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**THE ANALYSIS OF FORECASTS ACCURACY FOR MACROECONOMIC VARIABLES IN ROMANIA**

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**Abstract.** The main objective of this study is to select the most accurate forecasts for several macroeconomic indicators in Romania (GDP deflator, GDP in comparable prices, inflation rate, private consumption, unemployment rate, exports rate, exchange rate). A comparative analysis was developed for the predictions provided by two experts in forecasting (E1 and E2) on the horizon from 2004 to 2013. The selection and the use of the best forecast will improve the strategies of National Plan of Development for Romania. Moreover, the assessment was made also separately in pre-crisis period and during the economic crisis. The accuracy tests provided contradictory results. Some of these are also different from the results given by U1 Theil’s coefficient. Therefore, the human judgment intervened to combine the information of the two types of methods used in assessing the accuracy (U1 coefficient and accuracy tests). According to this approach, E1 provided most accurate predictions on all horizons.

**JEL Classification:** C10, C53, E17

**Keywords**: forecasts, accuracy, Dobrescu model, economic crisis, U1 Theil’s coefficient

**1. Introduction**

 The main goal of this study is to establish which expert provided the most accurate predictions of macroeconomic indicators for Romania. Therefore, two forecasters were selected (Centre for Macroeconomic Forecasting that made up Dobrescu model and an expert in forecasting that did not use any econometric model) and seven main macroeconomic variables were selected: GDP deflator, GDP in comparable prices, inflation rate, private consumption, unemployment rate, exports rate, exchange rate.

In Romania there are very few studies that treated the problem of forecasts accuracy. Excepting some studies of Simionescu (2013), there are not deep preoccupations for prediction accuracy analysis because the researchers are more interested in constructing some forecasts. The topic has a huge importance for a country. Only by choosing the institute with the most accurate predictions, the policy making decision will improve. The government, the National Bank and other institutions are directly interested by the use of the most accurate forecast. Moreover, the forecaster should understand if it is necessary to advance more efforts for improving the forecasting process. A recent study of Dobrescu (2014) tried to assess the accuracy for the prognoses provided by Dobrescu macromodel and National Commission for Prognosis.

The literature is oriented to the comparison of forecasts made be international organizations or to the comparison of these predictions with those made by national forecasters. Therefore, this study brings as novelty the comparison between two national institutes of forecasting from Romania. The accuracy assessment is made by the U1 statistic of Theil and some accuracy tests. The two methods conduct us in many cases to different results. Therefore, the subjective judgment was introduced and the results were different from those of the objective model. It seems that Dobrescu model predicted better all the macroeconomic variables. The introduction of this judgment is a novelty in literature, covering the limits of the quantitative methods. There are strong chances that Dobrescu model provides better forecasts for the next years.

In Romania, the National Plan for Development (NPD) is the main instrument for reducing the disparities from the social and economic point of view with respect to the European Union. NPD is a specific concept for economic and social cohesion and follows the social and economic development of Romania in accordance with the Cohesion Politics of European Union. The NPD strategy is based on macroeconomic forecasts provided by the National Commission for Prognosis. However, in Romania more public forecasters exist and it is important to choose the predictions with the highest accuracy. This fact will help Romania in achieving the goals of NPD, among them being the increase of competitiveness.

**2. Literature review**

Many of the international institutions build own macroeconomic forecasts for different countries. Most of the comparisons between predictions take into account these institutions anticipations (European Commission, OECD, IMF, World Bank, SPF etc.) and those of other international organizations, the accuracy assessment being made. Only few studiesmake the comparison with official forecast of the government. In general, the prediction errors for these institutions are found to be large non-systematic. However, other providers of forecasts are statistical institutes, ministries of finance, and private companies like banks or insurance companies.

International Monetary Fund (IMF) and Organisation for Economic Co-operation and Development (OECD) publish twice per year predictions for macroeconomic variables in spring and autumn. Vogel (2007) showed that the predictions for the current year are more accurate than those for the next year, checking this assumption for OECD and IMF forecasts.

Literature usually makes comparisons between OECD and IMF forecasts and Consensus Economics ones or private predictions. The accuracy is evaluated according to different criteria: forecasts errors and associated accuracy measures, comparisons with naïve predictions that is based on random walk, directional accuracy evaluation.

Three international institutions (European Commission- EC, IMF and OECD) made predictions using macroeconomic models, but these forecasts failed to anticipate the downturn from 2007. Therefore, Bezemer (2009) considered the replacement with account models that could forecast the economic crisis.

Loungani (2000) observed a high similarity between private predictions and those of IMF, OECD and the World Bank for 63 industrialized and developing countries on the horizon from 1989 to 1998. One-year-ahead forecasts made by OECD and national institutes for inflation rate and GDP growth rate in 13 European countries are assessed by Öller & Barot (2000). In their study, the authors showed that inflation forecasts are more accurate than GDP growth rate predictions. For GDP forecasts made by IMF and OECD, Pons (2000) analyzed the size and nature of errors for G7 countries. Batchelor (2001) compared the accuracy of predictions made by OECD and IMF for G7 countries, the benchmark being the forecasts’ mean of Consensus Economics. The private forecasters provided more accurate predictions for most of the macroeconomic forecasts. For G7 the government deficit forecasts were compared on accuracy criterion the alternative predictions being provided by European Commission, IMF and OECD, Artis and Marcellino (2001) recommending the use of an asymmetric loss function. Glück & Schleicher (2005) compared the forecasts performance of IMF with that of OECD, evaluating the errors between G7 countries.

Krkoska & Teksoz (2005) compared the changes in the EBRD (European Bank for Reconstruction and Development) predictions for transition countries with those made byother institutions (commercial and academic forecasters). They showed that the EBRD made on average higher changes in its earlier forecasts. Later, Krkoska & Teksoz (2007) showed for 25 transition countries that the EBRD predictions during 1994-2004 improve in accuracy with the progress in transition. These predictions accuracy for late GDP is better than of other institutions with around 0.4 percentage points. The Russian crisis seems to be the only structural break.

The European Commission's forecasts analyzed on the horizon from 1998 to 2005 are comparable in terms of accuracy with those of Consensus, IMF and OECD for variables like inflation rate, unemployment rate, GDP, total investment, general government balance and current account balance as Melander et al. (2007) stated.

Abreu (2011) assessed the forecasts accuracy for predictions made by international organizations like IMF, European Commission and OECD and by private institutions (Consensus Economics and The Economist). The author made also the assessment of directional accuracy. Forecasters from Netherlands used the macroeconomic model of the Netherlands Bureau for Economic Policy Analysis (CPB) to make predictions that were compared to experts’ anticipations. The results over the period 1997-2008 indicated that CPB model provided superior forecasts in terms of accuracy, the results being presented by Franses *et* al. (2011).

González *et* al. (2012) studied the forecasts accuracy of the predictions provided by European Commission before and during the recent economic crisis. They compared these forecasts with those provided by Consensus Economics, IMF and OECD. The Commission’s forecasts errors have increased because of the low accuracy from 2009 for variables as GDP, inflation rate, government budget balance, and investment.

For OECD and three experts predictions of Germany real GDP rate and inflation rate, Heilemann & Stekler (2013) evaluated the accuracy, but they did not observed an improvement in accuracy. The private experts in forecasting placed their predictions with three months away from IMF and OECD as Frenkel et al. (2013) observed. The private inflation predictions, including Survey of Professional Forecasters forecasts, were outperformed by Greenbook ones, according to Liu and Smith (2014).

In Romania, there are too few studies regarding the forecast accuracy comparisons, some works in this field belonging to Dobrescu (2014) and Simionescu (2013). Some accuracy measures were described by Ghizdeanu (2010). Dobrescu model provided the best unemployment rate predictions during 2001-2012.

**3. Methodology. Forecasts accuracy tests**

1. ***Morgan-Granger-Newbold test (MGN test)***

Let us consider the actual values of a variable and two predictions for it and . The prediction errors are computed as: , i=1,2. The loss function in this case is calculated as:

 (1)

In most cases this function is a square-error loss or an absolute error loss function.

Two predictions being given, the loss differential is:

 (2)

The two predictions have the same degree of accuracy if the expected value of loss differential is 0.

The assumptions are formulated as:

This test works if the loss function is quadratic and the predictions errors are: independent, Gaussian, zero mean and contemporaneously uncorrelated. Granger and Newbold test uses these assumptions, excepting the lack of contemporaneous correlation. This test

 (3)

The accuracy equality of forecasts is equivalent to null covariance of and , where . The MGN test statistic follows a t distribution
(T-1 degrees of freedom) and it is calculated:

 (4)

In this case r is defined as:

 (5)

x, z- vectors (dimension Tx1)

MGN test is used only for one-step-ahead predictions with errors following a white noise. The test must have a squared error loss.

1. ***Harvey-Leybourne-Newbold test (HLN test) makes a regression with variables from MGN test. It checks if the slope is zero or not.***

 (6)

It uses the same MGN statistic:

 (7)

 (8)

 (9)

For heavy-tailed distribution of forecast errors, HLN test is modified, the statistic having the following form:

 (10)

- OLS residuals at moment

The variance of b is estimated using a White-correction for heteroskedasticity.

The initial MGN test and HLN test are limited to one-step-ahead forecasts.

1. ***Meese and Rogoff test (MR test)***

The MR test admits that the errors are contemporaneously and serially correlated, assuming squared error loss function.

 (11)

,

,

The MR test statistic is:

 (12)

1. ***Diebold-Mariano asymptotic test (DM test)***

For DM the null assumption of equal accuracy checks if the expected value of differential loss is zero: The covariance stationary been given, the distribution of differential average follows a normal distribution. The DM statistic under null hypothesis is:

 (13)

Instead of estimating the variance we can study the prediction error auto-covariances. This test does not suppose restrictions like forecast errors with normal distribution, independent and contemporaneously uncorrelated predictions errors.

1. ***Standard sign test***

There is a class of non-parametric tests for comparing the accuracy of forecasts. The standard sign test is based on the restriction of independent and identically distributed loss differential data series. Under the null assumption of null median of loss-differential repartition, the number of positive loss-differentials (N) follows a binomial distribution. T is the number of trials and the probability of success is 0.5. The test statistic is:

 (14)

1. ***Wilcoxon’s signed rank test***

Wilcoxon’s signed rank test is based on the sum of the ranks for the absolute values of positive prediction differentials:

For T going to infinity, under the null assumption, the Wilcoxon’s signed rank test has the following statistic:

 (15)

1. ***Pesaran and Timmermann test***

Pesaran and Timmermann test (PT test) is based on the sign of the dependent variable and on the number of correct predicted signs. The distributions of the variables are independent, continuous and unchanged in time.

 proportion of times that the predictand sign is correctly anticipated

 proportion of times that real y is greater than 0

 proportion of times that forecast y is greater than 0

Under the null assumption that the values for predictions do not forecast the sign of predictant, the number of correct sign forecasts follows a binomial distribution (T trials and probability of success . For unknown and , we compute . For known and , the PT statistic is:

 (16)

For unknown and , the test statistic is:

 (17)

**4. The comparison of accuracy for alternative macroeconomic forecasts in Romania**

The National Plan for Development uses forecasts for macroeconomic variables and it is essential to use the predictions with the highest accuracy. The macroeconomic forecasts in Romania are correlated with the government provisions, the national, sector and regional strategies and the trends in national and world economy. From our point of view, these correlations are not enough. An accuracy evaluation is necessary for alternative predictions. The use of the most accurate predictions will improve the assessment of the main measures of economic politics on economic growth by using the objectives of the regional and national programs for development. A better elaboration of the Plan of programs and investment objectives will be made in order to include them in multi-annual budgets.

A comparison between the forecasts based on Dobrescu’s model (E1) and the subjective predictions of an expert (E2) is made using the forecasts accuracy tests on the horizon from 2004 to 2013, on the period that covers the recent economic crisis (2009-2013) and before the economic crisis (2004-2008). According to economic theory, the forecast accuracy should decrease during the crisis compared to the previous period. We will test this hypothesis by evaluating the prediction accuracy before and during the recent economic and financial crisis.

The first version of the Dobrescu model appeared in 1996, the predictions being made from 1997. The Center for Macroeconomic Forecasting (CMF) uses Dobrescu (2013) model, the last version of it being released in 2012. The integrated system of the model includes: output gap and macroeconomic production, labor market branches, capital, monetary variables, including prices, general consolidated budget, external debts, domestic absorption, balance of payment, foreign trade, the structure of the national economy, consumption of primary energy, and emissions of CO2.

In this study the accuracy of macroeconomic one-step-ahead forecasts in Romania for several variables is assessed (inflation rate, unemployment rate, export rate, exchange rate, GDP, GDP deflator and private consumption). The expert inflation rate has a tendency of slow decrease on the horizon from 2010 to 2013. Dobrescu model anticipated a decrease in the period from 2010 to 2012, for 2013 being proposed a higher inflation rate than the value predicted for 2012. The unemployment rate predictions have an obvious tendency of decrease that was perturbed in 2008 and 2009 by the anticipation of the economic crisis. A slow decrease was observed in the predictions made for GDP and GDP deflator, the lowest values being proposed for 2009 by both experts. Negative rates were anticipated for exports, only for 2013 Dobrescu model indicating a positive rate. It is interesting that during the crisis E2 anticipated a slow decrease of exchange rate while CMF predicted a constant increase of the indicator. The private consumption is in decrease according to national forecasters, but E2 predicted an increase for 2013.

For making comparisons between forecasts, the U1 Theil’s indicator is used.The U statistic takes into account both positive and negative changes in a variable:

 (18)

- the actual values

- the predicted values

- time

- error (e=a-p)

- number of time periods in the forecasts horizon

**Table 1. The values of U1 Theil’s coefficient
for macroeconomic forecasts in Romania**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable**  | **Horizon: 2004-2013** | **Horizon: 2009-2013** | **Horizon: 2004-2008** |
|  | **Dobrescu model** | **E2** | **Dobrescu model** | **E2** | **Dobrescu model** | **E2** |
| GDP deflator | 0.0984 | 0.3974 | 0.098 | 0.091 | 0.159 | 0.908 |
| Private consumption | 0.0376 | 0.4084 | 0.026 | 0.489 | 0.045 | 0.034 |
| GDP | 0.0746 | 0.0737 | 0.084 | 0.081 | 0.065 | 0.067 |
| Inflation rate | 0.0101 | 0.0102 | 0.009 | 0.007 | 0.011 | 0.012 |
| Unemployment rate | 0.1293 | 0.1061 | 0.099 | 0.095 | 0.159 | 0.121 |
| Exports rate | 0.7873 | 0.9721 | 0.508 | 0.992 | 0.998 | 0.751 |
| Exchange rate | 0.0098 | 0.0205 | 0.025 | 0.048 | 0.007 | 0.032 |

*Source: author’s computations*

On the overall horizon, only for GDP and unemployment rate the E2 provided better forecasts than Dobrescu’s model, but the differences are insignificant for GDP. In the period before the crisis (2004-2008), E2 offered more accurate predictions than Dobrescu’s model for private consumption, unemployment rate and exports rate.

In the period corresponding to actual economic crisis, according to U1 coefficient, for GDP deflator, GDP, unemployment rate and inflation rate, the E2 provided more accurate predictions than Dobrescu’s model did. One reason of this failure might be the fact that the model did not taken into account all the shocks in the economy. For private consumption, exports rate and exchange rate, Dobrescu’s model generated better predictions.

For GDP deflator predictions it is interesting that during the crisis period the accuracy was superior in comparison with the previous period for both forecasters. For private consumption, inflation rate, unemployment rate and exports rate, Dobrescu’s model predictions are more accurate during the crisis than in the previous horizon with the same length. For inflation rate and unemployment rate, E2 provided more accurate forecasts during the crisis.

For Diebold-Mariano test the maximum lag is selected according to Schwartz criterion and the kernel is uniform. The criterion s the mean squared error and the test is applied in Stata.

The results of the accuracy tests and the proper conclusions are applied in the following table. For the final decision the results of U1 indicator were taken into account if differences were observed between forecasts.

For GDP deflator and private consumption predictions on the overall horizon, all the accuracy tests indicated that Dobrescu model is the best. Only HLN and DM test indicated that E2 forecasts for GDP are better, the other tests showing no significant differences in accuracy. For the inflation rate and unemployment rate forecasts only DM test showed that E2 provided more accurate forecasts, while the other tests indicated no differences. For the exports rate only MR test showed that there are not differences in accuracy degree, the other ones suggesting that Dobrescu model was more suitable for predicting the variable. For exchange rate non-parametric tests showed no significant differences between predictions, while the other tests recommended the use of Dobrescu model.

As we can observe, there are contradictory results between tests and between tests and U1 indicator. Therefore, we will analyze simultaneously the results and we will get a single decision regarding the superiority of the accuracy. Actually, these objective methods of assessing forecasts accuracy will be combined with human judgment.

**Table 2. The results of forecasts accuracy tests (Horizon: 2004-2013)**

| **Test** | **Statistic value for predictions made by:** | **Decision-more accurate predictions provided by:** |
| --- | --- | --- |
| **GDP deflator** |  |  |
| MGN test |  | -6,822 | Dobrescu’s model |
| HLN test |  | -5,267 | Dobrescu’s model |
| MR test |  | -3,5054 | Dobrescu’s model |
| DM test |  | S(1) = -2.724 p-value = 0.0064 | Dobrescu’s model |
| Standard sign test |  | chi-squared = 10.821 probability = 0.0010 | Dobrescu’s model |
| Wilcon’s signed rank test |  | z = -3.290Prob> |z| = 0.0010 | Dobrescu’s model |
| PT test |  | 2.2056 | Dobrescu’s model |
| **Private consumption** |  | E2 |  |
| MGN test |  | -21,448 | Dobrescu’s model  |
| HLN test |  | -53,130 | Dobrescu’s model |
| MR test |  | -7,0172 | Dobrescu’s model |
| DM test |  | S(1) = -1.641 p-value = 0.1009 | Dobrescu’s model |
| Standard sign test |  | chi-squared = 6.223 probability = 0.0126 | Dobrescu’s model |
| Wilcon’s signed rank test |  | z = -2.495Prob> |z| = 0.0126 | Dobrescu’s model |
| PT test |  | 3.0324 | Dobrescu’s model |
| **GDP**  |  | E2 |  |
| MGN test |  | -0,700 | No differences |
| HLN test |  | -3,354 | E2 |
| MR test |  | 0,5691 | No differences |
| DM test |  | S(1) = .3721 p-value = 0.7098 | E2 |
| Standard sign test |  | chi-squared = 0.143 probability = 0.7055 | No differences |
| Wilcon’s signed rank test |  | z = -0.378Prob> |z| = 0.7055 | No differences |
| PT test |  | 0.9784 | No differences |
| **Inflation rate** |  | E2 |  |
| MGN test |  | 0,068 | No differences |
| HLN test |  | 0,082 | No differences |
| MR test |  | 0.1458 | No differences |
| DM test |  | S(1) = .0118 p-value = 0.9906 | E2 |
| Standard sign test |  | chi-squared = 3.721 probability = 0.0537 | No differences |
| Wilcon’s signed rank test |  | z = 1.929Prob> |z| = 0.0537 | No differences |
| PT test |  | 0.7846 |  |
| **Unemployment rate** |  | E2 |  |
| MGN test |  | 0,631 | No differences |
| HLN test |  | 1,941 | No differences |
| MR test |  | 0,0857 | No differences |
| DM test |  | S(1) = 1.051 p-value = 0.2933 | E2 |
| Standard sign test |  | chi-squared = 0.367 probability = 0.5449 | No differences |
| Wilcon’s signed rank test |  | z = 0.605Prob> |z| = 0.5449 | No differences |
| PT test |  | 0.7125 | No differences |
| **Exports rate** |  | E2 |  |
| MGN test |  | -39,135 | Dobrescu’s model |
| HLN test |  | -6,727 | Dobrescu’s model |
| MR test |  | 0,0324 | No differences |
| DM test |  | S(1) = -1.871 p-value = 0.0613 | Dobrescu’s model |
| Standard sign test |  | chi-squared = 9.143 probability = 0.0025 | Dobrescu’s model |
| Wilcon’s signed rank test |  | z = -3.024Prob> |z| = 0.0025 | Dobrescu’s model |
| PT test |  | 2.0248 | Dobrescu’s model |
| **Exchange rate** |  | E2 |  |
| MGN test |  | -2,452 | Dobrescu’s model |
| HLN test |  | -6,851 | Dobrescu’s model |
| MR test |  | 20,2007 | Dobrescu’s model |
| DM test |  | S(1) = -1.942 p-value = 0.0521 | Dobrescu’s model |
| Standard sign test |  | chi-squared = 0.572 probability = 0.4495 | No differences |
| Wilcon’s signed rank test |  | z = 0.756Prob> |z| = 0.4495 | No differences |
| PT test |  | 0.5567 | No differences |

Note: The critical value for MGN test is 2.262

*Source: author’s computations*

In pre-crisis period, MGN and MR tests indicates no significant differences in accuracy between the two types of forecasts for GDP deflator, while the other tests stated that Dobrescu model predicted better than E2.

MGN and DM tests recommend E2 for consumption predictions in pre-crisis period, while the other tests showed no differences. For GDP and inflation rate predictions, only DM test suggests the superiority of Dobrescu model, while all the other tests indicated the lack of significant accuracy differences. For the unemployment rate DM test recommends the E2 predictions as better, while the other tests did not identified significant differences. MR and MGN for exports rate forecasts considered that Dobrescu model is better, while the rest of accuracy tests did not identify differences. The non-parametric tests did not indicated differences in accuracy for exchange rate forecasts, while the other tests recommended the use of Dobrescu model in pre-crisis period.

Only HLN and DM test indicated that E2 forecasts for GDP deflator are better, the other tests showing no significant differences in accuracy during the crisis period. On the horizon from 2009 to 2013, Dobrescu model predicted better the private consumption, only HLN test showing no differences in accuracy. According to all the tests, excepting DM that sustains the superiority of E2 predictions during the crisis, all the other tests did not evidenced large differences. For exports rate the parametric test recommends Dobrescu model while the non-parametric one did not identified differences. Exchange rate is better predicted by Dobrescu model, according to DM test, all the other methods indicating no differences in accuracy.

**Table 3. The results of forecasts accuracy
tests before crisis (Horizon: 2004-2008)**

| **Test**  | **Statistic value for predictions made by:** | **Decision-more accurate predictions made by:** |
| --- | --- | --- |
| **GDP deflator** |  |  |  |
| MGN test |  | -2,677 | No differences |
| HLN test |  | -3,512 | Dobrescu’s model |
| MR test |  | 0,0571 | No differences |
| DM test |  | S(1) = -27.88 p-value = 0.0000 | Dobrescu’s model |
| Standard sign test |  | chi-squared = 6.818 probability = 0.0090 | Dobrescu’s model |
| Wilcon’s signed rank test |  | z = -2.611Prob> |z| = 0.0090 | Dobrescu’s model |
| PT test |  | 3.0215 | Dobrescu’s model |
| **Private consumption** |  |  |  |
| MGN test |  | 1,978 | No differences |
| HLN test |  | -35,420 | E2 |
| MR test |  | 0,1091 | No differences |
| DM test |  | S(1) = 1.848 p-value = 0.0646 | E2 |
| Standard sign test |  | chi-squared = 0.884.probability = 0.3472 | No differences |
| Wilcon’s signed rank test |  | z = 0.940Prob> |z| = 0.3472 | No differences |
| PT test |  | 1.0247 | No differences |
| **GDP**  |  | E2 |  |
| MGN test |  | -2,057 | No differences |
| HLN test |  | -2,236 | No differences |
| MR test |  | -0,0173 | No differences |
| DM test |  | S(1) = -.6683 p-value = 0.5039 | Dobrescu’s model |
| Standard sign test |  | chi-squared = 0.535 probability = 0.4647 | No differences |
| Wilcon’s signed rank test |  | z = -0.731Prob> |z| = 0.4647 | No differences |
| PT test |  | 1.2247 | No differences |
| **Inflation rate** |  | E2 |  |
| MGN test |  | 0,782 | No differences |
| HLN test |  | 0,055 | No differences |
| MR test |  | 0,0899 | No differences |
| DM test |  | S(1) = -3.29e+07 p-value = 0.0000 | Dobrescu’s model |
| Standard sign test |  | chi-squared = 3.153 probability = 0.0758 | No differences |
| Wilcon’s signed rank test |  | z = 1.776Prob> |z| = 0.0758 | No differences |
| PT test |  | 0.4671 | No differences |
| **Unemployment rate** |  |  |  |
| MGN test |  | 0,130 | No differences |
| HLN test |  | 1,294 | No differences |
| MR test |  | 0,0190 | No differences |
| DM test |  | S(1) = 1.051 p-value = 0.2933 | E2 |
| Standard sign test |  | chi-squared = 1.098 probability = 0.2948 | No differences |
| Wilcon’s signed rank test |  | z = 1.048Prob> |z| = 0.2948 | No differences |
| PT test |  | 1.1497 | No differences |
| **Exports rate** |  |  |  |
| MGN test |  | 2,076 | No differences |
| HLN test |  | -4,484 | Dobrescu’s model |
| MR test |  | -0,0136 | No differences |
| DM test |  | S(1) = -46.65 p-value = 0.0000 | Dobrescu’s model |
| Standard sign test |  | chi-squared = 6.818 probability = 0.0090 | Dobrescu’s model |
| Wilcon’s signed rank test |  | z = -2.611Prob> |z| = 0.0090 | Dobrescu’s model |
| PT test |  | 4.032 | Dobrescu’s model |
| **Exchange rate** |  |  |  |
| MGN test |  | -4,437 | Dobrescu’s model |
| HLN test |  | -4,567 | Dobrescu’s model |
| MR test |  | 8,3052 | Dobrescu’s model |
| DM test |  | S(1) = -1.40e+08 p-value = 0.0000 | Dobrescu’s model |
| Standard sign test |  | chi-squared = 0.098 probability = 0.7540 | No differences |
| Wilcon’s signed rank test |  | z = 0.313Prob> |z| = 0.7540 | No differences |
| PT test |  | 1.5542 | No differences |

*Note:* The critical value for MGN test is 2.776

*Source: author’s computations*

All in all, before the crisis we can conclude that for the mentioned variables there are not large differences between Dobrescu’s forecasts and E2 predictions. In this period, the economy is quite stable and it is easier to predict the future evolution.

**Table 4. The results of forecasts accuracy tests
for crisis period (Horizon: 2009-2013)**

| **Test**  | **Statistic value for predictions made by:** | **Decision-more accurate predictions made by:** |
| --- | --- | --- |
| **GDP deflator** |  |  |  |
| MGN test |  | 2,597 | No differences |
| HLN test |  | -4,489 | E2 |
| MR test |  | -0,0066 | No differences |
| DM test |  | S(1) = 7.34e+07 p-value = 0.0000 | E2 |
| Standard sign test |  | chi-squared = 1.844 probability = 0.1745 | No differences |
| Wilcon’s signed rank test |  | z = -1.358Prob> |z| = 0.1745 | No differences |
| PT test |  | 1.8746 | No differences |
| **Private consumption** |  |  |  |
| MGN test |  | -26,160 | Dobrescu’s model |
| HLN test |  | 2,057 | No differences |
| MR test |  | 7,6992 | Dobrescu’s model |
| DM test |  | S(1) = -1.481 p-value = 0.1387 | Dobrescu’s model  |
| Standard sign test |  | chi-squared = 6.818 probability = 0.0090 | Dobrescu’s model |
| Wilcon’s signed rank test |  |  z = -2.611Prob> |z| = 0.0090 | Dobrescu’s model |
| PT test |  | 2.4173 | Dobrescu’s model |
| **GDP**  |  |  |  |
| MGN test |  | 0,203 | No differences |
| HLN test |  | -2,060 | No differences |
| MR test |  | 0,4386 | No differences |
| DM test |  | S(1) = 1.316 p-value = 0.1883 | E2 |
| Standard sign test |  | chi-squared = 0.273 probability = 0.6015 | No differences |
| Wilcon’s signed rank test |  |  z = -0.522Prob> |z| = 0.6015 | No differences |
| PT test |  | 0.9974 | No differences |
| **Inflation rate** |  |  |  |
| MGN test |  | 1,122 | No differences |
| HLN test |  | 0,981 | No differences |
| MR test |  | 0,0064 | No differences |
| DM test |  | S(1) = 1.679 p-value = 0.0931 | E2 |
| Standard sign test |  | chi-squared = 0.535 probability = 0.4647 | No differences |
| Wilcon’s signed rank test |  |  z = 0.731Prob> |z| = 0.4647 | No differences |
| PT test |  | 1.4517 | No differences |
| **Unemployment rate** |  |  |  |
| MGN test |  | 0,752 | No differences |
| HLN test |  | 0,437 | No differences |
| MR test |  | 0,0211 | No differences |
| DM test |  | S(1) = 1.855 p-value = 0.0636 | E2 |
| Standard sign test |  | chi-squared = 0.000 probability = 1.0000 | No differences |
| Wilcon’s signed rank test |  | z = 0.000Prob> |z| = 1.0000 | No differences |
| PT test |  | 1.7842 | No differences |
| **Exports rate** |  |  |  |
| MGN test |  | -31,394 | Dobrescu’s model |
| HLN test |  | 6,095 | Dobrescu’s model |
| MR test |  | 23,0307 | Dobrescu’s model |
| DM test |  | S(1) = -1.69e+08 p-value = 0.0000 | Dobrescu’s model |
| Standard sign test |  | chi-squared = 2.455 probability = 0.1172 | No differences |
| Wilcon’s signed rank test |  | z = -1.567Prob> |z| = 0.1172 | No differences |
| PT test |  | 1.3364 | No differences |
| **Exchange rate** |  |  |  |
| MGN test |  | -1,070 | No differences  |
| HLN test |  | -2,320 | No differences |
| MR test |  | -0,6751 | No differences |
| DM test |  | S(1) = -1.10e+08 p-value = 0.0000 | Dobrescu’s model |
| Standard sign test |  | chi-squared = 3.172 probability = 0.0749 | No differences |
| Wilcon’s signed rank test |  | z = 1.781Prob> |z| = 0.0749 | No differences |
| PT test |  | 0.8462 | No differences |

*Note:* The critical value for MGN test is 2.776

*Source: author’s computations*

Analyzing all these results, our subjective judgment is used in order to establish what provider predicted better a variable during and before the crisis, but also on the overall horizon. The results of U1 coefficient are combined with the accuracy tests and the subjective appreciation. The results are presented in the following table:

**Table 5. The final conclusions regarding
the forecasts accuracy assessment**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable**  | **Before the crisis** | **During the crisis** | **Overall horizon** |
| GDP deflator | Dobrescu model | No differences | Dobrescu model |
| Private consumption | No differences | Dobrescu model | Dobrescu model |
| GDP | No differences | No differences | No differences |
| Inflation rate | No differences | No differences | No differences |
| Unemployment rate | No differences | No differences | No differences |
| Exports rate | No differences | No differences | Dobrescu model |
| Exchange rate | Dobrescu model | Dobrescu model | Dobrescu model |

*Source: author’s computations*

According to our procedure, it seems that even if E2 is recommended for some predictions in certain time periods, the differences between its forecasts and Dobrescu model’s ones are not significant. All in all, Dobrescu model should be used for making predictions for the seven macroeconomic variables.

These results are very useful for the future predicting process. Our assumptions are not for sure, but provide us important hints for establishing the decision process. The government could use these results in order to establish the macroeconomic policies. The central bank is also interested in these results to select the best monetary policy. It is important to emphasize that this is an empirical study and the results are applied for a specific country with specific evolutions of macroeconomic variables, this being Romania.

**4. Conclusions**

 The evaluation of forecast accuracy at the macroeconomic level does not lack practical importance for Romania. The National Plan of Development is based on macroeconomic forecasts and has among its objectives the reduction of economic and social gaps between Romania and European Union. Nowadays, in Romania the government tries to achieve this objective and it uses the predictions of Finance Ministery that are made within the National Commission for Prognosis. Taking into account that in Romania alternative predictions are offered for the same macroeconomic indicator, it is necessary to make a discrimination and to choose the prediction with the highest accuracy. Therefore, this research proposes an accuracy analysis using real predictions offered by two providers.

In the study, we proposed to investigate the forecasts accuracy of two national providers from Romania: Dobrescu model proposed by Center for Macroeconomic Forecasting and a forecaster that did not use any econometric model. The accuracy was assessed using the U1 Theil’s coefficient and the accuracy tests. The results indicated by the two methods are in most cases contradictory. Therefore, our subjective judgment had the final role in proposing the final results regarding the comparative analysis of accuracy. This judgment had an essential role, because it established that Dobrescu model provided the most accurate forecasts for all predictions of the seven variables in all the periods: during the crisis, before the crisis and on the overall horizon.

This information is very useful for government in policy making process, for Central Bank in monetary policy establishment and for other national and international institutions. Even the researchers and the public opinion are very interested in these results. This means that they will consider from the proof of history, that Dobrescu model will continue to provide better forecasts than E2. The novelty of this study is also brought by the fact that there are not analyses in the literature that compare only the national providers’ forecasts. Before the crisis we can conclude that for the mentioned variables there are not large differences between Dobrescu’s forecasts and E2 predictions. In this period, the economy is quite stable and it is easier to predict the future evolution.

A future direction of research would be to make comparisons between Dobrescu’s predictions and European Commission anticipations or other international organizations that make forecasts for Romania.

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