexibility	Reputation
RBA								
$d_{10/01}$: economic	**-0.94**	[0.01]	-0.14	[0.43]	0.03	[0.93]	+	0
ECB								
$d_{12/00}$: economic	-0.11	[0.70]	**-0.61**	[0.01]	**-0.31**	[0.07]	+	+
$d_{11/01}$: policy	-0.12	[0.59]	-0.33	[0.21]	-0.03	[0.88]	0	0
EMU	**0.38**	[0.00]	**0.48**	[0.00]	**0.48**	[0.00]	–	–
BoJ								
$d_{01/98}$: political/proc.	-0.04	[0.84]†	0.02	[0.85]†	-0.07	[0.74]†	0	0
$d_{10/00}$: economic	0.03	[0.89]†	-0.03	[0.74]†	0.10	[0.73]†	0	0
$d_{03/01}$: operational	0.02	[0.92]†	-0.01	[0.90]†	0.27	[0.38]†	0	0
RBNZ								
$d_{03/99}$: policy/oper.	-0.63	[0.18]†	-0.63	[0.18]†	0.31	[0.22]	0	0
$d_{12/00}$: policy	-0.13	[0.76]†	-0.13	[0.76]†	-0.25	[0.41]	0	0
SRB								
$d_{03/97}$: economic	**0.75**	[0.00]	**0.41**	[0.01]‡	0.30	[0.19]†	–	0
$d_{01/99}$: political	-0.31	[0.18]	-0.25	[0.26]‡	**0.82**	[0.02]†	0	–
$d_{10/99}$: econ/policy	0.18	[0.65]	0.17	[0.65]‡	-0.91	[0.13]†	0	0
$d_{03/00}$: operational	-0.49	[0.22]	-0.20	[0.57]‡	0.04	[0.95]†	0	0
$d_{03/02}$: proc/policy	-0.33	[0.18]	-0.04	[0.84]‡	**-0.60**	[0.09]†	0	+
SNB								
$d_{12/99}$: polit./econ./oper.	0.06	[0.65]	**0.35**	[0.02]	**-0.39**	[0.01]	–	+
BoE								
$d_{06/97}$: political	0.00	[1.00]†	**1.37**	[0.00]	**-1.07**	[0.00]†	–	+
$d_{04/99}$: economic	-0.25	[0.48]†	-0.99	[0.16]	0.52	[0.28]†	0	0
$d_{08/99}$: operational	-0.31	[0.38]†	0.11	[0.88]	-0.52	[0.25]†	0	0
Fed								
$d_{02/94}$: policy	**0.50**	[0.08]	**0.42**	[0.06]	0.33	[0.25]	–	0
$d_{05/99}$: policy	**-0.53**	[0.06]	**-0.58**	[0.00]	-0.12	[0.52]	+	0

Note: Coefficient estimates (with p-values in brackets) for the transparency indicators $d_{MM/YY}$ in the specific model selected under the 'conservative' settings using the backward-looking GUM in (7) for the sample period 1993Q1-2004Q4. Marked results indicate autocorrelation (‡) or only nonnormality/heteroskedasticity (†). The last two columns show whether the relation between transparency and flexibility and reputation is positive (+), negative (–) or not significant (0).

Table 6: Summary of backward-looking results (non-forced)

	i_p		i_s		i_l		Flexibility	Reputation
RBA								
$d_{10/01}$: economic	**-0.94**	[0.01]	**-0.43**	[0.06]	-		+	0
ECB								
$d_{12/00}$: economic	-		-		-		0	0
$d_{11/01}$: policy	-		-		**-0.26**	[0.08]	0	+
EMU	**0.35**	[0.00]	**0.31**	[0.00]	**0.52**	[0.00]	–	–
BoJ								
$d_{01/98}$: political/proc.	-	†	-	†	-		0	0
$d_{10/00}$: economic	-	†	-	†	-		0	0
$d_{03/01}$: operational	-	†	-	†	-		0	0
RBNZ								
$d_{03/99}$: policy/oper.	-		-		-	‡	0	0
$d_{12/00}$: policy	-		-		**-0.58**	[0.02]‡	0	+
SRB								
$d_{03/97}$: economic	**0.54**	[0.00]	**0.53**	[0.00]‡	-		–	0
$d_{01/99}$: political	**-0.38**	[0.04]	**-0.38**	[0.02]‡	**0.58**	[0.00]	+	–
$d_{10/99}$: econ/policy	-		-	‡	-		0	0
$d_{03/00}$: operational	-		-	‡	-		0	0
$d_{03/02}$: proc/policy	-		-	‡	**-0.64**	[0.05]	0	+
SNB								
$d_{12/99}$: polit./econ./oper.	-		**0.38**	[0.01]	**-0.39**	[0.01]	–	+
BoE								
$d_{06/97}$: political	-	‡	**1.37**	[0.00]	**-1.15**	[0.00]	–	+
$d_{04/99}$: economic	-	‡	**-0.90**	[0.03]	-		+	0
$d_{08/99}$: operational	**-0.49**	[0.01]‡	-		-		+	0
Fed								
$d_{02/94}$: policy	**0.50**	[0.08]	**0.42**	[0.06]	-		–	0
$d_{05/99}$: policy	**-0.53**	[0.06]	**-0.58**	[0.00]	**-0.84**	[0.01]	+	+

Note: Coefficient estimates (with p-values in brackets) for the transparency indicators $d_{MM/YY}$ in the specific model selected under the 'non-forced' settings using the backward-looking GUM in (7) for the sample period 1993Q1-2004Q4. Marked results indicate autocorrelation (‡) or only nonnormality/heteroskedasticity (†). The last two columns show whether the relation between transparency and flexibility and reputation is positive (+), negative (–) or not significant (0).

Table 7: Summary of forward-looking results (conservative)

	i_p		i_s		i_l		Flexibility	Reputation
RBA								
$d_{10/01}$: economic	**-0.83**	[0.00]	**-0.40**	[0.02]	0.03	[0.93]	+	0
ECB								
$d_{12/00}$: economic	0.41	[0.33]	-0.60	[0.14]	-1.61	[0.18]†	0	0
$d_{11/01}$: policy	**-2.03**	[0.00]	**-1.85**	[0.00]	**-1.79**	[0.06]†	+	+
EMU	-0.59	[0.30]	-0.64	[0.14]	-0.50	[0.75]†	0	0
BoJ								
$d_{01/98}$: political/proc.	-0.22	[0.36]†	-0.05	[0.67]†	-0.24	[0.23]	0	0
$d_{10/00}$: economic	-0.30	[0.40]†	0.12	[0.37]†	0.20	[0.47]	0	0
$d_{03/01}$: operational	**0.35**	[0.08]†	-0.01	[0.87]†	0.11	[0.69]	–	0
RBNZ								
$d_{03/99}$: policy/oper.	-0.05	[0.92]‡	-0.05	[0.92]‡	0.31	[0.22]	0	0
$d_{12/00}$: policy	**-2.10**	[0.00]‡	**-2.11**	[0.00]‡	-0.25	[0.41]	+	0
SRB								
$d_{03/97}$: economic	**0.61**	[0.00]	**0.55**	[0.00]	-0.37	[0.42]	–	0
$d_{01/99}$: political	0.44	[0.12]	**-1.05**	[0.00]	0.62	[0.25]	+	0
$d_{10/99}$: econ/policy	-0.03	[0.94]	-0.01	[0.97]	-0.32	[0.65]	0	0
$d_{03/00}$: operational	-0.52	[0.18]	0.10	[0.74]	0.02	[0.98]	0	0
$d_{03/02}$: proc/policy	**-0.45**	[0.09]	**0.46**	[0.01]	**-0.76**	[0.09]	?	+
SNB								
$d_{12/99}$: polit./econ./oper.	**-1.68**	[0.00]	**0.35**	[0.01]	0.01	[0.95]	?	0
BoE								
$d_{06/97}$: political	**0.29**	[0.06]‡	**0.51**	[0.10]	**-1.34**	[0.00]†	–	+
$d_{04/99}$: economic	-0.32	[0.39]‡	-0.56	[0.45]	0.02	[0.97]†	0	0
$d_{08/99}$: operational	-0.24	[0.48]‡	0.51	[0.47]	-0.21	[0.60]†	0	0
Fed								
$d_{02/94}$: policy	0.10	[0.57]	0.08	[0.74]	**1.69**	[0.00]	0	–
$d_{05/99}$: policy	**-0.33**	[0.02]	-0.17	[0.27]	-0.40	[0.14]	+	0

Note: Coefficient estimates (with p-values in brackets) for the transparency indicators $d_{MM/YY}$ in the specific model selected under the 'conservative' settings using the forward-looking GUM in (8) for the sample period 1993Q1-2004Q4. Marked results indicate autocorrelation (‡) or only nonnormality/heteroskedasticity (†). The last two columns show whether the relation between transparency and flexibility and reputation is positive (+), negative (–), ambiguous (?) or not significant (0).

Table 8: Summary of forward-looking results (non-forced)

	i_p		i_s		i_l		Flexibility	Reputation
RBA								
$d_{10/01}$: economic	**-0.95**	[0.01]	**-0.54**	[0.00]	-	†	+	0
ECB								
$d_{12/00}$: economic	-		-	†	-		0	0
$d_{11/01}$: policy	-		-	†	-		0	0
EMU	-		-	†	-		0	0
BoJ								
$d_{01/98}$: political/proc.	**-0.46**	[0.04]‡	-	†	**-0.34**	[0.05]†	+	+
$d_{10/00}$: economic	-	‡	-	†	-	†	0	0
$d_{03/01}$: operational	0.35	[0.13]‡	-	†	-	†	0	0
RBNZ								
$d_{03/99}$: policy/oper.	-	†	-	†	-		0	0
$d_{12/00}$: policy	-	†	-	†	**0.54**	[0.03]	0	–
SRB								
$d_{03/97}$: economic	**0.47**	[0.00]	**0.57**	[0.00]	-	†	–	0
$d_{01/99}$: political	-		**-1.03**	[0.00]	-	†	+	0
$d_{10/99}$: econ/policy	-		-		-	†	0	0
$d_{03/00}$: operational	-		-		-	†	0	0
$d_{03/02}$: proc/policy	-		**0.48**	[0.01]	-	†	–	0
SNB								
$d_{12/99}$: polit./econ./oper.	**-1.23**	[0.00]	**-1.67**	[0.00]	-		+	0
BoE								
$d_{06/97}$: political	-		**0.61**	[0.01]	**-2.18**	[0.00]	–	+
$d_{04/99}$: economic	-		-		-		0	0
$d_{08/99}$: operational	-		-		-		0	0
Fed								
$d_{02/94}$: policy	-		-		**1.78**	[0.00]	0	–
$d_{05/99}$: policy	-		-		**-1.30**	[0.00]	0	+

Note: Coefficient estimates (with p-values in brackets) for the transparency indicators $d_{MM/YY}$ in the specific model selected under the 'non-forced' settings using the forward-looking GUM in (8) for the sample period 1993Q1-2004Q4. Marked results indicate autocorrelation (‡) or only nonnormality/heteroskedasticity (†). The last two columns show whether the relation between transparency and flexibility and reputation is positive (+), negative (–) or not significant (0).