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A Post-Mortem
on Economic Outlook
Projections

**Vassiliki
Koutsogeorgopoulou**

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A POST-MORTEM ON ECONOMIC OUTLOOK PROJECTIONS

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by
Vassiliki Koutsogeorgopoulou

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ABSTRACT/RÉSUMÉ

This paper reviews the accuracy of the *OECD Economic Outlook* projections — both “current year” and “year ahead” — for output growth, inflation and current account balances (as a percentage of GDP) for the major seven countries, as well as projections for world trade growth. The sample period differs somewhat between the variables, depending on data availability, but it runs until 1998 in all cases. Several evaluation criteria were used to assess the accuracy of the *OECD Economic Outlook* projections. These include an inspection of projection error summary statistics; comparisons with “naïve” alternative forecasts; statistical tests for unbiasedness and efficiency; and testing for directional accuracy. In addition, the paper provides an examination of the performance of *OECD Economic Outlook* projections over different time periods. The findings suggest that, on the basis of the conventional statistical criteria, the current year projections outperform the year ahead projections in the case of all variables under examination. In most cases the *OECD Economic Outlook* projections outperform the naïve predictions. The projection error is predominately non-systematic. Rationality tests indicate that the *Economic Outlook* projections are generally unbiased and efficient, on a country-to-country basis, although evidence of inefficiency was found on a pooled basis. The summary statistics show a deterioration in the forecasting record over time only in the case of current account balances. Finally, with a few exceptions, the *OECD Economic Outlook* projections tend to predict accurately the changes of directions in variables.

JEL Classification: E17, E37, F17, F47

Keywords: Forecasting accuracy, Error analysis, Unbiasedness and efficiency.

Cet article analyse la précision des prévisions pour l'année courante et pour l'année suivante des *Perspectives Économiques* de l'OCDE pour la croissance du PIB, l'inflation, et la balance courante (en pourcentage du PIB) pour les 7 pays les plus importants, aussi que les prévisions pour la croissance du commerce international. La période d'analyse varie selon la variable en question, en fonction de la disponibilité des données, jusqu'en 1998 dans tous les cas. Plusieurs critères ont été utilisés pour évaluer la précision des prévisions, y compris les statistiques d'erreur de projection, les comparaisons avec des prévisions “naïves”, les tests statistiques de biais et d'efficacité, et les tests de validité directionnelle. En outre, l'article examine la performance des prévisions des *Perspectives Économiques* de l'OCDE sur différentes périodes de temps. Les résultats montrent que, basées sur des critères statistiques conventionnels, les prévisions pour l'année courante sont meilleures que celles pour l'année suivante pour toutes les variables. Dans la plupart des cas, les prévisions des *Perspectives Économiques* de l'OCDE sont meilleures que les prévisions “naïves”. L'erreur des prévisions n'est pas systématique. Les tests de rationalité indiquent que les prévisions des *Perspectives Économiques* de l'OCDE sont généralement non biaisées et efficaces pour chaque pays, mais pas nécessairement pour l'ensemble des pays. Les statistiques d'erreurs des prévisions suggère une détérioration de la performance des prévisions au cours du temps pour la balance courante seulement. Finalement, à l'exception de quelques cas, les prévisions des *Perspectives Économiques* de l'OCDE prévoient correctement les variations de direction des variables.

Classification JEL : E17, E37, F17, F47

Mots-clés : Précision des prévisions, Analyses d'erreur de prévision, Biais et efficacité.

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A POST-MORTEM ON ECONOMIC OUTLOOK PROJECTIONS

Vassiliki Koutsogeorgopoulou¹

Introduction

1. This paper reviews the accuracy of the *OECD Economic Outlook* projections for output growth, inflation and current account balances (as a percentage of GDP) for the major seven countries, as well as projections for world trade growth. It updates a previous post-mortem undertaken by OECD in 1993.² The assessments of current account and world trade projections, as well as the directional accuracy of the projections, are extensions of the earlier work, which focused on output and inflation. The paper:

- provides a quantitative, as well as qualitative, assessment of the accuracy of the *OECD Economic Outlook* projections; and
- evaluates the accuracy of the *OECD Economic Outlook* projections during different time periods.

When assessing the accuracy of the *OECD Economic Outlook* projections, two main features of the OECD Secretariat's forecasting process should be kept in mind.

2. First, the objective of OECD is not to provide forecasts of the most likely outcomes, but rather to provide projections *conditional* on a number of key technical assumptions about future developments of important exogenous variables, as well as the stance of macroeconomic policies in the Member countries.³ These include, but are not limited to the following:

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1. I am grateful to Paul Atkinson, Sven Blöndal, Andrew Dean, Jørgen Elmeskov, Mike Feiner, Peter Hoeller, Ignazio Visco, Niels Westerlund and several other colleagues in the Economics Department for suggestions and comments; to Isabelle Duong for technical assistance, and Anne Eggimann, Valérie Luccioni-Lassaut, Nanette Mellage and Laura Schaub for secretarial assistance. Any errors and omissions are the author's responsibility.
 2. The OECD's forecasting performance was assessed last in *OECD Economic Outlook* 53 (June 1993). The analysis covered the period 1971 to 1992. For previous post-mortems, see Llewellyn and Arai (1984), and Ballis (1989). For a discussion of methodological issues included in such studies, see Artis (1988, 1997), and Ash *et al.* (1997, 1998).
 3. A study by Batchelor (2000) concludes that the Consensus Economic forecasts in each of the major seven countries had a better track record than the IMF and OECD over the period 1990-99. However, the OECD projections are not directly comparable with the Consensus Economic forecasts due to the following reasons: First, the nature of the OECD projections and the Consensus Economic forecasts is very different. The former are published twice a year and are conditional projections which rely upon a number of well-identified policy and technical assumptions, while the latter are usually not constrained in this way, are fine-tuned to the latest available data and are released every month. Second, the Consensus Economic forecasts are constructed as an average of a large sample of individual forecasts. In this respect, it would be appropriate to compare the OECD projections with each of the forecasts included in the Consensus Economic panel. Moreover, as it is pointed out by the study itself, the OECD projections are part of the information set private forecasts rely upon. Third, the main focus of the OECD forecasting process is on

- Nominal exchange rates are assumed to remain unchanged at the level prevailing on a pre-specified cut-off date, except for countries with stated or *de facto* policies for adjusting exchange rates.
- Fiscal policy assumptions reflect announced measures and stated policy intentions, where they are embodied in well-defined programmes.
- Policy-controlled interest rates are also assumed to be set in line with national authorities' stated objectives, usually with respect to inflation or exchange rates.
- Up to the mid-1980s, the price of crude oil was assumed to be that set by OPEC in the short term and to remain constant thereafter in real terms (specifically, in terms of the OECD manufactured export prices). Since then, projections for the short term have been based on an assessment of world oil market trends in consultation with the International Energy Agency. Throughout the period market conditions have been taken into account for short-term projections of non-oil commodity prices which have been, as for oil, assumed to remain constant thereafter in real terms.

The main implication of the conditional nature of the *OECD Economic Outlook* projections for post-mortem analyses is that results are affected by the non-materialisation of these “exogenous” assumptions. Nevertheless, the present note makes no attempt to assign any part of projection error arising from erroneous exogenous assumptions.

3. Second, the *OECD Economic Outlook* projections are not purely, or even mainly, model-based. Rather, they involve an important *judgmental element* based upon the knowledge and expertise of the OECD Secretariat. The OECD's multi-country model INTERLINK is used in an informal way, for “setting the scene” at the start of each projection round, for ensuring a high degree of global consistency and for generating alternative scenarios to facilitate assessment of risks to the projections, but not for producing projections for the endogenous variables on the basis of the exogenous assumptions. The fact that the *OECD Economic Outlook* projections are not model-based implies that post-mortem methods applicable to formal forecasting would not be appropriate. The informal nature of the OECD projections makes it impossible to decompose an *ex-post* projection error into “exogenous variable, judgmental and model-based” error (Artis 1988, 1997).

4. The section that follows describes the basic concepts and methods employed, as well as the macroeconomic variables under examination. The third section presents the main results. A final section summarises the main findings.

framing the policy debate, by identifying potential problems and providing recommendations on what should be changed in member countries, rather than on predicting the future, as is the case of Consensus forecasts (OECD 2000). For more elaboration about the OECD projection process, see OECD (1999).

Basic concepts and methods of accuracy analysis

Basic concepts

5. The paper considers projections made for both the “*current year*” and “*year ahead*”. The “*current year*” projection for year t is reported in the June edition of *OECD Economic Outlook* for the same year. The outcome data — termed “*first available estimates*” — for this projection are published in June of the following year, $t+1$. The “*year ahead*” projection values for year t are taken from the December *OECD Economic Outlook* of year $t-1$. The actual values — termed “*following year*” estimates — are those reported in the December *OECD Economic Outlook* of year $t+1$.⁴ Thus, for example, the projections for 1993 are reported in the December 1992 edition of the *OECD Economic Outlook*, while actual outcomes are taken from the December 1994 issue.

6. Post-mortem results depend heavily on the definition of the outcome against which projections are compared, although there is no widely agreed appropriate vintage of the actual data. An alternative approach to that employed in the present analysis, could be, for example, to use the latest available actual data. This would have the advantage of assessing whether projections have been indeed accurate indicators of economic developments. At the same time, however, such an approach would require forecasters to be able to also predict data revisions and changes in the definitions of variables that may take place over time.

7. The *OECD Economic Outlook* provides projections for a large number of macroeconomic variables and, to be manageable, the present analysis narrows the focus to those that are of most interest for policy analysis and forecasting. These are real GDP growth, inflation, current account balances (as a percentage of GDP) for the seven major countries, and world trade. In addition, the data of the individual G7 countries have been pooled in order to obtain an overall evaluation of the OECD projections for the major countries as a group. While obscuring cross-country differences in forecasting errors, the pooling procedure enhances the power of statistical tests, particularly when the post-mortem analysis refers to sub-periods.

8. The sample period differs somewhat between the variables, depending on data availability, but it runs until 1998 in all cases. For output projections, it begins in 1971; for the inflation projections it starts in 1974; for the current account balance projections it begins in 1982; and for world trade projections it starts in 1985.

Methods of accuracy analysis

9. Several evaluation criteria were used to assess the accuracy of the *OECD Economic Outlook* projections. These include:

- inspection of projection error summary statistics;
- comparisons with “naive” alternative forecasts;

4. These definitions were first suggested by Kenen and Schwarz (1986) and were used in the studies by Artis (1988, 1997) and Keereman (1999).

- statistical tests for unbiasedness and efficiency; and
- testing for directional accuracy.

10. Finally, the results for the entire sample period were supplemented by the findings from an examination of the statistical properties of the projection errors over selected sub-periods, in an attempt to examine the performance of the *OECD Economic Outlook* projections during different time periods. Conclusions about the forecasting record during specific periods lend support to those derived from the study of the whole sample period.

Summary statistics

11. Two principal summary statistics⁵ used here are the *root mean square error* (RMSE) — which measures the deviation of the projected outcome from the actual — and the *mean absolute error* (MAE). Both statistics, however, need to be standardised in some way to take into account the fact that some variables are more difficult to forecast for some countries (or time periods) than others. To this end, the RMSE has also been divided by the *standard deviation* of the actual outcome, and the MAE by the *mean absolute deviation* of the actual outcome.⁶ Finally, the two statistics have been standardised on the mean actual value of the corresponding outcome. Of the alternative measures of accuracy, the RMSE is the most popular one, since it “penalises” large individual errors more heavily and is consistent with a notional quadratic loss function. The *average forecast error* (AFE), which is close to zero if large positive errors cancel out negative ones, is used in the analysis as a measure of the projection bias. AFE is defined as the difference between the actual and projected value of its variable. A positive sign indicates an under-prediction of the actual value, while a negative sign indicates an over-prediction.

12. Other accuracy measures used in the analysis include the *correlation coefficient* (ρ) between forecasts and outcomes, and the *ratio of the standard deviations* of forecasts and outcomes. It is well known that for “optimal” predictors, the variance of the projected series should understate the variance of the actual series.⁷ This is because the actual variance of a stochastic economic process incorporates, in addition to a systematic component replicated by its optimal predictor, the variance of random disturbances, which post-date the projection (Ash *et. al.* 1995). Finally, the mean square error of prediction (MSE) has been decomposed into three sources: *i*) the *bias proportion* (UB), which is an indication of systematic error (since it measures the distance between the mean of the projection and that of the actual series); *ii*) the *variance proportion* (UV), which measures the proportion of error arising from the misforecasting of the systematic component of the variance of outcomes; and *iii*) the *covariance proportion* (UC), measuring the unsystematic error (*i.e.* the error remaining after taking into account deviations from average values and average variabilities). If the projection is accurate, the bias and variance proportions should be close to zero and the covariance proportion close to unity.⁸

5. For the definitions of the main accuracy measures used in the analysis, see Annex I.

6. See Öller (1998).

7. See for example Granger and Newbold (1977).

8. Since in the more general forecasting context a perfect correlation between projections and actual outcomes will not be achieved, despite the wide set of information employed, the covariance component of the projection error is less worrisome. For a discussion see Pindyck and Rubinfeld (1981).

Comparison with “naive” alternatives

13. The *Theil inequality coefficient*, which can be generally defined as the ratio of the RMSEs for alternative forecasts, is used to compare the accuracy of the *OECD Economic Outlook* projections against projections that would result from an alternative “naïve” forecasting model. Two estimates of Theil’s inequality coefficients have been computed: the first (“*Theil1*”), evaluates the predictive performance of OECD projections with respect to the prediction of a “naïve model”, which assumes that the projection for the current year is equal to last year’s outcome; the second (“*Theil2*”), evaluates the predictive performance of the OECD projections with respect to a “no change” prediction.⁹ By construction, values of the Theil statistics in excess of unity would show that the OECD projections are inferior to the forecasts derived from the alternative “naïve” models.

Rationality

14. The usefulness of the *Economic Outlook* projections were further assessed by using the rational expectations hypothesis associated with Muth (1961). It states that market participants use all cost efficient knowledge to forecast economic variables so that their forecasts are *unbiased* and *efficient*. Unbiased projections have the same mean as the actual outcomes, thereby implying a zero average forecast error, while efficiency requires that the projection makes complete use of all information available at the time when it was made. Otherwise, forecasting accuracy could be improved by taking into account the additional unused information (Wallis, 1989; Ash *et al.*, 1997).

15. The standard way of testing for bias involves the estimation of the following ‘realisation-forecast’ regression, introduced by Mincer and Zarnowitz (1969):

$$A_t = \beta_0 + \beta_1 F_t + u_t, \quad (1)$$

where A_t and F_t denote the actual value and forecast respectively, and u_t is an error term. If the forecast is unbiased, β_0 and β_1 are equal to zero and unity respectively, and the error term is a white noise. Following Holden and Peel (1985), a joint test was applied to examine whether or not these desirable restrictions hold. However, Holden and Peel (1990) show that the null hypothesis that $\beta_0 = 0$ and $\beta_1 = 1$ is only a sufficient condition for the absence of bias. They propose a further test for unbiasedness performed directly on forecast errors: by testing the null hypothesis $\beta_0 = 0$ in the following equation¹⁰:

$$A_t - F_t = \mu + u_t, \quad (2)$$

Where μ is the mean forecast error.

9. These coefficients can be employed to assess the accuracy of forecasts against “naïve” alternative forecasts, such as “the no change in the level” or “no change in the rate of change”. The coefficients abstain from the inconveniences involved in the first inequality coefficient proposed by Theil (1961) (see Visco, 1984).

10. The null hypothesis, $\beta_0 = 0$ and $\beta_1 = 1$, is only a sufficient condition for the absence of bias. In particular, while it is true that when the joint hypothesis holds there will be no bias, a significant deviation of these estimates from zero and unity, does not necessarily imply significant bias, as it is possible for the AFE to be close to zero in such circumstances (Wallis 1989; Artis 1988, 1997). The appropriate test for unbiasedness is to regress the forecast error on a constant, as discussed earlier. Granger and Newbold (1977), Wallis (1989) and Barionuevo (1992) provide an informative discussion of these issues.

16. Efficient forecasts reflect fully all relevant given information. As a test of the efficiency property of rational expectations, Mullineaux (1978) proposes that the forecast error should not be correlated with any element in the assumed set of information available at the time the forecasts were formed, such as the past history of the variable concerned, forecasts and errors.¹¹ Forecasts for h steps ahead should have errors with autocorrelations of order h and higher equal to zero, for otherwise the forecast error would be correlated with available information at the time the forecast were made, and hence the forecast could have been improved upon (Granger and Newbold (1977)). Following Ash *et al.* (1990, 1997), efficiency was tested by computing Box-Ljung statistics for both forecast errors and the residuals from the realisation-forecast equation (1). We have also conducted a test for orthogonality of errors to available information by regressing the forecast error on the most recent known forecast error at the time of the forecast:¹²

$$A_t - F_t = \beta_0 + \beta_1(A_{t-1} - F_{t-1}) + u_t \quad (3)$$

If the forecast takes into account the information contained in the past error then it should be possible to impose the joint hypothesis $\beta_0 = \beta_1 = 0$.

Directional accuracy

17. An important dimension of forecasting accuracy is the correctness of the projected direction of macroeconomic change, which is usually overlooked by the traditional quantitative evaluations. Given the policy importance of the early, or even timely, recognition of business cycle turning points, the present analysis also includes a non-parametric test of directional accuracy, examining whether the predicted changes have the same sign as the actual ones. The assessment of the directional accuracy involves arranging the directional data for each variable and country in a 2x2, or *four-fold contingency table*,¹³ in which the two columns represent projections of positive and negative change and the two rows positive and negative changes in outcomes. If the number of cases where the projected and actual changes have the same sign (*i.e.* the sum of the first and fourth columns in Tables 7, 8 and 11 is sufficiently 'large'), then the projection is considered to have directional significance. In a more formal framework, the null hypothesis is that projections and outcomes are independent. The acceptance of the null hypothesis

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11. While equation (1) is often interpreted as a test for unbiasedness, since $\beta_0 = 0$ and $\beta_1 = 1$ the forecasts are unbiased, it is in fact a stricter test and was originally presented by Mincer and Zarnowitz as a test for efficiency. In particular, since $A_t \equiv F_t + e_t$ (where e is the forecast error), if the estimate of β_1 in the above equation differs significantly from unity, then the forecast and error must be correlated, and therefore, it would be possible to improve the forecast by exploiting the correlation (Pain and Britton, 1992; Artis 1997). It is now recognised, however, that the concept of efficiency underlying equation (1) is relatively weak. Granger and Newbold (1977) argue that $\beta_0 = 0$ and $\beta_1 = 1$ neglects possible autocorrelation in forecast errors, the existence of which would indicate that the forecast is not making efficient use at least of the own-variable information set, since knowledge of the past forecast error can then improve current forecasts.
12. See McNees (1978) and Figlewski and Wachtel (1981), Visco (1984), Pain and Britton (1992) and Ash *et al.* (1990, 1997).
13. For a more detailed discussion on the contingency tables, see Yates (1984), Daniel (1990), and Daniel and Terrell (1995). Ash *et al.* (1998) provide a directional analysis of the OECD *Economic Outlook* semi-annual one-, two-, and three-step ahead forecasts for the G7 countries for the first half of 1967 to the second half 1987, covering the main components of aggregate demand and output, inflation and the balance of payments.

implies a weak or no relationship between the signs of forecasts and outcomes. A *chi-squared* test is applied to the results of the contingency table.

Accuracy of *OECD Economic Outlook* projections

Projections for output, inflation and current account balances: the overall period

18. Figures 1 and 2 provide a graphic overview of the performance of *OECD Economic Outlook* projections for output growth, inflation and current account balances — in terms of the size of projection errors. The figures suggest that, on average over the seven countries, projections have usually performed fairly well relative to outcomes, although important discrepancies (as measured by the size of projection errors) occurred in the period around the first oil shock in 1973-74; in 1988, following the stock market crisis; and during the downturn in the 1990s (the corresponding figures for the individual countries are presented in Figures A1 to A6 in Annex II).

19. Tables 1 to 6 report the results from the evaluation analysis in more detail for each of the G7 countries over the entire period for which the data are available. The last column in each table presents the results for the pooled sample covering these countries.¹⁴

20. The summary statistics (Tables 1 to 3) clearly support the view that the current year projections for output growth, inflation and current account balances are better than the year ahead projections: when averaging across variables, the RMSE is, on a pooled basis, around 60 per cent lower in the current year projections than in the case of the year ahead projections, and a similar margin was found for the pooled MAE. Relative to the mean absolute value of the actual series and its standard deviation, the projections for inflation are markedly better than those for output and the current account, for both the current year and year ahead sets of projections. Among individual countries, Japan has the least accurate output (both current-year and year-ahead) and year ahead inflation projections - under both RMSE and MAE criteria. The accuracy ranking for output projections changes, however, when taking into account cross-country differences in forecasting difficulty, with the Italian projections (both current-year and year-ahead) underperforming (Tables 1 and 2). Finally, for the current account balance as a percentage of GDP, the findings for the year ahead projections suggest that Canada has the largest RMSE and MAE among the seven countries, even after the standardisation of the two statistics. In the case of the current year projections, the largest MAE — in both absolute and relative terms — was found for the United Kingdom, while the Canadian projections, once again, have the largest RMSE (Table 3).

21. The *OECD Economic Outlook* projections are generally superior to the naive alternative forecasting models. The Theil coefficients (Theil1 and Theil2) are below unity in all but three cases, namely the year ahead current account projections for Italy, the United Kingdom, and Canada. Judged by the size of the pooled values of the Theil statistics, the current year projections perform better than the year ahead projections, in terms of comparisons with naïve predictors, in the case of all three variables under consideration. Current account projections (showing the highest pooled values of the Theil statistics) provide the least improvement compared to the naive forecasts, in both sets of projections (current- and year-ahead), although the findings are not absolutely comparable due to the difference in sample size for the examined variables.

14. The pooled time series/cross section sample for the year-ahead output projections has 196 (=7x28) observations, while the year-ahead inflation and current account balance projection have, respectively, 175 (=7x25) and 119 (=7x17) observations.

22. The decomposition of MSE provides strong evidence that the projection error is predominately random. The pooled value of UC (the covariance proportion) is very close to unity for all three variables, especially in the case of the current-year projections. On an individual country basis, only 14, out of a total 42, cases show a UB or UV value which is above 10 per cent, while more than half record an UC value exceeding 90 per cent. When systematic errors occur, these are usually due to the difference in the variation of the projections and actual outcomes, rather than to the bias component — especially in the case of the year ahead projections for output growth and inflation. Among individual countries, the largest bias and variance components were found, respectively, in the case of the current year inflation projections for Japan and Canada. Canada also shows the largest variance component in the case of year ahead output projections.

23. The OECD *Economic Outlook* projections meet the requirement that the variance of the projection series is less than the actual one. The standard deviation of projections exceeds the standard deviation of the associated outcomes in only 8 out of the total 42 cases, thereby providing evidence for optimality.¹⁵

24. Turning to rationality tests (Tables 4 to 6), the results for the “realisation-forecast” regressions provide scanty evidence of bias on a country-by-country basis, as only two, out of a total 42 cases, fail — at the 5 per cent significance level — the joint F-test: the current year inflation projections for Japan, and the US current year projections for current account balances. When the data are pooled, evidence of biasedness emerges solely in the case of the year ahead projections, and in particular those for output growth and inflation, while no statistically significant bias was detected in the case of current year projections. The results of the second test for unbiasedness used in the analysis — *the t-test for an average forecast error of zero* — confirm the previous conclusion that on a country-by-country basis the *Economic Outlook* projections are generally unbiased. It is worth noting, however, that in most instances (11 out of 14), the bias of output projections is of a negative sign, indicating a tendency toward over-prediction of the actual outcome, especially in the case of year ahead projections for Canada (exhibiting an AFE of 0.5 percentage point over the period 1971-98, though not statistically significant). In a similar way, there is a predominance of negative signs in the current-year country inflation errors (statistically significant only for Japan) and those for the current account balance errors, while the opposite holds in the case of the year ahead projections (with a statistically significant under-prediction only in the case of the Italian inflation projections).¹⁶ The data pooling also suggests that there is a tendency to output growth optimism in the *Economic Outlook's* projections, with the over-estimation being, on average, 0.2 percentage point. For inflation and current balances, the year ahead projections tend to underestimate actuals by around 0.1 percentage point in each case, while the difference between the predicted and actual values is around zero in the case of current year projections. None of the pooled errors, however, show any evidence of bias (*i.e.* they are all not significantly different than zero at the five per cent level of significance).¹⁷

15. All, but two, of the instances in which the ratio of the standard deviations of forecasts and outcomes exceeds unity, refer to the current year projections (particularly to those for the current account balances).

16. The evidence is less clear in the case of the year ahead projections for the current account balances, as the AFE value for France is zero.

17. By comparison, the analysis of the year ahead pooled data for the G7 countries in the *Economic Outlook* 53 found the same average output projection errors for 1971-92, but an average inflation error of 0.3 percentage points -- although these errors were not statistically significant. The updated results therefore suggest that the bias in *OECD Economic Outlook's* inflation projections has been reduced since 1992, while it has remained the same in the case of output projections.

25. In addition to being unbiased, the *Economic Outlook* projections are, on a country-by-country basis, generally efficient.¹⁸ This is especially true in the case of projections for output growth (both current year and year ahead), where there is no evidence of inefficiency at the 5 per cent level of significance (Table 4). The results for inflation and the current account balance projections are also generally reassuring. The only exceptions concern: the inflation projections for Japan (both current year and year ahead) and the current year inflation projections for Canada, which fail the orthogonality test indicating the presence of a linear dependency between successive projection errors (Table 5); and the year ahead projections for Germany, which fail all three tests of efficiency employed in the analysis (*i.e.* the BL-test on forecast errors, BL-test on the residuals from the “realisation-forecast” equation, and orthogonality test) (Table 6). The record with respect to efficiency is less satisfactory when the data are pooled, as evidence of inefficiency emerges in all cases, apart from those of the year ahead projections for inflation and the current year projections for current account balances. The least satisfactory performance, on a pooled basis, was found in the case of the year ahead forecasts for current balances which fail all three tests for efficiency.

26. Tables 7 and 8 present estimates of the directional accuracy of *OECD Economic Outlook* current year and year ahead projections, respectively, over the entire sample period. With respect to the output growth and inflation projections, the results are very reassuring, for both the current year and year ahead projections, as the performance of sign prediction was acceptable, on a statistical basis, in all cases. The success rate is less satisfactory, however, in the case of the current balance projections, as 5 out of a total 14 cases fail to maintain directional accuracy at an appropriate rate, especially for Italy, probably reflecting policy measures which had not yet been announced during the period the projections were done. The pooled results provide strong evidence in favour of directional accuracy in the case of all three variables, including that of the current account balances.

World trade projections

27. The statistical results for the world trade growth projections are reported in Tables 9 and 10, while Figure 3 provides a graphical overview of their accuracy. The main features are the following:

- The performance of the current-year forecasts is notably better than that of the year ahead projections in terms of both RMSE and MAE. This conclusion holds even when the error statistics are divided by the standard deviation of the actual outcome. Both sets of *OECD Economic Outlook* projections outperform the alternative naive forecasting models. However, the Theil inequality coefficients (Theil1 and Theil2) for the year ahead projections are markedly larger than that for the current year forecasts.
- The decomposition of MSE reveals that projection error is largely random. The value of UC (the covariance proportion) stands at around 95 per cent for the current year projections and 90 per cent for the year ahead ones. The variance proportion accounts once more for the major part of the systematic errors, especially in the case of year ahead projections.
- The standard deviation of the projections falls below the standard deviation of the associated outcomes in both sets of projections, thereby providing evidence for optimality. The year

18. Artis (1997, p. 13) points out, however, that a forecast may satisfy all the tests of bias, serial correlation and weak efficiency without being the minimum variance forecast and without being good enough for its purpose.

ahead world trade projections, however, seem to meet more successfully the requirement that the variance of the projection series is less than the actual.

- Both year-ahead and current-year forecasts are unbiased in a statistical sense (Table 10). The positive AFEs in both sets of forecasts, however, suggest that there is a tendency towards an under-prediction of the actual growth of world trade by around 0.2 percentage point in each case. In addition to being unbiased, both year-ahead and current-year forecasts are also efficient.
- Finally, in terms of directional accuracy, the results in Table 11 indicate that the record for the year-ahead forecasts is considerably less satisfactory than that for the current-year forecasts, as judged by the statistically significant accuracy rate they exhibit (although, once more the small sample size calls for a careful consideration of the findings).

Overall, the findings for the world trade growth forecasts suggest (unsurprisingly) that current year forecasts are better than the year-ahead projections.

Accuracy of *Economic Outlook* projections during different time periods

28. A simple way of examining the performance of the *OECD Economic Outlook* projections during different time periods is to break down the overall sample into specific sub-periods and compare the corresponding summary error statistics. Tables 12 to 18 show the findings for two sub-samples, the break being in 1989. Following the analysis for the entire period the RMSEs and MAEs have been standardised to take account of differences in the forecasting difficulty across sub-periods (reflecting for example the impact of the two oil crises) and across countries. The main conclusions are as follows:

Output projections

- There are no big differences between the current year and year ahead output growth projections with respect to their relative performance in the two sub-samples, under the RMSE, MAE and Theil criteria (Tables 12 and 13). For both sets of projections, there was a reduction in the pooled mean projection errors (RMSE, MAE), in absolute terms, between the examined periods, with the RMSE falling by around 0.3 and 0.5 percentage points in the case of the current year and year ahead projections, respectively. Nevertheless, the RMSEs and MAEs have increased relative to the actual growth and its standard deviation between the periods. The average Theil statistics have also tended to rise between 1971-89 and 1990-98, suggesting an improvement of the “naive” model projections as economies had become broadly stable.
- The decomposition of the pooled MSEs shows a predominance of non-systematic errors. The importance of systematic errors increases somewhat in the second sub-period, compared to the previous one (1971-89), especially in the case of the year ahead projections, where they account for 48 per cent of overall inequality between 1990 and 1998.
- The standard deviation of projections, on a pooled basis, falls below the standard deviation of the associated outcomes in both sub-periods, thereby providing evidence for optimality. The year ahead projections, however, seem to meet more successfully the requirement that the variance of the projection series is less than the actual in both sub-periods. In both sets of

projections (current-year and year-ahead) the value of the corresponding ratio declines between the two sub-periods.

- The pooled results for the “realisation-forecast” equation indicate that there is a statistically significant bias in the year ahead projections for output, evident in both sub-periods, while the current year projections are free of bias. The AFE statistics for the pooled sample further reveal an over-prediction of the actual growth in each of the two sub-periods, which however is statistically significant only in the case of the year ahead forecasts between the years 1990 and 1998. The only case that the individual country projections fail the statistical tests for unbiasedness is that of the year-ahead projections for Canada over the period 1990-98.

Inflation projections

- For inflation, the pooled RMSE and MAE have declined, in absolute terms, between the two sample sub-periods. In relative terms, however, the RMSEs and AFEs increased compared to both actual inflation and its standard deviation between the periods 1974-89 and 1990-98, especially in the case of the current year. The average Theil statistics have also tended to rise between 1974-89 and 1990-98, for both current year and year ahead projections, suggesting an improvement of the “naive” model projections (Tables 14 and 15).
- The decomposition of the pooled MSE statistics shows a predominance of non-systematic errors. As with output growth, the importance of systematic errors increases somewhat in the second sub-period, compared to the previous one (1974-89).
- The standard deviation of projections, on a pooled basis, falls below the standard deviation of the associated outcomes in both sub-periods, providing, once again, evidence of optimality. The value of the corresponding ratio declines between the two periods in the case of the current year inflation projections, while increasing in the year-ahead projections.
- The findings for the pooled sample provide evidence of a statistically significant bias for the second sub-period (1990-98), in both current year and year ahead projections. The results of the t-test for an AFE of zero, suggest a statistically significant overestimation of actual inflation over the second sub-period, in the case of the year ahead projections.¹⁹ Looking at individual countries, a statistically significant bias emerges in the current year projections for Japan, over both sub-periods, and for France and Canada over the period 1990-98. In the year ahead projections, evidence for a significant bias arises for Japan, France and Canada over the period 1990-98, as well as, for Italy between the years 1974 and 1989.

Current account balance projections

- For the current account balance as a percentage of GDP, the pooled values of both RMSE and MAE increased between the periods 1982-89 and 1990-98, both in absolute terms and relative to the standard deviation of the actual outcome, especially for the current year projections. The average Theil statistics have also tended to rise between the two sub-

19. The p-value of the t-test of an AFE of zero was around 0.06 (compared to the threshold on 0.05), in the case of the current year projections for inflation over the period 1990-98.

periods, for both current year and year ahead projections, suggesting an improvement of the “naive” model projections (Tables 16 and 17).

- The decomposition of the pooled MSEs shows a predominance of non-systematic errors, with the significance of the systematic errors diminishing even further over the 1990s, compared to the previous period, for both the current year and year ahead projections.
- The standard deviation of projections, on a pooled basis, falls below the standard deviation of the associated outcomes between the years 1982 and 1989, in both sets of projections, but it exceeds the actual value over the 1990s, thereby providing evidence for optimality only for the first sub-period.
- The results reveal a statistically significant bias, upon pooling, only for the second sub-period, while the first sub-period is free of bias. Taken individually, the current year projections for the current account balances are generally unbiased, with the sole exception the projections for Germany in each of the two sub-periods. In the case of year ahead projections, biasedness was detected, once more, for Germany over the two sub-periods and for the United Kingdom in the 1990s.

World trade growth

- Finally, as concerns the world trade forecasts the current-year projections improved between the two sub-periods, independently of whether the summary error statistics (RMSEs and MAEs) are measured in either absolute or relative terms. In the case of the year-ahead forecasts, the RMSEs and MAEs statistics have remained unchanged, or even increased, in absolute terms, although in relative terms they declined (suggesting improvement). The Theil statistics have also tended to decline between the two sub-periods, for both current year and year ahead projections, suggesting an improvement in the relative accuracy of the *Economic Outlook* projections over time (Tables 18).
- The decomposition of the MSEs shows a predominance of non-systematic errors in both sub-periods. The importance of the systematic errors increased in the 1990s, for both the current year and year ahead forecasts, entirely due to a rise in the share of the variance proportion.
- The standard deviation of projections falls below the standard deviation of the associated outcomes in both sub-periods, especially in the case of the year ahead projections.
- Both year-ahead and current-year forecasts are not significantly biased in the statistical sense, although the positive AFEs in the first sub-period provide evidence of an under-prediction of actual growth, especially for the year-ahead projections. In the latter period (1990-98) the projections tend to over-estimate actual trade growth.
- Once more, judging by the size of the summary statistic errors, the current year forecasts for the current account balances seem to outperform the year-ahead ones.

Summary of main results

29. The main results derived from the analysis are as follows:

- The current year projections for output growth, inflation and current account balances (as a percentage of GDP) outperform the year ahead projections on the basis of the conventional summary statistics: both RMSE and MAE are, upon pooling and averaging across variables, around 60 per cent lower in the current year projections than in the case of the year ahead projections.
- Relative to the mean absolute value of the actual series and its standard deviation, the projections for inflation are markedly better than those for output and the current account balances, for both the current year and year ahead projections.
- In most cases the *OECD Economic Outlook* projections outperform the naive alternative forecasting models, with the current year projections providing the greatest improvement in this respect.
- The projection error is predominately random, especially in the case of the current year projections.
- For the full sample period, projections for output growth, inflation and current account balances (as a percentage of GDP) were generally unbiased, on a country-by-country basis, indicating no systematic tendency to under- or over-prediction.
- In addition, the *OECD Economic Outlook* projections for the three macroeconomic variables are, on a country-to-country basis, generally efficient (*i.e.* they fully exploit the available information), although evidence of inefficiency was found on a pooled basis, especially in the case of the year ahead projections for the current account balances.
- The summary statistics do not provide clear evidence about changes in accuracy of *OECD Economic Outlook* projections for output growth and inflation during different time periods, but the forecasting record has deteriorated over time in the case of current balances (as a percentage of GDP)
- Based on the pooled results of the *t-test for a mean forecast error of zero*, which is considered as a necessary and sufficient condition for the absence of bias, a statistically significant over-prediction was found solely in the case of the year ahead projections for output growth and inflation over the sub-period 1990-98. The incidence of bias tends to increase, however, when the results of the joint *F-test* for unbiasedness are also taken into account.
- With a few exceptions, regarding entirely the current account balances, the *OECD Economic Outlook* projections have predicted correctly the change of direction in variables.
- Forecasts for world trade growth -- both current year and year ahead -- have shown no systematic bias, with the former set of forecasts outperforming the latter in most regards. No evidence of inefficiency was found for either set.

- The summary statistics for the current-year projections for world trade growth have declined in the period 1992-98, compared to previous period 1985-92, in both absolute and relative terms. The summary statistic errors also decreased for the year-ahead projections, relative to the actual growth and its standard deviation, although the opposite holds for their values in absolute terms.
- For the year ahead the world trade projections record on directional accuracy is considerably less satisfactory than it is for the current year projections.

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Table 1. Accuracy of Economic Outlook projections for real GDP growth (1971-98): summary statistics

	Per cent							
	United States	Japan	Germany	France	Italy	United Kingdom	Canada	Pooled G7average ^a
	Current year							
Sample statistics								
<i>Outcome</i>								
Mean actual value (MV(O))	2.66	3.73	2.20	2.40	2.04	1.72	2.79	2.51
Mean absolute actual value (MAV(O))	3.14	4.06	2.63	2.64	2.48	2.34	3.24	2.93
Standard deviation(SD(O))	2.40	2.94	1.98	1.87	2.06	2.01	2.37	2.31
Mean absolute deviation (MAD(O))	1.78	2.29	1.41	1.42	1.56	1.57	1.64	1.72
<i>Projection</i>								
Mean forecast value (MV(F))	2.74	3.81	2.19	2.51	2.06	1.68	3.05	2.58
Standard deviation (SD(F))	2.45	2.92	1.91	1.80	1.61	1.92	1.97	2.19
SD(F)/SD(O)	1.02	0.99	0.96	0.96	0.78	0.95	0.83	0.95
Projection error statistics								
RMSE ^b	0.82	1.30	0.93	0.89	1.11	0.82	1.03	1.00
MAE ^c	0.66	1.01	0.79	0.61	0.77	0.62	0.78	0.75
RMSE/SD(O)	0.34	0.44	0.47	0.48	0.54	0.41	0.43	0.43
MAE/MAD(O)	0.37	0.44	0.56	0.43	0.50	0.39	0.47	0.44
RMSE/MV(O)	0.31	0.35	0.42	0.37	0.54	0.48	0.37	0.40
MAE/MAV(O)	0.21	0.25	0.30	0.23	0.31	0.26	0.24	0.26
<i>Decomposition of MSE^d</i>								
bias proportion (UB)	0.01	0.00	0.00	0.01	0.00	0.00	0.06	0.00
variance proportion (UV)	0.00	0.00	0.01	0.01	0.16	0.01	0.15	0.01
covariance proportion (UC)	0.99	1.00	0.99	0.98	0.84	0.98	0.79	0.98
<i>Theil statistics^e</i>								
Theil1	0.27	0.41	0.35	0.39	0.38	0.39	0.35	0.36
Theil2	0.23	0.28	0.32	0.29	0.38	0.31	0.28	0.29
<i>correlation coefficient (rho)</i>	0.94	0.90	0.88	0.88	0.84	0.91	0.91	0.90
Year ahead								
Sample Statistics								
<i>Outcome</i>								
Mean actual value (MV(O))	2.76	3.75	2.26	2.47	2.05	1.86	2.80	2.56
Mean absolute actual value (MAV(O))	3.27	4.08	2.66	2.63	2.49	2.47	3.23	2.97
Standard deviation(SD(O))	2.43	2.99	1.97	1.77	2.10	2.03	2.37	2.31
Mean absolute deviation (MAD(O))	1.81	2.34	1.42	1.38	1.58	1.56	1.68	1.73
<i>Projection</i>								
Mean forecast value (MV(F))	2.66	4.19	2.44	2.70	2.31	2.01	3.26	2.80
Standard deviation (SD(F))	1.94	2.39	1.19	1.46	1.89	1.56	1.36	1.83
SD(F)/SD(O)	0.80	0.80	0.60	0.83	0.90	0.77	0.57	0.79
Projection error statistics								
RMSE ^b	1.34	2.42	1.69	1.30	1.99	1.53	1.80	1.76
MAE ^c	1.00	1.61	1.22	0.90	1.48	1.13	1.40	1.25
RMSE/SD(O)	0.55	0.81	0.86	0.74	0.95	0.75	0.76	0.76
MAE/MAD(O)	0.55	0.69	0.86	0.66	0.93	0.72	0.83	0.72
RMSE/MV(O)	0.49	0.65	0.75	0.53	0.97	0.82	0.64	0.69
MAE/MAV(O)	0.31	0.39	0.46	0.34	0.59	0.46	0.43	0.42
<i>Decomposition of MSE^d</i>								
bias proportion (UB)	0.00	0.03	0.01	0.03	0.02	0.01	0.07	0.02
variance proportion (UV)	0.13	0.06	0.21	0.05	0.01	0.09	0.30	0.07
covariance proportion (UC)	0.86	0.91	0.78	0.92	0.97	0.90	0.63	0.91
<i>Theil statistics^e</i>								
Theil1	0.43	0.78	0.64	0.64	0.67	0.72	0.63	0.65
Theil2	0.37	0.51	0.57	0.43	0.69	0.56	0.49	0.51
<i>correlation coefficient (rho)</i>	0.83	0.61	0.50	0.69	0.49	0.66	0.67	0.66

a) The pooled results for the G7 countries are based on an unweighted arithmetic average. For the pooled sample, the number of observations is seven times the number of years.

b) Root mean square error.

c) Mean absolute error.

d) Mean square error.

e) The Theil statistic is the ratio of the RMSE of the *OECD Economic Outlook* projection to the RMSE of a "naïve" alternative. A value greater than unity implies that the "naïve" alternative projection is better.

Table 2. Accuracy of Economic Outlook projections for inflation (1974-98): summary statistics

	Per cent							
	United States	Japan	Germany	France	Italy	United Kingdom	Canada	Pooled G7average ^a
Current year								
Sample statistics								
<i>Outcome</i>								
Mean actual value (MV(O))	4.67	2.79	3.35	6.04	10.29	8.15	5.12	5.77
Mean absolute actual value (MAV(O))	4.67	2.85	3.35	6.04	10.29	8.15	5.15	5.79
Standard deviation(SD(O))	2.71	4.37	1.80	4.22	5.94	6.23	4.06	5.02
Mean absolute deviation (MAD(O))	2.24	2.60	1.38	3.82	5.35	4.84	3.43	3.87
<i>Projection</i>								
Mean forecast value (MV(F))	4.77	3.33	3.35	6.19	9.92	7.92	5.17	5.81
Standard deviation (SD(F))	2.56	4.62	1.63	4.21	6.09	6.15	3.38	4.86
SD(F)/SD(O)	0.94	1.06	0.91	1.00	1.03	0.99	0.83	0.97
Projection error statistics								
RMSE ^b	0.47	0.92	0.53	0.64	1.13	1.05	1.20	0.89
MAE ^c	0.34	0.68	0.44	0.49	0.85	0.82	0.82	0.63
RMSE/SD(O)	0.17	0.21	0.29	0.15	0.19	0.17	0.30	0.18
MAE/MAD(O)	0.15	0.26	0.32	0.13	0.16	0.17	0.24	0.16
RMSE/MV(O)	0.10	0.33	0.16	0.11	0.11	0.13	0.23	0.15
MAE/MAV(O)	0.07	0.24	0.13	0.08	0.08	0.10	0.16	0.11
<i>Decomposition of MSE^d</i>								
bias proportion (UB)	0.04	0.34	0.00	0.05	0.11	0.05	0.00	0.00
variance proportion (UV)	0.10	0.07	0.09	0.00	0.02	0.01	0.31	0.03
covariance proportion (UC)	0.86	0.59	0.91	0.95	0.87	0.95	0.69	0.97
<i>Theil statistics^e</i>								
Theil1	0.30	0.27	0.37	0.44	0.45	0.23	0.55	0.37
Theil2	0.09	0.18	0.14	0.09	0.10	0.10	0.18	0.12
<i>correlation coefficient (rho)</i>	0.99	0.99	0.96	0.99	0.98	0.99	0.96	0.98
Year ahead								
Sample statistics								
<i>Outcome</i>								
Mean actual value (MV(O))	4.75	2.75	3.37	6.07	10.33	8.11	5.11	5.78
Mean absolute actual value (MAV(O))	4.75	2.80	3.37	6.07	10.33	8.11	5.16	5.80
Standard deviation(SD(O))	2.74	4.33	1.78	4.36	5.93	6.13	4.09	5.01
Mean absolute deviation (MAD(O))	2.28	2.53	1.34	3.94	5.35	4.75	3.45	3.87
<i>Projection</i>								
Mean forecast value (MV(F))	5.00	3.25	3.29	6.04	9.34	7.47	5.30	5.67
Standard deviation (SD(F))	2.63	3.35	1.52	4.06	5.57	4.94	3.11	4.27
SD(F)/SD(O)	0.96	0.77	0.85	0.93	0.94	0.81	0.76	0.85
Projection error statistics								
RMSE ^b	1.18	3.05	0.69	0.97	2.23	2.47	1.97	1.97
MAE ^c	0.88	1.69	0.56	0.73	1.58	1.62	1.41	1.21
RMSE/SD(O)	0.43	0.70	0.39	0.22	0.38	0.40	0.48	0.39
MAE/MAD(O)	0.39	0.67	0.41	0.19	0.30	0.34	0.41	0.31
RMSE/MV(O)	0.25	1.11	0.20	0.16	0.22	0.30	0.39	0.34
MAE/MAV(O)	0.19	0.60	0.17	0.12	0.15	0.20	0.27	0.21
<i>Decomposition of MSE^d</i>								
bias proportion (UB)	0.04	0.03	0.01	0.00	0.20	0.07	0.01	0.00
variance proportion (UV)	0.01	0.10	0.14	0.09	0.02	0.22	0.24	0.14
covariance proportion (UC)	0.95	0.87	0.85	0.91	0.78	0.71	0.76	0.85
<i>Theil statistics^e</i>								
Theil1	0.73	0.88	0.52	0.57	0.89	0.53	0.92	0.72
Theil2	0.22	0.60	0.18	0.13	0.19	0.24	0.30	0.26
<i>correlation coefficient (rho)</i>	0.90	0.71	0.92	0.97	0.94	0.93	0.88	0.92

a) The pooled results for G7 countries are based on an unweighted arithmetic average. For the pooled sample, the number of observations is seven times the number of years.

b) Root mean square error.

c) Mean absolute error.

d) Mean square error.

e) The Theil statistic is the ratio of the RMSE of the *OECD Economic Outlook* projection to the RMSE of a "naïve" alternative. A value greater than unity implies that the "naïve" alternative projection is better.

Table 3. Accuracy of Economic Outlook projections for current account balances (1982-98): summary statistics

	Percentage of GDP							
	United States	Japan	Germany	France	Italy	United Kingdom	Canada	Pooled G7 average ^a
Current year								
Sample statistics								
<i>Outcome</i>								
Mean actual value (MV(O))	-2.06	2.54	1.03	0.29	0.26	-0.72	-1.79	-0.06
Mean absolute actual value (MAV(O))	2.06	2.54	1.76	0.94	1.51	1.15	1.99	1.71
Standard deviation(SD(O))	0.97	0.98	2.11	1.26	1.81	1.51	1.54	2.10
Mean absolute deviation (MAD(O))	0.74	0.79	1.81	0.95	1.55	1.20	1.19	1.70
<i>Projection</i>								
Mean forecast value (MV(F))	-1.95	2.52	1.13	0.22	0.31	-0.84	-1.68	-0.04
Standard deviation (SD(F))	1.10	0.98	1.95	1.16	1.99	1.44	1.57	2.08
SD(F)/SD(O)	1.13	1.00	0.92	0.92	1.10	0.95	1.02	0.99
Projection error statistics								
RMSE ^b	0.34	0.44	0.53	0.59	1.05	1.00	1.10	0.78
MAE ^c	0.29	0.35	0.39	0.49	0.72	0.82	0.79	0.55
RMSE/SD(O)	0.35	0.44	0.25	0.46	0.58	0.66	0.71	0.37
MAE/MAD(O)	0.39	0.45	0.22	0.51	0.47	0.68	0.66	0.32
RMSE/MV(O)	-0.17	0.17	0.52	2.04	3.97	-1.39	-0.61	-12.03
MAE/MAV(O)	0.14	0.14	0.22	0.52	0.48	0.71	0.40	0.32
<i>Decomposition of MSE^d</i>								
bias proportion (UB)	0.11	0.00	0.04	0.01	0.00	0.02	0.01	0.00
variance proportion (UV)	0.14	0.00	0.09	0.03	0.03	0.00	0.00	0.00
covariance proportion (UC)	0.76	1.00	0.88	0.96	0.97	0.98	0.99	1.00
<i>Theil statistics^e</i>								
Theil1	0.45	0.54	0.41	0.85	0.85	0.79	0.95	0.73
Theil2	0.15	0.16	0.23	0.47	0.59	0.61	0.47	0.37
<i>correlation coefficient (rho)</i>	0.96	0.89	0.97	0.88	0.84	0.76	0.74	0.93
Year ahead								
Sample statistics								
<i>Outcome</i>								
Mean actual value (MV(O))	-1.99	2.55	1.05	0.21	0.19	-0.59	-1.74	-0.05
Mean absolute actual value (MAV(O))	1.99	2.55	1.79	0.96	1.47	1.16	2.01	1.70
Standard deviation(SD(O))	0.92	0.98	2.15	1.29	1.75	1.52	1.72	2.09
Mean absolute deviation (MAD(O))	0.69	0.79	1.85	0.98	1.48	1.17	1.34	1.70
<i>Projection</i>								
Mean forecast value (MV(F))	-2.04	2.44	1.06	0.21	0.21	-1.03	-1.65	-0.12
Standard deviation (SD(F))	0.93	0.84	1.95	1.08	1.94	1.27	1.45	2.02
SD(F)/SD(O)	1.01	0.86	0.91	0.84	1.11	0.84	0.84	0.96
Projection error statistics								
RMSE ^b	0.50	0.67	1.08	0.61	1.29	1.14	1.61	1.06
MAE ^c	0.38	0.61	0.76	0.51	1.01	0.98	1.15	0.77
RMSE/SD(O)	0.54	0.69	0.50	0.47	0.74	0.75	0.94	0.50
MAE/MAD(O)	0.54	0.77	0.41	0.52	0.68	0.84	0.86	0.45
RMSE/MV(O)	-0.25	0.26	1.04	2.87	6.88	-1.94	-0.93	-23.28
MAE/MAV(O)	0.19	0.24	0.43	0.52	0.68	0.84	0.57	0.45
<i>Decomposition of MSE^d</i>								
bias proportion (UB)	0.01	0.03	0.00	0.00	0.00	0.15	0.00	0.00
variance proportion (UV)	0.00	0.04	0.03	0.11	0.02	0.04	0.03	0.01
covariance proportion (UC)	0.99	0.93	0.97	0.89	0.98	0.81	0.97	0.99
<i>Theil statistics^e</i>								
Theil1	0.67	0.83	0.82	0.81	1.06	1.10	1.36	1.02
Theil2	0.23	0.25	0.46	0.48	0.76	0.72	0.67	0.51
<i>correlation coefficient (rho)</i>	0.85	0.73	0.86	0.87	0.74	0.71	0.46	0.87

a) The pooled results for the G7 countries are based on an unweighted arithmetic average. For the pooled sample, the number of observations is seven times the number of years.

b) Root mean square error.

c) Mean absolute error.

d) Mean square error.

e) The Theil statistic is the ratio of the RMSE of the *OECD Economic Outlook* projection to the RMSE of a "naïve" alternative. A value greater than unity implies that the "naïve" alternative projection is better.

Table 4. Accuracy of Economic Outlook projections for real GDP growth (1971-98): rationality tests

		Per cent							
		United States	Japan	Germany	France	Italy	United Kingdom	Canada	Pooled G7average ^a
		Current year							
<i>Tests for unbiasedness</i>									
F-statistic ^b		0.90 [0.42]	0.66 [0.53]	0.41 [0.67]	0.55 [0.58]	0.16 [0.85]	0.15 [0.86]	1.34 [0.28]	1.69 [0.19]
AFE ^c		-0.08 [0.64]	-0.08 [0.76]	0.01 [0.95]	-0.11 [0.54]	-0.02 [0.92]	0.04 [0.81]	-0.26 [0.18]	-0.07 [0.33]
<i>Test for efficiency^d</i>									
BL-test on FE									
	Q(1)	0.85 [0.36]	1.36 [0.24]	0.47 [0.49]	1.03 [0.31]	0.79 [0.37]	1.28 [0.26]	1.90 [0.17]	4.39*
	Q(2)	5.10 [0.08]	1.52 [0.47]	3.03 [0.22]	1.04 [0.59]	0.95 [0.62]	2.05 [0.36]	1.92 [0.38]	4.48
	Q(3)	5.12 [0.16]	2.18 [0.54]	3.04 [0.39]	2.41 [0.49]	2.07 [0.56]	2.05 [0.56]	2.03 [0.57]	4.54
BL-test on the residuals of the forecast-realisation equation									
	Q(1)	0.30 [0.59]	0.36 [0.55]	0.28 [0.60]	0.65 [0.42]	0.69 [0.41]	0.62 [0.43]	2.77 [0.10]	2.91
	Q(2)	5.71 [0.06]	0.87 [0.65]	2.43 [0.30]	1.07 [0.59]	0.81 [0.67]	1.42 [0.49]	2.82 [0.24]	3.26
	Q(3)	5.89 [0.12]	1.72 [0.63]	2.62 [0.45]	3.93 [0.27]	1.90 [0.59]	1.48 [0.69]	2.84 [0.42]	3.26
<i>Test for orthogonality of errors</i>									
F-statistic ^e		0.47 [0.63]	0.74 [0.49]	0.21 [0.81]	0.58 [0.57]	0.41 [0.67]	0.59 [0.56]	1.90 [0.17]	2.22 [0.11]
		Year ahead							
<i>Tests for unbiasedness</i>									
F-statistic ^b		0.11 [0.90]	1.19 [0.32]	0.33 [0.73]	0.92 [0.41]	3.06 [0.06]	0.42 [0.66]	1.18 [0.32]	4.69 [0.01]
AFE ^c		0.09 [0.72]	-0.45 [0.34]	-0.19 [0.57]	-0.23 [0.36]	-0.26 [0.51]	-0.15 [0.61]	-0.47 [0.17]	-0.23 [0.06]
<i>Test for efficiency^d</i>									
BL-test on FE									
	Q(1)	0.33 [0.56]	0.07 [0.79]	0.20 [0.66]	0.47 [0.50]	0.84 [0.36]	2.63 [0.11]	0.27 [0.60]	0.06
	Q(2)	1.43 [0.49]	4.23 [0.12]	0.41 [0.82]	0.84 [0.66]	2.10 [0.35]	3.05 [0.22]	0.61 [0.74]	5.61
	Q(3)	1.44 [0.70]	7.13 [0.07]	0.63 [0.89]	1.67 [0.64]	3.52 [0.32]	3.14 [0.37]	1.00 [0.80]	7.97*
BL-test on the residuals of the forecast-realisation equation									
	Q(1)	0.36 [0.55]	0.00 [0.98]	0.15 [0.70]	0.59 [0.44]	0.08 [0.78]	2.65 [0.10]	0.45 [0.50]	0.12
	Q(2)	1.12 [0.57]	4.66 [0.10]	0.66 [0.72]	1.17 [0.56]	2.63 [0.27]	3.40 [0.18]	1.15 [0.56]	8.01*
	Q(3)	1.15 [0.77]	6.04 [0.11]	0.89 [0.83]	2.39 [0.50]	2.87 [0.41]	3.41 [0.33]	1.33 [0.72]	8.53*
<i>Test for orthogonality of errors</i>									
F-statistic ^e		0.30 [0.74]	0.28 [0.76]	0.23 [0.80]	0.54 [0.59]	0.49 [0.62]	1.26 [0.30]	1.35 [0.28]	1.17 [0.31]

p-values in brackets.

a) The pooled results for the G7 countries are based on an unweighted arithmetic average. For the pooled sample, the number of observations is seven times the number of years.

b) The F-statistic for the test for unbiasedness is based on the regression $A_t = b_0 + b_1 F_t + u_t$, where A_t is the actual value in year t and F_t is the forecast for the year t. A p-value above 0.05 indicates that the joint restriction $b_0 = 0$ and $b_1 = 1$ can be accepted at the 5 per cent significance level.

c) Unbiasedness is identified by the significance of the average forecast error (AFE), defined as the outcome minus the projection. The test for unbiasedness involves regressing the AFE on a constant and an error term. A p-value above 0.05 indicates the absence of bias.

d) Box-Ljung portmanteau test (or modified Q-statistic). The Q statistics are independently distributed as chi-squared random variables with degrees of freedom equal to the number of autocorrelations. The null hypothesis is that all the autocorrelations to that order are zero. A p-value above 0.05 (or, an * in the case of the pooled sample) indicates that the null hypothesis can be accepted at the 5 per cent level of significance.

e) The F-statistic for the test for orthogonality of errors is based on the regression $A_t F_t = a + b(A_{t-1} - F_{t-1}) + u_t$, where A_t is the actual value in year t and F_t is the forecast for the year t. A p-value above 0.05 indicates that the joint restriction $a = b = 0$ can be accepted at the 5 per cent significance level.

Table 5. Accuracy of Economic Outlook projections for inflation (1974-98): rationality tests

		Per cent							
		United States	Japan	Germany	France	Italy	United Kingdom	Canada	Pooled G7 average ^a
Current year									
<i>Tests for unbiasedness</i>									
F-statistic ^b		1.21 [0.32]	9.22 [0.00]	0.28 [0.76]	0.67 [0.52]	2.12 [0.14]	0.55 [0.59]	2.66 [0.09]	0.73 [0.48]
AFE ^c		-0.09 [0.33]	-0.53 [0.00]	0.01 [0.96]	-0.15 [0.26]	0.37 [0.10]	0.22 [0.30]	-0.06 [0.82]	-0.03 [0.63]
<i>Test for efficiency^d</i>									
BL-test on FE									
	Q(1)	0.22 [0.64]	0.05 [0.82]	0.39 [0.53]	0.07 [0.79]	3.31 [0.07]	0.12 [0.73]	2.39 [0.12]	1.48
	Q(2)	0.26 [0.88]	0.71 [0.70]	1.96 [0.38]	0.47 [0.79]	3.68 [0.16]	0.12 [0.94]	2.92 [0.23]	7.39*
	Q(3)	0.29 [0.96]	0.92 [0.82]	2.21 [0.53]	3.69 [0.30]	3.68 [0.30]	0.86 [0.84]	2.97 [0.40]	10.00*
BL-test on the residuals of the forecast-realisation equation									
	Q(1)	0.54 [0.46]	0.45 [0.50]	0.35 [0.55]	0.10 [0.75]	3.44 [0.06]	0.12 [0.73]	1.07 [0.30]	1.06
	Q(2)	0.58 [0.75]	1.46 [0.48]	1.82 [0.40]	0.58 [0.75]	3.92 [0.14]	0.12 [0.94]	1.08 [0.58]	6.15*
	Q(3)	0.59 [0.90]	1.64 [0.65]	1.98 [0.58]	3.26 [0.35]	3.99 [0.26]	0.86 [0.84]	1.66 [0.65]	8.07*
<i>Test for orthogonality of errors</i>									
F-statistic ^e		1.97 [0.16]	5.05 [0.02]	0.19 [0.83]	0.53 [0.60]	2.74 [0.09]	0.31 [0.74]	4.15 [0.03]	1.37 [0.26]
Year ahead									
<i>Tests for unbiasedness</i>									
F-statistic ^b		0.72 [0.50]	0.43 [0.66]	0.53 [0.59]	0.44 [0.65]	2.81 [0.08]	2.04 [0.15]	0.83 [0.45]	3.20 [0.04]
AFE ^c		-0.25 [0.31]	-0.50 [0.42]	0.08 [0.57]	0.03 [0.87]	0.99 [0.02]	0.64 [0.20]	-0.20 [0.63]	0.11 [0.45]
<i>Test for efficiency^d</i>									
BL-test on FE									
	Q(1)	0.93 [0.34]	3.77 ^f [0.05]	0.00 [0.96]	1.90 [0.17]	0.49 [0.48]	1.76 [0.19]	0.48 [0.49]	0.01
	Q(2)	1.26 [0.53]	4.35 [0.11]	1.15 [0.56]	2.57 [0.28]	2.39 [0.30]	1.81 [0.41]	0.96 [0.62]	3.02
	Q(3)	1.40 [0.71]	4.37 [0.22]	1.29 [0.73]	2.59 [0.46]	4.05 [0.26]	2.10 [0.55]	1.26 [0.74]	3.24
BL-test on the residuals of the forecast-realisation equation									
	Q(1)	1.11 [0.29]	3.21 [0.07]	0.01 [0.91]	1.09 [0.30]	0.48 [0.49]	0.65 [0.42]	0.00 [1.00]	0.74
	Q(2)	1.33 [0.51]	3.76 [0.15]	0.97 [0.62]	2.71 [0.26]	2.38 [0.30]	1.21 [0.55]	0.01 [1.00]	2.95
	Q(3)	1.37 [0.71]	3.77 [0.29]	1.35 [0.72]	3.10 [0.38]	4.02 [0.26]	2.05 [0.56]	1.69 [0.64]	4.24
<i>Test for orthogonality of errors</i>									
F-statistic ^e		3.23 [0.06]	16.58 [0.00]	0.19 [0.83]	2.01 [0.16]	2.65 [0.09]	1.40 [0.27]	2.16 [0.14]	0.50 [0.61]

p-values in brackets.

- a) The pooled results for the G7 countries are based on an unweighted arithmetic average. For the pooled sample, the number of observations is seven times the number of years.
- b) The F-statistic for the test for unbiasedness is based on the regression $A_t = b_0 + b_1 F_t + u_t$, where A_t is the actual value in year t and F_t is the forecast for the year t . A p-value above 0.05 indicates that the joint restriction $b_0 = 0$ and $b_1 = 1$ can be accepted at the 5 per cent significance level.
- c) Unbiasedness is identified by the significance of the average forecast error (AFE), defined as the outcome minus the projection. The test for unbiasedness involves regressing the AFE on a constant and an error term. A p-value above 0.05 indicates the absence of bias.
- d) Box-Ljung portmanteau test (or modified Q-statistic). The Q statistics are independently distributed as chi-squared random variables with degrees of freedom equal to the number of autocorrelations. The null hypothesis is that all the autocorrelations to that order are zero. A p-value above 0.05 (or, an * in the case of the pooled sample) indicates that the null hypothesis can be accepted at the 5 per cent level of significance.
- e) The F-statistic for the test for orthogonality of errors is based on the regression $A_t - F_t = a + b(A_{t-1} - F_{t-1}) + u_t$, where A_t is the actual value in year t and F_t is the forecast for the year t . A p-value above 0.05 indicates that the joint restriction $a = b = 0$ can be accepted at the 5 per cent significance level.
- f) The p-value of the Q-statistic turned out to be 0.052, i.e. exceeds slightly the customary level (0.05).

Table 6. Accuracy of Economic Outlook projections for current account balances (1982-98): rationality tests

		Percentage of GDP							
		United States	Japan	Germany	France	Italy	United Kingdom	Canada	Pooled G7 average ^a
		Current year							
<i>Tests for unbiasedness</i>									
F-statistic ^b		3.97 [0.04]	0.31 [0.74]	0.53 [0.60]	0.14 [0.87]	1.72 [0.21]	0.79 [0.47]	1.36 [0.29]	1.56 [0.21]
AFE ^c		-0.11 [0.19]	0.02 [0.83]	-0.10 [0.46]	0.06 [0.66]	-0.04 [0.88]	0.12 [0.63]	-0.11 [0.69]	-0.02 [0.76]
<i>Test for efficiency^d</i>									
BL-test on FE									
	Q(1)	0.60 [0.44]	0.83 [0.36]	2.58 [0.11]	0.08 [0.78]	0.01 [0.93]	0.04 [0.84]	2.11 [0.15]	0.01
	Q(2)	0.61 [0.74]	2.54 [0.28]	2.58 [0.28]	0.44 [0.80]	0.01 [0.99]	0.65 [0.72]	2.47 [0.29]	0.59
	Q(3)	1.18 [0.76]	3.19 [0.36]	3.79 [0.29]	2.01 [0.57]	0.09 [0.99]	1.35 [0.72]	2.91 [0.41]	0.61
BL-test on the residuals of the forecast-realisation equation									
	Q(1)	0.17 [0.68]	1.01 [0.32]	1.90 [0.17]	0.02 [0.89]	0.12 [0.73]	0.09 [0.77]	0.12 [0.73]	0.82
	Q(2)	0.35 [0.84]	2.96 [0.23]	1.93 [0.38]	0.24 [0.89]	0.40 [0.82]	0.68 [0.71]	1.25 [0.54]	2.88
	Q(3)	0.37 [0.95]	4.25 [0.24]	3.98 [0.26]	1.43 [0.70]	0.40 [0.94]	1.24 [0.74]	1.25 [0.74]	3.43
<i>Test for orthogonality of errors</i>									
F-statistic ^e		0.73 [0.50]	0.32 [0.73]	1.55 [0.25]	0.40 [0.68]	0.02 [0.98]	0.15 [0.86]	2.66 [0.10]	0.37 [0.69]
		Year ahead							
<i>Tests for unbiasedness</i>									
F-statistic ^b		0.81 [0.46]	0.51 [0.61]	0.08 [0.92]	0.04 [0.97]	2.25 [0.14]	1.60 [0.23]	1.39 [0.28]	2.42 [0.09]
AFE ^c		0.05 [0.71]	0.11 [0.51]	-0.01 [0.97]	0.00 [1.00]	-0.02 [0.96]	0.44 [0.11]	-0.08 [0.84]	0.07 [0.47]
<i>Test for efficiency^d</i>									
BL-test on FE									
	Q(1)	0.56 [0.46]	0.53 [0.47]	6.86 [0.01]	0.04 [0.85]	0.02 [0.90]	0.94 [0.33]	0.95 [0.33]	6.35*
	Q(2)	1.81 [0.41]	2.62 [0.27]	6.94 [0.03]	0.07 [0.97]	0.93 [0.63]	2.38 [0.30]	0.98 [0.61]	6.47*
	Q(3)	2.41 [0.49]	5.42 [0.14]	7.29 [0.06]	0.42 [0.94]	1.40 [0.71]	2.41 [0.49]	1.15 [0.76]	6.79
BL-test on the residuals of the forecast-realisation equation									
	Q(1)	0.72 [0.40]	0.77 [0.38]	7.26 [0.01]	0.13 [0.71]	0.10 [0.75]	1.53 [0.22]	4.14 [0.04]	12.07*
	Q(2)	1.44 [0.49]	2.66 [0.27]	7.48 [0.02]	0.23 [0.89]	0.21 [0.90]	2.87 [0.24]	4.90 [0.09]	12.62*
	Q(3)	1.73 [0.63]	5.96 [0.11]	7.65 ^f [0.05]	0.49 [0.92]	0.78 [0.86]	2.92 [0.40]	4.91 [0.18]	12.24*
<i>Test for orthogonality of errors</i>									
F-statistic ^e		0.41 [0.67]	0.75 [0.49]	3.79 [0.05]	0.12 [0.88]	0.01 [0.99]	1.31 [0.30]	1.39 [0.28]	3.67 [0.03]

p-values in brackets.

- a) The pooled results for the G7 countries are based on an unweighted arithmetic average. For the pooled sample, the number of observations is seven times the number of years.
- b) The F-statistic for the test for unbiasedness is based on the regression $A_t = b_0 + b_1 F_t + u_t$, where A_t is the actual value in year t and F_t is the forecast for the year t . A p-value above 0.05 indicates that the joint restriction $b_0 = 0$ and $b_1 = 1$ can be accepted at the 5 per cent significance level.
- c) Unbiasedness is identified by the significance of the average forecast error (AFE), defined as the outcome minus the projection. The test for unbiasedness involves regressing the AFE on a constant and an error term. A p-value above 0.05 indicates the absence of bias.
- d) Box-Ljung portmanteau test (or modified Q-statistic). The Q statistics are independently distributed as chi-squared random variables with degrees of freedom equal to the number of autocorrelations. The null hypothesis is that all the autocorrelations to that order are zero. A p-value above 0.05 (or, an * in the case of the pooled sample) indicates that the null hypothesis can be accepted at the 5 per cent level of significance.
- e) The F-statistic for the test for orthogonality of errors is based on the regression $A_t F_t = a + b(A_{t-1} - F_{t-1}) + u_t$, where A_t is the actual value in year t and F_t is the forecast for the year t . A p-value above 0.05 indicates that the joint restriction $a = b = 0$ can be accepted at the 5 per cent significance level.
- f) The p-value of the Q-statistic turned out to be 0.054, i.e. exceeds slightly the customary level (0.05).

Table 7: Directional forecast accuracy: ^{a,b} current year projections

	DF > 0 and DA > 0	DF > 0 and DA ≤ 0	DF ≤ 0 and DA > 0	DF ≤ 0 and DA ≤ 0	Percentage of correct forecasts	x-test ^c
GDP growth						
United States	11	1	4	11	0.81	**
Japan	10	1	4	12	0.81	**
Germany	10	2	3	12	0.81	**
France	10	3	2	12	0.81	**
Italy	11	3	1	12	0.85	**
United Kingdom	12	2	0	13	0.93	**
Canada	12	1	1	13	0.93	**
Pooled G7 countries ^d	76	13	15	85	0.85	**
Inflation						
United States	7	2	1	14	0.88	**
Japan	7	5	1	11	0.75	**
Germany	10	1	2	11	0.88	**
France	5	4	1	13	0.78	**
Italy	5	0	5	14	0.79	**
United Kingdom	9	0	1	14	0.96	**
Canada	6	4	2	12	0.75	*
Pooled G7 countries ^d	49	16	13	89	0.83	**
Current account balances^e						
United States	4	1	2	9	0.81	*
Japan	7	1	1	7	0.88	**
Germany	7	3	3	3	0.63	ns
France	7	3	4	2	0.56	ns
Italy	5	4	1	6	0.69	ns
United Kingdom	4	0	3	9	0.81	**
Canada	5	2	1	8	0.81	*
Pooled G7 countries ^d	39	14	15	44	0.74	**

a) For the entire sample period.

b) F and A denote the year ahead forecast and the outcome respectively; $DF = F_t - A_{t-1}$ and $DA = A_t - A_{t-1}$.

c) In the last column, "***" indicates that the null hypothesis of independence can be rejected at the 1 per cent significance level; "**" at the 5 per cent significance level; "ns" indicates no rejection at 5 per cent significance level.

d) The pooled results for the seven major countries are based on an unweighted arithmetic average.

e) As a percentage of GDP.

Table 8: Directional forecast accuracy: ^{a,b} year ahead projections

	DF > 0 and DA > 0	DF > 0 and DA ≤ 0	DF ≤ 0 and DA > 0	DF ≤ 0 and DA ≤ 0	Percentage of correct forecasts	x-test ^c
GDP growth						
United States	10	0	2	14	0.92	**
Japan	9	2	1	14	0.88	**
Germany	10	3	4	9	0.73	*
France	12	1	3	10	0.85	**
Italy	10	3	3	9	0.76	**
United Kingdom	10	3	5	8	0.69	*
Canada	11	1	4	10	0.81	**
Pooled G7 countries ^d	72	13	22	74	0.81	**
Inflation						
United States	8	1	1	13	0.91	**
Japan	8	4	0	11	0.83	**
Germany	6	2	3	12	0.78	*
France	5	4	1	13	0.78	**
Italy	5	0	4	14	0.83	**
United Kingdom	5	1	4	13	0.78	**
Canada	6	4	2	11	0.74	*
Pooled G7 countries ^d	43	16	15	87	0.81	**
Current account balances^e						
United States	5	0	2	8	0.87	**
Japan	6	0	2	7	0.87	**
Germany	10	1	1	3	0.87	*
France	9	1	2	3	0.80	*
Italy	6	2	2	5	0.73	ns
United Kingdom	4	1	3	7	0.73	ns
Canada	4	4	0	7	0.73	*
Pooled G7 countries ^d	44	9	12	40	0.80	**

a) For the entire sample period.

b) F and A denote the year ahead forecast and the outcome respectively; $DF = F_t - A_{t-2}$ and $DA = A_t - A_{t-2}$.

c) In the last column, "***" indicates that the null hypothesis of independence can be rejected at the 1 per cent significance level; "**" at the 5 per cent significance level; "ns" indicates no rejection at the 5 per cent significance level.

d) The pooled results for the seven major countries are based on an unweighted arithmetic average.

e) As a percentage of GDP.

Table 9. Accuracy of Economic Outlook projections for world trade growth (1985-98): summary statistics

Sample Statistics	<i>Per cent</i>	
	Current year	Year ahead
<i>Outcome</i>		
Mean actual value (MV(O))	6.06	6.25
Mean absolute actual value (MAV(O))	6.06	6.25
Standard deviation(SD(O))	2.37	2.39
Mean absolute deviation (MAD(O))	2.00	1.98
<i>Projection</i>		
Mean forecast value (MV(F))	5.85	6.03
Standard deviation (SD(F))	1.99	1.57
SD(F)/SD(O)	0.84	0.66
Projection error statistics		
RMSE ^b	1.69	2.45
MAE ^c	1.36	2.06
RMSE/SD(O)	0.71	1.02
MAE/MAD(O)	0.68	1.04
RMSE/MV(O)	0.28	0.39
MAE/MAV(O)	0.22	0.33
<i>Decomposition of MSE^d</i>		
bias proportion (UB)	0.02	0.01
variance proportion (UV)	0.05	0.11
covariance proportion (UC)	0.94	0.89
<i>Theil Statistics^e</i>		
Theil1	0.51	0.76
Theil2	0.26	0.37
<i>correlation coefficient (rho)</i>	0.69	0.24

a) The pooled results for the seven major countries are based on an unweighted arithmetic average. For the pooled sample, the number of observations is seven times the number of years.

b) Root mean square error.

c) Mean absolute error.

d) Mean square error.

e) The Theil statistics is the ratio of the RMSE of the *OECD Economic Outlook* projection to the RMSE of a "naïve" alternative. A value greater than unity implies that the "naïve" alternative projection is better.

Table 10. Accuracy of Economic Outlook projections for world trade growth (1985-98): rationality tests

	Per cent	
	Current year	Year ahead
<i>Tests for unbiasedness</i>		
F-statistic ^a	0.35 [0.71]	1.18 [0.34]
AFE ^b	0.21 [0.66]	0.23 [0.75]
<i>Test for efficiency^c</i>		
BL-test on FE		
Q(1)	0.30 [0.59]	0.38 [0.54]
Q(2)	1.83 [0.40]	0.58 [0.75]
Q(3)	1.91 [0.59]	1.05 [0.79]
BL-test on the residuals of the forecast- realisation equation		
Q(1)	0.39 [0.53]	0.01 [0.92]
Q(2)	1.55 [0.46]	0.09 [0.95]
Q(3)	1.57 [0.66]	0.94 [0.82]
<i>Test for orthogonality of errors</i>		
F-statistic ^d	0.52 [0.61]	0.34 [0.72]

p-values in brackets.

a) The F-statistic for test for unbiasedness is based on the regression $A_t = b_0 + b_1 F_t + u_t$, where A_t is the actual value in year t and F_t is the forecast for the year t . A p-value above 0.05 indicates that the joint restriction $b_0 = 0$ and $b_1 = 1$ can be accepted at the 5 per cent significance level.

b) Unbiasedness is identified by the significance of the average forecast error (AFE), defined as the outcome minus the projection. The test for unbiasedness involves regressing the AFE on a constant and an error term. A p-value above 0.05 indicates the absence of bias.

c) Box-Ljung portmanteau test (or modified Q-statistic). The Q statistics are independently distributed as chi-squared random variables with degrees of freedom equal to the number of autocorrelations. The null hypothesis is that all the autocorrelations to that order are zero. A p-value above 0.05 indicates that the null hypothesis can be accepted at the 5 per cent level of significance.

d) The F-statistic for the test for orthogonality of errors is based on the regression $A_t - F_t = a + b(A_{t-1} - F_{t-1}) + u_t$, where A_t is the actual value in year t and F_t .

Table 11: **Directional forecast accuracy: world trade growth projections^a**

	DF > 0 and DA > 0	DF > 0 and DA ≤ 0	DF ≤ 0 and DA > 0	DF ≤ 0 and DA ≤ 0	Percentage of correct forecasts	x-test ^d
Current year ^b	5	0	1	7	0.92	**
Year ahead ^c	3	3	3	4	0.54	n.s

a) For the entire sample period.

b) F and A denote the year ahead forecast and the outcome respectively; $DF = F_t - A_{t-1}$ and $DA = A_t - A_{t-1}$.

c) F and A denote the year ahead forecast and the outcome respectively; $DF = F_t - A_{t-2}$ and $DA = A_t - A_{t-2}$.

d) In the last column, "***" indicates that the null hypothesis of independence can be rejected at the 1 per cent significance level;

"ns" indicates no rejection at the 5 per cent significance level.

Table 12. Accuracy of Economic Outlook projections for real GDP growth over time: current year projections

		Per cent							
	Period	United States	Japan	Germany	France	Italy	United Kingdom	Canada	Pooled G7average ^a
Sample statistics									
<i>Outcome</i>									
Mean actual value (MV(O))	1971-89	2.79	4.72	2.21	2.67	2.35	1.83	3.18	2.82
	1990-98	2.39	1.63	2.17	1.83	1.38	1.49	1.97	1.84
Mean absolute actual value (MAV(O))	1971-89	3.42	4.91	2.72	2.93	2.92	2.44	3.68	3.29
	1990-98	2.54	2.26	2.46	2.03	1.53	2.11	2.30	2.18
Standard deviation(SD(O))	1971-89	2.73	2.62	2.19	2.08	2.36	2.10	2.55	2.49
	1990-98	1.56	2.55	1.58	1.23	1.04	1.91	1.79	1.68
Mean absolute deviation (MAD(O))	1971-89	2.04	1.86	1.59	1.65	1.75	1.64	1.64	1.84
	1990-98	1.17	1.96	1.04	0.92	0.72	1.48	1.35	1.28
<i>Projection</i>									
Mean forecast value (MV(F))	1971-89	2.84	4.70	2.37	2.80	2.21	1.72	3.29	2.85
	1990-98	2.51	1.92	1.80	1.89	1.74	1.60	2.54	2.00
Standard deviation (SD(F))	1971-89	2.89	3.04	2.02	1.97	1.83	2.09	2.15	2.44
	1990-98	1.20	1.49	1.70	1.22	1.02	1.60	1.50	1.39
SD(F)/SD(O)	1971-89	1.06	1.16	0.92	0.95	0.77	0.99	0.84	0.98
	1990-98	0.77	0.59	1.08	0.99	0.98	0.84	0.84	0.83
Projection error statistics									
RMSE ^b	1971-89	0.85	1.34	1.03	1.02	1.25	0.90	1.07	1.08
	1990-98	0.77	1.21	0.69	0.52	0.72	0.63	0.94	0.81
MAE ^c	1971-89	0.71	1.01	0.88	0.70	0.84	0.67	0.76	0.79
	1990-98	0.57	1.02	0.59	0.43	0.63	0.51	0.82	0.65
RMSE/SD(O)	1971-89	0.31	0.51	0.47	0.49	0.53	0.43	0.42	0.43
	1990-98	0.49	0.48	0.44	0.42	0.69	0.33	0.53	0.48
MAE/MAD(O)	1971-89	0.35	0.54	0.56	0.42	0.48	0.41	0.46	0.43
	1990-98	0.49	0.52	0.57	0.47	0.88	0.35	0.61	0.51
RMSE/MV(O)	1971-89	0.30	0.28	0.46	0.38	0.53	0.49	0.34	0.38
	1990-98	0.32	0.74	0.32	0.28	0.52	0.42	0.48	0.44
MAE/MAV(O)	1971-89	0.21	0.21	0.33	0.24	0.29	0.27	0.21	0.24
	1990-98	0.22	0.45	0.24	0.21	0.41	0.24	0.36	0.30
Decomposition of MSE^d									
bias proportion (UB)	1971-89	0.00	0.00	0.02	0.02	0.01	0.01	0.01	0.00
	1990-98	0.03	0.06	0.28	0.01	0.26	0.03	0.38	0.04
variance proportion (UV)	1971-89	0.03	0.09	0.02	0.01	0.17	0.00	0.13	0.00
	1990-98	0.20	0.67	0.03	0.00	0.00	0.21	0.08	0.13
covariance proportion (UC)	1971-89	0.96	0.91	0.95	0.97	0.82	0.99	0.86	1.00
	1990-98	0.78	0.27	0.69	0.99	0.74	0.76	0.54	0.83
Theil statistics^e									
Theil1	1971-89	0.24	0.38	0.35	0.41	0.36	0.41	0.33	0.35
	1990-98	0.48	0.56	0.36	0.32	0.49	0.35	0.49	0.45
Theil2	1971-89	0.22	0.25	0.33	0.30	0.38	0.33	0.26	0.29
	1990-98	0.27	0.42	0.26	0.24	0.42	0.27	0.36	0.33
correlation coefficient (ρ)	1971-89	0.95	0.89	0.88	0.87	0.84	0.90	0.91	0.90
	1990-98	0.86	0.94	0.93	0.90	0.80	0.95	0.90	0.88
Tests for unbiasedness									
F-statistic ^f	1971-89	1.05	2.96	0.28	0.35	0.26	0.49	0.28	2.06
		[0.37]	[0.08]	[0.76]	[0.71]	[0.78]	[0.62]	[0.76]	[0.13]
F-statistic ^f	1990-98	0.22	4.36	2.15	0.18	1.64	0.50	2.22	1.74
		[0.81]	[0.06]	[0.19]	[0.84]	[0.26]	[0.63]	[0.18]	[0.18]
AFE ^g	1971-89	-0.05	0.02	-0.16	-0.13	0.14	0.11	-0.11	-0.03
		[0.80]	[0.94]	[0.52]	[0.60]	[0.63]	[0.61]	[0.66]	[0.79]
AFE ^g	1990-98	-0.12	-0.29	0.37	-0.06	-0.37	-0.11	-0.58	-0.17
		[0.66]	[0.51]	[0.12]	[0.77]	[0.13]	[0.62]	[0.06]	[0.11]

p-values in brackets.

a) The pooled results for the G7 countries are based on an unweighted arithmetic average. For the pooled sample, the number of observations is seven times the number of years.

b) Root mean square error.

c) Mean absolute error.

d) Mean square error.

e) The Theil statistic is the ratio of the RMSE of the OECD Economic Outlook projection to the RMSE of a "naïve" alternative. A value greater than unity implies that the "naïve" alternative projection is better.

f) The F-statistic for the test for unbiasedness is based on the regression $A_t = b_0 + b_1 F_t + u_t$, where A_t is the actual value in year t and F_t is the forecast for the year t. A p-value above 0.05 indicates that the joint restriction $b_0 = 0$ and $b_1 = 1$ can be accepted at the 5 per cent significance level.

g) Unbiasedness is identified by the significance of the average forecast error (AFE), defined as the outcome minus the projection. The test for unbiasedness involves regressing the AFE on a constant and an error term. A p-value above 0.05 indicates the absence of bias.

Table 13. Accuracy of Economic Outlook projections for real GDP growth over time: year ahead projections

		Per cent							
	Period	United States	Japan	Germany	France	Italy	United Kingdom	Canada	Pooled G7average ^a
Sample statistics									
<i>Outcome</i>									
Mean actual value (MV(O))	1971-89	2.87	4.77	2.28	2.76	2.37	1.99	3.23	2.90
	1990-98	2.51	1.59	2.20	1.86	1.37	1.58	1.88	1.85
Mean absolute actual value (MAV(O))	1971-89	3.51	4.96	2.76	2.89	2.94	2.60	3.69	3.34
	1990-98	2.78	2.21	2.44	2.08	1.52	2.20	2.26	2.21
Standard deviation(SD(O))	1971-89	2.74	2.68	2.18	1.91	2.41	2.11	2.49	2.47
	1990-98	1.75	2.54	1.57	1.30	1.04	1.94	1.90	1.73
Mean absolute deviation (MAD(O))	1971-89	2.08	1.92	1.60	1.54	1.78	1.59	1.63	1.82
	1990-98	1.27	1.94	1.00	0.96	0.73	1.50	1.45	1.33
<i>Projection</i>									
Mean forecast value (MV(F))	1971-89	2.79	5.07	2.53	2.88	2.41	1.92	3.39	3.00
	1990-98	2.40	2.36	2.27	2.32	2.09	2.19	2.99	2.37
Standard deviation (SD(F))	1971-89	2.32	2.34	1.33	1.70	2.24	1.80	1.51	2.11
	1990-98	0.66	1.17	0.85	0.68	0.77	0.94	0.98	0.88
SD(F)/SD(O)	1971-89	0.85	0.87	0.61	0.89	0.93	0.85	0.61	0.85
	1990-98	0.38	0.46	0.54	0.52	0.73	0.48	0.52	0.51
Projection error statistics									
RMSE ^b	1971-89	1.37	2.63	1.86	1.34	2.30	1.57	1.89	1.90
	1990-98	1.27	1.93	1.27	1.22	1.10	1.45	1.59	1.43
MAE ^c	1971-89	0.95	1.66	1.30	0.87	1.72	1.18	1.40	1.30
	1990-98	1.11	1.50	1.04	0.98	0.97	1.01	1.40	1.14
RMSE/SD(O)	1971-89	0.50	0.98	0.85	0.70	0.95	0.74	0.76	0.77
	1990-98	0.72	0.76	0.81	0.94	1.06	0.75	0.84	0.83
MAE/MAD(O)	1971-89	0.46	0.87	0.81	0.56	0.97	0.74	0.86	0.71
	1990-98	0.87	0.77	1.04	1.02	1.33	0.68	0.97	0.86
RMSE/MV(O)	1971-89	0.48	0.55	0.81	0.49	0.97	0.79	0.58	0.66
	1990-98	0.50	1.21	0.58	0.66	0.81	0.92	0.85	0.77
MAE/MAV(O)	1971-89	0.27	0.33	0.47	0.30	0.58	0.45	0.38	0.39
	1990-98	0.40	0.68	0.43	0.47	0.64	0.46	0.62	0.52
<i>Decomposition of MSE^d</i>									
bias proportion (UB)	1971-89	0.00	0.01	0.02	0.01	0.00	0.00	0.01	0.00
	1990-98	0.01	0.16	0.00	0.15	0.43	0.18	0.49	0.13
variance proportion (UV)	1971-89	0.09	0.02	0.20	0.02	0.00	0.04	0.25	0.04
	1990-98	0.65	0.45	0.29	0.24	0.06	0.42	0.29	0.35
covariance proportion (UC)	1971-89	0.91	0.97	0.79	0.97	1.00	0.96	0.74	0.96
	1990-98	0.34	0.40	0.71	0.62	0.52	0.40	0.22	0.52
<i>Theil statistics^e</i>									
Theil1	1971-89	0.39	0.76	0.63	0.62	0.66	0.69	0.60	0.62
	1990-98	0.70	0.91	0.67	0.70	0.75	0.81	0.80	0.78
Theil2	1971-89	0.35	0.48	0.60	0.40	0.69	0.55	0.47	0.50
	1990-98	0.42	0.67	0.48	0.55	0.66	0.60	0.61	0.57
<i>correlation coefficient (rho)</i>									
	1971-89	0.86	0.43	0.50	0.72	0.49	0.67	0.63	0.66
	1990-98	0.74	0.72	0.52	0.41	0.56	0.74	0.83	0.65
<i>Tests for unbiasedness</i>									
F-statistic ^f	1971-89	0.03	2.16	0.28	0.61	2.21	0.51	0.07	4.39
		[0.97]	[0.15]	[0.76]	[0.56]	[0.14]	[0.61]	[0.93]	0.01
F-statistic ^f	1990-98	1.01	1.24	0.01	0.65	2.89	1.38	5.54	5.78
		[0.41]	[0.35]	[0.99]	[0.55]	[0.12]	[0.31]	[0.04]	[0.01]
AFE ^g	1971-89	0.08	-0.30	-0.24	-0.12	-0.03	0.07	-0.16	-0.10
		[0.80]	0.64	[0.59]	[0.71]	[0.95]	[0.86]	[0.72]	[0.55]
AFE ^g	1990-98	0.11	-0.77	-0.07	-0.47	-0.72	-0.61	-1.11	-0.52
		[0.81]	0.26	[0.89]	[0.28]	[0.04]	[0.22]	[0.03]	[0.00]

p-values in brackets.

a) The pooled results for the G7 countries are based on an unweighted arithmetic average. For the pooled sample, the number of observations is seven times the number of years.

b) Root mean square error.

c) Mean absolute error.

d) Mean square error.

e) The Theil statistic is the ratio of the RMSE of the OECD Economic Outlook projection to the RMSE of a "naïve" alternative. A value greater than unity implies that the "naïve" alternative projection is better.

f) The F-statistic for the test for unbiasedness is based on the regression $A_t = b_0 + b_1 F_t + u_t$, where A_t is the actual value in year t and F_t is the forecast for the year t. A p-value above 0.05 indicates that the joint restriction $b_0 = 0$ and $b_1 = 1$ can be accepted at the 5 per cent significance level.

g) Unbiasedness is identified by the significance of the average forecast error (AFE), defined as the outcome minus the projection. The test for unbiasedness involves regressing the AFE on a constant and an error term. A p-value above 0.05 indicates the absence of bias.

Table 14. Accuracy of Economic Outlook projections for inflation over time: current year projections

		Per cent							
	Period	United States	Japan	Germany	France	Italy	United Kingdom	Canada	Pooled G7average ^a
Sample statistics									
<i>Outcome</i>									
Mean actual value (MV(O))	1974-89	5.91	3.91	3.73	8.42	13.44	10.64	7.29	7.62
	1990-98	2.48	0.80	2.69	1.81	4.70	3.72	1.26	2.49
Mean absolute actual value (MAV(O))	1974-89	5.91	3.94	3.73	8.42	13.44	10.64	7.29	7.62
	1990-98	2.48	0.91	2.69	1.81	4.70	3.72	1.34	2.52
Standard deviation(SD(O))	1974-89	2.61	5.14	1.78	3.38	5.05	6.50	3.42	5.30
	1990-98	0.91	0.90	1.73	0.80	1.72	1.74	1.10	1.80
Mean absolute deviation (MAD(O))	1974-89	2.26	3.32	1.31	2.89	4.40	5.08	3.00	4.25
	1990-98	0.64	0.76	1.45	0.68	1.22	1.41	0.84	1.37
<i>Projection</i>									
Mean forecast value (MV(F))	1974-89	5.98	4.58	3.67	8.45	13.09	10.41	6.88	7.58
	1990-98	2.60	1.10	2.77	2.16	4.28	3.51	2.14	2.65
Standard deviation (SD(F))	1974-89	2.37	5.38	1.68	3.58	5.31	6.38	2.95	5.18
	1990-98	0.92	1.06	1.46	0.82	1.55	1.64	1.34	1.56
SD(F)/SD(O)	1974-89	0.91	1.05	0.94	1.06	1.05	0.98	0.86	0.98
	1990-98	1.01	1.18	0.85	1.03	0.90	0.94	1.21	0.86
Projection error statistics									
RMSE ^b	1974-89	0.55	1.09	0.48	0.73	1.30	1.19	1.27	1.00
	1990-98	0.29	0.46	0.61	0.45	0.71	0.76	1.05	0.66
MAE ^c	1974-89	0.42	0.84	0.39	0.56	1.01	0.94	0.78	0.71
	1990-98	0.21	0.39	0.52	0.37	0.56	0.61	0.89	0.51
RMSE/SD(O)	1974-89	0.21	0.21	0.27	0.22	0.26	0.18	0.37	0.19
	1990-98	0.32	0.51	0.35	0.56	0.41	0.44	0.95	0.37
MAE/MAD(O)	1974-89	0.18	0.25	0.30	0.19	0.23	0.19	0.26	0.17
	1990-98	0.33	0.51	0.36	0.54	0.45	0.43	1.06	0.37
RMSE/MV(O)	1974-89	0.09	0.28	0.13	0.09	0.10	0.11	0.17	0.13
	1990-98	0.12	0.57	0.23	0.25	0.15	0.20	0.84	0.26
MAE/MAV(O)	1974-89	0.07	0.21	0.10	0.07	0.08	0.09	0.11	0.09
	1990-98	0.09	0.43	0.19	0.20	0.12	0.16	0.66	0.20
Decomposition of MSE^d									
bias proportion (UB)	1974-89	0.02	0.37	0.01	0.00	0.07	0.04	0.11	0.00
	1990-98	0.18	0.43	0.02	0.59	0.35	0.08	0.72	0.06
variance proportion (UV)	1974-89	0.17	0.04	0.04	0.07	0.04	0.01	0.13	0.01
	1990-98	0.00	0.11	0.17	0.00	0.05	0.02	0.04	0.14
covariance proportion (UC)	1974-89	0.81	0.59	0.95	0.93	0.89	0.95	0.77	0.99
	1990-98	0.82	0.46	0.81	0.41	0.60	0.91	0.24	0.81
Theil statistics^e									
Theil1	1974-89	0.28	0.26	0.30	0.41	0.44	0.21	0.48	0.30
	1990-98	0.53	0.85	0.58	0.95	0.57	0.69	1.06	0.73
Theil2	1974-89	0.09	0.17	0.12	0.08	0.09	0.10	0.16	0.11
	1990-98	0.11	0.39	0.19	0.23	0.14	0.19	0.65	0.22
correlation coefficient (rho)	1974-89	0.98	0.99	0.96	0.98	0.97	0.98	0.93	0.98
	1990-98	0.95	0.94	0.93	0.93	0.94	0.90	0.90	0.94
Tests for unbiasedness									
F-statistic ^f	1974-89	0.98	5.58	0.12	1.07	1.37	0.28	1.14	0.10
		[0.40]	[0.02]	[0.89]	[0.37]	[0.29]	[0.76]	[0.35]	[0.90]
F-statistic ^f	1990-98	0.89	5.73	0.26	5.65	1.96	0.33	15.16	3.20
		[0.45]	[0.03]	[0.77]	[0.03]	[0.21]	[0.73]	[0.00]	[0.05]
AFE ^g	1974-89	-0.08	-0.67	0.05	-0.03	0.34	0.23	0.41	0.04
		[0.59]	[0.01]	[0.67]	[0.86]	[0.31]	[0.45]	[0.20]	[0.69]
AFE ^g	1990-98	-0.12	-0.30	-0.08	-0.34	0.42	0.21	-0.89	-0.16
		[0.22]	[0.04]	[0.72]	[0.01]	[0.07]	[0.44]	[0.00]	[0.06]

p-values in brackets.

a) The pooled results for the G7 countries are based on an unweighted arithmetic average. For the pooled sample, the number of observations is seven times the number of years.

b) Root mean square error.

c) Mean absolute error.

d) Mean square error.

e) The Theil statistic is the ratio of the RMSE of the OECD Economic Outlook projection to the RMSE of a "naïve" alternative. A value greater than unity implies that the "naïve" alternative projection is better.

f) The F-statistic for the test for unbiasedness is based on the regression $A_t = b_0 + b_1 F_t + u_t$, where A_t is the actual value in year t and F_t is the forecast for the year t . A p-value above 0.05 indicates that the joint restriction $b_0 = 0$ and $b_1 = 1$ can be accepted at the 5 per cent significance level.

g) Unbiasedness is identified by the significance of the average forecast error (AFE), defined as the outcome minus the projection. The test for unbiasedness involves regressing the AFE on a constant and an error term. A p-value above 0.05 indicates the absence of bias.

Table 15. Accuracy of Economic Outlook projections for inflation over time: year ahead projections

		Per cent							
	Period	United States	Japan	Germany	France	Italy	United Kingdom	Canada	Pooled G7average ^a
Sample statistics									
<i>Outcome</i>									
Mean actual value (MV(O))	1974-89	5.98	3.84	3.74	8.48	13.45	10.53	7.28	7.61
	1990-98	2.58	0.81	2.70	1.79	4.78	3.80	1.24	2.53
Mean absolute actual value (MAV(O))	1974-89	5.98	3.86	3.74	8.48	13.45	10.53	7.28	7.62
	1990-98	2.58	0.92	2.70	1.79	4.78	3.80	1.38	2.56
Standard deviation(SD(O))	1974-89	2.66	5.10	1.76	3.60	5.07	6.40	3.47	5.31
	1990-98	0.95	0.91	1.70	0.75	1.74	1.80	1.10	1.83
Mean absolute deviation (MAD(O))	1974-89	2.28	3.21	1.27	3.02	4.43	5.02	3.05	4.27
	1990-98	0.73	0.77	1.42	0.65	1.29	1.44	0.78	1.39
<i>Projection</i>									
Mean forecast value (MV(F))	1974-89	6.23	4.41	3.53	8.13	12.06	9.50	6.81	7.24
	1990-98	2.80	1.20	2.86	2.32	4.50	3.87	2.62	2.88
Standard deviation (SD(F))	1974-89	2.42	3.67	1.59	3.62	5.14	5.01	2.79	4.50
	1990-98	1.12	0.99	1.36	0.86	1.54	1.82	1.32	1.60
SD(F)/SD(O)	1974-89	0.91	0.72	0.90	1.01	1.01	0.78	0.80	0.85
	1990-98	1.18	1.08	0.80	1.14	0.89	1.01	1.20	0.88
Projection error statistics									
RMSE ^b	1974-89	1.44	3.79	0.73	1.13	2.66	3.05	2.20	2.37
	1990-98	0.46	0.58	0.61	0.60	1.10	0.67	1.48	0.86
MAE ^c	1974-89	1.18	2.36	0.57	0.84	1.98	2.26	1.43	1.52
	1990-98	0.36	0.50	0.53	0.53	0.88	0.49	1.38	0.67
RMSE/SD(O)	1974-89	0.54	0.74	0.42	0.31	0.52	0.48	0.63	0.45
	1990-98	0.48	0.63	0.36	0.80	0.64	0.38	1.35	0.47
MAE/MAD(O)	1974-89	0.52	0.73	0.45	0.28	0.45	0.45	0.47	0.35
	1990-98	0.49	0.65	0.38	0.82	0.68	0.34	1.76	0.48
RMSE/MV(O)	1974-89	0.24	0.99	0.20	0.13	0.20	0.29	0.30	0.31
	1990-98	0.18	0.71	0.22	0.34	0.23	0.18	1.19	0.34
MAE/MAV(O)	1974-89	0.20	0.61	0.15	0.10	0.15	0.21	0.20	0.20
	1990-98	0.14	0.54	0.20	0.30	0.18	0.13	1.00	0.26
Decomposition of MSE^d									
bias proportion (UB)	1974-89	0.03	0.02	0.08	0.10	0.27	0.11	0.05	0.02
	1990-98	0.23	0.45	0.07	0.79	0.06	0.01	0.86	0.17
variance proportion (UV)	1974-89	0.03	0.13	0.05	0.00	0.00	0.20	0.09	0.11
	1990-98	0.12	0.02	0.28	0.03	0.03	0.00	0.02	0.07
covariance proportion (UC)	1974-89	0.94	0.84	0.86	0.90	0.73	0.69	0.86	0.86
	1990-98	0.65	0.53	0.66	0.18	0.91	0.99	0.12	0.76
Theil statistics^e									
Theil1	1974-89	0.72	0.88	0.49	0.54	0.90	0.53	0.86	0.71
	1990-98	0.86	1.04	0.60	1.20	0.80	0.69	1.47	0.95
Theil2	1974-89	0.22	0.61	0.18	0.12	0.19	0.25	0.27	0.26
	1990-98	0.17	0.49	0.19	0.31	0.22	0.16	0.92	0.28
correlation coefficient (rho)	1974-89	0.84	0.66	0.91	0.95	0.89	0.89	0.77	0.90
	1990-98	0.93	0.89	0.94	0.94	0.77	0.92	0.90	0.90
Tests for unbiasedness									
F-statistic ^f	1974-89	0.36	0.21	0.65	0.97	3.29	1.39	0.35	2.11
		[0.71]	[0.81]	[0.54]	[0.40]	[0.07]	[0.28]	[0.71]	[0.13]
F-statistic ^f	1990-98	3.08	4.03	0.89	19.04	0.37	0.22	34.46	6.36
		[0.11]	[0.07]	[0.45]	[0.00]	[0.70]	[0.81]	[0.00]	[0.00]
AFE ^g	1974-89	-0.26	-0.57	0.21	0.35	1.39	1.03	0.47	0.37
		[0.49]	[0.57]	[0.26]	[0.23]	[0.03]	[0.18]	[0.41]	[0.10]
AFE ^g	1990-98	-0.22	-0.39	-0.16	-0.53	0.28	-0.07	-1.38	-0.35
		[0.16]	[0.03]	[0.47]	[0.00]	[0.48]	[0.79]	[0.00]	[0.00]

p-values in brackets.

a) The pooled results for the G7 countries are based on an unweighted arithmetic average. For the pooled sample, the number of observations is seven times the number of years.

b) Root mean square error.

c) Mean absolute error.

d) Mean square error.

e) The Theil statistic is the ratio of the RMSE of the OECD Economic Outlook projection to the RMSE of a "naïve" alternative. A value greater than unity implies that the "naïve" alternative projection is better.

f) The F-statistic for the test for unbiasedness is based on the regression $A_t = b_0 + b_1 F_t + u_t$, where A_t is the actual value in year t and F_t is the forecast for the year t . A p-value above 0.05 indicates that the joint restriction $b_0 = 0$ and $b_1 = 1$ can be accepted at the 5 per cent significance level.

g) Unbiasedness is identified by the significance of the average forecast error (AFE), defined as the outcome minus the projection. The test for unbiasedness involves regressing the AFE on a constant and an error term. A p-value above 0.05 indicates the absence of bias.

Table 16. Accuracy of Economic Outlook projections for current account balances over time: current year projections
Percentage of GDP

	Period	United States	Japan	Germany	France	Italy	United Kingdom	Canada	Pooled G7average ^a
Sample statistics									
<i>Outcome</i>									
Mean actual value (MV(O))	1982-89	-2.38	2.71	2.56	-0.46	-0.54	-0.63	-0.90	0.05
	1990-98	-1.79	2.39	-0.33	0.96	0.98	-0.80	-2.59	-0.17
Mean absolute actual value (MAV(O))	1982-89	2.38	2.71	2.56	0.61	0.81	1.38	1.33	1.68
	1990-98	1.79	2.39	1.04	1.22	2.13	0.96	2.59	1.73
Standard deviation(SD(O))	1982-89	1.13	1.22	1.69	0.81	0.85	1.98	1.38	2.17
	1990-98	0.76	0.75	1.40	1.25	2.16	1.05	1.26	2.04
Mean absolute deviation (MAD(O))	1982-89	0.91	0.93	1.51	0.53	0.66	1.51	1.18	1.69
	1990-98	0.55	0.61	0.89	0.93	1.81	0.87	1.01	1.71
<i>Projection</i>									
Mean forecast value (MV(F))	1982-89	-2.20	2.71	2.31	-0.36	-0.44	-0.18	-0.79	0.15
	1990-98	-1.73	2.34	0.08	0.74	0.97	-1.43	-2.48	-0.22
Standard deviation (SD(F))	1982-89	1.35	1.21	1.51	0.89	0.89	1.53	1.22	2.02
	1990-98	0.84	0.71	1.72	1.16	2.48	1.13	1.45	2.13
SD(F)/SD(O)	1982-89	1.19	0.99	0.89	1.09	1.05	0.77	0.88	0.93
	1990-98	1.11	0.95	1.23	0.93	1.15	1.07	1.15	1.04
Projection error statistics									
RMSE ^b	1982-89	0.39	0.39	0.35	0.59	0.39	0.86	1.14	0.65
	1990-98	0.29	0.47	0.65	0.58	1.40	1.11	1.06	0.88
MAE ^c	1982-89	0.35	0.33	0.28	0.48	0.35	0.65	0.79	0.46
	1990-98	0.23	0.38	0.50	0.50	1.06	0.97	0.80	0.63
RMSE/SD(O)	1982-89	0.35	0.32	0.21	0.73	0.46	0.43	0.83	0.30
	1990-98	0.39	0.62	0.47	0.47	0.65	1.05	0.84	0.43
MAE/MAD(O)	1982-89	0.39	0.35	0.18	0.90	0.53	0.43	0.67	0.27
	1990-98	0.43	0.62	0.56	0.54	0.58	1.12	0.79	0.37
RMSE/MV(O)	1982-89	-0.16	0.15	0.14	-1.28	-0.72	-1.37	-1.27	12.14
	1990-98	-0.16	0.20	-1.96	0.61	1.43	-1.39	-0.41	-5.16
MAE/MAV(O)	1982-89	0.15	0.12	0.11	0.78	0.43	0.47	0.59	0.27
	1990-98	0.13	0.16	0.48	0.41	0.49	1.01	0.31	0.37
Decomposition of MSE^d									
bias proportion (UB)	1982-89	0.20	0.00	0.51	0.03	0.07	0.28	0.01	0.02
	1990-98	0.04	0.01	0.40	0.13	0.00	0.33	0.01	0.00
variance proportion (UV)	1982-89	0.27	0.00	0.25	0.01	0.01	0.25	0.02	0.06
	1990-98	0.07	0.01	0.21	0.02	0.05	0.00	0.03	0.01
covariance proportion (UC)	1982-89	0.53	1.00	0.24	0.96	0.92	0.48	0.97	0.92
	1990-98	0.89	0.98	0.39	0.85	0.95	0.67	0.96	0.99
Theil statistics^e									
Theil1	1982-89	0.49	0.47	0.36	0.78	0.33	0.63	0.94	0.63
	1990-98	0.41	0.61	0.42	0.92	1.07	0.94	0.95	0.81
Theil2	1982-89	0.15	0.13	0.12	0.67	0.40	0.44	0.72	0.30
	1990-98	0.15	0.19	0.48	0.38	0.62	0.87	0.37	0.43
correlation coefficient (ρ)	1982-89	0.97	0.94	0.99	0.73	0.90	0.93	0.57	0.95
	1990-98	0.93	0.77	0.96	0.89	0.80	0.61	0.67	0.91
Tests for unbiasedness									
F-statistic ^f	1982-89	3.87	0.06	7.96	0.95	0.60	2.00	0.46	0.87
		[0.08]	[0.94]	[0.02]	[0.44]	[0.58]	[0.22]	[0.65]	[0.43]
F-statistic ^f	1990-98	0.99	0.30	7.66	0.56	1.16	3.46	1.53	3.20
		[0.42]	[0.75]	[0.02]	[0.59]	[0.37]	[0.09]	[0.28]	[0.05]
AFE ^g	1982-89	-0.18	0.00	0.25	-0.10	-0.10	-0.45	-0.11	-0.10
		[0.23]	[1.00]	[0.03]	[0.66]	[0.50]	[0.15]	[0.80]	[0.26]
AFE ^g	1990-98	-0.06	0.04	-0.41 ^h	0.21	0.01	0.63	-0.11	0.05
		[0.60]	[0.80]	[0.05]	[0.30]	[0.98]	[0.09]	[0.77]	[0.68]

p-values in brackets.

a) The pooled results for the G7 countries are based on an unweighted arithmetic average. For the pooled sample, the number of observations is seven times the number of years.

b) Root mean square error.

c) Mean absolute error.

d) Mean square error.

e) The Theil statistic is the ratio of the RMSE of the OECD Economic Outlook projection to the RMSE of a "naïve alternative". A value greater than unity implies that the "naïve" alternative projection is better.

f) The F-statistic for the test for unbiasedness is based on the regression $A_t = b_0 + b_1 F_t + u_t$, where A_t is the actual value in year t and F_t is the forecast for the year t . A p-value above 0.05 indicates that the joint restriction $b_0 = 0$ and $b_1 = 1$ can be accepted at the 5 per cent significance level.

g) Unbiasedness is identified by the significance of the average forecast error (AFE), defined as the outcome minus the projection. The test for unbiasedness involves regressing the AFE on a constant and an error term. A p-value above 0.05 indicates the absence of bias.

h) The significance level of the t-statistic turned out to be 0.051, i.e. exceeds slightly the customary level (0.05).

Table 17. Accuracy of Economic Outlook projections for current account balances over time: year ahead projections

Per cent									
	Period	United States	Japan	Germany	France	Italy	United Kingdom	Canada	Pooled G7average ^a
Sample statistics									
<i>Outcome</i>									
Mean actual value (MV(O))	1982-89	-2.35	2.71	2.61	-0.54	-0.59	-0.43	-0.79	0.09
	1990-98	-1.67	2.40	-0.34	0.88	0.88	-0.73	-2.58	-0.17
Mean absolute actual value (MAV(O))	1982-89	2.35	2.71	2.61	0.64	0.81	1.50	1.24	1.69
	1990-98	1.67	2.40	1.06	1.26	2.06	0.87	2.69	1.71
Standard deviation(SD(O))	1982-89	1.04	1.22	1.75	0.78	0.79	2.01	1.35	2.16
	1990-98	0.71	0.75	1.39	1.31	2.11	1.00	1.62	2.04
Mean absolute deviation (MAD(O))	1982-89	0.81	0.93	1.56	0.52	0.64	1.53	1.21	1.70
	1990-98	0.49	0.60	0.85	0.98	1.76	0.84	1.34	1.69
<i>Projection</i>									
Mean forecast value (MV(F))	1982-89	-2.23	2.63	1.86	-0.28	-0.54	-0.30	-1.04	0.02
	1990-98	-1.87	2.27	0.34	0.64	0.87	-1.68	-2.20	-0.23
Standard deviation (SD(F))	1982-89	1.25	0.97	1.51	0.77	0.65	1.24	1.35	1.90
	1990-98	0.56	0.73	2.10	1.17	2.48	0.93	1.38	2.12
SD(F)/SD(O)	1982-89	1.20	0.79	0.87	0.99	0.82	0.62	1.00	0.88
	1990-98	0.79	0.98	1.51	0.90	1.17	0.93	0.85	1.04
Projection error statistics									
RMSE ^b	1982-89	0.38	0.54	0.85	0.59	1.00	1.22	1.64	0.98
	1990-98	0.58	0.77	1.25	0.62	1.51	1.07	1.59	1.12
MAE ^c	1982-89	0.35	0.49	0.75	0.49	0.85	1.03	0.95	0.70
	1990-98	0.40	0.71	0.78	0.52	1.14	0.94	1.33	0.83
RMSE/SD(O)	1982-89	0.37	0.45	0.49	0.76	1.26	0.61	1.21	0.45
	1990-98	0.82	1.03	0.90	0.47	0.72	1.07	0.98	0.55
MAE/MAD(O)	1982-89	0.43	0.52	0.48	0.93	1.33	0.67	0.78	0.41
	1990-98	0.82	1.19	0.91	0.54	0.65	1.13	1.00	0.49
RMSE/MV(O)	1982-89	-0.16	0.20	0.33	-1.10	-1.70	-2.87	-2.08	10.73
	1990-98	-0.35	0.32	-3.64	0.71	1.72	-1.45	-0.62	-6.73
MAE/MAV(O)	1982-89	0.15	0.18	0.29	0.76	1.05	0.68	0.77	0.41
	1990-98	0.24	0.30	0.74	0.42	0.56	1.09	0.50	0.49
Decomposition of MSE^d									
bias proportion (UB)	1982-89	0.11	0.03	0.77	0.20	0.00	0.01	0.02	0.01
	1990-98	0.12	0.03	0.30	0.14	0.00	0.79	0.06	0.00
variance proportion (UV)	1982-89	0.26	0.19	0.07	0.00	0.02	0.35	0.00	0.07
	1990-98	0.06	0.00	0.28	0.04	0.05	0.00	0.02	0.01
covariance proportion (UC)	1982-89	0.64	0.78	0.16	0.80	0.98	0.64	0.98	0.92
	1990-98	0.82	0.97	0.42	0.82	0.95	0.21	0.92	0.99
Theil statistics^e									
Theil1	1982-89	0.51	0.64	0.84	0.72	0.90	1.06	1.45	0.99
	1990-98	0.80	1.00	0.81	0.92	1.15	1.16	1.29	1.04
Theil2	1982-89	0.15	0.18	0.28	0.65	1.06	0.63	1.10	0.45
	1990-98	0.32	0.31	0.93	0.41	0.69	0.89	0.53	0.55
correlation coefficient (rho)	1982-89	0.96	0.89	0.97	0.73	-0.09	0.78	0.18	0.89
	1990-98	0.61	0.41	0.87	0.89	0.77	0.86	0.42	0.85
Tests for unbiasedness									
F-statistic ^f	1982-89	2.78	0.21	13.12	1.27	2.52	0.25	2.22	0.18
		[0.14]	[0.81]	[0.01]	[0.35]	[0.16]	[0.79]	[0.19]	[0.83]
F-statistic ^f	1990-98	0.68	1.52	10.08	0.58	1.41	13.20	1.05	4.10
		[0.53]	[0.28]	[0.01]	[0.59]	[0.31]	[0.00]	[0.40]	[0.02]
AFE ^g	1982-89	-0.13	0.09	0.75	-0.26	-0.05	-0.13	0.25	0.08
		[0.39]	[0.68]	[0.00]	[0.23]	[0.90]	[0.79]	[0.70]	[0.57]
AFE ^g	1990-98	0.20	0.13	-0.69	0.23	0.01	0.94	-0.38	0.07
		[0.33]	[0.63]	[0.10]	[0.29]	[0.98]	[0.00]	[0.51]	[0.65]

p-values in brackets.

a) The pooled results for the G7 countries are based on an unweighted arithmetic average. For the pooled sample, the number of observations is seven times the number of years.

times the number of years

b) Root mean square error.

c) Mean absolute error.

d) Mean square error.

e) The Theil statistic is the ratio of the RMSE of the OECD Economic Outlook projection to the RMSE of a "naïve" alternative. A value greater than unity implies that the "naïve" alternative projection is better.

f) The F-statistic for the test for unbiasedness is based on the regression $A_t = b_0 + b_1 F_t + u_t$, where A_t is the actual value in year t and F_t is the forecast for the year t. A p-value above 0.05 indicates that the joint restriction $b_0 = 0$ and $b_1 = 1$ can be accepted at the 5 per cent significance level.

g) Unbiasedness is identified by the significance of the average forecast error (AFE), defined as the outcome minus the projection. The test for unbiasedness involves regressing the AFE on a constant and an error term. A p-value above 0.05 indicates the absence of bias.

Table 18. Accuracy of Economic Outlook projections for world trade growth over time

	Per cent		
	Period	Current year	Year ahead
Sample statistics			
<i>Outcome</i>			
Mean actual value (MV(O))	1985-89	5.66	5.99
	1990-98	6.29	6.40
Mean absolute actual value (MAV(O))	1985-89	5.66	5.99
	1990-98	6.29	6.40
Standard deviation(SD(O))	1985-89	2.32	2.09
	1990-98	2.50	2.66
Mean absolute deviation (MAD(O))	1985-89	1.87	1.61
	1990-98	2.07	2.20
<i>Projection</i>			
Mean forecast value (MV(F))	1985-89	5.05	5.10
	1990-98	6.30	6.54
Standard deviation (SD(F))	1985-89	2.19	1.63
	1990-98	1.84	1.36
SD(F)/SD(O)	1985-89	0.95	0.78
	1990-98	0.74	0.51
Projection error statistics			
RMSE ^a	1985-89	1.87	2.45
	1990-98	1.59	2.45
MAE ^b	1985-89	1.55	1.99
	1990-98	1.26	2.10
RMSE/SD(O)	1985-89	0.81	1.17
	1990-98	0.63	0.92
MAE/MAD(O)	1985-89	0.83	1.24
	1990-98	0.61	0.95
RMSE/MV(O)	1985-89	0.33	0.41
	1990-98	0.25	0.38
MAE/MAV(O)	1985-89	0.27	0.33
	1990-98	0.20	0.33
<i>Decomposition of MSE^c</i>			
bias proportion (UB)	1985-89	0.11	0.13
	1990-98	0.00	0.00
variance proportion (UV)	1985-89	0.00	0.03
	1990-98	0.15	0.25
covariance proportion (UC)	1985-89	0.89	0.84
	1990-98	0.85	0.75
<i>Theil statistics^d</i>			
Theil1	1985-89	0.58	0.87
	1990-98	0.47	0.72
Theil2	1985-89	0.31	0.39
	1990-98	0.24	0.36
correlation coefficient (<i>rho</i>)	1985-89	0.62	0.07
	1990-98	0.74	0.30
<i>Tests for unbiasedness</i>			
F-statistic ^e	1985-89	0.47	1.09
		[0.66]	[0.44]
F-statistic ^e	1990-98	0.00	0.19
		[1.00]	[0.83]
AFE ^f	1985-89	0.61	0.89
		[0.53]	[0.48]
AFE ^f	1990-98	-0.01	-0.14
		[0.99]	[0.87]

p-values in brackets.

a) Root mean square error.

b) Mean absolute error.

c) Mean square error.

d) The Theil statistics is the ratio of the RMSE of the OECD Economic Outlook projection to the RMSE of a "naïve" alternative.

A value greater than unity implies that the "naïve" alternative projection is better.

e) The F-statistic for the test for unbiasedness is based on the regression $A_t = b_0 + b_1 F_t + u_t$, where A_t is the actual value in year t and F_t is the forecast for the year t . A p-value above 0.05 indicates that the joint restriction $b_0 = 0$ and $b_1 = 1$ can be accepted at the 5 per cent significance level.

f) Unbiasedness is identified by the significance of the average forecast error (AFE), defined as the outcome minus the projection. The test for unbiasedness involves regressing the AFE on a constant and an error term. A p-value above 0.05 indicates the absence of bias.

Figure 1. Economic Outlook pooled current-year projections for the G7 countries

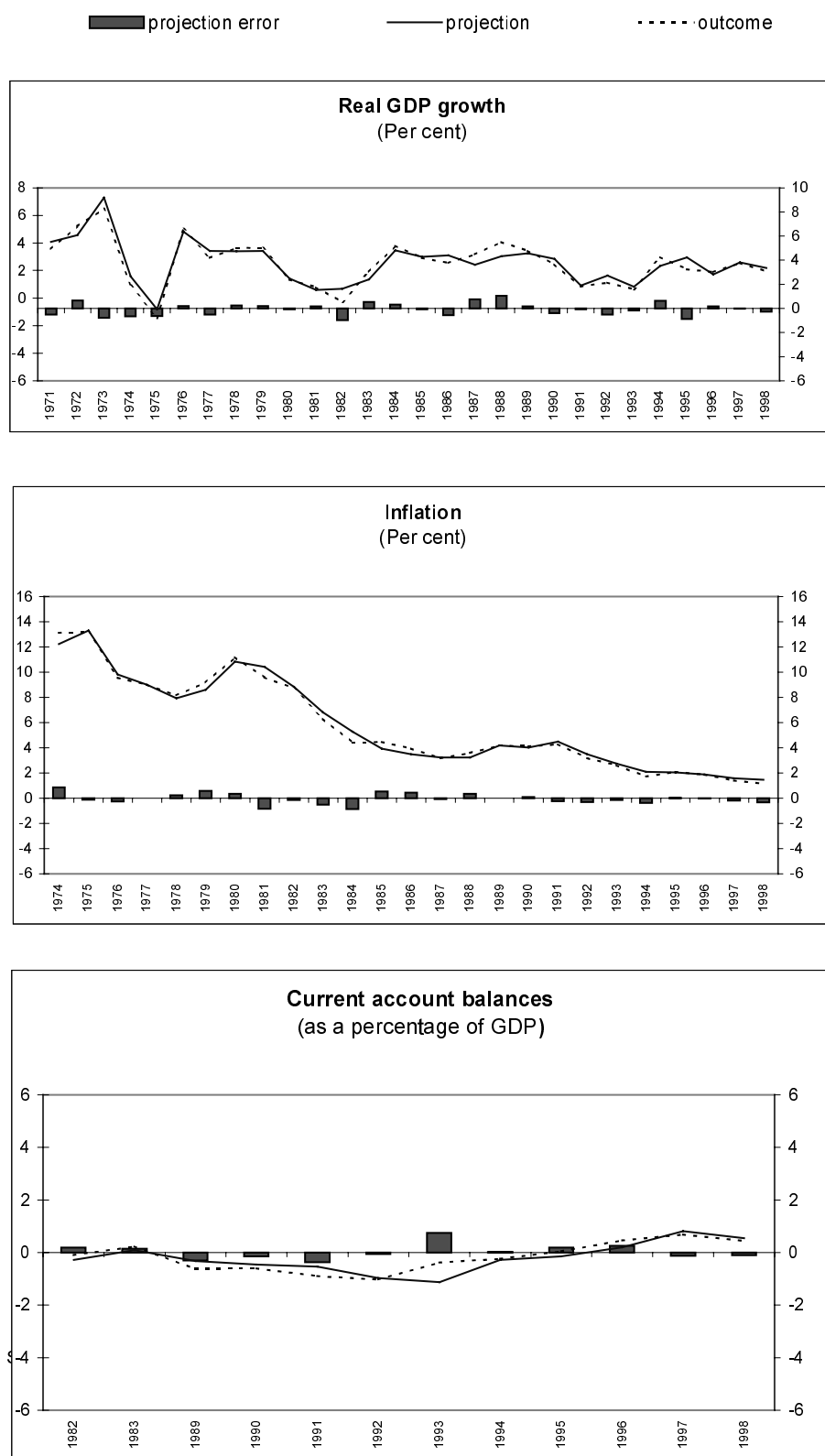
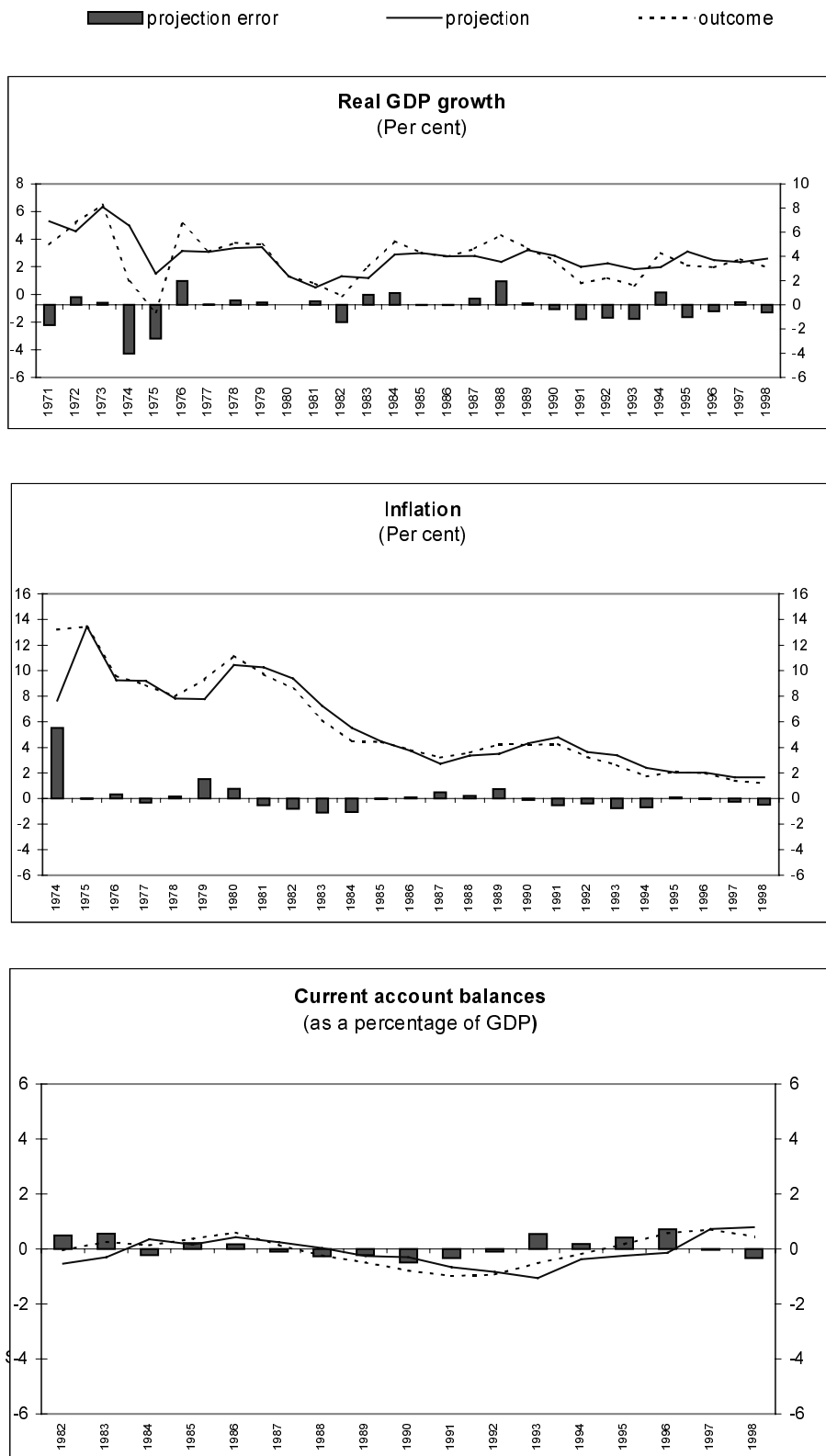
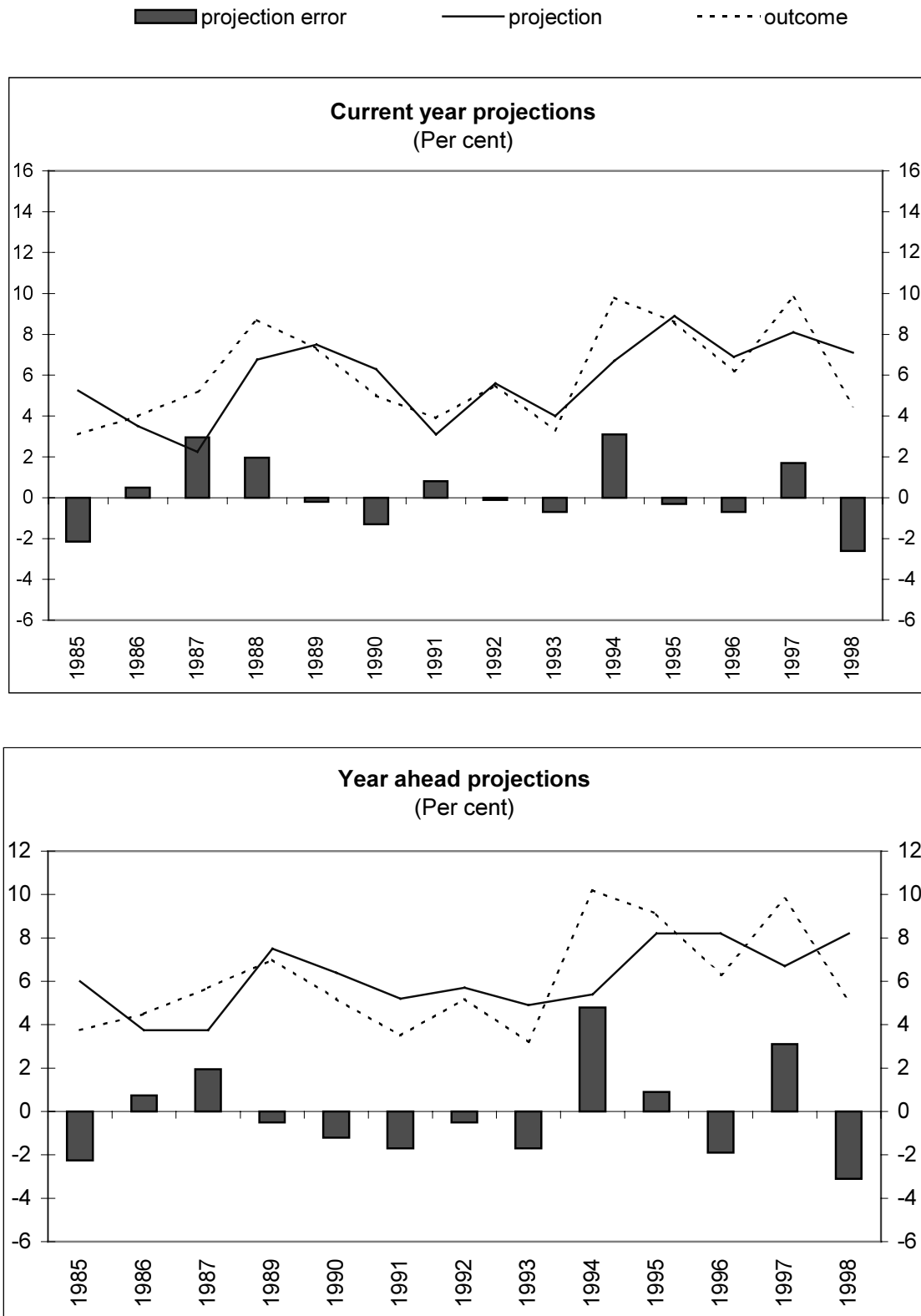
Source: OECD, OECD *Economic Outlook*.

Figure 2. Economic Outlook pooled year-ahead projections for the G7 countries



Source: OECD, OECD Economic Outlook.

Figure 3. Economic Outlook projections for world trade growth



Source: OECD, OECD Economic Outlook.

ANNEX I

DEFINITIONS OF MAIN ACCURACY MEASURES

$$AFE = \sum_{t=1}^T (A_t - F_t) / T$$

$$RMSE = [\sum_{t=1}^T (A_t - F_t)^2 / T]^{1/2}$$

$$MAE = \sum_{t=1}^T |A_t - F_t| / T$$

$$Theil1 = [\sum_{t=1}^T (A_t - F_t)^2 / \sum_{t=1}^T (A_t - A_{t-1})^2]^{1/2}$$

$$Theil2 = [\sum_{t=1}^T (A_t - F_t)^2 / \sum_{t=1}^T A_t^2]^{1/2}$$

$$UB = AFE^2 / MSE$$

$$UV = [V(F_t, F_t)^{1/2} - rho \cdot V(A_t, A_t)^{1/2}]^2 / MSE$$

$$UC = (1 - rho^2) \cdot V(A_t, A_t) / MSE$$

where:

{A_t}: actual series;

{F_t}: projected series;

T: number of observations;

AFE: average forecast error

MSE: mean square forecast error (= RMSE²);

MAE: mean absolute error;

Theil1: Theil's inequality coefficient, 1;

Theil2: Theil's inequality coefficient, 2;

UB: bias proportion of MSE;

UV: variance proportion of MSE;

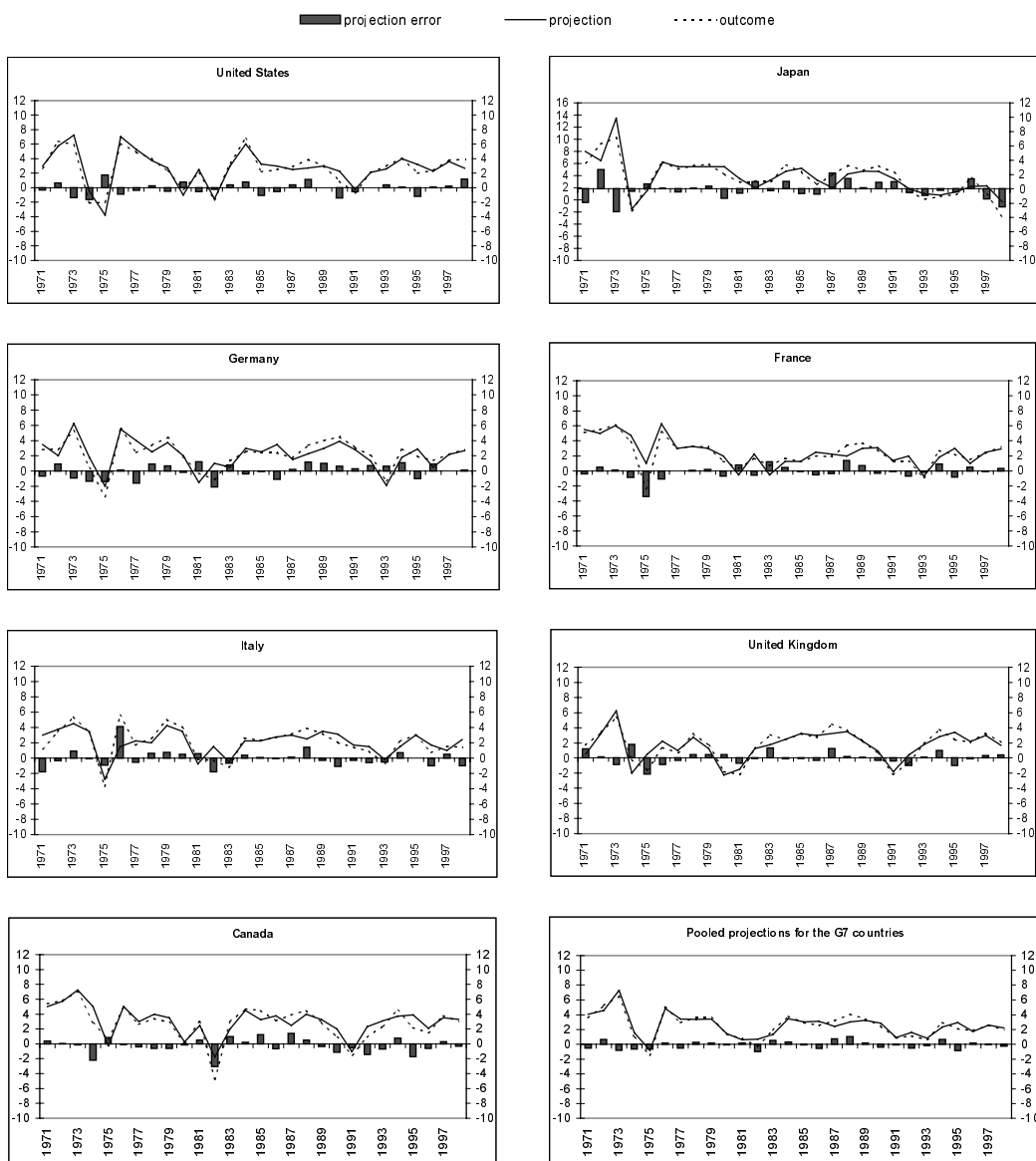
UC: covariance proportion of MSE; and,

rho: correlation coefficient between predictions and outcomes.

ANNEX II

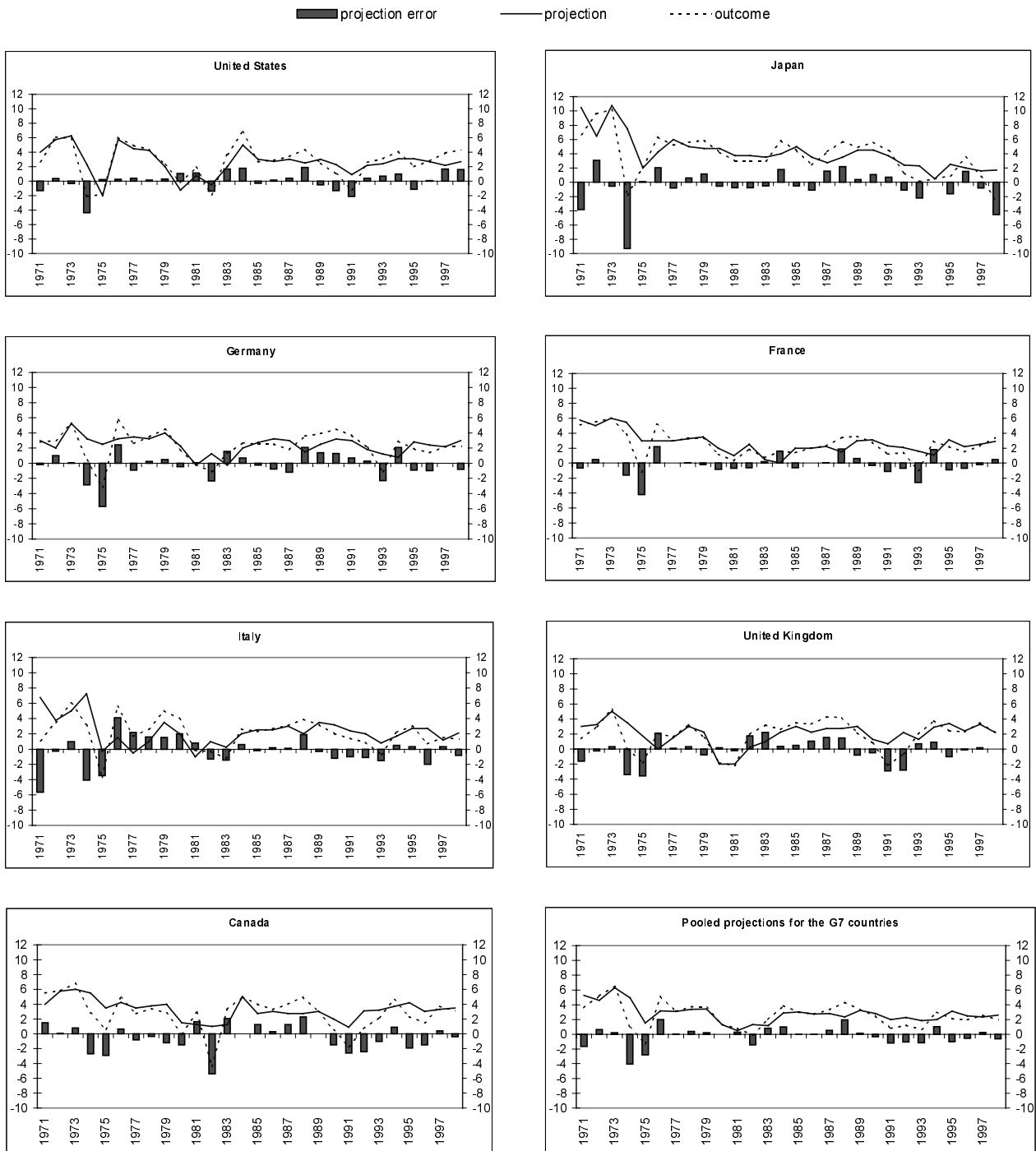
OECD ECONOMIC OUTLOOK PROJECTIONS FOR THE MAJOR SEVEN COUNTRIES

Figure A1. *Economic Outlook* projections for real GDP growth: current year projections
Per cent



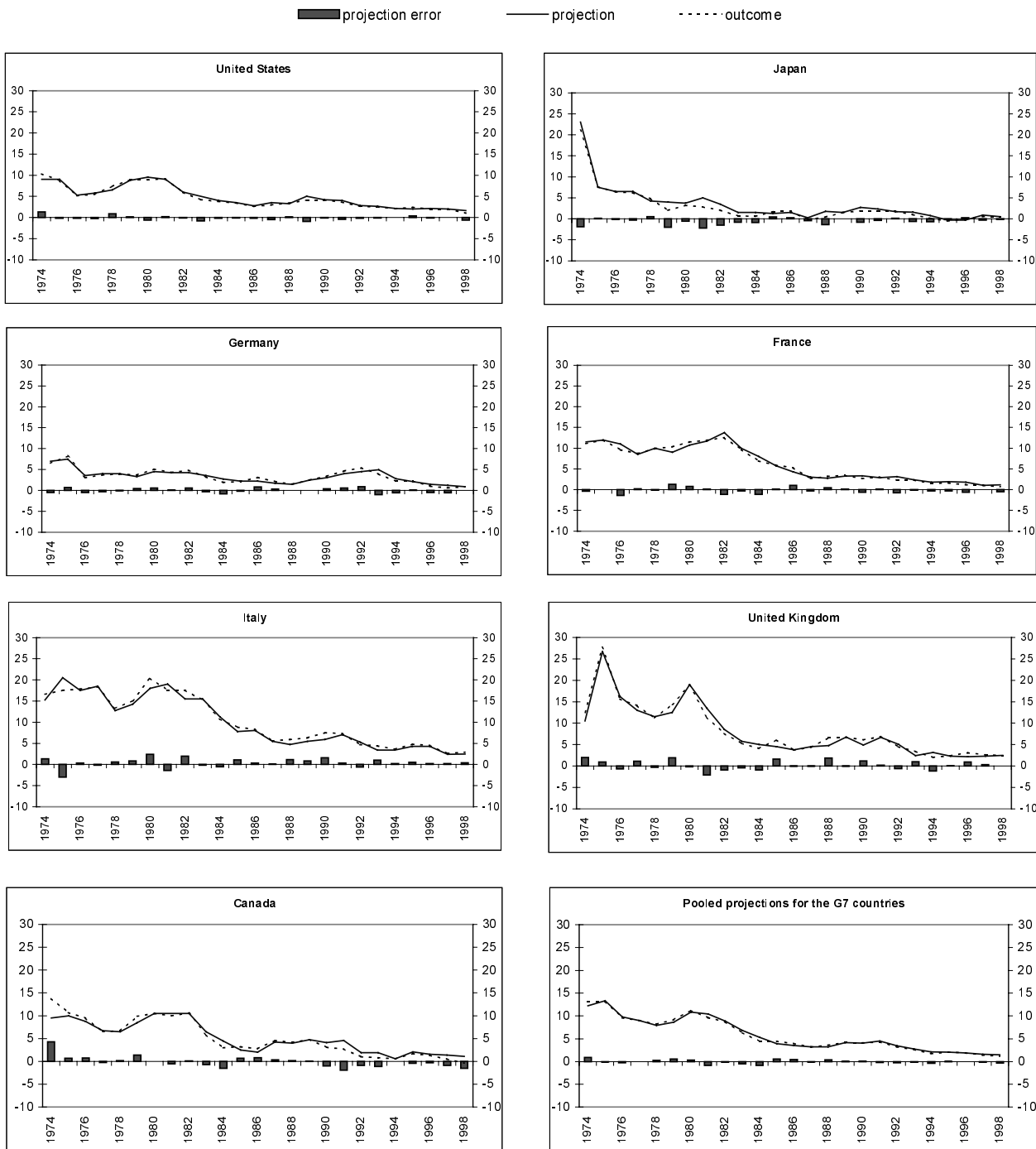
Source: OECD, *OECD Economic Outlook*.

Figure A2. *Economic Outlook p* projections for real GDP growth: year ahead projections
Per cent



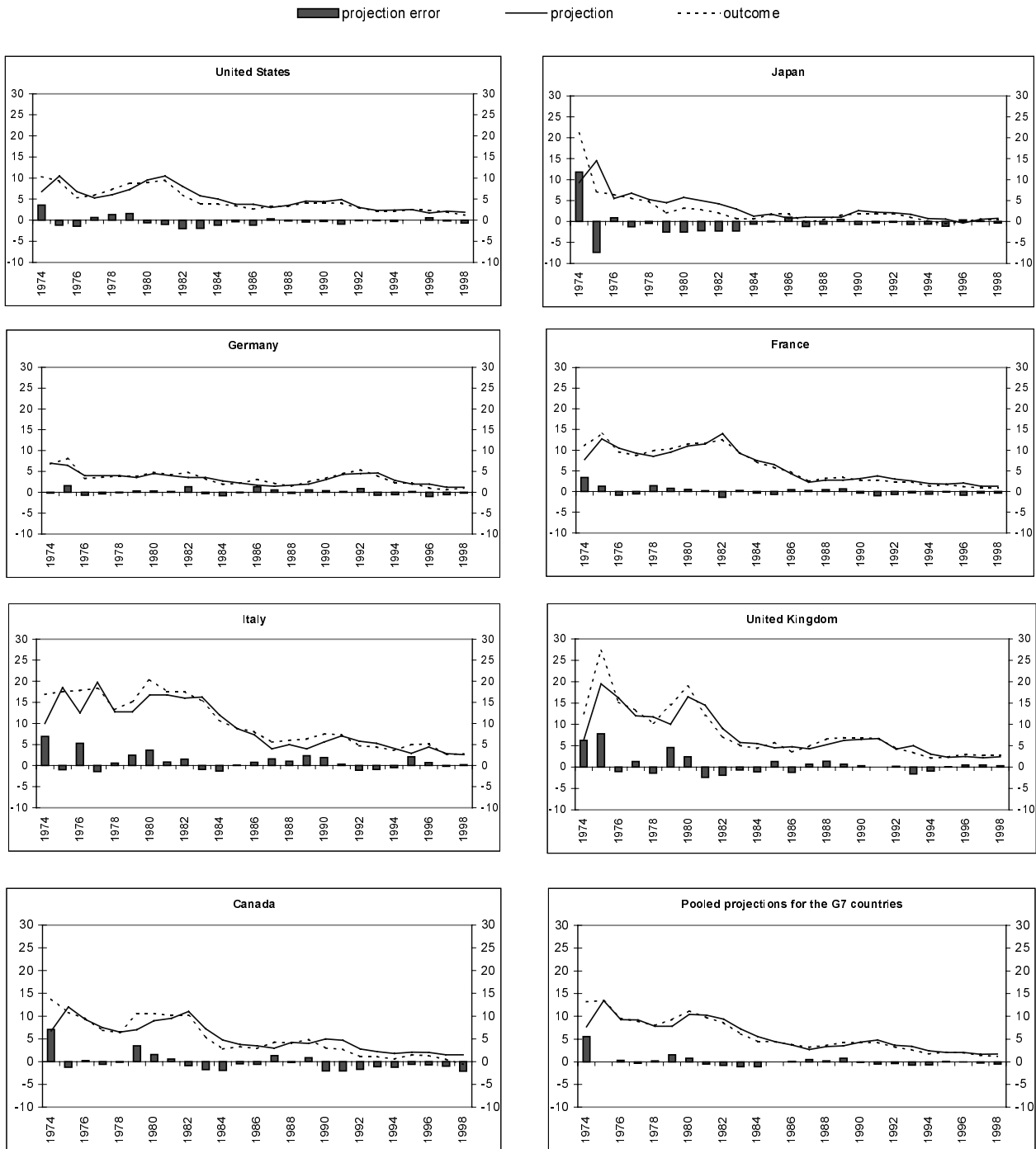
Source: OECD, *OECD Economic Outlook*.

Figure A3. *Economic Outlook* projections for inflation: current year projections
Per cent



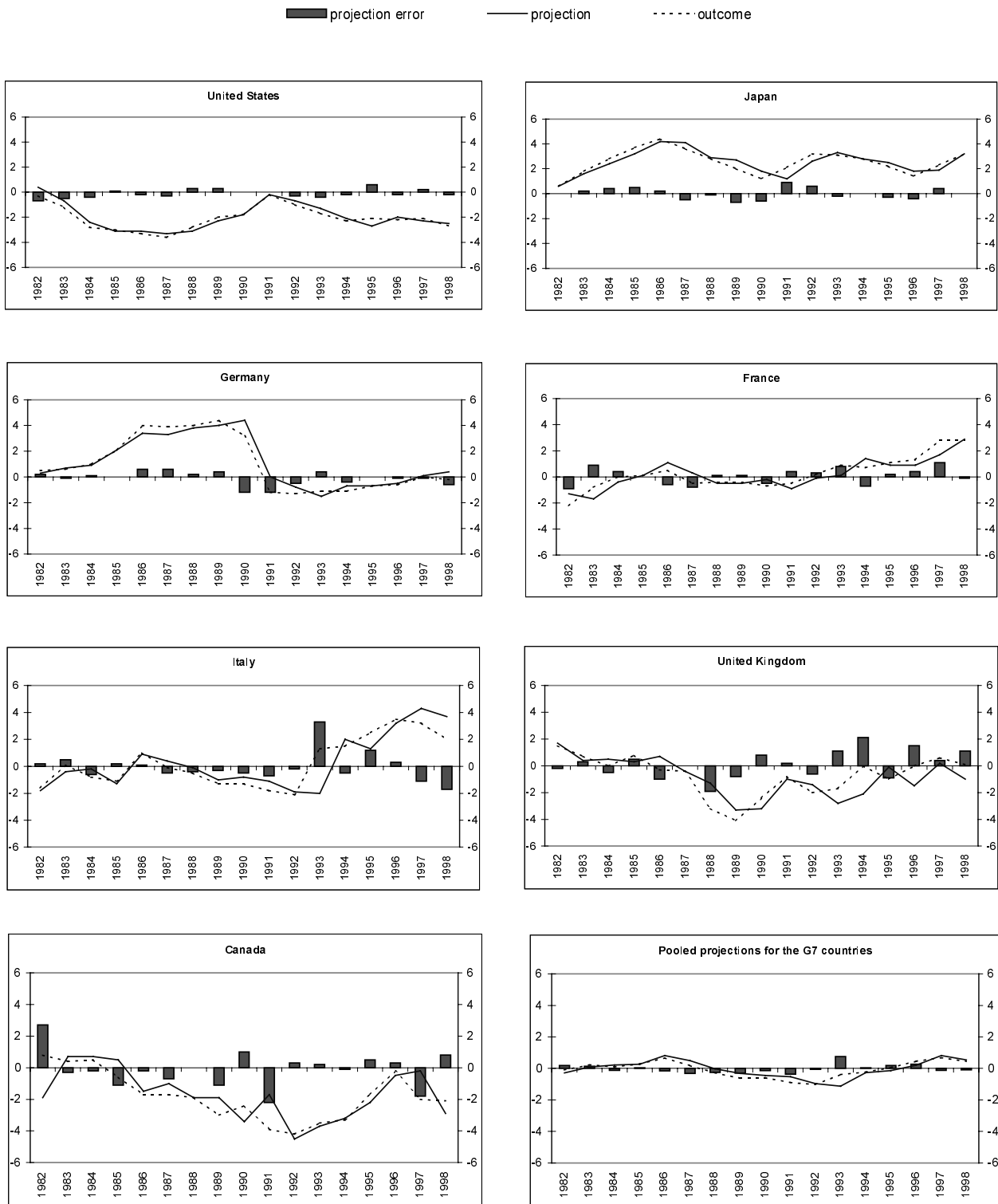
Source: OECD, *OECD Economic Outlook*.

Figure A4. *Economic Outlook* projections for inflation: year ahead projections
Per cent



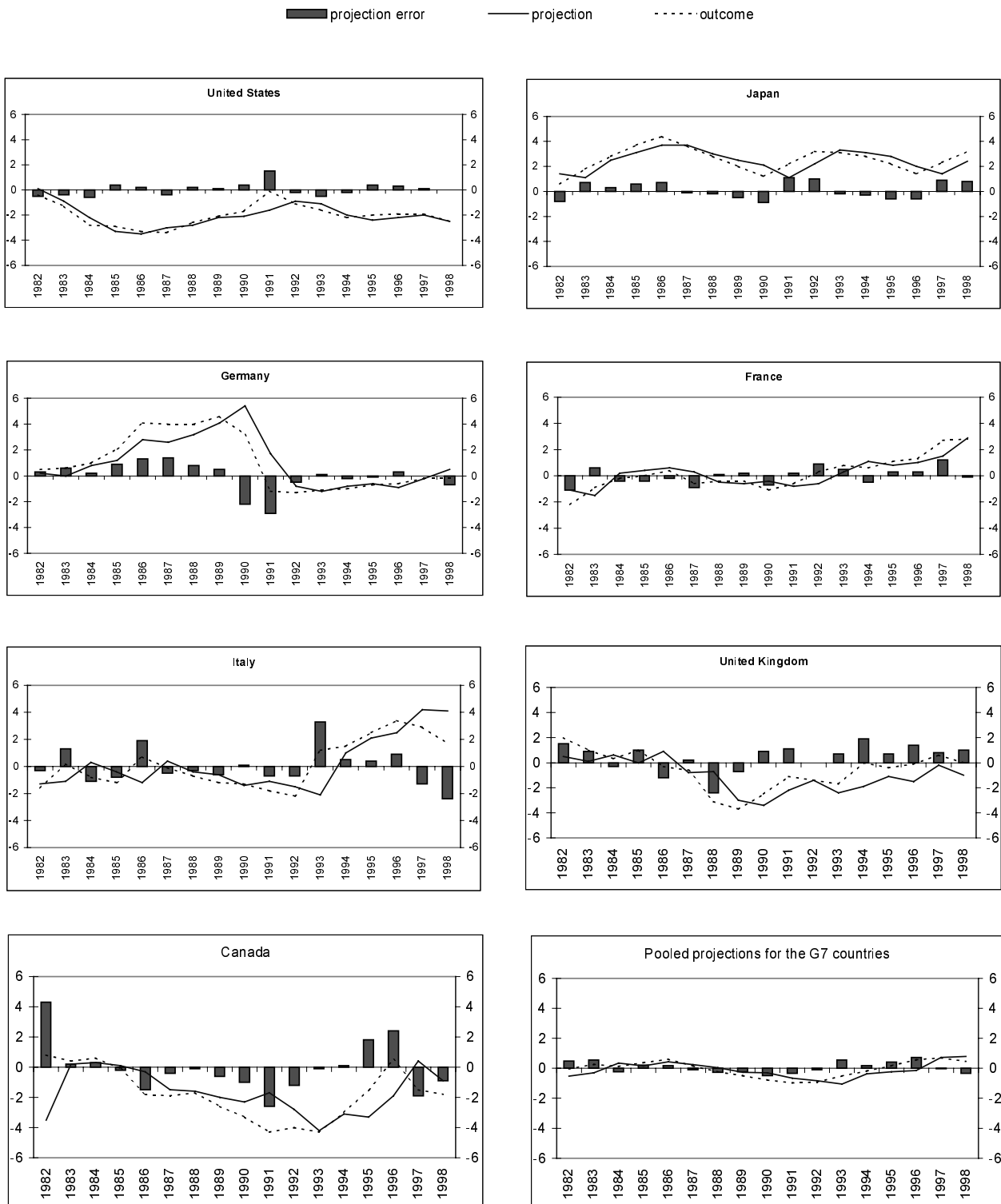
Source: OECD, *OECD Economic Outlook*.

Figure A5. *Economic Outlook* p projections for current account balances: current year projections
Percentage of GDP



Source: OECD, *OECD Economic Outlook*.

Figure A6. *Economic Outlook p* projections for current account balances: year ahead projections
Percentage of GDP



Source: OECD, *OECD Economic Outlook*.

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