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**Working Paper**

## Managing financial market expectations: The role of central bank transparency and central bank communication

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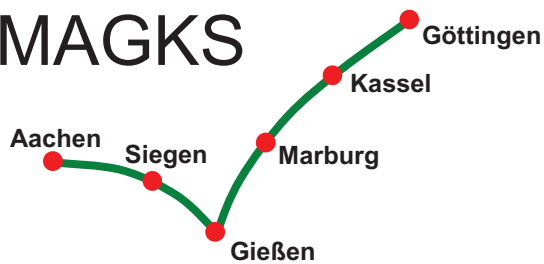
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# **Managing Financial Market Expectations: The Role of Central Bank Transparency and Central Bank Communication**

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# **Managing Financial Market Expectations: The Role of Central Bank Transparency and Central Bank Communication**

## **Abstract**

In this paper, we study the influence of central bank transparency and informal central bank communication on the money market adjustment process between two interest rate decisions. The sample covers nine major central banks for the period from January 1999 to July 2007. We find, first, that both transparency and communication facilitate understanding upcoming interest rate decisions. Second, transparency, as measured by various subcategories of the Eijffinger and Geraats (2006) index, leads to better anticipation of monetary policy. Provision of information on (unanticipated) macroeconomic disturbances and explicit prioritization of central bank objectives are the most important of these subcategories. Finally, there is no unique optimal design for central banks as (i) a very high degree of transparency, (ii) frequent communication on an informal basis, (iii) gradualism in target rate changes, or (iv) a high frequency of interest rate decisions all contribute to sound understanding regarding future interest rate decisions.

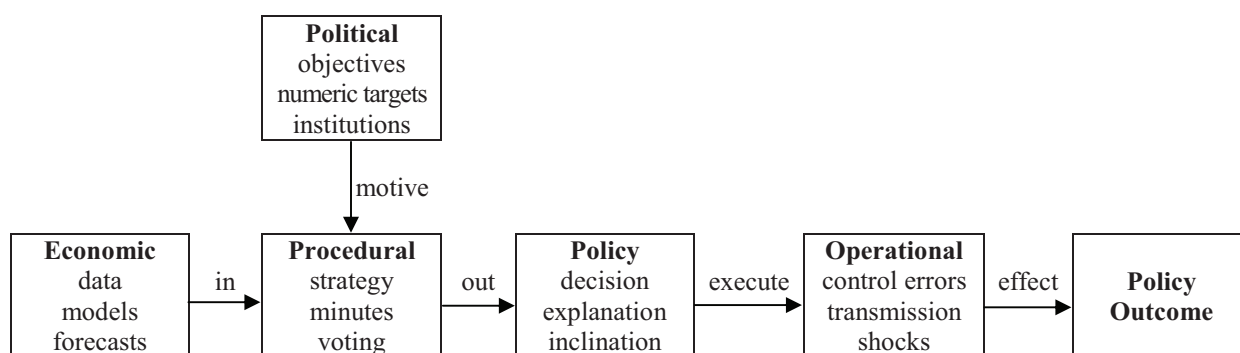
JEL: E52, E58

Keywords: Central Bank Communication, Central Bank Transparency, Financial Market Expectations, Interest Rate Decision, Monetary Policy, Money Market

## 1. Introduction

Since the 1990s, central banks across the world have made huge efforts to increase their transparency. Central bank objectives and goals have been specified and quantified, macroeconomic forecasts are published, interest rate decisions are announced and explained immediately, and some central banks provide indications of the likely course of monetary policy in the near future.<sup>1</sup> Geraats (2002) provides a theoretical framework to explain the rationale for increasing central bank transparency and the effects of different types of transparency. She differentiates between five types of transparency (see Figure 1). Political, economic, and operational transparency are factors that could enhance the credibility of a low inflation monetary policy. Procedural transparency is an obvious determinant of the quality of decision-making, and policy transparency can boost the effectiveness of interest rate setting.

Figure 1: Theoretical Framework for Central Bank Transparency



Source: Geraats (2002, F 541).

The empirical literature mostly finds beneficial effects of transparency. Van der Crujsen and Eijffinger (2010) review the literature and conclude that transparency (1) improves consensus across forecasters, (2) lowers the level of inflation and anchors inflation expectations, (3) improves the credibility, reputation, and flexibility of central banks, (4) has no obvious influence on output and output variability, and (5) improves policy anticipation.<sup>2</sup> The objective of this paper is related to the last point, ‘policy anticipation’. We examine the impact of transparency on the course of short-term interest rates between two intermeeting periods. In this context, one question is of particular interest: Does transparency increase the smoothness of the adjustment process from the old target rate to the (currently, mostly

<sup>1</sup> These inclinations can be provided via a qualitative statement, e.g., as given by the European Central Bank and the Federal Reserve after every interest rate decision, or be even more sophisticated, e.g., as by the repo rate charts provided by the Sveriges Riksbank. The latter provide an explicit figure for the future repo rate over the next years in reference to different macroeconomic conditions.

<sup>2</sup> A more detailed and stylised overview of the empirical results can be found in van der Crujsen (2008, 30).

expected) new target rate? A smooth transition implies lower adjustment costs for market participants and thus enhances an efficient implementation of monetary policy.

In the literature, the effectiveness of central banking in this context is measured by focussing on decision anticipation only, i.e., whether or not the actual interest rate decision was anticipated by financial markets. For example, Coppel and Connolly (2003) find that the extent to which market participants anticipate changes in the policy rate has gradually risen since the late 1980s, as has the speed of reaction to interest rate announcements. The results are quite similar across the countries in their sample (Australia, Canada, the Euro area (Germany), Japan, New Zealand, Sweden, the United Kingdom, and the United States). Thus, it is difficult to discover the specific contribution of a certain transparency type or to isolate any specific preferred model of monetary policy transparency. In a more recent paper, Andersson and Hoffmann (2009) compare the performances of the forward guidance strategies adopted by the Reserve Bank of New Zealand, the Norges Bank, and the Riksbank. They find evidence that all three central banks have been highly predictable in their monetary policy decisions, regardless of whether forward guidance involved publication of an own interest rate path.

Many papers focus on the predictability of the Federal Reserve's interest rate setting. Demiralp (2001) documents that most market rates adjust to anticipated policy actions prior to the actual announcement. Rafferty and Tomljanovich (2002) find that forecasting error has decreased since 1994 for interest rates on US bonds for most maturity lengths. Lange et al. (2003) obtain similar results and identify two components of the enhanced predictability: gradualism in adjusting the Federal Funds interest rate target (i.e., autoregressive interest rate setting) as well as transparency regarding setting the target and future policy intentions. Finally, Swanson (2006) shows that since the late 1980s, US financial markets and private-sector forecasters have become less surprised by Federal Reserve announcements.

Lildholdt and Wetherilt (2004) show that the Bank of England's predictability improved over the period 1975–2003, most markedly after introduction of inflation targeting in 1992. They posit that this enhanced predictability is due to greater transparency in the monetary policy process, together with greater credibility of the Bank of England. Finally, the Bank of Canada's efforts to increase its transparency also has helped market participants to anticipate pending monetary policy actions (Muller and Zelmer, 1999).

However, most of the literature on this top shares three shortcomings. First, different transparency regimes are often measured in a rough way by splitting the time series into two or more subsamples. Yet, changes in transparency are made gradually over a longer horizon.

Thus, splitting the observations into two or three subsamples fails to capture the effects of incremental change in monetary policy transparency. All central banks examined in this paper (Reserve Bank of Australia (RBA), Bank of Canada (BOC), European Central Bank (ECB), Bank of Japan (BOJ), Reserve Bank of New Zealand (RBNZ), Sveriges Riksbank (Riksbank), Swiss National Bank (SNB), Bank of England (BOE), and Federal Reserve Bank (Fed)) have increased their transparency at least once in the past 15 years. To overcome this shortcoming, we provide *a continuous test of the effects of transparency* on the smoothness of the adjustment process between two interest rate decisions. We employ the transparency index by Eijffinger and Geraats (2006) (and its subcomponents) as an explanatory variable in our econometric setup and use one time series for each country instead of comparing several subsamples.

Second, judging the success of monetary policy outcome by employing a surprise measure, as is done in most of the relevant literature, is not a good reflection of what central banks actually do. Central banks attempt to manage financial market expectations over at least the period between two interest rate decisions and usually over an even longer horizon. Thus, a measure like Equation (1), which is commonly used in the literature, fails to capture the entire adjustment process in the markets.

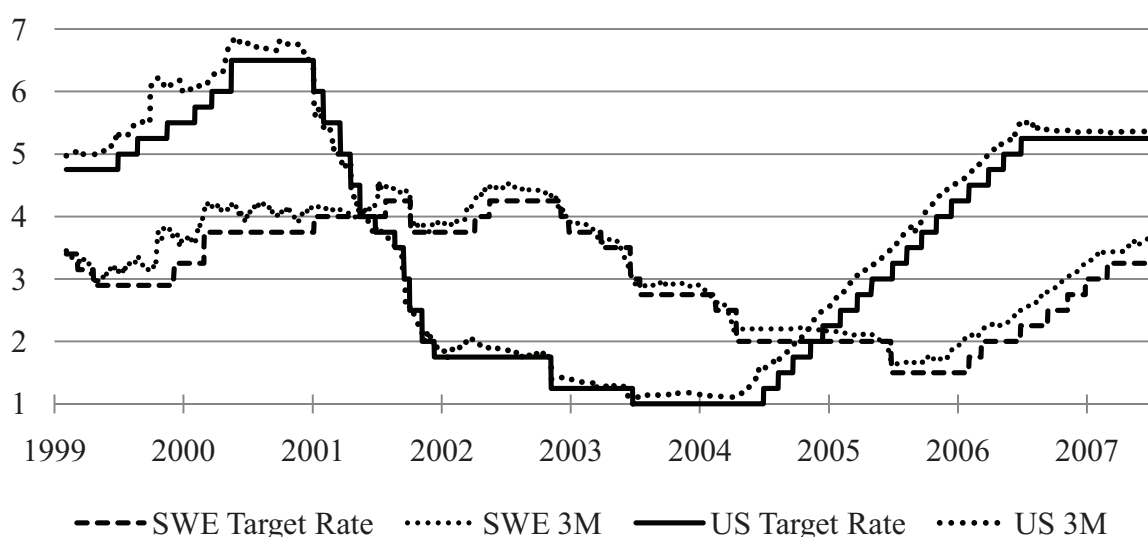
$$(1)\Delta(\text{interest rate})_t = \alpha + \beta\Delta(\text{target rate})_t + \gamma(\text{control variables})_t + \varepsilon_t,$$

where the change in a short-term interest rate is explained by the change in the target rate. If the interest rate does not change significantly after target rate adjustments, monetary policy was correctly anticipated by the markets. Thus, another contribution this paper makes to the literature is that we employ an *indicator that incorporates the behaviour of short-term interest rates over the entire intermeeting period*. We ensure that the success of central banking is measured not only by financial market reaction on interest rate decision days; our indicator also measures *the smoothness of the adjustment process in the run-up to the (expected) decision*.

Third, focussing on central bank transparency only could be misleading. For example, the Fed has had a transparency index of 10 ever since 1999, whereas the Riksbank increased its transparency from 9.5 in 1999 to 15 in 2006 (Table A1 in the Appendix shows the index for our sample period). Figure 2 shows the Federal Funds target rate, the Riksbank's repo rate, and the US and Swedish three-month money market rates. Both countries' money market rates seem to follow the target rate very closely, particularly since 2001. Apparently, the Fed does not pre-commit itself in terms of formal rules, such as a prioritisation of its objectives or

a quantification of the latter. However, the Fed frequently uses informal communication (e.g., speeches by its officials) as a means of indicating its views of the economy and the likely future course of monetary policy.<sup>3</sup> Informal speeches are not included in the transparency index and thus it is of interest to discover whether and, if so, to what extent this type of communication plays a role in addition to central bank transparency. For every major central bank there is at least one study showing that communications other than postmeeting statements or monetary policy reports (both of which are captured by the transparency index) exert an influence on financial markets.<sup>4</sup> To explore the impact of communication in this context, we include *a measure of informal central bank communication* in our analysis.

Figure 2: Target Rates and Short-Term Interest Rates for Sweden and the United States



Sources: Riksbank, Fed, and British Bankers Association.

Our survey starts in January 1999 with the inception of the ECB and ends in July 2007. Since the beginning of the recent financial crisis, money market rates have no longer aligned with the respective country's target rate and, therefore, are no longer an appropriate indicator for the effectiveness of monetary policy. We focus on nine countries in this survey: Australia (AUS), Canada (CAN), the Euro area (EMU), Japan (JAP), New Zealand (NZ), Sweden (SWE), Switzerland (SUI), the United Kingdom (UK), and the United States (US). Econometrically, we employ country-specific OLS models and a pooled OLS model to assess

<sup>3</sup> From 1999 to 2007, Board of Governors' members spoke to the public 648 times; Riksbank's officials delivered 291 speeches during that period.

<sup>4</sup> For instance, see Guthrie and Wright (2000) for the RBNZ, Andersson et al. (2006) for the Riksbank, Connolly and Kohler (2004) for six central banks (RBA, BOC, ECB, RBNZ, BOE, and the Fed), Ehrmann and Fratzscher (2007) for the BOE, ECB, and the Fed, Hayo and Neuenkirch (2010) for the BOC, and Ranaldo and Rossi (2010) for the SNB.

the following research questions: (1) *Does transparency ensure monetary policy effectiveness in terms of a smooth adjustment of money market rates?* (2) *Is transparency the only factor enhancing effectiveness or can central banks use frequent informal communication with the public as a substitute for transparency?* As an endogenous variable, we employ a newly constructed indicator that measures the adjustment process over the entire intermeeting period.

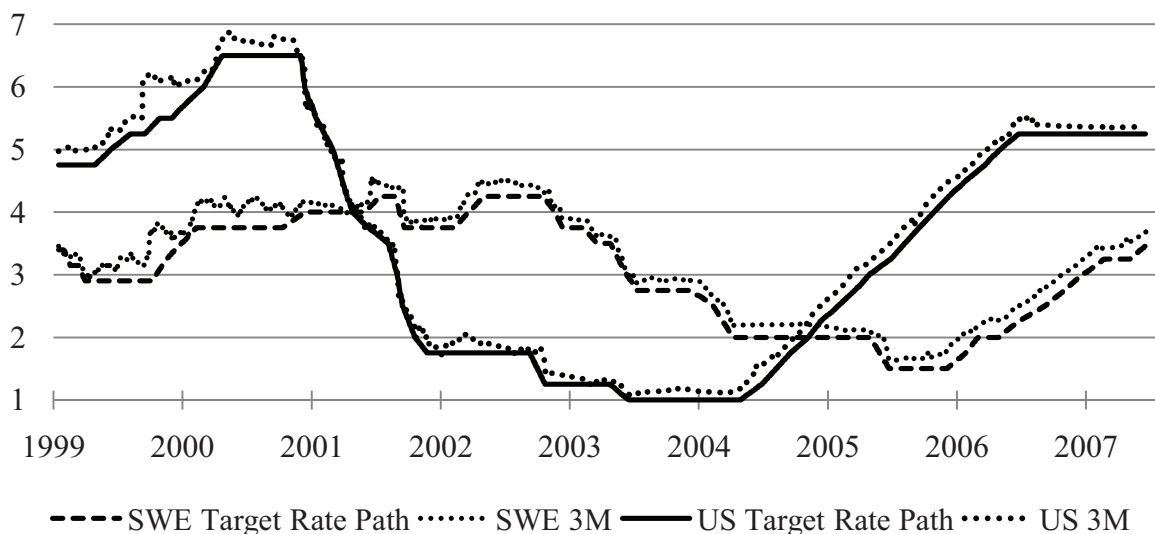
The remainder of this paper is organised as follows. Section 2 introduces the data set and explains our econometric methodology. Section 3 presents the country-specific results for the influence of transparency and communication on the adjustment process between two interest rate decisions. Section 4 shows the corresponding pooled-model results. Section 5 concludes.

## 2. Data and Econometric Methodology

### Smoothness Indicator

As the dependent variable, we employ a newly constructed measure that incorporates the course of short-term interest rates during the entire intermeeting period. Figure 2 shows that markets adjust gradually in the run-up to the next interest rate decision. Money market rates follow an almost linear adjustment process from the old target rate to the new one during every intermeeting period. In Figure 3, we replace the discrete target rate steps with a linear adjustment path between two interest rate decisions.

Figure 3: Target Rate ‘Paths’ and Short-Term Interest Rate for Sweden and the United States



Sources: Riksbank, Fed, British Bankers Association, and own calculations.

Thus, we interpolate hypothetical target rates between two interest rate meetings by the following linear adjustment process.

$$(2) \text{ target rate}_t^* = \text{target rate}_{last} + m/n (\text{target rate}_{next} - \text{target rate}_{last}),$$

where the hypothetical target rate is calculated as sum of the last target rate and the gradual adjustment component. The latter is computed by apportioning the actual interest rate step over the entire intermeeting period (length  $n$ ) and multiplying this apportionment factor by the number of days since the last rate decision ( $m$ ). That is, when the target rate is left unchanged, the hypothetical line coincides with the old target rate. In contrast, when the target rate will be changed in, say, twenty business days, one-twentieth of the upcoming change is added every day until the actual decision. Of course, this linear adjustment process is not a perfect reflection of actual money market behaviour, but it does serve as a useful benchmark as it depicts the least volatile adjustment between two interest rate periods.<sup>5</sup>

In this paper, we examine how closely the money markets follow this adjustment line and inquire into which factors explain this behaviour. We utilise an indicator that measures the difference between the actual money market rate and the adjustment line. However, central banks have different intermeeting periods and Figure 3 shows that there are ‘time-varying risk premia’ in the money markets. To normalise the indicator for the intermeeting period length, we calculate the standard deviation of the spreads between the money market rate and the target rate for all intermeeting periods. We thus directly control for the length of time between two interest rate decisions and are also able to incorporate a time-varying risk premium (which is constant for every intermeeting period).

$$(3) \text{ smoothness}_k = \left[ 1/n \sum_{t=1}^n (\text{money market rate}_t - \text{target rate}_t^*)^2 \right]_k,$$

where  $n$  is the length of the  $k^{\text{th}}$  intermeeting period.<sup>6</sup> This composition of the indicator ensures that abrupt and huge changes in money market rates (e.g., caused by interest rate surprises) are penalised by the indicator, whereas a smooth and gradual adjustment will result in a particularly low number.

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<sup>5</sup> As part of our robustness tests, other adjustment processes (e.g., concave and convex adjustment functions) are employed to create the target rate path. The results are very similar to those presented in Sections 3 and 4. To conserve space, we present only the results based on the most basic and intuitive adjustment process (e.g., the linear one) in this paper. Other results are available on request.

<sup>6</sup> Table A2 in the Appendix sets forth descriptive statistics for the smoothness indicator.

### Transparency Index

In a next step, we need to parameterise central bank transparency. The index from Eijffinger and Geraats (2006), which was updated by Siklos (2010), is commonly used for this purpose.<sup>7</sup> This index captures all categories in the theoretical framework by Geraats (2002) and is available as a yearly time series covering our sample period. For each category (political, economic, procedural, policy, and operational transparency), three questions address different aspects of transparency (a short excerpt of the Eijffinger and Geraats (2006) questionnaire can be found in the Appendix). The index is available for every question and the total index is created as a sum of scores for the 15 questions.

Each of the index's five subcategories could have a positive impact on the smoothness of the adjustment process, i.e., could cause a decline in the smoothness indicator. *Political transparency* allows market participants to know the central bank's policy objectives. This sort of transparency makes explicit the priority of multiple goals or sometimes quantifies a primary objective. *Economic transparency* refers to the economic information upon which monetary policy is based, such as economic data, forecasts, or the central bank's economic model. Thus, market participants are able to learn about the central bank's view of the economy. *Procedural transparency* involves an explicit monetary policy rule or strategy, an account of policy deliberations, and how the policy decision was reached. *Policy transparency* aims to provide prompt disclosure (and explanation) of policy decisions and an explicit inclination of likely future policy actions. *Operational transparency* involves a discussion of control errors in achieving operating targets and (unanticipated) macroeconomic disturbances. In addition to employing the overall index as an explanatory variable, we also take advantage of the subindices and individual questions to discover which transparency factors are particularly important.

### Central Bank Communication

In our analysis, we evaluate the impact of informal central bank communication on the smoothness of the money market adjustment process. Some central banks communicate often with the public (e.g., the ECB and the Fed), while others (e.g., RBA, BOC, or RBNZ) engage in informal communication much less frequently.<sup>8</sup> It could be argued that inflation-targeting countries do not need to communicate as frequently as, e.g., the United States, as their

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<sup>7</sup> Dincer and Eichengreen (2009) use the same questionnaire as Eijffinger and Geraats (2006). There are other indices as well, e.g., Crowe and Meade (2008) who use the data of Fry et al. (2000). However, these indices are not available as a time series covering the sample period covered by this paper.

<sup>8</sup> Table A3 in the Appendix shows the number of speeches delivered by central bank governors during our sample period.

primary objective is explicitly quantified. However, even inflation-targeting countries need to enhance and maintain credibility. Furthermore, they have some room for discretion in their interest rate setting as they mostly bound to an inflation band and not to a single figure. They can also be hit by unexpected macroeconomic disturbances and will need to communicate that they are aware of the disturbances and explain how they are going to deal with them.<sup>9</sup> However, every speech can contain valuable information for financial market agents no matter what the occasion for the speech. The audience has the opportunity to ask questions of particular interest, e.g., about the future course of monetary policy or the economic outlook. Thus, every informal speech should be considered as a potential source of information. Central banks can choose the number of speeches and their timing and thus speeches can be employed by them as an additional and less formalised communication tool.

Several papers show that communication often has a horizon beyond the next meeting (e.g., Ehrmann and Fratzscher, 2007, who examine the ECB, BOE, and the Fed; Neuenkirch, 2009, who addresses the BOC and the Fed). Thus, communication during a given intermeeting period may not be an appropriate measure for the upcoming interest rate decision. Furthermore, there is some seasonality in communication as during the summer and at the beginning and end of the year there is notably less communication. Preliminary tests confirm the intuition that communication in a particular intermeeting period is not a good indicator<sup>10</sup> and reveal results in favour of an annual communication measure. Therefore, we use the latter in our analysis and employ the natural logarithm of speeches delivered during a particular year to facilitate comparison between different countries.

### Money Market Data

As financial market data, we employ daily three-month<sup>11</sup> money market rates over the period January 1999–July 2007.<sup>12</sup> For Canada, the sample starts in December 2000 with the introduction of fixed announcement dates for interest rate decisions. The RBNZ introduced the official cash rate as its operating instrument in March 1999. The SNB introduced a three-month LIBOR band as the target zone in January 2000. Thus, the SUI sample starts at this

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<sup>9</sup> One could also attribute the larger number of speeches in the United States and the EMU to the countries' size. However, normalising the communication indicator for country size does not change the results.

<sup>10</sup> As part of the robustness test, communication over the last two (three) intermeeting periods was employed as explanatory variable. Results are available on request.

<sup>11</sup> We also created a smoothness indicator for one-month money market rates. The results are similar to those for three-month returns, but the significance is more pronounced in the case of the latter. Results are available on request.

<sup>12</sup> For AUS, CAN, EMU, JAP, SUI, UK, and US, we use three-month LIBOR rates obtained from the British Bankers Association. Money market rates for NZ and SWE are taken from the respective central bank websites.

point and we employ the midpoint of the band as the reference value for the hypothetical target rate.

In September/October 1999, all money market rates series are characterised by a hump (see also Figures 2 and 3) that cannot be explained by the central bank's interest rate setting or the uncertainty surrounding the future course of monetary policy. In fact, this hump can be attributed to market perception of the so-called millennium problem (e.g., ECB, 1999) as market participants required a premium for the availability of funds at the turn of the year. To ensure that this event does not influence the results, we assign an impulse dummy for the intermeeting period covering that event.<sup>13</sup>

### Empirical Methodology

Our econometric setup, first, consists of an OLS model<sup>14</sup> for each country to analyse the influence of country-specific differences in central bank transparency and communication. The general specification is as follows:

(4)  $smoothness_k$

$$= \alpha + \beta smoothness_{k-1} + \gamma interest\ rate\ smoothing_k \\ + \delta transparency_k + \eta communication_k + \lambda dummy\ Sep/Oct\ 1999 + \varepsilon_k,$$

where  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ ,  $\eta$ , and  $\lambda$  are parameters and  $\varepsilon$  is an i.i.d. error term.<sup>15</sup> One lag of the smoothness indicator is sufficient to remove serial correlation in the residuals of all country-specific models except the ones for Sweden and the United States. 'Interest rate smoothing' is an indicator variable that takes the value 1 when the central bank repeats the last interest rate step, i.e., if it follows an autoregressive interest rate path (Lange et al., 2003); 0 otherwise. Autoregressive interest rate setting should contribute to understanding a central bank's intentions and, therefore, lower the indicator. The communication and transparency variables enter Equation (4) as yearly measures. A dummy variable captures the anomaly in the money market in September/October 1999. Finally, heteroscedasticity-consistent (White, 1980) or heteroscedasticity- and autocorrelation-consistent (Newey and West, 1987) standard errors are used if necessary.

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<sup>13</sup> We also considered a dummy variable for the intermeeting period surrounding 9/11. However, this dummy variable exerts no noticeable influence on the results and thus is omitted from the analysis.

<sup>14</sup> Of course, the dependent variable is censored as it can take values only of zero or greater. However, Tobit estimations (Tobin, 1958) and the corresponding marginal effects confirm our results.

<sup>15</sup> There are no ARCH effects (Engle, 1982) in the country-specific or pooled models at a 5 percent significance level or better.

Second, a pooled model including all nine countries is utilised. In addition to the obvious gain in the number of observations, a pooled model allows a more detailed examination of the subindices as the variation increases with the number of countries.<sup>16</sup> The multi-country model cannot be estimated as a balanced panel as each of the central banks has its own interest rate setting calendar, with substantial variation in the number of target rate decisions per year. Thus, we estimate the corresponding pooled OLS model for Equation (4). The only difference is that country-specific effects are included using the United States as the reference country.

### 3. Country-Specific Results

Table 1 sets out the results for the country-specific models.

Table 1: Explaining Money Market Adjustment Smoothness (Country-Specific Models)

	AUS	CAN	ECB	JAP	NZ
Constant Term	37.65 ***	44.04 ***	9.09 **	1.93	26.75
Smoothness Lag	0.03	-0.02	0.13 *	0.28 **	-0.12
ID October 1999	8.64 ***	—	22.77 ***	6.85 ***	3.83
IR Smoothing	-1.81 ***	-1.63 ***	-1.75 ***	-2.42 **	-1.21
Communication	-4.37 ***	-2.67 ***	-0.94	0.25	-0.95
Transparency	-2.12 ***	-3.00 ***	-0.16	0.06	-1.44
R <sup>2</sup>	0.39	0.68	0.52	0.27	0.14
Observations	92	53	137	137	67
AR Test	2.07	1.95	0.99	1.88	0.40
Hetero Test	1.18	0.63	3.53 ***	3.00 ***	2.95 ***

	SUI	SWE	UK	US
Constant Term	54.46 ***	7.89	79.00 **	26.36 ***
Smoothness Lag	-0.43 **	0.16	0.04	0.21 **
ID October 1999	—	18.85 ***	17.64 ***	16.67 ***
IR Smoothing	-2.62 **	-0.85	-0.79 *	-2.18 **
Communication	-5.63 *	-0.20	1.19	-5.07 **
Transparency	-3.33 **	-0.31 *	-6.38 **	—
R <sup>2</sup>	0.62	0.52	0.61	0.55
Observations	33	76	102	69
AR Test	0.45	6.63 ***	1.00	2.41 *
Hetero Test	1.11	2.75 ***	6.20 ***	2.04 *

Notes: \*\*\*/\*\*/\* indicates significance at the 1%/5%/10% level. White (1980) standard errors are used if heteroscedasticity was detected. Newey-West (1987) standard errors are used if autocorrelation was detected.

<sup>16</sup> An obvious drawback is the assumption of equal coefficients across countries and a common error structure. Nonetheless, the selection of a homogenous group of countries should minimise these potential problems.

The best fit as measured by the  $R^2$  is found for Canada (0.68), Switzerland (0.62), and the United Kingdom (0.61). The models for JAP (0.27) and NZ (0.14) perform worst in terms of explanatory power. Gradual interest rate setting contributes to the adjustment process in all countries except NZ and SWE: the coefficients vary from  $-0.79$  in the United Kingdom up to  $-2.42$  in JAP and  $-2.62$  in SUI.<sup>17</sup> That is, if the SNB replicates its last interest rate decision, the adjustment indicator goes down by 2.62 bps. Thus, autoregressive interest rate setting (cf. Lange et al., 2003) contributes to market participants' understanding of the central bank's interest rate path.

The transparency indicator exerts a significant and theory-consistent (i.e., decreasing) impact in five out of eight countries.<sup>18</sup> The largest impact can be found in the United Kingdom, as a one-unit increase in the index decreases the smoothness indicator by 6.38 bps. The adjustment process is also affected in SUI ( $-3.33$  bps), CAN ( $-3$  bps), and AUS ( $-2.12$  bps), whereas the coefficient for SWE ( $-0.31$  bps) is significant only at the 10 percent level.<sup>19</sup> Central bank communication affects four out of nine countries, a finding in line with our expectations (i.e., it also facilitates the adjustment process): a 1 percent increase in the number of speeches delivered by the SNB officials lowers the indicator by 5.63 bps.<sup>20</sup> Speeches by Fed ( $-5.07$  bps), BOC ( $-2.67$  bps), and RBA ( $-4.37$  bps) officials also significantly contribute to smooth adjustment of money markets between two interest rate decisions.<sup>21</sup>

The most pronounced results are found for two inflation-targeting countries (AUS and CAN) where all three categories contribute to an improved understanding of the monetary policy. However, as SWE and the United Kingdom are less affected and NZ<sup>22</sup> performs worst, one cannot attribute the success of AUS and CAN to their inflation-targeting regime. The result for the BOJ (neither communication nor the transparency index matters) is not surprising for two reasons. (1) The BOJ has faced the zero interest bound problem since the mid-1990s and thus there are only five interest rate changes during our sample period, which makes the interest rate course easy to predict. (2) The BOJ meets at very high frequency (137

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<sup>17</sup> Statistical tests of differences in means under the assumption of independent samples do not reveal differences between the significant coefficients.

<sup>18</sup> There is no variation in the US transparency index during our sample period.

<sup>19</sup> Statistical tests show that the coefficient is the smallest in Sweden (vs. UK:  $z = 2.24^{**}$ ; vs. SUI:  $z = 2.29^{**}$ ; vs. CAN:  $z = 2.74^{***}$ ; vs. AUS:  $z = 2.97^{***}$ ), while failing to differentiate between the other countries.

<sup>20</sup> The impact is statistically indifferent from a one-unit change in the transparency index ( $F(1,28) = 0.35$ ).

<sup>21</sup> In the case of AUS ( $F(1,86) = 1.73$ ) and CAN ( $F(1,48) = 0.07$ ), the impact of transparency and communication is statistically equal.

Statistical testing also fails to differentiate between the impact of communication in these four countries.

<sup>22</sup> Nonetheless, the coefficients for interest rate smoothing ( $p = 0.11$ ) and the transparency index ( $p = 0.18$ ) in NZ are only marginally insignificant at the 10 percent level.

observations in our sample), which further facilitates understanding its future course.<sup>23</sup> Similar results are obtained for the ECB, even though the model has a good fit. Like the BOJ, the ECB has a very high frequency of interest rate meetings (twice a month until October 2001, monthly starting November 2001), which makes it highly predictable, too.<sup>24</sup>

To ensure the robustness of our findings and obtain further insights, we conduct several experiments. First, we control for US and ECB interest rate setting (surprises) in the other countries' regressions. However, only in case of Sweden the ECB interest rate setting does increase the smoothness indicator (i.e., has a worsening impact), whereas in all other cases both variables are insignificant. This implies that the interest rate setting of the largest two central banks is no surprise to the other central banks and market participants. Second, we differentiate between communication by the respective committee's head and that by other members of the decision-making body. The results indicate that there is no additional impact if the head is speaking. Third, the ECB (in November 2001) and the Riksbank (in January 2000) switched to a lower frequency of interest rate decisions. Restricting the sample to the new schedule does not affect the results. Fourth, neither controlling for unscheduled target rate decisions nor the exclusion of these events changes the results. Finally, instead of using the aggregated transparency index, we employ its subindices to discover which transparency factors are particularly important. However, there is rarely enough variation within one country, which is one major reason for pooling the country samples.

#### 4. Multi-Country Results

Table 2 shows the results of the pooled model. Model (1) employs both variables, whereas Model (2) includes only the communication measure and Model (3) focuses on the transparency index. The fit of the models (measured by the  $R^2$ ) is nearly the same as the joint model; Model (1) performs only marginally better (0.43) than the other models (0.42). There is not much variation in the coefficients for transparency or communication across different models, indicating that there is no noticeable degree of collinearity. Formal transparency and informal communication are almost orthogonal,<sup>25</sup> in line with the statistics in Tables A1 and

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<sup>23</sup> The Japanese smoothness indicator has the lowest mean and standard deviation of all nine countries (see Table A2).

<sup>24</sup> The ECB smoothness indicator has the second smallest mean and one of the smallest standard deviations (see Table A2).

<sup>25</sup> Including an interaction term between communication and transparency to Model (1) yields an insignificant coefficient and confirms this impression.

A3: central banks with a high frequency of informal speeches are not necessarily the most transparent ones, and vice versa.<sup>26</sup>

As in the country-specific models, interest rate smoothing contributes to understanding monetary policy. The indicator goes down by 1.75 bps in Models (1) and (2) (–1.79 bps in Model (3)). A 1 percent increase in the number of central bank speeches decreases the smoothness indicator by 1.07 bps (–1.15 bps in Model (2)). Finally, if a central bank chooses to increase its transparency (measured by a one-unit change in the index), the adjustment indicator is reduced by 0.39 bps (–0.40 in Model (3)).<sup>27</sup>

Table 2: Explaining Money Market Adjustment Smoothness (Pooled Model)

	(1)	(2)	(3)
Constant Term	12.94 ***	9.30 ***	8.51 ***
Std. Dev. Lag	0.15 ***	0.18 ***	0.16 ***
ID October 1999	14.18 ***	14.61 ***	14.03 ***
AUS	–2.18 **	–2.35 **	–0.42
CAN	–2.00 **	–2.40 ***	–0.32
EMU	–1.01 **	–0.93 *	–1.07 **
JAP	–4.48 ***	–4.06 ***	–2.47 ***
NZ	–1.35	–2.98 **	1.26 *
SUI	–1.28	–0.89	0.06
SWE	–0.39	–1.54 **	0.51
UK	–0.74	–1.74 **	0.31
IR Smoothing	–1.75 ***	–1.75 ***	–1.79 ***
Communication	–1.07 **	–1.15 ***	—
Transparency	–0.39 ***	—	–0.40 ***
R <sup>2</sup>	0.43	0.42	0.42
Observations	766	766	766
AR Test	12.41 ***	13.96 ***	13.00 ***
Hetero Test	5.38 ***	5.58 ***	6.54 ***

Notes: \*\*\*/\*\*/\* indicates significance at the 1%/5%/10% level. White (1980) standard errors are used if heteroscedasticity was detected. Newey-West (1987) standard errors are used if autocorrelation was detected. Country-specific effects cannot be excluded ( $F(8,752) = 4.06***$ ;  $F(8,753) = 4.40***$ ;  $F(8,753) = 4.58***$ ).

Another novel aspect of this paper is that we assess the influence of all subcategories of Eijffinger and Geraats's (2006) transparency index (political, economic, procedural, policy, and operational). The results are displayed in Table 3.<sup>28</sup> The fit is virtually the same in all five

<sup>26</sup> The correlation coefficient between average communication and average transparency per country over the sample period is –0.14.

<sup>27</sup> The impact is statistically indifferent from a 1 percent change in central bank speeches ( $F(1,752) = 2.30$ ).

<sup>28</sup> Including all five subcategories in one model results in collinearity problems.

models (the  $R^2$  ranges from 0.42 to 0.43). The coefficients for communication and interest rate smoothing are almost unchanged from the results in Table 2.

Although all subcategories have a theory-consistent declining impact on the indicator, there is some variation across the different subindices. The largest impact is found for political transparency, which has to do with openness about policy objectives (e.g., a formal statement and prioritization of objectives or a quantification of the primary objective). If a central bank has a clear and quantified mandate, e.g., an inflation target, it is very easy for market participants to anticipate the bank's future monetary policy. Second in terms of influence is procedural transparency, which includes (among other things) an explicit monetary policy rule and an account of the policy deliberations. Again, this helps to explain how past decisions were reached and thus facilitates prediction of interest rates in the near future. Operational transparency (though only significant at the 10 percent level) ranks third in impact.

Table 3: Assessing Different Categories of Transparency (Pooled Model)

	<b>Political</b>	<b>Economic</b>	<b>Procedural</b>	<b>Policy</b>	<b>Operational</b>
IR Smoothing	-1.75 ***	-1.73 ***	-1.79 ***	-1.76 ***	-1.74 ***
Communication	-0.98 **	-1.08 **	-1.19 ***	-1.13 ***	-1.08 ***
Transparency	-3.57 **	-0.62 ***	-1.84 ***	-0.76 **	-1.37 *
$R^2$	0.43	0.43	0.43	0.42	0.42

Notes: \*\*\*/\*\*/\* indicates significance at the 1%/5%/10% level. White (1980) standard errors are used if heteroscedasticity was detected. Newey-West (1987) standard errors are used if autocorrelation was detected. Country-specific effects cannot be excluded ( $F(8,752) = 3.78***; 4.61***; 5.95***; 3.59***; 3.75***$ ). Full tables are available on request.

Geraats (2002) views policy transparency as a factor that could boost the effectiveness of interest rate setting. Thus, it is at first a bit surprising that the prompt disclosure and explanation of policy decisions and an explicit policy indication of likely future policy action exert a much smaller impact than all other categories (except economic transparency).<sup>29</sup> However, all central banks promptly disclose their decisions and perhaps the information contained in explanations of likely future interest rate decisions can also be obtained by studying discussions of past interest rate decisions (procedural transparency). Finally, economic transparency is the least important category. These days, publicly available macroeconomic data and forecasts are almost as accurate as those provided by the central

<sup>29</sup> The tests of differences in means under the assumption of independent samples show that political transparency is more important than policy and economic transparency ( $z = 1.88^*$  and  $z = 2.02^{**}$ , respectively). Similar differences can be found for procedural transparency and policy and economic transparency ( $z = 1.72^*$  and  $z = 2.24^{**}$ , respectively).

bank. Thus, there may not be much benefit in providing internal data and the macroeconomic model to the public.<sup>30</sup>

The data set by Siklos (2010) also provides the score for all 15 questions utilised in creation of the index. Table 4 sets out the results for 10 of the 15 questions.<sup>31</sup> As in Tables 2 and 3, model fit varies only marginally (0.42–0.44), with Model Q5b performing best. In fact, this question has the largest influence<sup>32</sup> on the smoothness indicator and seemingly drives the results for operational transparency in Table 3, as the other questions (Q5a and Q5c) exert no significant impact. The provision of information on (unanticipated) macroeconomic disturbances helps market participants (i) become aware of a disturbance and (ii) understand what the central bank is going to do in this context. As a consequence, transparent dealing with disturbances reduces market uncertainty and also facilitates the adjustment process.

Table 4: Assessing Different Questions of the Transparency Index (Pooled Model)

	<b>Q1a</b>	<b>Q2a</b>	<b>Q2b</b>	<b>Q2c</b>	<b>Q3c</b>
IR Smoothing	–1.75 ***	–1.74 ***	–1.74 ***	–1.73 ***	–1.79 ***
Communication	–0.98 **	–1.30 ***	–1.10 **	–0.98 **	–1.19 ***
Transparency	–3.57 **	–1.72 **	–0.73 ***	–1.18 **	–1.84 ***
R <sup>2</sup>	0.43	0.42	0.43	0.42	0.43

	<b>Q4b</b>	<b>Q4c</b>	<b>Q5a</b>	<b>Q5b</b>	<b>Q5c</b>
IR Smoothing	–1.75 ***	–1.79 ***	–1.75 ***	–1.72 ***	–1.76 ***
Communication	–1.14 ***	–1.19 ***	–1.16 ***	–1.14 ***	–1.18 ***
Transparency	–0.06	–1.84 ***	0.25	–4.55 ***	–1.96
R <sup>2</sup>	0.42	0.43	0.42	0.44	0.42

Notes: \*\*\*/\*\*/\* indicates significance at the 1%/5%/10% level. White (1980) standard errors are used if heteroscedasticity was detected. Newey-West (1987) standard errors are used if autocorrelation was detected. Country-specific effects cannot be excluded ( $F(8,752) = 3.78***; 3.96***; 4.26***; 4.96***; 5.95***; 3.90***; 5.92***; 2.57***; 5.00***; 4.72***$ ). An excerpt of the Eijffinger and Geraats (2006) questionnaire can be found in the Appendix. Full tables are available on request.

Second in terms of reaction size is Q1a:<sup>33</sup> a formal statement of the objective(s) of monetary policy is provided by all central banks in our sample; thus, it is explicit

<sup>30</sup> We also try to evaluate the impact of conditional policy rate projections (not captured by the index) as published by the RBNZ since 1999 and the Riksbank since 2007. However, the coefficient is insignificant as the variable mostly coincides with the country-specific effects for NZ.

<sup>31</sup> We are able to employ only 10 of these questions as (i) in some cases the variation coincides with country dummies and we cannot distinguish the impact from a country-specific effect or (ii) there is no variation in the variable at all. Therefore, Q1b and Q1c (political transparency), Q3a and Q3b (procedural transparency), and Q4a (policy transparency) have to be omitted from the analysis.

<sup>32</sup> Statistical tests show that it exerts a larger influence than all other questions (except Q1a and Q5c): Q2a ( $z = 1.73^*$ ), Q2b ( $z = 2.71***$ ), Q2c ( $z = 2.29**$ ), Q3c ( $z = 1.84^*$ ), Q4b ( $z = 3.01***$ ), Q4c ( $z = 1.84^*$ ), and Q5a ( $z = 2.43**$ ).

<sup>33</sup> The impact is statistically larger than for questions Q2b ( $z = 1.93^*$ ), Q4b ( $z = 2.27**$ ), and Q5a ( $z = 1.83^*$ ).

prioritization in case of multiple objectives that helps market participants better understand the central bank's intentions. Finally, a highly significant smoothing impact can be attributed to Q3c and Q4c.<sup>34</sup> The disclosure of how each target rate decision was reached (Q3c) and an explicit indication of likely future policy action (Q4c) also facilitate predicting future monetary policy.

Again, we conduct several experiments to ensure the robustness of our findings. First, we control for different types of target rate decisions by including variables for target rate hikes and cuts. Usually, target rate cuts are less discussed by central banks in the run-up than are rate hikes because cheaper liquidity tends to cause few problems for market participants. Second, we employ a variable to address different sizes of target rate decisions. It could be that a larger interest rate step is more difficult for market participants to anticipate. Third, we focus on only those interest rate decisions where the central bank did not repeat the last interest rate step, i.e., we leave out all autoregressive interest rate decisions. Finally, we interact the speeches with the (absolute) size of the interest rate step. The prior is that communication could have an additional facilitating effect on large adjustments. However, the first three robustness tests do not affect the results presented above, and the last has no significant impact. Thus, we retain our parsimonious specification.

## 5. Conclusions

In this paper, we study the impact of central bank transparency and informal central bank communications on the money market adjustment process between two interest rate decisions. The sample covers nine major central banks (RBA, BOC, ECB, BOJ, RBNZ, Riksbank, SNB, BOE, and the Fed) for the period from January 1999 to July 2007. We employ a continuous test for the influence of both factors using an adjustment indicator that incorporates the behaviour of short-term interest rates during the entire intermeeting period. Country-specific OLS models and a pooled OLS model reveal several interesting results.

First, in case of the country-specific models, a higher degree of transparency leads to a smoother transition from the old target rate to the new one in the UK, SUI, CAN, AUS, and SWE. Informal central bank speeches by the SNB, Fed, RBA, and BOC also contribute to an improved adjustment in the money markets. JAP and the EMU are virtually unaffected by both variables but show the smoothest adjustments in the first place (partly due to their frequent decision schedule). Gradualist interest rate setting also facilitates a smooth transition in all countries except NZ and SWE. The pooled regressions confirm the country-specific

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<sup>34</sup> Note that there is only joint variation in both variables. Thus, we cannot assign the impact exclusively to one of the questions.

results: communication, transparency, and gradualist interest rate setting significantly facilitate the transition from the old target rate to the new one. Furthermore, we show that formal transparency and informal communication are almost orthogonal in their influence on the adjustment process.

Second, the pooled model permits a more detailed examination of the subcategories of the Eijffinger and Geraats (2006) index: all subcategories have a theory-consistent facilitating impact on the adjustment indicator. However, openness about policy objectives (political transparency) as well as an explicit monetary policy rule and an account of the policy deliberations (procedural transparency) are more important than the other categories (operational, policy, and economic transparency). The detailed data provided by Siklos (2010) also enable assessing the 15 items of the original questionnaire. A subcategory of operational transparency performs best: the provision of information on (unanticipated) macroeconomic disturbances. Other transparency items that noticeably facilitate the adjustment process in money markets are (i) explicit prioritization of multiple central bank objectives (a subcategory of political transparency), (ii) disclosure of how each target rate decision was reached (a subcategory of procedural transparency), and (iii) explicit indication of likely future policy actions (a subcategory of policy transparency).

Third, we cannot identify an optimal design for central banks that will perform best in managing financial market expectations. There are four different (nonexclusive) options for central banks: (i) establish a very high degree of transparency, e.g., as do the Riksbank and the BOE, (ii) communicate frequently with the public on an informal basis, e.g., as does the Fed, (iii) implement changes in the interest rate in a gradualist way, as is done by most central banks, or (iv) facilitate the accuracy of market expectations with a high frequency of interest rate decisions, e.g., as does the ECB. All four options contribute to a sound understanding of monetary policy.

The countries studied in this paper are relatively homogenous. All of their central banks rely on a short-term interest rate as the main instrument of monetary policy, none of them face severe inflation problems, and each of them is characterised by a relatively high degree of transparency. Investigating emerging markets that have more variation in their monetary regimes and greater concerns about inflation would be an interesting task for future research.

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## Appendix

Table A1: Transparency Indices

	1999	2000	2001	2002	2003	2004	2005	2006	2007
<b>AUS</b>	9.5	9.5	9.5	10.5	10.5	10.5	10.5	10.5	10.5
<b>CAN</b>	10.5	10.5	10.5	10.5	10.5	11	11	11	11
<b>EMU</b>	8.5	8.5	10	10.5	10.5	11	11	11	11
<b>JAP</b>	8	8.5	8	8	8	9.5	9.5	10	10
<b>NZ</b>	13	13	13.5	14	14	14	14	14	14
<b>SUI</b>	7	7.5	8	8	9	9.5	9.5	9.5	9.5
<b>SWE</b>	9.5	11.5	11.5	14.5	14.5	14.5	14.5	15	15
<b>UK</b>	12	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
<b>US</b>	10	10	10	10	10	10	10	10	10

Source: Siklos (2010).

Table A2: Descriptive Statistics of Smoothness Indicator

	Observations	Mean	Std. Deviation	Skewness	Minimum	Maximum
<b>Overall</b>	766	3.04	3.18	2.67	0.00	25.61
<b>AUS</b>	92	3.45	2.96	1.63	0.47	14.69
<b>CAN</b>	53	3.28	2.25	0.97	0.43	9.91
<b>EMU</b>	137	2.68	2.98	3.65	0.14	24.49
<b>JAP</b>	137	1.11	1.96	3.04	0.03	12.62
<b>NZ</b>	67	3.94	2.45	1.37	0.97	11.68
<b>SUI</b>	33	5.01	4.87	2.35	0.60	25.61
<b>SWE</b>	76	3.56	3.39	2.92	0.12	22.47
<b>UK</b>	102	3.40	3.13	3.42	0.20	24.58
<b>US</b>	69	4.00	3.91	1.94	0.00	22.25

Table A3: Number of Speeches Delivered by Central Bank Governors

	1999	2000	2001	2002	2003	2004	2005	2006	2007
<b>AUS</b>	17	13	14	13	12	12	17	19	14
<b>CAN</b>	8	7	7	18	17	15	19	18	24
<b>EMU</b>	102	68	68	59	65	100	80	96	111
<b>JAP</b>	11	10	8	8	18	9	13	18	15
<b>NZ</b>	10	10	8	4	5	6	6	9	7
<b>SUI</b>	18	13	13	23	21	23	31	27	21
<b>SWE</b>	37	36	28	30	20	37	42	41	34
<b>UK</b>	31	37	38	28	17	27	26	30	36
<b>US</b>	69	63	62	78	72	102	87	73	72

Note: The figures in 2007 contain only speeches delivered in the period January–July 2007 due to a considerable increase of central bank communication with the beginning of the recent financial crisis. To ensure comparability with the earlier years, figures for the first seven months of 2007 are projected for a total year.

Source: Central bank websites and own calculations.

## **Transparency Index Questionnaire**

Source: Eijffinger and Geraats (2002).

### 1. Political Transparency

- a) Is there a formal statement of the objective(s) of monetary policy, with an explicit prioritization in case of multiple objectives?
- b) Is there a quantification of the primary objective(s)?
- c) Are there explicit contracts or other similar institutional arrangements between the monetary authorities and the government?

### 2. Economic Transparency

- a) Is the basic economic data relevant for the conduct of monetary policy publicly available?
- b) Does the central bank disclose the macroeconomic model(s) it uses for policy analysis?
- c) Does the central bank regularly publish its own macroeconomic forecasts?

### 3. Procedural Transparency

- a) Does the central bank provide an explicit policy rule or strategy that describes its monetary policy framework?
- b) Does the central bank give a comprehensive account of policy deliberations (or explanations in case of a single central banker) within a reasonable amount of time?
- c) Does the central bank disclose how each decision on the level of its main operating instrument or target was reached?

### 4. Policy Transparency

- a) Are decisions about adjustments to the main operating instrument or target announced promptly?
- b) Does the central bank provide an explanation when it announces policy decisions?
- c) Does the central bank disclose an explicit policy inclination after every policy meeting or an explicit indication of likely future policy actions (at least quarterly)?

### 5. Operational Transparency

- a) Does the central bank regularly evaluate to what extent its main policy operating targets (if any) have been achieved?
- b) Does the central bank regularly provide information on (unanticipated) macroeconomic disturbances that affect the policy transmission process?
- c) Does the central bank regularly provide an evaluation of the policy outcome in light of its macroeconomic objectives?