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The empirical (ir)relevance of the interest rate assumption for central bank forecasts

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Non-technical summary

Over the past two decades, in particular in the context of the so-called *inflation targeting*, academia and central banks have intensively discussed the role of central bank forecasts. Inter alia, central bank forecasts are supposed to be important determinants of central bank transparency and private sector expectations.

When constructing these forecasts, the path future key interest rates are assumed to take over the forecast horizon is of particular concern. In practice, one can basically find three approaches. Under the first approach, forecasts are made leaving the interest rate unchanged. That is, over the forecast horizon, the interest rate remains at the level that it has attained at the time the forecast is made. This approach was pursued, for instance, by the European Central Bank until 2005 and the Swedish central bank until 2006. Under the second approach, forecasts are made assuming interest rates to follow a path as expected by market participants. Under certain assumptions, such an interest rate path can be derived from money and capital market rates. This approach is currently used, for example, at the Japanese central bank and the European Central Bank. Finally, it can be assumed that the interest rate follows the expectations of the central bank itself. This third approach is current practice at the Norwegian, the Swedish and the US central bank.

While the first two approaches yield conditional forecasts, the third approach leads to unconditional forecasts. According to economic theory, unconditional forecasts are usually preferred, not least because they are supposed to yield the highest forecast accuracy among all approaches. Moreover, from theoretical discussions one can deduce that, with a transparent and clearly communicated monetary policy, expectations of the markets about the key interest rate should only be subject to small deviations from the expectations of the central bank itself. Therefore, forecasts made conditional on a constant rate path ought to be less accurate than forecasts made conditional on a market rate path, which in turn ought to be less accurate than unconditional forecasts.

The present study attempts to verify the theoretical ranking by analyzing forecasts from the central bank of the United Kingdom and the Brazilian central bank. These two central banks are suitable candidates because they both publish forecasts based on different interest rate assumptions. While unconditional forecasts from these central banks are not available, ex post, at least corresponding proxies can be constructed. We investigate the inflation and output growth forecasts as well as the forecasts for the interest rate. While descriptive statistics suggest that the accuracy ranking is valid at least for the interest rate forecasts, statistical tests show virtually no significant differences in forecast accuracy of the interest rate, inflation and output growth forecasts with respect to their underlying interest rate assumption.

The empirical irrelevance of the interest rate paths for forecast accuracy implies that it is likely to be very challenging for central banks to shape private-sector forecasts by publishing unconditional forecasts. Moreover, the theoretically correct argument that forecasts made conditional on certain interest rate paths cannot be suitably evaluated by standard methods seems to be of minor relevance empirically.

Nicht-technische Zusammenfassung

Die akademische Welt und die Zentralbanken haben im Verlauf der letzten zwei Dekaden — insbesondere im Rahmen des sogenannten *inflation targeting* — die Rolle von Zentralbankprognosen intensiv diskutiert. Unter anderem wird diesen Prognosen eine wichtige Funktion bei der Schaffung von Transparenz und der Beeinflussung der Erwartungen des privaten Sektors zugeschrieben.

Bei der Erstellung der Zentralbankprognosen kommt dem unterstellten Verlauf des von der Zentralbank gesetzten Leitzinssatzes über den Prognosezeitraum eine besondere Bedeutung zu. In der Praxis werden hier im Wesentlichen drei Ansätze unterschieden. Beim ersten Ansatz werden die Prognosen unter der Annahme erstellt, dass der Zins konstant verläuft, d.h. im Prognosezeitraum unverändert auf dem Niveau verharrt, auf welchem er sich zum Zeitpunkt der Prognose befindet. Dieser Ansatz wurde beispielsweise von der Europäischen Zentralbank bis 2005 und der schwedischen Zentralbank bis 2006 praktiziert. Beim zweiten Ansatz werden Prognosen unter der Annahme erstellt, dass der Zentralbankzinssatz einen Verlauf nimmt, wie er von den Marktteilnehmern erwartet wird. Ein solcher Marktzinspfad kann unter bestimmten Annahmen aus am Geld- und Kapitalmarkt herrschenden Zinssätzen abgeleitet werden und findet gegenwärtig im Prognoseprozess unter anderem bei der japanischen Zentralbank und der Europäischen Zentralbank Verwendung. Darüber hinaus wird bei einem dritten Ansatz unterstellt, dass die Zinsen im Prognosezeitraum den Verlauf nehmen, den die Zentralbank selbst erwartet. Dieser Ansatz wird heute zum Beispiel von der norwegischen, der schwedischen und der US-amerikanischen Zentralbank verfolgt.

Während man bei den ersten beiden Ansätzen von der Erstellung bedingter Prognosen spricht, handelt es sich beim dritten Ansatz um die Erstellung von unbedingten Prognosen. In der theoretischen Betrachtung werden unbedingte Prognosen den bedingten Prognosen in der Regel vorgezogen, nicht zuletzt weil sie mit der im Vergleich der drei Ansätze besten Prognosegüte in Verbindung gebracht werden. Zusätzlich kann man den theoretischen Diskussionen entnehmen, dass im Rahmen einer auf Transparenz ausgelegten, klar kommunizierten Geldpolitik die Markterwartungen über Zentralbankzinssätze nur geringfügig von den Zentralbankerwartungen über Zentralbankzinssätze abweichen sollten. Daraus lässt sich eine Rangfolge ableiten, wonach die Prognosegüte von Prognosen, die auf einen konstanten Zinsverlauf bedingt sind, niedriger ist als die von Prognosen bedingt auf einen von Marktteilnehmern erwarten Zinspfad, wobei deren Prognosegüte wiederum niedriger ausfällt als die von unbedingten Prognosen.

Die vorliegende Studie versucht, diese theoretische Rangfolge anhand von Prognosen der Zentralbank des Vereinigten Königreichs und der brasilianischen Zentralbank empirisch zu verifizieren. Diese beiden Zentralbanken zeichnen sich dadurch aus, dass sie seit einiger Zeit Prognosen unter verschiedenen Zinsannahmen veröffentlichen. Unbedingte Prognosen werden zwar von keiner dieser beiden Zentralbanken publiziert, sie können aber ex post zumindest näherungsweise konstruiert werden. Es werden sowohl die Inflations- und BIP-Prognosen auf Basis der drei Ansätze als auch die verwendeten Zinspfade selbst auf ihre Prognosegüte hin untersucht. Während beschreibende Statistiken die theoretische Rangfolge zumindest für die Zinsprognosen selbst bestätigen, lassen sich mit statistischen Tests praktisch keine signifikanten Unterschiede in der Prognosegüte der Zins-, Inflations- und BIP- Prognosen in Abhängigkeit von den verschiedenen Zinspfaden feststellen.

Die empirische Irrelevanz der Zinspfade für die Prognosegüte impliziert unter anderem, dass es für Zentralbanken nicht einfach sein dürfte, durch die Verwendung unbedingter Prognosen die Erwartungen privater Akteure zu beeinflussen. Auch dürfte das häufig vorgebrachte Argument, dass auf bestimmte Zinspfade bedingte Zentralprognosen eben wegen ihrer Bedingtheit nicht mit den üblichen Evaluationsmethoden untersucht werden können, obgleich theoretisch zutreffend, in der Praxis von eher geringer Bedeutung sein.

Bundesbank Discussion Paper No 11/2013

The Empirical (Ir)Relevance of the Interest Rate Assumption for Central Bank Forecasts*

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Abstract

The interest rate assumptions for macroeconomic forecasts differ considerably among central banks. Common approaches are given by the assumption of constant interest rates, interest rates expected by market participants, or the central bank's own interest rate expectations. From a theoretical point of view, the latter should yield the highest forecast accuracy. The lowest accuracy can be expected from forecasts conditioned on constant interest rates. However, when investigating the predictive accuracy of the forecasts for interest rates, inflation and output growth made by the Bank of England and the Banco Central do Brasil, we hardly find any significant differences between the forecasts based on different interest assumptions. We conclude that the choice of the interest rate assumption, while being a major concern from a theoretical point of view, appears to be at best of minor relevance empirically.

Keywords: Forecast Accuracy, Density Forecasts, Projections

JEL classification: C12, C53.

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1 Introduction

It is well known that, due to lags in the monetary transmission mechanism, central banks have to rely on forecasts for the variables they intend to control, often given by inflation and output. In these forecasts, the policy variable, i.e. the short-term interest rate set by the central bank, plays a special role. According to Galí (2011), in practice one can basically distinguish three approaches. Firstly, forecasts can be conditioned on a constant interest-rate (henceforth CIR) assumption where the interest rate is assumed to remain at the level it had attained at the time the forecast was made. The CIR approach was pursued, for example, by the ECB until 2006 and the Sveriges Riksbank until the end of 2005. Secondly, the expectations of market participants can serve as a conditioning assumption about the interest rate path, which is current practice at, for example, the Bank of Japan and the ECB. Market expectations (ME) are usually derived from the term structure of interest rates. Finally, a central bank can issue unconditional forecasts for its target variables by using its own expectations about the interest rate path. The central bank expectation (CBE) approach has been adopted, for instance, by the Norges Bank, the Riksbank and the Federal Reserve System. The Fed's December 2011 FOMC statement, announcing that "participants agreed that adding their projections of the target federal funds rate to the economic projections already provided in the SEP [Summary of Economic Projections] would help the public better understand the Committee's monetary policy decisions", contributed to drawing the attention of economists to the topic of interest rate assumptions.

Among academics, there seems to be a clear favorite among the three approaches, CIR, ME and CBE, in terms of its suitability for central bank forecasts. Galí (2011), Svensson (2006) and Woodford (2005) advocate the CBE approach, i.e. unconditional forecasts. Galí (2011) shows that it is possible to construct different forecasts conditional on one given nominal interest rate path based on different policy rules, thus calling into question any conditioning assumptions about interest rates. A similar point is raised by Woodford (2005). However, if central bank forecasts are based on models, in practice the modest-interventions approach in the spirit of Leeper and Zha (2003) appears to be the most popular approach when conditioning assumptions are used.[1] In this case, a sequence of unanticipated monetary policy shocks generating the desired conditional interest rate path is assumed, yielding unique conditional forecasts.[2]

Independently of the method employed to construct the conditional forecasts, it is evident that the CBE approach is supposed to yield the highest forecast accuracy.[3] Actually, this property serves as one of the main reasons for preferring the CBE approach over conditional forecasts. (Galí, 2011, p.539) states that "it is not clear why the central bank would want to base its projections on a rule other than the actual rule it follows for, among other things, in that case the projections would also correspond to the best unconditional forecasts". Svensson (2006) also resorts to the potential gains in forecast accuracy

[1]This approach is employed in the models used by Christoffel, Coenen, and Warne (2007) and Adolfson, Laséen, Lindé, and Villani (2005). Faust and Wright (2008) state that the conditional forecasts of the Bank of England are also produced in a way that is in line with the modest-interventions approach. Yet, the work of Laséen and Svensson (2011) suggests that a different approach is currently considered at the Sveriges Riksbank.

[2]Yet, the assumption that the associated policy interventions are modest is not necessarily justified, as found by Adolfson et al. (2005).

[3]The forecast-accuracy measure should, of course, take the forecaster's loss function into account. We will elaborate on this issue below.

when advocating the CBE approach.[4] The literature does not provide comparably clear ideas concerning the relative forecast accuracy of the ME approach with respect to the CIR approach. However, it seems plausible that the ME approach should perform better unless the policy rate is best described by a random walk.[5]

Practitioners do not necessarily share the views prevalent among academics, as reflected by the fact that a large share of central banks does not base its forecasts on its own interest rate expectations. This could be due to several reasons, among other things communication issues. For example, Goodhart (2009) finds that using the central bank's expectations of the interest rate could be misunderstood as a commitment. Therefore, an interest rate path derived from market expectations could be regarded as "a brilliant compromise" (Goodhart 2009, p.94) between the potential lack of credibility of a constant rate assumption and the problems associated with publishing a path of future interest rates expected by the central bank. However, there are also central banks that use the constant interest rate assumption, for instance the Swiss National Bank. Arguments in favor of this approach can be found in Goodhart (2001). An interesting argument against the CBE approach follows from Morris and Shin (2002), who find that more precise public information can, in principle, decrease welfare by crowding out private information.

Several empirical aspects related to interest rate assumptions are investigated in Andersson and Hofmann (2009). When comparing central banks which either use the ME approach or the CBE approach, Andersson and Hofmann (2009) conclude that if a central bank is transparent and committed to maintaining price stability, the behavior of key variables like inflation expectations and long-term bond yields does not seem to be affected by the type of interest-rate assumption. In contrast to that, Winkelmann (2010) finds that using the CBE approach instead of the ME approach leads to better private-sector forecasts of longer-term interest rates.

In this paper, we propose to assess the effects of the interest rate assumptions by testing for differences in forecast accuracy. We do so because forecast accuracy is one the main reasons given in the academic literature for preferring the CBE approach. Forecast accuracy is, of course, also directly related to all other issues mentioned above. For example, it appears unlikely that the central bank will be able to better steer market expectations for interest rates, inflation, and output growth, and, thus, financial variables like bond yields, with the CBE approach, if the central bank's forecasts with the CBE approach do not turn out to be more accurate than with the CIR approach or the ME approach, at least in the medium term.[6] The validity of the reasons brought forward against the CBE approach depends on forecast accuracy as well. For example, misunderstanding the CBE approach as the central bank's commitment to an interest rate path will be unlikely, if the CBE approach does not turn out to yield better interest rate forecasts than the ME approach or the CIR approach. The potential crowding out of private

[4]Svensson (2006, p.2), referring to the CBE approach as the optimal projection, claims that "Since monetary policy has an impact on the economy via the private-sector expectations of inflation, output, and interest rates that it gives rise to, announcing the optimal projection (including the instrument-rate projection) and the analysis behind it would have the largest impact on private sector expectations and be the most effective way to implement monetary policy. Since the optimal projection is the best forecast in the sense of minimizing expected squared forecast errors, it also provides the private sector with the best aggregate information for making individual decisions."

[5]Svensson (2006, p.5) notes that "ME are usually more realistic than the CIR, depending on the market's understanding and prediction of future instrument-rate decisions. This makes projections based on ME better forecasts of future instrument-rate decisions than CIR projections."

[6]In the short term, market participants might simply believe that the central bank's forecasts become more accurate with the CBE approach. In the medium term, this belief can be assessed using the forecasting record obtained with the CBE approach.

information as stated by Morris and Shin (2002) also requires the forecasts with the CBE approach to be sufficiently precise.

Comparisons of forecast accuracy under different approaches can also be important in other respects. As noted, for example, by D'Agostino, Giannone, and Surico (2006), since the start of the Great Moderation, for macroeconomic forecasters it has become very difficult to issue more accurate forecasts than naive models do. One explanation for this fact, mentioned by Edge and Gurkaynak (2010), could be given by successful monetary policy. If the central bank aims at stabilizing inflation, and if it has a well-specified model at its disposal which describes the economy in a sufficiently precise manner, it will set interest rates such that inflation is always close to a desired target value.[7] Under certain conditions, this behavior can also imply very stable growth rates of output.[8] If this explanation is correct, we should observe that forecasts made by the central bank which are based on a counterfactual policy, like, for instance, the forecasts under the CIR approach, yield larger forecast errors than the forecasts based on the CBE approach.

Finally, another very basic interest in the comparison between the forecast accuracies with the different interest rate assumptions results from the way central banks construct prediction intervals around their forecasts. Many central banks assess their future forecast uncertainty based on past forecast errors.[9] If there was a switch in the interest assumption, the question arises whether using forecast errors from the time before the switch may distort the prediction intervals too much.[10] Similarly, the evaluation of central bank forecasts commonly ignores their conditionality with respect to the assumed interest rates, as stated in Faust and Wright (2008). Therefore, Faust and Wright (2008) derive an evaluation framework which takes the conditionality into account. It is, thus, interesting to assess how large the errors might be if conditionality is ignored and simple standard evaluation procedures are used.

In principle, comparisons of forecast accuracy could be made for two central banks which operate under distinct interest rate assumptions, or for two samples from a single central bank which switched from one approach to another approach. Both types of comparisons can be found in Andersson and Hofmann (2009), and only the latter is used in Winkelmann (2010). However, when comparing the forecasts of two central banks, the differences in forecast accuracy could, of course, be due to country-specific issues. A comparison of two samples from a single central bank is likely to suffer from the instability of the predictive content of forecasting models over time often encountered in the case of macroeconomic forecasts.[11] In this work, we therefore exploit the forecasts of the Bank of England (BoE) in order to assess the impact of the interest rate assumption on forecast accuracy. The feature which makes these forecasts excellent candidates for our investigation is given by the fact that, since 1998, the BoE has published forecasts for inflation and output growth conditional on two different interest rate assumptions: CIR and ME. Thus, conclusions reached with these data should be rather robust with

[7] Deviations from the target value are only due to unforecastable shocks in this case. Thus, a naive forecast which simply predicts the target value cannot be beaten by more sophisticated models in terms of forecast accuracy.

[8] See Blanchard and Galí (2007) for details.

[9] For a short survey, see Deutsche Bundesbank (2010, p.13).

[10] For example, Reifschneider and Tulip (2007) ask if the interest rate assumption affects the usefulness of past forecast errors of the Greenbook forecasts (produced with the CIR approach) for assessing the uncertainty surrounding current FOMC forecasts (employing the CBE approach). Reifschneider and Tulip (2007, p.13) conjecture that "the Greenbook's historical forecast errors may tend to overstate the uncertainty of the outlook to some degree."

[11] See, for instance, Rossi (forthcoming).

respect to instabilities over time. A drawback of these data is the absence of forecasts with the CBE approach. However, reasonable proxies for CBE forecasts can be constructed using additional data on forward rates. In addition to the BoE data, we also consider forecasts issued by the Banco Central do Brasil (BCB). Similar to the BoE, the BCB has published forecasts for inflation conditional on two different interest rate assumptions: CIR and ME. Yet, due to data limitations, we cannot construct proxies for forecasts with the CBE approach in this case. The remainder of this paper is organized as follows. Section 2 describes the data set of this study, and in Section 3 proxies for additional BoE forecasts are constructed. Section 4 presents some properties of the forecasts, and in Section 5, test results for equal predictive accuracy of point and density forecasts are presented. Section 6 concludes.

2 The Data

There have been many changes in the interest rate assumptions used for central bank forecasts. In Table 1 we show the history for selected central banks that have varied their assumptions in recent years.[12] In general, central banks have tended to move away from the CIR approach towards the ME or the CBE approach. In some cases, the ME approach has turned out to be an intermediate step only on the way towards the CBE approach.

With respect to data availability, the BoE and the BCB are special cases among the central banks considered. Since 1998, the BoE's quarterly Inflation Reports comprise two different forecasts for inflation and output growth, respectively, made by the Monetary Policy Committee (MPC) for up to eight quarters ahead. The difference between the forecasts is given by the underlying interest rate assumption. For one of the forecasts, nominal interest rates are assumed to be constant over the forecast horizon (CIR approach), whereas the other forecast is conditioned on an interest rate path that is based on market expectations about the future level of the official bank rate (ME approach). The forecast data are publicly available on the BoE website.[13] The BoE has no clearly laid-out preference for one over the other interest rate assumption. With the Inflation Report of August 2004, however, the emphasis was slightly shifted towards the ME approach.

In a similar fashion, the BCB Inflation Reports since 1999Q4 contain quarterly inflation nowcasts and forecasts for at least up to five quarters out, based on the CIR approach as well as the ME approach.[14] In contrast to the BoE, the BCB forecasts are also made conditional on exchange rate paths using the two competing conditioning assumptions, i.e. constant exchange rates and market expectations. These exchange rate paths, however, are rather similar, because the market expectations are mostly very close to a random walk. Therefore, we neglect the exchange rates issue in the following analysis.[15] Regarding the preference of the conditioning assumption, the BCB's September 1999 Report, p.79, puts more weight

[12] Appendix B lists references and statements of central bank publications on which Table 1 is based.

[13] The forecast data are available at `www.bankofengland.co.uk/publications/inflationreport/irprobab.htm`.

[14] Up to December 2000, the number of forecast horizons of the BCB inflation forecasts varied between six and at most ten. With the December 2000 report, the BCB started to publish forecasts for up to the end of the next year, with the December forecasts made for up to eight quarters out and the number of forecast horizons diminishing one by one over the three consecutive Inflation Reports. Since December 2007, every Inflation Report contains quarterly forecasts made for up to eight quarters out.

[15] Exchange rate expectations are available from the BCB online under `https://www3.bcb.gov.br/expectativas/publico/en/serieestatisticas`.

Table 1: Interest rate assumptions in central banks

Central Bank	Constant Rates **(CIR)**	Market Expectations **(ME)**	Central Bank Expectations **(CBE)**
Banco Central do Brasil	CIR since report of September 1999	ME since report of September 1999	-
Banco Central de Chile	CIR for reports of May 2000 to May 2004	ME since report of September 2004	-
Bank of England	CIR since report of February 1993 for inflation and since August 1997 for real output growth	ME added with report of February 1998	-
Bank of Japan	CIR for reports of October 2000 to October 2005	ME since report of April 2006	-
Board of Governors of the Federal Reserve System	CIR assumption for earlier Greenbook forecasts*	-	CBE assumption for FOMC forecasts since 2007**
European Central Bank	CIR for Eurosystem Staff Macroeconomic Projections from June 2001 to March 2006	ME for Eurosystem Staff Macroeconomic Projections since June 2006	-
Magyar Nemzeti Bank	CIR for reports of June 2000 to November 2010	-	CBE since report of March 2011
Norges Bank	CIR for reports of June 2001 to June 2003	ME for reports of March 2000 to March 2001 and March 2003 to November 2004	CBE since report of March 2005
Reserve Bank of Australia	CIR up to report of May 2009	ME since report of August 2009	-
Reserve Bank of New Zealand	CIR before 1997	-	CBE since 1997
Sveriges Riksbank	CIR for reports from March 1997 to June 2005***	ME for reports from October 2005 to October 2006	CBE since report of February 2007
Swiss National Bank	CIR since 1999	-	-

Note: The above categorization is based on references and quotations shown in Appendix B.
* Based on Reifschneider and Tulip (2007) and Goodhart (2009).
** Based on the Fed's Semiannual Monetary Policy Report to the Congress of February 2007.
*** Including scenario analyses using market rates.

on the CIR approach when stating that "Normally, the Inflation Reports will issue two fan charts. The first and most important is constructed on the assumption of a constant nominal interest rate over the course of the projection period, while the second is accessory by nature and is based on the assumption that the nominal interest rate will be that built-into market expectations."

A special feature of the BoE Inflation Report forecasts, or, rather, the forecasts by the Monetary Policy Committee (MPC) is that they are actually issued as density forecasts, using the two-piece normal distribution. The BoE reports the three location parameters mean, mode, and median along with measures of skew and uncertainty, from which the parameters of the forecast densities can be inferred using the formulas in Wallis (2004). The inflation forecasts will be evaluated based on the price indices targeted and forecast by the BoE.[16] Real output growth realizations are those calculated for the seasonally adjusted GDP chained volume measure ABMI, taken from the BoE realtime database.[17] We use the second vintage thereof, yielding observations up to 2010Q4 for the construction of forecast errors and determining the end of the BoE data set.[18] The forecast horizons under study range from 0 (the nowcast) to 8 quarters ahead, such that $h = 0, \dots, 8$.[19]

The forecasts made by the BCB's monetary policy committee, the COPOM (Comitê de Política Monetária), are also published as density forecasts. Yet, different from the BoE's publication practice, the COPOM forecasts are presented as quantiles belonging to the 10%, 30% and 50% prediction intervals of the central projection for inflation. Moreover, this central projection is a median forecast. The forecast data are publicly available in the Inflation Reports from 1999Q4 to 2011Q4.[20] To utilize information from the entire period, we restrict the sample to contain the nowcast and forecasts for up to five quarters out, i.e. $h = 0, \dots, 5$. Yet, there are no market rate forecasts available for 2002Q4 and 2003Q1, such that these quarters are missing in our data set. As we are interested in the mean and standard deviation of the distributions underlying the fan charts, we back out these parameters by fitting a normal distribution to the medians and quantiles provided in the BCB Inflation Reports, using a least squares criterion. Since the confidence intervals are symmetric around the median, and there is no significant forecast skewness in the BCB figures, the normal distribution appears to be a proper choice and the central projection being a median no crucial point.[21] The BCB generally forecasts inflation in the *Broad National Consumer Price Index*, or IPCA (Índice Nacional de Preços ao Consumidor Amplo), as reported by the Brazilian Institute of Geography and Statistics (IBGE). "The IPCA is the most important price index from the

[16]Before 2004, the relevant price index was the 'retail price index excluding mortgage interest payments', called RPIX in short. Since 2004, the forecast objective is the inflation rate of the 'all items consumer price index', abbreviated CPI. The UK's Office for National Statistics (ONS) provides inflation figures for RPIX and CPI with one decimal place. To be closer to the two-decimal-place precision of the BoE inflation forecasts, we recalculate the quarterly year-on-year growth rates of these indices.

[17]The realtime database is available under `http://www.bankofengland.co.uk/statistics/gdpdatabase/`.

[18]In anticipation of the statistical inference conducted later in this study, we can state at this point that all test results are robust with respect to varying the real GDP vintage. For the price indices, there are no real-time data available. However, the RPIX figures are never revised, see for instance the discussion in Groen, Kapetanios, and Price (2009). The CPI comprises only minimal revisions, as described by the ONS (2003).

[19]The BoE has been publishing CPI inflation forecasts and real output growth forecasts made conditional on market rates for up to 12 quarters ahead since August 2004.

[20]See `http://www.bcb.gov.br/?id=INFLAREPORT&ano=1999` for further details.

[21]Specifically, the Inflation Report of September 2005, p.96, says that "With the exception of June 1999 and December 2002, past issues of the *Inflation Report* presented symmetric fan charts."

standpoint of macroeconomic policy because it is the consumer price index that is used in the country's inflation targeting regime adopted in June 1999", as stated in the BCB's 'Price Indices' explanations on p.7.[22]

In addition to the BoE inflation and output growth forecasts and BCB inflation forecasts, we also evaluate the BoE's and BCB's interest rate paths. The constant interest rate path used by the BoE corresponds to the level of the official bank rate (formerly the repo rate) in the mid-quarter months February, May, August and November, constantly written forth over the two-year horizon. The available market rates data begin in 2000Q1 and thus determine the start date of the BoE data set.[23] This date corresponds to the introduction of a new calculation method for market expectations of the BoE's official bank rate, as stated in the August 2000 Inflation Report.[24] Forecast errors of the interest rate paths are calculated by subtracting a quarterly average of the monthly interest rates from the respective interest rate forecast. It should be noted at this stage that the constant interest rate path uses the interest rate which is set *in the MPC meetings* in February, May, August and November. The market rate path is constructed based on data available until the day *before these meetings*. Thus, the constant rate path contains information which is not present in the market rate path. This issue will be addressed in the following analysis.

The constant interest rate path that is underlying the BCB's benchmark scenario for inflation is the level of the SELIC rate set by the COPOM in the meeting of the publication month of the Inflation Report.[25,26,27] Since the Inflation Reports are published quarterly in the end-of-quarter months March, June, September and December, we naturally obtain a quarterly series of interest rate decisions, which is written forth constantly over the forecast horizon.[28] The market expectations about the SELIC rate are also publicly available on the BCB's website.[29] The daily data is carefully matched to the constant-rate path using the fixing dates provided in the BCB Minutes and Inflation Reports. The starting date of the interest rate sample is determined by the availability of the market expectations, which are reported from November 2001 onwards. Both the constant-rate path and the market-rate path aim at forecasting SELIC interest rates at the end the quarter. Hence, the series of SELIC observations is identical to the nowcast of the constant-rate path.

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[22]IPCA figures are obtained from the International Monetary Fund's International Finance Statistics database.

[23]"Market expectations of the Bank's official interest rate" from 2000Q1 to 2004Q3 were collected from the respective Inflation Reports for that period. "Conditioning paths for Bank Rate published in successive editions of the Inflation Report since November 2004" are available at `www.bankofengland.co.uk/publications/inflationreport/market_profiles.xls`.

[24]The passage cites as follows: "Since the November 1999 Report, market expectations have been derived from interest rates on gilt-edged securities used as collateral in short-term sale and repurchase agreements and from the gilt-edged yield curve. These rates provide a more direct guide to market expectations of the future path of official interest rates." Moreover, the calculation of the market rates path is changing from time to time to adjust to market conditions, as stated under `http://www.bankofengland.co.uk/publications/inflationreport/conditioning_path.htm`.

[25]The 2006Q2 fan charts' rates were set in May 2006, see the BCB Inflation Report June 2006, p.89, while the 2006Q3 fan charts' constant rates were set in August 2006, see the BCB Inflation Report September 2006, p.108.

[26]The SELIC rate is a short-term interest rate and the main monetary instrument of the BCB, where SELIC is an acronym terming the *Sistema Especial de Liquidação e Custodia*, translated as *Special Clearance and Escrow System*.

[27]Until March 1999, the TBC rate (basic interest rate) and the TBAN (Financial Assistance Rate) served as main monetary instruments.

[28]Although the BCB publishes forecasts four times a year, there are eight MPC meetings a year since 2006. Initially, there were monthly COPOM meetings, beginning with the first meeting of June 1996, with occasional extra meetings, see `http://www.bcb.gov.br/?COMMITTEE`.

[29]Again, see `http://www.bcb.gov.br/?id=INFLAREPORT&ano=1999` for further details.

3 Proxies for BoE Forecasts Under Additional Interest Rate Assumptions

3.1 The Interest Rate Forecast of the BoE

As mentioned above, due to timing issues, the CIR forecasts contain information which is not present in the ME forecasts. This might make the forecasts with the CIR approach more accurate than those with the ME approach, above all at short horizons. Moreover, no CBE forecasts are available. In the following subsections, these problems will be addressed for the case of the BoE.

In a first step, we will try to construct proxies for the own interest rate forecast of the BoE. In order to do so, it is convenient to employ daily yield curve data on forward rates for UK government bonds and forward interbank rates published by the BoE. The policy rate forecast of the ME approach is actually based on these data. In order to derive the forward rates of the policy rate, the level of the yield curve data has to be adjusted due to certain types of premia and other issues, as explained in Brooke, Cooper, and Scholtes (2000).[30] Denoting the instantaneous forward rate m months ahead that was expected on the day δ of the policy rate decision by $g_m(\delta)$, and the forward rate that was expected on the day after the decision by $g_m(\delta+1)$, we measure the monthly monetary policy surprise with respect to the m-months-ahead policy rate forecast based on the published yield curve data as

$$\tilde{s}_m(\delta) = g_m(\delta+1) - g_m(\delta). \tag{1}$$

Note that, by taking differences, the difference in levels between the published forward rates and the forward rates of the policy rate does not affect our measure of the monetary policy surprise as long as that difference in levels is approximately constant over time. According to the information in Brooke et al. (2000), this appears to be a reasonable assumption, but this issue will be briefly discussed below.

While the surprises have a monthly frequency and are defined for monthly policy rates, the forecasts to be investigated are available on a quarterly basis only. Since the surprises are a relatively smooth and persistent function of the horizon in months, i.e. because of $\tilde{s}_m(\delta) \approx \tilde{s}_{m+1}(\delta)$, we simply use $\hat{s}_h(\delta) \equiv \tilde{s}_{3h+1}(\delta)$ as the measure of the surprise for the quarterly rates with respect to a horizon of h quarters.[31] Note that $\hat{s}_h(\delta)$ itself has a monthly frequency, because the surprises for the quarterly rates are calculated for each MPC meeting, and these meetings take place every month. Henceforth, a hat will be used to indicate quantities that are subject to measurement uncertainty or estimation uncertainty.[32]

The measures $\tilde{s}_m(\delta)$ and, thus, $\hat{s}_h(\delta)$ might be distorted mainly due to three reasons. Firstly, news other than the monetary policy surprise also affect the forward rates. However, since the window

[30] The data are available at `http://www.bankofengland.co.uk/statistics/Pages/yieldcurve/default.aspx`. As done by the BoE when deriving the market expectations of the policy rate, for our analysis, we employ the government liability curve until October 2004 and the commercial bank liability forward curve thereafter. Due to problems related to the financial crises, the BoE has further modified its derivation of market expectations since November 2007, but the corresponding yield curves are not available on its website. However, the modifications were necessary mainly in order to estimate the correct levels of forward rates. We will be using differenced data only, which should be robust with respect to level effects caused by higher liquidity or risk premia. See `http://www.bankofengland.co.uk/publications/Pages/inflationreport/conditioning_path.aspx` for further details.

[31] For instance, the surprise for the quarterly rates for two quarter out, i.e. $h = 2$ and, hence, $\hat{s}_2(\delta)$, is the monthly monetary policy surprise of the monthly rates seven month ahead, $\tilde{s}_7(\delta)$.

[32] Measurement uncertainty is only indicated for variables constructed in this work. Of course, $\tilde{s}_m(\delta)$ is also subject to measurement uncertainty, but it will not be used in what follows.

for these shocks to occur lasts 24 hours only, their effect should be relatively small. Secondly, in contrast to what was observed in the more distant past considered by Brooke et al. (2000), it might be that the risk premia in the forward curves changed due to the monetary policy decision during the financial crisis, but it is difficult to quantify the importance of this issue. Yet, for example, on 06 November 2008, the BoE decreased the policy rate by as much as 150 basis points in order to demonstrate its resoluteness to dampen the effects of the financial crisis, which might have led to a pronounced decrease in risk premia. While the financial markets had apparently expected the policy rate to decrease strongly in the coming months, they were surprised by the unprecedented size of the decrease on a single day.[33] Consequently, the 1-month forward rate dropped by 119 basis points, but the change in the 60-month forward rate amounted to 8 basis points only. This might suggest that the risk-premia effects of the monetary policy decisions do not lead to large distortions in the measurement of the monetary policy shock at least at longer horizons.[34] Finally, as pointed out by Anderson and Sleath (1999), there can be considerable uncertainty about the rates at the short end of the forward curve.

Denoting the market expectations of the policy rate in quarter t for quarter $t+h$ by $ME_{t+h|t}$ with $h = 0, 1, \ldots, 8$, we calculate a proxy for the BoE's own interest rate forecast $\widehat{CBE}_{t+h|t}$ as

$$\widehat{CBE}_{t+h|t} = ME_{t+h|t} + \sum_{i=0}^{h} \hat{s}^{(t)}_{t+h|t+i} \tag{2}$$

where $\hat{s}^{(t)}_{t+h|t+i}$ is the monetary policy surprise that occurred in quarter $t+i$ for the forecast made in quarter t for $t+h$. In general, this quarterly surprise is the sum of the three monthly monetary policy surprises that occurred within quarter $t+i$. To be more precise, $\hat{s}^{(t)}_{t+h|t+i}$ is determined by

$$\hat{s}^{(t)}_{t+h|t+i} = \begin{cases} \hat{s}_h\left(\delta_{1,t+i}\right) + \hat{s}_h\left(\delta_{2,t+i}\right) + \hat{s}_h\left(\delta_{3,t+i}\right) & \text{for } i = 1, 2, \ldots, h;\ h > 0 \\ \hat{s}_h\left(\delta_{2,t+i}\right) + \hat{s}_h\left(\delta_{3,t+i}\right) & \text{for } i = 0; h \geq 0 \end{cases} \tag{3}$$

where $\delta_{j,t+i}$ is the day of the monetary policy decision in the jth month of quarter $t+i$. Since the Inflation Reports are published in the second month of a quarter, and, thus, the market expectations of the policy rate are also determined at that date, $\hat{s}^{(t)}_{t+h|t+i}$ only contains the surprises of the second and third month if $i = 0$.

At first sight, it might appear that we assume that the BoE knows how it will surprise the markets h quarters ahead, which might seem implausible. However, the approach proposed should rather be thought of as capturing surprises which result from the updating of market expectations.[35] Whether the proxy

[33] According to the Consensus Forecasts from 13 October 2008, the most likely policy rate change mentioned by survey participants was a decrease by 50 basis points. Put differently, financial markets had expected the interest to decrease by 150 basis points and more, but they had not expected this decrease to happen immediately.

[34] This conclusion rests on the assumption that on 06 November 2008, the BoE did not make statements which led the markets to revise their expectations concerning the interest rate in 60 months upwards. However, we have not found any indications for such statements.

[35] To give an example, neglecting the nowcasting issue, assume that in quarter $t-2$, markets expect an interest rate of 3% in quarter t, while the central bank expects 4%. In quarter $t-1$, the central bank still has the same expectation, and in its Inflation Report, it thus communicates that its own expectations are above those of the markets (without stating the number itself). The markets then revise their expectations upwards from 3% to x%. Finally, in quarter t, the central bank sets the interest rate to 4%. The central bank's expectation of 4% in quarter $t-2$ thus equals the markets' expectation of 3% in quarter $t-2$ plus the

of the BoE's own interest rate forecast defined by equation (2) is useful in spite of the simplifications used and the distortions potentially having occurred is also an empirical question. Below, we will present empirical evidence suggesting that the proxy appears to be useful.

3.2 Synchronizing Market Expectations and Constant Rate Forecasts

In order to make the interest rate forecasts based on market expectations and the constant interest rate forecasts comparable, they should be adjusted such that both forecasts are conditioned on information at the same point in time. In order to clarify the differences between the forecasts, a more precise notation than used before is now needed. The market expectations of the policy rate are based on data immediately before the MPC decision. Instead of denoting these forecasts by $ME_{t+h|t}$, they will henceforth be referred to as $ME^{pre}_{t+h|t}$. Consequently, the h-quarter-ahead constant-rate policy rate forecasts based on the rate immediately after the MPC decision in quarter t will be denoted by $CIR^{post}_{t+h|t}$. These are the two interest rate paths that the BoE (and the BCB) actually condition their forecasts on. In what follows, the constant-rate policy rate forecasts based on the rate before the MPC decision will be denoted by $CIR^{pre}_{t+h|t}$, and the market expectations of the policy rate based on data immediately after the MPC decision by $ME^{post}_{t+h|t}$.

The latter forecast is calculated as

$$\widehat{ME}^{post}_{t+h|t} = ME^{pre}_{t+h|t} + \hat{s}_h\left(\delta_{2,t}\right). \quad (4)$$

Thus, the construction of $\widehat{ME}^{post}_{t+h|t}$ uses the monetary policy surprises as defined above, but only those which occurred on the day of the MPC decisions prior to which $ME^{pre}_{t+h|t}$ was calculated.

3.3 Effects of an Interest Rate Change on Inflation and Output Growth

The previous calculations yield additional interest rate paths that can be investigated. In what follows, corresponding proxies for inflation and output growth will be constructed.

The basis for this construction is given by the forecasts based on $ME^{pre}_{t+h|t}$ and $CIR^{post}_{t+h|t}$. The BoE does not mention any differences between these forecasts except for the interest rate path. Thus, the differences between the inflation and output growth forecasts should be uniquely determined by the differences in interest rates. We assume that the modest-interventions approach is used for the forecasts. As mentioned above, this assumption is based on Faust and Wright (2008) and the corresponding references therein. Moreover, like Faust and Wright (2008), we assume that the responses of inflation and output growth to an interest rate shock are linear.

Under the assumptions mentioned, forecasts for a variable x made in t are related by

$$\left(x^{ME^{pre}}_{t+h|t} - x^{CIR^{post}}_{t+h|t}\right) = \sum_{j=0}^{h} \alpha_{t,j}\left(ME^{pre}_{t+h-j|t} - CIR^{post}_{t+h-j|t}\right), \quad (5)$$

two surprises $x\% - 3\%$ (the surprise in quarter $t-1$) and $4\% - x\%$ (the surprise in quarter t). This example can easily be extended to more general cases with more periods and time-varying expectations due to shocks.

with $h = 0, 1, 2, \ldots, H$, where $x^{p}_{t+h|t}$ denotes the h-period-ahead mean forecast conditional on the interest rate path $p = \left\{p_{t|t}, p_{t+1|t}, \ldots, p_{t+h|t}\right\}$. That is, the H coefficients $\alpha_{t,j}$ for the forecast from period t can simply be calculated using the corresponding H observations concerning the differences with respect to the interest rate and the variable x. Note that time variation is accounted for by letting the response coefficient $\alpha_{t,j}$ depend on t. Given the coefficients $\alpha_{t,j}$, forecasts $x^{q}_{t+h|t}$ being conditional on the interest rate path q can either be constructed as

$$x^{q}_{t+h|t} = x^{CIR^{post}}_{t+h|t} + \sum_{j=0}^{h} \alpha_{t,j} \left(q_{t+h-j|t} - x^{CIR^{post}}_{t+h|t} \right) \tag{6}$$

or

$$x^{q}_{t+h|t} = ME^{pre}_{t+h-j|t} + \sum_{j=0}^{h} \alpha_{t,j} \left(q_{t+h-j|t} - ME^{pre}_{t+h-j|t} \right). \tag{7}$$

Under the assumptions mentioned, relationship (5) holds with equality. However, even in this case, the coefficients $\alpha_{t,j}$ could not be pinned down exactly based on the available data, because all variables used are only published as rounded numbers.[36] If equation (5) is nevertheless used to calculate the coefficients $\alpha_{t,j}$, they can imply very implausible effects of interest rate changes, such as sign switches and explosive dynamics. This issue is also described in Faust and Leeper (2005). Moreover, if $ME^{pre}_{t+h|t} - CIR^{post}_{t+h|t}$ equals zero for at least one h, it is impossible to calculate the coefficients $\alpha_{t,j}$.

Therefore, we use more data and restrictions on the coefficients to estimate them. In order to rely on more data, if the time variation is not too extreme, one can estimate the coefficients employing the system of equations

$$\left(x^{ME^{pre}}_{t+i+h|t+i} - x^{CIR^{post}}_{t+i+h|t+i} \right) = \sum_{j=0}^{h} \alpha_{t,j} \left(ME^{pre}_{t+i+h-j|t+i} - CIR^{post}_{t+i+h-j|t+i} \right) + \varepsilon_{t+i,h} \tag{8}$$

with $h = 0, 1, 2, \ldots, H$ and $i = -n, -n+1, \ldots, n$ with $n \geq 1$. This system collapses to the case described above if $n = 0$. Implicitly, here it is assumed that the coefficients $\alpha_{t,j}$ for the forecast made in t are well approximated by the average of these coefficients for the forecasts made in $t-n, t-n+1, \ldots, t+n$. Thus, mH observations are used to estimate H coefficients, with $m = 2n + 1$.

Instead of estimating H coefficients $\alpha_{t,j}$ for the forecast made in t, one can also try to model the coefficients as a function of a smaller number of parameters. This can be achieved using the functional form proposed by Almon (1965), yielding

$$\alpha^{A}_{t,h} = \sum_{k=0}^{K} \gamma_{t,k} h^{k}, \tag{9}$$

with $K < H$. Given that inflation and output growth are unlikely to increase in response to higher interest rates, it is also interesting to consider the exponential Almon lag model proposed by Lütkepohl

[36]Rounding is important here, because, for example, the differences in inflation rates due to interest rate differences are very close to zero for short horizons. The rounded effects are thus likely to equal zero, but setting $a_{t,0}, a_{t,1}, \ldots$ to zero distorts the values of $a_{t,h}$ for larger horizons.

(1981), with the coefficients determined by

$$\alpha_{t,h}^{eA} = -\exp\left(\sum_{k=0}^{K} \gamma_{t,k} h^k\right). \tag{10}$$

In what follows, we set $K = 2$.[37] It should be noted that the estimation uncertainty for $\alpha_{t,h}$, $\alpha_{t,h}^{A}$ and $\alpha_{t,h}^{eA}$ increases with h, because the number of equations which include these coefficients decreases with h.

The estimated coefficients imply a response path with respect to a change in the interest rate. This response path is only indirectly related to the impulse-responses with respect to a monetary policy shock. While monetary policy shocks tend to lead to long-lasting increases in interest rates, as, for example, found in Stock and Watson (2001), the response paths described by the coefficients $\alpha_{t,h}$ with $h = 0, 1, 2, \ldots, H$ are caused by a one-unit increase in the interest rate in t, a one-unit decrease in $t+1$ and no changes after that period. That is, for example $\alpha_{t,4}$ indicates how much lower inflation would be in $t+4$ due to a one-unit increase in the interest rate in t which is offset in $t+1$.

The estimated coefficients for inflation $\hat{\alpha}_{t,h}$, $\hat{\alpha}_{t,h}^{A}$, and $\hat{\alpha}_{t,h}^{eA}$, i.e. the response paths for inflation are displayed in Figure 1. Due to the time variation, each panel contains $44 - m + 1$ response paths. The upper left panel shows the results if equation (5) is employed to calculate $\hat{\alpha}_{t,h}$. Obviously, increasing m, i.e. using more data, yields more plausible results. However, the inflation response can become positive for longer horizons. Using the Almon lag model displayed in the panels in the middle leads to smoother responses, but the values for longer horizons are still positive. By construction, this problem is avoided with the exponential Almon lag model for which results are shown in the right panel. In general, increasing m from 9 to 13 only leads to minor changes, whereas an increase from 5 to 9 has noticeable effects.

Corresponding results for output growth can be found in Figure 2. The response paths with unrestricted coefficients and with the Almon lag model do not appear to be very plausible even for large values of m. Often, the responses are negative for short horizons, positive for medium horizons, and again pronouncedly negative for long horizons. Even using the exponential Almon lag model would result in some very peculiar paths.[38] Therefore, the additional restriction $\gamma_{t,2} < 0$ is imposed in the estimations. This approach leads to several paths with a negative response on impact and almost no response thereafter. However, there is also a large number of responses that approach zero for long horizons only. Again, increasing m from 9 to 13 only leads to minor changes.

Apart from plausibility considerations, statistical criteria are helpful for selecting a set of coefficients. In Table 2, the average R^2 of the regressions for each panel is shown. For inflation, the restrictions imposed with the exponential Almon lag model lead to an almost identical R^2 as the standard Almon lag model and the approach with unrestricted coefficients, and the R^2 always exceeds 0.9. Thus, the restrictions imposed on the coefficients $\hat{\alpha}_{t,h}^{eA}$ appear to be very mild. Since they also give economically plausible response paths, in what follows they will be used, with m set to 9. For output growth, the

[37] Similar results are obtained with $K = 3$, but the estimation uncertainty increases with K.

[38] These paths show a strong negative response on impact, then virtually no response for all horizons but the longest, and then again a strongly negative response for the latter.

results are not as clear. In order to facilitate comparisons with inflation, and because of the still relatively high fit obtained, we will focus on the coefficients $\hat{\alpha}^{eA}_{t,h}$ and $m = 9$ also for output growth.

It should be noted that the importance of the estimated coefficients for the subsequent analyses decreases with h. This is due to the the fact that, for example, $\hat{\alpha}^{eA}_{t,H}$ only affects the forecast $x_{t+H|t}$, and that this effect is only caused by the differences in the interest rate assumptions in t, where these differences are typically small. In contrast to that, $\hat{\alpha}^{eA}_{t,0}$ affects all forecasts $x_{t+h|t}$ with $h = 0, 1, 2, \ldots, H$, given the differences in the interest rate assumptions in $t, t+1, \ldots, t+H$. Therefore, the differences in the coefficients observed across methods for large h hardly affect the following results.[39]

For the construction of the proxies based on $\widehat{CBE}_{t+h|t}$ and $\widehat{ME}^{post}_{t+h|t}$, we use equation (7), i.e. these proxies are calculated using the BoE's forecasts with the ME approach as the baseline. For the determination of the proxies based on $CIR^{post}_{t+h|t}$, equation (6) is employed, so that these proxies are calculated using the BoE's forecasts with the CIR approach as the baseline.[40]

4 Properties of the Forecasts

It might be interesting to shed some light on the results of the constructions in the previous section. A good impression can be obtained simply by looking at two examples. In Figure 3, the different forecasts of the BoE dating from 2004Q2 and 2008Q4, respectively, are displayed together with the corresponding realizations. At both forecast dates, the policy rate was changed. In 2004Q2, the proxy $\widehat{CBE}_{t+h|t}$ suggests that the BoE was aiming for lower future policy rates than expected by the markets, whereas in 2008Q4, there were no such discrepancies for the longer horizons.[41]

The most striking feature of the inflation and output growth forecasts based on different interest rate assumptions is their strong similarity. At short horizons, the forecasts are virtually indistinguishable. While small differences can be observed for longer horizons, the forecast errors appear to be of similar magnitudes. At best, the inflation forecasts based on $CIR^{pre}_{t+h|t}$ might be expected to perform somewhat differently.

The observations based on two examples only are confirmed by the correlations of the forecasts. For the interest rate forecasts considered, these are shown in Table 3. Obviously, the correlations between all interest rate forecasts are very pronounced for short horizons. For medium and long horizons, the correlations between constant rates and market rates are mostly below 0.9, with 0.35 being the lowest value observed.

The correlations of the inflation forecasts can be found in Table 4. In the case of the BoE, except for long horizons, they are close to 1. Only for $h = 7$ and $h = 8$, the correlations between forecasts based on constant rates and the other forecasts can fall short of 0.9, with the lowest value being equal to 0.78. In contrast to that, for the BCB, the correlations are around 0.7 for the medium horizons $h = 4$ and

[39] We also conducted large parts of the following analyses using the coefficients $\hat{\alpha}_{t,h}$ and $\hat{\alpha}^{A}_{t,h}$. Basically, this led to the same conclusions as those reached with the coefficients $\hat{\alpha}^{eA}_{t,h}$. The results are available upon request.

[40] We also conducted the following analyses employing all other possible combinations of baselines. Again, this led to the same conclusions as with the choices described above. The results are available upon request.

[41] In the short run, however, before the interest rate decision the markets had expected the interest rate to decrease to 3% over the next quarters, but did not expect this to happen immediately. The surprise observed is thus similiar to what is called a timing surprise by Gürkaynak (2005) and Gürkaynak, Sack, and Swanson (2007).

$h = 5$. Of course, the strong correlations at short horizons are, in both cases, due to the fact that interest rate surprises affect inflation with a certain delay only. In the case of the BoE, even stronger correlations than for inflation can be observed for the output growth forecasts, which are given in Table 5. Here, the smallest correlation equals 0.84.

It remains to be investigated whether the proxies for the policy rate forecasts constructed above have plausible empirical properties. To this end, we compute the root mean squared errors (RMSEs) of the forecasts which are displayed in Table 6. Obviously, the RMSEs are as expected. For horizons $h \geq 1$, the ME approach gives more accurate forecasts than the corresponding CIR approach, and the best forecasts are obtained with the CBE approach. Moreover, forecasts based on information including the policy rate decision are more accurate than their respective counterparts that do not contain the information about the policy rate decision. The ME approach gives better forecasts than the CIR approach for $h \geq 2$ even if the former is based on pre-decision information while the latter is not. For the BCB forecasts and $h = 5$, the forecast accuracy of the CIR approach is larger, but this might at least partly be due to the small sample size for this horizon.

The fact that the ranking of the ME approach, the CIR approach and the CBE approach with respect to forecast accuracy is different for $h = 0$ could be caused by the difficulties in estimating the rates at the short end of the forward curve mentioned by Anderson and Sleath (1999). Of course, the information about the policy rate decision is especially important for the nowcasts, so that it is not too surprising that, for example, $CIR^{post}_{t+h|t}$ gives better forecasts than $ME^{pre}_{t+h|t}$ for $h = 0$.

For inflation and output growth, in addition to the mean forecasts, we can also evaluate the density forecasts. BoE density forecasts under the ME approach and the CIR approach only differ with respect to the location parameter, whereas the variance and the skewness parameters are always identical. Therefore, we use these two parameters for the construction of the density forecasts as well. We employ a standard scoring function for density forecasts, the logarithmic score.[42] Since density forecasts are available, we could also evaluate other types of point forecasts like quantiles which imply loss functions other than the quadratic loss associated with the mean forecast.[43] However, using, for example, the absolute errors of the median forecasts of the BoE does not yield additional insights, so that we do not report them in what follows.[44]

The results for inflation can be found in Table 7. As expected, the differences between the RMSEs and the mean logarithmic scores (henceforth referred to as MLSs) are very small for short horizons at least in the case of the BoE. For medium and long horizons, the differences become larger, but remain at a low level. For example, one of the largest differences observed for the BoE occurs for $h = 8$, where the RMSE of $\hat{\pi}^{CIR^{pre}}_{t+h|t}$ is about 10% larger than the RMSE of $\hat{\pi}^{ME^{post}}_{t+h|t}$.

The accuracy ranking found for interest rates does not hold for the inflation forecasts. While $\hat{\pi}^{CIR^{pre}}_{t+h|t}$ tends to be the least accurate forecast, $\hat{\pi}^{CBE}_{t+h|t}$ is never the single most accurate forecast. Espe-

[42]The logarithmic score is the only proper local scoring rule as shown by Bernardo (1979) and explained in Gneiting and Raftery (2007).

[43]See Gneiting (2011) for a comprehensive treatment of loss functions and the corresponding point forecasts. The central forecast discussed by the BoE is the mode forecast, but as pointed out by Wallis (1999), the corresponding all-or-nothing loss function is unrealistic.

[44]The results for the median forecasts conditional on $CIR^{post}_{t+h|t}$ and $ME^{pre}_{t+h|t}$ are available from the authors upon request.

cially with respect to the MLS, the performance of $\hat{\pi}^{CBE}_{t+h|t}$ is often worse than that of all other forecasts except for $\hat{\pi}^{CIR^{pre}}_{t+h|t}$. The highest MLS for $h \geq 5$ is mostly obtained by $\pi^{CIR^{post}}_{t+h|t}$.

In the case of output growth, the results differ pronouncedly from what one would expect, as shown in Table 8. While also in this case, the differences between the RMSEs and the MLSs are very small, the most accurate forecasts are almost always given by $\hat{y}^{CIR^{pre}}_{t+h|t}$ and $y^{CIR^{post}}_{t+h|t}$. $\hat{y}^{CBE}_{t+h|t}$ tends to deliver the least accurate forecasts, and its performance is very similar to that of $\hat{y}^{ME^{post}}_{t+h|t}$.

In summary, while the results for the interest rate forecasts are in line with our expectations, the inflation forecasts and the output growth forecasts do not display the expected patterns of forecast accuracy.

5 Testing For Equal Predictive Accuracy

In this section, we try to evaluate the predictive accuracy of the forecasts based on different interest rate assumptions. Given the sample sizes and the strong correlations observed, the tests can, of course, not be expected to have large power.

The forecasts for inflation and output growth can probably be thought of as coming from nested models. However, the forecast models are not available to us, so that its population-level predictive accuracy cannot be evaluated.[45] Yet, the test for finite-sample predictive accuracy by Giacomini and White (2006) can be employed, assuming that the forecasting models are subject to non-vanishing parameter estimation uncertainty. Put differently, this test is valid if the central banks do not expand the size of the estimation window over time.[46]

Concerning the point forecasts, in the following analysis we concentrate on the means of the forecast series. Moreover, as also noted by Mitchell and Wallis (2011), the framework of Giacomini and White (2006) is general enough to encompass density forecasts. Therefore, we also evaluate the competing density forecasts for inflation and for real output growth based on their logarithmic scores. Let

$$d_{SE}(x^p_{t+h|t}, x^q_{t+h|t}) \equiv (x^p_{t+h|t} - x_{t+h})^2 - (x^q_{t+h|t} - x_{t+h})^2 \tag{11}$$

denote the difference in the squared forecast errors of two competing mean forecasts for the variable x based on the interest rate paths p and q, respectively.[47] Furthermore, let

$$d_{LS}(x^p_{t+h|t}, x^q_{t+h|t}) \equiv -\left(\log(f^p_{t+h|t}(x_{t+h})) - \log(f^q_{t+h|t}(x_{t+h}))\right) \tag{12}$$

be the difference in the logarithmic scores of the two competing density forecasts. The score is the value of the forecast density made in t for $t + h$ at the value of the realization x_{t+h}. Note that both differences are defined such that positive values occur if the forecasts using interest rate path q imply a

[45] See Clark and McCracken (2010) for a survey on forecast evaluation methods.

[46] Probably, none of the estimation schemes typically considered in the literature (recursive, rolling, fixed) exactly corresponds to the approach of practitioners. Rather, practitioners might switch between the schemes, with their choice depending on structural breaks and data availability. For example, the estimation window might expand for some time and then be reduced again, because data prior to a structural break is discarded. Therefore, asymptotically, the assumption of non-vanishing estimation uncertainty is probably justified here, even if neither the rolling nor the fixed scheme are used.

[47] If x refers to the interest rate forecast, we have $x^p_{t+h|t} = p_{t+h|t}$ and $x^q_{t+h|t} = q_{t+h|t}$.

higher forecast accuracy than the forecasts based on the interest rate path p. Given the ordering of interest rate paths that we are going to use (CIR^{pre}, CIR^{post}, ME^{post}, ME^{pre}, CBE), we would expect the means of the loss differentials d_{SE} and d_{LS} to be positive.

We calculate the loss differentials for the interest rate, inflation, and output growth forecasts. To conduct a Giacomini and White (2006) test (henceforth GW test), we simply regress the respective differences on a constant. An estimate of the constant being significantly different from zero implies the rejection of the null of equal predictive accuracy of the two competing forecasts. We use a significance level of 5%. Note that, given that there are going to be many pairwise tests, one can expect some rejections even if all forecasts are equally accurate.[48]

The results for the interest rate mean forecasts, based on quadratic loss, are shown in Table 9. In line with the RMSEs displayed in Table 6, the means of d_{SE} are positive except for some cases at short horizons for the BoE and for $h = 4$ for the BCB. However, it turns out that d_{SE} is never significantly different from zero. Thus, even for the conditioning assumptions themselves, we cannot detect significant differences in their forecast accuracies. Of course, this result suggests that significant results for inflation and output growth are unlikely, at least with respect to the mean forecasts, because of the uncertainty about the effects of an interest rate change on these variables. If, for instance, the true inflation response to an interest rate change does not coincide with the response assumed by the forecaster, it could easily happen that an inflation forecast based on the CBE approach is not more accurate than an inflation forecast based on the CIR approach, even if the interest rate forecast of the central bank is very precise.

For the inflation mean forecasts, indeed, there are no significant differences, as shown in Table 10. For output growth, the results reported in Table 11 contain three significant differences. Two of them, however, are negative. Thus, in the samples under study, there is no convincing evidence for differences in mean forecast accuracy for inflation and output growth caused by the rate interest assumption.

For the tests of the density forecasts of inflation and output growth based on the logarithmic scores, displayed in Tables 12 and 13, in total, four significant differences appear. Yet, two of them are negative. Thus, again, there is no evidence that 'better' interest rate assumptions lead to more accurate forecasts of inflation and output growth.

It might be argued that the sample sizes under study are simply to small in order to detect significant differences in forecast accuracy. The results observed for the interest rate forecasts of the BoE, indeed, suggest that with moderately larger samples it might become possible to empirically confirm the results expected based on economic theory, because the differences, albeit insignificant, have the expected signs. For inflation and output growth, however, many differences are negative. Thus, much larger samples would be needed in order to unveil the supposed superiority of, for example, the CBE approach, if this superiority exists at all. In our opinion, this need for much larger samples casts considerable doubts on the empirical relevance of the interest rate assumption.

[48] Moreover, according to the results in Harvey, Leybourne, and Newbold (1997), the GW test can be expected to overreject pronouncedly in small persistent samples. In order to avoid this problem, we estimate the variance of the loss differentials under the null hypothesis of equal predictive accuracy, i.e. with the mean of d_{SE} and d_{LS} set to zero. This Lagrange Multiplier version of the test is more conservative in small samples.

6 Conclusion

The choice of the interest rate path underlying the forecasts of central banks has been intensively discussed in the economic literature. Empirical studies concerning the choice of the interest rate assumption have hardly been conducted. In this work, we attempt to rank the different approaches with respect to their effects on forecast accuracy. From a theoretical point of view, the CBE approach is the preferred option and should lead to the highest accuracy. While there is no clear theoretical ranking for ME approach and the CIR approach with respect to forecast accuracy, it seems plausible to expect the ME approach to yield more accurate forecasts than the CIR approach. The macroeconomic forecasts by the BoE and the BCB turn out to be ideal candidates for a comparison, because both central banks publish forecasts using the ME approach as well as the CIR approach. The data situation for the BoE also allows the construction of proxies for the CBE forecasts.

In stark contrast to our expectations, we hardly find any significant differences between the performance of forecasts based on different interest rate assumptions. In general, for the interest rate mean forecasts themselves, the proxy for the central bank's own expectations are more accurate than the market expectations. The latter yield better forecasts than the assumption of a constant interest rate. However, the differences are all insignificant. For the inflation and output growth mean and density forecasts, there is no clear relation between forecast accuracy and the interest rate assumption. Very few significant differences are found, and about half of them do not have the expected sign.

One might argue that the sample under study is simply too small in order to find significant differences between the forecasts conditioned on constant or on market rates. Yet, if about ten years of data are not enough to detect such differences, it seems that the relevance of the conditioning assumption is rather limited, at least empirically.

The empirical irrelevance of the interest rate assumption for forecast accuracy has important implications for the issues raised at the beginning. Firstly, at least in the medium term, it is going to be difficult for central banks to steer market expectations by using the CBE approach, especially for variables other than the policy rate itself. Of course, this also implies that it does not appear very likely that markets misunderstand the central bank's own interest rate expectation as a commitment. Secondly, at least for the samples under study, successful inflation- and growth-stabilizing monetary policy is unlikely to be a major cause for the difficulties to beat naive forecasting models, because the inflation and output growth forecasts conditional on a counterfactual monetary policy (on the CIR approach) have virtually the same accuracy as forecasts conditional on the actual monetary policy (on the CBE approach). Thirdly, the construction of prediction intervals for central bank forecasts and the evaluation of central bank forecasts can probably be agnostic toward the underlying interest rate assumptions. Put differently, past forecast errors are a good indicator for future forecast uncertainty if the only structural change is due to a change in the interest rate assumption used. And the errors made when using standard evaluation procedures instead of those proposed by Faust and Wright (2008) are probably going to be small. Finally, the risk that private information is crowded out if central banks switch to the CBE approach is unlikely as well.

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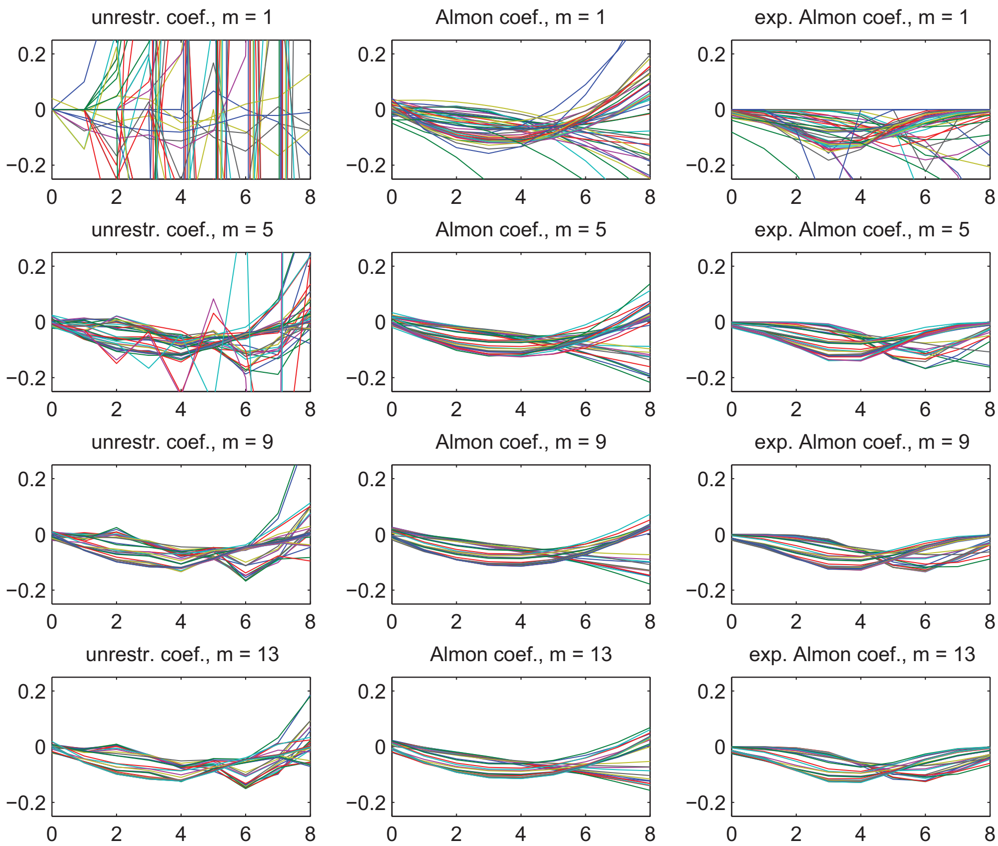
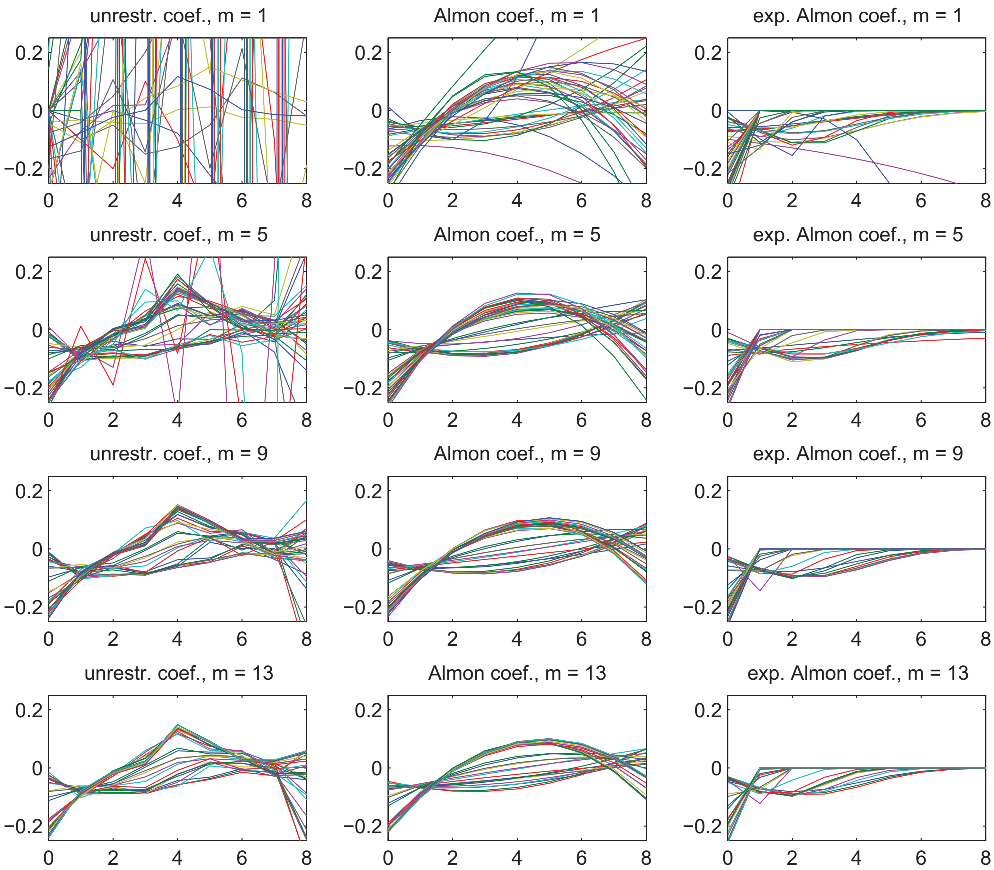
A Figures and Tables

Figure 1: Response paths for inflation



Note: Response paths for inflation, given by the coefficients $\hat{\alpha}_{t,h}$ (unrestricted coefficients, shown in first column), $\hat{\alpha}^{A}_{t,h}$ (coefficients restricted by Almon lag model, shown in second column), and $\hat{\alpha}^{eA}_{t,h}$ (coefficients restricted by exponential Almon lag model, shown in third column). These are responses to a one-unit increase in the interest rate in $h = 0$, a one-unit decrease in $h = 1$ and no changes thereafter. m denotes the number of adjacent forecasts used to estimate the coefficients.

Figure 2: Response paths for real output growth



Note: Response paths for output growth, given by the coefficients $\hat{\alpha}_{t,h}$ (unrestricted coefficients, shown in first column), $\hat{\alpha}^{A}_{t,h}$ (coefficients restricted by Almon lag model, shown in second column), and $\hat{\alpha}^{eA}_{t,h}$ (coefficients restricted by exponential Almon lag model, where the additional restriction $\gamma_{t,2} < 0$ is imposed, shown in third column). These are responses to a one-unit increase in the interest rate in $h = 0$, a one-unit decrease in $h = 1$ and no changes thereafter. m denotes the number of adjacent forecasts used to estimate the coefficients.

Table 2: Average R^2 for different estimation approaches

m	inflation	output growth
	unrestricted coefficients	
1	–	–
5	0.96	0.96
9	0.94	0.94
13	0.93	0.93
	Almon lag	
1	0.96	0.98
5	0.95	0.95
9	0.94	0.94
13	0.93	0.92
	exponential Almon lag	
1	0.97	0.86
5	0.96	0.85
9	0.94	0.85
13	0.93	0.85

Note: No entries for $m = 1$ and unrestricted coefficients, because coefficients cannot be calculated for forecasts where values of conditioning interest rate paths are identical for at least one horizon.

Figure 3: Forecasts by the BoE and corresponding realizations for the policy rate, inflation, and output growth from 2004Q2 and 2008Q4, respectively

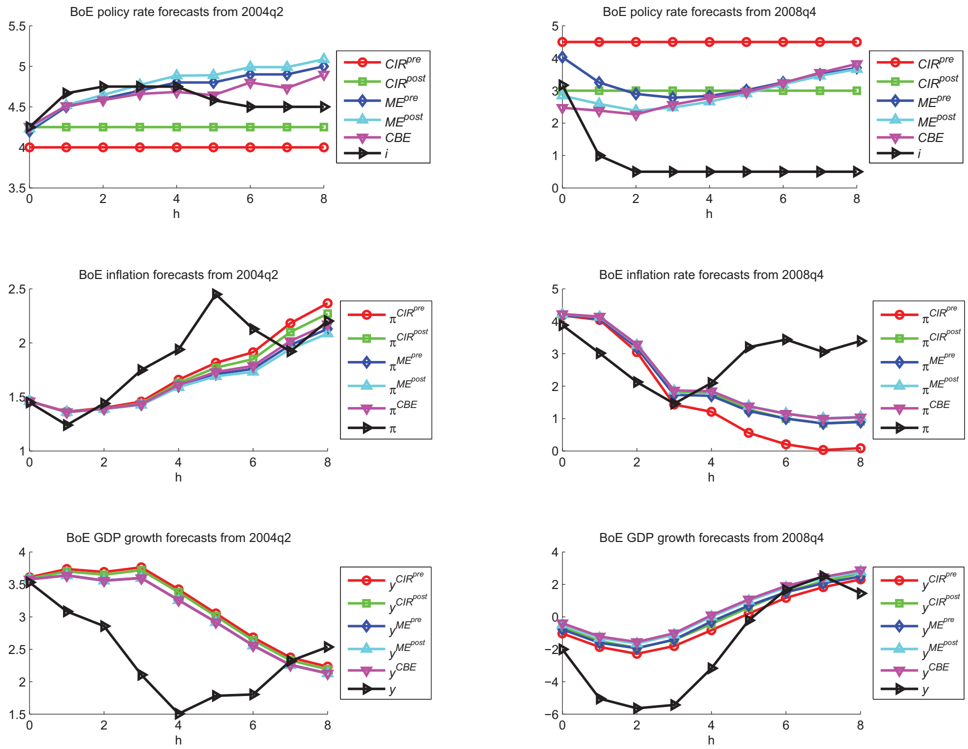


Table 3: Correlations of interest rate forecasts

h	0	1	2	3	4	5	6	7	8
	Bank of England								
N	36	36	36	36	36	35	34	33	32
	correlation of $CIR^{pre}_{t+h\|t}$ with...								
$CIR^{post}_{t+h\|t}$	0.98	0.98	0.98	0.98	0.98	0.97	0.96	0.94	0.89
$ME^{pre}_{t+h\|t}$	1.00	0.96	0.94	0.91	0.89	0.84	0.79	0.68	0.39
$\widehat{ME}^{post}_{t+h\|t}$	0.98	0.95	0.92	0.90	0.88	0.83	0.77	0.65	0.35
$\widehat{CBE}_{t+h\|t}$	0.97	0.93	0.90	0.85	0.83	0.79	0.78	0.70	0.55
	correlation of $CIR^{post}_{t+h\|t}$ with...								
$ME^{pre}_{t+h\|t}$	0.99	0.99	0.98	0.96	0.94	0.91	0.88	0.81	0.59
$\widehat{ME}^{post}_{t+h\|t}$	1.00	0.99	0.97	0.95	0.94	0.90	0.86	0.79	0.56
$\widehat{CBE}_{t+h\|t}$	1.00	0.97	0.95	0.91	0.88	0.86	0.83	0.78	0.63
	correlation of $ME^{pre}_{t+h\|t}$ with...								
$\widehat{ME}^{post}_{t+h\|t}$	0.99	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99
$\widehat{CBE}_{t+h\|t}$	0.98	0.98	0.98	0.98	0.97	0.94	0.91	0.85	0.73
	correlation of $\widehat{ME}^{post}_{t+h\|t}$ with...								
$\widehat{CBE}_{t+h\|t}$	1.00	0.98	0.98	0.98	0.97	0.95	0.92	0.86	0.74
	Banco Central do Brasil								
N	39	38	37	30	19				
	correlation of $CIR^{post}_{t+h\|t}$ with...								
$ME^{pre}_{t+h\|t}$	1.00	0.98	0.95	0.93	0.93				

Note: N denotes the sample size, h is the forecast horizon in quarters.

Table 4: Correlations of inflation forecasts

h	0	1	2	3	4	5	6	7	8
	Bank of England								
N	36	36	36	36	36	35	34	33	32
	correlation of $\hat{\pi}_{t+h\|t}^{CIR^{pre}}$ with...								
$\pi_{t+h\|t}^{CIR^{post}}$	1.00	1.00	1.00	0.99	0.97	0.97	0.97	0.97	0.97
$\pi_{t+h\|t}^{ME^{pre}}$	1.00	1.00	1.00	0.99	0.97	0.94	0.92	0.88	0.85
$\hat{\pi}_{t+h\|t}^{ME^{post}}$	1.00	1.00	1.00	0.99	0.95	0.93	0.90	0.86	0.83
$\hat{\pi}_{t+h\|t}^{CBE}$	1.00	1.00	1.00	0.99	0.94	0.90	0.88	0.87	0.78
	correlation of $\pi_{t+h\|t}^{CIR^{post}}$ with...								
$\pi_{t+h\|t}^{ME^{pre}}$	1.00	1.00	1.00	1.00	0.99	0.98	0.97	0.93	0.89
$\hat{\pi}_{t+h\|t}^{ME^{post}}$	1.00	1.00	1.00	1.00	0.99	0.98	0.96	0.93	0.88
$\hat{\pi}_{t+h\|t}^{CBE}$	1.00	1.00	1.00	1.00	0.98	0.96	0.93	0.91	0.83
	correlation of $\pi_{t+h\|t}^{ME^{pre}}$ with...								
$\hat{\pi}_{t+h\|t}^{ME^{post}}$	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
$\hat{\pi}_{t+h\|t}^{CBE}$	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.98	0.96
	correlation of $\hat{\pi}_{t+h\|t}^{ME^{post}}$ with...								
$\hat{\pi}_{t+h\|t}^{CBE}$	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.98	0.97
	Banco Central do Brasil								
N	47	46	45	44	43	42			
	correlation of $\pi_{t+h\|t}^{CIR^{post}}$ with...								
$\pi_{t+h\|t}^{ME^{pre}}$	1.00	1.00	0.98	0.90	0.72	0.67			

Note: N denotes the sample size, h is the forecast horizon in quarters.

Table 5: Correlations of output growth forecasts

h	0	1	2	3	4	5	6	7	8
	Bank of England								
N	36	36	36	36	36	35	34	33	32
	correlation of $\hat{y}_{t+h\|t}^{CIR^{pre}}$ with...								
$y_{t+h\|t}^{CIR^{post}}$	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.98
$y_{t+h\|t}^{ME^{pre}}$	1.00	1.00	1.00	1.00	0.99	0.97	0.93	0.89	0.87
$\hat{y}_{t+h\|t}^{ME^{post}}$	1.00	1.00	1.00	1.00	0.98	0.96	0.92	0.87	0.84
$\hat{y}_{t+h\|t}^{CBE}$	1.00	1.00	1.00	0.99	0.98	0.96	0.93	0.88	0.87
	correlation of $y_{t+h\|t}^{CIR^{post}}$ with...								
$y_{t+h\|t}^{ME^{pre}}$	1.00	1.00	1.00	1.00	0.99	0.98	0.94	0.90	0.87
$\hat{y}_{t+h\|t}^{ME^{post}}$	1.00	1.00	1.00	1.00	0.99	0.97	0.93	0.90	0.87
$\hat{y}_{t+h\|t}^{CBE}$	1.00	1.00	1.00	1.00	0.99	0.97	0.95	0.92	0.91
	correlation of $y_{t+h\|t}^{ME^{pre}}$ with...								
$\hat{y}_{t+h\|t}^{ME^{post}}$	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99
$\hat{y}_{t+h\|t}^{CBE}$	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.98
	correlation of $\hat{y}_{t+h\|t}^{ME^{post}}$ with...								
$\hat{y}_{t+h\|t}^{CBE}$	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Note: N denotes the sample size, h is the forecast horizon in quarters.

Table 6: Root mean squared errors of interest rate mean forecasts

h	0	1	2	3	4	5	6	7	8
	Bank of England								
N	36	36	36	36	36	35	34	33	32
$CIR^{pre}_{t+h\|t}$	0.27	0.76	1.13	1.44	1.69	1.93	2.15	2.34	2.51
$CIR^{post}_{t+h\|t}$	0.06	0.51	0.94	1.27	1.54	1.80	2.04	2.24	2.43
$ME^{pre}_{t+h\|t}$	0.16	0.54	0.90	1.18	1.46	1.75	2.00	2.22	2.40
$\widehat{ME}^{post}_{t+h\|t}$	0.08	0.46	0.85	1.15	1.43	1.73	1.99	2.20	2.38
$\widehat{CBE}_{t+h\|t}$	0.14	0.33	0.72	1.06	1.37	1.64	1.91	2.14	2.34
	Banco Central do Brasil								
N	39	38	37	30	19				
$CIR^{post}_{t+h\|t}$	0	1.85	2.96	3.70	4.69				
$ME^{pre}_{t+h\|t}$	0.15	1.62	2.66	3.69	4.83				

Note: N denotes the sample size, h is the forecast horizon in quarters.

Table 7: Root mean squared errors and mean logarithmic scores of inflation mean and density forecasts

h	0	1	2	3	4	5	6	7	8
	Bank of England								
N	36	36	36	36	36	35	34	33	32
	RMSE of mean forecasts								
$\hat{\pi}_{t+h\|t}^{CIR^{pre}}$	0.18	0.45	0.71	0.92	1.03	1.12	1.10	1.08	1.03
$\pi_{t+h\|t}^{CIR^{post}}$	0.18	0.45	0.71	0.92	1.01	1.06	1.02	1.00	0.96
$\pi_{t+h\|t}^{ME^{pre}}$	0.18	0.45	0.70	0.91	1.02	1.09	1.05	1.01	0.94
$\hat{\pi}_{t+h\|t}^{ME^{post}}$	0.18	0.45	0.70	0.90	1.01	1.07	1.04	1.01	0.93
$\hat{\pi}_{t+h\|t}^{CBE}$	0.18	0.46	0.72	0.92	1.02	1.08	1.04	1.01	0.94
	MLS of density forecasts								
$\hat{\pi}_{t+h\|t}^{CIR^{pre}}$	0.13	-0.51	-1.00	-1.34	-1.50	-1.59	-1.48	-1.44	-1.44
$\pi_{t+h\|t}^{CIR^{post}}$	0.13	-0.52	-1.00	-1.33	-1.48	-1.53	-1.41	-1.38	-1.41
$\pi_{t+h\|t}^{ME^{pre}}$	0.13	-0.51	-0.99	-1.31	-1.48	-1.57	-1.46	-1.40	-1.39
$\hat{\pi}_{t+h\|t}^{ME^{post}}$	0.13	-0.52	-0.99	-1.31	-1.47	-1.55	-1.45	-1.40	-1.39
$\hat{\pi}_{t+h\|t}^{CBE}$	0.13	-0.52	-1.01	-1.34	-1.49	-1.58	-1.47	-1.43	-1.43
	Banco Central Do Brasil								
N	47	46	45	44	43	42			
	RMSE of mean forecasts								
$\pi_{t+h\|t}^{CIR^{post}}$	0.19	0.78	3.53	8.07	13.52	17.64			
$\pi_{t+h\|t}^{ME^{pre}}$	0.19	0.89	3.76	8.22	12.80	15.77			
	MLS of density forecasts								
$\pi_{t+h\|t}^{CIR^{post}}$	-0.41	-1.14	-1.85	-2.42	-2.83	-2.99			
$\pi_{t+h\|t}^{ME^{pre}}$	-0.43	-1.14	-1.87	-2.45	-2.77	-2.88			

Note: N denotes the sample size, h is the forecast horizon in quarters.

Table 8: Root mean squared errors and mean logarithmic scores of output growth mean and density forecasts

h	0	1	2	3	4	5	6	7	8
	Bank of England								
N	36	36	36	36	36	35	34	33	32
	RMSE of mean forecasts								
$\hat{y}_{t+h\|t}^{CIR^{pre}}$	0.53	0.88	1.32	1.77	2.19	2.48	2.67	2.82	2.92
$y_{t+h\|t}^{CIR^{post}}$	0.56	0.92	1.36	1.79	2.21	2.48	2.67	2.82	2.92
$y_{t+h\|t}^{ME^{pre}}$	0.55	0.91	1.37	1.82	2.24	2.51	2.69	2.84	2.95
$\hat{y}_{t+h\|t}^{ME^{post}}$	0.57	0.95	1.39	1.84	2.26	2.51	2.69	2.84	2.95
$\hat{y}_{t+h\|t}^{CBE}$	0.58	0.96	1.40	1.85	2.26	2.51	2.69	2.84	2.95
	MLS of density forecasts								
$\hat{y}_{t+h\|t}^{CIR^{pre}}$	−1.08	−1.30	−2.07	−2.82	−3.46	−3.75	−3.89	−4.09	−4.56
$y_{t+h\|t}^{CIR^{post}}$	−1.10	−1.34	−2.12	−2.86	−3.48	−3.75	−3.88	−4.08	−4.54
$y_{t+h\|t}^{ME^{pre}}$	−1.09	−1.34	−2.14	−2.90	−3.54	−3.78	−3.90	−4.11	−4.60
$\hat{y}_{t+h\|t}^{ME^{post}}$	−1.10	−1.37	−2.17	−2.93	−3.56	−3.78	−3.90	−4.11	−4.60
$\hat{y}_{t+h\|t}^{CBE}$	−1.11	−1.39	−2.18	−2.95	−3.57	−3.79	−3.90	−4.11	−4.60

Note: N denotes the sample size, h is the forecast horizon in quarters.

Table 9: Test results for equal predictive accuracy of interest rate mean forecasts based on squared errors

h	0	1	2	3	4	5	6	7	8
	Bank of England								
N	36	36	36	36	36	35	34	33	32
	mean of $d_{SE}\left(CIR^{pre}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \dots$								
$CIR^{post}_{t+h\|t}$	0.07	0.32	0.40	0.45	0.48	0.48	0.45	0.43	0.38
	(0.17)	(0.16)	(0.13)	(0.09)	(0.08)	(0.10)	(0.15)	(0.19)	(0.26)
$ME^{pre}_{t+h\|t}$	0.05	0.29	0.48	0.67	0.72	0.68	0.59	0.54	0.54
	(0.11)	(0.15)	(0.11)	(0.09)	(0.17)	(0.26)	(0.30)	(0.30)	(0.28)
$\widehat{ME}^{post}_{t+h\|t}$	0.06	0.37	0.56	0.73	0.79	0.75	0.64	0.61	0.63
	(0.16)	(0.17)	(0.12)	(0.09)	(0.16)	(0.25)	(0.31)	(0.30)	(0.27)
$\widehat{CBE}_{t+h\|t}$	0.05	0.48	0.76	0.93	0.98	1.03	0.97	0.89	0.81
	(0.14)	(0.16)	(0.12)	(0.12)	(0.19)	(0.24)	(0.27)	(0.25)	(0.20)
	mean of $d_{SE}\left(CIR^{post}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \dots$								
$ME^{pre}_{t+h\|t}$	−0.02	−0.03	0.07	0.22	0.25	0.20	0.14	0.11	0.16
	(0.28)	(0.33)	(0.19)	(0.24)	(0.48)	(0.65)	(0.74)	(0.75)	(0.61)
$\widehat{ME}^{post}_{t+h\|t}$	0.00	0.05	0.15	0.28	0.31	0.27	0.19	0.18	0.25
	(0.27)	(0.27)	(0.14)	(0.20)	(0.41)	(0.58)	(0.69)	(0.67)	(0.52)
$\widehat{CBE}_{t+h\|t}$	−0.01	0.15	0.35	0.48	0.51	0.55	0.52	0.46	0.42
	(0.25)	(0.22)	(0.18)	(0.22)	(0.39)	(0.45)	(0.49)	(0.50)	(0.47)
	mean of $d_{SE}\left(ME^{pre}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \dots$								
$\widehat{ME}^{post}_{t+h\|t}$	0.02	0.08	0.08	0.06	0.07	0.07	0.05	0.07	0.09
	(0.29)	(0.25)	(0.20)	(0.14)	(0.10)	(0.18)	(0.41)	(0.37)	(0.33)
$\widehat{CBE}_{t+h\|t}$	0.01	0.19	0.28	0.26	0.26	0.35	0.38	0.35	0.26
	(0.33)	(0.23)	(0.20)	(0.23)	(0.30)	(0.30)	(0.33)	(0.38)	(0.50)
	mean of $d_{SE}\left(\widehat{ME}^{post}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \dots$								
$\widehat{CBE}_{t+h\|t}$	−0.01	0.11	0.20	0.20	0.19	0.28	0.33	0.28	0.17
	(0.27)	(0.30)	(0.25)	(0.28)	(0.38)	(0.33)	(0.33)	(0.41)	(0.62)
	Banco Central do Brasil								
N		38	37	30	19				
	mean of $d_{SE}\left(CIR^{post}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \dots$								
$ME^{pre}_{t+h\|t}$		0.82	1.70	0.07	−1.36				
		(0.26)	(0.36)	(0.98)	(0.83)				

Note: N denotes the sample size, h is the forecast horizon in quarters. Positive values of d_{SE} indicate that the forecast $x^q_{t+h|t}$ is more accurate. p-values are in parentheses. For the tests, Newey-West (1987) standard errors are employed. The truncation lag is set to h.

Table 10: Test results for equal predictive accuracy of inflation mean forecasts based on squared errors

h	0	1	2	3	4	5	6	7	8
	Bank of England								
N	36	36	36	36	36	35	34	33	32
	mean of $d_{SE}\left(\hat{\pi}_{t+h\|t}^{CIR^{pre}}, x_{t+h\|t}^{q}\right)$ with $x_{t+h\|t}^{q} = \ldots$								
$\pi_{t+h\|t}^{CIR^{post}}$	0.00	0.00	−0.01	0.01	0.04	0.12	0.16	0.17	0.14
	(0.45)	(0.44)	(0.59)	(0.16)	(0.27)	(0.33)	(0.31)	(0.34)	(0.37)
$\pi_{t+h\|t}^{ME^{pre}}$	0.00	0.00	0.01	0.03	0.03	0.07	0.10	0.15	0.19
	(0.56)	(0.80)	(0.57)	(0.09)	(0.41)	(0.57)	(0.55)	(0.43)	(0.33)
$\hat{\pi}_{t+h\|t}^{ME^{post}}$	0.00	0.00	0.00	0.03	0.05	0.10	0.12	0.16	0.20
	(0.44)	(0.53)	(0.90)	(0.07)	(0.27)	(0.46)	(0.50)	(0.43)	(0.37)
$\hat{\pi}_{t+h\|t}^{CBE}$	0.00	−0.01	−0.02	0.00	0.03	0.08	0.11	0.15	0.19
	(0.44)	(0.31)	(0.43)	(0.91)	(0.41)	(0.49)	(0.52)	(0.50)	(0.46)
	mean of $d_{SE}\left(\pi_{t+h\|t}^{CIR^{post}}, x_{t+h\|t}^{q}\right)$ with $x_{t+h\|t}^{q} = \ldots$								
$\pi_{t+h\|t}^{ME^{pre}}$	0.00	0.00	0.01	0.02	−0.01	−0.05	−0.06	−0.02	0.05
	(0.31)	(0.16)	(0.08)	(0.11)	(0.55)	(0.09)	(0.09)	(0.53)	(0.31)
$\hat{\pi}_{t+h\|t}^{ME^{post}}$	0.00	0.00	0.01	0.02	0.01	−0.02	−0.04	−0.01	0.06
	(0.46)	(0.95)	(0.13)	(0.09)	(0.55)	(0.34)	(0.19)	(0.86)	(0.42)
$\hat{\pi}_{t+h\|t}^{CBE}$	0.00	0.00	−0.01	−0.01	−0.01	−0.03	−0.05	−0.02	0.05
	(0.46)	(0.25)	(0.39)	(0.65)	(0.46)	(0.12)	(0.13)	(0.76)	(0.67)
	mean of $d_{SE}\left(\pi_{t+h\|t}^{ME^{pre}}, x_{t+h\|t}^{q}\right)$ with $x_{t+h\|t}^{q} = \ldots$								
$\hat{\pi}_{t+h\|t}^{ME^{post}}$	0.00	0.00	0.00	0.00	0.01	0.03	0.02	0.01	0.01
	(0.32)	(0.31)	(0.46)	(0.39)	(0.05)	(0.10)	(0.22)	(0.49)	(0.74)
$\hat{\pi}_{t+h\|t}^{CBE}$	0.00	−0.01	−0.02	−0.03	−0.01	0.01	0.02	0.00	−0.01
	(0.35)	(0.20)	(0.20)	(0.32)	(0.75)	(0.54)	(0.52)	(0.99)	(0.92)
	mean of $d_{SE}\left(\hat{\pi}_{t+h\|t}^{ME^{post}}, x_{t+h\|t}^{q}\right)$ with $x_{t+h\|t}^{q} = \ldots$								
$\hat{\pi}_{t+h\|t}^{CBE}$	0.00	0.00	−0.02	−0.03	−0.02	−0.01	0.00	−0.01	−0.02
	(0.45)	(0.21)	(0.17)	(0.20)	(0.33)	(0.47)	(0.87)	(0.66)	(0.60)
	Banco Central Do Brasil								
N	47	46	45	44	43	42			
	mean of $d_{SE}\left(\pi_{t+h\|t}^{CIR^{post}}, x_{t+h\|t}^{q}\right)$ with $x_{t+h\|t}^{q} = \ldots$								
$\pi_{t+h\|t}^{ME^{pre}}$	0.00	−0.11	−0.22	−0.15	0.72	1.87			
	(0.31)	(0.45)	(0.57)	(0.78)	(0.34)	(0.15)			

Note: N denotes the sample size, h is the forecast horizon in quarters. Positive values of d_{SE} indicate that the forecast $x_{t+h|t}^{q}$ is more accurate. p-values are in parentheses. For the tests, Newey-West (1987) standard errors are employed. The truncation lag is set to h.

Table 11: Test results for equal predictive accuracy of output growth mean forecasts based on squared errors

h	0	1	2	3	4	5	6	7	8
	Bank of England								
N	36	36	36	36	36	35	34	33	32
	mean of $d_{SE}\left(\hat{y}^{CIR^{pre}}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \ldots$								
$y^{CIR^{post}}_{t+h\|t}$	-0.03	-0.08	-0.09	-0.09	-0.06	-0.01	0.01	0.02	0.02
	(0.17)	(0.26)	(0.25)	(0.25)	(0.28)	(0.65)	(0.61)	(0.35)	(0.66)
$y^{ME^{pre}}_{t+h\|t}$	-0.02	-0.07	-0.12	-0.19	-0.22	-0.14	-0.09	-0.08	-0.13
	(0.16)	(0.19)	(0.16)	(0.20)	(0.29)	(0.40)	(0.45)	(0.31)	(0.09)
$\hat{y}^{ME^{post}}_{t+h\|t}$	-0.05	-0.13	-0.19	-0.26	-0.27	-0.16	-0.09	-0.07	-0.15
	(0.22)	(0.24)	(0.19)	(0.20)	(0.27)	(0.39)	(0.47)	(0.38)	(0.09)
$\hat{y}^{CBE}_{t+h\|t}$	-0.05	-0.15	-0.21	-0.30	-0.30	-0.17	-0.09	-0.08	-0.16
	(0.23)	(0.25)	(0.19)	(0.18)	(0.24)	(0.36)	(0.47)	(0.35)	(0.08)
	mean of $d_{SE}\left(y^{CIR^{post}}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \ldots$								
$y^{ME^{pre}}_{t+h\|t}$	0.01	0.01	-0.04	-0.10	-0.16	-0.13	-0.10	-0.11	-0.15
	(0.26)	(0.61)	(0.27)	(0.26)	(0.31)	(0.37)	(0.35)	(0.22)	(0.05)
$\hat{y}^{ME^{post}}_{t+h\|t}$	-0.01	-0.05	-0.10	-0.17	-0.21	-0.14	-0.10	-0.10	$\mathbf{-0.16}$
	(0.39)	(0.21)	(0.16)	(0.20)	(0.28)	(0.36)	(0.37)	(0.27)	(0.04)
$\hat{y}^{CBE}_{t+h\|t}$	-0.02	-0.07	-0.12	-0.20	-0.24	-0.16	-0.10	-0.10	$\mathbf{-0.18}$
	(0.34)	(0.23)	(0.16)	(0.17)	(0.24)	(0.32)	(0.37)	(0.25)	(0.03)
	mean of $d_{SE}\left(y^{ME^{pre}}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \ldots$								
$\hat{y}^{ME^{post}}_{t+h\|t}$	-0.02	-0.06	-0.06	-0.07	-0.05	-0.01	0.00	**0.01**	-0.01
	(0.32)	(0.30)	(0.29)	(0.28)	(0.30)	(0.44)	(0.06)	(0.04)	(0.54)
$\hat{y}^{CBE}_{t+h\|t}$	-0.03	-0.08	-0.09	-0.10	-0.08	-0.03	0.00	0.01	-0.03
	(0.31)	(0.30)	(0.27)	(0.22)	(0.21)	(0.24)	(0.73)	(0.48)	(0.30)
	mean of $d_{SE}\left(\hat{y}^{ME^{post}}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \ldots$								
$\hat{y}^{CBE}_{t+h\|t}$	-0.01	-0.02	-0.02	-0.03	-0.03	-0.01	0.00	-0.01	-0.02
	(0.28)	(0.31)	(0.22)	(0.12)	(0.09)	(0.15)	(0.71)	(0.29)	(0.06)

Note: N denotes the sample size, h is the forecast horizon in quarters. Positive values of d_{SE} indicate that the forecast $x^q_{t+h|t}$ is more accurate. Bold numbers are significantly different from 0 at the 5% significance level. p-values are in parentheses. For the tests, Newey-West (1987) standard errors are employed. The truncation lag is set to h.

Table 12: Test results for equal predictive accuracy of inflation density forecasts based on logarithmic scores

h	0	1	2	3	4	5	6	7	8
	Bank of England								
N	36	36	36	36	36	35	34	33	32
	mean of $d_{LS}\left(\hat{\pi}^{CIR^{pre}}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \dots$								
$\pi^{CIR^{post}}_{t+h\|t}$	0.00	0.00	0.00	0.01	0.03	0.06	0.07	0.05	0.04
	(0.70)	(0.50)	(0.79)	(0.10)	(0.26)	(0.40)	(0.37)	(0.49)	(0.61)
$\pi^{ME^{pre}}_{t+h\|t}$	0.00	0.00	0.01	0.03	0.02	0.02	0.02	0.04	0.06
	(0.95)	(0.98)	(0.45)	(0.07)	(0.48)	(0.84)	(0.86)	(0.72)	(0.59)
$\hat{\pi}^{ME^{post}}_{t+h\|t}$	0.00	0.00	0.01	0.04	0.04	0.03	0.03	0.04	0.05
	(0.69)	(0.63)	(0.64)	(0.07)	(0.25)	(0.67)	(0.78)	(0.73)	(0.70)
$\hat{\pi}^{CBE}_{t+h\|t}$	0.00	−0.01	−0.02	0.00	0.01	0.01	0.01	0.01	0.01
	(0.68)	(0.29)	(0.48)	(0.87)	(0.69)	(0.87)	(0.93)	(0.96)	(0.92)
	mean of $d_{LS}\left(\pi^{CIR^{post}}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \dots$								
$\pi^{ME^{pre}}_{t+h\|t}$	0.00	0.00	0.01	0.02	0.00	−0.04	−0.05	−0.02	0.02
	(0.31)	(0.17)	(0.08)	(0.09)	(0.86)	(0.27)	(0.23)	(0.52)	(0.60)
$\hat{\pi}^{ME^{post}}_{t+h\|t}$	0.00	0.00	0.01	0.03	0.01	−0.02	−0.04	−0.02	0.01
	(0.74)	(0.82)	(0.18)	(0.10)	(0.48)	(0.52)	(0.27)	(0.59)	(0.81)
$\hat{\pi}^{CBE}_{t+h\|t}$	0.00	−0.01	−0.01	−0.01	−0.02	−0.04	**−0.06**	−0.05	−0.02
	(0.70)	(0.22)	(0.37)	(0.69)	(0.45)	(0.11)	(0.05)	(0.28)	(0.80)
	mean of $d_{LS}\left(\pi^{ME^{pre}}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \dots$								
$\hat{\pi}^{ME^{post}}_{t+h\|t}$	0.00	0.00	0.00	0.00	**0.01**	**0.02**	0.01	0.00	−0.01
	(0.36)	(0.29)	(0.45)	(0.35)	(0.03)	(0.04)	(0.33)	(0.92)	(0.68)
$\hat{\pi}^{CBE}_{t+h\|t}$	0.00	−0.01	−0.03	−0.03	−0.01	0.00	−0.01	−0.03	−0.04
	(0.40)	(0.18)	(0.14)	(0.21)	(0.56)	(0.86)	(0.68)	(0.25)	(0.31)
	mean of $d_{LS}\left(\hat{\pi}^{ME^{post}}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \dots$								
$\hat{\pi}^{CBE}_{t+h\|t}$	0.00	−0.01	−0.02	−0.03	−0.03	−0.02	−0.02	−0.03	−0.03
	(0.58)	(0.20)	(0.13)	(0.13)	(0.23)	(0.29)	(0.23)	(0.09)	(0.17)
	Banco Central Do Brasil								
N	47	46	45	44	43	42			
	mean of $d_{LS}\left(\pi^{CIR^{post}}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \dots$								
$\pi^{ME^{pre}}_{t+h\|t}$	−0.02	0.00	−0.02	−0.03	0.06	0.11			
	(0.43)	(0.96)	(0.70)	(0.63)	(0.35)	(0.18)			

Note: N denotes the sample size, h is the forecast horizon in quarters. Positive values of d_{LS} indicate that the forecast $x^q_{t+h|t}$ is more accurate. Bold numbers are significantly different from 0 at the 5% significance level. p-values are in parentheses. For the tests, Newey-West (1987) standard errors are employed. The truncation lag is set to h.

Table 13: Test results for equal predictive accuracy of output growth density forecasts based on logarithmic scores

h	0	1	2	3	4	5	6	7	8
	Bank of England								
N	36	36	36	36	36	35	34	33	32
	mean of $d_{LS}\left(\hat{y}^{CIR^{pre}}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \dots$								
$y^{CIR^{post}}_{t+h\|t}$	−0.02	−0.05	−0.04	−0.04	−0.02	0.00	0.01	0.01	0.01
	(0.44)	(0.28)	(0.29)	(0.30)	(0.38)	(0.87)	(0.56)	(0.28)	(0.37)
$y^{ME^{pre}}_{t+h\|t}$	−0.01	−0.04	−0.06	−0.08	−0.08	−0.03	−0.01	−0.02	−0.04
	(0.75)	(0.22)	(0.20)	(0.32)	(0.41)	(0.62)	(0.79)	(0.44)	(0.14)
$\hat{y}^{ME^{post}}_{t+h\|t}$	−0.02	−0.08	−0.10	−0.11	−0.10	−0.04	−0.01	−0.02	−0.04
	(0.52)	(0.24)	(0.21)	(0.28)	(0.37)	(0.59)	(0.80)	(0.50)	(0.15)
$\hat{y}^{CBE}_{t+h\|t}$	−0.03	−0.09	−0.11	−0.13	−0.11	−0.04	−0.01	−0.02	−0.05
	(0.48)	(0.25)	(0.20)	(0.25)	(0.33)	(0.55)	(0.78)	(0.46)	(0.12)
	mean of $d_{LS}\left(y^{CIR^{post}}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \dots$								
$y^{ME^{pre}}_{t+h\|t}$	0.01	0.01	−0.02	−0.05	−0.06	−0.03	−0.02	−0.03	−0.05
	(0.20)	(0.70)	(0.39)	(0.43)	(0.45)	(0.58)	(0.66)	(0.28)	(0.07)
$\hat{y}^{ME^{post}}_{t+h\|t}$	0.00	−0.03	−0.06	−0.08	−0.08	−0.04	−0.02	−0.03	−0.06
	(0.77)	(0.20)	(0.19)	(0.30)	(0.38)	(0.55)	(0.68)	(0.33)	(0.07)
$\hat{y}^{CBE}_{t+h\|t}$	−0.01	−0.04	−0.07	−0.09	−0.09	−0.04	−0.02	−0.03	−0.06
	(0.59)	(0.23)	(0.17)	(0.24)	(0.33)	(0.50)	(0.66)	(0.30)	(0.05)
	mean of $d_{LS}\left(y^{ME^{pre}}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \dots$								
$\hat{y}^{ME^{post}}_{t+h\|t}$	−0.01	−0.04	−0.03	−0.03	−0.02	0.00	0.00	0.00	0.00
	(0.39)	(0.29)	(0.29)	(0.28)	(0.29)	(0.44)	(0.27)	(0.07)	(0.70)
$\hat{y}^{CBE}_{t+h\|t}$	−0.02	−0.05	−0.05	−0.05	−0.03	−0.01	0.00	0.00	−0.01
	(0.37)	(0.30)	(0.26)	(0.21)	(0.18)	(0.19)	(0.87)	(0.95)	(0.26)
	mean of $d_{LS}\left(\hat{y}^{ME^{post}}_{t+h\|t}, x^q_{t+h\|t}\right)$ with $x^q_{t+h\|t} = \dots$								
$\hat{y}^{CBE}_{t+h\|t}$	−0.01	−0.01	−0.01	−0.02	−0.01	−0.01	0.00	0.00	**−0.01**
	(0.34)	(0.33)	(0.19)	(0.10)	(0.08)	(0.15)	(0.54)	(0.20)	(0.03)

Note: N denotes the sample size, h is the forecast horizon in quarters. Positive values of d_{LS} indicate that the forecast $x^q_{t+h|t}$ is more accurate. Bold numbers are significantly different from 0 at the 5% significance level. p-values are in parentheses. For the tests, Newey-West (1987) standard errors are employed. The truncation lag is set to h.

B Central Bank Statements on Forecast Conditioning Assumptions

Banco Central Do Brasil

First report available is from September 1999 ("Inflation Report") and states on p.79 that "Normally, the Inflation Reports will issue two fan charts. The first and most important is constructed on the assumption of a constant nominal interest rate over the course of the projection period, while the second is accessory by nature and is based on the assumption that the nominal interest rate will be that built-into market expectations."

Banco Central de Chile

Reports available since May 2000 ("Monetary Policy Report").

CIR for reports of May 2000 to May 2004. For instance, the report of September 2000, p.8, states that

"Confidence intervals [...] summarize the Central Bank's risk assessment for future economic growth, on the assumption that the monetary policy rate will remain at UF + 5.0% over the next two years."

ME assumption since report of September 2004, p.63:

"This section presents the Board's recent evaluation of Chile's economic prospects for the next two years, including the analysis and the decisions made during the last monetary policy meeting of 7 September 2004. It provides projections for the most likely course of inflation and economic growth, and examines the main risks. These projections are based on the methodological assumption that the monetary policy rate will reflect a gradual decline in the monetary impulse in coming years, consistent with achieving the inflation target focused on 3% and which is comparable to trends deduced from financial asset prices. Projections are also conditional on a series of developments that make up the baseline, or most likely, scenario. New information will modify this scenario and associated projections. Forecasts are presented in the form of confidence intervals, to reflect the future risks to monetary policy."

Also variations are reported, e.g. in the report of May 2009, p.23:

"The projections used in this Report are based on the working assumption that, in the short term, the MPR path will be similar to what can be inferred from financial asset prices on 8 May 2009. However, toward the end of the projection horizon, the MPR path will be lower than the trend being signaled by these prices."

Bank of England

Reports are available since 1997 ("Inflation Report").

CIR inflation forecasts since 1993 are available in a spreadsheet format under
`www.bankofengland.co.uk/publications/inflationreport/irprobab.htm`

The report of February 1998 states on p.42 that

"The projection for inflation is based on the assumption that official interest rates will remain unchanged at 7.25% during the next two years. The projection was agreed by the Monetary Policy Committee (MPC) on 5 February. In addition, for the first time, a new projection is presented under the assumption that official interest rates follow market expectations over the next two years."

Bank of Japan

Reports available since October 2000 ("Outlook and Risk Assessment of the Economy and Prices", since April 2004 "Outlook for Economic Activity and Prices").

CIR assumption in early days, for instance in October 2000 (only available online under `http://www.boj.or.jp/en/mopo/outlook/gor0010.htm/`):

"The forecasts of Policy Board members are based on the assumption that there will be no change in monetary policy. Forecasts of the majority of Policy Board members are shown as a range with the highest and lowest figures excluded. If there are multiple highest and/or lowest figures, only one from either end is excluded."

Switch from CIR to ME assumption made with report of April 2006, p.8:

"Individual Policy Board members make the above forecasts with reference to market participants' view regarding the future course of the policy interest rate that is incorporated in market interest rates. Their forecasts made in October 2005 were based on the assumption that there would be no change in monetary policy."

Example of ME assumption in report of October 2011, p.17:

"Individual Policy Board members make their forecasts with reference to the view of market participants regarding the future course of the policy interest rate - a view that is incorporated in market interest rates."

Board of Governors of the Federal Reserve System

The conditioning assumptions of the Fed are not entirely clear.

Reifschneider and Tulip (2007), pp.12-13, state that Greenbook based on interest rate assumptions, while FOMC projections are made rather on a CBE assumption:

"A final issue of comparability concerns the conditionality of forecasts. Currently, each FOMC participant conditions his or her individual projection on "appropriate monetary policy", defined as the future policy most likely to foster trajectories for output and inflation consistent with the participant's interpretation of the dual mandate. Although the definition of "appropriate monetary policy" was less explicit in the past, Committee participants presumably had a similar idea in mind when making their forecasts historically. Whether or not the other forecasters in our sample generated their projections on a similar basis is unknown, but we think it reasonable to assume that most sought to maximize the accuracy of their predictions and so conditioned their forecasts on their assessment of the most likely outcome for monetary policy. However, this assumption is not valid for the Greenbook projections. Through most of the 1990s, the Federal Reserve staff conditioned its forecasts on a roughly flat path for the federal funds rate. This practice meant that real activity and inflation might evolve over the projection period in a way that was potentially inconsistent with the FOMC's policy objectives and, therefore, unlikely to occur. That is, the staff took the approach over much of our sample period of designing its forecasts not to maximize forecasting accuracy but instead to inform the FOMC about the potential consequences of unchanged policy. Thus, the Greenbook's historical forecast errors may tend to overstate the uncertainty of the outlook to some degree."

The "Semiannual Monetary Policy Report to the Congress" of February 2007 names for the first time the term "appropriate monetary policy" which is likely to correspond to a

CBE assumption (available online under `http://www.federalreserve.gov/newsevents/testimony/bernanke20070214a.htm`):
"The central tendency of those forecasts - which are based on the information available at that time and on the assumption of appropriate monetary policy–is for real GDP to increase about 2-1/2 to 3 percent in 2007 and about 2-3/4 to 3 percent in 2008."

Goodhart (2009), p.87, finds that
"For simplicity, most MPCs initially chose constant future policy interest rates, from the latest available level, as their main framing assumption. Occasionally, such an assumption would have been grossly at odds with perceived reality, as in the case of the United States from 2004 until early 2006, when the explicit position of the Federal Open Market Committee (FOMC) was for there to be a "measured increase" in policy rates over time. In that case, the Greenbook conditioning assumption, which has also been usually for constant rates,3 is widely believed to have been changed, but the degree of secrecy, and length of lag before publication (five years), means that we will not have confirmation of this for some time."

European Central Bank

The ECB in "A Guide to Eurosystem Staff Macroeconomic Projection Exercises" of June 2001 states on p.7 the CIR assumption:
"The projections are based on the technical assumption that three-month interest rates in the euro area remain constant over the horizon of the projection."

Publication of June 2006 staff projections, p.1, available online under `http://www.ecb.int/pub/pub/mopo/html/index.en.html?skey=staff+macroeconomic+projections`, has the ME assumption underlying:
"For the first time, the Eurosystem projections are based on the technical assumption that short-term market interest rates move in line with market expectations rather than, as previously assumed, remain constant over the projection horizon. This change is of a purely technical nature. It was introduced in order to further improve the quality and the internal consistency of the macroeconomic projections and does not imply any change in the ECB's monetary policy strategy or in the role of projections within that strategy."

Magyar Nemzeti Bank

Reports available since June 2000 ("Report on Inflation").

MNB has moved from CIR assumption to CBE assumption, as stated in the report of March 2011 on p.15:
"Starting in march 2011, the staff of the national Bank of Hungary moved on to the preparation of a forecast with endogenous policy rate path from former forecasts with unchanged policy rate. The change is in line with the practice of inflation targeting central banks, the majority of which also having shifted to forecasts with endogenous policy rate path."

Reserve Bank of Australia

First report available is from February 1997 (changing names since then; “Quarterly Report on the Economy and Financial Markets”, “Semi-Annual Statement on Monetary Policy”, “The Economy and Financial Markets”; since November 2000 “Statement on Monetary Policy”).

Switch from CIR to ME assumption with “Statement on Monetary Policy” of August 2009:
“The forecasts presented below are based on the assumption that the exchange rate remains around its current level and that oil prices move broadly in line with near-term futures pricing. In previous Statements the forecasts were prepared using the additional technical assumption that the cash rate remained constant throughout the forecast period. In the current environment, however, it is not particularly realistic to assume that the cash rate remains at the historically low level of 3 per cent out to the end of 2011. Given this, the current forecasts have been prepared on the technical assumption of a return towards a more normal setting of monetary policy over the forecast horizon. This use of a more realistic technical assumption by the Bank staff in no way constitutes a commitment by the Board to a particular future path of the cash rate.”

Reserve Bank of New Zealand

In the Reserve Bank of New Zealand Bulletin 65 No. 2 of June 2002, the article by Hampton (2002) states on p.6:
“In order to understand our preference for using an endogenous interest rate path, it is intuitive to refer to the period prior to our use of the endogenous policy reaction function. Up until 1997, the projections used in policy evaluation and in the Bank’s publications were conventional constant interest rate projections. Interest rates and the exchange rate were generally held constant throughout the projection horizon at the values prevailing at the time the forecasts were prepared.”

Sveriges Riksbank

The report of March 1997, p.21, (“Inflation Report” until 2007, since 2007 “Monetary Policy Report”) introduces CIR assumption; before 1997 not really forecasting but rather deriving inflation expectations:
“The assessment of inflation in the coming years is presented in this chapter, together with some conceivable alternative paths. [...] A technical assumption for the assessment is that economic policy remains unchanged.”

Example from report of December 2002, p.46 hints at scenario analysis with ME assumption:
“In the Riksbank’s main scenario [...], inflation is forecast as usual on the technical assumption that the repo rate will be unchanged at the present level of 4.0 per cent; this serves to bring out the consequences for the formation of monetary policy. An illustrative calculation is therefore presented here that incorporates a path for the repo rate that is in line with market expectations as reported in the survey that Prospera undertook on behalf of the Riksbank in November 2002.”

Switch to ME assumption with report 2005:3, p.5, of October 2005:
“The analyses in the Report’s main scenario to date have been based on the assumption that the repo rate is held unchanged for the coming two years. In this Report the forecasts in the main scenario are based instead on the assumption that the repo rate evolves in line with financial market expectations, as reflected in implied forward interest rates. These forecasts extend three years ahead. One advantage of such an

assumption is that it normally provides a more realistic picture of future monetary policy. Another benefit is that it makes it easier to compare the Riksbank's forecasts with those of other forecasters. Moreover, it facilitates evaluations of the forecasts. One advantage of extending the forecast horizon is that it gives a clearer idea of how inflation is being influenced by various temporary shocks."

Explanations on the entire strategy are provided in the Monetary Policy Report 2007/1 of February 2007 in a box starting on p.19:

"Up to the autumn of 2005, the Riksbank based its forecasts in the main scenario on the assumption that the repo rate remained constant during the forecast period. This made it easy for the Riksbank to communicate, which was particularly important when establishing the new monetary policy regime and building up credibility for the inflation target. At the same time, it was mostly an unrealistic assumption that made it difficult to make good forecasts. Moreover, it gave no clear guidance as to how the Riksbank viewed future interest rate developments. This was a disadvantage since the general public's and the markets' expectations of the future interest rate path are just as important for the way monetary policy influences the economy as the expectations regarding the decision on the current level of the interest rate. These problems diminished when the Riksbank began making forecasts based on market expectations, as reflected in implied forward rates (Footnote: Between 1999 and 2003, the Riksbank published alternative inflation forecasts based on repo rate expectations in market surveys. The Riksbank's decision to publish its own forecasts for the repo rate is a further step towards greater clarity. Market expectations do not necessarily reflect the considerations that form the basis for monetary policy decisions. By making its own forecasts for the repo rate, the Riksbank can explain more clearly to the general public and the financial markets how it envisages future interest rate developments and how it reasons when making monetary policy decisions. It is also natural in forecasting work to treat the repo rate as one forecast variable among others."

Swiss National Bank

SNB has introduced the CIR assumption in 1999 and has since not changed it.

In the Monetary Policy Report of 2000, p.1, available online under `http://www.snb.ch/en/iabout/monpol/earlier/id/monpol_earlier_1999/pdf/monpol_earlier_1999.pdf`, is says that

"At the end of 1999, the National Bank for the first time published a medium-term inflation forecast and a target range for the three-month Libor rate."

The Monetary Policy Report of 2001, p.1, available online under `http://www.snb.ch/en/iabout/monpol/earlier/id/monpol_earlier_2000/pdf/monpol_earlier_2000.pdf`, completes:

"The inflation forecast published by the National Bank in December 2000 predicted that, at an unchanged interest rate of 3.5%, inflation would increase somewhat in the course of 2001 and slightly exceed 2% for a limited period of time."

The Quarterly Bulletin of December 2011 reports on p.7 that

"These forecasts are based on the assumption of a constant three-month Libor of 0% over the entire twelve-month forecast horizon and implies a depreciating Swiss franc."