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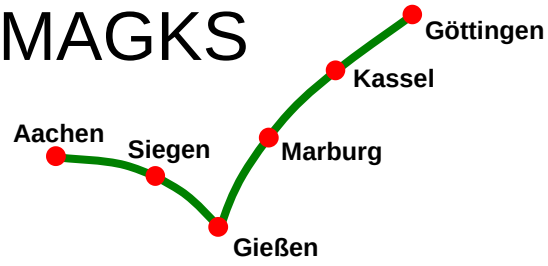

Joint Discussion Paper Series in Economics

by the Universities of

Aachen · Gießen · Göttingen
Kassel · Marburg · Siegen

ISSN 1867-3678

No. 28-2010

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

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This version: 18 May 2011

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* The first draft of this paper was written during my stay at the Wilfrid Laurier University. I am grateful to the members of the Viessmann European Research Centre for the academic hospitality they so generously offered. I also thank two anonymous referees, Bernd Hayo, Edith Neuenkirch, Florian Neumeier, Britta Niehof, Pierre Siklos, Matthias Uhl, and participants of the Joint Laurier-Waterloo Research Seminar for their helpful comments on earlier versions of the paper. The usual disclaimer applies.

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 formation of money market expectations. The sample covers nine major central banks from January 1999 to July 2007. We find, first, that transparency reduces the bias in money market expectations and dampens their variation. Second, informal communications help manage financial market expectations by reducing the variation of expectations. Third, various subcategories of the Eijffinger and Geraats (2006) transparency index lead to a smaller bias in expectations (in particular, evaluation of policy outcome and explanation of interest rate decisions) and to a reduction in the variation of expectations (in particular, explicit prioritization of objectives and provision of information on unanticipated macroeconomic disturbances).

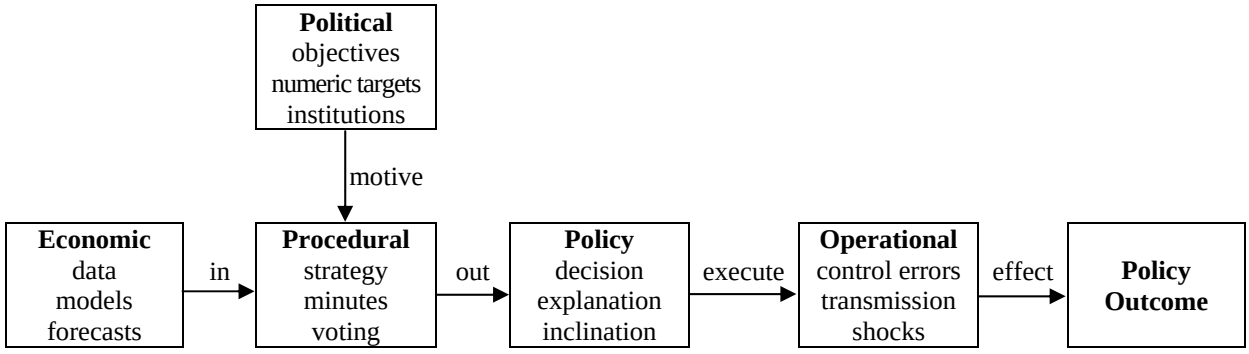
JEL: E52, E58

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 worked hard to increase their transparency: objectives and goals are specified and quantified, macroeconomic forecasts are published, interest rate decisions are announced and immediately explained, and some central banks provide indications of the likely course of monetary policy in the near future.[1] 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 have the potential to 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 Cruijsen and Eijffinger (2010) review the literature and conclude that transparency (1) improves consensus across forecasters, (2) lowers 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.[2] 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. One question is of particular interest: Does a higher degree of transparency improve the formation of expectations in the money market in the period between two interest rate decisions?

[1] These inclinations can be provided via qualitative statements, 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.

[2] A more detailed and stylised overview of the empirical results can be found in van der Cruijsen (2008, 30).

Our survey starts in January 1999 with the inception of the ECB and ends in July 2007.[3] 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 the following research questions: (1) *Does transparency decrease the expectation bias in money markets?* (2) *Is the variation of money market expectations reduced by a higher degree of transparency?* (3) *Is transparency the only factor improving the formation of expectations in money markets or can central banks use frequent informal communication with the public as a substitute for transparency?* As endogenous variables, we employ two newly constructed indicators that measure the bias and variation of money market expectations over the entire intermeeting period.

The remainder of this paper is organised as follows. Section 2 reviews the literature and explains the paper's contribution. Section 3 introduces the data set and explains our econometric methodology. Section 4 presents the country-specific results for the influence of transparency and communication on central banks' ability to manage financial market expectations. Section 5 shows the corresponding pooled model results. Section 6 concludes.

2. Related Literature and Contribution

In the recent literature, the effectiveness of central banking 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 increased 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 (AUS, CAN, EMU, JAP, NZ, SWE, UK, and US). 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.

[3] Since the beginning of the recent financial crisis, money market rates are no longer aligned with the respective country's target rate and, therefore, are no longer an appropriate indicator for the effectiveness of monetary policy.

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 the 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 contributors to the enhanced predictability: gradualism in adjusting the Federal Funds interest rate target (i.e., autoregressive interest rate setting) and 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 the introduction of inflation targeting in 1992. They posit that this is due to greater transparency in the monetary policy process, in combination with the bank's greater credibility. Finally, the Bank of Canada's efforts to increase its transparency also have helped market participants more accurately anticipate pending monetary policy actions (Muller and Zelmer, 1999).

Our work improves on the current literature in at least three ways. First, the impact of different transparency regimes is often measured only roughly by splitting the time series into subsamples. However, changes in transparency are often made gradually. 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 (Fed)) have increased their transparency at least once in the past 15 years. We thus provide *a continuous test of the effects of transparency* on the money market adjustment process between two interest rate decisions. We employ Eijffinger and Geraats's (2006) transparency index (and its subcomponents) as an explanatory variable in our econometric setup and use one time series for each country instead of comparing several subsamples.[4]

Second, judging the success of monetary policy outcomes by employing a surprise measure, focussing mainly on decision days, 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 (de Haan

[4] Note that some papers employ continuous tests of transparency changes. See, for instance, Geraats et al. (2006) for the impact of transparency on the level of interest rates or van der Cruijsen and Demertzis (2007) for the influence on inflation expectations.

et al., 2007). Thus, a measure like Equation (1), which is commonly used in the literature, fails to capture the entire adjustment process in the markets.

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

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 of this paper is that we employ two indicators that incorporate the behaviour of short-term interest rates *over the entire intermeeting period*. This ensures that the success of central banking is measured not only by financial market reaction on interest rate decision days; our indicators also measure the bias and variation of money market expectations *in the run-up to the (expected) decision*.

Third, focussing only on central bank *transparency* 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). The Fed does not pre-commit itself in terms of formal rules, such as a prioritisation or quantification of its objectives. 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.[5] 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 are captured by the transparency index) have an influence on financial markets.[6] To explore the impact of communication in this context, we include *a measure of informal central bank communication* in our analysis.

3. Data and Econometric Methodology

As dependent variables we employ two newly constructed measures that account for the course of short-term interest rates during the entire intermeeting period. (1) The *bias indicator* captures the deviation of money market rates from the 'optimal' rate. (2) The *variation*

[5] From 1999 to 2007, Board of Governors' members spoke to the public 648 times; Riksbank's officials delivered 291 speeches during that period.

[6] 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 (2011) for the BOC, and Ranaldo and Rossi (2010) for the SNB. Blinder et al. (2008) provide a comprehensive overview of the theory of and evidence for central bank communication.

indicator measures the fluctuation of money market rates around the 'optimal' rate given an error in expectations that is constant for every intermeeting period.

Bias Indicator

Consider a bond with a maturity of *n* days. According to the term structure of interest rates, the bond's return equals a weighted average of the expected target for the overnight rate over that period. Equation (2) describes the relationship:

$$(2)\ interest\ rate_t^n = \prod_{i=0}^{n} E_t(target\ rate_{t+i})^{1/n},$$

where 'interest rate' denotes the revenues on the bond with a maturity of *n* days and $E_t(target\ rate_{t+i})$ the expected target rate *i* days in the future based on all information available at day *t*. Modern central banking is often described as the 'art of managing expectations' (e.g., de Haan et al., 2007, 2). Thus, if a central bank is able to manage financial market expectations perfectly, the expectation operator on the right-hand side of Equation (2) disappears:

$$(3)\ interest\ rate_t^n = \prod_{i=0}^{n} target\ rate_{t+i}^{1/n}.$$

In the case of perfect management, the actual and optimal interest rate should be equal. Thus, the difference between the interest rates—the 'bias'—is a good proxy for the central bank's effectiveness:

$$(4)\ bias_t^{90} = interest\ rate_t^{90} - \prod_{i=0}^{90} target\ rate_{t+i}^{1/90},$$

where 'bias' measures the difference between the actual interest rate and optimal interest rate (for a maturity of 90 days). This paper aims at assessing the process of managing expectations between two interest rate decisions. Therefore, we aggregate the biases over each intermeeting period and normalise the indicator by the distance of two decisions as the length of the intermeeting period varies within and across central banks[7]:

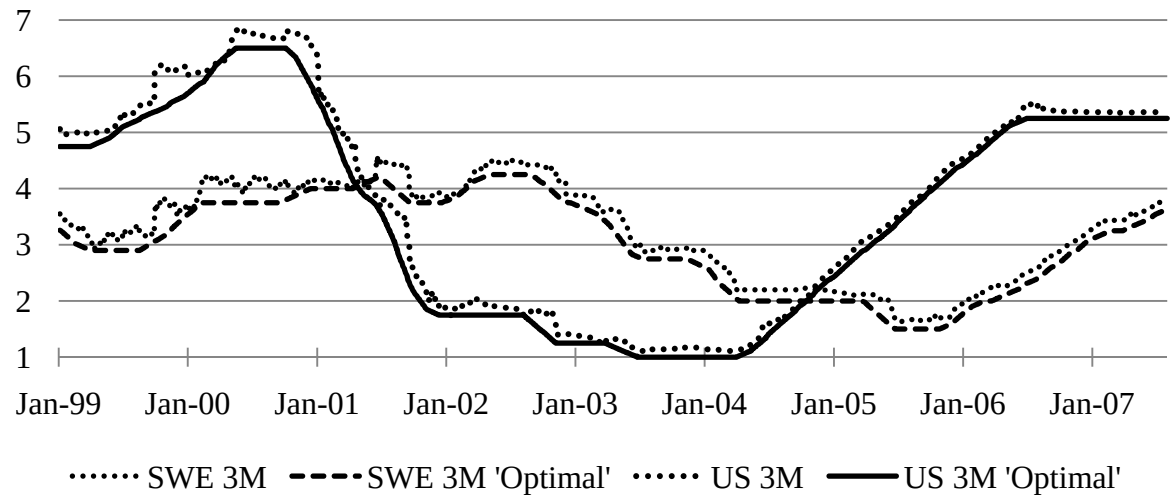
[7] A different way to control for the intermeeting length is to include the distance between two decisions as a further exogenous variable in the econometric setup. However, interpretation of the bias indicator put forward in Equation (5) is more straightforward as it measures the 'bias per intermeeting day' instead of the 'overall bias per intermeeting period'.

$$(5)\ bias\ indicator_k = \sqrt{{}^{1}/_{m}\sum_{t=1}^{m}(bias_t^{90})^2}_{k},$$

where *m* is the length of the k[th] intermeeting period.[8] This composition of the bias indicator ensures that larger deviations from the 'optimal interest rate' are penalised more severely than smaller ones. In contrast, the bias indicator becomes smaller the better interest rates are aligned with the expected overnight rates over the next 90 days.

Figure 2 shows US and Swedish three-month money market rates and the optimal interest rates based on weighted averages of the US and Swedish overnight rates (Federal Funds target rate, Riksbank's repo rate). US money market rates follow the expected target rate closely (especially since 2002). Financial markets do not abruptly adjust if the central bank changes its target for the overnight rate. They seem to 'know' the central bank's intentions and, thus, interest rates alter gradually in the run-up to the next (expected) interest rate decision.

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



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

In the case of Sweden, money market rates co-move with the expected target rate (especially since 2002) but do not exactly follow the 'optimal rate'. However, as in the US, Swedish financial markets seem to track changes in the expected target very closely. Thus, it might be of interest to allow for a time-varying expectations error and to assess the

[8] Each 'intermeeting period' starts one day after the preceding interest rate decision and ends on the day of the subsequent interest rate decision.

fluctuations of money market rates around the 'optimal' rate given an error in expectations that is constant for every intermeeting period.

Variation Indicator

The *variation indicator* measures the fluctuation of money market rates around the expected target rate while allowing for a constant expectation error during every intermeeting period:

$$(6)\ variation\ indicactor_k = \sqrt{{}^{1}\!/_{m} \sum_{t=1}^{m} \left(bias_t^{90} - \overline{bias}_k^{90}\right)^2}_{k},$$

where *m* is the length of the k[th] intermeeting period, 'bias' is obtained from Equation (4), and the mean bias is calculated for the k[th] intermeeting period. This indicator allows testing whether communication and transparency exert an influence on the variation of (biased) expectations. The composition of the indicator ensures that abrupt and huge changes in money market rates (e.g., caused by interest rate surprises) are penalised, whereas a smooth and gradual adjustment will result in a particularly low indicator—even though there might be an error in interest rate expectations.[9]

Transparency Index

In the next step, we need to parameterise central bank transparency. The index from Eijffinger and Geraats (2006), which was updated by Siklos (2011), is commonly used.[10] This index captures all categories of 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 the scores for the 15 questions.

One would expect that each of the index's five subcategories has a positive impact on the ability to steer financial market expectations, i.e., causes a decline in both indicators. *Political transparency* reveals the central bank's policy objectives, ranks them according to their priority in case of multiple goals, or sometimes quantifies a primary objective. *Economic*

[9] Table A2 in the Appendix sets forth descriptive statistics for the bias and variation indicator; Figure A1 presents a graphical illustration of both variables.

[10] 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 investigated in this paper.

transparency refers to the economic information on which monetary policy is based, such as economic data, forecasts, or the central bank's economic model. Thus, market participants are able to discover the central bank's view of the economy. *Procedural transparency* involves an explicit monetary policy rule or strategy, an account for policy deliberations, and how a 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

We evaluate the impact of informal central bank communication on the ability to manage expectations as to the future target rate. 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 less frequently.[11] It could be argued that inflation-targeting countries do not need to communicate as frequently as, e.g., the United States, as their 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 are mostly bound to an inflation band and not to a single figure. They can also experience unexpected macroeconomic disturbances and need to communicate their awareness of the disturbance and explain how they plan to deal with it.[12] However, every speech can contain valuable information for financial market agents, no matter the occasion for the speech, especially if the audience is given the opportunity to ask questions, e.g., about the future course of monetary policy or the economic outlook. Thus, every informal speech should be considered a potential source of information. Central banks can choose the number of speeches and their timing and thus they can use speeches 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

[11] Table A3 in the Appendix shows the number of speeches delivered by central bank governors during our sample period.

[12] One could also attribute the larger number of speeches in the United States and the EMU to those countries' size. However, normalising the communication indicator for country size does not change the results presented in Sections 4 and 5.

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. To ensure comparability to the yearly transparency measure, we use an annual communication measure 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 money market rates over the period January 1999–July 2007.[13] 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 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 rate series are characterised by a hump (see also Figures 2) that cannot be explained by the central bank's interest rate setting or the uncertainty surrounding the future course of monetary policy. In fact, the hump is due 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 a dummy variable (dummy Y2K) for the intermeeting period(s) covering that event. Another dummy variable (dummy 9/11) absorbs the extraordinary events in the intermeeting period surrounding 9/11.

Empirical Methodology

Our econometric setup consists of an OLS model for each country to analyse the influence of country-specific differences in central bank transparency and communication on (i) the bias indicator and (ii) the variation indicator. The general specification is:

$$(7)\ indicator_k = \alpha + \beta\ dummy\ Y2K\ + \gamma\ dummy\ 9/11 + \delta\ communication_k + \eta\ transparency_k\ + \varepsilon_k,$$

[13] 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.

where α, β, γ, δ, and η are parameters and ε is an i.i.d. error term. Heteroscedasticity-consistent (White, 1980) or heteroscedasticity- and autocorrelation-consistent (Newey and West, 1987) standard errors are used if necessary.

4. Country-Specific Results

Table 1a shows the results for the bias indicator in nine countries. The best fit, as measured by the R^2, is found for Switzerland (0.90) and the European Monetary Union (0.56). The model for JAP (0.13) performs worst in terms of explanatory power. The transparency indicator exerts a significant and theory-consistent bias-decreasing impact in five out of eight countries.[14] The largest impact can be found in Japan, as a one-unit increase in the index decreases the bias in money market expectations by 1.35 bps. The bias is also affected in SUI (–1.08 bps), the EMU (–0.95 bps), AUS (–0.63 bps), and SWE (–0.52 bps). In contrast, central bank communication has no systematic and positive influence on the bias indicator.[15]

The results for the variation indicator in nine countries are presented in Table 1b. The models for Canada (0.67), the European Monetary Union (0.64), and the United Kingdom (0.61) yield the best fit. The worst coefficients of determination are found for NZ (0.13) and JAP (0.11). As in case of the bias indicator, an increase in the transparency index is helpful in five out of eight countries. The largest influence is detected in the United Kingdom, as a one-unit increase in the index decreases the variation of money market rates around the expected target rate (given an error) by 5.24 bps. A positive influence is also found in CAN (–4.11 bps), AUS (–2.22 bps), the EMU (–0.51 bps), and SWE (–0.31 bps). Central bank communication decreases the variation indicator in five out of nine countries: a 1 percent increase in the number of speeches by SNB officials lowers the variation in money market expectations by 9.59 bps. Speeches by Fed (–9.12 bps), BOC (–4.14 bps), Riksbank (–2.95 bps), and ECB (–2.60 bps) officials also significantly contribute to the central bank's ability to reduce the variation in money market expectations between two interest rate decisions.[16]

[14] There is no variation in the US transparency index during our sample period.
[15] In the United States, a 1 percent increase in the number of speeches by Fed officials significantly causes a lower bias (–11.44 bps), but this is the only country for which such an effect occurs. In case of NZ and UK, we even find a detrimental influence of communication.
[16] In case of the BOE, we find a positive coefficient for central bank communication.

Table 1a: Explaining the Bias in Money Market Expectations (Country-Specific Models)

	Bias Indicator								
	AUS	CAN	EMU	JAP	NZ	SUI	SWE	UK	US
Constant	14.85 ***	9.74	16.88 **	16.87 ***	–14.01	11.35 ***	9.65 *	–7.75	53.28 ***
Dummy Y2K	4.26 ***	—	8.18 ***	2.61 **	0.45	—	4.89 ***	4.99 ***	5.21 ***
Dummy 9/11	–0.52 **	3.82 ***	24.13 ***	–3.09 ***	6.68 ***	20.27 ***	7.29 ***	11.71 ***	14.00 ***
Communication	–2.24	–0.19	–0.74	–0.82	2.67 **	–0.11	0.46	2.23 **	–11.44 ***
Transparency	–0.63 *	–0.66	–0.95 ***	–1.35 **	0.94	–1.08 *	–0.52 ***	0.27	—
R^2	0.25	0.24	0.56	0.13	0.31	0.90	0.46	0.49	0.41
Observations	92	53	137	137	67	33	76	102	69
AR 1-2 Test	8.23 ***	20.33 ***	50.78 ***	193.3 ***	2.45 *	0.02	18.06 ***	8.79 ***	5.16 ***
Hetero-X Test	1.56	1.90	2.10 *	4.97 ***	1.65	2.72 **	5.15 ***	5.61 ***	1.84

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.

Table 1b: Explaining the Variation in Money Market Expectations (Country-Specific Models)

	Variation Indicator								
	AUS	CAN	EMU	JAP	NZ	SUI	SWE	UK	US
Constant	31.85 ***	59.40 ***	18.67 ***	2.11	22.38	45.73 ***	17.88 ***	62.61 ***	42.99 ***
Dummy Y2K	5.90 ***	—	20.25 ***	6.51 ***	3.03	—	16.57 ***	17.75 ***	16.03 ***
Dummy 9/11	5.68 ***	–4.12 **	13.58 ***	0.14	4.81 **	–1.60	8.61 ***	–0.32	2.77
Communication	–2.19	–4.14 ***	–2.60 ***	–0.15	–0.73	–9.59 **	–2.95 **	1.60 **	–9.12 ***
Transparency	–2.22 ***	–4.11 ***	–0.51 ***	–0.09	–1.25	–1.32	–0.31 **	–5.24 ***	—
R^2	0.32	0.67	0.64	0.11	0.13	0.42	0.47	0.61	0.45
Observations	92	53	137	137	67	33	76	102	69
AR 1-2 Test	4.25 **	2.06	1.45	11.54 ***	0.01	2.45	2.29	2.13	1.91
Hetero-X Test	1.17	1.34	2.49 **	1.21	1.52	2.56 *	1.27	1.47	2.28

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.

Considering both indicators, the most pronounced results are found for the EMU and SWE, where communication and transparency decrease the variation of money market expectations and transparency mitigates the bias in expectations. In general, transparency is beneficial in mitigating the bias in money market expectations and in dampening the variation of expectations (given an error), whereas communication contributes positively only in the latter case. The literature on central bank communication finds that speeches by central bank officials move interest rates in the intended direction (Blinder et al., 2008) but does not test for a potential bias to an optimal rate. Therefore, the finding that communication only lowers the variation indicator (moves money market rates in the intended direction) does not contradict the existing literature. Another noteworthy finding is that two central banks with a relatively low degree of formal transparency (the SNB and Fed) show the largest coefficients for central bank communication. Thus, an increase in informal communications might be a substitute for formal transparency (at least in case of the variation indicator).

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 in the other countries' regressions. We find no significant and systematic influence, which implies that the interest rate setting of the largest two central banks is no surprise to central banks and market participants in other countries. 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 when the head is speaking. 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 in the next section.[17]

5. Multi-Country Results

To explore the influence of the transparency subindices in more detail, we utilise a pooled model including all nine countries. Pooling the countries increases the variation in the subindices and thus makes it possible to discover which transparency factors are particularly important.[18] 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

[17] All omitted results are available on request.

[18] Furthermore, a pooled model allows for more efficient estimation of the coefficients due to a gain in the number of observations. 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.

number of target rate decisions per year. Thus, we estimate the corresponding pooled OLS model for Equation (7) using (i) the bias indicator and (ii) the variation indicator. The general specification is:

$$(8)\ indicator_{j,k} = \alpha + \beta\ dummy\ Y2K + \gamma\ dummy\ 9/11 + \delta_j\ country\ dummies + \eta_j\ communication_{j,k} + \lambda_i\ transparency_{j,k} + \varepsilon_{j,k},$$

where α, β, γ, δ, η, and λ are parameters, ε is an i.i.d. error term, and the variables are defined as above. The only difference from Equation (7) is that country-specific effects are included using the United States as reference country.

Table 2 shows the results of the pooled model. Models (1)–(3) employ the bias indicator as endogenous variable: Model (1) uses both communication and transparency as explanatory variables, 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: the joint model (Model (1)) and the transparency model (Model (3)) perform marginally better (0.32) than the communication model (Model (2)) (0.28). Confirming the findings of the country-specific models, communication does not significantly affect the bias in money market expectations. However, transparency significantly lowers the bias: if a central bank chooses to increase its transparency (measured by a one-unit change in the index), the bias indicator is reduced by 0.76 bps (–0.77 in Model (3)).

The right-hand side of Table 2 shows the results for the corresponding models employing the variation indicator as endogenous variable. All three models yield almost the same fit: the joint model (Model (1')) performs marginally better (0.37) than the other models (Model (2'): 0.35; Model (3'): 0.34). In line with the results of the country-specific models, both communication and transparency reduce the variation in money market expectations: A 1 percent increase in the number of central bank speeches decreases the variation indicator by 2.03 bps (–2.17 bps in Model (2')). A one-unit increase in the transparency index reduces the variation by 0.53 bps (–0.56 in Model (3')).

There is not much variation in the coefficients for transparency or communication across different models for either indicator, indicating that there is no noticeable degree of collinearity. Formal transparency and informal communication are almost orthogonal,[19] in

[19] Including an interaction term between communication and transparency to Models (1) and (1') yields insignificant coefficients and confirms this impression.

line with the statistics in Tables A1 and A3: central banks with a high frequency of informal speeches are not necessarily the most transparent, and vice versa.[20]

Table 2: Explaining Bias and Variation in Money Market Expectations (Pooled Model)

	Bias Indicator			Variation Indicator		
	(1)	(2)	(3)	(1')	(2')	(3')
Constant	14.09 **	7.43 **	11.79 **	17.75 **	13.08 **	9.40 **
Dummy Y2K	5.14 **	5.95 **	5.06 **	12.82 **	13.39 **	12.52 **
Dummy 9/11	9.65 **	9.95 **	9.75 **	4.34 **	4.55 **	4.71 **
AUS	–2.56 *	–3.05 **	–1.63 *	–3.56 **	–3.87 **	–0.22
CAN	–2.35 *	–3.26 **	–1.47	–2.93 **	–3.54 **	0.26
EMU	0.39	0.49	0.36	–1.31 **	–1.25 **	–1.45 **
JAP	–3.20 **	–2.65 *	–2.16 **	–7.36 **	–6.94 **	–3.59 **
NZ	1.36	–1.99	2.75 **	–2.92 *	–5.22 **	2.07 **
SUI	–3.86 **	–3.13 **	–3.15 **	–1.96	–1.45	0.60
SWE	2.19 *	–0.14	2.68 **	–0.23	–1.83 **	1.52
UK	0.40	–1.66	0.96	–1.59 *	–3.01 **	0.41
Communication	–0.56	–0.79	——	–2.03 **	–2.17 **	——
Transparency	–0.76 **	——	–0.77 **	–0.53 **	——	–0.56 **
R^2	0.32	0.28	0.32	0.37	0.35	0.34
Observations	766	766	766	766	766	766
Country Effects	10.55 **	6.96 **	10.85 **	8.51 **	11.04 **	8.43 **
AR 1–2 Test	241.4 **	260.4 **	242.6 **	29.52 **	36.64 **	37.31 **
Hetero–X Test	6.93 **	7.13 **	7.93 **	5.74 **	6.02 **	5.97 **

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.

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 for both indicators are displayed in Table 3.[21] The upper (lower) line shows the results using the bias (variation) indicator as endogenous variable.

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

	Political	Economic	Procedural	Policy	Operational
Bias Indicator	–3.27 ***	–1.63 ***	–1.71 **	–2.40 ***	–0.22
Variation Indicator	–5.93 ***	–0.95 ***	–1.70 **	–1.05 **	–1.50 *

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. Full tables are available on request.

[20] The correlation coefficient between average communication and average transparency per country over the sample period is –0.14.

[21] Including all five subcategories in one model results in collinearity problems.

Although all subcategories have a theory-consistent declining impact on both indicators,[22] there is some variation across different subindices.[23] The largest impact for the bias indicator and the variation indicator in our sample 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.

Procedural transparency ranks second (third) in the case of the variation (bias) indicator. It includes (among other things) an explicit monetary policy rule and an account of policy deliberations. This helps explain how past decisions were reached and thus facilitates prediction of interest rates in the near future. Geraats (2002) views policy transparency as a factor that could boost the effectiveness of interest rate setting. Thus, it is not surprising that the prompt disclosure and explanation of policy decisions and an explicit policy indication of likely future policy action has a larger impact on the bias indicator than all other categories (except political transparency). However, in the case of the variation indicator, its impact only exceeds that of economic transparency. Finally, in our sample, economic transparency[24] seems to be less important than the other subcategories. Currently, publicly available macroeconomic data and forecasts are almost as accurate as those provided by the central bank. Thus, there may not be much benefit in the bank providing the public with internal data and the macroeconomic model.

The data set by Siklos (2011) also provides the scores for all 15 questions utilised in creating the index. Table 4 sets out the results for 10 of the 15 questions and both indicators.[25] In the case of the bias indicator, a subcategory of operational transparency (Q5c) performs best among the 10 items analysed: A regular evaluation of the central bank's policy outcome in light of its macroeconomic objective has the largest decreasing influence on the bias in money market expectations. Market participants learn whether or not monetary policy is beneficiary to the central bank's macroeconomic objectives and thus can alter their expectations about future interest rates if necessary. Also noteworthy is the influence of Q4b:

[22] The coefficient for operational transparency is insignificant in the regression employing the bias indicator as an endogenous variable.

[23] 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 by the Riksbank since 2007. However, the coefficient is insignificant as the variable mostly coincides with the country-specific effects for NZ.

[24] Table 4 shows that Q5a has a detrimental impact on both indicators, which explains the poor performance of operational transparency.

[25] 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) were omitted from the analysis.

an explanation helps agents understand the rationale for a given interest rate decision and, accordingly, to alter their expectations for future decisions.

A subcategory of political transparency (Q1a) exerts the largest influence on the variation of money market expectations among the 10 items analysed: every central bank in our sample provides a formal statement of the objective(s) of monetary policy; thus, it is explicit prioritization in case of multiple objectives that helps market participants better understand the central bank's intentions. Second in terms of reaction size is Q5b: the provision of information on (unanticipated) macroeconomic disturbances helps market participants (i) become aware of a disturbance and (ii) understand how the central bank plans to deal with it. As a consequence, transparent dealing with disturbances reduces market uncertainty and decreases the variation indicator.

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

	Q1a	Q2a	Q2b	Q2c	Q3c
Bias Indicator	–3.27 ***	–3.22 ***	–1.85 ***	–3.63 ***	–1.71 **
Variation Indicator	–5.93 ***	–2.54 **	–0.99 ***	–2.38 ***	–1.70 **

	Q4b	Q4c	Q5a	Q5b	Q5c
Bias Indicator	–4.23 ***	–1.71 **	4.61 **	–3.65 ***	–6.00 ***
Variation Indicator	–0.90	–1.70 **	0.57	–5.51 ***	–1.34

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. An excerpt of the Eijffinger and Geraats (2006) questionnaire can be found in the Appendix. Full tables are available on request.

Finally, in the recent empirical literature (van der Cruijsen et al., 2010) it is shown that there might be a limit to the benefits of transparency and that, in fact, an intermediate degree of transparency might be desirable. As part of our robustness tests we estimated Equation (8) with 'communication^2' and 'transparency^2' as additional exogenous variables. However, the results do not provide robust or meaningful insights as to the optimal level of transparency for either indicator.[26]

6. Conclusions

In this paper, we study the influence of central bank transparency and informal central bank communication on the formation of money market expectations. The sample covers nine major central banks (RBA, BOC, ECB, BOJ, RBNZ, Riksbank, SNB, BOE, and the Fed)

[26] Full tables are available on request.

from January 1999 to July 2007. We employ a continuous test for the influence of both factors using two indicators that account for the bias and variation of money market expectations during the entire intermeeting period. Country-specific OLS models and a pooled OLS model reveal several interesting results.

First, in the case of the country-specific models, transparency mitigates the bias in money market expectations and dampens the variation of expectations (given an error in expectations). A higher degree of transparency leads to a lower expectation bias in AUS, the EMU, JAP, SUI, and SWE, whereas the variation of expectations is reduced in AUS, CAN, the EMU, SWE, and the UK. In contrast, central bank communication only contributes in the case of the variation indicator. Informal central bank speeches by the BOC, ECB, SNB, Riksbank, and Fed reduce the variation of expectations. Thus, informal communications do help manage financial market expectations but not to the same extent as formal transparency measures. Another finding is that two central banks with a relatively low degree of formal transparency (the SNB and Fed) show the largest coefficients for central bank communication. An increase in informal communications might be a substitute for formal transparency (at least in the case of the variation indicator). The pooled regressions confirm the country-specific results: transparency mitigates the bias and dampens the variation of expectations, whereas communication contributes only in the latter case. Furthermore, we show that formal transparency and informal communication are almost orthogonal in their influence on both variables.

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 decreasing impact on the bias and variation of money market expectations. However, in our sample, political transparency, procedural transparency, and policy transparency seem to be more important than economic transparency. The detailed data provided by Siklos (2011) also enable assessing 10 out of 15 items of the original questionnaire. In the case of the bias in money market expectations, the regular evaluation of the central bank's policy outcome in light of its macroeconomic objectives (a subcategory of operational transparency) and the provision of an explanation of interest rate decisions (policy transparency) have the largest decreasing influence of the 10 items analysed. An explicit prioritization in the case of multiple objectives (political transparency) and the provision of information on (unanticipated) macroeconomic disturbances (operational transparency) contribute to a lower variation in money market expectations.

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 faces 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
AUS	9.5	9.5	9.5	10.5	10.5	10.5	10.5	10.5	10.5
CAN	10.5	10.5	10.5	10.5	10.5	11	11	11	11
EMU	8.5	8.5	10	10.5	10.5	11	11	11	11
JAP	8	8.5	8	8	8	9.5	9.5	10	10
NZ	13	13	13.5	14	14	14	14	14	14
SUI	7	7.5	8	8	9	9.5	9.5	9.5	9.5
SWE	9.5	11.5	11.5	14.5	14.5	14.5	14.5	15	15
UK	12	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
US	10	10	10	10	10	10	10	10	10

Source: Siklos (2011).

Table A2a: Descriptive Statistics of the Bias Indicator

	Observat.	Mean	Std. Dev.	Skewness	Minimum	Maximum
Overall	766	3.68	3.30	2.63	0.09	28.41
AUS	92	2.59	1.78	1.11	0.27	9.38
CAN	53	2.20	1.24	0.71	0.45	6.28
EMU	137	4.80	3.96	2.65	0.49	28.41
JAP	137	3.15	3.86	1.85	0.21	21.36
NZ	67	4.16	1.88	0.89	0.98	10.94
SUI	33	2.22	3.98	4.54	0.09	22.68
SWE	76	4.82	2.64	1.01	0.59	12.51
UK	102	3.39	2.24	2.33	0.36	15.45
US	69	4.44	4.48	2.87	1.06	26.43

Table A2b: Descriptive Statistics of the Variation Indicator

Variation	Observat.	Mean	Std. Dev.	Skewness	Minimum	Maximum
Overall	766	3.02	3.14	2.81	0.00	25.61
AUS	92	3.63	2.66	1.55	0.47	15.31
CAN	53	3.67	2.56	1.15	0.43	11.79
EMU	137	2.48	2.81	3.85	0.14	22.54
JAP	137	1.00	1.75	3.69	0.03	12.62
NZ	67	3.97	2.32	1.77	1.15	14.18
SUI	33	5.22	5.79	2.62	0.60	25.61
SWE	76	3.89	3.50	2.32	0.12	20.85
UK	102	2.95	2.80	4.07	0.20	22.99
US	69	4.00	3.73	1.77	0.00	20.42

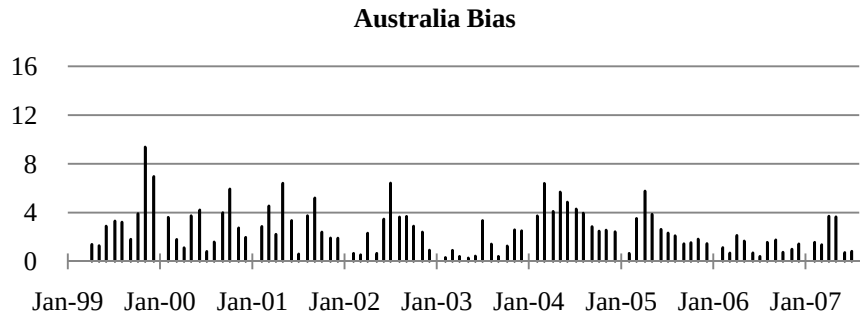
Table A3: Number of Speeches Delivered by Central Bank Governors

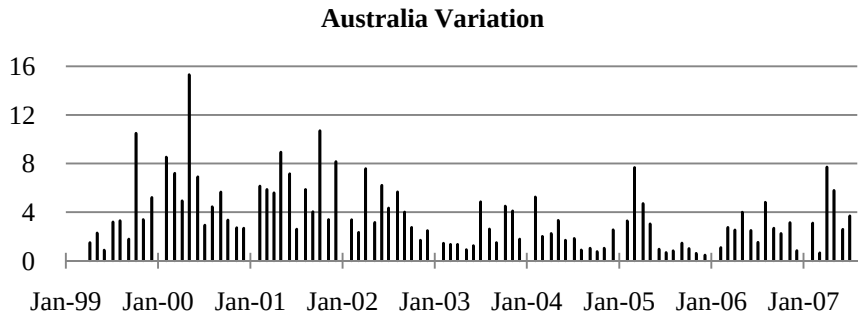
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
AUS	17	13	14	13	12	12	17	19	14
CAN	8	7	7	18	17	15	19	18	24
EMU	102	68	68	59	65	100	80	96	111
JAP	11	10	8	8	18	9	13	18	15
NZ	10	10	8	4	5	6	6	9	7
SUI	18	13	13	23	21	23	31	27	21
SWE	37	36	28	30	20	37	42	41	34
UK	31	37	38	28	17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

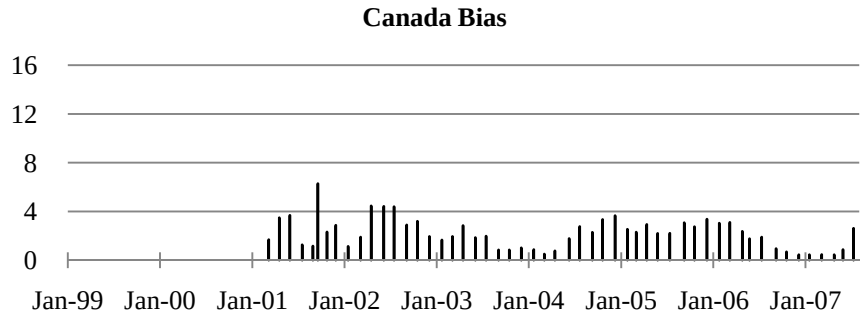
Note: The figures in 2007 contain only speeches delivered in the period January–July 2007 due to a considerable increase of central bank communication with the beginning of the recent financial crisis. To ensure comparability with the earlier years, figures for the first seven months of 2007 are projected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

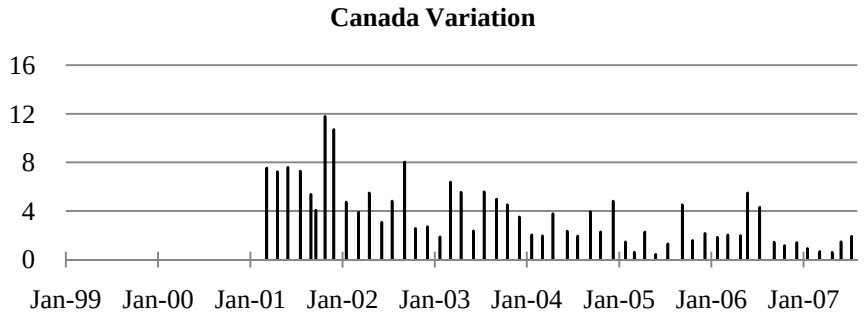
Source: Central bank websites and own calculations.

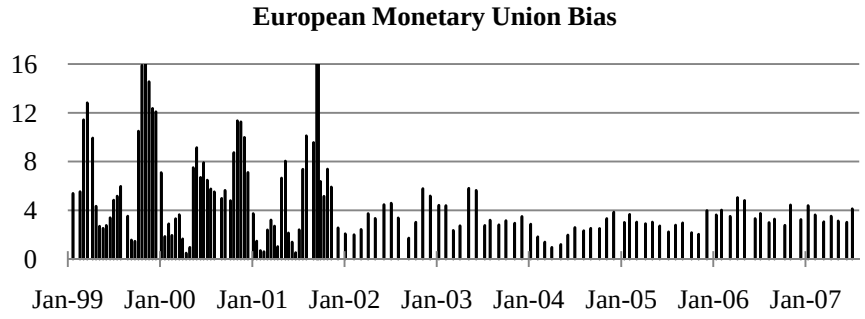
Figure A1: Bias and Variation Indicator for Nine Central Banks











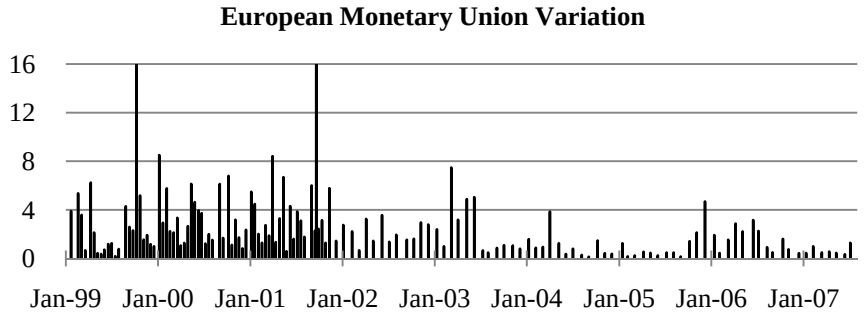
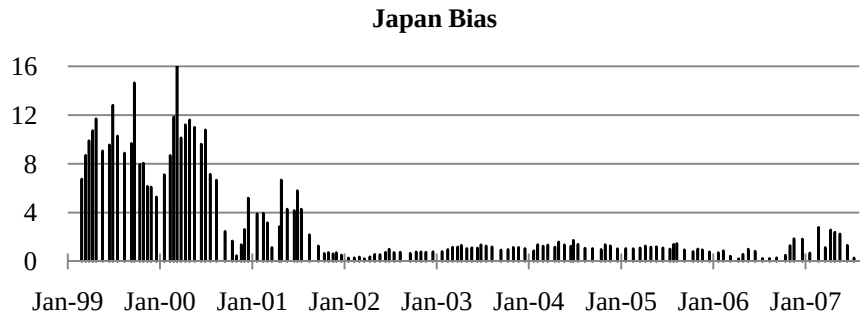
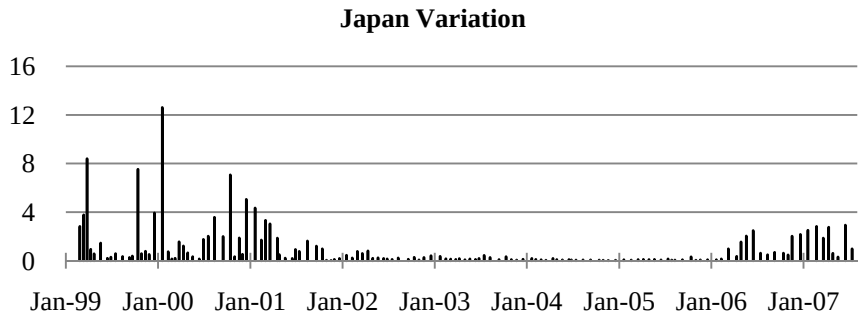
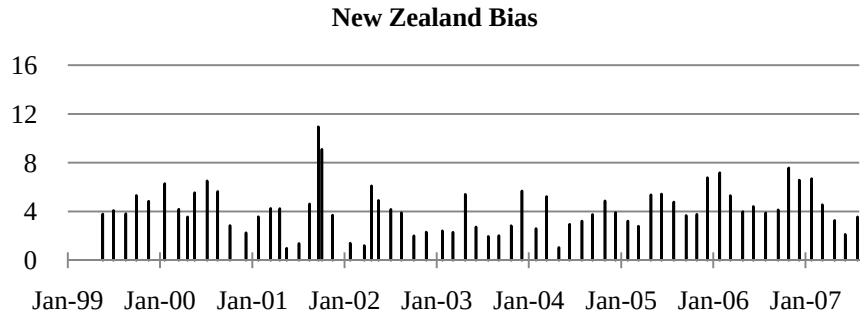
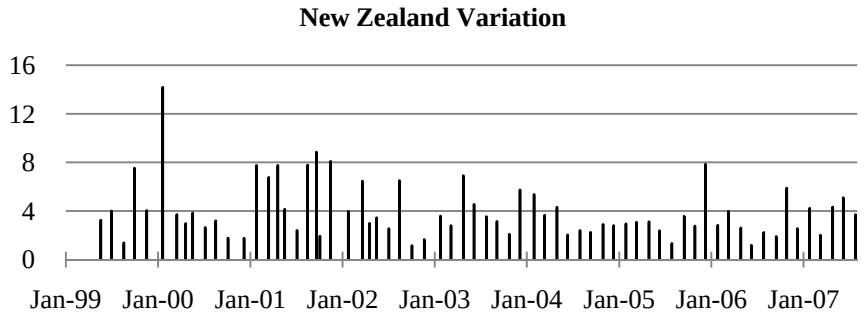


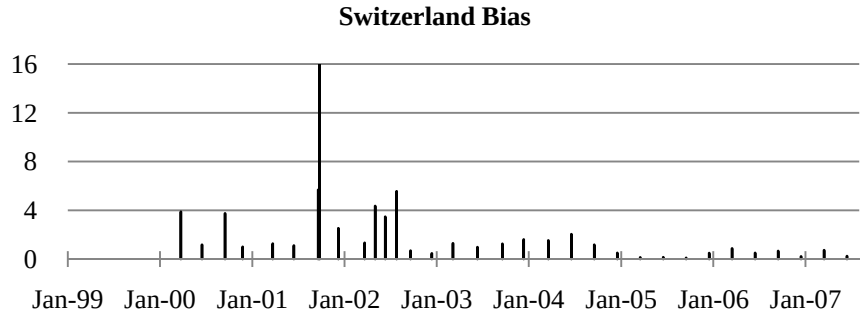
Figure A1: Bias and Variation Indicator for Nine Central Banks (continued)











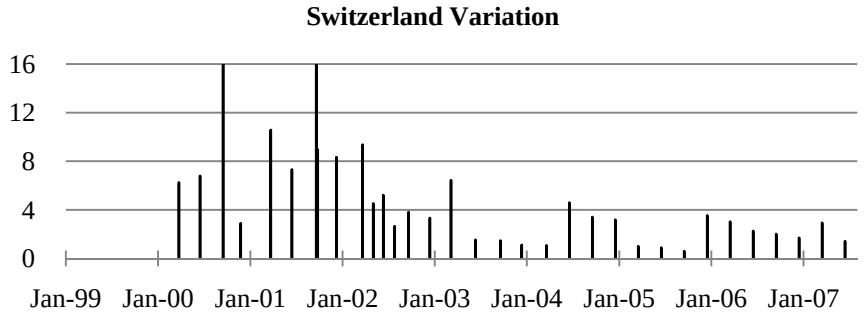
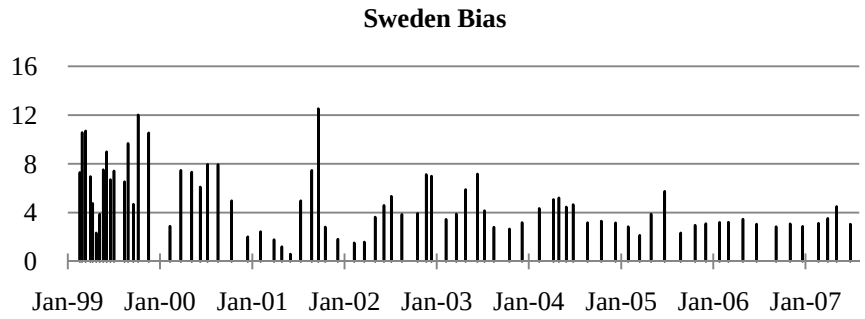
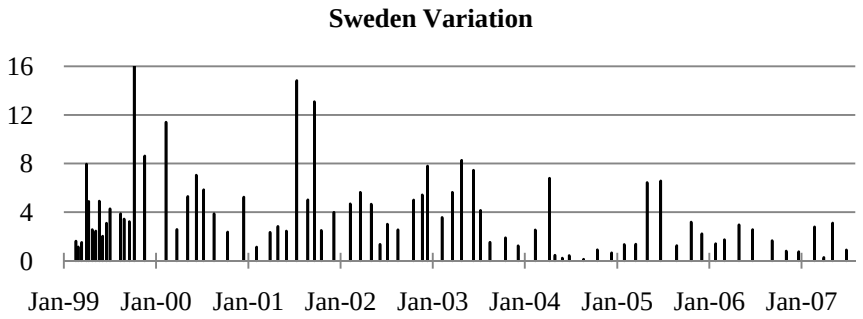
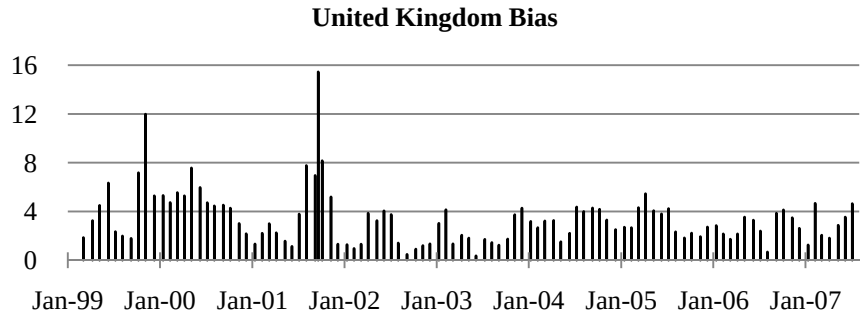
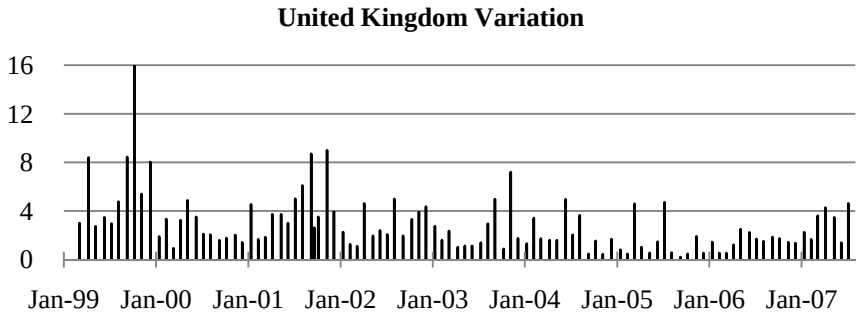


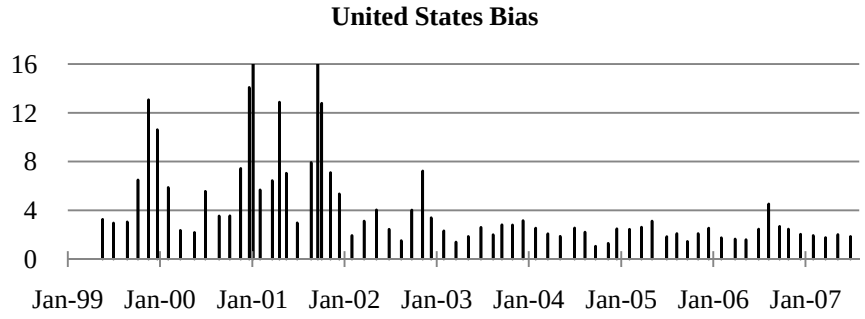
Figure A1: Bias and Variation Indicator for Nine Central Banks (continued)

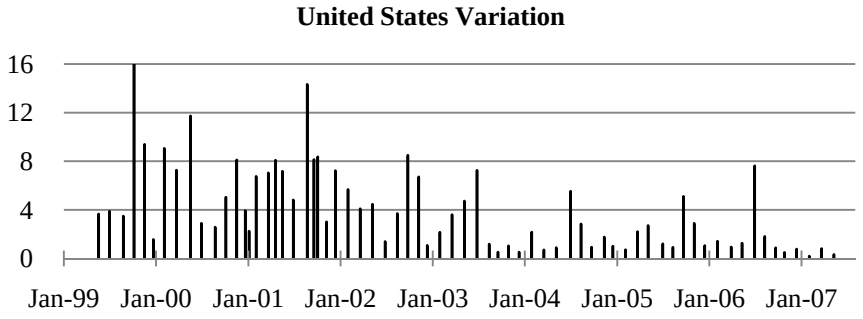












Transparency Index Questionnaire

Source: Eijffinger and Geraats (2006).

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?