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Forecast quality and simple instrument rules – a real-time data approach

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Abstract:

We start from the assertion that a useful monetary policy design should be founded on more realistic assumptions about what policymakers can know at the time when policy decisions have to be made. Since the Taylor rule – if used as an operational device - implies a forward looking behaviour, we analyze the reliability of the input information. We investigate the forecasting performance of OECD projections for GDP growth rates and inflation. We diagnose a much better forecasting record for inflation rates compared to GDP growth rates, which for most countries are almost uninformative at the time a Taylor rule should sensibly be applied. Using this data set, we find significant differences between Taylor rules estimated over revised data compared to real-time data. There is evidence that monetary policy seems to react more actively in real time than rules estimated over revised data suggest.

Given the evidence of systematic errors in OECD forecasts, in a next step we attempt to correct for these forecast biases and check to which extent this can lower the errors in interest rate policy setting. An ex-ante simulation for the years 1991 to 2001 supports the proposal that correcting for forecast errors and biases based on an error model can lower the resulting policy error in interest rate setting for most countries under consideration. In addition we investigate to what extent structural changes in the policy reaction behaviour can be handled with moving instead of expanding samples.

Our results point out that the information set available needs a careful examination when applied to instrument rules like those of the Taylor type. Limited forecast quality and significant data revisions recommend a more sophisticated handling of the dated information, for which we present an operational procedure that has the potential of reducing the risk of severe policy errors.

Keywords: Monetary policy rules, economic forecasting, OECD, real-time data

JEL-Classification: C53, C82, E52

Non-Technical Summary

Monetary policy formulation, evaluation and interpretation by means of simple policy rules, as for instance the popular Taylor rule, have attracted much attention in recent years. Such rules have not only been viewed as guidelines to (the transparency of) policy decisions, but also as benchmarks for predicting future policy and as a tool to judge whether current or past policy has been appropriately set.

It has been pointed out, however, that the results of such a procedure will be misleading, if policy reaction functions, whose parameters are estimated on the basis of preliminary or final data, are used for understanding how policymakers react to real-time data, which are still subject to revisions (Orphanides, 2001). The problem is aggravated by the fact that in monetary policy the necessity to take into account long lags leaves the policymaker with only forecasts for the variables entering his reaction function.

In order to obtain a better understanding for real-time data issues we evaluate accuracy and efficiency of OECD's forecasts for the G7 countries, paying attention to ex-post data revisions. Apart from a rather disappointing forecast performance for GDP over horizons of more than one year, we identify significant biases in the forecasts and a rather different behavior among countries as to data revisions. Applied to Taylor rules, we find significant differences between rules estimated over revised data as compared to those estimated over real-time data that are still subject to later revisions.

Furthermore we try to evaluate potential policy errors caused by erroneous and biased forecasts and we suggest methods to correct forecasts and preliminary data for some of these defects, thus enabling policymakers to use more efficiently the information set available at a certain moment of time. We propose procedures to control for distorting influences on the rule's dated data input and show that policy errors can be reduced. Generally, however, our results support skepticism against the use of simple instrumental rules in practical monetary policy, mainly because they imply large policy errors if they are based on unadjusted real-time input data.

Nicht-technische Zusammenfassung

Formulierung, Evaluierung und Interpretation von Geldpolitik mit Hilfe einfacher Politikregeln, wie z.B. der Taylor-Regel, haben in den letzten Jahren große Aufmerksamkeit erfahren. Solche Regeln werden nicht nur als Richtlinien für geldpolitische Entscheidungen, sondern auch zur Vorhersage von Maßnahmen und zur Beurteilung der Frage verwendet, ob eine bestimmte Politik über einen zu untersuchenden Zeitraum angemessen war oder nicht.

Es wurde jedoch darauf hingewiesen, dass eine Vorgehensweise irreführend sein kann, bei der geldpolitische Reaktionsfunktionen, die über mehrfach revidierte oder „endgültige“ Daten geschätzt wurden, zur Beschreibung des Verhaltens von Geldpolitikern in konkreten Entscheidungssituationen verwendet werden, in denen nur vorläufige Daten und Prognosewerte zur Verfügung stehen (Orphanides, 2001).

Wir evaluieren die Prognosen der OECD für die G7-Länder hinsichtlich ihrer Treffsicherheit und Effizienz, wobei wir insbesondere auch die nachträglich erfolgenden Datenrevisionen beobachten. Abgesehen von einer eher enttäuschenden Prognosequalität für das BIP über Horizonte von mehr als einem Jahr finden wir auch signifikante Verzerrungen in den Prognosen sowie ein offenkundig unterschiedliches Verhalten der einzelnen Länder gegenüber Datenrevisionen. Für die Schätzung von Taylor-Regeln impliziert dies naturgemäß deutliche Unterschiede, je nachdem, ob über Echtzeit- oder ex-post-Daten geschätzt wird.

Desweiteren versuchen wir, den potentiellen Politikfehler zu evaluieren, der durch ungenaue und verzerrte Prognosen verursacht wird, und wir schlagen Methoden vor, mit deren Hilfe diese Datenfehler korrigiert werden können, damit die Geldpolitik größeren Nutzen aus dem zum konkreten Zeitpunkt zur Verfügung stehenden Datenkranz ziehen kann. Wir zeigen, dass geeignete Verfahren zur Reduzierung des potentiellen Politikfehlers gefunden werden können. Im allgemeinen jedoch unterstützen unsere Ergebnisse den Skeptizismus gegenüber der unkritischen und mechanischen Anwendung der einfachen Instrumentenregel, da sie bei Anwendung auf unkorrigierte Datensätze erhebliche Politikfehler impliziert.

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Forecast Quality and Simple Instrument Rules - A Real-Time Data Approach[*)]

There is a long tradition of Austrian, or neo-Austrian, economics within which the scope for policy action is limited on the grounds that the knowledge base of policymakers is insufficient,…
(Sheila Dow, 2002)

1. Introduction

The future is uncertain – and there are few indications that our capabilities to reduce uncertainty by econometric forecasting have increased: An evaluation of OECD forecasts does not show any significant improvement of forecast accuracy over the course of the last thirty years[1], though we admit that it could be argued that over this period "reality" has become more complex and more difficult to forecast.

To degrees differing over the history of economic thought, economists have always been aware of uncertainty. Recently, methodological concerns have put new and increased emphasis on the issue of uncertainty in economics. Dow (2002), for instance, asks for the justification of policy actions, if their outcome is uncertain. Uncertainty is not only a property of the real world, she argues, but also a property of our knowledge about the real world. Economists, thus, have an uncertain view about economic actors, which themselves hold uncertain views about the real world, and support policymakers in influencing the economic process with uncertain results.

This is the framework in which monetary policy operates; even worse, it operates on long and variable lags, implying that current policy decisions are made on the basis

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1 See Glück, Schleicher and Catena (2000). We want to point out that it is not our intention to blame anybody for deficiencies of forecast quality. It is our intention to learn from the observed problems and try to develop procedures to improve upon them.

of assumptions and forecasts about the state of the economy in the future rather than on the basis of the actual state. When current policies are chosen, policymakers are uncertain about the state of the economy which is to prevail at the time the planned policy is expected to impact.

For the discretionary case, Cukierman and Gerlach (2003) have recently shown that an inflation bias could be caused by the simple existence of uncertainty in case of asymmetric attitudes of the central bank towards positive or negative forecast errors even if the desired level of employment is equal to its normal level. For policy under commitment, the literature on policy rules and, especially, on forecast-based rules, brought the problem of forecast quality and reliability even more to the forefront. Some authors found that such forecast-based rules seem to be able to control better for current and future inflation (Batini and Haldane, 1999). Ex post, however, forecasts might turn out to be quite wrong, mostly if forecasts for national account data enter the rule (as in the case of flexible inflation targeting), implying policy error and welfare losses.

Orphanides (2001) has pointed out that "(t)he discussion (on monetary policy rules)… often does not place proper emphasis on the informational problem associated with some of the advocated policy rules." Taking into account that the policymaker when making a decision has at his disposal only forecast values for the arguments entering his reaction function, Orphanides argues that the weights attached to these arguments when estimated by means of "realised" or revised data could be rather misleading. A voluminous literature on "real-time issues" was elicited by this observation, and there is an ongoing debate about its implications. Thus far, the evidence on whether it really matters if a central bank uses real-time data or final data is not yet clear. Orphanides (2001) finds that revisions of recommendations tend to be "very large" comparing results from these two data sets, whereas Adema (2003) for "quasi-real time" data, Bernanke and Boivin (2000) and others cannot find much difference.

On more basic grounds, however, Svensson (2003) has judged simple instrumental rules as "inadequate as a description of real-world inflation targeting" and even their use as mere guidelines as "incomplete and too vague to be operational". For the prescriptive case, we try to show that insufficient forecast quality and the fact of frequent and significant data revisions imply high uncertainty concerning the parameters to be used in such rules, thus increasing potential policy error.

There seems to be a complex set of errors and mistakes which threaten to be incurred if monetary policy rules, whose parameter values are obtained from estimation over "final" data from the past, are applied to real-time decisions. We see at least three sources of such potential mistakes:

- Forecast uncertainty: The policymaker wishing to influence some future outcome in an optimal sense has, as mentioned, at his disposal only forecasts for the period in question. These forecasts may be wrong and the mistake usually is the larger the longer the forecast horizon is. Thus, for the sensible application of a monetary policy rule, it has to be asked which the forecast horizon is starting from which the forecast performance shows some reliability.
- Forecast bias: Errors do not sum up to zero over time, but in many cases forecasts can be shown to be severely biased. If such biases can be identified, is it possible and does it make sense to correct for them in order to bring the policymaker's real-time decision closer to "reality"?
- Data revisions: In some cases – apart from the fact of significant revisions –, there seem to exist systematic components in the revision process. Again, if identifiable, they could be incorporated into some correction mechanism.

Neglecting these errors may render Taylor rules estimated over revised data practically irrelevant for real-time decisions and may lead to an interest rate setting consistently too high or too low with high costs incurred by such policy errors. However, by closer examination of OECD forecasts it seems possible to obtain some estimates of the size and evolution of these mistakes by evaluating forecasts over longer periods, by calculating the forecast errors over changing forecast horizons, by investigating for biases, and by observing the ex-post data revisions. If successful, the policy error incurred by a "final-data Taylor rule" when applied to real-time decisions can be enumerated and procedures can be developed to correct for these distortions.

The outline of the paper is as follows: In section 2 we explain the content of our data base, quantify forecast errors and biases. In section 3 we show the difference between „real-time data“ and „last reported data" Taylor rules and we experiment with different procedures to improve the information content of data available in the real-time situation. Finally, in section 4 we draw the conclusions.

2. Dynamics and Bias in Forecasting

There is a vast literature on the evaluation of forecast accuracy trying to discriminate between models based on their relative forecasting record. Although this seems to be potentially an objective criterion, considerable difficulties remain nonetheless.

The first difficulty inherent in such an exercise relates to the measurement of forecast quality. What should be the appropriate metric? As regards *quantitative* measures, there are many to choose from – absolute errors, root mean square errors, Theil's U, etc. Similarly, a number of *qualitative* measures are available; for instance, we might be interested in correctly predicting turning points. Furthermore, it is widely acknowledged that accurate short-run forecasts are better made by small time series or reduced form models than by structural relations. Such time series models, however, have limited economic content. Policy institutions, by contrast, typically value the economic content of a forecast and the forecast "story", since it facilitates internal and external communication and allows them to conceptualise risks and scenarios around the forecast.

Second, even if we assume that some suitable forecasting metric can be found, there still remains the question of how one interprets and makes use of that metric. For example, over which horizon do we judge performance? Results will inevitably differ at different forecast horizons. Moreover, ex-post data revisions will change those errors. Indeed, even if we can identify the best (ex-post) performer, there is no guarantee that this will extrapolate into the future. It should also be borne in mind that small forecast failure does not necessarily imply that the model is well-specified; the forecast error is a compound of different errors – specification (i.e. model) errors, errors in residual adjustment and errors in exogenous assumptions, and it is not clear how to disentangle these different aspects. For many projection exercises, the outcome is a combination of model and off-model judgment.

Recent papers[2], however, conclude that more serious problems seem to be involved in forecasting than the simple problem of accuracy, namely bias, rationality and efficiency as well as the problem of data revisions. It is found that efficiency (e.g. in terms of bias and variance) does not seem to be guaranteed, as shown for instance by Joutz and Stekler (2000) as well as by Loungani (2000), and obviously there are extended periods of bias towards systematic over- or underestimation. Whereas Joutz and Stekler in their study of the Fed forecasts find that on average these were unbiased, Loungani (2000) in his investigation on private sector forecasts finds evidence of an upward bias. These results relate predominantly to GDP forecasts, but generally they also apply to previsions of inflation.

In the following, we put special emphasis on the *dynamic* aspects of the forecasting and data revision processes and on biases as this will provide us with a data base appropriate to deal with some of the problems discussed above. For this purpose, we take under scrutiny the forecasts of the Organisation of Economic Cooperation and Development (OECD)[3] .

2.1 Data Base

Since the sixties, the OECD in its *Economic Outlook* has been publishing forecasts for some of its member countries. Projections for the major macroeconomic aggregates are published twice a year, one in June (mid-year forecast) and one in December (end-year forecast). Originally, the first forecast for a particular year was the mid-year forecast one year ahead. This has been extended in the late seventies to the end-year forecast two years ahead. Thus, for instance, the first forecast for 2006 is published in December 2004.

We analyze the gross domestic product (GDP) and consumer price forecasts, both in rates of change, for the G7 countries (USA, Japan, Germany, United Kingdom, France, Italy and Canada). The basic data for this study were taken from every published *Economic Outlook* since 1967. The evolution of forecasts for the particular

[2] A more elaborate review of this literature was given in Glück, Schleicher and Catena (2000).

[3] An alternative way would have been to investigate the forecasts of national institutes. However, in most countries there exists more than one institution producing forecasts – so which one to choose? We preferred to use the data base of a highly respected international institution which supposedly also bases its projections on consensus based approaches.

years as well as the data revisions constitute the data base which is analyzed. That sums up to nine estimates (one two-year-ahead estimate, two one-year-ahead, two current year and two estimates each one year and two years after) for every country. These estimates are compared to the final data, where “final” still means preliminary and should be better termed “last reported” since many countries continue their data revisions. The final data in this study are the last reported values for every year that were published in late 2003.

For several reasons, these forecasts are tempting for a thorough analysis. First, the forecasting process in this institution obviously takes into account a lot of national and international information, and political influence cannot be fully excluded. Second, the sequence of these forecasts provides a good documentation of the gradual revisions of the forecasts, since five semi-annual revisions for the predictions of a particular year are available. Third, a very special feature of this data base is the documentation of the data revision process that follows afterwards which can be traced over four additional estimates (revisions) of the data for a particular year.

Some examples of this sequence of forecasts and data revisions are shown in Figures 1 to 3 for the evolution of GDP rates and inflation rates from the OECD data set and for comparison from IMF. As a first impression we observe large adjustments in the GDP forecasts, but much more stability in the inflation predictions.

This data base offers the possibility to investigate

- if there is an improvement of forecasting accuracy over the sample period and in the data revision process[4],
- if regularities in forecasts and data revisions can be used to adjust the preliminary data in order to obtain estimates that are closer to the final data and
- if there are major differences with respect to the quality of forecasts among the G7 countries.

[4] This was extensively analysed in Glück, Schleicher and Catena (2000). No improvement in forecast quality over time could be diagnosed.

2.2 Forecast and Revision Dynamics

Formally, we observe the evolution of the value for a variable *y* at time *t* for which information is available at time $t-\tau$. We talk about

forecasts if $\tau = 0, 1, 2, \ldots$

and about

data revisions if $\tau = -1, -2, \ldots$

In the following we will deal with both cases symmetrically and denote *estimates* for a particular variable *y* at time *t* based on information at $t-\tau$ by $y^e_{t|t-\tau}$.

The relationship between the actual (last reported) value of variable y_t and the estimate made at different periods τ before (forecast) or after period t (data revision) $y^e_{t|t-\tau}$ and the corresponding estimation error $e_{t|t-\tau}$ is

Fehler! Es ist nicht möglich, durch die Bearbeitung von Feldfunktionen Objekte zu erstellen.= $y^e_{t|t-\tau}$ +**Fehler! Es ist nicht möglich, durch die Bearbeitung von Feldfunktionen Objekte zu erstellen.**, $\tau = -2, -1, 0, 1, 2.$ (1)

The Tables A.1 and A.2 in the Annex report the error analysis for relation (1). For rates of change of GDP and of consumer price deflators, various vintages of dated measurements and last reported values are compared for the G7 countries, using the following country abbreviations: *United States* (USA), *Japan* (JPN), *Germany* (DEU), *United Kingdom* (GBR), *France* (FRA), *Italy* (ITA) and *Canada* (CAN). The rows in the tables refer to the dates when the corresponding estimates (predictions or data revisions) were published.

The general impression we get from Tables A.1 and A.2 corresponds to what we would expect as to forecast errors which improve with the age of an estimate. But it may not be that well-known that the data revision process continues with remarkably pronounced errors over more than two years after the date a forecast belongs to. The precision of the inflation forecast is at the beginning of the forecast sequence higher than for GDP growth.

Figure 1: OECD forecasts and data revisions: GDP USA

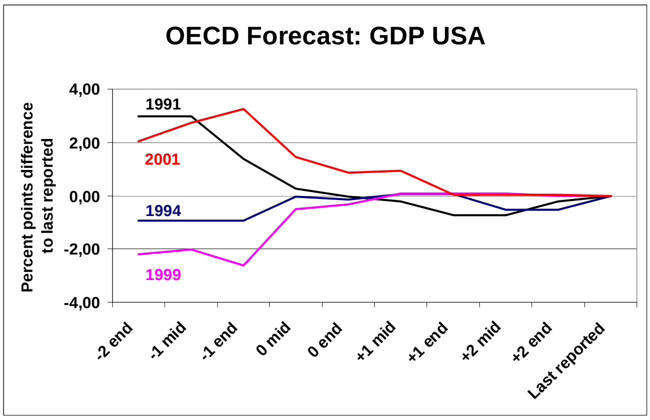


Figure 2: IMF forecasts and data revisions: GDP USA

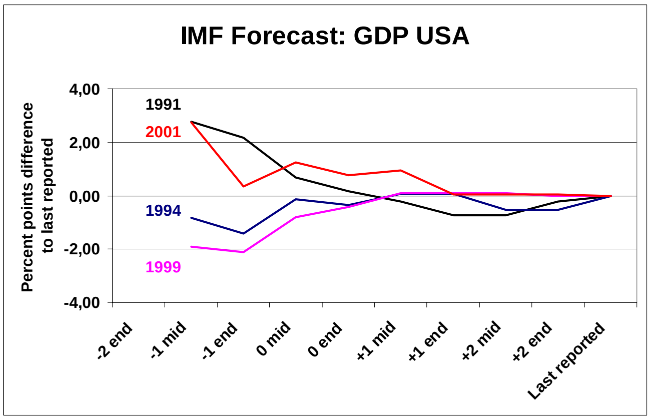
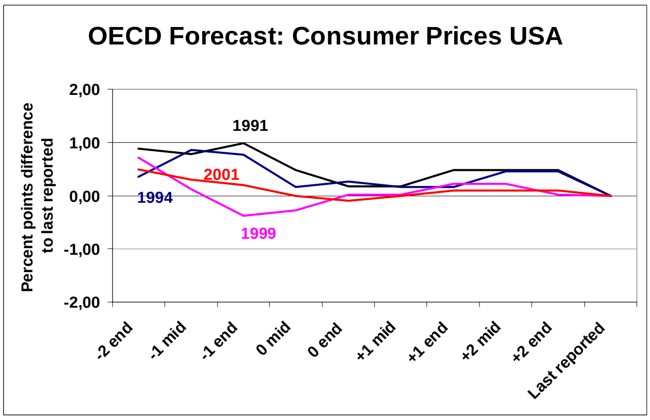


Figure 3: OECD forecasts and data revisions: Consumer prices USA



As to GDP, all countries seem to have a tendency of starting with an overestimation, except the USA. More details will be revealed in the error model which we will present below. For the United States we discover a substantial and systematic underestimation both during the forecast as well as the data revision period. Quite the reverse holds true for Japan. This country's GDP is systematically overestimated (as indicated by negative average errors) in both periods. Compared to this, Germany and France show very different error behaviour: They start with an overestimation of the GDP growth rates but the errors quickly converge to zero and stay there. This means that both countries hardly revise their data afterwards[5]. Italy and the United Kingdom start out with overestimates in their first forecasts but keep underestimating during forecast and data revisions. A similar behaviour is exhibited by Canada with a pronounced overestimation of its first forecast.

2.3 Error Model of Dated Estimates

Next we investigate the relationship between dated estimates for forecasts and data revisions and the last reported values by specifying the following error model:

$$y_t = b_0 + b_1 y^e_{t|t-\tau} + u_{t|t-\tau} \quad \tau = -2, -1, 0, 1, 2 \qquad (2)$$

Thus we estimate the linear relationship between the final (last reported) series y_t and its dated estimates $y^e_{t|t-\tau}$, covering both forecasts (if τ = 2, 1, 0) and data revisions (if τ = -1, -2).

We use model (2) to test the joint hypothesis that the coefficients b_0 and b_1 do not differ significantly from 0 and 1, respectively, and that there is no serial correlation in the errors, as is required for efficiency and unbiasedness. In addition, we would expect that the sequence of these regressions shows a converging behaviour both with respect to the parameters b_0 and b_1, the improvement of the overall fit (as reported by R^2) and a lowering of serial correlation (indicated by the *DW* statistic). The results of these regressions for GDP forecasts are reported in Tables A.3 and A.4 in the Annex.

[5] It remains open if this is to be interpreted as proof of an excellent quality of the data generating process or rather as neglect of information coming up later.

A summary of these results expressed by the multiple coefficient of correlation is contained in Tables 1.

Obviously the forecast performance for the inflation rate is far superior to the GDP rates which up to the end-year forecast one year ahead do not seem to convey predictive information.

Table 1a: Error analysis for dated estimates of GDP

Date of estimate	R^2						
	USA	JPN	DEU	GBR	FRA	ITA	CAN
2 ys. ahead (end)	0,000	0,012	0,050	0,108	0,287	0,100	0,185
1 y. ahead (mid)	0,191	0,071	0,000	0,068	0,035	0,000	0,110
1 y. ahead (end)	0,587	0,584	0,428	0,408	0,516	0,416	0,423
Current year (mid)	0,804	0,779	0,769	0,853	0,747	0,627	0,734
Current year (end)	0,883	0,920	0,898	0,871	0,929	0,821	0,837
1 y. after (mid)	0,900	0,954	0,915	0,909	0,908	0,889	0,905
1 y. after (end)	0,947	0,950	0,919	0,919	0,936	0,898	0,914
2 ys. after (mid)	0,947	0,956	0,914	0,918	0,945	0,883	0,923

Source: Calculated from OECD Economic Outlook

Table 1b: Error analysis for dated estimates of consumer prices

Date of estimate	R^2						
	USA	JPN	DEU	GBR	FRA	ITA	CAN
2 ys. ahead (end)	0,525	0,731	0,707	0,711	0,579	0,575	0,683
1 y. ahead (mid)	0,780	0,750	0,537	0,649	0,930	0,941	0,894
1 y. ahead (end)	0,850	0,865	0,760	0,884	0,956	0.939	0,936
Current year (mid)	0,987	0,931	0,915	0,906	0,984	0.983	0,962
Current year (end)	0,980	0,929	0,943	0,960	0.992	0,992	0,985
1 y. after (mid)	0.979	0,947	0,940	0,976	0,995	0,992	0,983
1 y. after (end)	0,977	0,945	0,936	0,981	0,994	0,994	0,982
2 ys. after (mid)	0,977	0,940	0,938	0,983	0,994	0,995	0,981

Source: Calculated from OECD Economic Outlook

Thus the error model confirms that the first and second forecasts obviously carry no useful information for future GDP growth. There is convergence towards $b_0 = 0$ and $b_1 = 1$, but only very late in the revision period and not in the forecasting phase.

Since all estimates starting with the one-year ahead forecast produced at the end of that year show a significant relationship between estimated data and last reported data this fact can be exploited for improving both the dated forecasts and the data revisions in order to obtain combined estimates that come closer to the final series. This pattern holds for all G7 countries.

Thus, the impression gained from visual inspection of Figures 1 to 3 is confirmed by the error model: The forecast record for GDP growth rates is quite disappointing. The first two published forecasts contain hardly any useful information as to the last reported values.

Estimates for inflation rates, however, are much more accurate than estimates for GDP growth. The end-year inflation forecast two years ahead captures on average more than 50% of the variance of the last reported data. This means that inflation forecasts contain more useful information that can be incorporated into monetary policy rules. Thus, in the following we will concentrate mainly on the GDP forecasts, as they seem to be the source of larger potential errors than the inflation forecasts.

3. Overcoming Real-Time Data Problems in the Case of Taylor Rules

Given these data problems, a policymaker faces two options for dealing with the phenomenon of real-time data:

- to apply parameter values of instrument rules which are estimated from real-time data, or
- to correct real-time data for the known deficiencies like forecasting and revision errors - if they can be identified - and structural breaks and to re-estimate parameter values of instrument rules accordingly.

In this section we demonstrate operational procedures for overcoming the problem of dated information which characterizes real-time data in the case of Taylor rules.

3.1 The Impact of Dated Information on the Parameters of Taylor Rules

We want to investigate to what extent central bankers behave differently in applying simple instrument rules whether there is a real-time situation or an ex-post information set. Or, put differently, how would policy reactions change if parameter values gained from last reported data were applied instead of those from real-time data?

In order to investigate this, we estimate Taylor rules using forecast values as arguments. Thus, we regress the short-term interest rate of the current period on the forecasts made a certain time span ahead. As indicated, however, GDP forecasts over horizons of more than one year are of no predictive value; therefore, we estimate Taylor rules based on one-year-ahead forecasts for GDP and inflation. In addition we apply interest-rate smoothing by including the lagged interest rate, i.e. we regress

$$r_t = \alpha_0 + \alpha_1 p^e_{t|t-1} + \alpha_2 y^e_{t|t-1} + \alpha_3 r_{t-1} + u_{t|t-1}, \qquad (3)$$

with $p^e_{t|t-1}$ being the inflation rate for year *t* forecast at time *t*-1, $y^e_{t|t-1}$ being the forecast output gap for the next year (defined as the difference between forecast GDP growth and smoothed GDP growth as a measure for potential GDP growth). We use equation (3) to generate a forecast for the short-term interest rate $r_{t|t-1}$ in period *t* by using the forecasts for GDP and inflation available in period *(t-1)* for period *t*[6].

The results for Taylor rules using one-year-ahead forecasts are summarized in Table 2a. This ex-post analysis indicates that for all G7 countries current year's short-run interest rates are significantly related to inflation forecasts made at the end of the preceding year. The size of the estimated coefficients varies between 0.4 and 1.4. The impact of the same dated predictions for GDP gap on short-run interest rates is obviously much weaker and only significant for Japan and United Kingdom.

The estimation results for the same Taylor rule specification but with last reported values are contained in Table 2b. We recognize that the significance of the inflation rate increases. As to the GPD gap, in contrast to the estimates based on predictions, the United States and Germany show significant impacts, but the United Kingdom does not.

Compared to the final data rules, as reported in Table 2b, we recognize that in the real-time data rules of Table 2a the reaction to the inflation rate in most cases is somewhat stronger (though not always statistically significant), whereas for the real-time output gap the significance is reduced. The coefficients on the lagged interest rates suggest that the desire to keep the interest rate stable seems somewhat stronger than in the final data case.

[6] Given the high error in GDP forecasts, we do not invest more sophistication into the calculation of the output gap.

Table 2a Historical evidence of Taylor rules estimated with end-year forecasts one year ahead

Country	Inflation a_1	Inflation t_1	GDP gap a_2	GDP gap t_2	Lagged dep. var. a_3	Lagged dep. var. t_3	Constant a_4	Constant t_4	R^2	DW
USA	0,973	4,07	-0,377	1,33	0,406	2,66	0,697	0,82	0,847	0,97
Japan	0,796	4,79	-0,580	2,40	0,541	4,83	1,522	2,56	0,895	2,07
Germany	1,394	3,07	-0,302	0,88	0,321	1,45	0,676	0,67	0,709	1,45
United Kingdom	0,789	4,19	-1,078	2,90	0,604	3,75	-0,060	0,04	0,817	1,03
France	0,358	3,04	-0,102	0,24	0,656	4,07	1,229	1,17	0,870	1,72
Italy	0,520	3,83	-0,399	0,98	0,625	5,58	0,956	0,94	0,915	1,87
Canada	1,250	3,37	-0,111	0,19	-0,057	0,17	3,665	1,97	0,742	1,44

Source: Own calculations based on data from OECD Economic Outlook, 1980-2001.

Table 2b Historical evidence of Taylor rules estimated with last reported values

Country	Inflation a_1	Inflation t_1	GDP gap a_2	GDP gap t_2	Lagged dep. var. a_3	Lagged dep. var. t_3	Constant a_4	Constant t_4	R^2	DW
USA	0,874	7,42	-0,417	3,34	0,514	5,95	0,278	0,52	0,930	1,76
Japan	0,875	4,67	-0,380	2,26	0,481	3,83	1,548	2,88	0,883	2,28
Germany	0,949	5,02	-0,551	2,86	0,500	3,75	0,993	1,46	0,826	1,64
United Kingdom	0,610	4,81	-0,310	1,30	0,457	3,35	1,834	1,51	0,841	1,38
France	0,368	4,07	-0,146	0,53	0,649	5,32	1,210	1,46	0,895	1,63
Italy	0,362	5,07	-0,700	0,24	0,667	6,84	0,709	0,80	0,928	1,97
Canada	0,912	3,77	-0,132	0,44	0,229	0,85	2,650	1,64	0,782	1,74

Source: Own calculations based on data from OECD Economic Outlook, 1980-2001.

These results seem to point in the direction that central banks in real-time react more actively to deviations in inflation from their targets than rules estimated over final data would suggest, whereas the reaction to deviations in output in most cases seems less significant than for final data.

Thus, it is confirmed that parameters of estimated Taylor rules are rather sensitive with respect to dated sample information. In addition there is evidence from CUSUM tests about structural changes.

3.2 The Handling of Dated Information in the Context of Taylor Rules

We are proposing therefore a procedure which attempts to deal with a real-time policy decision environment that takes into account both the aspect of dated sample information and structural changes in the policy reaction behaviour.

As to the difficulties with dated sample information we propose two types of sample strategies:

- The *unadjusted sample* only deals with last reported values but neglects the most recent four values because of the evidence of major data revisions.

- The *adjusted sample* also deals with last reported values but replaces the most recent four values by estimates from the measurement error model. This means that the preliminary values for these values are replaced by bias-corrected values.

As to the difficulties with structural changes we are also dealing with two types of sample strategies:

- *Expanding samples* start with a first sample 1980-1990 and expand in annual increments to the final sample 1980-2000.

- *Moving samples* start with a first sample 1980-1990 and move in annual increments with 11 years sample sizes to the final sample 1990-2000.

For both types of samples, based on the estimated parameters, the one-period outside sample forecast for the short-term interest rate from 1991 to 2001 is estimated.

Thus we have designed four types of real-time simulations which we apply to information sets that were available to policymakers when attempting to predict the adequate policy reaction for short-term interest rates from 1991 to 2001. The real-time forecast errors, measured in means, variance and mean square errors (MSE) of the short-term interest rate are reported in Tables 3.

These real-time simulations reflect the decision of a policymaking institution that needs to fix the short-term interest rate in late autumn for the next year. The results seem to be quite revealing:

In the case of expanding samples as reported in Table 3a, e.g. for the United States, interest rates were set too low over the period under consideration by about 30 basis points in the unadjusted sample. Adjusting the sample leads to a reduction of this policy error to about 8 basis points, though the variance increases.

In the case of moving samples as reported in Table 3b, we observe again a reduction of the predicted short-term interest rate forecasts from an underestimation of 84 basis points to an overestimation of 46 basis points, but a substantial reduction in variance that that also reduces the mean square error.

With only two exceptions (USA and Italy) out of 14 simulations, instead of using unadjusted samples the switch to adjusted samples substantially improves the forecast performance as observed in the decline of the mean square error.

Switching to moving samples improves in eight out of 14 simulations the forecast performance. The reason for this improvement seems to be the handling of structural changes by flexible fixed size samples instead of increasing samples.

Table 3a: Real-time simulation of Taylor rules using expanding samples estimated with dated data values

	Unadjusted Sample			Adjusted Sample		
	Mean	Variance	MSE	Mean	Variance	MSE
USA	0,330	1,065	**1,174**	0,080	3,300	**3,306**
Japan	-1,780	4,283	**7,451**	-1,097	1,527	**2,730**
Germany	-0,067	2,865	**2,869**	-0,615	1,060	**1,438**
United Kingdom	-2,392	6,674	**12,396**	-1,138	2,811	**4,106**
France	-0,841	4,816	**5,523**	-0,819	2,066	**2,737**
Italy	-1,491	3,455	**5,678**	-0,888	3,113	**3,902**
Canada	-0,987	3,672	**4,646**	-1,472	1,503	**3,670**

Source: Own calculations based on data from OECD Economic Outlook, sample starts 1980 and expands from 1991 to 2001.

Table 3b: Real-time simulation of Taylor rules using moving samples estimated with dated data values

	Unadjusted Sample			Adjusted Sample		
	Mean	Variance	MSE	Mean	Variance	MSE
USA	0,843	5,703	**6,414**	-0,458	2,965	**3,175**
Japan	0,730	1,482	**2,015**	-0,526	1,111	**1,388**
Germany	0,574	2,087	**2,416**	-0,603	0,536	**0,900**
United Kingdom	-0,559	8,516	**8,828**	0,022	7,422	**7,422**
France	0,239	7,898	**7,955**	-0,840	2,619	**3,325**
Italy	-1,398	3,059	**5,013**	-1,243	3,817	**5,362**
Canada	-0,406	9,827	**9,992**	-0,622	4,424	**4,811**

Source: Own calculations based on data from OECD Economic Outlook, moving 11 year sample start with1980-1990 and move to 1991–2001.

Being aware of the fact that different samples may yield different results from the real-time simulations, we performed on the OECD data set a ranking of the four different sampling strategies for dealing with dated information in the context of Taylor rule based interest rate decisions. Table 4 lists this ranking according to the mean square error for ex-ante interest rate forecasts.

Table 4 Ranking of sampling strategies

	Ranking			
	1	2	3	4
USA	unadjusted expanding	adjusted moving	adjusted expanding	unadjusted moving
Japan	adjusted moving	unadjusted moving	adjusted expanding	unadjusted expanding
Germany	adjusted moving	adjusted expanding	unadjusted moving	unadjusted expanding
United Kingdom	adjusted expanding	adjusted moving	unadjusted moving	unadjusted expanding
France	adjusted expanding	adjusted moving	unadjusted expanding	unadjusted moving
Italy	adjusted expanding	unadjusted moving	adjusted moving	unadjusted expanding
Canada	adjusted expanding	adjusted moving	unadjusted expanding	unadjusted moving

Source: Own calculations based on data from OECD Economic Outlook.
Data are “adjusted” if they are modified according to the estimated error model, otherwise they are “unadjusted”. Samples are “expanding” if the sample size increases or “moving” if the sample size is kept constant.

4. Conclusions

We started from the assertion that a useful monetary policy design should be founded on more realistic assumptions about what policymakers can know at the time when policy decisions have to be made.

Since the Taylor rule – if used as an operational device - implies a forward looking behaviour, we analyze the reliability of the input information. We use OECD forecasts for inflation and GDP growth rates and investigate the forecasting performance for these variables. We diagnose a much better forecasting record for inflation rates compared to GDP growth rates, which for most countries are almost uninformative at the time a Taylor rule should sensibly be applied. Using this data set, we find significant differences between Taylor rules estimated over revised ex-post data and over real-time data and there is evidence that monetary policy seems to react more actively in real time than rules estimated over revised data suggest.

Since the OECD forecasts for GDP growth rates exhibit systematic errors, in a next step we attempted to correct for these forecast biases and checked to which extent this can lower the errors in interest rate policy setting. An ex-ante simulation for the years 1991 to 2001 supports the proposal that correcting for forecast errors and biases based on an error model can lower the resulting policy error in interest rate setting for most countries under consideration. In addition we investigated to what extent structural changes in the policy reaction behaviour can be handled with moving instead of expanding samples.

Generally, our analysis supports critics and sceptics of the Taylor rule who argue that a mechanical application of this rule will not be appropriate and should at least be accompanied by a careful examination of a broad set of additional information.

Svensson (2003) presented a long list of what may be wrong with the Taylor rule. Our results additionally point out the fact that the informational basis needs a careful examination. Limited forecast quality and significant data revisions recommend a more sophisticated handling of the dated information for which we present an operational procedure that has the potential of reducing the risk of severe policy errors.

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ANNEX

Table A.1 Error analysis of GDP

	Mean of errors of estimates								
	2 y. ahead	1 year ahead		current year		1 year after		2 years after	
	end	mid	end	mid	end	mid	end	mid	end
USA	0,32	0,35	0,41	0,27	0,38	0,34	0,34	0,36	0,32
JPN	-0,71	-0,25	-0,36	-0,07	-0,15	-0,30	-0,30	-0,35	0,04
DEU	-0,76	-0,60	-0,10	0,06	0,07	0,04	-0,03	-0,04	0,05
FRA	-0,72	-0,36	-0,14	-0,09	0,09	0,04	-0,01	-0,03	0,13
ITA	-0,73	-0,49	0,13	0,28	0,53	0,44	0,49	0,49	0,08
GBR	-0,15	0,36	0,28	0,60	0,61	0,55	0,41	0,36	0,21
CAN	-0,65	-0,44	0,11	0,23	0,47	0,40	0,39	0,36	

	Root mean square of errors of estimates								
	2 y. ahead	1 year ahead		current year		1 year after		2 years after	
	end	mid	end	mid	end	mid	end	mid	end
USA	1,58	1,69	1,37	1,01	0,86	0,79	0,64	0,64	0,55
JPN	2,12	1,98	2,24	1,69	1,21	1,08	1,12	0,96	0,66
DEU	1,92	1,73	1,52	0,99	0,79	0,67	0,68	0,69	0,37
FRA	1,77	1,54	1,22	1,00	0,75	0,63	0,53	0,51	0,40
ITA	1,50	1,38	1,77	1,36	1,08	0,84	0,85	0,91	0,24
GBR	1,30	1,43	1,49	0,94	0,93	0,80	0,68	0,66	0,47
CAN	1,86	2,12	1,58	1,10	1,01	0,77	0,74	0,70	

	Standard deviation of errors of estimates								
	2 y. ahead	1 year ahead		current year		1 year after		2 years after	
	end	mid	end	mid	end	mid	end	mid	end
USA	1,60	1,62	1,47	0,85	0,77	0,70	0,49	0,48	0,47
JPN	2,06	1,93	1,34	0,74	0,99	0,76	0,76	0,59	0,59
DEU	1,82	1,73	1,41	0,91	0,72	0,57	0,55	0,54	0,48
FRA	1,67	1,60	1,15	0,72	0,57	0,48	0,50	0,46	0,44
ITA	1,27	1,22	0,84	0,67	0,47	0,26	0,27	0,23	0,23
GBR	1,33	1,26	1,14	0,79	0,54	0,39	0,38	0,39	0,40
CAN	1,79	1,87	1,76	1,19	0,74	0,58	0,48	0,48	

Table A.2 Error analysis of consumer prices

	Mean of errors of estimates								
	2 y. ahead	1 year ahead		current year		1 year after		2 years after	
	end	mid	end	mid	end	mid	end	mid	end
USA	-0,55	-0,63	-0,28	-0,07	0,03	0,09	0,01	-0,03	-0,10
JPN	-0,53	-0,63	-0,36	-0,21	-0,06	0,03	0,01	0,02	-0,02
DEU	-0,12	-0,24	-0,09	-0,11	-0,13	-0,12	-0,09	-0,09	-0,15
FRA	0,00	-0,01	0,14	0,04	0,06	0,22	0,21	0,22	0,20
ITA	0,88	0,64	0,92	0,40	0,31	0,21	0,20	0,19	0,21
GBR	0,03	-0,03	-0,02	0,15	0,45	0,44	0,40	0,44	0,34
CAN	-0,40	-0,34	-0,10	-0,07	0,09	0,12	0,09	0,09	

	Root mean square of errors of estimates								
	2 y. ahead	1 year ahead		current year		1 year after		2 years after	
	end	mid	end	mid	end	mid	end	mid	end
USA	1,01	1,01	1,01	0,31	0,37	0,37	0,37	0,37	0,38
JPN	0,92	1,12	0,96	0,77	0,71	0,63	0,63	0,57	0,59
DEU	0,80	1,01	0,91	0,60	0,54	0,48	0,48	0,40	0,41
FRA	0,62	0,80	0,87	0,51	0,36	0,38	0,39	0,53	0,30
ITA	1,45	1,16	1,67	0,84	0,58	0,47	0,48	0,42	0,35
GBR	1,33	1,27	1,28	1,19	0,88	0,79	0,69	0,69	0,63
CAN	1,23	1,12	1,02	0,84	0,67	0,57	0,58	0,44	

	Standard deviation of errors of estimates								
	2 y. ahead	1 year ahead		current year		1 year after		2 years after	
	end	mid	end	mid	end	mid	end	mid	end
USA	0,88	0,60	0,83	0,31	0,30	0,26	0,23	0,26	0,31
JPN	0,70	0,79	0,80	0,63	0,51	0,51	0,50	0,52	0,52
DEU	0,58	0,64	0,58	0,38	0,37	0,42	0,44	0,43	0,43
FRA	0,65	0,55	0,54	0,32	0,32	0,25	0,27	0,21	0,19
ITA	1,19	1,01	0,92	0,36	0,42	0,30	0,31	0,24	0,26
GBR	1,38	1,37	0,97	1,13	0,88	0,79	0,66	0,64	0,64
CAN	0,81	0,51	0,53	0,44	0,36	0,33	0,30	0,30	

Table A.3a Error model for GDP

USA GDP

Date of estimate	Estimated variable b_1	t_1	Constant b_0	t_0	R2	DW
2 ys. ahead (end)	-0,03	0,1	3,00	2,1	0,000	1,48
1 y. ahead (mid)	1,05	2,2	0,21	0,2	0,191	1,36
1 y. ahead (end)	0,89	7,2	0,71	1,8	0,587	1,94
Current year (mid)	0,83	12,0	0,75	3,1	0,804	1,78
Current year (end)	0,85	16,3	0,78	4,3	0,883	1,74
1 y. after (mid)	0,87	17,5	0,69	4,0	0,900	1,48
1 y. after (end)	0,87	24,5	0,67	5,3	0,947	1,69
2 ys. after (mid)	0,89	24,3	0,65	5,0	0,947	1,74

JAPAN GDP

Date of estimate	Estimated variable b_1	t_1	Constant b_0	t_0	R2	DW
2 ys. ahead (end)	0,17	0,4	1,44	1,3	0,012	1,03
1 y. ahead (mid)	0,41	1,3	1,37	1,4	0,071	1,09
1 y. ahead (end)	0,83	7,1	0,39	0,6	0,584	1,78
Current year (mid)	0,83	11,1	0,63	1,6	0,779	1,87
Current year (end)	0,81	20,1	0,64	2,8	0,920	1,70
1 y. after (mid)	0,82	26,5	0,51	2,8	0,954	1,95
1 y. after (end)	0,81	25,5	0,53	2,8	0,950	1,91
2 ys. after (mid)	0,86	26,8	0,30	1,6	0,956	1,93

GERMANY GDP

Date of estimate	Estimated variable b_1	t_1	Constant b_0	t_0	R2	DW
2 ys. ahead (end)	-0,78	0,9	3,89	1,6	0,050	1,26
1 y. ahead (mid)	-0,06	0,1	2,02	1,2	0,000	1,05
1 y. ahead (end)	1,00	5,2	-0,09	0,5	0,428	1,64
Current year (mid)	0,88	10,7	0,33	1,4	0,769	1,94
Current year (end)	0,81	17,2	0,48	3,1	0,898	1,98
1 y. after (mid)	0,85	19,1	0,38	2,6	0,915	1,8
1 y. after (end)	0,84	19,5	0,35	2,5	0,919	1,71
2 ys. after (mid)	0,83	18,8	0,38	2,5	0,914	1,64

UNITED KINGDOM

Date of estimate	Estimated variable b_1	t_1	Constant b_0	t_0	R2	DW
2 ys. ahead (end)	0,93	1,3	0,01	0,0	0,108	1,22
1 y. ahead (mid)	0,59	1,2	1,28	1,1	0,068	0,86
1 y. ahead (end)	0,82	5,0	0,67	1,6	0,408	1,45
Current year (mid)	1,04	14,3	0,53	3,0	0,853	1,84
Current year (end)	0,93	15,3	0,74	4,7	0,871	1,83
1 y. after (mid)	1,03	18,4	0,50	3,5	0,909	2,57
1 y. after (end)	1,02	19,7	0,36	2,6	0,919	2,96
2 ys. after (mid)	1,01	19,2	0,34	2,4	0,918	3,17

Table A.3b Error model for GDP (continued)

FRANCE

Date of estimate	Estimated variable		Constant		R2	DW
	b_1	t_1	b_0	t_0		
2 ys. ahead (end)	-1,78	2,5	6,67	3,4	0,287	1,14
1 y. ahead (mid)	-0,38	0,8	2,95	2,6	0,035	0,93
1 y. ahead (end)	0,85	6,2	0,29	0,7	0,516	1,50
Current year (mid)	0,75	10,2	0,60	2,4	0,747	1,25
Current year (end)	0,86	21,1	0,38	2,8	0,929	1,21
1 y. after (mid)	0,81	18,3	0,55	3,6	0,908	1,45
1 y. after (end)	0,80	15,0	0,60	3,4	0,936	1,22
2 ys. after (mid)	0,85	22,8	0,37	2,8	0,945	0,91
2 ys. after (end)	0,93	10,1	0,26	1,3	0,879	1,12

ITALY GDP

Date of estimate	Estimated variable		Constant		R2	DW
	b_1	t_1	b_0	t_0		
2 ys. ahead (end)	-1,06	1,3	4,46	2,2	0,100	1,21
1 y. ahead (mid)	-0,02	0,1	1,88	2,0	0,000	1,16
1 y. ahead (end)	0,69	5,1	0,95	2,1	0,416	1,42
Current year (mid)	0,88	7,7	0,57	1,6	0,627	1,74
Current year (end)	0,88	12,7	0,76	3,5	0,821	1,61
1 y. after (mid)	0,97	16,5	0,49	2,6	0,889	1,12
1 y. after (end)	0,95	17,3	0,58	3,3	0,898	1,20
2 ys. after (mid)	0,89	15,8	0,75	4,0	0,883	1,39

CANADA

Date of estimate	Estimated variable		Constant		R2	DW
	b_1	t_1	b_0	t_0		
2 ys. ahead (end)	1,23	1,8	-1,39	0,6	0,185	1,22
1 y. ahead (mid)	0,92	1,6	-0,18	0,1	0,110	1,24
1 y. ahead (end)	1,10	5,1	-0,21	0,3	0,423	2,09
Current year (mid)	1,03	9,8	0,12	0,3	0,734	1,75
Current year (end)	0,87	13,4	0,84	3,6	0,837	1,38
1 y. after (mid)	0,93	18,0	0,60	3,2	0,905	1,31
1 y. after (end)	0,94	19,0	0,58	3,2	0,914	1,34
2 ys. after (mid)	0,94	19,9	0,55	3,1	0,923	1,32

Table A.4a Error model for consumer prices

USA Consumer Prices

Date of estimate	Estimated variable b_1	t_1	Constant b_0	t_0	R2	DW
2 ys. ahead (end)	0,65	3,9	0,47	0,9	0,525	1,25
1 y. ahead (mid)	0,67	8,6	0,51	1,7	0,780	1,65
1 y. ahead (end)	0,93	11,7	-0,03	0,1	0,850	1,21
Current year (mid)	1,02	41,9	-0,16	1,5	0,987	1,63
Current year (end)	1,02	34,1	-0,07	0,5	0,980	1,48
1 y. after (mid)	1,06	33,2	-0,10	0,7	0,979	1,27
1 y. after (end)	1,06	32,2	-0,20	1,3	0,977	1,32
2 ys. after (mid)	1,06	31,3	-0,25	1,6	0,977	1,57

JAPAN Consumer Prices

Date of estimate	Estimated variable b_1	t_1	Constant b_0	t_0	R2	DW
2 ys. ahead (end)	0,89	6,2	-0,46	2,3	0,731	1,20
1 y. ahead (mid)	0,74	8,0	-0,30	1,6	0,750	2,19
1 y. ahead (end)	0,91	12,4	-0,23	1,2	0,865	2,82
Current year (mid)	0,94	18,0	-0,13	0,9	0,931	1,96
Current year (end)	1,07	17,7	-0,14	1,0	0,929	1,52
1 y. after (mid)	0,99	20,7	0,32	0,2	0,947	1,56
1 y. after (end)	1,04	20,4	-0,01	0,8	0,945	1,64
2 ys. after (mid)	1,02	19,0	0,01	0,1	0,940	1,68

GERMANY Consumer Prices

Date of estimate	Estimated variable b_1	t_1	Constant b_0	t_0	R2	DW
2 ys. ahead (end)	1,03	5,8	-0,20	0,5	0,707	1,72
1 y. ahead (mid)	0,91	4,9	-0,06	0,1	0,537	1,52
1 y. ahead (end)	1,19	8,9	-0,57	1,5	0,760	1,53
Current year (mid)	1,10	16,1	-0,37	1,9	0,915	1,72
Current year (end)	1,00	19,9	-0,14	0,9	0,943	1,94
1 y. after (mid)	0,98	19,3	-0,11	0,7	0,940	1,89
1 y. after (end)	0,97	18,7	-0,03	0,2	0,936	1,72
2 ys. after (mid)	0,97	18,7	-0,05	0,3	0,938	1,67

UNITED KINGDOM Consumer Prices

Date of estimate	Estimated variable b_1	t_1	Constant b_0	t_0	R2	DW
2 ys. ahead (end)	1,65	5,9	-2,12	2,2	0,711	1,68
1 y. ahead (mid)	0,92	6,2	0,31	0,5	0,649	0,78
1 y. ahead (end)	1,06	13,5	-0,33	0,7	0,884	1,06
Current year (mid)	0,92	15,2	0,52	1,3	0,906	1,66
Current year (end)	1,03	24,1	0,29	1,1	0,960	1,28
1 y. after (mid)	1,02	31,1	0,30	1,4	0,976	1,77
1 y. after (end)	0,99	35,0	0,41	2,2	0,981	1,93
2 ys. after (mid)	0,99	36,3	0,47	2,5	0,983	1,47

Table A.4b Error model for consumer prices (continued)

FRANCE Consumer Prices

Date of estimate	Estimated variable b_1	t_1	Constant b_0	t_0	R2	DW
2 ys. ahead (end)	1,23	4,4	-0,44	0,8	0,579	1,17
1 y. ahead (mid)	0,91	16,7	0,28	1,2	0,930	2,31
1 y. ahead (end)	1,04	22,8	-0,58	0,2	0,956	1,98
Current year (mid)	0,98	39,0	0,12	0,8	0,984	2,41
Current year (end)	0,99	55,7	0,79	0,7	0,992	1,69
1 y. after (mid)	0,99	0,2	0,24	2,6	0,995	1,82
1 y. after (end)	1,01	62,5	0,12	1,2	0,994	1,23
2 ys. after (mid)	1,01	64,1	0,12	1,2	0,994	1,31

ITALY Consumer Prices

Date of estimate	Estimated variable b_1	t_1	Constant b_0	t_0	R2	DW
2 ys. ahead (end)	0,94	4,4	1,09	1,4	0,575	1,48
1 y. ahead (mid)	0,94	18,3	0,96	2,8	0,941	2,33
1 y. ahead (end)	1,09	19,2	0,37	0,8	0,939	0,86
Current year (mid)	0,96	37,0	0,69	2,9	0,983	2,52
Current year (end)	0,98	54,6	0,45	2,7	0,992	1,72
1 y. after (mid)	0,98	53,0	0,30	1,6	0,992	1,58
1 y. after (end)	0,99	63,5	0,21	1,3	0,994	1,74
2 ys. after (mid)	0,99	71,3	0,22	1,6	0,995	2,08

CANADA Consumer Prices

Date of estimate	Estimated variable b_1	t_1	Constant b_0	t_0	R2	DW
2 ys. ahead (end)	0,69	5,5	0,40	1,1	0,683	1,26
1 y. ahead (mid)	0,83	13,3	0,24	0,9	0,894	1,45
1 y. ahead (end)	1,04	18,7	-0,24	0,9	0,936	1,20
Current year (mid)	0,98	24,7	0,52	0,3	0,962	1,68
Current year (end)	0,97	39,7	0,20	1,6	0,985	2,18
1 y. after (mid)	0,96	37,0	0,34	2,4	0,983	1,78
1 y. after (end)	0,95	35,7	0,38	2,7	0,982	1,60
2 ys. after (mid)	0,95	34,7	0,38	2,5	0,981	1,51

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