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Accuracy of growth forecasts for transition countries: Assessing ten years of EBRD forecasting

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Abstract

This paper analyses the accuracy of GDP growth forecasts prepared by the EBRD for 25 transition countries between 1994 and 2004. It provides the first comprehensive statistical analysis of output growth forecasts for transition countries in central and eastern Europe and the Commonwealth of Independent States. The analysis finds that EBRD forecasts are mostly unbiased and efficient, that forecast errors are not autocorrelated and do not depend on the value of the forecasted variable. In addition, it shows that forecast accuracy has improved with progress in transition as well as with the expansion in the information domain. The Russian crisis was the only clear unexpected economic shock in the available time series. The EBRD's forecast accuracy for late within-year GDP forecasts were found to be better by 0.4 percentage points than the forecast accuracy of other institutions.

Keywords: forecasting, GDP growth, bias and efficiency, transition, EBRD

JEL Classification Number: C53, D8, E37, P2

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INTRODUCTION

This paper provides the first comprehensive statistical analysis of the accuracy of output growth forecasts for transition countries in central and eastern Europe and the Commonwealth of Independent States. The analysis, covering 25 countries in the transition region[1] over 1994-2004, shows that forecasts provided by the European Bank for Reconstruction and Development (EBRD) are mostly unbiased and efficient. That is, forecast errors behave like a random walk and do not depend on the actual current value of the forecasted variable. In addition, the analysis shows that forecast accuracy improves with progress in transition as well as with increases in the information domain. The paper identifies the Russian crisis[2] in August 1998 as the only clear unexpected economic shock in the available time series. The performance of EBRD forecasts against those of other institutions is also compared.

The EBRD has been providing forecasts of GDP growth, as well as other macroeconomic indicators,[3] since 1994.[4] Three forecasts with a different lead time are available: one-year ahead forecasts (forecasts for the following year published in the *Transition Report*); early within-year forecasts (forecasts for the current year published in the *Transition Report Update*); and late within-year forecasts (forecasts for the current year published in the *Transition Report*).[5] The EBRD applies judgemental forecasting technique, based on available information about major economic and political developments, progress in structural reforms and recent research on long-term potential growth rates. Judgmental forecasting techniques are used instead of a formal econometric model, mainly due to the limited availability of the necessary times series for all transition countries. Simple modelling techniques are also applied for selected countries, where the available information allows such approach.

A summary of the existing literature on forecasting and some of the methodological difficulties with forecasting in transition countries, particularly concerning data limitations, are presented in the next section. The methodology applied in our assessment of forecast accuracy is presented together with the results of empirical analysis in the second section.

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[1] Albania, Armenia, Azerbaijan, Belarus, Bulgaria, Croatia, Czech Republic, Estonia, FYR Macedonia, Georgia, Hungary, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Moldova, Poland, Romania, Russia, Slovak Republic, Slovenia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan. Data for Bosnia and Herzegovina and Serbia and Montenegro (formerly Federal Republic of Yugoslavia) are not available on a consistent basis for most of the analysed period and were thus excluded from the sample.

[2] On 17 August 1998, Russia simultaneously devalued its currency, defaulted on a sizeable magnitude of its domestic government debt and declared a moratorium on the external debts of Russian companies and banks. For a detailed analysis of the Russian crisis, see Annex 1.1 of the EBRD *Transition Report* 1998.

[3] In addition to GDP growth forecasts, the *Transition Report* (both the main report and the update) contains current year and one-year ahead forecasts of annual average inflation and current year forecasts of end-year inflation, general government balance, current account balance, trade balance, merchandise imports, merchandise exports, GDP in local currency and current account to GDP ratio.

[4] The EBRD has been forecasting GDP growth for the current year since 1994. EBRD forecasts for the year ahead are available from 1996 onwards.

[5] The *Transition Report* is published in November each year, with a cut-off point for data analysis in September. The *Transition Report Updat*e is published in April or May of the following year, with the cut-off date for data revisions in February or March.

Section 3 concludes and provides some potentially useful insights and suggestions for improvements in forecasting macroeconomic indicators for transition countries. The issue of which outcome of forecasted variable to use, namely whether to use the first official estimate of GDP growth or focus on the later revisions, is analysed in Annex 1.[6]

[6] It is worth noting that later revisions in transition countries are sometimes based on a different methodology and thus include another error element, namely estimation error.

1. EXISTING LITERATURE AND DATA LIMITATIONS

Analysis of forecasting performance is regularly undertaken for forecasts prepared by other international financial institutions, such as the IMF (Kenen and Schwartz, 1986; Artis, 1988; Barrionuevo, 1992; Artis 1996; Loungani 2000) and the OECD (Ash *et al*. 1990; Koutsogeorgopoulou, 2000). The standard approach of such analyses is to investigate the bias of forecasts, their efficiency in terms of incorporating all available information and assess their relative performance compared to forecasts of other institutions and formal models. The papers listed above found that the forecast errors are by and large non-systematic, and the forecasts prepared by the IMF and the OECD are generally unbiased and efficient. The evidence on comparative performance of forecasts by different institutions is mixed.

Batchelor (2001) compares the accuracy of forecasts for G7 countries for the period 1990-99 prepared by the OECD and the IMF with the average of private sector forecasts as published in Consensus Forecasts.[7] This paper finds that the private sector forecasts are less biased and more accurate (in their mean absolute error and root square error) than the public sector forecasts. However, a similar analysis by Loungani (2000) finds a remarkably high degree of similarity between private forecasts and those of international organisations such as the IMF, OECD and the World Bank. This analysis uses a larger dataset of Consensus Forecasts, comprising 63 industrialised and developing countries for the period 1989-98. Other papers also find no significant difference between public and private forecasts. Artis (1996) analyses short-term forecasts prepared by the IMF between 1977 and 1994. Comparing these forecasts with the private sector Consensus Forecasts does not yield much difference between the two series.

Only a small number of forecasters, mostly based in public or academic institutions, forecast GDP growth and other macroeconomic indicators for transition countries. The EBRD *Transition Report* presents selected forecasts supplied by the leading forecasters for transition countries, including both public and private institutions. This paper focuses mainly on the performance of the EBRD forecasts but also provides a comparison of forecasts prepared by the EBRD and other institutions.

Unfortunately, forecasts by different institutions presented in the *Transition Reports* are not prepared at the same time. They are available to the EBRD before it finalises its forecasts, and thus are not independent and contemporaneous. Therefore, the data do not allow the performance of different forecasters to be compared. Nevertheless interactions among forecasts prepared by different institutions can be analysed.

Another issue frequently investigated in relation to forecast accuracy is the difference between judgmental and model-based forecasting. Batista and Zalduendo (2004) found that out-of-sample predictions of a reduced-form neoclassical growth model outperform the IMF forecasts by a sizeable margin. Hence their paper argues in favour of model-based, as opposed to judgmental, forecasting. Similar conclusions on the usefulness of formal models were reached by Barionuevo (1992) who compares forecasts published in the IMF's *World Economic Outlook* with the results of time-series estimations for seven major industrial countries for the period 1971-91. The overall conclusion of this paper is that time series models provide more accurate predictions than the *World Economic Outlook* forecasts for the

[7] Consensus Forecasts is a monthly publication of macroeconomic forecasts by private institutions available initially for industrialised countries since October 1989. The publication has gradually expanded its coverage to some developing and transition countries and currently covers 17 out of 27 transition countries.

period, and that there is a case to be made for model-based, as opposed to judgmental, forecasts. Hendry and Mizon (2001) underline the importance of accounting for structural breaks in the data with the implication of the need to correct the forecasts using sophisticated econometric models. Accordingly, this technique leads to reduced biases but cannot be used for transition countries because of the insufficient length of available time series.

The EBRD applies judgmental forecasting techniques following the basic principles of forecasting, including independence, completeness, consistency and simplicity (see Armstrong, 2001, for the full set of forecasting principles). The EBRD forecasts are not only based on available information on recent economic developments, but also on regularly updated empirical studies of potential growth rates. These studies use traditional growth models such as Barro (1991), Levine and Renelt (1992), Benhabib and Spiegel (1994), Fischer *et al*. (1998), Doppelhofer *et al*. (2000) and Doyle *et al*. (2001).[8] The limited length of the necessary times series has so far restricted the formation of formal time series forecasting models for the transition countries. However, as longer time series become available, a model-based approach to forecasting is becoming tenable for some of the more advanced transition countries, including forecasting the probability distributions (see Clements, 2002, on probability distribution forecasting). This paper looks only at the simple rule-based forecasting with the latest available outcome being used as a forecast for the next period. In line with the literature (e.g., Loungani, 2000), such forecasts are referred to as naïve forecasts.

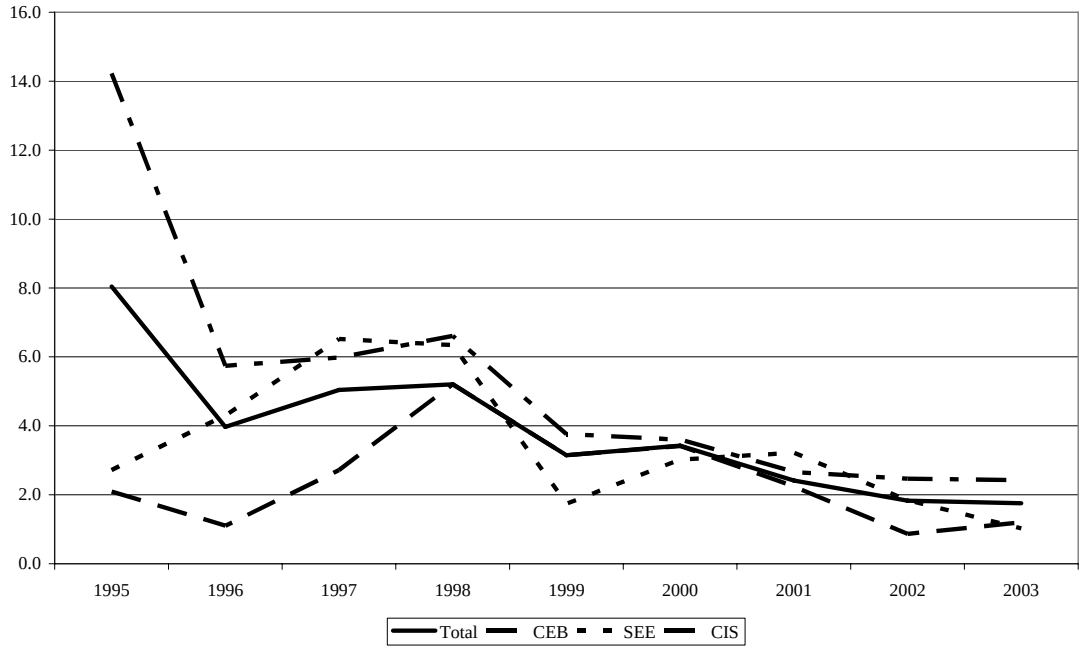
Forecasting of macroeconomic indicators for transition countries is undoubtedly more difficult that forecasting for mature market economies. Not only are available time series relatively short but other factors contribute to the uncertainty associated with forecasting in transition economies. These include deep structural changes due to transition reforms that have been or are being implemented. Structural changes are also reflected in high output volatility in early transition years (see EBRD, 1996, for a detailed discussion of these issues in early transition years).

Chart 1 provides strong evidence of the steep decline over time in the variability of output growth data. The average absolute difference in GDP growth between two consecutive years in individual transition countries was just above eight percentage points in 1995. The same measure of data variability in 2003 was already less than two percentage points, with a broadly declining trend in both the overall region and the three main sub-regions,[9] particularly following the 1998 Russian crisis. These regions include central eastern Europe and the Baltic states (CEB), south-eastern Europe (SEE) and the Commonwealth of Independent States (CIS).

[8] The *Transition Report* and the *Transition Report Update* publishes only short-term forecasts by EBRD staff. Given that the mentioned models are designed for medium to long-term forecasting, they are used only for the formation of views on potential trends in GDP growth rates.

[9] The division of the transition region into these particular sub-regions follows the classification in the EBRD's *Transition Reports*. Accordingly, CEB consists of Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic and Slovenia; SEE consists of Albania, Bosnia and Herzegovina (not included here), Bulgaria, Croatia, FYR Macedonia, Romania, Serbia and Montenegro (not included here); and finally the CIS consists of Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

Chart 1 – Time development of GDP growth volatility



Source: EBRD.
Note: The chart shows simple arithmetic average of absolute values of differences between GDP growth in two consecutive years for all countries and the three main regions. See footnote 9 for the country breakdown of CEB, SEE and CIS.

The assessment of forecast accuracy is complicated by changes in official methodologies for measuring economic activity. Statistical methods used to collect data in transition countries have improved significantly over the past ten years. However, even the most advanced transition countries continue to make substantial and frequent changes in their estimation methods. A recent example of such a methodological change is related to the accession of eight transition countries into the EU in May 2004. (See Annex 1 for analysis of estimation error measured as the difference between two consecutive official estimates of the GDP growth rate provided by relevant authorities one and two years following the forecasted period.) While one might argue in favour of using the most recent revisions of official data for calculating forecast errors, such an approach may lead to spurious evidence of increasing forecast accuracy over time. This is because the forecast error would also include the estimation error, which is expected to be smallest for the most recent data.

2. EMPIRICAL ANALYSIS

2.1 Definitions

The forecasted time series of a macroeconomic indicator, in our case GDP growth, is denoted as $\{x_{i,t}\}$, where *i* is the country and *t* is a time period of non-negligible length. The true value of the time series at time *t* is denoted as $x_{i,t}$, its forecast at time *t*-1 as $x_{i,t|t-1}$, its forecast at the beginning of time period *t* as $x_{i,t|t-}$, and its forecast towards the end of time period *t* as $x_{i,t|t+}$.

Since the true value of many macroeconomic indicators cannot be observed directly and statistical offices provide only estimates for variables such as the GDP growth (usually on the basis of surveys), it is also important to highlight the differences between official estimates of the same variable provided at different times. This paper focuses on the differences between estimates published one time period later, denoted $x_{i,t|t+1}$, and estimates published two time periods later, denoted $x_{i,t|t+2}$.

The definition of forecast and estimation errors follows the definitions of the forecasted time series. The forecast error one time period ahead is $\varepsilon_{i,t|t-1} = x_{i,t} - x_{i,t|t-1}$, the forecast error at the beginning of the time period *t* is $\varepsilon_{i,t|t-} = x_{i,t} - x_{i,t|t-}$, the forecast error at the end of the time period *t* is $\varepsilon_{i,t|t+} = x_{i,t} - x_{i,t|t+}$, the estimation error one period later is $\varepsilon_{i,t|t+1} = x_{i,t} - x_{i,t|t+1}$, and the estimation error two periods later is $\varepsilon_{i,t|t+2} = x_{i,t} - x_{i,t|t+2}$.

As noted earlier, the true value of a macroeconomic indicator is not always revealed, and therefore forecast errors cannot be observed either. However, the difference between forecast and estimation errors or between different forecast errors (which are the same as the difference between forecasts and estimates prepared at different points in time) can be observed as:

$$\varepsilon_{i,t|r} - \varepsilon_{i,t|s} = [x_{i,t} - x_{i,t|r}] - [x_{i,t} - x_{i,t|s}] = x_{i,t|s} - x_{i,t|r},$$

where $s, r = t-1, t-, t+, t+1, t+2$, and $r<s$.

In order to test our hypotheses, some relatively strong assumptions must be made to have a reasonable sample population, namely that forecast/estimation errors are independently and identically distributed across countries and time. This assumption can be relaxed to allow for variation by country, sub-region and time. Following suggestions presented in Harvey and Newbold's (2003) study of the properties of forecast errors, this paper uses robust testing methods on the basis of Student's t-distribution with low degrees of freedom.

2.2 The basic characteristics of the data – bias, efficiency

In this paper, the empirical analysis of forecast accuracy begins with the investigation of potential forecast bias. Most transition countries experienced unexpectedly deep recessions in the early 1990s. The natural question to ask is whether this has led to a cautious approach, resulting in a negative bias in more recent growth forecasts with forecasters consistently underestimating actual growth rate. A cautious approach to forecasting was already identified in the EBRD (1996) analysis of the within-year forecasts from 1994 and 1995.

Chart 2a presents the trends in the forecast and estimation errors. The charts suggest that negative forecast errors (a positive bias) prior to the Russian crisis in 1998 were replaced by positive forecast errors (a negative bias) later in the period. This hints that a more cautious

approach may have been used in recent years. The hypothesis is also supported by the visual evidence in Chart 2b, which suggests a shift from downward revisions towards upwards revisions.

The statistical analysis of forecast errors, estimation errors and forecast revisions is based on the null hypothesis of no bias, H_0: $\alpha = 0$ in $x_{i,t|s} - x_{i,t|r} = \alpha + u_{i.t}$ where $s,r = t-1,t-,t+,t+1,t+2$; $r<s$, and $u_{i.t}$ is an i.i.d. random term. The results presented in Table 1 show that the hypothesis that one-year ahead and early within-year EBRD forecasts are not biased cannot be rejected. However, the late within-year forecasts (forecast of GDP growth made in September for the current year) have a negative bias of more than half a percentage point on average. This is driven by a negative bias for CEB and CIS sub-regions of about half a percentage and almost one percentage point respectively. In addition, one-year ahead forecasts for the CIS also show a significant and large negative bias to the tune of 1.5 percentage points. This supports the hypothesis of a cautious approach for current year forecasts when figures for the first half of the year are already known. This finding is in line with the cautious approach of the official data providers, who also tend to revise their estimates upwards, albeit to a smaller extent (see Annex 1).

Chart 2a – Time development of mean forecast and estimation errors and change in forecasts

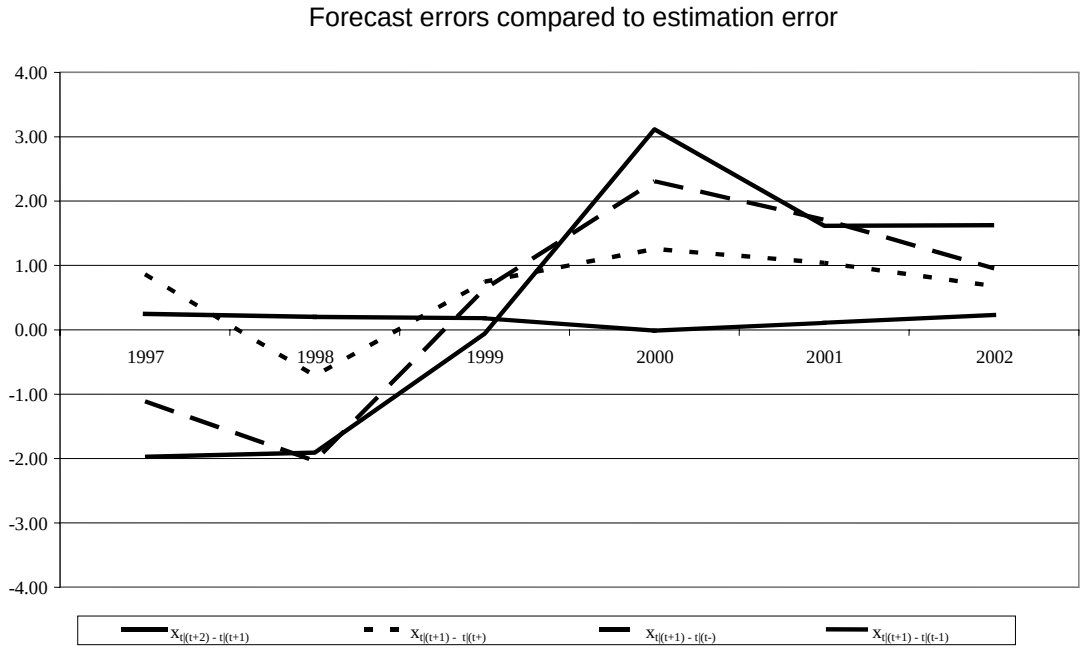
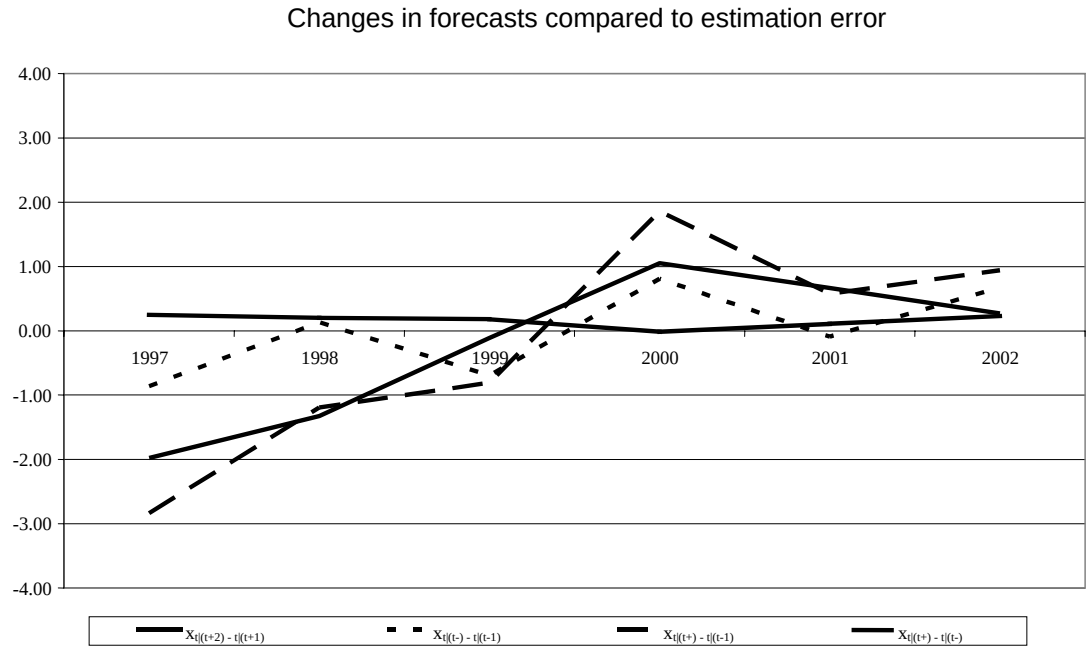


Chart 2b – Time development of mean forecast and estimation errors and change in forecasts



Source: EBRD.

Table 1 – Bias test results

	All countries	CEB	SEE	CIS
Change in forecasts:				
$gdp_{t\|t+} - gdp_{t\|t-1}$	-0.24 (0.33)	-0.36 (0.24)	-1.88 (0.94)	0.52 (0.52)
$gdp_{t\|t-} - gdp_{t\|t-1}$	-0.01 (0.19)	-0.18 (0.11)	-0.92 (0.46)	0.49 (0.32)
$gdp_{t\|t+} - gdp_{t\|t-}$	-0.24 (0.24)	-0.18 (0.19)	-0.97 (0.61)	0.03 (0.41)
Estimation error:				
$gdp_{t\|t+2} - gdp_{t\|t+1}$	0.16** (0.05)	0.18* (0.08)	0.01 (0.08)	0.21** (0.07)
Forecast errors:				
$gdp_{t\|t+1} - gdp_{t\|t-1}$	0.40 (0.40)	0.11 (0.37)	-1.66 (0.82)	1.46* (0.68)
$gdp_{t\|t+1} - gdp_{t\|t-}$	0.41 (0.34)	0.30 (0.34)	-0.75 (0.50)	0.97 (0.64)
$gdp_{t\|t+1} - gdp_{t\|t+}$	0.65** (0.20)	0.47* (0.21)	0.22 (0.39)	0.94** (0.36)
$gdp_{t\|t+1}$ – naïve for.	0.65 (0.43)	0.03 (0.49)	0.45 (1.03)	1.14 (0.73)

Source: EBRD.
Note: The table reports average errors over all years and within country groups. Statistically significant differences from 0 are denoted by * for the 5 per cent significance level and ** for the 1 per cent significance level. Robust standard errors are in brackets. Results are based on 150 observations for all countries, 48 observations for CEB, 30 observations for SEE and 72 observations for CIS. Results based on official estimates with the two-year time lag are qualitatively similar in terms of statistical significance. (Exceptions include the one-year ahead forecast error for SEE, which is significant at the 5 per cent level, and the late within-year forecast for CEB, which is significant only at the 5 per cent level.

To expand upon the analysis of bias in forecasts for transition countries, this paper also looks at the potential bias in individual years in respective countries. Evidence of a positive bias was found in the EBRD's one-year ahead and early within-year forecasts in 1998, the year of the Russian crisis, which is a sign of a structural break. On the other hand, there is evidence of statistically significant negative bias for all forecasts with a different time lead (one-year ahead, early within-year, late within-year) for four CIS countries – Azerbaijan, Belarus, Tajikistan and Uzbekistan – and also for all countries in 2000 and 2001. It is not surprising that all four countries identified by the statistical analysis also recorded the highest positive average forecast error. Although Turkmenistan has the highest average forecast error in absolute value, EBRD forecasts for Turkmenistan do not seem to be biased at a statistically significant level. This may be due to the volatility of the output data for Turkmenistan.

Next, the efficiency of the forecasts is analysed. One simple test of efficiency is based on the view that the error term should behave like a random walk and forecast revisions should not be autocorrelated. Since for a given year only two forecast revisions are made, our null hypothesis is: H_0: $\beta = 0$ in the regression equation: $x_{i,t|t+} - x_{i,t|t-} = \alpha + \beta \cdot [x_{i,t|t-} - x_{i,t|t-1}] + u_{i.t}$ where $u_{i.t}$ is an i.i.d. random term across time and countries (note that country and time fixed effects are used given the evidence of bias for certain countries and years).

The test results are presented in Table 2. The forecast process is said to be efficient if the earlier change in the forecasts does not have any relation to the later change. Accordingly, it finds that forecast revisions are not autocorrelated, meaning that the data thus support the hypothesis of efficiency of EBRD forecasts. That is, there are no systemic shortcomings in the incorporation of all the available information in forecast revisions.

Table 2 – Efficiency tests results

Equation	Est. α	Est. β	R^2
Efficiency based on change in forecasts:			
$gdp_{t\|t+} - gdp_{t\|t-} = \alpha + \beta\ [gdp_{t\|t-} - gdp_{t\|t-1}]$	-0.69 (1.35)	0.47 (0.27)	0.34
Efficiency based on estimation error:			
$gdp_{t\|t+2} - gdp_{t\|t+1} = \alpha + \beta\ gdp_{t\|t+1}$	0.49 (0.36)	0.00 (0.01)	0.24
Efficiency based on forecast errors:			
$gdp_{t\|t+1} - gdp_{t\|t-1} = \alpha + \beta\ gdp_{t\|t-1}$	-0.14 (2.34)	-0.31 (0.26)	0.33
$gdp_{t\|t+1} - gdp_{t\|t-} = \alpha + \beta\ gdp_{t\|t-}$	-1.51 (2.00)	0.16 (0.26)	0.40
$gdp_{t\|t+1} - gdp_{t\|t+} = \alpha + \beta\ gdp_{t\|t+}$	-0.62 (0.80)	0.03 (0.12)	0.35
$gdp_{t\|t+1}$ – naïve for. = $\alpha + \beta$ naïve for.	1.42 (1.80)	-0.72** (0.13)	0.46

Source: EBRD.
Note: Statistically significant differences from 0 are denoted by * for the 5 per cent significance level and ** for the 1 per cent significance level. Robust standard errors are in brackets. The equations are estimated using fixed effects for countries and years. The results are based on 150 observations and 31 variables (including fixed effects).

Another type of efficiency test assumes that the forecast is based on the complete set of available information at a given point in time. This is specified as the test of the null

hypothesis, H_0: $\alpha = 0$ in the regression: $x_{i,t|s} - x_{i,t|r} = \alpha \cdot z_{i,t|r} + u_{i.t}$ where $z_{i,t|r}$ is the vector of indicators comprising all available information at time r, $r<s$, and $u_{i.t}$ is i.i.d. random term. This paper has focused on the information already contained in the latest available growth rate and $z_{i,t|r} = x_{i,r|r}$, and performed the so-called weak efficiency test. The alternative hypothesis is $\alpha > 0$, i.e., a hypothesis of a positive relationship between the forecast error and the growth rate. For illustrative purposes it can be described as the hypothesis that a country with higher growth rates, such as one of the Baltic states, has a higher potential forecast error. Analysis of the data shows that the null hypothesis of efficiency cannot be rejected at either the 5 or 1 per cent significance level for all time leads of forecasts – one-year ahead, early within-year and late within-year forecast (see Table 2). Hence, the data support the hypothesis of efficiency of the EBRD forecasts also on the basis of this test.[10]

A particularly interesting issue is the comparison between the performance of EBRD forecasts and the performance of a naïve forecast, i.e., a forecast based on the assumption that the growth rate does not change from the last observed period. This question could also be reformulated as one about the relationship between forecast accuracy and the variability of the underlining data (see Chart 1 on variability of the analysed data).

A similar analysis of the comparative performance of a naïve forecast was already done for forecasts by other international institutions. Koutsogeorgopoulou (2000) analysed the accuracy of OECD Economic Outlook forecasts of the current year and one-year ahead output growth, conducting tests of bias and efficiency, and comparing OECD forecasts to the alternative of naïve forecasts. In most cases, the OECD projections perform better than the naïve forecasts. The forecast error turns out to be non-systematic, and the forecasts are efficient and unbiased on a cross-sectional basis. However, Koutsogeorgopoulou finds evidence for the presence of inefficiency once the data is pooled. Ash *et al*. (1990) similarly examines the accuracy of OECD forecasts, comparing them to naïve forecasts and time-series predictions, concluding that OECD forecasts are generally superior in spite of a considerable degree of variation, and that the error is non-systematic.

The tests for bias and efficiency of naïve forecasts used in this paper (see Tables 1 and 2) show that naïve forecasts are also not biased, a surprising observation given the strong decline in the variability in the data. One might expect that there would be a negative bias in naïve forecasts as transition countries recovered from the initial deep output declines in the early to mid-1990s. There is also no evidence of country/year-level bias for naïve forecasts. Tests of efficiency show, however, that unlike EBRD forecasts, naïve forecasts are not efficient, which is consistent with the decline in the variability in the data.

2.3 Evidence of the relationship between forecast accuracy and regional differences / progress in transition

An important hypothesis related to forecast accuracy concerns regional differences in forecast accuracy and their relationship with the level of development or progress in transition. The empirical analysis in EBRD (1996) identified greater margins of error for the least developed part of the region – the CIS – than in other transition countries. (However, this finding was based on only two years of observations of current year forecasts.) Similarly, Artis (1996)

[10] It should be noted that efficiency tests are based on a model using fixed effects for years and countries, given the previous finding of statistically significant bias for certain years and countries. Without the use of fixed effects, the simple efficiency tests would reject the null hypothesis of efficiency.

analysed short-term forecasts by the IMF between 1977 and 1994 and found larger forecast errors for developing countries compared to those for industrialised countries.

Whether there is any significant difference in forecast performance by sub-region is investigated, paying particular attention to the question of whether forecasts for new EU member countries in CEB are more precise than forecasts for less advanced transition countries. A positive link between forecast accuracy and progress in transition, where the latter is measured by the average EBRD transition score, would suggest a better understanding of economic developments in more advanced countries. This is particularly the case for forecasts for the current year, when the official results of economic performance for up to two quarters are known. Advanced transition countries are closer to standard market economies and therefore should react to shocks in a more predictable way.

Tables 3 and 4 present the mean absolute errors and root mean squared errors. The empirical results suggest significant differences of forecast errors between the main sub-regions. The forecast errors are the smallest for CEB, the largest for CIS, with SEE lying somewhere in between. These findings support an *a priori* hypothesis that the EBRD forecasts for CEB are relatively more accurate, which may be related to the fact that these countries are more advanced in transition.

Table 3 – Mean absolute errors

	Average total	Average CEB	Average SEE	Average CIS
Change in forecasts:				
$gdp_{t\|t+} - gdp_{t\|t-1}$	2.40 (0.26)	1.23 (0.16)	2.97 (0.84)	2.95 (0.39)
$gdp_{t\|t-} - gdp_{t\|t-1}$	1.26 (0.16)	0.61 (0.08)	1.52 (0.40)	1.59 (0.27)
$gdp_{t\|t+} - gdp_{t\|t-}$	1.71 (0.19)	0.93 (0.14)	2.02 (0.51)	2.10 (0.32)
Estimation error:				
$gdp_{t\|t+2} - gdp_{t\|t+1}$	0.27 (0.04)	0.35 (0.07)	0.18 (0.07)	0.26 (0.07)
Forecast errors:				
$gdp_{t\|t+1} - gdp_{t\|t-1}$	3.28 (0.29)	1.90 (0.25)	3.15 (0.66)	4.26 (0.49)
$gdp_{t\|t+1} - gdp_{t\|t-}$	2.80 (0.26)	1.70 (0.23)	2.26 (0.31)	3.76 (0.47)
$gdp_{t\|t+1} - gdp_{t\|t+}$	1.80 (0.14)	1.15 (0.14)	1.37 (0.30)	2.41 (0.24)
$gdp_{t\|t+1}$ – naïve for.	3.51 (0.33)	2.34 (0.35)	3.78 (0.76)	4.20 (0.55)

Source: EBRD.
Note: Robust standard errors in brackets.

When testing the statistical significance of the results in Table 3, the mean absolute forecast errors for CEB are found to be statistically significantly smaller than those for the CIS at the 5 per cent significance level. There is, however, no statistically significant difference between forecast errors for CEB and SEE. Furthermore, mean absolute forecast errors for SEE are statistically significantly smaller than those for the CIS only in the case of within-year forecasts but not of one-year ahead forecasts. An analysis of root mean squared errors, presented in Table 4, shows that regional differences between CEB and CIS are statistically different only for the one-year ahead and late within-year forecast errors. That is, CEB

forecast errors are smaller than CIS forecast errors, but none of the other inter-regional relations is statistically significant.

An analysis of regional differences in changes of forecasts in absolute terms also shows that EBRD forecasters made significantly smaller changes for countries in the CEB sub-region compared to the CIS and SEE. In the analysis of the changes in the forecasts using root mean squared errors, a similar relationship holds only for the change between one-year ahead and early within-year forecasts, and in addition, between one-year ahead and late within-year forecasts for CEB and the CIS.

The differences between sub-regions do not necessarily apply to all pairs of countries in sub-regions. There are big differences between individual countries within the three main sub-regions. For example mean forecast errors in several CIS countries, such as the Kyrgyz Republic or Uzbekistan, are comparable to, or even smaller than, the mean forecast errors in advanced Baltic countries. To extend the analysis of regional differences, the relationship between errors (both absolute and squared) and progress in transition (see Tables 5 and 6 for the empirical results) has been reviewed. To account for the general upward trend in the progress in transition indicators, either time dummies or a continuous time variable have been included. (The results related to progress in transition are the same regardless of the specification of the time dummies.)

Table 4 – Root mean squared errors

	Average total	Average CEB	Average SEE	Average CIS
Change in forecasts:				
$gdp_{t\|t+}$ - $gdp_{t\|t-1}$	4.00	1.67	5.40	4.39
	(2.18)	(0.84)	(4.38)	(2.41)
$gdp_{t\|t-}$ - $gdp_{t\|t-1}$	2.29	0.80	2.62	2.76
	(1.31)	(0.39)	(1.75)	(1.81)
$gdp_{t\|t+}$ - $gdp_{t\|t-}$	2.92	1.33	3.42	3.42
	(1.76)	(0.63)	(2.73)	(2.37)
Estimation error:				
$gdp_{t\|t+2}$ - $gdp_{t\|t+1}$	0.59	0.58	0.41	0.66
	(0.33)	(0.35)	(0.35)	(0.46)
Forecast errors:				
$gdp_{t\|t+1}$ - $gdp_{t\|t-1}$	4.84	2.57	4.74	5.93
	(2.48)	(1.32)	(3.06)	(3.46)
$gdp_{t\|t+1}$ - $gdp_{t\|t-}$	4.21	2.33	2.80	5.49
	(2.55)	(1.23)	(1.45)	(3.65)
$gdp_{t\|t+1}$ - $gdp_{t\|t+}$	2.52	1.49	2.13	3.14
	(1.08)	(0.75)	(1.49)	(1.47)
$gdp_{t\|t+1}$ – naïve for.	5.35	3.33	5.58	6.26
	(2.72)	(1.72)	(3.35)	(3.81)

Note: Robust standard errors in brackets.
Source: EBRD.

The null hypothesis, H_0: $\gamma = 0$ has been tested in the regressions: $|x_{i,t|s} - x_{i,t|r}| = \alpha + \beta \cdot t + \gamma \cdot ti_{i,t} + u_{i.t}$ and $[x_{i,t|s} - x_{i,t|r}]^2 = \alpha + \beta \cdot t + \gamma \cdot ti_{i,t} + u_{i.t}$ respectively, where t is a time variable, $ti_{i,t}$ is a variable denoting progress in transition for country i in time t measured as an average transition score, $r<s$, and $u_{i.t}$ is an i.i.d. random term across time and countries.

The results of the empirical analysis show a statistically significant and negative relationship as expected, i.e., more advanced transition countries have smaller forecast errors, as well as

smaller revisions in forecasts by the EBRD. In addition, this relationship is the strongest for the one-year ahead forecast error, and the weakest for the late within-year forecast error. However, while this relationship is very strong for results using data in absolute values, it holds only for one-year ahead and late within-year forecast errors in the case of data in squared values (which magnify larger errors).

A potential explanation for the relationship between forecast revisions with different time lead and transition indicators could be linked to the actual timing of the updates of the EBRD transition indicators.[11] EBRD transition indicators are updated only at the time when one-year ahead and late within-year forecasts are prepared, but not at the time when early within-year forecasts are prepared. Accordingly, the strongest relationship between changes are found in the forecasts and progress in transition regarding one-year ahead and late within-year forecasts, but not early within-year forecasts. It might be argued that review of the progress in transition has an influence on the judgmental forecasting of GDP growth. Therefore, the impact of structural reforms on output growth is thus incorporated into the forecast at this time. This may be the reason why it is amplified in the analysis of errors in squared values, but not in absolute values.

As explained in the footnotes to the relevant tables, the results are based on regressions using progress in reform and time variables as explanatory factors. Similar regressions using time dummies have also been run, and arrived at similar results. Interestingly, there is evidence of a statistically significant relationship between progress in transition and naïve forecast errors in absolute values, probably reflecting lower variability of data for more advanced transition countries, although this does not hold in the case of naïve forecast errors in squared values.

2.4 Evidence of learning-by-doing and the impact of an expanded information domain

An important question is whether the accuracy of forecasts for transition countries has improved over time. A related question is the impact of the expanded information domain on forecast accuracy. Given that our understanding of the transition process has increased rapidly since the early 1990s, it is possible to form a hypothesis that the accuracy of forecasts has improved over time. An alternative hypothesis is that most of the learning process had already occurred in the early 1990s and therefore further improvements are statistically insignificant. Artis (1996) found that there is no evidence of learning-by-doing in IMF forecasts between 1977 and 1994, since forecast accuracy did not seem to improve over time.[12]

To estimate the impact of the expansion of the information domain the differences in forecast errors between one-year ahead forecasts, early current year forecasts and late current year forecasts are studied. New information on economic developments should in principle increase the accuracy of the forecasts. Koutsogeorgopoulou (2000) analysed the accuracy of OECD Economic Outlook forecasts of the current year and one-year ahead output growth and found that current year projections perform much better than one-year ahead projections.

[11] For details on EBRD transition indicators methodology and the time series, see the most recent issue of the annual *Transition Report* series published by the EBRD.

[12] If the alternative hypothesis of quick and early learning-by-doing is true, it will not be possible to substantiate it by the statistical analysis of our data set. This is because the forecast time series start only in 1994 and full forecast time series for all countries and all lead times (one-year ahead as well as within-year) are available only from 1996 onwards.

An examination of summary statistics suggests a downward trend in EBRD forecast errors during the analysed period, with a noticeable (albeit temporary) increase around the time of the Russian crisis. Average forecast error for one-year ahead forecasts declined in absolute terms from 5 per cent in 1997 to just over 2 per cent in 2002. A similar, but smaller decline also seems to have been the case for early and late within-year forecasts.

Tables 5 and 6 present results of the statistical analysis of the time trend in forecast errors, for data in absolute values and squared values respectively, based on the null hypothesis, H_0: $\beta = 0$ in $| x_{i,t|s} - x_{i,t|r} | = \alpha + \beta \cdot t + \gamma \cdot ti_{i,t} + u_{i.t}$ and $[x_{i,t|s} - x_{i,t|r}]^2 = \alpha + \beta \cdot t + \gamma \cdot ti_{i,t} + u_{i.t}$. The results show no statistically significant time trend either in forecast errors or in the forecast revisions. This observation holds for both transformations of error terms (absolute values and squared values). In addition, simple correlations between time and forecast accuracy, including fixed country effects, with the same results have been analysed. The only type of forecast with a clear time trend appears to be the naïve forecast, reflecting progressively declining variability in the data.

Table 5 – Test results for dependency of absolute errors on time and progress in transition

Equation	Estimate of β	Estimate of γ	R^2
Change in forecasts:			
$\|gdp_{t\|t+} - gdp_{t\|t-1}\| = \alpha + \beta$ time $+ \gamma$ ti	-0.24 (0.17)	-1.97** (0.56)	0.16
$\|gdp_{t\|t-} - gdp_{t\|t-1}\| = \alpha + \beta$ time $+ \gamma$ ti	-0.11 (0.08)	-1.23** (0.42)	0.17
$\|gdp_{t\|t+} - gdp_{t\|t-}\| = \alpha + \beta$ time $+ \gamma$ ti	-0.23 (0.12)	-1.36** (0.44)	0.16
Estimation error:			
$\|gdp_{t\|t+2} - gdp_{t\|t+1}\| = \alpha + \beta$ time $+ \gamma$ ti	-0.02 (0.03)	0.00 (0.10)	0.00
Forecast errors:			
$\|gdp_{t\|t+1} - gdp_{t\|t-1}\| = \alpha + \beta$ time $+ \gamma$ ti	-0.29 (0.17)	-2.45** (0.63)	0.20
$\|gdp_{t\|t+1} - gdp_{t\|t-}\| = \alpha + \beta$ time $+ \gamma$ ti	-0.23 (0.15)	-2.07** (0.66)	0.18
$\|gdp_{t\|t+1} - gdp_{t\|t+}\| = \alpha + \beta$ time $+ \gamma$ ti	-0.08 (0.09)	-1.23** (0.30)	0.19
$\|gdp_{t\|t+1}$ – naïve for.$\| = \alpha + \beta$ time $+ \gamma$ ti	-0.60** (0.16)	-2.08** (0.79)	0.18

Source: EBRD.
Note: Statistically significant differences from 0 are denoted by * for the 5 per cent significance level and ** for the 1 per cent significance level. Robust standard errors are in brackets. ti stands for average transition indicators (see the EBRD *Transition Reports*). Estimates of constant are not reported. Results are based on 150 observations and 3 variables. Those results based on official estimates with a two-year time lag are qualitatively similar in terms of statistical significance except for the estimate of γ for naïve forecast error which is significant at the 5 per cent level.

The statistical analysis of the time trend in the data thus shows that, contrary to some expectations, there is in fact no statistically significant evidence of forecast accuracy improving over time. However, it should be stressed once again that the data exclude the first half of the 1990s, when most of the learning process is likely to have happened. The interpretation of the results related to potential learning-by-doing is linked to the earlier

results of the efficiency of the EBRD forecasts. The lack of time trend in forecast errors in the analysed time period may be interpreted as further evidence in favour of the forecast efficiency since the mid-1990s. In other words, if the forecasts were already efficient to start with, there would be no improvement over time in terms of efficiency; hence one might expect the absence of a time trend.

While there is no evidence of learning-by-doing, defined as improving forecast accuracy over time, there is strong evidence in favour of a statistically positive impact of increasing the information domain on forecast accuracy for both mean absolute errors and root mean squared errors (see Tables 3 and 4). One-year ahead forecast errors are statistically significantly greater than early within-year forecast errors, which are, in turn, greater than late within-year forecast errors. These relationships also hold for the CEB sub-region. However, in the case of SEE and the CIS, one-year ahead forecast errors are not statistically different from early within-year forecast errors where the data is in absolute values. Also, there are no differences between forecast errors with different time lags for data in squared values for these two regions.

Table 6 – Test results for dependency of squared errors on time and progress in transition

Equation	Estimate of β	Estimate of γ	R^2
Change in forecasts:			
$[gdp_{t\|t+} - gdp_{t\|t-1}]^2 = \alpha + \beta$ time $+ \gamma$ ti	-4.28 (3.45)	-26.22** (9.46)	0.10
$[gdp_{t\|t-} - gdp_{t\|t-1}]^2 = \alpha + \beta$ time $+ \gamma$ ti	-0.53 (0.63)	-11.54 (5.86)	0.11
$[gdp_{t\|t+} - gdp_{t\|t-}]^2 = \alpha + \beta$ time $+ \gamma$ ti	-3.38 (2.13)	-14.70 (8.97)	0.09
Estimation error:			
$[gdp_{t\|t+2} - gdp_{t\|t+1}]^2 = \alpha + \beta$ time $+ \gamma$ ti	-0.05 (0.10)	-0.18 (0.28)	0.01
Forecast errors:			
$[gdp_{t\|t+1} - gdp_{t\|t-1}]^2 = \alpha + \beta$ time $+ \gamma$ ti	-6.32 (3.96)	-37.10* (18.73)	-0.12
$[gdp_{t\|t+1} - gdp_{t\|t-}]^2 = \alpha + \beta$ time $+ \gamma$ ti	-5.54 (4.32)	-32.16 (21.60)	0.08
$[gdp_{t\|t+1} - gdp_{t\|t+}]^2 = \alpha + \beta$ time $+ \gamma$ ti	-0.98 (0.79)	-8.55** (3.28)	0.15
$[gdp_{t\|t+1}$ – naïve for.$]^2 = \alpha + \beta$ time $+ \gamma$ ti	-9.43** (3.35)	-44.11 (23.80)	0.13

Source: EBRD.
Note: Statistically significant differences from 0 are denoted by * for the 5 per cent significance level and ** for the 1 per cent significance level. Robust standard errors are in brackets. Estimates of constant are not reported. ti stands for average transition indicators (see the EBRD T*ransition Reports*). Results are based on 150 observations and 3 variables. Those results based on official estimates with a two-year time lag are qualitatively similar in terms of statistical significance except for the estimate of γ for late within-year forecast error which is significant at the 5 per cent level.

The explanation for such regional differences is most likely linked to the timely availability of the most recent high frequency data on economic activities for the CEB countries. Meanwhile there is a greater time lag and more limited availability of such data for SEE and CIS countries. Further statistical evidence for such an interpretation of the results is provided by the significantly greater change in the forecasts between early within-year and late within-year forecasts than between one-year ahead and early within-year forecasts in the CEB countries. This can be attributed to the fact that late within-year changes in the forecasts make use of a full six months of additional information on economic activity in the year.

2.5 Evidence of an unexpected economic shock: the Russian crisis

It is not only gradual progress in transition reforms and slowly evolving institutions that must be considered when assessing forecast accuracy for transition countries. The region has been also affected by a number of internal crises as well as external shocks, potentially leading to structural breaks in the growth paths these countries take and may affect the performance of growth forecasts. The unexpected economic shock that is most evident in the data, indeed the only unexpected economic shock in the time series that is clearly identifiable, is the performance of forecasts around the time of the Russian crisis in August 1998.

There are many ways to analyse the impact of structural changes on forecast accuracy. The correlation between forecast errors and progress in transition was reported earlier in this paper. Another way to identify structural breaks in the underlying series is to look for evidence of possible anomalies in the behaviour of forecast performance, in this case mainly through an analysis of potential bias of forecasts.

The Russian crisis in August 1998 is the only unexpected economic shock in the data with a significant impact on forecast accuracy that could be identified. The forecast error for 1998 has a positive bias for one-year ahead and early within-year forecasts, i.e., before the crisis. However, the forecast error is unbiased for late within-year forecasts, just after the crisis, as the late within-year forecasts had already taken the impact of the crisis into account. This is also evident from the negative change in late within-year forecasts, which was statistically significant in 1998.

Another period of such re-adjustment in the forecasts, this time upwards, started in 2000. This phenomenon is most likely related to the stronger than expected rebound in the CIS (following the Russian crisis). Indeed, the countries identified to have a negative forecast bias are all CIS countries – Azerbaijan, Belarus, Tajikistan and Uzbekistan. (The exception is the early within-year forecast for the Slovak Republic,) The data do not allow a more precise identification of the cautious approach to forecasting of the post-Russian crisis rebound in later years. There are also no other periods where one could identify a structural break, although it should be stressed that the variability of the data for transition countries is substantially greater than for standard OECD market economies.

2.6 Comparison of EBRD forecasts with those of other institutions

An interesting question is related to the potential differences between forecasts provided by the EBRD and forecasts provided by other institutions (other IFIs as well as commercial and academic forecasters). The basic assumption of this paper is that any differences should be statistically insignificant, given that the forecasts by different institutions are based on almost the same underlying information. The forecast revisions with different time leads prepared by the EBRD, and forecast revisions by others, are compared. Again, since the forecast revisions should be based on roughly the same information, their direction and size should be broadly similar.

However, even if the null hypothesis of no difference between forecasts by different institutions is rejected, it would not be appropriate to interpret any statistically significant results as superiority of some forecasts over others. The forecasts of other institutions have been provided to the EBRD during the preparation of the *Transition Report*, and the EBRD forecasts were finalised only after these other forecasts were collected. Therefore, there is a possibility that EBRD forecasts would be more accurate than other forecasts published in the *Transition Reports*, which is our alternative hypothesis. The interpretation of potential differences is most likely to be related to a significant impact of information becoming available in the short time between the collection of other forecasts and final revisions of EBRD forecasts, as was the case around the time of the Russian crisis.

A comparison between EBRD forecasts and forecasts by other institutions, presented in Tables 7, 8 and 9 for average errors, absolute errors and squared errors respectively, shows some statistically significant results. Average errors for one-year ahead EBRD forecasts are smaller in magnitude than forecasts by others. This is also the case in CEB and the CIS but not so in SEE. Similar evidence of higher forecasts by other forecasters is found for CEB and SEE in the case of early within-year forecasts.

It is worth noting that forecasts prepared by the EBRD and other institutions are significantly different for one-year ahead forecasts, but the forecast accuracy, measured either by absolute errors or squared errors, identifies late within-year forecast of the EBRD as being more accurate, to the tune of 0.4 percentage points in terms of absolute errors. CEB is identified as the region where the EBRD forecast accuracy is better than that of other forecasters of the region for both absolute errors and squared errors.

Table 7 – Average differences between EBRD and other forecasts

	Average total	Average CEB	Average SEE	Average CIS
Change in forecasts:				
$gdp_{t\|t+} - gdp_{t\|t-1}$	0.54**	0.13	0.39	0.88*
	(0.20)	(0.21)	(0.38)	(0.36)
$gdp_{t\|t-} - gdp_{t\|t-1}$	0.36*	0.23	-0.68	0.89**
	(0.18)	(0.12)	(0.40)	(0.32)
$gdp_{t\|t+} - gdp_{t\|t-}$	0.18	-0.10	1.07*	-0.01
	(0.16)	(0.15)	(0.41)	(0.25)
Forecast errors:				
$gdp_{t\|t+1} - gdp_{t\|t-1}$	0.56**	0.40**	0.37	0.75**
	(0.13)	(0.13)	(0.22)	(0.25)
$gdp_{t\|t+1} - gdp_{t\|t-}$	0.20	0.17*	1.05**	-0.14
	(0.15)	(0.07)	(0.33)	(0.26)
$gdp_{t\|t+1} - gdp_{t\|t+}$	0.02	0.27	-0.02	-0.13
	(0.14)	(0.14)	(0.33)	(0.24)

Source: EBRD.
Note: Robust standard errors are in brackets. The data are constructed by first calculating error terms, then taking differences between the EBRD and other errors, and finally by averaging for the respective region. Note that in the case of forecasts, the difference is equal to the difference between other forecasts and the EBRD forecasts (e.g., a positive number simply reflects higher other forecasts on the average, so there is no difference if estimates for one or two years later are used).

Table 8 – Average differences between absolute errors of EBRD and other forecasters

	Average total	Average CEB	Average SEE	Average CIS
Change in forecasts:				
$gdp_{t\|t+} - gdp_{t\|t-1}$	0.30 (0.17)	0.07 (0.17)	0.16 (0.34)	0.50 (0.30)
$gdp_{t\|t-} - gdp_{t\|t-1}$	0.04 (0.16)	-0.17 (0.10)	0.56 (0.37)	-0.03 (0.29)
$gdp_{t\|t+} - gdp_{t\|t-}$	0.35** (0.13)	0.31** (0.11)	-0.25 (0.36)	0.62** (0.20)
Forecast errors:				
$gdp_{t\|t+1} - gdp_{t\|t-1}$	0.07 (0.12)	-0.03 (0.13)	-0.16 (0.21)	0.22 (0.22)
$gdp_{t\|t+1} - gdp_{t\|t-}$	-0.05 (0.12)	-0.04 (0.07)	-0.55 (0.36)	0.15 (0.18)
$gdp_{t\|t+1} - gdp_{t\|t+}$	-0.40** (0.12)	-0.30* (0.12)	-0.62* (0.29)	-0.38 (0.19)

Source: EBRD.
Note: Robust standard errors are in brackets. The data are constructed by first calculating error terms in absolute values, than taking differences between the EBRD and other errors in absolute values, and finally by averaging for the respective region.

Table 9 – Average differences between squared errors of EBRD and other forecasters

	Average total	Average CEB	Average SEE	Average CIS
Change in forecasts:				
$gdp_{t\|t+} - gdp_{t\|t-1}$	4.06 (2.17)	0.30 (0.63)	5.92 (7.09)	5.79 (3.42)
$gdp_{t\|t-} - gdp_{t\|t-1}$	1.60 (1.65)	-0.73** (0.27)	4.61 (3.05)	1.90 (3.18)
$gdp_{t\|t+} - gdp_{t\|t-}$	0.44 (1.54)	1.08** (0.33)	-8.68 (6.32)	3.81* (1.70)
Forecast errors:				
$gdp_{t\|t+1} - gdp_{t\|t-1}$	0.22 (1.41)	-0.91 (1.15)	0.29 (3.02)	0.95 (2.57)
$gdp_{t\|t+1} - gdp_{t\|t-}$	-1.72 (1.55)	-0.72 (0.58)	-0.99 (5.55)	1.06 (2.14)
$gdp_{t\|t+1} - gdp_{t\|t+}$	-2.88** (0.97)	-1.75* (0.69)	-3.16 (2.41)	-3.53* (1.70)

Source: EBRD.
Note: Robust standard errors are in brackets. The data are constructed by first calculating error terms in squares, than taking differences between the EBRD and other errors in squares, and finally by averaging for the respective region.

There are several possible explanations for the better forecast accuracy of the EBRD:

i) the EBRD is better able to incorporate available information in its forecasts due to its regional focus of operations, and its presence in the transition countries, giving it a deeper insight into the performance of these economies

ii) EBRD information on recent developments is more comprehensive and timely, again due to the Bank's regional focus

iii) the difference of a few weeks between the final revisions of the EBRD forecasts and the collection of other forecasts is critical for forecast accuracy. This is not least because the data for the first two-quarters for CEB countries (and for some in

SEE and the CIS) becomes available after the collection of forecasts prepared by other institutions, but before the finalisation of EBRD forecasts.

It should also be noted that forecasts by other institutions for CEB countries are based on a larger number of forecast providers than is the case for most SEE and CIS countries. The importance of point iii) on the expansion of the information domain is also highlighted by the forecast accuracy in 1998, as the Russian crisis is not fully reflected in other forecasts presented in the 1998 *Transition Report.*

An analysis of differences in forecast accuracy between the EBRD and other forecasters for individual years/countries highlights only year-ahead forecasts for Belarus and Uzbekistan as those cases where the EBRD's forecast accuracy is worse than the forecast accuracy of other institutions. On the other hand, 1998-2001 are highlighted as the years where the EBRD's forecast accuracy was better. The analysis for data in absolute values also picks Croatia and Russia as examples of better forecast accuracy for the EBRD for late within-year forecasts. The potential explanations for these latter results are relatively easy to find, namely, the importance of the summer tourism season for Croatian GDP performance, the economic impact of which is better known later in the year, just before the finalisation of the EBRD forecasts, and the impact of the Russian crisis, in which case the EBRD forecasts were prepared after the crisis, whereas those of the other institutions mostly, but not entirely, before the crisis. However, this does not explain better forecast accuracy of the EBRD for the post Russian crisis recovery where the possible explanations for the better forecast accuracy of the EBRD discussed above apply.

The potential relationship between progress in transition and the difference between forecast errors of the EBRD and other institutions has also been tested. The results suggest that there is no relationship between progress in transition and differences between EBRD forecasts and forecasts made by other institutions, regardless of whether absolute or square errors are used.

Comparing changes in the forecasts made by the EBRD and changes in the forecasts made by other institutions, show that the EBRD was making on average bigger changes in its earlier forecasts, i.e., between one-year ahead and late within-year forecasts, and between one-year ahead and early within-year forecasts. However, on the sub-region level the same statistically significant relationship is found only for the CIS.

Table 10 – Test results for the relationship between the changes in EBRD forecasts and changes in forecasts of other institutions

Equation	Est. α	Est. β	R^2
$[gdp_{t\|t+} - gdp_{t\|t-1}]_{EBRD} - [gdp_{t\|t+} - gdp_{t\|t-1}]_{other} =$ $= \alpha + \beta [gdp_{t\|t+} - gdp_{t\|t-1}]_{other}$	0.50* (0.22)	-0.06 (0.10)	0.01
$[gdp_{t\|t-} - gdp_{t\|t-1}]_{EBRD} - [gdp_{t\|t-} - gdp_{t\|t-1}]_{other} =$ $= \alpha + \beta [gdp_{t\|t-} - gdp_{t\|t-1}]_{other}$	0.20 (0.18)	-0.46** (0.15)	0.14
$[gdp_{t\|t+} - gdp_{t\|t-}]_{EBRD} - [gdp_{t\|t+} - gdp_{t\|t-}]_{other} =$ $= \alpha + \beta [gdp_{t\|t+} - gdp_{t\|t-}]_{other}$	0.10 (0.15)	-0.20 (0.11)	0.08

Source: EBRD.
Note: Statistically significant differences from 0 are denoted by * for the 5 per cent significance level and ** for the 1 per cent significance level. Robust standard errors are in brackets and results are based on 150 observations.

Another way to test the relationship between forecast revisions made by the EBRD and other institutions is presented in Table 10. Here, the relationship between forecast revisions with different time lags made by the EBRD and other forecasters is analysed by testing the null

hypothesis, H_0: $\alpha = 0$ and $\beta = 0$ in the regression: $[x_{i,t|s} - x_{i,t|r}]_{EBRD} - [x_{i,t|s} - x_{i,t|r}]_{other} = \alpha + \beta \cdot [x_{i,t|s} - x_{i,t|r}]_{other} + u_{i.t}$ where t is a time variable, $s, r = t-1, t-, t+$, $r<s$, and $u_{i.t}$ is an i.i.d. random term across time and countries. In this context, the failure to reject the null hypothesis would indicate that all institutions incorporate the available information in the same way. Again, the EBRD has a significantly different approach to forecast revisions made with a greater time lead.

3. SUMMARY AND CONCLUDING REMARKS

This paper presents the results of an empirical analysis of the forecast accuracy for transition countries since the mid-1990s on the basis of data published by the EBRD. The paper has shown that the EBRD's forecasts are efficient and mostly not biased except for late within-year forecasts where there is evidence of a negative, cautious bias. The negative bias partly reflects the inherent negative bias of the local providers of information, given that there is a negative bias in official estimates with a different time lag.

The analysis of forecast efficiency also shows that there is no relationship between the size of the forecast error and the GDP growth rate, dismissing a prior assumption that the forecast error for economies with higher growth rates would also be higher. However, there is a strong negative relationship between progress in transition and forecast errors. This suggests that EBRD forecasters understand better the advanced transition economies, which are closer in their economic structures to standard market economies. Not surprisingly, naïve forecasts, where the latest available actual growth rate is used as a forecast, perform significantly worse than EBRD forecasts in terms of forecast efficiency.

The data also show that the EBRD has had a consistent negative forecast bias in the cases of Azerbaijan, Belarus, Tajikistan and Uzbekistan. This partly reflects the different functioning of the less advanced transition countries, but may also be due to the uncertainty related to official statistics in countries with a strong role of the state, e.g., Belarus and Uzbekistan, where official data releases may not reflect the true performance of the economy.

A notable difference in forecast performance can be observed around the time of the 1998 Russian crisis, showing positive bias just before the crisis and negative bias right afterwards. The detailed analysis of the data indicates that the rebound following the crisis was much faster then initially expected.

The comparison of the EBRD forecasts with forecasts prepared by other institutions shows that the EBRD forecasts are not only cautious, i.e., with a negative bias, when prepared late within-year, but also more accurate to the tune of 0.4 percentage points in terms of absolute errors compared to other forecasts, a result driven mainly by CEB and partly also the CIS forecast performance of the Bank.

To conclude, the empirical analysis shows that it may be necessary to devote more resources to forecasting for early transition countries, such as Belarus and Uzbekistan, because of their non-standard market structures and sparse coverage by other forecasters. In addition, the potential for a post-crisis negative bias should also be noted and incorporated in the forecast preparation in crisis periods.

Potential extensions of the work presented in this paper include the assessment of the forecast accuracy of other variables forecasted by the EBRD, such as inflation, as well as fiscal and balance of payment data. Further efforts should also be directed towards specification of a formal forecasting model for all transition countries that could be used directly for improving current judgmental forecasting approach, most importantly by formalising consistency checks of EBRD forecasts.

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ANNEX 1: THE IMPACT OF REVISIONS OF OFFICIAL ESTIMATES ON FORECAST ACCURACY

The statistical institutes in transition countries have faced the challenging task of learning how to estimate actual values of economic indicators in emerging market economies (as opposed to their long-term experience of dealing with centrally planned economies). As a result, the decision between using the actual values of the first available official estimates of the studied indicators, or the later, revised values becomes of greater significance. The use of latest revisions may lead to spurious evidence of learning-by-doing as the revisions for earlier data would be larger in magnitude than revisions for the latest data. Corollary to this issue is the difference between the forecast errors, and the official data estimation errors as acknowledged in official data revisions. One would naturally assume that forecast error is significantly greater than estimation error, but it is important to substantiate such an expectation by a rigorous statistical analysis.

A related issue is whether there is any relationship between progress in transition made by a particular country and its estimation error. On the one hand, one might expect that more advanced countries in transition will be able to estimate their GDP growth with greater precision early on and would need to make smaller revisions. On the other hand, it is also possible that statistical offices in less advanced transition countries revise their initial estimates to a much smaller extent since they have no additional information to use for revisions. As a result, their estimation error would be seemingly better than the estimation error of more advanced countries.

Table 1 shows that the statistical offices are cautious in their estimates of GDP growth as the difference between estimates made with one and two-year lags is statistically significant and positive. However, this is the case only in CEB and the CIS, where the average increase in the growth rate is about 0.2 percentage points. Meanwhile in SEE there is no statistical evidence of significant changes in official estimates with different time lags. A more detailed analysis of the significant revisions of official estimates highlights only a negative bias in Kazakhstan. However, there is not a single individual year where the average official estimate could be identified as being cautious across the region.

Results presented in Table 3 might suggest that official estimates are revised to a largest extent in CEB, and the revisions in SEE are the smallest in magnitude, potentially implying that the statistical offices in advanced transition countries make their best efforts to keep the data as up-to-date and accurate as possible. However, a rigorous analysis of these differences shows that they are not statistically significant. The relationship between estimation errors and progress in transition, measured by the EBRD transition indicators, as well as the relationship between estimation errors and time, found none of them to be statistically significant (see Tables 5 and 6).

Furthermore, average revisions in official estimates in absolute values are statistically significantly smaller than mean absolute forecast errors and the same holds for mean squared forecast errors. This finding holds for all three forecasts with different time leads as well as in all three main sub-regions (CEB, SEE and the CIS). On average, estimation errors are smaller than 0.3 percentage points while the forecast errors for late within-year forecast are about 1.8 percentage points. The size of the estimation error is also statistically significantly smaller than changes made in forecasts with different time lags.

The statistical analysis in this paper is presented for estimates with a one-year time lag. All results have also been re-estimated using official estimates with two-year time lags. Overall, the findings are qualitatively the same, with only a few minor changes in terms of statistical significance, reported in the footnotes to the tables. The main differences are results for individual countries/years but the results based on data for a single year or one country only should be treated with caution since the underlying sample is inevitably very small.