International Labour Office

ILO RESEARCH DEPARTMENT WORKING PAPER NO. 1

An Accuracy Assessment of the *Global Employment Trends'* Unemployment Rate Forecasts

EVANGELIA BOURMPOULA AND
CHRISTINA WIESER

JANUARY 2014

Research Department Paper No. 1

An Accuracy Assessment of the *Global Employment Trends'* Unemployment Rate Forecasts

*Evangelia Bourmpoula and Christina Wieser**

January 2014
International Labour Office

---

* Economists in the Employment Trends Unit of the International Labour Office until November 2013. For further enquiries on this paper please contact the authors (ebourboula@gmail.com or christina_wieser@yahoo.com).

First published 2014

Acknowledgements

The authors are grateful to Ekkehard Ernst, Steven Kapsos, Jean Michel Pasteels, Isabelle Salle and Christian Viegelahn, for their invaluable comments and helpful suggestions at different stages of the drafting process of this paper. Any remaining omission or errors are the authors' sole responsibility.

Abstract

This study provides a quantitative assessment of the bias, accuracy, and efficiency of the Global Employment Trends (GET) global and regional unemployment rate forecasts made in three recent annual GET reports. After conducting a series of statistical tests, the results suggest that, on average across all countries with data availability, the GET unemployment rate forecasts are slightly biased; we over-predict one and two years ahead and under-predict three and four years ahead. However, this bias is not significant for one to three years ahead. Moreover, our tests for accuracy show that the shorter the prediction period, the more accurate our forecasts indicated by smaller forecast errors for shorter prediction periods and larger forecast errors for longer periods.

Keywords: forecasts, unemployment rate, bias, accuracy, efficiency

JEL classification: E24, E27, J11, J60

Abbreviations

AFE	Average forecast error
EU	European Union
GDP	Gross Domestic Product
GET	Global Employment Trends
ILO	International Labour Organization
IMF	International Monetary Fund
MAE	Mean absolute forecast error
MedAE	Median absolute forecast error
MedSE	Median squared forecast error
MSE	Mean squared forecast error
RMSE	Root mean squared forecast error
UB	Bias proportion of MSE
UC	Covariance proportion of MSE
UV	Variance proportion of MSE
WEO	World Economic Outlook

Contents

Tables

Annex Tables

Figures

1. Introduction

The annual *Global Employment Trends* (GET) is one of the International Labour Organization's (ILO) flagship reports and analyses economic and social developments in labour markets, both globally and at the regional level. Taking into account the macroeconomic context, the report presents the employment and unemployment dynamics and provides estimates and forecasts of various labour market indicators such as unemployment, employment, status in employment, employment by sector, working poverty and labour productivity.

The GET model is one of the main data sources feeding the GET report. The GET model was built to provide consistent and comparable estimates and short-term forecasts of labour market indicators, both globally and at the regional level. Relying on an empirically estimated Okun's law, the output of the model is a complete dataset of 178 countries with the time series starting in 1991. In more detail, unemployment rate forecasts are obtained using the historical (negative) relationship between the unemployment rate and GDP growth (see Box 1).

Any forecast needs to be assessed in terms of its bias, accuracy, and efficiency. A thorough and systematic assessment of the quality can help inform efforts to improve forecasts. However, due to the short period for which forecasts are available, the quality of the GET unemployment rate forecasts has not yet been evaluated in a systematic manner. This note aims to address this gap by providing a quantitative assessment of the bias, accuracy, and efficiency of the GET global and regional unemployment rate forecasts made in three recent annual GET reports that were released each year in January (ILO 2010b, 2011, 2012). The purpose is not to examine each individual model run but rather to evaluate the average performance of all forecasts over the last three years against the actual outcomes and alternative forecasts. This note therefore conducts a series of statistical tests to evaluate the quality of the ILO unemployment rate forecasts and to assess whether forecasts were unbiased, accurate, and informatively efficient.

Section 2 describes the dataset used in this post-mortem analysis in terms of data sources and coverage and sets the conventions used in this analysis. Section 3 discusses the various measures used in the literature concerning the evaluation of forecasts and in particular the ones utilized in this note. Section 4 presents summary statistics regarding the unemployment rate forecast errors, both at a global and at a regional level. Since the underpinning element in the GET unemployment rate forecasts is Okun's Law, section 5 presents a similar analysis to that conducted in section 4 but using GDP growth rates, rather than unemployment rates, to compare the International Monetary Fund's (IMF) GDP forecasts to ILO's unemployment rate forecasts. Section 6 compares the evaluation of the GET model versus alternatives and section 7 provides conclusions and areas of future work.

Box 1. Note on global and regional projections

Unemployment rate projections are obtained using the historical relationship between unemployment rates and GDP growth during the worst crisis/downturn period for each country between 1991 and 2005 and during the corresponding recovery period.[1] This was done through the inclusion of interaction terms of crisis and recovery dummy variables with GDP growth in fixed effects panel regressions.[2] Specifically, the logistically transformed unemployment rate was regressed on a set of covariates, including the lagged unemployment rate, the GDP growth rate, the lagged GDP growth rate and a set of covariates consisting of the interaction of the crisis dummy, and of the interaction of the recovery dummy with each of the other variables.

Separate panel regressions were run across three different groupings of countries and are controlled for by using fixed effects in the regressions, based on:

1) geographic proximity and economic/institutional similarities;
2) income levels;
3) level of export dependence (measured as exports as a percentage of GDP).

The rationale behind these groupings is the following: countries within the same geographic area or with similar economic/institutional characteristics are likely to be similarly affected by the crisis, and have similar mechanisms to attenuate the crisis impact on their labour markets. Furthermore, because countries within geographic areas often have strong trade and financial linkages, the crisis is likely to spill over from one economy to its neighbour (e.g. Canada's economy and labour market developments are intricately linked to developments in the United States). Countries of similar income levels are also likely to have more similar labour market institutions (e.g. social protection measures) and similar capacities to implement fiscal stimulus and other policies to counter the crisis impact. Finally, as the decline in exports was the primary crisis transmission channel from developed to developing economies, countries were grouped according to their level of exposure to this channel, as measured by their exports as a percentage of GDP. The impact of the crisis on labour markets through the export channel also depends on the type of exports (the affected sectors of the economy), the share of domestic value added in exports, and the relative importance of domestic consumption (for instance, countries such as India or Indonesia with a large domestic market were less vulnerable than countries such as Singapore and Thailand). These characteristics are controlled for by using fixed-effects in the regressions.

In addition to the panel regressions, country-level regressions were run for countries with sufficient data. The ordinary least-squares country-level regressions included the same variables as the panel regressions. The final projection was generated as a simple average of the estimates obtained from the three group panel regression and, for countries with sufficient data, the country-level regressions as well.

For more information on the methodology of producing world and regional estimates, see www.ilo.org/trends and ILO (2010a).

[1] The crisis period comprises the span between the year in which a country experienced the largest drop in GDP growth, and the "turning point year", when growth reached its lowest level following the crisis, before starting to climb back to its pre-crisis level. The recovery period comprises the years between the "turning point year" and the year when growth has returned to its pre-crisis level.

[2] In order to project unemployment during the current recovery period, the crisis-year and recovery-year dummies were adjusted based on the following definition: a country was considered "currently in crisis" if the drop in GDP growth after 2007 was larger than 75 per cent of the absolute value of the standard deviation of GDP growth over the 1991–2008 period and/or larger than 3 percentage points.

2. Description of the dataset

The GET model was built in 2003 and its first (current year) forecast was used in the GET 2004 report (Crespi, 2004; ILO, 2004). The GET model was initially developed to provide annual estimates of unemployment rates about once per year. However, in 2009, there was a need to evaluate more often the rapidly worsening conditions in the labour market due to the highly uncertain economic environment. Hence, the GET model was extended and has been run more frequently since (ILO, 2010a). The first forecasts from the model's extension were utilized in the GET 2010 report (ILO, 2010b) and we therefore examine the most recent set of forecasts that were analysed in the three latest annual GET reports (ILO 2010b, 2011, 2012) in this post-mortem analysis. We treat the available (reported) rates in the most recent GET 2013 report (ILO, 2013) as our final/actual rates and use them to calculate the forecast errors.[3]

The latest available year for which a comparison of forecasted unemployment rates and actual values is possible, is 2012 and these results were displayed in the GET 2013 (see Annex 4). However, we also include forecasts prior to 2010 to increase our sample size if reported (actual) data were not included in the respective GET model run. Our calculations therefore start in 2007 and a maximum of four forecast periods are examined: one to four years ahead. We use 2007 as the cut-off year due to our interest in examining the forecasting performance of the model during the most recent years and due to the fact that 2007 is the latest year across all four runs with relatively high reporting rates. On average, there are 92 predictions for one year ahead, 86 for two years ahead, 82 for three years ahead and only 61 for 4 years ahead.

In the example in Table 1, the earliest year included in the analysis for the GET January 2010, is 2007, for the GET January 2011, the earliest year included is 2008 and so forth. As a result, a maximum of three errors can be calculated for the GET January 2010 model run (i.e. for 2007−09), two errors for the GET January 2011 model run (i.e. for 2008−09) and one error for the GET January 2012 model run (i.e. 2009).

Table 1. Example of error calculations for country X across the three GET Model runs

GET Model Run	Latest year available (*t*)	Errors calculated for:
GET January 2013	*2010*	-
GET January 2012	2009	*t+1* (2010)
GET January 2011	2008	*t+1; t+2* (2009-10)
GET January 2010	2007	*t+1; t+2; t+3* (2008-10)

To avoid including data revisions in the calculation of errors, we exclude countries for which historical data series have been revised (e.g. change in the repository or source used, past-revised series, etc.). As a result, 15 countries were excluded from at least one of the three model runs under examination.

[3] That is, we treat the input data for the GET 2013 model run, and not the estimates or forecasts as our actual unemployment rates to which we compare the previous forecasts.

3. Properties of *good* forecasts and measures used

The predictive power of any model depends on the quality of the data used, the forecast horizon, as well as the statistical measures for its evaluation. There are three fundamental properties of a good forecast: *bias*, *accuracy*, and *informational efficiency* (Makridakis et al., 1998; Timmermann, 2006, 2007; Vogel, 2007; Leal et al., 2008).[4] This section is divided into these three forecast properties and GET forecasts are evaluated according to these properties.

In general, a best forecast has a zero average forecast error and predicts the direction correctly. It also uses all available and relevant information at the time of the forecast so that the forecast errors are random and uncorrelated over time (i.e. serially uncorrelated). An optimal forecast should also have declining variance of forecast error as the forecast horizon shortens. There is a large body of literature on the evaluation of forecast performance and used statistics.

Table A1Table A1 in Annex 1 summarizes selected literature and the measures used to evaluate forecast performance.

For this post-mortem analysis we chose a combination of measures most commonly used in the literature to evaluate the performance of the GET forecasts. Measures were chosen according to their compatibility with data constraints, simplicity of interpretation and inclusion of a wide enough range of measures to analyse bias, accuracy, and informational efficiency of the GET forecasts. Each of the measures is briefly summarized below.

3.1 Bias

A forecast is said to be unbiased if the forecast does not show a tendency to go in either direction (over- and under-prediction). The **average forecast error** (AFE) gives an indication about the projection bias with values close to zero indicating unbiased predictions. Average forecast errors are said to be over-predicted if the predicted rate is larger than the actual rate (AFE has a negative sign) and under-predicted if the predicted rate is smaller than the actual rate (AFE has a positive sign).

Furthermore, kurtosis and skewness of the error distribution give information about the bias as both indicators measure the shape of the distribution. Kurtosis measures how steep the peak of the distribution is and skewness measures how much the distribution leans towards the right or left hand-side of the mean.

The most common indicator for kurtosis is the **excess kurtosis** which compares the shape of the distribution with the shape of a normal distribution.[5] Therefore, in the case of over- or under-prediction, we expect non-zero excess kurtosis, meaning that the variance of the distribution is mostly influenced by infrequent extreme deviations. Negative excess kurtosis indicates flatter/wider peaks, compared to positive excess kurtosis indicating steeper peaks.

[4] The common assumptions is a symmetric quadratic loss function, but for an overview of properties of good forecasts under asymmetric loss function and nonlinear data generating processes, see Patton and Timmermann (2007).

[5] Zero excess kurtosis indicates a normal distribution.

Regarding skewness, a positive skew occurs when the right-hand side tail is longer than the left-hand side tail. In this case, positive errors are more common and hence under-prediction takes place (i.e. the predicted rate is smaller than the actual rate). Similarly, a negative skew occurs when the left-hand side tail is longer than on the right-hand side and over-prediction is more common. Therefore, we expect a **right-skewed** distribution to be associated with under-prediction and a **left-skewed** distribution with over-prediction. These measures though are only briefly discussed at a global level.

Despite the fact that we are restricted to a short period of forecast errors (maximum of four errors can be calculated, see section 2), the following simple Ordinary Least Squares (OLS) regression is run as a pooled panel to test for forecast bias:

$$E_{t+j}^{i} = \alpha + \varepsilon_{t+j} \quad (1)$$

where $E_{t+j}^{i} = A_{t+j}^{i} - F_{t+j}^{i}$ is the forecast error (averaged across the three model runs), A stands for available (actual) observation, F stands for forecasted observation, j stands for the j^{th} year ahead from the latest available observation (1,2,3,4), i stands for country and ε is a stochastic term. For an unbiased forecast, the constant of regression 1 should be zero.

3.2 Accuracy

Forecast measures are said to be accurate if the size of the forecast error is small and the forecast has the capability to predict the right direction of the actual outcome (Leal et al., 2008). Various tools are available to measure this predictability of the realization of forecasts of which the ones used in this post-mortem analysis will be discussed.

The **mean absolute forecast error** (MAE) measures the absolute magnitude of the error and the closer to zero the MAE, the more accurate the forecast. In addition, the **root mean squared forecast error** (RMSE), just as the MAE, assumes a symmetric loss function for projection errors (i.e. equal weights to over- and under-predictions) but larger errors are penalized to a greater extent due to the squared computation. It measures the deviation of the forecast from the actual value and it is compatible with a quadratic loss function.

Due to extreme values, only considering mean forecast errors can be misleading. As a result, we also calculate the **median absolute forecast error** (MedAE) and **median squared forecast error** (MedSE) as alternative measures for accuracy. Values close to zero indicate accurate predictions and in cases in which the mean and the median are equal, the distribution of errors is closer to normal.

Furthermore, we also consider the **mean squared forecast error** (MSE) and decompose it into a bias proportion, a variance proportion, and a covariance proportion (see e.g. Koutsogeorgopoulou, 2000). The **bias proportion** (UB) measures the deviation of the mean prediction from the mean actual value and gives an indication for systematic forecast error. The **variance proportion** (UV) measures the error in forecasting the systematic component of variation of the actual values, and the **covariance proportion** (UC) measures the error in forecasting the unsystematic component of the variance of the actual values. For a forecast to be accurate, the UC of the MSE is closer to unity and the UB and UV are close to zero (Koutsogeorgopoulou, 2000).

We also calculate the $\mathbf{R^2}$ of forecasts as an indication of the percentage of the variation of the actual values which the predictions have correctly taken into account. Negative values of R^2 indicate "misleading" projections, meaning that the noise that the projections produced is higher than the

variation in the actual data. Values close to zero indicate that the projections are "uninformative", meaning that the projection errors have similar variation to the actual outcomes (Vogel, 2007).

3.3 Informational efficiency

Informational efficiency contains two dimensions, 1) whether information is available and 2) to what extent this information is used. An optimal forecast would contain all available information efficiently and would therefore not produce forecast errors (Timmermann, 2007). The informational efficiency can be tested with the simple OLS regression:

$$A_{t+j}^{i} = \alpha + \beta F_{t+j}^{i} + \varepsilon_{t+j} \quad (2)$$

where A stands for available (actual) observation, F stands for forecasted observation, j stands for the j^{th} year ahead from the latest available observation (1,2,3,4), i stands for country and ε is a stochastic term. For an efficient forecast, the constant α of regression 2 should equal zero and the regression coefficient β should equal unity (Koutsogeorgopoulou, 2000).

4. Summary statistics of forecast errors

4.1 Global summary statistics

A good forecast should be unbiased, show small errors and should incorporate all relevant information so that forecast errors that do appear are random (Vogel, 2007). Summary statistics of statistical error analysis and regression analysis display that these conditions are partially met with significant variations concerning different forecast horizons.

4.1.1 Testing for bias

The (unweighted) averages of the actual unemployment rates for those countries included in this post-mortem analysis were 9.2, 9.1, 9.0 and 8.7 per cent for one to four years ahead, while the (unweighted) averages of forecasted rates were 9.3, 9.2, 8.7 and 7.7 per cent, respectively (see Annex 2, Table B1). Figure 1 plots the actual vs. the forecasted unemployment rates.6 If a country is found precisely on the diagonal line, the forecasted rate is equal to the actual rate. If a country is found above (below) the line, the forecasted rate is larger (smaller) than the actual rate. For one and two years ahead, many observations (i.e. countries) are close to the 45^0 line with the majority of observations being above the line (i.e. over-predictions). Forecasts for three and four years are more concentrated under the line (i.e. under-predictions).

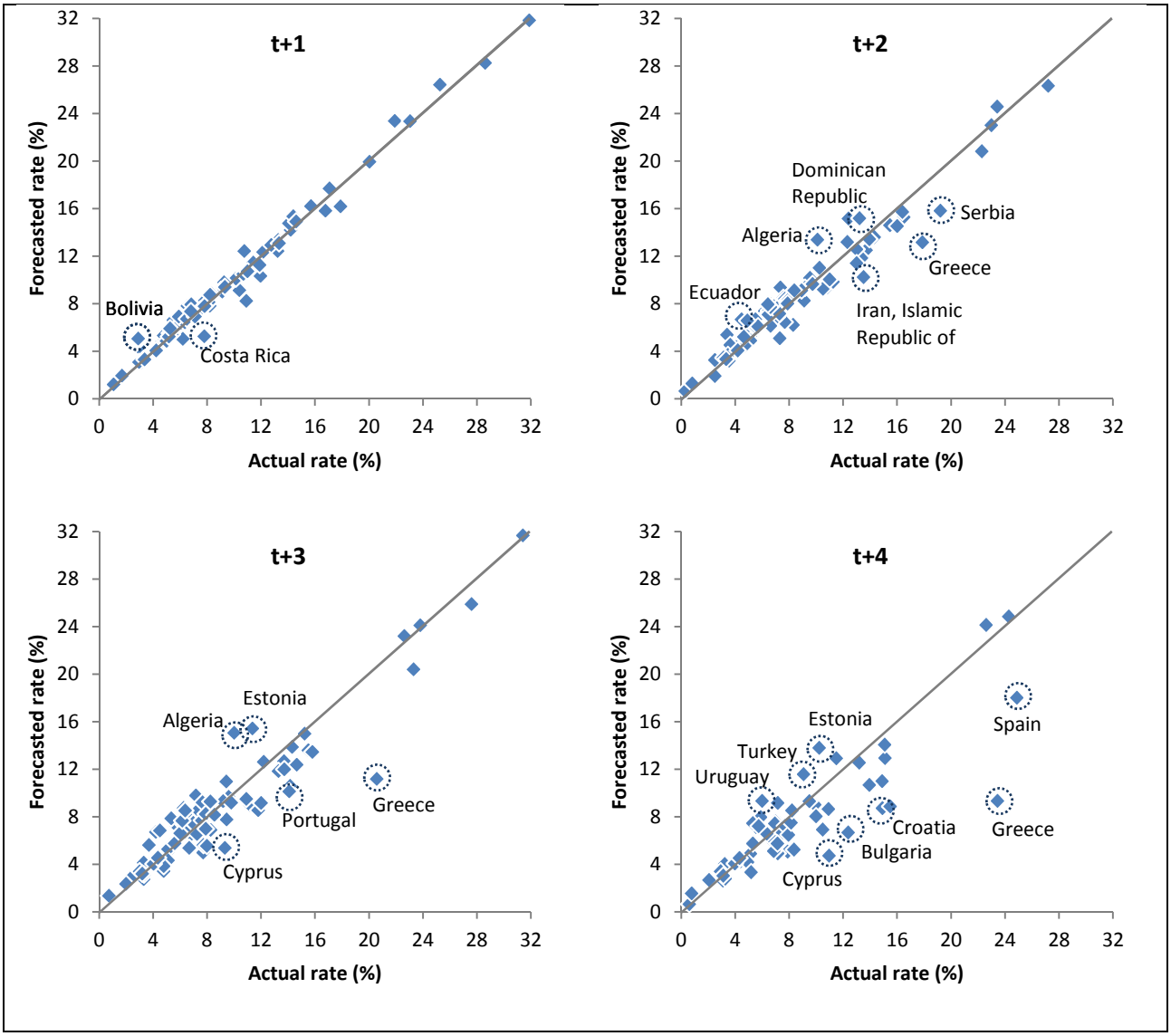
Using the AFE, results show that our GET forecasts were slightly biased; we over-predicted[7] one and two years ahead by 0.1 percentage points on average at the global level and under-predicted[8] over

[6] Each country in the figure can comprise several observations. For example, for t+1, country X has several observations, one comparing one year ahead forecast from the GET 2009 to the actual value, another one comparing one year ahead forecast from the GET 2010 to the actual value and so forth.

[7] The term over-prediction is used when the predicted unemployment rate is higher than the actual rate (AFE is negative).

longer time horizons by 0.2 and almost 1 percentage points for three and four years ahead (see Annex 2, Table B1).

Figure 1. Actual versus forecasted rates



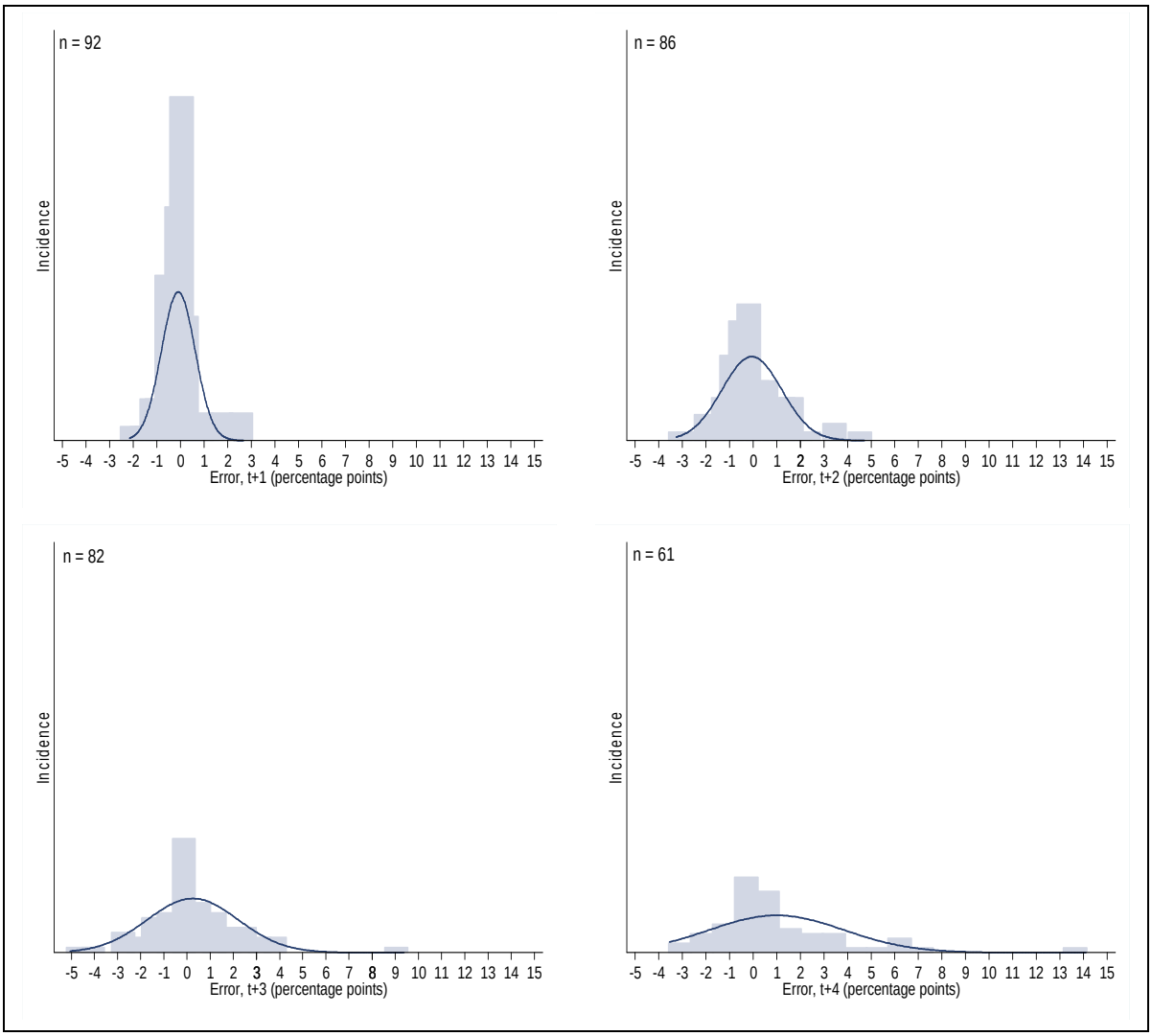
Note: The line in the figures indicates the 45^0 line. t + j refer to the j^{th} year ahead forecast (j = 1,…,4).

Source: ILO calculations based on the *Global Employment Trends* (GET) January 2010; January 2011; January 2012; January 2013.

Similar results can be observed in Figure 2 which displays the distribution of errors for each forecast period. In all cases, the respective distribution is significantly different than the normal distribution. For one, three and four years ahead, the kurtosis and skewness are above 7 and 1, respectively, and for two years ahead the kurtosis is about 5 and the skewness about 0.7. However, by just looking at the figures, two, three and four years ahead show signs of right-hand skewness (i.e. under-prediction).

[8] The term under-prediction is used when the predicted unemployment rate is lower than the actual rate (AFE is positive).

Figure 2. Distribution of errors



Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013.

Moreover, the results from equation 1 indicate that there was no significant bias for forecasts of one to three years ahead, but forecasts for four years ahead showed a positive bias indicating under-prediction (see Table 2 and Annex 2, Table B3).

Table 2. Testing for bias, for global unemployment rate forecasts

		Year(s) ahead			
		1	**2**	**3**	**4**
World	α	-0.0898	-0.0542	0.2473	0.9934***
		(0.0749)	(0.1372)	(0.2182)	(0.3683)
	F (α=0)	1.4370	0.1561	1.2836	7.2771***
	N	92	86	82	61

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

4.1.2 Testing for accuracy

Applying the MAE to check for accuracy (the size of the absolute forecast error), we find that GET forecasts were more accurate the shorter the time horizon. In absolute terms, our one, two, three, and four years ahead forecasts were off by 0.5, 0.9, 1.4 and almost 2.4 percentage points respectively (see Table 3 and Annex 2, Table B2 for more details). The MedAE was smaller than the mean absolute error indicating that there were some extreme values that are punished to a greater extent in the mean absolute forecast error. Values close to zero indicate accurate predictions; the MedAE shows that 50 per cent of the range of MAE for one and two years ahead was below 0.2 and 0.7 percentage points, respectively. Similarly, for three and four years ahead, 50 per cent of the absolute forecast errors were below 1 percentage point.

Table 3. Summary of accuracy statistics for global unemployment rate forecasts

	Year(s) ahead	**MAE** (Mean Absolute Error)	**RMSE** (Root Mean Squared Error)	**MedSE** (Median Squared Error)	**MedAE** (Median Absolute Error)	**MSE** (Mean Squared Error)	**UB** (Bias proportion of MSE)	**UV** (Variance proportion of MSE)	**UC** (Covariance proportion of MSE)	**R^2**
World	1	0.45	0.72	0.06	0.25	0.52	0.02	0.00	0.98	0.98
	2	0.94	1.27	0.52	0.72	1.60	0.00	0.02	0.98	0.94
	3	1.36	1.98	0.98	0.99	3.92	0.02	0.00	0.98	0.85
	4	1.91	3.02	1.01	1.01	9.12	0.11	0.00	0.89	0.73

Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013.

According to the MAE and the MedAE, our forecasts for one and two years ahead were relatively accurate on average in comparison to longer term forecasts. The decomposition of the MSE into the bias and the variance proportion (UB and UV), which give an indication for systematic forecast errors and are close to zero for accurate forecasts, indicates that our forecasts one, two and three years ahead are indeed close to zero and therefore accurate (ranging from 0 to 2 per cent). However, for four years ahead, the bias proportion increases to 11 per cent. The co-variance proportion of the MSE (UC) also points to the accuracy of our forecasts one to three years ahead with a value close to unity of 98 per cent for one to three years ahead but only 89 per cent for the four years ahead forecasts.

Furthermore, based on the R^2 of forecasts which indicates accuracy with values close to unity, 98, 94, 85 and only 73 per cent of the variation of the actual outcomes is captured by the forecasts for one, two, three, and four years ahead, respectively. Overall, the shorter the prediction period, the more accurate our forecasts; this result is also confirmed by the RMSE which increases largely with the time horizon of the forecasts.

In every GET report, the global and regional forecasts are accompanied with a confidence interval to acknowledge uncertainty around the baseline forecast, particularly during the economic crisis. Therefore, we also compare our errors with these confidence intervals (i.e. at the country level). We found that at the global level, one year ahead forecasts, 87 per cent of the errors were within the confidence interval (80 out of 92); for two years ahead forecast 84 per cent fall into the confidence interval (72 out of 86); for three years ahead 65 per cent also were not larger than the confidence interval (53 out of 82); and for four years ahead only 52 per cent of the errors lied within the confidence interval (32 out of 61).

These results do not come as a surprise; the effects of the crisis, which had particularly severe consequences on unemployment, enter the model as a huge exogenous shock, which pushes

unemployment rates away from their "average" predicted level. The largest forecast errors for four years ahead are mainly due to the crisis in Europe (for example, Cyprus, Greece, Spain) and the situation in countries on the periphery (for example Bulgaria, Croatia, Estonia) (see Figure 1). Since the GET model relies on an augmented concept of Okun's law, those highest forecast errors for the specific crisis period (especially for the four years ahead forecasts for 2007 for 2011) do not put the model into question.

4.1.3 Testing for informational efficiency

On average, our forecasts were informatively efficient, based on the results from equation 2 above (see Table 4 and Annex 2, Table B4). The results indicate that for one to three years ahead, the forecasts have informational value. The estimate for δ is significantly positive and very close to unity while the estimate for the constant is not significant but close to zero.[9] For forecasts of one to three years ahead, we do not reject the null joint hypothesis of informative forecasts (i.e. unity coefficient, zero constant and white-noise residuals). In the case of forecasts for four years ahead, the null hypothesis is rejected. However, for all four cases, the estimate for β is not negative which would indicate *misleading* forecasts.

Table 4. Testing for efficiency, for global unemployment rate forecasts

		Year(s) ahead			
		1	**2**	**3**	**4**
World	α	-0.0103	-0.3307	0.103	0.8638
		(0.1339)	(0.2121)	(0.2798)	(0.5542)
	δ	0.9914***	1.0302***	1.0165***	1.0168***
		(0.0128)	(0.0259)	(0.0333)	(0.0784)
	F (α=0, δ=1)	0.8641	1.236	0.6352	4.1530**
	R^2	0.9839	0.9515	0.8815	0.7223
	N	92	86	82	61

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1;
R^2 refers to the regression results.

4.1.4 Summary of world average

On average across all countries, we have some forecast bias; we slightly over-predict one and two years ahead and under-predict three and four years ahead. However, our regression analyses show that this bias is not significant for one to three years ahead. Overall, the shorter the prediction period, the more accurate our forecasts and our tests show that one to three years ahead were accurate but four years ahead were not. Nevertheless, in most cases the errors fall into the confidence intervals that accompanied the GET forecasts. Furthermore, our results also indicate that we have informational efficiency for one to three years ahead.

[9] A simple t-test for the estimate for δ equal 1 does not reject the null hypothesis.

4.2 Regional summary statistics

4.2.1 Developed Economies and European Union (EU)

Testing for bias

For the Developed Economies and European Union (EU) region where response rates are highest among all regions (see Annex 4, Figure D1), the (unweighted) average of actual unemployment rates were 8.7, 9.1, 9.1 and 9.4 per cent for one to four years ahead, respectively (see Annex 2, Table B1). The (unweighted) averages of the forecasted rates were 8.7, 8.8, 8.3 and 7.5 per cent for one to four years ahead, respectively.

On average, according to the AFE, we over-predict one year ahead by 0.04 points and under-predict two to four years ahead by 0.3, 0.8 and almost 2 percentage points respectively (see Annex 2, Table B1). Furthermore, the results from equation 1 indicate that there was no significant bias for forecasts of one to two years ahead, but the forecasts for three and four years ahead had a positive bias, implying under-prediction (see Table 5 and Annex2, Table B3).

Table 5. Testing for bias, for Developed Economies and EU unemployment rate forecasts

		Year(s) ahead			
		1	**2**	**3**	**4**
Developed Economies and EU	α	-0.0358	0.2615	0.8281**	1.8874***
		(0.0531)	(0.1888)	(0.3587)	(0.5294)
	F (α=0)	0.4532	1.9188	5.3296**	12.7111***
	N	36	36	36	35

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Testing for accuracy

The median of the forecast errors' distribution was below the mean pointing towards outliers with large forecast errors. In addition, for this region the forecasts for one and two years ahead were relatively accurate according to our error statistics but the forecasts for three and four years ahead were less precise. The bias proportion of the MSE (UB), which measures the deviation of the mean prediction form the mean actual value, was relatively small (and therefore accurate) for one and two years ahead, but it increased to about 13 and 27 per cent for the three and four years ahead (see Table 6 and Annex 2, Table B2). However, the variance proportion (UV), which measures the error in forecasting the systematic component of the variation of the actual values points to an accurate forecast as the levels stayed around zero for one to four years ahead.

Table 6. Summary of accuracy statistics for unemployment rate forecasts in the Developed Economies and EU

	Year(s) ahead	**MAE** (Mean Absolute Error)	**RMSE** (Root Mean Squared Error)	**MedSE** (Median Squared Error)	**MedAE** (Median Absolute Error)	**MSE** (Mean Squared Error)	**UB** (Bias proportion of MSE)	**UV** (Variance proportion of MSE)	**UC** (Covariance proportion of MSE)	**R^2**
Developed Economies and EU	1	0.21	0.32	0.02	0.13	0.10	0.01	0.07	0.92	0.99
	2	0.76	1.15	0.27	0.52	1.32	0.05	0.08	0.87	0.93
	3	1.42	2.28	0.87	0.93	5.19	0.13	0.02	0.86	0.74
	4	2.28	3.62	1.94	1.39	13.09	0.27	0.03	0.70	0.45

Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013.

Based on the R^2 of forecasts, the proportion of the variation of the actual values that was captured by the predictions was 99 and 93 per cent for one and two years ahead, but it dropped to 74 and 45 per cent for three and four years ahead, making our forecasts inaccurate for longer time horizons.

As already mentioned in section 4.1.2, the finding that three and four years ahead forecasts are not accurate is not surprising when taking the effects of the crisis into consideration, which had particularly severe consequences on unemployment in this region. The largest forecast errors for three and four years ahead are mainly due to the crisis in Europe. For example, in the GET 2010, the four years ahead forecast for Cyprus, Greece, Portugal and Spain was about 5, 9, 9 and 18 per cent, respectively, versus the realizations which were about 12, 24, 16 and 25 per cent, respectively.[10]

Testing for informational efficiency

Regression results to test for informational efficiency indicate that for one to two years ahead, the forecasts were informative. The estimate for δ was positive and significant and very close to unity while we did not reject the null joint hypothesis of informative forecasts (see Table 7 and Annex 2, Table B4). However, the joint null hypothesis for three and four years ahead was rejected, confirming the previous results that the forecasts' performance after two years ahead begins to deteriorate.

Table 7. Testing for efficiency, for Developed Economies and EU unemployment rate forecasts

		Year(s) ahead			
		1	**2**	**3**	**4**
Developed Economies and EU	α	0.1558 (0.1294)	-0.5141 (0.3862)	0.1893 (0.7389)	0.4828 (1.1423)
	δ	0.9781*** (0.0179)	1.0880*** (0.0535)	1.0773*** (0.1109)	1.1878*** (0.1772)
	F (α=0, δ=1)	0.7553	1.4916	3.1385*	6.8691***
	R^2	0.9937	0.9364	0.7756	0.6161
	N	36	36	36	35

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1;
R^2 refers to the regression results.

4.2.2 Central and South-Eastern Europe (non-EU) and Commonwealth of Independent States (CIS)

Testing for bias

For the sample of countries examined in the Central and South-Eastern Europe (non-EU) and CIS region, we under-predict unemployment rates by 0.04, 0.16, 0.01 and 0.3 percentage points for one, two, three, and four years ahead, respectively (see Annex 2, Table B1). Testing whether this bias is significant, we do not reject the null hypothesis (insignificance based on the results from equation 1) (see Table 8 and Annex 2, Table B3).

[10] Similarly, the four years ahead GDP growth rate forecast in IMF/WEO October 2009 for the same countries was about 3 per cent for Cyprus and 1 per cent for the other three countries versus the realizations of -2 per cent for Cyprus and Spain, -6 per cent for Greece and -3 per cent for Portugal.

Table 8. Testing for bias, for Central and South-Eastern Europe (non-EU) and CIS unemployment rate forecasts

		Year(s) ahead			
		1	**2**	**3**	**4**
Central and South-Eastern Europe (non-EU) and CIS	α	0.0380 (0.2213)	0.1556 (0.4296)	0.0105 (0.5849)	0.2973 (1.3600)
	F (α=0)	0.0295	0.1312	0.0003	0.0478
	N	13	11	10	6

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Testing for accuracy

The median of the forecast errors' distribution was below the mean for all years ahead except for three years ahead. Our forecasts for this sample were relatively accurate for one and two years ahead which can be seen by the MedSE and MedAE as well as the proportion of the variation of the actual values that was captured by the forecasts; the R^2 was 99 and 98 per cent, respectively. However, our accuracy for three and particularly for four years ahead dropped sharply, with an R^2 down to 49 per cent for the four years ahead forecast (see Table 9). These results have to be taken with care because the sample size within this region was small, particularly for four years ahead (only six countries were included in the analysis).

Table 9. Summary of accuracy statistics for unemployment rate forecasts in Central and South-Eastern Europe (non-EU) and CIS

	Year(s) ahead	**MAE** (Mean Absolute Error)	**RMSE** (Root Mean Squared Error)	**MedSE** (Median Squared Error)	**MedAE** (Median Absolute Error)	**MSE** (Mean Squared Error)	**UB** (Bias proportion of MSE)	**UV** (Variance proportion of MSE)	**UC** (Covariance proportion of MSE)	**R^2**
Central & South-Eastern Europe and CIS	1	0.59	0.77	0.25	0.50	0.59	0.00	0.01	1.00	0.99
	2	1.12	1.37	0.76	0.87	1.87	0.01	0.05	0.95	0.98
	3	1.42	1.75	2.29	1.51	3.08	0.00	0.08	0.94	0.96
	4	2.48	3.06	4.62	2.15	9.34	0.01	0.03	0.99	0.49

Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013.

Testing for informational efficiency

Based on the results from equation 2, the estimate for δ was positive, significant and very close to unity while we did not reject the null joint hypothesis of informative forecasts (see Table 10 and Annex 2, Table B4).

Table 10. Testing for efficiency, for Central and South-Eastern Europe (non-EU) and CIS unemployment rate forecasts

		Year(s) ahead			
		1	**2**	**3**	**4**
Central & South-Eastern Europe and CIS	α	-0.0809 (0.3294)	-0.3581 (0.6713)	-0.7532 (0.9482)	-1.5223 (3.0898)
	δ	1.0083*** (0.0214)	1.0380*** (0.0519)	1.0593*** (0.0527)	1.2035** (0.3380)
	F (α=0, δ=1)	0.0776	0.2719	0.6409	0.1843
	R^2	0.9923	0.9767	0.9650	0.5078
	N	13	11	10	6

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1;
R^2refers to the regression results.

4.2.3 Asia

Due to a relatively small sample of countries within each of the three sub-regions in Asia (East Asia, South-East Asia and the Pacific, and South Asia) we report the summary statistics within one section.

Testing for bias

For the sample of countries in Asia for which forecast errors were calculated, we infer that the volatility in both actual and forecasted unemployment rates was small. Our forecast for one year ahead was on average higher than the actual rate by 0.1, 0.2 and 0.3 percentage points in East Asia, South-East Asia and the Pacific; and South Asia, respectively (see AFE in Annex 2, Table B1).

However, the results from equation 1 also indicate that for Asia as a whole there was a negative bias (i.e. over-prediction) in the one to three years ahead forecasts (see Table 11 and Annex 2, Table B3).

Table 11. Testing for bias, for Asia unemployment rate forecasts

		Year(s) ahead			
		1	**2**	**3**	**4**
Asia	α	-0.1799**	-0.5921***	-0.3920**	-0.2943
		(0.0712)	(0.1680)	(0.1667)	(0.1831)
	F (α=0)	6.3833**	12.4162***	5.5306**	2.5828
	N	11	10	10	8

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Testing for accuracy

Due to the small number of forecast errors calculated, the conclusions drawn from the accuracy statistics were not robust. It appears that the forecast error did not decline the longer the prediction period was. For example, the RMSE for two years ahead for East and South Asia was larger than the RMSE for three and four years ahead, while for South-East Asia the RMSE was larger in the case of three years ahead than in the case of four years ahead (see Table 12).

Table 12. Summary of accuracy statistics for unemployment rate forecasts in Asia

	Year(s) ahead	**MAE** (Mean Abso-lute Error)	**RMSE** (Root Mean Squared Error)	**MedSE** (Median Squared Error)	**MedAE** (Median Abso-lute Error)	**MSE** (Mean Squar-ed Error)	**UB** (Bias proport-ion of MSE)	**UV** (Variance proport-ion of MSE)	**UC** (Covariance proportion of MSE)	**R^2**
East Asia	1	0.07	0.07	0.01	0.07	0.01	0.55	0.01	0.46	0.99
	2	0.61	0.66	0.45	0.66	0.43	0.85	0.00	0.15	0.39
	3	0.43	0.50	0.13	0.34	0.25	0.42	0.04	0.57	0.54
	4	0.52	0.56	0.29	0.54	0.32	0.25	0.08	0.71	0.49
South-East Asia and the Pacific	1	0.23	0.30	0.04	0.18	0.09	0.58	0.23	0.20	0.99
	2	0.55	0.59	0.24	0.49	0.35	0.85	0.07	0.08	0.95
	3	0.64	0.74	0.24	0.49	0.55	0.74	0.10	0.17	0.92
	4	0.57	0.59	0.23	0.48	0.35	0.94	0.03	0.03	0.95
South Asia	1	0.37	0.42	0.13	0.36	0.17	0.44	0.07	0.53	0.81
	2	1.01	1.21	1.45	1.01	1.45	0.29	0.77	0.00	-1.39
	3	0.56	0.56	0.31	0.56	0.31				
	4	0.50	0.50	0.25	0.50	0.25				

Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013.

Testing for informational efficiency

The regression results for Asia as a whole indicated efficient forecasts as the estimate for ϭ was significantly positive and close to unity (see Table 13 and Annex 2, Table B4). However, we rejected the null joint hypothesis of informative forecasts.

Table 13. Testing for efficiency, for Asia unemployment rate forecasts

		Year(s) ahead			
		1	**2**	**3**	**4**
Asia	α	0.0423	0.0048	0.1080	-0.1385
		(0.1447)	(0.3499)	(0.3620)	(0.4669)
	ϭ	0.9517***	08716***	0.8746***	0.9570***
		(0.0275)	(0.0726)	(0.0769)	(0.0819)
	F (α=0, ϭ=1)	4.9828**	8.2241**	5.4244**	5.0726*
	R^2	0.9862	0.9423	0.9456	0.9179
	N	11	10	10	8

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1;
R^2 refers to the regression results.

4.2.4 Latin America and the Caribbean

Testing for bias

For the sample of Latin America and the Caribbean, we over-predict (we forecast higher unemployment rates than the actual values) by 0.3, 0.4, 0.01 and 0.3 percentage points for one, two, three, and four years ahead, respectively (see AFE in Annex 2, Table B1.

Based on the results from equation 1 though, there is no sign of a systematic bias as the α is negative but not significant, and we do not reject the hypothesis that it is not significantly different from zero (see Table 14 and Annex 2, Table B3).

Table 14. Testing for bias, for Latin America and the Caribbean unemployment rate forecasts

		Year(s) ahead			
		1	**2**	**3**	**4**
Latin America and the Caribbean	α	-0.3121	-0.4475	-0.0329	-0.7546
		(0.2098)	(0.3056)	(0.4495)	(0.8230)
	F (α=0)	2.2132	2.1443	0.0054	0.8407
	N	22	20	18	7

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Testing for accuracy

The median of the forecast errors' distribution lied below the mean for all years ahead except for year three ahead. In general, our forecasts for Latin America and the Caribbean were relatively accurate, particularly for one and two years ahead (see Table 15). The deviation of the mean forecast from the mean actual value (bias proportion) shows that our prediction do not show a systematic forecast error, for one, two and three years ahead, as the bias proportion is close to zero. The variance proportion of the MSE shows even better results ranging from 0 to 0.1 per cent while the measurement of the error in forecasting of the unsystematic component of the variance of the actual values (the covariance proportion), shows values close to unity for one, two and four years ahead, with slightly lower values for three years ahead (ranging from 86 to 100 per cent). The R^2 of forecasts which measures the variation of the actual values that the predictions have taken into account, shows that our forecasts for

one, two and four years ahead are better than the three years ahead forecasts, with values ranging from 86 to 95 per cent.

Table 15. Summary of accuracy statistics for unemployment rate forecasts in Latin America and the Caribbean

	Year(s) ahead	MAE (Mean Absolute Error)	RMSE (Root Mean Squared Error)	MedSE (Median Squared Error)	MedAE (Median Absolute Error)	MSE (Mean Squared Error)	UB (Bias proportion of MSE)	UV (Variance proportion of MSE)	UC (Covariance proportion of MSE)	R^2
Latin America and the Caribbean	1	0.77	1.01	0.28	0.53	1.02	0.10	0.05	0.86	0.95
	2	1.21	1.41	1.40	1.18	1.97	0.10	0.01	0.89	0.92
	3	1.63	1.85	3.30	1.78	3.44	0.00	0.00	1.01	0.86
	4	1.88	2.15	4.02	2.01	4.63	0.12	0.02	0.88	0.95

Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013.

Testing for informational efficiency

Regression results to test for informational efficiency indicate that the forecasts were informative. The estimate for ϭ was positive, significant and very close to unity. Although we reject the null hypothesis of informative forecasts for the one year ahead forecast, the two to four years ahead forecast show that the ϭ and the α are not significantly different from unity and zero, respectively (see Table 16 and Annex 2, Table B4).

Table 16. Testing for efficiency, for Latin America and the Caribbean unemployment rate forecasts

		Year(s) ahead			
		1	2	3	4
Latin America and the Caribbean	α	0.0948 (0.4307)	-0.1752 (0.5260)	0.0770 (0.7990)	-0.2122 (1.2012)
	ϭ	0.9526*** (0.0310)	0.9696*** (0.0520)	0.9876*** (0.0609)	0.9486*** (0.0460)
	F (α=0, ϭ=1)	6.4290***	1.1091	0.0290	1.8527
	R^2	0.9598	0.9284	0.8562	0.8858
	N	22	20	18	7

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1;
R^2 refers to the regression results.

4.2.5 Middle East and Africa

The number of countries with forecast errors in the Middle East and Africa region was too small to infer robust results, particularly for accuracy (see Annex 2, Table B1 and Table B2).

Testing for bias

Nevertheless, looking at the results, we find that for the six countries examined in the Middle East, we under-predict the one and two years ahead rate by 0.6 and 0.3 percentage points and over-predict three and four years ahead by 0.4 and 0.7 per cent respectively (see AFE in Annex 2, Table B2). For North Africa and Sub-Saharan Africa, we over-predict one, two and three years ahead. Even though the Middle East and Africa tends to have the largest forecast bias compared to other regions, the sample size is too small to use these results with confidence. Taking into account the small sample size, the regression results show that there is no sign for a significant bias in the forecasts (see Table 17).

Table 17. Testing for bias, for the Middle East and Africa unemployment rate forecasts

		Year(s) ahead			
		1	**2**	**3**	**4**
Middle East and Africa	α	0.1381	-0.1017	-0.6412	0.0783
		(0.3776)	(0.5794)	(0.7859)	(0.6047)
	F (α=0)	0.1337	0.0308	0.6656	0.0168
	N	10	9	8	5

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Testing for accuracy

For the Middle East, 50 per cent of the absolute errors for two years ahead was below 0.3 percentage points (see MedAE in Table 18 and Annex 2, Table B2). However, the bias proportion of MSE for the one year ahead forecast was far above zero (20 per cent). For the three countries for which forecast errors for three and four years ahead were calculated, we find that the longer the prediction period, the larger the RSME. For the sample in North Africa and Sub-Saharan Africa, again the shorter the forecast period, the more accurate the predictions were. However, in case of North Africa, there was an indication of misleading forecasts for two and three years ahead due to a negative R^2 of forecasts.

Table 18. Summary of accuracy statistics for unemployment rate forecasts in the Middle East and Africa

	Year(s) ahead	**MAE** (Mean Absolute Error)	**RMSE** (Root Mean Squared Error)	**MedSE** (Median Squared Error)	**MedAE** (Median Absolute Error)	**MSE** (Mean Squared Error)	**UB** (Bias proportion of MSE)	**UV** (Variance proportion of MSE)	**UC** (Covariance proportion of MSE)	**R^2**
Middle East	1	0.85	1.30	0.10	0.31	1.68	0.20	0.19	0.63	0.94
	2	0.99	1.54	0.18	0.42	2.37	0.04	0.00	0.99	0.96
	3	0.36	0.42	0.17	0.41	0.18	0.72	0.25	0.05	1.00
	4	0.68	0.88	0.34	0.59	0.78	0.59	0.07	0.36	0.99
North Africa	1	0.60	0.97	0.01	0.11	0.94	0.37	0.59	0.08	0.22
	2	1.56	2.02	1.56	1.25	4.09	0.13	0.85	0.08	-2.66
	3	2.66	3.35	8.13	2.85	11.22	0.05	0.88	0.12	-5.74
	4	0.20	0.20	0.04	0.20	0.04				
Sub-Saharan Africa	1	0.37	0.37	0.13	0.37	0.13				
	2	0.35	0.35	0.12	0.35	0.12				
	3	1.03	1.36	1.84	1.03	1.84	0.42	0.63	0.00	0.51
	4	2.23	2.23	4.96	2.23	4.96				

Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013.

Testing for informational efficiency

The regression results for the Middle East and Africa as a whole indicate efficient forecasts as the estimate for $\hat{\theta}$ was significantly positive and close to unity and the constant was close to zero and not significant (see Table 19 and Annex 2, Table B4). In addition, we did not reject the null joint hypothesis of informative forecasts.

Table 19. Testing for efficiency, for the Middle East and Africa unemployment rate forecasts

		Year(s) ahead			
		1	**2**	**3**	**4**
Middle East and Africa	α	0.9382	0.2423	0.4775	0.8218
		(0.8581)	(0.6604)	(1.4749)	(1.0258)
	ϭ	0.9303***	0.9676***	0.9014***	0.9293***
		(0.0508)	(0.0488)	(0.1272)	(0..0530)
	F (α=0, ϭ=1)	1.0590	0.2222	0.4857	1.1361
	R^2	0.9429	0.9171	0.8476	0.9813
	N	10	9	8	5

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1;
R^2 refers to the regression results.

4.2.6 Summary regional analysis

Due to the short time horizon in our sample, regional analyses are not as meaningful in some regions as the global results. Nevertheless, there are some important lessons concerning forecast bias and accuracy from regional results.

In the Developed Economies and EU, the region with the largest sample size, there was no significant forecast bias for one to two years ahead, but a positive bias for three and four years ahead. Our forecasts for one and two years ahead capture 99 and 93 per cent of the variation of the actual values, while 92 and 87 per cent of the average squared forecast error is due to the unsystematic component of the variance of the actual values. Moreover, for one to two years ahead, the forecasts were informative. Similarly with the global results, the shorter the forecast period, the more accurate the predictions are.

For the Central and South-Eastern Europe (non-EU) and CIS region, we under-predicted unemployment rates, but our predictions were relatively accurate for one and two years ahead. Nevertheless, our regression results concluded that there is no systematic bias in all forecasts in this region, and also that the forecasts were informative. In addition, the unsystematic component of the variance of the actual values is mostly responsible for the forecast errors.

Due to the small number of forecast errors calculated in Asia, the conclusions drawn from the accuracy statistics were not robust. Furthermore, the regressions results indicate that there is a systematic bias in our forecasts but again the small sample size does not allow us to draw strong conclusions.

In Latin America and the Caribbean on the other hand, we forecasted higher unemployment rates than the actual values and in general, our forecasts were relatively accurate, particularly for one and two years ahead. The forecast bias is not significant for all forecasts, but for the one year ahead our forecasts are not informative.

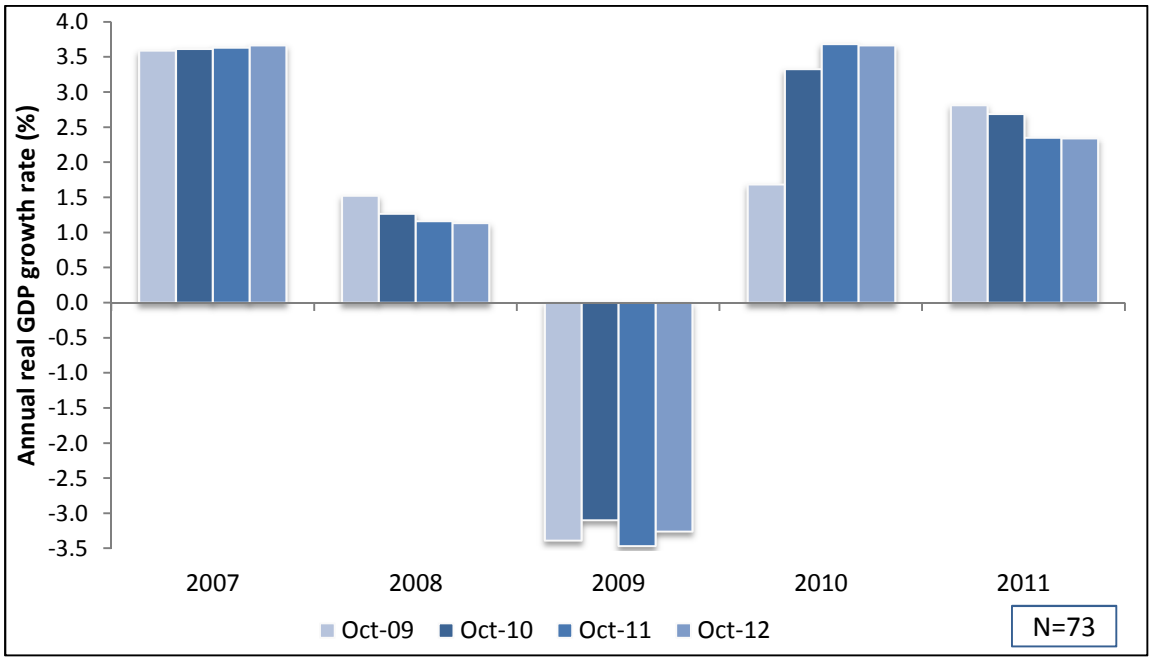
Finally, even though the Middle East and Africa region tends to have the largest forecast bias compared to other regions, the sample size is too small to use these results with confidence and we are not able to infer robust results, particularly for accuracy.

5. Comparison of unemployment rates with GDP growth rate revisions

As discussed above, the GET Model's theoretical basis is Okun's Law. Therefore, any revisions in the GDP growth rate forecasts also influence the forecasting performance of the unemployment rates. With the aim to relate the forecasting performance of unemployment rates and the revisions of GDP growth rates made by the International Monetary Fund in the *World Economic Outlook* Database (IMF WEO), we present a comparison of the two in this section. The comparison is directed at observing whether the direction and the size of the revisions of GDP growth rates are similar to the forecast errors of unemployment rates. To facilitate the comparison, we calculated similar indicators to the summary statistics of the unemployment rate, treating GDP forecast revisions as forecast errors.

Figure 3 graphically presents the revisions made in the IMF WEO database for a sample of 73 countries based on the last three October updates. This sample is comprised of countries for which we have real unemployment rates for all years between 2007 and 2011 and hence, we also have forecasts errors calculated as an average across the three GET Model runs.

Figure 3. Annual real GDP growth rate, selected economies



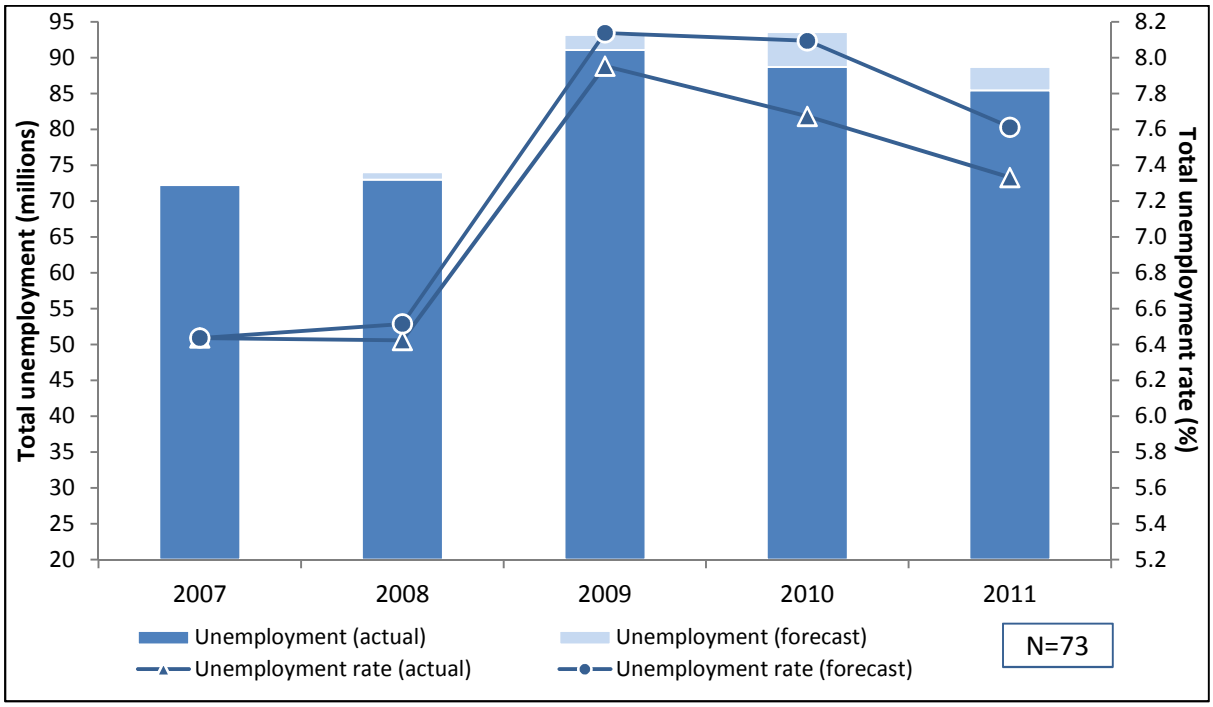
Note: 73 countries are included in this figure (for which there has been at least one unemployment rate forecast between 2008 and 2011, based on one of the GET Model runs).

Source: ILO calculations based on International Monetary Fund, *World Economic Outlook* Database, October 2009; October 2010; October (released on September) 2011; October 2012.

Actual and forecasted unemployment for the sample of countries utilized above are presented in Figure 4. In order to keep the number of countries the same for all years, a country with no forecast for a year was not excluded from the figure. Instead, the actual value is plotted for the year in which all GET Model runs had an actual rate (and thus no forecasts were made). This is only the case for some countries for 2008 for which, even in the earliest model run, data were available. In 2011, the GDP growth rate was downwards revised by half a percentage point since the October 2009 update. The ILO estimates of the forecasted unemployment rate of 7.6 per cent were therefore incorrect and we

incurred a positive unemployment rate forecast error of 0.3 percentage points (actual unemployment of 7.3 per cent and forecasted unemployment rate of 7.6 per cent, see Figure 4). This 0.3 percentage point forecast error translates to an inaccurate estimation of the number of unemployed of more than 3 million.

Figure 4. Actual vs. forecasted unemployment and unemployment rate, selected economies



Note: 73 countries are included in this figure (for which there has been at least one unemployment rate forecast between 2008 and 2011, based on one of the GET Model runs). The unemployment numbers are benchmarked on the ILO Estimates and Projections of the Economically Active Population (EAPEP), 6th edition (Update July 2012).

Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013.

In this section, we will only report forecast errors at the global level, but more detail on each of the regions discussed in this paper can be found in Annex 2, Table B5, Table B6, Table B7 and Table B8.

5.1 Testing for bias

Overall, the (unweighted) average of actual GDP growth rates for the countries included in this post-mortem analysis were 1.5, 3, 2.9 and 2 per cent for one to four years ahead, while the (unweighted) average of the revised rate were 1.3, 2.6, 3.3 and 3.6 per cent, respectively (Annex 2, GDP growth rate, Table B5). The average forecast error (AFE) therefore indicates an over-prediction (the predicted GDP growth rate is higher than the revised rate) of 0.2 and 0.5 per cent for one and two years ahead, respectively, and an under-prediction of 0.4 and 1.6 per cent for three and four years ahead, respectively.

When comparing the results of GDP growth rates to the results of the world average of unemployment rates, the closely tied relationship of these two can be observed. An under-prediction of GDP growth rates for one and two years ahead results in an over-prediction of unemployment rates for the same time frame. Since forecasts for GDP growth rates were lower than the actual rates, forecasts for the

GET unemployment rates were higher than the actual rates. It can also be observed, that the forecast bias of unemployment rates is much lower than the forecast bias of GDP growth rates for all years ahead.

It is worth mentioning here that it comes as no surprise that the output of the GET model (i.e. the unemployment forecast) is less noisy than the GDP forecasts that enter the model as a noisy input. This stems from the fact that the model also uses lags of unemployment rate (see ILO, 2010a). From an empirical observation, small revisions in the GDP growth series and small revisions/changes in unemployment rate data would roughly cause about 30 and 70 per cent of the changes in the final global numbers.

As expected, regression 1 run for GDP growth rates shows that the revisions are not done completely at random. The F-statistic rejects unbiasedness for all years' revisions except the three years ahead (see Table 20 and Annex 2, Table B7). This result should be treated with care because a bias in revisions does not necessarily mean that the forecasts are biased. It might simply mean that the IMF receives the full components of the GDP or the final estimates (e.g. from the National Statistical Offices or Ministries) with a lag of one or two years and this might be the reason of a systematic upwards revision.

Table 20. Testing for bias, for global GDP growth revisions

		Year(s) ahead			
		1	**2**	**3**	**4**
World	α	0.2304**	0.4688***	-0.3915	-1.6339***
		(0.0920)	(0.1642)	(0.2457)	(0.2877)
	F (α=0)	6.2715**	8.1477***	2.5388	32.2607***
	N	87	81	78	58

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

5.2 Testing for accuracy

The one year ahead global root mean squared error (RMSE) was 0.9 per cent, it increased to 1.5 per cent for two years ahead, to 2.2 per cent for three years ahead and to 2.7 per cent for four years ahead (see Table 21 and Annex 2, Table B6). To compare these with the results of unemployment rate forecasts, we standardize the RMSE by dividing it with the standard deviation of the actual rates. For one up to four years ahead the standardized RMSEs for GDP growth rate were 0.27, 0.53, 0.79 and 0.93, and the standardized RMSEs for unemployment were 0.13, 0.22, 0.35 and 0.56, respectively. As we can see, the deviation of the forecasts to the actual values was larger for forecasts in GDP growth rates than for unemployment rates. This result is also confirmed with the mean absolute error, the median squared error and the median absolute error.

Table 21. Summary of accuracy statistics for revisions of GDP growth rates

	Year(s) ahead	MAE (Mean Absolute Error)	RMSE (Root Mean Squared Error)	MedSE (Median Squared Error)	MedAE (Median Absolute Error)	MSE (Mean Squared Error)	UB (Bias proportion of MSE)	UV (Variance proportion of MSE)	UC (Covariance proportion of MSE)	R^2
IMF revisions (GDP) World	1	0.58	0.88	0.11	0.33	0.78	0.07	0.06	0.88	0.96
	2	1.12	1.54	0.52	0.72	2.38	0.09	0.11	0.80	0.82
	3	1.67	2.19	1.92	1.38	4.80	0.03	0.02	0.95	0.65
	4	2.11	2.72	3.09	1.76	7.39	0.36	0.01	0.63	0.59
GET forecasts World	1	0.45	0.72	0.06	0.25	0.52	0.02	0.00	0.98	0.98
	2	0.94	1.27	0.52	0.72	1.60	0.00	0.02	0.98	0.94
	3	1.36	1.98	0.98	0.99	3.92	0.02	0.00	0.98	0.85
	4	1.91	3.02	1.01	1.01	9.12	0.11	0.00	0.89	0.73

Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013, and on IMF World Economic Outlook Database, October 2009; October 2010; October (released in September) 2011; October 2012.

Similarly to the results from equation 1, the decomposition of the MSE into the bias and the variance proportion (UB and UV) indicates that the GDP revisions are not unbiased (ranging from 1 to 11 per cent). The co-variance proportion of the MSE (UC) points to relatively low accuracy as compared to unemployment forecasts. Furthermore, based on the R^2 of forecasts (i.e. revisions in the case of GDP) which indicates accuracy with values close to unity, 96, 82, 65 and only 59 per cent of the variation of the most recent estimates of GDP growth rates is captured by the past estimates for one, two, three, and four years ahead, respectively.

5.3 Testing for informational efficiency

Results from equation 2 confirm the biasedness of the revisions as seen previously, but the revisions are informative (see Table 22 and Annex 2, Table B8). The estimate for δ is close to unity and significant. However, perhaps due to the size of the bias the F-statistic rejects the null joint hypothesis of informative revisions (i.e. unity coefficient, zero constant and white-noise residuals).

Table 22. Testing for efficiency, for global GDP growth revisions

		Year(s) ahead			
		1	2	3	4
World	α	-0.0103	-0.3307	0.103	0.8638
		(0.1339)	(0.2121)	(0.2798)	(0.5542)
	δ	0.9914***	1.0302***	1.0165***	1.0168***
		(0.0128)	(0.0259)	(0.0333)	(0.0784)
	F (α=0, δ=1)	0.8641	1.236	0.6352	4.1530**
	R^2	0.9839	0.9515	0.8815	0.7223
	N	92	86	82	61

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1; R^2refers to the regression results.

6. GET forecasts vs. alternative forecasts

As seen in section 3.1, one of the properties of an optimal forecast is that it provides additional information to alternatives (e.g. Vogel, 2007). The ILO is the only institution providing the public with global and regional forecasts of unemployment rates and we are therefore not able to compare our unemployment rates to other forecasts of unemployment rates. Thus, we therefore have to construct alternative forecast models to compare our results to; an obvious alternative to be examined is the naïve forecast model.

In general, a naïve forecast is one in which the actual value of the previous period is projected into the next period with the assumption that tomorrow will be like the last available observation. Due to its simplistic nature, it is often used as an alternative forecast model, such as in Ash et al. (1998). The results of the naïve forecast model show that the GET model outperforms the naïve model in every aspect (see Table 24). GET predictions are less biased, more accurate and contain a higher informational efficiency than the naïve forecasts.[11]

The alternative forecast used for comparison is similar to the naïve model but slightly more complex which for simplicity, we will call baseline forecast. This alternative forecast model to be chosen here, assumes a *simple autoregressive model* of second order with country dummies.[12]

$$ur_t = \alpha + \alpha_i + \beta_1 ur_{t-1} + \beta_2 ur_{t-2} + \varepsilon_t \qquad (3)$$

where α is a constant, α_i is the country-specific constant, and ε is a stochastic term. To estimate the coefficients we pooled all the countries together.

Figure 5 shows the distribution of the errors across the three alternative forecasts. Already this figure depicts that the GET forecasts errors are more concentrated around zero with steeper peaks for all forecast periods.

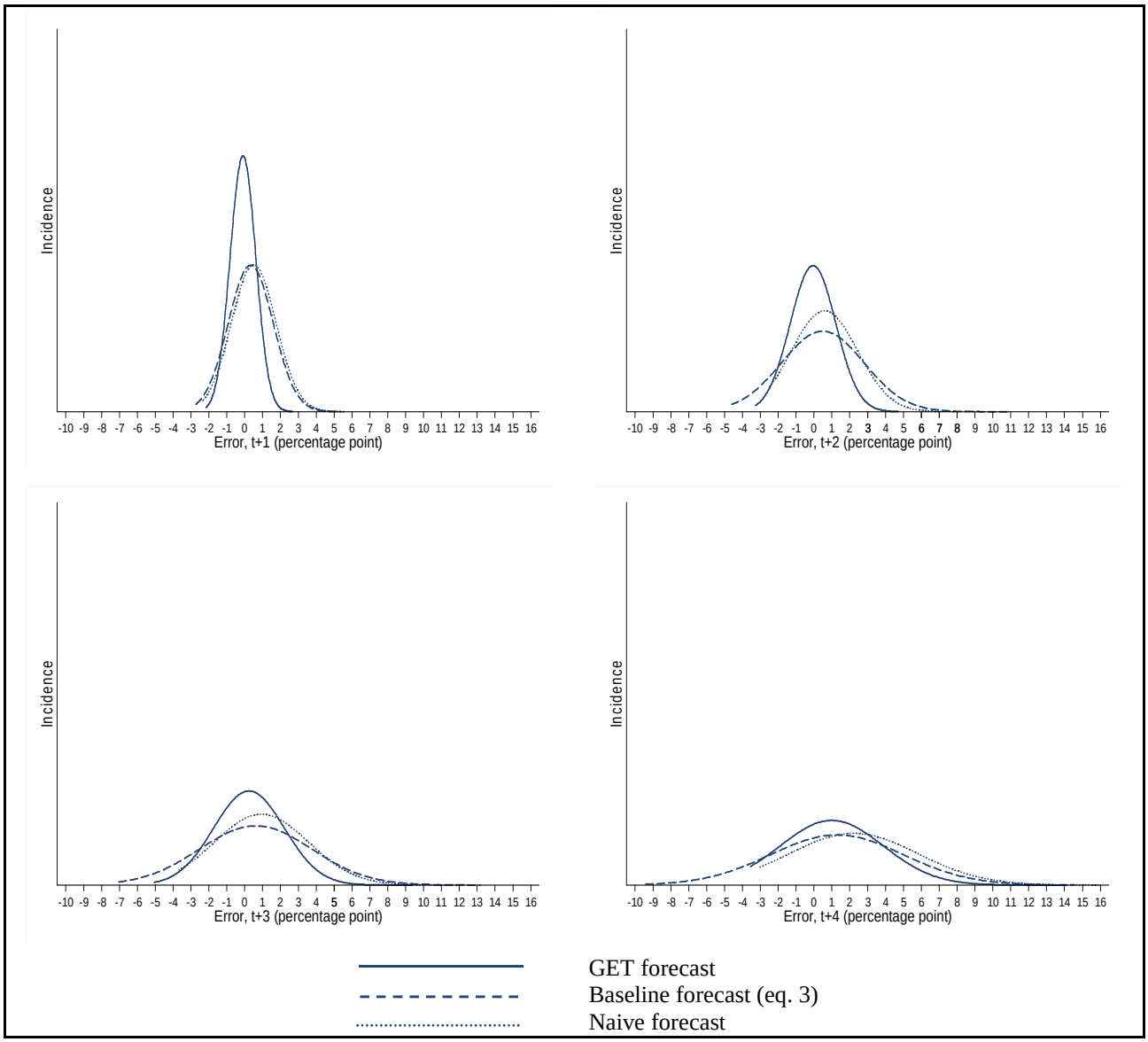
6.1 Testing for bias

Judging from the summary statistics of this baseline (simple autoregressive) model, on average, we would have under-predicted all years ahead by 0.3, 0.5, 0.6 and 1.3 percentage points and the actual unemployment rate would have been larger than the predicted rate(see AFE in Annex 2, Table B9). When comparing these baseline forecasts to the GET forecasts, we see that the average forecast error has a different bias for one and two years ahead but overall, is smaller for the GET forecasts. Moreover, the results from equation 1 clearly indicate that the baseline forecasts are significantly downwards biased for all years (see Table 23 and Annex 2, Table B10).

[11] The results of the naïve forecast model are not shown in this report but are available upon request. Only the distribution of the errors is shown in Figure 5 and some accuracy statistics in Table 24.

[12] The second lag was chosen based on the Akaike information and Bayesian information criteria.

Figure 5. Distribution of errors across alternative forecasts



Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013.

Table 23. Testing for bias, baseline forecasts

		Year(s) ahead			
		1	**2**	**3**	**4**
Baseline forecasts World	α	0.3428**	0.4906*	0.6261*	1.2837**
		(0.1330)	(0.2518)	(0.3530)	(0.4832)
	F (α=0)	6.6454**	3.7942*	3.1460*	7.0585**
	N	89	84	79	59

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

6.2 Testing for accuracy

When looking at our accuracy statistics, we observe that according to the mean absolute error, on average, the baseline forecasts would have been different than the actual value by 1, 1.5, 2.1 and 2.5 points for one up to four years ahead, respectively (see Table 24). These values point to a more inaccurate forecast using the baseline model than using our GET model. These results are backed up by other accuracy statistics, such as the median squared error and the median absolute error which are all further away from zero than our GET forecasts for all time periods.

Table 24. Comparison accuracy statistics GET forecasts and alternative forecasts

	Year(s) ahead	**MAE** (Mean Absolute Error)	**RMSE** (Root Mean Squared Error)	**MedSE** (Median Squared Error)	**MedAE** (Median Absolute Error)	**MSE** (Mean Squared Error)	**UB** (Bias proportion of MSE)	**UV** (Variance proportion of MSE)	**UC** (Covariance proportion of MSE)	**R^2**
Baseline forecasts World	1	0.90	1.29	0.33	0.57	1.67	0.07	0.13	1.04	0.93
	2	1.54	2.35	1.08	1.04	5.51	0.04	0.02	0.95	0.80
	3	2.14	3.18	1.84	1.36	10.11	0.04	0.00	0.96	0.61
	4	2.54	3.90	2.27	1.51	15.19	0.11	0.01	0.89	0.56
Naïve forecasts World	1	0.94	1.35	0.35	0.59	1.83	0.16	0.00	0.84	0.93
	2	1.34	1.94	0.68	0.82	3.77	0.11	0.01	0.87	0.86
	3	1.93	2.79	1.89	1.37	7.81	0.13	0.00	0.87	0.70
	4	2.67	4.14	1.98	1.41	17.14	0.26	0.00	0.74	0.50
GET forecasts World	1	0.45	0.72	0.06	0.25	0.52	0.02	0.00	0.98	0.98
	2	0.94	1.27	0.52	0.72	1.60	0.00	0.02	0.98	0.94
	3	1.36	1.98	0.98	0.99	3.92	0.02	0.00	0.98	0.85
	4	1.91	3.02	1.01	1.01	9.12	0.11	0.00	0.89	0.73

Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013.

Even though the deviation of the mean prediction from the mean actual value (measured by the bias proportion of the mean squared error) for the baseline forecasts points towards no systematic component of the forecast error, the GET forecasts still performed better. However, measuring the variance proportion as well as the covariance proportion, the baseline forecast would have performed slightly better than the GET forecast indicating a better prediction of the systematic and unsystematic component of variation of the actual values with the baseline forecasts. However, based on the R^2 of forecasts, our GET forecasts perform better concerning the variation of the actual values which the predictions have correctly taken into account. The baseline forecasts show that only 93, 80, 61 and only 56 per cent of the variation of the actual outcomes would have been captured by these forecasts for one up to four years ahead, respectively. Therefore, at least for this sample of results, the GET unemployment rate forecasts have been superior to the alternative.

6.3 Testing for informational accuracy

Regarding the results from equation 2, although the estimate for $\hat{\alpha}$ is close to unity and significant, for all forecasts but two years ahead, we do reject the null joint hypothesis of informative forecasts (i.e. unity coefficient, zero constant and white-noise residuals) (see Table 25 and Annex 2, Table B11).

Table 25. Testing for efficiency, baseline forecasts

		Year(s) ahead			
		1	2	3	4
Baseline forecasts World	α	0.1074 (0.2839)	-0.0434 (0.4912)	0.8166 (0.5291)	1.9764*** (0.7122)
	δ̂	1.0272*** (0.0361)	1.0607*** (0.0682)	0.9787*** (0.0731)	0.9079*** (0.1071)
	F (α=0, δ̂=1)	3.4096**	1.9196	2.6579*	6.4875***
	R^2	0.9449	0.8392	0.7028	0.5390
	N	89	84	79	59

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1;
R^2 refers to the regression results.

Overall, it is shown that the GET forecasts produce less biased, more accurate and more informatively efficient results than our alternatives.

7. Conclusions and further work

The results in this post-mortem analysis of the GET unemployment rates suggest that, on average across all countries for which data are available, the GET unemployment rate forecasts are slightly biased; that is we over-predict one and two years ahead and under-predict three and four years ahead. However, this bias is not significant for one to three years ahead.

In general, our tests for accuracy show that the shorter the prediction period, the more accurate our forecasts indicated by smaller forecast errors for shorter prediction periods and larger forecast errors for longer periods. The one, two, and three years ahead forecasts were accurate; however, the four years ahead forecast was inaccurate. Furthermore, our results also indicate that we have informational efficiency for one to three years ahead.

Regional comparisons are difficult due to the small sample size resulting from the short time horizon in our sample. Nevertheless, there are some important lessons to be learned concerning forecast bias and accuracy from regional results. In the Developed Economies and the EU, the region with the largest sample size, there was no significant forecast bias for one to two years ahead, but a positive bias for three and four years ahead. Furthermore, the shorter the forecast period, the more accurate the predictions and for one to two years ahead, the forecasts were informative.

For the Central and South-Eastern Europe (non-EU) and CIS region, we under-predict unemployment rates and our predictions were relatively accurate for one and two years ahead, but forecasts for three and four years ahead were not accurate. In Latin America and the Caribbean we forecasted higher unemployment rates than the actual values and, in general, our forecasts were relatively accurate, particularly for one and two years ahead.

Furthermore, we showed that our GET unemployment rates forecasts have similar or in some cases even better performance than GDP growth rates revisions using the same tests for bias accuracy and informational efficiency. We also saw that the GET forecasts produce less biased, more accurate and more informatively efficient results than alternative models.

In general, the GET model provides quite good projections, but projections at longer horizons are more problematic. Part of this inaccuracy may be due to the specific period over which the model is evaluated (the crisis and its effects, especially in Europe). Some areas to consider for further

examination, especially once the time series of forecast errors is longer, are the comparison with other alternative forecasting models, further statistical tests for efficiency and bias, an evaluation of the diachronic performance and an evaluation in forecasting turning points as well as an in-sample evaluation of the model. Additionally, it would be useful to evaluate each of the GET model runs individually, i.e. GET 2010, GET 2011, etc., to assess whether small changes implemented in the model in the past, improved the forecasts (see Box 2 for a preliminary comparison across model runs).

Box 2. Testing for accuracy based on the three model runs separately

The table below shows the main accuracy measures for each individual model run. For the most recent runs, we have very few observations for three and four years ahead, which prevents us from drawing strong conclusions. Nevertheless, for one and two years ahead forecasts, the more recent model runs have clearly improved the forecasts, as the most recent run ranks the lowest errors (in terms of every measure) among the others. However, this comes to no surprise because the model might performed moderately to precisely forecast the initial impact of the crisis, but with the evolution of the crisis, as the more recent information was incorporated in the model, the forecasts became more accurate.

Box Table 2.1. Testing for accuracy based on the three model runs separately

	Year(s) ahead	**Obs**	**MAE** (Mean Absolute Error)	**RMSE** (Root Mean Squared Error)	**MedSE** (Median Squared Error)	**MedAE** (Median Absolute Error)	**MSE** (Mean Squared Error)	**UB** (Bias proportion of MSE)	**UV** (Variance proportion of MSE)	**UC** (Covariance proportion of MSE)	**R^2**
GET Jan. 2011	1	81	0.45	0.71	0.05	0.22	0.51	0.00	0.00	1.00	0.98
	2	73	0.93	1.44	0.36	0.60	2.08	0.01	0.07	0.92	0.91
	3	7	1.37	1.77	0.48	0.69	3.13	0.51	0.06	0.44	0.91
	4	2	0.86	1.19	1.42	0.86	1.42	0.48	0.57	0.00	
GET Jan. 2010	1	86	0.52	0.83	0.07	0.26	0.68	0.01	0.01	0.97	0.97
	2	84	0.94	1.33	0.45	0.67	1.76	0.02	0.00	0.98	0.93
	3	73	1.32	2.08	0.73	0.85	4.31	0.02	0.02	0.97	0.82
	4	3	0.70	0.86	0.25	0.50	0.74	0.18	0.70	0.16	
GET Jan. 2009	1	87	0.55	0.74	0.86	0.09	0.30	0.02	0.03	0.95	0.97
	2	81	1.27	2.60	1.61	1.01	1.01	0.01	0.01	0.99	0.89
	3	77	1.55	4.38	2.09	1.56	1.25	0.03	0.00	0.97	0.80
	4	59	1.94	9.39	3.06	1.01	1.01	0.12	0.01	0.88	0.57

Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013.

References

Artis, M. and M. Marcellino. 2001. "Fiscal Forecasting: The track record of the IMF, OECD and EC", *The Econometrics Journal*, 2001, Vol. 4, Issue 1, pp. 30−36.

Ash, J.C.K., D.J. Smyth and S.M. Heravi. 1998. "Are OECD forecasts rational and useful?: A directional analysis", *International Journal of Forecasting* 14, pp. 381−391.

Barnichon, R. and C. J. Nekarda. 2013. *The Ins and Outs of Forecasting Unemployment: Using Labor Force Flows to Forecast the Labor Market*. Finance and Economics Discussion Series (FEDS), Divisions of Research & Statistics and Monetary Affairs, Federal Reserve Board, Washington (D.C.), 2013−19.

Blix, M., J. Wadefjord, U. Wienecke and M. Ådahl. 2001. *How Good is the Forecasting Performance of Major Institutions*. Sveriges Riksbank Economic Review, 3/2001, pp. 37−67.

Bowles, C., R. Friz, V. Genre, G. Kenny, A. Meyler and T. Rautanen. 2010. "An Evaluation of the Growth and Unemployment Forecasts in the ECB Survey of Professional Forecasters", *Journal of Business Cycle Measurement and Analysis*, Vol. 2010/2, pp. 63−90, OECD (Paris).

Bratu, M. 2013. *An Evaluation of USA Unemployment Rate Forecasts in Terms of Accuracy and Bias; Empirical Methods to Improve the Forecasts Accuracy*. Annals of the *Constantin Brâncuşi*, University of Târgu Jiu, Economy Series, Issue 1/2013, pp. 170−180.

Crespi Tarantino, G. 2004. *Imputation, estimation and prediction using the Key Indicators of the Labour Market (KILM) data set*. Employment Strategy Paper 2004/16, ILO (Geneva).

Giacomini, R. and H. White. 2006. "Tests of Conditional Predictive Ability", *Econometrica* 74, pp. 1545−78.

Glück, H. and S.P. Schleicher. 2005. Common Biases in OECD and IMF Forecasts: Who Dares to be Different? Paper presented at the workshop "A Real Time Database for the Euro-Area" hosted by the National Bank of Belgium, 13−14 June 2005, in Brussels.

International Labour Organization (ILO). 2013. *Global Employment Trends. Recovering from a second jobs dip* (Geneva).

—. 2012. *Global Employment Trends. Preventing a deeper jobs crisis* (Geneva).

—. 2011. *Global Employment Trends. The challenge of a jobs recovery* (Geneva).

—. 2010a. *Trends Econometric Models: A Review of Methodology*. Working Paper, ILO Employment Trends Unit (Geneva). Available at: http://www.ilo.org/empelm/pubs/WCMS_120382/lang--en/index.htm.

—. 2010b. *Global Employment Trends* (Geneva).

—. 2004. *Global Employment Trends* (Geneva).

Koutsogeorgopoulou, V. 2000. *A Post-Mortem on Economic Outlook Projections*. OECD Economics Department Working Papers, No. 274, OECD (Paris).

Leal, T., J.J. Pérez, M. Tujula and J.P. Vidal. 2008. "Fiscal Forecasting: Lessons from the Literature and Challenges", *Fiscal Studies*, Vol. 29, No. 3, pp. 347−386.

Makridakis, S., S.C. Wheelwright and R.J. Hyndman. 1998. *Forecasting Methods and Applications*. John Wiley & Sons, Inc., Third Edition, p. 642, ISBN 0-471-53233-9.

Milas, C. and P. Rothman. 2008. “Out-of-sample forecasting unemployment rates with pooled STVECM forecasts”, *International Journal of Forecasting* 24, pp. 101−121.

Patton, A.J. and A. Timmermann. 2007. “Properties of optimal forecasts under asymmetric loss and nonlinearity”, *Journal of Econometrics* 140, pp. 884−918.

Schanne, N., R. Wapler and A. Weyh. 2010. “Regional unemployment forecasts with spatial interdependencies”, *International Journal of Forecasting* 26, pp. 908−926.

Tserkezos, D. 2010. “Evaluation of the Diachronic Performance of the OECD Macroeconomic Forecasts for Greece”, *East-West Journal of Economics and Business*, Vol. XII, No.1, pp. 83−101.

Timmermann, A. 2007. “An Evaluation of the World Economic Outlook Forecasts”, *IMF Staff Papers*, Vol. 54, No. 1 (International Monetary Fund, Washington DC)

—. 2006. *An Evaluation of the World Economic Outlook Forecasts*. International Monetary Fund, Working Paper No. 06/59 (Washington DC).

Vogel, L. 2007. *How Do the OECD Growth Projections for the G7 Economies Perform? A Post-Mortem*. OECD Economics Department Working Paper No. 573 (Paris).

Annexes

Annex 1. Literature on forecast errors and measures used

Table A1. Evaluation of forecast performance in selected literature

Author(s)	Forecasts	Selected measures used
Forecasting GDP growth and government deficit		
Glück and Schleicher (2005)	Examination of common bias in OECD and IMF forecasts	- Smoothed first and second moments of forecast errors
Blix **et al.** (2001)	Examination of forecast performance of 52 thousand GDP and inflation forecasts based on 250 institutions	- Average root mean squared error - Average forecast error
Ash **et al.** (1998)	Evaluation of the directional accuracy of OECD forecasts	- Non-parametric tests
Timmermann (2006, 2007)	Evaluation of the World Economic Outlook Forecasts	- Mean error - Median error - Standard deviation - Serial correlation
Koutsogeorgopoulou (2000) & Vogel (2007)	Evaluation of the OECD forecasts	- Average forecast error - Average root mean squared error - Mean absolute error - Frequency of positive errors - Errors' serial correlation - Theil inequality coefficient - Correlation coefficient between forecasts and realizations - R^2 - Contingency tables to test for directional accuracy
Artis and Marcellino (1998)	Analysis of the performance of the IMF, OECD and European Commission forecasts for government deficit	- Mean error - MAE - RMSE - Lagrange Multiplier test - Diebold and Mariano statistics - Theil index
Forecasting unemployment rates		
Milas and Rothman (2008)	Evaluation of the out-of-sample forecast performance of non-linear and linear models	- Root mean squared error - Median squared errors - Root mean squared error ratios
Schanne **et al.** (2010)	Evaluation of the performance of univariate spatial global vector autoregressive models controlling for regional interdependencies versus traditional methods for regional forecasting	- Mean absolute percentage forecast error
Barnichon and Nekarda (2013)	Test of the forecasting performance of models using labour flows versus the survey of professional forecasters (SPF) and time-series models	- Root mean squared error - Giacomini-White statistic
Bowles **et al.** (2010)	Evaluation of the accuracy of the SPF's GDP and unemployment rate forecasts	- Mean error - Mean absolute error - Root mean squared error - Theil index
Bratu (2013)	Examination of the forecasting performance for the unemployment rate in the United States made by several institutions	- Root mean squared error - Average forecast error - Mean absolute error - Theil index

Annex 2. Tables

Unemployment rate

Table B1. Summary statistics of actual and forecasted unemployment rates

Region	Year(s) ahead	Number of countries	Actual		Forecasted		AFE
			Mean	Standard deviation	Mean	Standard deviation	(Average Forecast Error)
World	1	92	9.20	5.62	9.29	5.62	-0.09
	2	86	9.10	5.70	9.15	5.40	-0.05
	3	82	8.99	5.70	8.74	5.27	0.25
	4	61	8.71	5.42	7.72	4.53	0.99
Developed Economies and European Union	1	36	8.70	3.81	8.74	3.88	-0.04
	2	36	9.07	4.24	8.81	3.77	0.26
	3	36	9.09	4.45	8.26	3.64	0.83
	4	35	9.37	4.90	7.48	3.24	1.89
Central and South-Eastern Europe (non-EU) and CIS	1	13	14.32	8.76	14.29	8.66	0.04
	2	11	13.66	8.73	13.51	8.31	0.16
	3	10	12.89	9.07	12.88	8.41	0.01
	4	6	9.24	4.33	8.94	2.57	0.30
East Asia	1	4	4.00	0.84	4.06	0.84	-0.06
	2	4	3.55	0.78	4.16	0.77	-0.61
	3	4	3.33	0.73	3.65	0.73	-0.32
	4	4	3.21	0.81	3.50	0.81	-0.28
South-East Asia and the Pacific	1	4	4.73	2.69	4.97	2.83	-0.23
	2	4	4.47	2.68	5.02	2.83	-0.55
	3	5	3.86	2.54	4.50	2.75	-0.64
	4	3	3.55	2.63	4.12	2.52	-0.57
South Asia	1	3	4.57	0.94	4.84	0.78	-0.28
	2	2	4.22	0.71	4.88	1.76	-0.65
	3	1	3.30	0.00	2.74	0.00	0.56
	4	1	3.10	0.00	2.60	0.00	0.50
Latin America and the Caribbean	1	22	8.26	4.68	8.58	4.81	-0.31
	2	20	8.52	4.97	8.97	4.94	-0.45
	3	18	8.84	4.91	8.87	4.60	-0.03
	4	7	9.81	5.97	10.56	5.92	-0.75
Middle East	1	6	13.11	5.35	12.53	5.81	0.58
	2	5	11.44	7.52	11.12	7.37	0.32
	3	3	14.40	6.18	14.76	6.39	-0.36
	4	3	12.12	9.95	12.80	10.17	-0.68
North Africa	1	3	9.97	0.73	10.56	1.41	-0.59
	2	3	9.92	0.57	10.65	1.98	-0.73
	3	3	10.40	1.21	11.16	2.83	-0.76
	4	1	9.50	0.00	9.30	0.00	0.20
Sub-Saharan Africa	1	1	7.63	0.00	8.00	0.00	-0.37
	2	1	7.58	0.00	7.93	0.00	-0.35
	3	2	5.61	2.00	6.49	0.92	-0.88
	4	1	7.14	0.00	4.92	0.00	2.23

Notes: The country-level results are available upon request. The mean and standard deviation is unweighted.
Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013.

Table B2. Summary of accuracy statistics for the GET unemployment rate forecasts

Region	Year(s) ahead	MAE (Mean Absolute Error)	RMSE (Root Mean Squared Error)	MedSE (Median Squared Error)	MedAE (Median Absolute Error)
World	1	0.45	0.72	0.06	0.25
	2	0.94	1.27	0.52	0.72
	3	1.36	1.98	0.98	0.99
	4	1.91	3.02	1.01	1.01
Developed Economies and European Union	1	0.21	0.32	0.02	0.13
	2	0.76	1.15	0.27	0.52
	3	1.42	2.28	0.87	0.93
	4	2.28	3.62	1.94	1.39
Central and South-Eastern Europe (non-EU) and CIS	1	0.59	0.77	0.25	0.50
	2	1.12	1.37	0.76	0.87
	3	1.42	1.75	2.29	1.51
	4	2.48	3.06	4.62	2.15
East Asia	1	0.07	0.07	0.01	0.07
	2	0.61	0.66	0.45	0.66
	3	0.43	0.50	0.13	0.34
	4	0.52	0.56	0.29	0.54
South-East Asia and the Pacific	1	0.23	0.30	0.04	0.18
	2	0.55	0.59	0.24	0.49
	3	0.64	0.74	0.24	0.49
	4	0.57	0.59	0.23	0.48
South Asia	1	0.37	0.42	0.13	0.36
	2	1.01	1.21	1.45	1.01
	3	0.56	0.56	0.31	0.56
	4	0.50	0.50	0.25	0.50
Latin America and the Caribbean	1	0.77	1.01	0.28	0.53
	2	1.21	1.41	1.40	1.18
	3	1.63	1.85	3.30	1.78
	4	1.88	2.15	4.02	2.01
Middle East	1	0.85	1.30	0.10	0.31
	2	0.99	1.54	0.18	0.42
	3	0.36	0.42	0.17	0.41
	4	0.68	0.88	0.34	0.59
North Africa	1	0.60	0.97	0.01	0.11
	2	1.56	2.02	1.56	1.25
	3	2.66	3.35	8.13	2.85
	4	0.20	0.20	0.04	0.20
Sub-Saharan Africa	1	0.37	0.37	0.13	0.37
	2	0.35	0.35	0.12	0.35
	3	1.03	1.36	1.84	1.03
	4	2.23	2.23	4.96	2.23

Table B2. Summary of accuracy statistics for the GET unemployment rate forecasts (*cont.*)

Region	Year(s) ahead	MSE (Mean Squared Error)	UB (Bias proportion of MSE)	UV (Variance proportion of MSE)	UC (Covariance proportion of MSE)	R^2
World	1	0.52	0.02	0.00	0.98	0.98
	2	1.60	0.00	0.02	0.98	0.94
	3	3.92	0.02	0.00	0.98	0.85
	4	9.12	0.11	0.00	0.89	0.73
Developed Economies and European Union	1	0.10	0.01	0.07	0.92	0.99
	2	1.32	0.05	0.08	0.87	0.93
	3	5.19	0.13	0.02	0.86	0.74
	4	13.09	0.27	0.03	0.70	0.45
Central and South-Eastern Europe (non-EU) and CIS	1	0.59	0.00	0.01	1.00	0.99
	2	1.87	0.01	0.05	0.95	0.98
	3	3.08	0.00	0.08	0.94	0.96
	4	9.34	0.01	0.03	0.99	0.49
East Asia	1	0.01	0.55	0.01	0.46	0.99
	2	0.43	0.85	0.00	0.15	0.39
	3	0.25	0.42	0.04	0.57	0.54
	4	0.32	0.25	0.08	0.71	0.49
South-East Asia and the Pacific	1	0.09	0.58	0.23	0.20	0.99
	2	0.35	0.85	0.07	0.08	0.95
	3	0.55	0.74	0.10	0.17	0.92
	4	0.35	0.94	0.03	0.03	0.95
South Asia	1	0.17	0.44	0.07	0.53	0.81
	2	1.45	0.29	0.77	0.00	-1.39
	3	0.31				
	4	0.25				
Latin America and the Caribbean	1	1.02	0.10	0.05	0.86	0.95
	2	1.97	0.10	0.01	0.89	0.92
	3	3.44	0.00	0.00	1.01	0.86
	4	4.63	0.12	0.02	0.88	0.95
Middle East	1	1.68	0.20	0.19	0.63	0.94
	2	2.37	0.04	0.00	0.99	0.96
	3	0.18	0.72	0.25	0.05	1.00
	4	0.78	0.59	0.07	0.36	0.99
North Africa	1	0.94	0.37	0.59	0.08	0.22
	2	4.09	0.13	0.85	0.08	-2.66
	3	11.22	0.05	0.88	0.12	-5.74
	4	0.04				
Sub-Saharan Africa	1	0.13				
	2	0.12				
	3	1.84	0.42	0.63	0.00	0.51
	4	4.96				

Note: For the details on the measurements, please, see Annex 3.
Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013.

Table B3. Testing for bias

Region		Year(s) ahead			
		1	**2**	**3**	**4**
World	α	-0.0898	-0.0542	0.2473	0.9934***
		(0.0749)	(0.1372)	(0.2182)	(0.3683)
	F (α=0)	1.4370	0.1561	1.2836	7.2771***
	N	92	86	82	61
Developed Economies and European Union	α	-0.0358	0.2615	0.8281**	1.8874***
		(0.0531)	(0.1888)	(0.3587)	(0.5294)
	F (α=0)	0.4532	1.9188	5.3296**	12.7111***
	N	36	36	36	35
Central and South-Eastern Europe (non-EU) and CIS	α	0.0380	0.1556	0.0105	0.2973
		(0.2213)	(0.4296)	(0.5849)	(1.3600)
	F (α=0)	0.0295	0.1312	0.0003	0.0478
	N	13	11	10	6
Asia	α	-0.1799**	-0.5921***	-0.3920**	-0.2943
		(0.0712)	(0.1680)	(0.1667)	(0.1831)
	F (α=0)	6.3833**	12.4162***	5.5306**	2.5828
	N	11	10	10	8
Latin America and the Caribbean	α	-0.3121	-0.4475	-0.0329	-0.7546
		(0.2098)	(0.3056)	(0.4495)	(0.8230)
	F (α=0)	2.2132	2.1443	0.0054	0.8407
	N	22	20	18	7
Middle East and Africa	α	0.1381	-0.1017	-0.6412	0.0783
		(0.3776)	(0.5794)	(0.7859)	(0.6047)
	F (α=0)	0.1337	0.0308	0.6656	0.0168
	N	10	9	8	5

Notes: Only the regions displayed showed a sufficient number of observations to run regression analysis. Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Table B4. Testing for efficiency

Region		Year(s) ahead			
		1	2	3	4
World	α	-0.0103	-0.3307	0.103	0.8638
		(0.1339)	(0.2121)	(0.2798)	(0.5542)
	ϐ	0.9914***	1.0302***	1.0165***	1.0168***
		(0.0128)	(0.0259)	(0.0333)	(0.0784)
	F (α=0, ϐ=1)	0.8641	1.236	0.6352	4.1530**
	R^2	0.9839	0.9515	0.8815	0.7223
	N	92	86	82	61
Developed Economies and European Union	α	0.1558	-0.5141	0.1893	0.4828
		(0.1294)	(0.3862)	(0.7389)	(1.1423)
	ϐ	0.9781***	1.0880***	1.0773***	1.1878***
		(0.0179)	(0.0535)	(0.1109)	(0.1772)
	F (α=0, ϐ=1)	0.7553	1.4916	3.1385*	6.8691***
	R^2	0.9937	0.9364	0.7756	0.6161
	N	36	36	36	35
Central and South-Eastern Europe (non-EU) and CIS	α	-0.0809	-0.3581	-0.7532	-1.5223
		(0.3294)	(0.6713)	(0.9482)	(3.0898)
	ϐ	1.0083***	1.0380***	1.0593***	1.2035**
		(0.0214)	(0.0519)	(0.0527)	(0.3380)
	F (α=0, ϐ=1)	0.0776	0.2719	0.6409	0.1843
	R^2	0.9923	0.9767	0.9650	0.5078
	N	13	11	10	6
Asia	α	0.0423	0.0048	0.1080	-0.1385
		(0.1447)	(0.3499)	(0.3620)	(0.4669)
	ϐ	0.9517***	08716***	0.8746***	0.9570***
		(0.0275)	(0.0726)	(0.0769)	(0.0819)
	F (α=0, ϐ=1)	4.9828**	8.2241**	5.4244**	5.0726*
	R^2	0.9862	0.9423	0.9456	0.9179
	N	11	10	10	8
Latin America and the Caribbean	α	0.0948	-0.1752	0.0770	-0.2122
		(0.4307)	(0.5260)	(0.7990)	(1.2012)
	ϐ	0.9526***	0.9696***	0.9876***	0.9486***
		(0.0310)	(0.0520)	(0.0609)	(0.0460)
	F (α=0, ϐ=1)	6.4290***	1.1091	0.0290	1.8527
	R^2	0.9598	0.9284	0.8562	0.8858
	N	22	20	18	7
Middle East and Africa	α	0.9382	0.2423	0.4775	0.8218
		(0.8581)	(0.6604)	(1.4749)	(1.0258)
	ϐ	0.9303***	0.9676***	0.9014***	0.9293***
		(0.0508)	(0.0488)	(0.1272)	(0..0530)
	F (α=0, ϐ=1)	1.0590	0.2222	0.4857	1.1361
	R^2	0.9429	0.9171	0.8476	0.9813
	N	10	9	8	5

Notes: Only the regions displayed showed a sufficient number of observations to run regression analysis. Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1; R2refers to the regression results.

GDP growth rate

Table B5. Summary statistics of latest and revised GDP growth rates

Region	Year(s) ahead	Number of countries	Latest		Revised		AFE
			Mean	Standard deviation	Mean	Standard deviation	(Average Forecast Error)
World	1	92	1.53	3.28	1.30	2.96	0.23
	2	86	3.02	2.93	2.56	2.08	0.47
	3	82	2.87	2.76	3.27	1.46	-0.39
	4	61	1.98	2.92	3.62	2.24	-1.63
Developed Economies and European Union	1	36	-0.29	1.79	-0.34	1.81	0.06
	2	36	1.44	1.77	1.50	1.01	-0.06
	3	36	1.25	2.09	2.43	0.98	-1.18
	4	35	0.67	2.13	2.84	1.17	-2.17
Central and South-Eastern Europe (non-EU) and CIS	1	13	2.07	3.81	1.57	3.51	0.50
	2	11	3.47	2.38	2.70	1.15	0.77
	3	10	3.67	2.51	3.91	0.89	-0.24
	4	6	3.49	2.55	4.30	0.76	-0.81
East Asia	1	4	3.63	0.51	3.09	0.29	0.54
	2	4	4.74	0.48	4.22	0.11	0.52
	3	4	3.09	0.32	4.43	0.24	-1.34
	4	4	1.95	0.58	4.70	0.28	-2.75
South-East Asia and the Pacific	1	4	3.85	1.44	3.75	1.21	0.10
	2	4	5.45	0.67	4.53	0.56	0.92
	3	5	4.85	1.29	4.89	0.77	-0.03
	4	3	4.94	0.50	5.00	0.42	-0.06
South Asia	1	3	7.05	3.56	5.11	2.63	1.93
	2	2	6.88	0.92	6.10	1.15	0.78
	3	1	11.80	0.00	6.85	0.00	4.95
	4	1	5.27	0.00	6.62	0.00	-1.36
Latin America and the Caribbean	1	22	2.01	3.92	1.94	3.48	0.07
	2	20	3.81	3.89	2.63	2.77	1.19
	3	18	4.50	2.64	3.13	1.61	1.38
	4	7	3.57	1.77	2.98	1.59	0.60
Middle East	1	6	3.17	1.60	2.77	1.82	0.40
	2	5	6.60	3.44	5.05	3.37	1.55
	3	3	3.12	0.34	4.68	0.08	-1.56
	4	3	8.56	5.81	10.92	6.18	-2.36
North Africa	1	3	3.60	0.90	3.66	0.77	-0.06
	2	3	3.38	0.40	4.01	0.86	-0.63
	3	3	2.98	0.91	4.49	0.57	-1.52
	4	1	2.87	0.00	5.00	0.00	-2.13
Sub-Saharan Africa	1	1	3.77	0.00	3.28	0.00	0.49
	2	1	3.89	0.00	3.41	0.00	0.48
	3	2	4.93	1.23	5.41	0.92	-0.48
	4	1	3.37	0.00	4.19	0.00	-0.83

Notes: The country-level results are available upon request. The mean and standard deviation is unweighted. Forecasts in this table describe revisions of the estimates and/or forecasts in one of the three October versions of WEO as compared to October 2012 WEO. The number of observations is exactly the same as in Table B1, but excluding 5 countries which are not included in the WEO database (Cuba, Guadeloupe, Macau-China, Puerto Rico, West Bank and Gaza Strip).

Source: ILO calculations based on IMF *World Economic Outlook* Database October 2009; October 2010; October (released in September) 2011; October 2012.

Table B6. Summary of accuracy statistics for the revisions of GDP growth rates

Region	Year(s) ahead	MAE (Mean Absolute Error)	RMSE (Root Mean Squared Error)	MedSE (Median Squared Error)	MedAE (Median Absolute Error)
World	1	0.58	0.88	0.11	0.33
	2	1.12	1.54	0.52	0.72
	3	1.67	2.19	1.92	1.38
	4	2.11	2.72	3.09	1.76
Developed Economies and European Union	1	0.42	0.61	0.04	0.21
	2	0.89	1.21	0.38	0.62
	3	1.64	2.16	1.95	1.39
	4	2.32	2.97	3.10	1.76
Central and South-Eastern Europe (non-EU) and CIS	1	0.70	1.02	0.05	0.23
	2	1.35	1.78	0.61	0.78
	3	1.77	2.01	3.56	1.89
	4	1.79	2.56	2.14	1.27
East Asia	1	0.54	0.58	0.19	0.43
	2	0.52	0.64	0.23	0.48
	3	1.34	1.41	2.39	1.55
	4	2.75	2.80	6.22	2.49
South-East Asia and the Pacific	1	0.45	0.56	0.29	0.50
	2	0.92	1.00	1.13	1.05
	3	0.75	0.98	0.16	0.40
	4	0.67	0.74	0.33	0.57
South Asia	1	1.93	2.26	2.71	1.65
	2	1.99	2.14	4.56	1.99
	3	4.95	4.95	24.53	4.95
	4	1.36	1.36	1.84	1.36
Latin America and the Caribbean	1	0.68	0.98	0.24	0.49
	2	1.42	1.98	0.69	0.83
	3	2.04	2.68	1.91	1.35
	4	1.87	2.48	1.89	1.31
Middle East	1	0.67	0.95	0.26	0.51
	2	2.07	2.31	3.70	1.84
	3	1.56	1.61	2.59	1.56
	4	2.36	2.38	5.69	2.36
North Africa	1	0.16	0.18	0.02	0.14
	2	0.63	0.91	0.06	0.23
	3	1.52	1.95	0.78	0.88
	4	2.13	2.13	4.52	2.13
Sub-Saharan Africa	1	0.49	0.49	0.24	0.49
	2	0.48	0.48	0.23	0.48
	3	0.48	0.57	0.32	0.48
	4	0.83	0.83	0.69	0.83

Table B6. Summary of accuracy statistics for the revisions of GDP growth rates (cont.)

Region	Year(s) ahead	MSE (Mean Squared Error)	UB (Bias proportion of MSE)	UV (Variance proportion of MSE)	UC (Covariance proportion of MSE)	R^2
World	1	0.78	0.07	0.06	0.88	0.96
	2	2.38	0.09	0.11	0.80	0.82
	3	4.80	0.03	0.02	0.95	0.65
	4	7.39	0.36	0.01	0.63	0.59
Developed Economies and European Union	1	0.38	0.01	0.05	0.95	0.98
	2	1.47	0.00	0.07	0.94	0.72
	3	4.65	0.30	0.00	0.70	0.40
	4	8.81	0.54	0.02	0.45	0.07
Central and South-Eastern Europe (non-EU) and CIS	1	1.04	0.24	0.04	0.73	0.97
	2	3.16	0.19	0.17	0.65	0.74
	3	4.02	0.01	0.17	0.84	0.77
	4	6.57	0.10	0.00	0.92	0.66
East Asia	1	0.34	0.87	0.14	0.00	0.99
	2	0.41	0.66	0.33	0.03	0.98
	3	2.00	0.90	0.06	0.05	0.91
	4	7.84	0.97	0.00	0.04	0.65
South-East Asia and the Pacific	1	0.31	0.03	0.05	0.96	0.99
	2	1.00	0.84	0.00	0.16	0.96
	3	0.96	0.00	0.00	1.03	0.96
	4	0.55	0.01	0.66	0.39	0.98
South Asia	1	5.12	0.73	0.13	0.16	0.85
	2	4.56	0.13	0.94	0.00	0.88
	3	24.53				
	4	1.84				
Latin America and the Caribbean	1	0.97	0.01	0.11	0.89	0.95
	2	3.91	0.36	0.21	0.44	0.76
	3	7.16	0.26	0.01	0.73	0.47
	4	6.16	0.06	0.47	0.50	0.46
Middle East	1	0.90	0.18	0.19	0.66	0.92
	2	5.31	0.45	0.03	0.55	0.85
	3	2.59	0.94	0.07	0.00	0.88
	4	5.69	0.98	0.02	0.00	0.96
North Africa	1	0.03	0.11	0.36	0.58	1.00
	2	0.83	0.49	0.43	0.11	0.95
	3	3.80	0.60	0.24	0.17	0.82
	4	4.52				
Sub-Saharan Africa	1	0.24				
	2	0.23				
	3	0.32	0.72	0.31	0.00	0.99
	4	0.69				

Note: For the details on the measurements, please see Annex 3. Errors on this table describe revisions of the estimates/forecasts from the October versions of WEO as compared to October 2012 WEO. The calculation of these errors is done for exactly the same observations as in Table B2, excluding 5 countries which are not included in the WEO database (Cuba, Guadeloupe, Macau-China, Puerto Rico, West Bank and Gaza Strip).
Source: ILO calculations based on IMF *World Economic Outlook* Database October 2009; October 2010; October (released in September) 2011; October 2012.

Table B7. Testing for bias, GDP revisions

Region		Year(s) ahead			
		1	2	3	4
World	α	0.2304**	0.4688***	-0.3915	-1.6339***
		(0.0920)	(0.1642)	(0.2457)	(0.2877)
	F (α=0)	6.2715**	8.1477***	2.5388	32.2607***
	N	87	81	78	58
Developed Economies and European Union	α	0.0567	-0.0613	-1.1756***	-2.1720***
		(0.1033)	(0.2048)	(0.3054)	(0.3470)
	F (α=0)	0.3011	0.0896	14.8200***	39.1714***
	N	36	36	36	35
Central and South-Eastern Europe (non-EU) and CIS	α	0.5034*	0.7665	-0.2364	-0.8090
		(0.2560)	(0.5074)	(0.6640)	(1.0879)
	F (α=0)	3.8675*	2.2819	0.1267	0.5530
	N	13	11	10	6
Asia	α	0.7829*	0.7547*	0.0857	-1.3996**
		(0.3573)	(0.3573)	(0.6997)	(1.0879)
	F (α=0)	4.8019*	4.4608*	0.0150	6.1904**
	N	10	9	9	7
Latin America and the Caribbean	α	0.0704	1.1869***	1.3751**	0.5956
		(0.2314)	(0.3954)	(0.5925)	(1.0779)
	F (α=0)	0.0927	9.0091***	5.3867**	0.3053
	N	19	17	16	6
Middle East and Africa	α	0.2542	0.5968	-1.2321**	-1.9174**
		(0.2427)	(0.6140)	(0.3964)	(0.3951)
	F (α=0)	1.0974	0.9446	9.6630**	23.5523**
	N	9	8	7	4

Notes: Only the regions displayed showed a sufficient number of observations to run regression analysis. Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Table B8. Testing for efficiency, GDP revisions

Region		Year(s) ahead			
		1	2	3	4
World	α	0.1379	-0.1538	-1.0341	-1.1933**
		(0.0935)	(0.2485)	(0.7583)	(0.5767)
	β	1.0714***	1.2436***	1.1967***	0.8782***
		(0.0380)	(0.0832)	(0.2078)	(0.1110)
	F (α=0, β=1)	4.2891**	7.9495***	1.5177	22.3225***
	R^2	0.9363	0.7789	0.4006	0.4540
	N	87	81	78	58
Developed Economies and European Union	α	0.0321	-0.5208	-1.3499	-1.1962
		(0.1000)	(0.5378)	(1.0052)	(1.0855)
	β	0.9282***	1.3065***	1.0718***	0.6567*
		(0.0680)	(0.2854)	(0.3504)	(0.3480)
	F (α=0, β=1)	0.6124	0.5832	7.9863***	21.3000***
	R^2	0.8879	0.5588	0.2537	0.1309
	N	36	36	36	35
Central and South-Eastern Europe (non-EU) and CIS	α	0.4110	-0.9721	-3.8204	-0.1772
		(0.2711)	(1.0410)	(2.4605)	(4.3792)
	β	1.0589***	1.6433***	1.9177**	0.8531
		(0.0600)	(0.3674)	(0.6134)	(0.8161)
	F (α=0, β=1)	2.2459	2.4984	1.2055	0.5215
	R^2	0.9482	0.6358	0.4638	0.0646
	N	13	11	10	6
Asia	α	-0.6967	3.0534*	-7.5549*	-2.1892
		(0.8748)	(1.3775)	(3.6370)	(3.1081)
	β	1.3736***	0.5187	2.5432**	1.1548*
		(0.2122)	(0.2970)	(0.7921)	(0.5082)
	F (α=0, β=1)	4.7802**	4.9240*	2.6349	5.8987*
	R^2	0.8955	0.2358	0.7329	0.2642
	N	10	9	9	7
Latin America and the Caribbean	α	-0.117	0.3297	1.9479	3.7610
		(0.2408)	(0.3113)	(1.4296)	(2.1740)
	β	1.0938***	1.3265***	0.8169*	-0.0636
		(0.0572)	(0.0705)	(0.4168)	(0.5201)
	F (α=0, β=1)	1.3556	12.3713***	2.6692	2.2900
	R^2	0.9436	0.8872	0.2476	0.0033
	N	19	17	16	6
Middle East and Africa	α	0.9281	0.8063	-1.4765	-1.1919
		(0.7319)	(1.3493)	(2.7415)	(0.6473)
	β	0.7843***	0.9530***	1.0508	0.9065***
		(0.1793)	(0.2134)	(0.5903)	(0.0406)
	F (α=0, β=1)	0.8109	0.4157	4.4985*	586.7457***
	R^2	0.7786	0.6778	0.3733	0.9901
	N	9	8	7	4

Notes: Only the regions displayed showed a sufficient number of observations to run regression analysis. Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1; R^2 refers to the regression results.

Baseline forecast

Table B9. Summary accuracy statistics for unemployment rate forecasts based on the baseline model

Region	Year(s) ahead	Number of countries	AFE (Average Forecast Error)	MAE (Mean Absolute Error)	RMSE (Root Mean Squared Error)	MedSE (Median Squared Error)	MedAE (Median Absolute Error)
World	1	89	0.34	0.90	1.29	0.33	0.57
	2	84	0.49	1.54	2.35	1.08	1.04
	3	79	0.63	2.14	3.18	1.84	1.36
	4	59	1.28	2.54	3.90	2.27	1.51
Developed Economies and European Union	1	36	0.73	0.87	1.21	0.27	0.52
	2	36	1.21	1.57	2.35	0.84	0.92
	3	36	1.57	2.12	3.23	1.38	1.17
	4	35	2.77	3.00	4.52	3.48	1.86
Central and South-Eastern Europe (non-EU) and CIS	1	12	0.53	0.98	1.35	0.52	0.72
	2	11	1.28	2.48	3.97	2.54	1.59
	3	10	0.90	2.69	4.53	3.51	1.79
	4	6	0.37	2.10	2.50	6.59	2.57
East Asia	1	4	-0.09	0.24	0.28	0.06	0.25
	2	4	-0.54	0.60	0.77	0.44	0.53
	3	4	-0.82	0.85	1.12	0.93	0.78
	4	4	-0.64	0.89	1.12	0.57	0.72
South-East Asia and the Pacific	1	4	-0.36	0.36	0.44	0.16	0.35
	2	4	-0.86	0.86	0.97	0.69	0.78
	3	4	-1.20	1.20	1.35	1.17	1.03
	4	3	-0.94	0.94	1.02	0.52	0.72
South Asia	1	2	-0.30	0.30	0.38	0.14	0.30
	2	2	-0.49	0.54	0.73	0.53	0.54
	3	1	-0.63	0.63	0.63	0.40	0.63
	4	1	-0.79	0.79	0.79	0.63	0.79
Latin America and the Caribbean	1	22	0.07	1.14	1.63	0.84	0.91
	2	20	-0.43	1.36	1.60	1.66	1.27
	3	18	-0.20	2.42	2.84	5.03	2.24
	4	7	-2.55	3.35	4.34	2.47	1.57
Middle East	1	5	0.11	0.92	1.09	0.54	0.73
	2	3	0.64	1.66	1.80	2.35	1.53
	3	2	-0.11	1.25	1.25	1.57	1.25
	4	1	-0.48	0.48	0.48	0.23	0.48
North Africa	1	3	-0.69	1.32	1.68	0.88	0.94
	2	3	-1.30	1.97	2.73	1.01	1.01
	3	3	-1.57	3.37	4.36	7.30	2.70
	4	1	-0.15	0.15	0.15	0.02	0.15
Sub-Saharan Africa	1	1	0.45	0.45	0.45	0.21	0.45
	2	1	0.58	0.58	0.58	0.34	0.58
	3	1	0.96	0.96	0.96	0.91	0.96
	4	1	1.16	1.16	1.16	1.34	1.16

Table B9. Summary accuracy statistics for unemployment rate forecasts based on the baseline model (*cont.*)

Region	Year(s) ahead	No. of countries	MSE (Mean Squared Error	UB (Bias proportion of MSE)	UV (Variance proportion of MSE)	UC (Covariance proportion of MSE)	R^2
World	1	89	1.67	0.07	0.13	1.04	0.93
	2	84	5.51	0.04	0.02	0.95	0.80
	3	79	10.11	0.04	0.00	0.96	0.61
	4	59	15.19	0.11	0.01	0.89	0.56
Developed Economies and European Union	1	36	1.47	0.36	0.18	0.46	0.91
	2	36	5.51	0.27	0.09	0.65	0.71
	3	36	10.42	0.24	0.04	0.73	0.49
	4	35	20.46	0.38	0.05	0.58	0.14
Central and South-Eastern Europe (non-EU) and CIS	1	12	1.82	0.15	0.59	0.95	0.98
	2	11	15.78	0.10	0.02	0.89	0.80
	3	10	20.50	0.04	0.00	0.98	0.75
	4	6	6.24	0.02	0.29	0.71	0.66
East Asia	1	4	0.08	0.11	0.36	0.57	0.92
	2	4	0.60	0.48	0.01	0.54	0.15
	3	4	1.26	0.53	0.08	0.41	-1.37
	4	4	1.25	0.33	0.22	0.48	-0.98
South-East Asia and the Pacific	1	4	0.19	0.68	0.28	0.05	0.97
	2	4	0.95	0.78	0.17	0.05	0.86
	3	4	1.83	0.79	0.23	0.05	0.73
	4	3	1.04	0.85	0.14	0.03	0.84
South Asia	1	2	0.14	0.61	1.60	0.00	0.84
	2	2	0.53	0.46	0.20	0.00	0.13
	3	1	0.40				
	4	1	0.63				
Latin America and the Caribbean	1	22	2.66	0.00	0.00	1.01	0.88
	2	20	2.55	0.07	0.01	0.93	0.90
	3	18	8.05	0.00	0.02	0.99	0.66
	4	7	18.87	0.34	0.06	0.61	0.80
Middle East	1	5	1.20	0.01	1.60	0.23	0.96
	2	3	3.23	0.13	0.29	0.27	0.94
	3	2	1.57	0.01	0.54	0.00	0.96
	4	1	0.23				
North Africa	1	3	2.82	0.17	0.80	0.08	-1.35
	2	3	7.45	0.23	0.78	0.04	-5.66
	3	3	18.97	0.13	0.85	0.07	-10.39
	4	1	0.02				
Sub-Saharan Africa	1	1	0.21				
	2	1	0.34				
	3	1	0.91				
	4	1	1.34				

Note: For the details on the measurements, please see Annex 3.
Source: ILO calculations based on the baseline model as described in equation 3 using the input data from the GET January 2010; January 2011; January 2012; January 2013.

Table B10. Testing for bias, baseline forecasts

Region		Year(s) ahead			
		1	2	3	4
World	α	0.3428**	0.4906*	0.6261*	1.2837**
		(0.1330)	(0.2518)	(0.3530)	(0.4832)
	F (α=0)	6.6454**	3.7942*	3.1460*	7.0585**
	N	89	84	79	59
Developed Economies and European Union	α	0.7286***	1.2130	1.5732	2.7711***
		(0.1634)	(0.3396)	(0.4764)	(0.6132)
	F (α=0)	19.8879***	12.7611***	10.9037***	20.4238***
	N	36	36	36	35
Central and South-Eastern Europe (non-EU) and CIS	α	0.5256	1.2809	0.9042	0.3700
		(0.3744)	(1.1893)	(1.4787)	(1.1050)
	F (α=0)	1.9707	1.1600	0.3739	0.1121
	N	12	11	10	6
Asia	α	-0.2410**	-0.6570***	-0.9686***	-0.7731**
		(0.0940)	(0.1803)	(0.2448)	(0.2663)
	F (α=0)	6.5757**	13.2752***	15.6501***	8.4255**
	N	10	10	9	8
Latin America and the Caribbean	α	0.0671	-0.4293	-0.1964	-2.5451
		(0.3553)	(0.3527)	(0.6866)	(1.4372)
	F (α=0)	0.0357	1.4816	0.0818	3.1359
	N	22	20	18	7
Middle East and Africa	α	-0.1212	-0.1991	-0.6609	0.1758
		(0.4487)	(0.8740)	(1.3945)	(0.5010)
	F (α=0)	0.0729	0.0519	0.2246	0.1232
	N	9	7	6	3

Note: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Table B11. Testing for efficiency, baseline forecasts

Region		Year(s) ahead			
		1	2	3	4
World	α	0.1074	-0.0434	0.8166	1.9764***
		(0.2839)	(0.4912)	(0.5291)	(0.7122)
	β	1.0272***	1.0607***	0.9787***	0.9079***
		(0.0361)	(0.0682)	(0.0731)	(0.1071)
	F (α=0, β=1)	3.4096**	1.9196	2.6579*	6.4875***
	R^2	0.9449	0.8392	0.7028	0.5390
	N	89	84	79	59
Developed Economies and European Union	α	-0.5511**	-0.5553	-0.0889	0.0676
		(0.2361)	(0.6710)	(1.0927)	(1.6568)
	β	1.1605***	1.2250***	1.2212***	1.4098***
		(0.0314)	(0.0965)	(0.16442)	(0.2827)
	F (α=0, β=1)	19.2420***	7.2510***	5.6119***	11.2171***
	R^2	0.9536	0.8014	0.6174	0.5071
	N	36	36	36	35
Central and South-Eastern Europe (non-EU) and CIS	α	-0.0063	0.3544	0.8288	-4.5632
		(0.7956)	(1.9259)	(1.8187)	(4.0861)
	β	1.0422***	1.0748***	1.0063***	1.5563**
		(0.0799)	(0.1823)	(0.1518)	(0.4075)
	F (α=0, β=1)	1.1293	0.5446	0.1926	1.3113
	R^2	0.9774	0.8155	0.7570	0.7629
	N	12	11	10	6
Asia	α	0.1388	-0.0158	-0.0494	-0.1437
		(0.1777)	(0.3090)	(0.4061)	(0.3963)
	β	0.9104***	0.8558***	0.8061***	0.8464***
		(0.0307)	(0.0479)	(0.0653)	(0.0462)
	F (α=0, β=1)	8.6452***	25.8159***	19.2402***	20.1721***
	R^2	0.9830	0.9508	0.9139	0.8503
	N	10	10	9	8
Latin America and the Caribbean	α	0.0209	-0.6897	0.5684	-0.3374
		(0.5033)	(0.6328)	(1.1368)	(0.9151)
	β	1.0056***	1.0291***	0.9154***	0.8213***
		(0.0388)	(0.0618)	(0.1126)	(0.2243)
	F (α=0, β=1)	0.0301	0.8750	0.2947	1.4372
	R^2	0.8779	0.9041	0.6700	0.6758
	N	22	20	18	7
Middle East and Africa	α	1.5892***	2.2387	3.3338	1.0993
		(0.3900)	(1.0871)	(2.1411)	(0.9151)
	β	0.8559***	0.8060***	0.6970**	0.9314**
		(0.0242)	(0.0917)	(0.2179)	(0.0381)
	F (α=0, β=1)	19.3607***	2.5407	1.2124	3.8947
	R^2	0.9559	0.8409	0.7085	0.9967
	N	9	7	6	3

Notes: Robust standard errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1;
R^2 refers to the regression results.

Annex 3. Definitions of summary statistics

Indicator	Formula
Average Forecast Error (AFE)	$AFE_{a,t+j} = \left[\sum_{i=1}^{N} \frac{\sum_{r=1}^{R}(A_{t+j}^{i} - F_{t+j}^{i,r})}{R}\right]/N$
Mean Absolute Forecast Error (MAE)	$MAE_{a,t+j} = \left[\sum_{i=1}^{N} \frac{\sum_{r=1}^{R}\left\|(A_{t+j}^{i} - F_{t+j}^{i,r})\right\|}{R}\right]/N$
Mean Squared Forecast Error (MSE)	$MSE_{a,t+j} = \left[\sum_{i=1}^{N} \frac{\sum_{r=1}^{R}(A_{t+j}^{i} - F_{t+j}^{i,r})^2}{R}\right]/N$
Bias proportion of MSE (UB)	$UB_{a,t+j} = AFE_{a,t+j}^2/MSE_{a,t+j}$
Variance proportion of MSE (UV)	$UV_{a,t+j} = \left[V(F_{t+j}^{i,r}, F_{t+j}^{i,r})^{1/2} - \rho V(A_{t+j}^{i}, A_{t+j}^{i})^{1/2}\right]^2/MSE_{a,t+j}$
Covariance proportion of MSE (UC)	$UC_{a,t+j} = (1-\rho^2)V(A_{t+j}^{i}, A_{t+j}^{i})/MSE_{a,t+j}$
Root Mean Squared Forecast Error (RMSE)	$RMSE_{a,t+j} = MSE_{a,t+j}^{1/2}$
Median Squared Forecast Error (MedSE)	$Median\left[\sum_{r=1}^{R} \frac{(A_{t+j}^{i} - F_{t+j}^{i,r})^2}{R}\right]$
Median Absolute Forecast Error (MedAE)	$Median\left[\sum_{r=1}^{R} \frac{\left\|A_{t+j}^{i} - F_{t+j}^{i,r}\right\|}{R}\right]$
R^2 of forecasts	$R_{a,t+j}^2 = 1 - \frac{\sum_{i=1}^{N}\frac{\sum_{r=1}^{R}(A_{t+j}^{i} - F_{t+j}^{i,r})^2}{R}}{\sum_{i=1}^{N}(A_{t+j}^{i} - \overline{A_{t+j}})^2}$

where
A stands for available (actual) observation,
F stands for forecasted observation,
a stands for regions (1,2,…,9) and world,
j stands for the j^{th} year ahead from the latest available observation (1,2,3,4),
i stands for country,
r stands for GET January report (2010, 2011, 2012) and hence R=3,
$V(\dots,\dots)$ stands for variance, and
ρ stands for the correlation coefficient between forecasted and available observations.

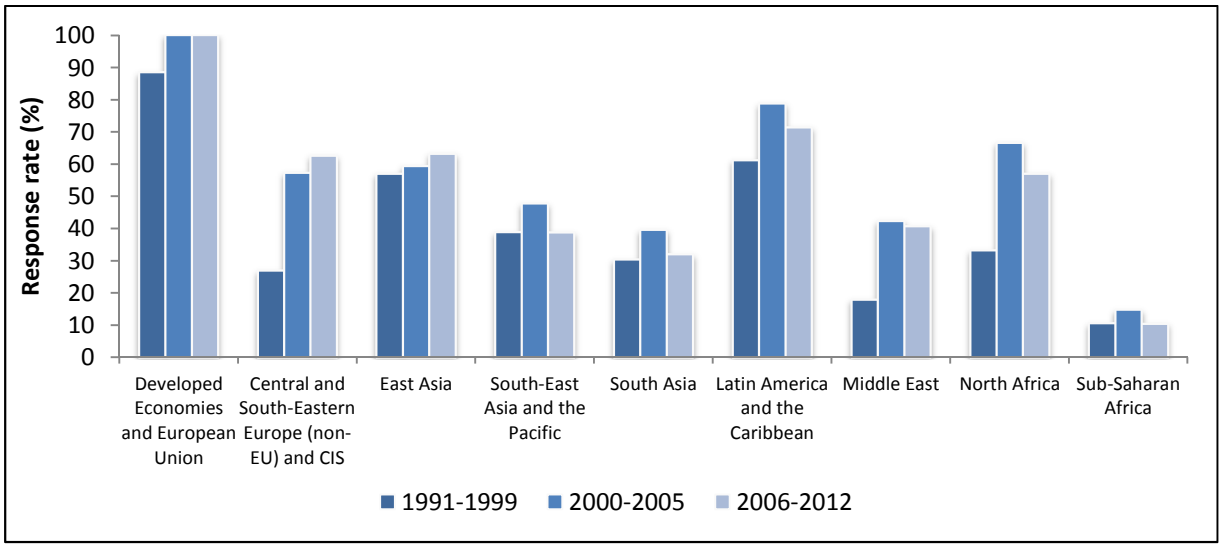
Annex 4. Reported rates

Table D1. Reported total unemployment rates by year and by run (units)

Year	GET January 2010	GET January 2011	GET January 2012	GET January 2013
1991	62	60		58
1992	64	64	63	63
1993	69	68	68	68
1994	74	72	71	71
1995	84	83	80	80
1996	85	86	85	84
1997	88	87	86	86
1998	86	86	87	86
1999	95	94	94	95
2000	96	96	95	95
2001	99	101	101	100
2002	94	96	97	98
2003	98	100	99	100
2004	105	106	107	107
2005	100	102	105	106
2006	100	104	106	107
2007	99	102	106	108
2008	86	96	103	110
2009		73	88	101
2010			74	97
2011				84
2012				60
Total	1 584	1 676	1 715	1 964

Source: ILO calculations based on the GET January 2010; January 2011; January 2012; January 2013.

Figure D1. Response rates in the latest GET Model run (of total unemployment rate) by region and selected time period



Note: The response rate is calculated by dividing the number of countries which reported unemployment rate with the number of countries per regional group times the years of each time period.
Source: ILO calculations based on the GET January 2013.

Annex 5. Country groupings used in the *Global Employment Trends* Model and Reports

Developed Economies and European Union
European Union
Austria
Belgium
Bulgaria
Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Latvia
Lithuania
Luxembourg
Malta
Netherlands
Poland
Portugal
Romania
Slovakia
Slovenia
Spain
Sweden
United Kingdom
North America
Canada
United States
Other Developed Economies
Australia
Israel
Japan
New Zealand
Western Europe (non-EU)
Iceland
Norway
Switzerland

Central and South-Eastern Europe (non-EU) and CIS
Central and South-Eastern Europe (non-EU)
Albania
Bosnia and Herzegovina
Croatia
Serbia and Montenegro
The former Yugoslav Republic of Macedonia
Turkey
Commonwealth of Independent States
Armenia
Azerbaijan
Belarus
Georgia
Kazakhstan
Kyrgyzstan
Republic of Moldova
Russian Federation
Tajikistan
Turkmenistan
Ukraine
Uzbekistan

South Asia
Afghanistan
Bangladesh
Bhutan
India
Maldives
Nepal
Pakistan
Sri Lanka

South-East Asia and the Pacific
South-East Asia
Brunei Darussalam
Cambodia
East Timor
Indonesia
Lao People's Democratic Republic
Malaysia
Myanmar
Philippines
Singapore
Thailand
Viet Nam
Pacific Islands
Fiji
Papua New Guinea
Solomon Islands

East Asia
China
Hong Kong, China
Korea, Democratic People's Republic of
Korea, Republic of
Macau, China
Mongolia
Taiwan, China

Latin America and the Caribbean
Caribbean
Bahamas
Barbados
Cuba
DominicanRepublic
Guadeloupe
Guyana
Haiti
Jamaica
Martinique
NetherlandsAntilles
Puerto Rico
Suriname
Trinidad and Tobago
Central America
Belize
Costa Rica
El Salvador
Guatemala
Honduras
Mexico
Nicaragua
Panama
South America
Argentina
Bolivia
Brazil
Chile
Colombia
Ecuador
Paraguay
Peru
Uruguay
Venezuela, Bolivarian Republic of

Middle East
Bahrain
Iran, Islamic Republic of
Iraq
Jordan
Kuwait
Lebanon
Oman
Qatar
Saudi Arabia
Syrian Arab Republic
United Arab Emirates
West Bank and Gaza Strip
Yemen

North Africa
Algeria
Egypt
Libya
Morocco
Sudan
Tunisia

Sub-Saharan Africa
Eastern Africa
Burundi
Comoros
Eritrea
Ethiopia
Kenya
Madagascar
Malawi
Mauritius
Mozambique
Réunion
Rwanda
Somalia
Tanzania, United Republic of
Uganda
Zambia
Zimbabwe
Middle Africa
Angola
Cameroon
Central African Republic
Chad
Congo
Congo, Democratic Republic of
Equatorial Guinea
Gabon
Southern Africa
Botswana
Lesotho
Namibia
South Africa
Swaziland
Western Africa
Benin
Burkina Faso
Cape Verde
Côted'Ivoire
Gambia
Ghana
Guinea
Guinea-Bissau
Liberia
Mali
Mauritania
Niger
Nigeria
Senegal
Sierra Leone
Togo