National Bank of the Republic of Macedonia

Working Paper

GDP Data Revisions in Macedonia – Is There Any Systematic Pattern?

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Abstract: This paper investigates the existence of any systematic relationship between preliminary estimates and subsequent revisions of GDP growth rates in Macedonia. Accordingly, we use various statistical tools for testing the 'news' and 'noise' hypotheses and empirically assess if GDP data revisions are unbiased and efficient and vice versa. The results based on different empirical approaches in general provide mixed results about the predictability of GDP revisions, although the empirical evidence tends to incline that the long-term and final GDP revisions are efficient and contain new information that is in line with the 'news' hypothesis. We conclude that each subsequent revision is unpredictable.

Key words: preliminary data, final data, revision, GDP, Macedonia

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1. Introduction

Central banks and other macroeconomic actors regularly face the problem of inaccurate initial measurements of macro variables such as Gross Domestic Product (GDP). National account figures often undergo revisions and the first estimate of a certain quarter's GDP can differ significantly from the subsequent revised estimates. Thus, using real-time information about central macro economic variables, such as GDP, can be problematic, especially if real-time data tends to be biased and unreliable. GDP data represents one of the key indicators in the process of making macroeconomic decisions. Therefore, revisions make the process of decision making difficult because every current decision related to the economic activity is based on the preliminary published data which later could be revised. Hence, the possibility to predict data revisions, such as determination of their size and direction, may be of great importance for optimal decision-making.

Data revisions are distinguished by two polar characterizations introduced by Mankiw and Shapiro (1986), namely, the 'noise' and the 'news' characterization. Under the noise characterization, the revisions are biased, so that they are correlated with the preliminary estimates. The preliminary estimates contain information which could be useful in predicting subsequent GDP revisions. Revisions arise from measurement error in preliminary estimates. Such error could occur, for example, if the preliminary estimates are based on unrepresentative and insufficiently large sample, contain clerical mistakes, and so forth. In contrast with the 'noise' characterization, revisions are unbiased in the 'news' characterization. For example, if GDP estimates released after the preliminary estimates reflect news, there is no correlation between the preliminary estimate and the revision term because the estimate contains all available information. Thus, under the 'news' characterization, revision is unpredictable. Consequently, the major aim of this analysis is to examine if the GDP data revisions are efficient and unbiased, i.e. whether the 'news' or 'noise' hypothesis applies in the case of the Republic of Macedonia for which different empirical approaches will be applied.

The remainder of this paper is as follows: Section 2 presents the literature review of data revisions, mostly focusing on advanced economies. Construction of dataset is described in Section 3. Empirical methods for testing the news and noise hypotheses are given in Section 4. Section 5 discusses baseline results and sensitivity analysis, whereas the final section provides the concluding remarks of this research.

2. Literature review

The research on real GDP data revision issues in Macedonia and in the region, according to authors' knowledge, is limited as a result of data issues and difficulties to have access to data documentation. Our research in this field is one of the first studies in Macedonia; besides some earlier short analyses by the National Bank of the Republic of Macedonia (NBRM) on the size and direction of GDP data revisions.[3]

A review of earlier research focuses mainly on the studies of developed countries because of the researchers' ability to construct database and get access to data documentation. Many studies investigated the size of revision errors, e.g. Faust et al. (2004). They argue that revisions to GDP announcements are quite large in all G-7 countries and many revisions in quarterly GDP growth are over a full percentage point at annualized rate. The mean revision to GDP growth is positive for all countries, except for Japan, indicating a general tendency toward 'pessimism' in initial numbers. Moreover, Faust et al. (2004) examined the predictability of G-7 GDP data revisions and found out that the degree of predictability varies throughout the G-7. Thus, the evidence shows that for the U.S., revisions are very slightly predictable, but for Italy, Japan and the UK, about half of the variability of subsequent revisions can be accounted for by the information available at the time of the preliminary announcement. For these countries, they showed that revisions reflect, to a significant extent, removal of 'noise' from the preliminary numbers, rather than arrival of 'news'.

Palis et al. (2004) extended Faust et al. (2004) analysis to study revisions to the Brazilian GDP estimates. They documented that revisions to the Brazilian GDP are largely relative to those of the G-7 countries. They also found some evidence that the Brazilian GDP revisions are predictable, which is consistent with the view that GDP revisions correct errors in preliminary GDP rather than reflect 'news'. However, they point out that GDP revisions are far from being entirely predictable. Although GDP revisions were the largest only one year following the initial GDP release, still those revisions are nearly unpredictable.

Mankiw and Shapiro (1986) already did some earlier research and concluded that the revisions for the US Gross National Product (GNP) are more or less unpredictable. York and Atkinson (1997) analyzed the behavior of revisions for the seven largest OECD countries and

[3] See the box entitled "Revision of GDP 2002-2007 (size, direction and predictability)", *Quarterly Report*, NBRM, July 2009.

found that revisions of GDP growth were large, but not significantly different from zero, so there was no systematic bias in the preliminary national accounts figures.

Roodenburg (2004) investigated the quality of the first Dutch GDP releases by using the same technique as in the study of Faust et al. (2004). His findings suggested that Dutch GDP revisions were also predictable to some extent. Those results were reinforced with the application of the more general state-space estimation procedure in the second part of his paper.

Daniel Heller Sahlgren (2006), in the first part of his study, investigated revisions of Statistics Sweden's first announcements of quarterly GDP and found weak evidence suggesting that some of these revisions could be predicted. In the second part, he followed Orphanides and van Norden (2002) who examined the accuracy and reliability of alternative output detrending methods in real-time. He argued that the main reason for revising the Swedish output gap were not the revisions in the national accounts, but the uncertainty about the trend at the end of the sample. Revisions due to changes in the national accounts were of lower magnitude and persistence than the revisions that occur because of new information about the position of the economy in the business cycle.

Aruoba (2006) documented the empirical properties of revisions to major macroeconomic variables in the United States[4]. He found out that the revisions of variables of interest do not satisfy simple desirable statistical properties. In particular, he found that the means of final revisions are different from zero, which indicates that the initial announcements of statistical agencies are biased. Aruoba (2006) also found that the magnitudes of revisions are quite large compared to the original variables. Consequently, he found evidence of predictability of revisions using the information set at the time of the initial announcement, which means that the initial announcements of statistical agencies are not rational forecasts.

Overall, the assessed empirical studies provide different results about the developed economies, whereas the empirical evidence about the developing and transition economies is quite scarce. Also, authors in theirs empirical studies use several approaches to test for news and noise hypotheses of data revisions. Hence, in the reminder of this paper we aim to test if Macedonian GDP data revisions contain news or noise and whether any systematic pattern can be determined.

[4] The analysis focused on eight variables: growth of real output, real final sales, nominal output, inflation based on output deflator, unemployment rate, levels and growth rates of employment, capacity utilization and industrial production.

3. Data

In order to analyze year-on-year GDP growth revisions, we use data from Sate Statistical Office (SSO) of Macedonia. Our data sources include GDP press releases, beginning with the press release for 2002Q1. The last recorded press release in this paper ends with the period 2011Q3.

The data on the Macedonian GDP and its components (investments, household and public consumption, exports and imports) are subject to many revisions before publishing the final data. The first data on the quarterly GDP is published approximately 75 days after the end of the reference quarter, while the final data are released with longer time lag. For instance, the provisional data for annual national accounts are being published approximately 10 months after the end of the reference year, while the full set of national accounts with final data is being published 15 months after the end of the reference year. Although the SSO has no official calendar for implementation of the revision process, the quarterly data on GDP are revised almost in each new quarterly press release. We suspect that these estimates may contain some measurement error and may differ from the final data.

Throughout this paper for the GDP preliminary and revised estimates and GDP revisions we use the following definitions and notations:

P_t^t is a preliminary GDP year-on-year growth estimate (release) at time *t*;

P_t^{t+n} is a revised GDP year-on-year growth estimate (release) at time *t+n , where n = 1,2,3….*

P_t^f is a final GDP year-on-year growth estimate (release) at time *f*;

R_t^{t+n} is a difference between the GDP revised estimate at time *n* and the preliminary GDP estimate (release) at time *t* called GDP revision.

Consequently, in this paper we define:

a) short-term GDP revision that is a difference between the revised GDP estimate after one quarter and the preliminary GDP estimate: $R_t^{t+1} = P_t^{t+1} - P_t^t$;

b) long-term GDP revision that is a difference between the revised GDP estimate after seven quarters[5] and the preliminary GDP estimate: $R_t^{t+7} = P_t^{t+7} - P_t^t$;

[5] This is the last announcement of revised GDP estimate published in quarterly press releases.

c) final GDP revision that is a difference between the revised GDP estimate after more than seven quarters (treated as final estimate from SSO) and the preliminary GDP estimate:

$R_t^f = P_t^f - P_t^t$

4. Testing the 'news' and 'noise' hypotheses

This section presents the major statistical tools for testing the 'news' and 'noise' hypotheses. In other words, this section describes how we can empirically assess if GDP data revisions are unbiased and efficient. In that respect, we test for the following five hypotheses:

1. If the GDP revised estimates are unbiased and contain new information, the regression line of the scatter plots between preliminary and revised GDP estimates will lie on the 45-degree line, i.e. on the so-called "line of perfect forecasts" (see Mincer and Zarnowitz, 1969). Otherwise, if it intersects with the "line of perfect forecasts", the revised GDP estimates are biased and may contain measurement errors. Moreover, additional indication of bias in the GDP revisions may be observed in the regression line from the scatter plots between GDP preliminary estimates and GDP revisions. Any systematic pattern of this line that is different from zero, could suggests bias in the revisions, thus supporting the 'noise' hypothesis.

2. If the GDP revisions are unbiased, the mean of the revisions (μ_r) is expected to be equal to zero: $E(\mu_r) = 0$. This is set according to the Mincer and Zarnowitz (1969) forecast efficiency hypothesis arguing that when the mean of the revisions is zero, the revised values of the preliminary estimate of GDP lie on the so-called "line of perfect forecasts", indicating that GDP data revisions contain 'news'. Otherwise, if the mean of the revisions is different from zero, the revisions are biased and may contain 'noise'.

3. If the revisions are efficient and unpredictable, the revisions and preliminary GDP estimates should be uncorrelated: corr ($P_t^t, R_t^{t+n} = 0$). This is derived from the Mincer and Zarnowitz (1969) and Mankiw and Shapiro (1986) arguments about the 'news' hypothesis. More precisely, if the revisions of GDP contain new set of information that was not available at the time when the preliminary estimate was made, the revision should be uncorrelated with the preliminary estimate of GDP. In contrast, according to the 'noise' hypothesis, if the revision is correlated with

the preliminary GDP estimate, it is an indicator of 'noise' in the GDP data revisions (Mankiw and Shapiro, 1986; Faust et al., 2004 and Aruoba, 2006). Moreover, according to Mankiw and Shapiro (1986) and Aruoba (2006), another way to test the 'news' hypothesis of efficient GDP forecasts is that the GDP revision and the revised GDP estimate should be correlated. More precisely, if the revised estimate of GDP contains new information that was not available when the previous GDP estimate was made, the revised estimate of GDP should then be correlated with its latest revision.

4. Under the 'news' hypothesis, if the preliminary release of GDP is efficient forecast, "…. the variance of the subsequent estimates increase. Efficient forecasts are necessarily smoother than the object being forecast." (Mankiw and Shapiro, 1986, p. 22). This implies that the variance of the subsequent revisions of the GDP preliminary estimates should increase and vice versa, for the 'noise' hypothesis.

5. The predictability of the GDP revisions can also be tested by using a regression analysis. In respect of 'news' hypothesis, if the GDP revisions contain 'news' and therefore, are efficient forecasts, the revisions should be unpredictable (Mincer and Zarnowitz, 1969 and Mankiw and Shapiro, 1986). The rationale behind these arguments can be explained with the following equations:

$$P_t^t = P_t^f + \varepsilon_t \qquad (1)$$

where: preliminary GDP estimate (P_t^t) equals final GDP estimate (P_t^f) plus a disturbance term ε_t (Faust et al., 2004). In the case of efficient forecast (the 'news' hypothesis), the disturbance term should be white noise process and orthogonal to the preliminary GDP estimate. In the case of 'noise' hypothesis, the opposite conclusion should hold: the disturbance term should be orthogonal to the final GDP estimate while correlated with the preliminary GDP estimate. In the second case, when the disturbance is correlated with the preliminary GDP estimate, the latter may be used for predicting the final GDP estimate. Under this condition, the 'noise' hypothesis holds, and in accordance to Mincer and Zarnowitz (1969) work, the equation 1 can be re-arranged as follows:

$$R_t^{t+n} = \beta_0 + \beta_1 P_t^t + u_t \qquad (2)$$

where: R_t is the revision of the GDP forecast at time $t + n$ (explained in Section 3); P_t^t is preliminary GDP estimate, β_0 is the intercept term, β_1 is a parameter to be estimated, u_t are disturbances of the model and t is a time subscript.

In order to test for the efficiency of the GDP forecast and thus, the predictability of the possible revisions, and whether the 'news' hypothesis holds, we test for the following joint hypothesis:

$$H_0: \beta_0 = \beta_1 = 0 \qquad (3)$$

If we fail to reject the joint hypothesis H_0, it indicates that the intercept and the slope coefficient of equation 2 are statistically not different from zero. This implies that the whole regression is meaningful and consequently, the revisions may not be predictable. This means that the GDP forecast may be efficient and the revisions are in line with the 'news' hypothesis, i.e. the newly gathered information is incorporated in the revised GDP estimate and the revisions are not prone to measurement errors. As argued by Aruoba (2006), although the 'news' and 'noise' hypotheses are mutually exclusive (the rejection of the 'news' hypothesis from equation 3 may implicitly suggest non-rejection of the alternative 'noise' hypothesis) however, "……..they are not collectively exhaustive, that is, we can reject both hypotheses, especially when the unconditional mean of revisions is not equal to zero." (p. 14). In order to check for the latter, according to Mankiw and Shapiro (1986) and Aruoba (2006), the 'noise' hypothesis can also be tested separately. For example, if GDP estimates are efficient, and with each subsequent revision new information is incorporated that was not available previously, the revision should be correlated with the revised GDP estimate. In this light, in the style of Auroba (2006), we can test the 'noise' hypothesis separately with the following equation:

$$R_t^{t+n} = \alpha_0 + \alpha_1 P_t^{t+n} + e_t \qquad (4)$$

where: same as in equation 2, R_t is the revision of the GDP estimate at time $t + n$; P_t^{t+n} is revised GDP estimate at time $t + n$, α_0 is the intercept term, α_1 is a slope parameter to be estimated, e_t are disturbances of the model and t is a time subscript. Under the 'noise' hypothesis, we test for the following joint hypothesis:

$$H_0: \alpha_0 = \alpha_1 = 0 \qquad (5)$$

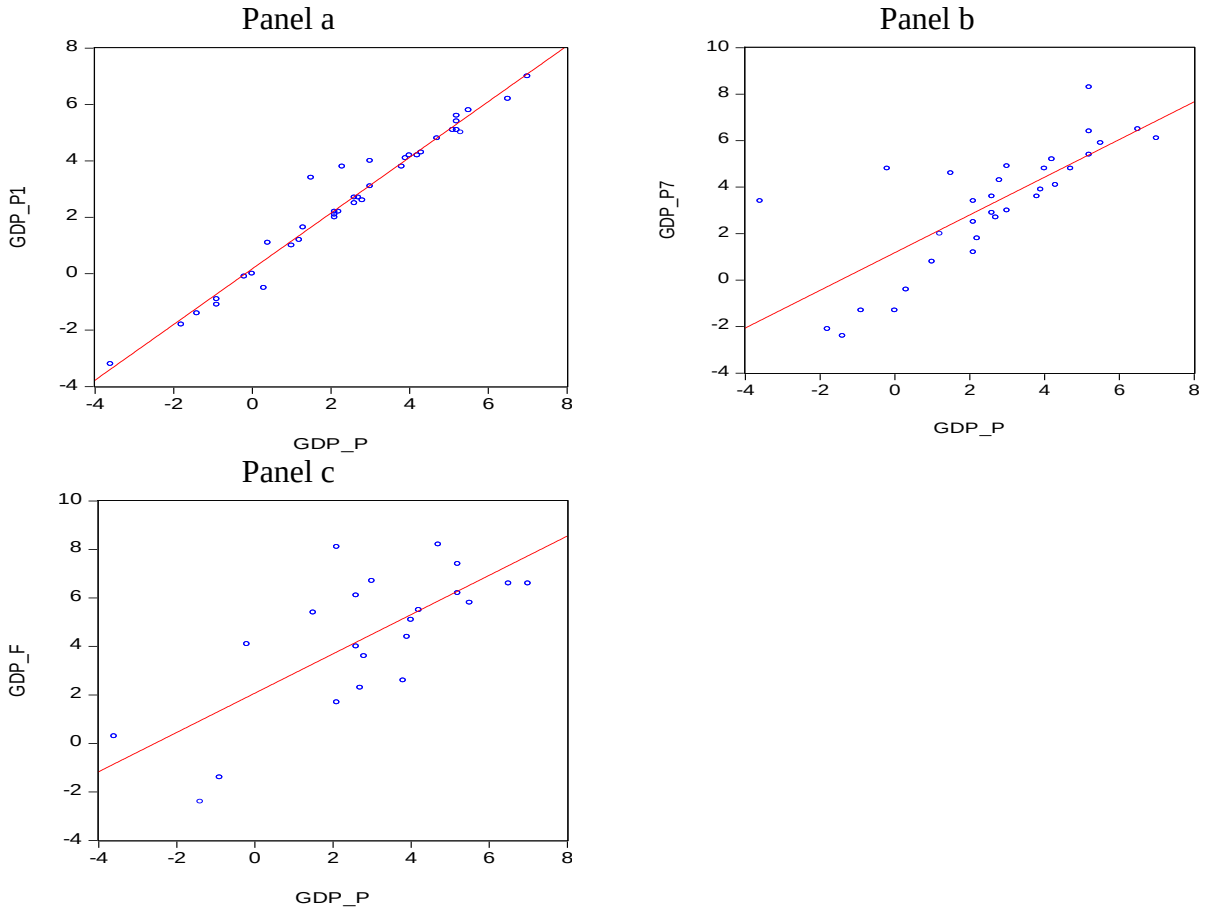
where non-rejection of the null hypothesis implies that both coefficients in equation 4 are jointly statistically not different from zero and therefore, we do not reject the 'noise' hypothesis. Rejection of the null hypothesis from equation 5 suggests that the revised GDP estimate is correlated with the revision, which is in line with the 'news' hypothesis. Consequently, in the next section, we statistically test the aforementioned five hypotheses.

5. Discussion of the results

In this section, we discuss the results from testing the hypotheses presented in the previous section. By testing hypothesis 1, the scatter plots between the preliminary GDP estimates and revised GDP estimates are presented in Figure 1, whereas the scatter plots between preliminary GDP estimates and revisions (difference between revised estimates and preliminary estimates) are presented in Figure 2.

The scatter plot between the GDP preliminary estimate P_t^t and the very short-term revised estimate P_t^{t+1} (see Figure 1, panel a) indicate that regression line has a slope of almost 45-degree line, and lies on the so-called "line of perfect forecasts", implying that the revised GDP estimates after one quarter are likely unbiased. The scatter plots between the preliminary GDP estimate and the long-term GDP revised estimate (after seven quarters) and the final GDP estimate (Figure 1, panels b and c) imply that the regression lines intersect the "line of perfect forecasts", suggesting that the long-term and final GDP revised estimates may be biased.

Figure 1: Scatter plots between GDP preliminary estimate (horizontal axis) and GDP revised estimates (vertical axis)

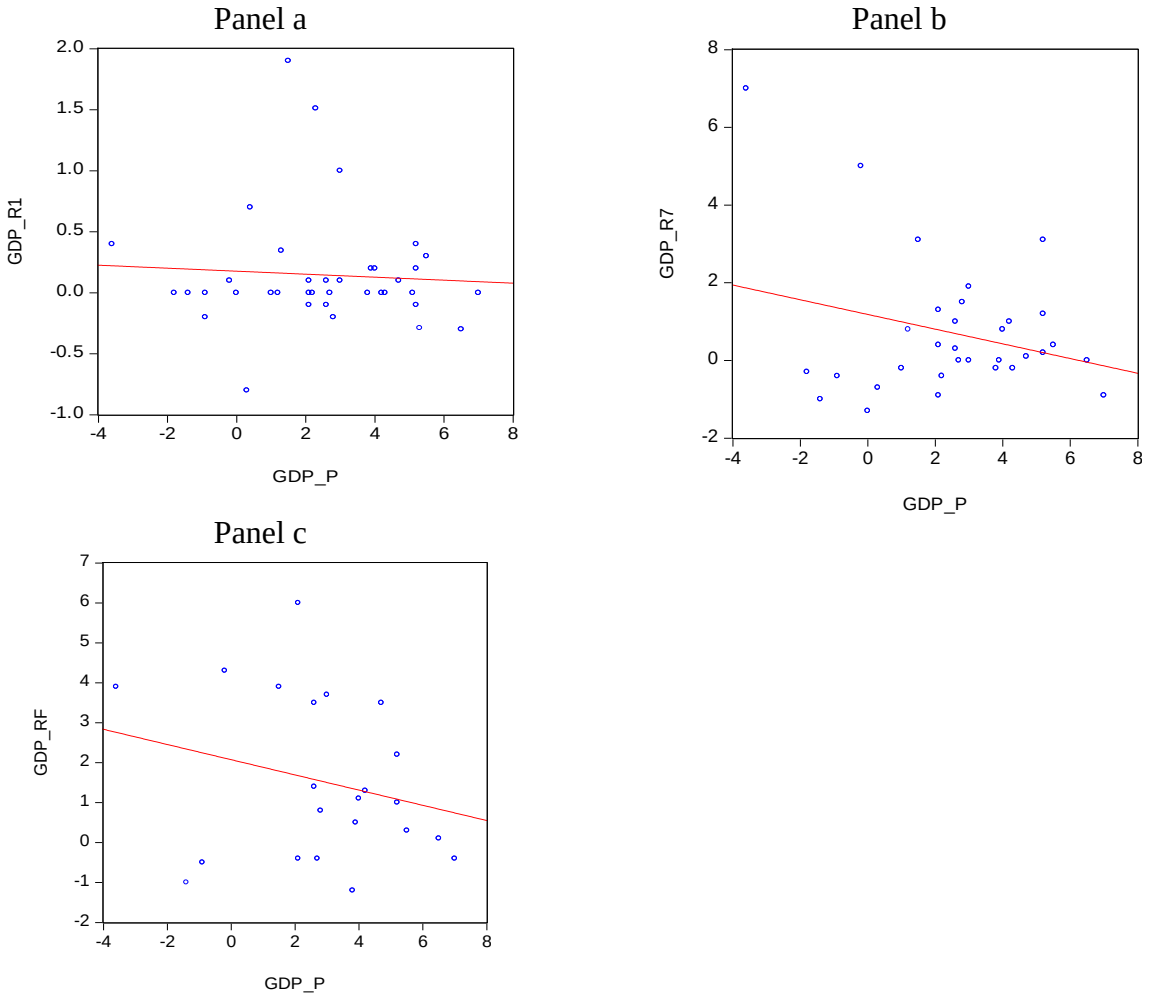


Panel a is a scatter plot between GDP preliminary estimate and short-term revised estimate; Panel b is a scatter plot between GDP preliminary estimate and long-term revised estimate; Panel c is a scatter plot between GDP preliminary estimate and final revised estimate.
Source: Authors' calculations based upon data from SSO performed in Eviews 7.

By analyzing the scatter plots between the GDP preliminary estimate and revisions (short-term, long-term and final revision, see Figure 2), the regression line is downward sloping in all three figures and is much steeper and systematically different from zero between the GDP preliminary estimate and the long-term and final revisions (see Figure 2, panels b and c). This indicates a possible existence of a systematic relationship between the GDP preliminary estimates and revisions. The downward sloping regression line in scatter plots in Figure 2 (panel b and c) generally relies on the positive zone of x and y axis, which may imply that high preliminary estimated GDP growth rates are revised upward in a smaller size or magnitude. The

opposite is true when the preliminary estimate of GDP growth rate is small or low. Then the upward revision is of a bigger size.

Figure 2: Scatter plots between GDP preliminary estimate (horizontal axis) and GDP revisions (vertical axis)



Panel a is a scatter plot between GDP preliminary estimate and short-term revision; Panel b is a scatter plot between GDP preliminary estimate and long-term revision; Panel c is a scatter plot between GDP preliminary estimate and final revision.
Source: Authors' calculations based upon data from SSO performed in Eviews 7.

When assessing the mean of revisions (testing hypothesis 2 from previous section), the data presented in Table 1 indicate that the mean is close to zero only for the short-term revisions, while for the long-term and final revisions, it is increasing and is above zero especially for the final GDP revision. This implies rejection of the null hypothesis of Mincer and Zarnowitz (1969) forecast efficiency test and hence, the revisions may be biased and contain 'noise'. These results

can also be supported with the t-statistics, by which we test if the mean of the revisions is statistically not different from zero. The results from the t-statistics for the short-term revisions indicate rejection of the null hypothesis that the mean of the revisions is statistically not different from zero at 10% level of significance, whereas the t-statistics results for the long-term and final revisions imply rejection of the null hypothesis at 5% and 1% level of significance, respectively. Consequently, the t-statistics suggest that the mean of revisions is not statistically equal to zero.

Table 1: Mean of revisions, variance of GDP estimates and correlation coefficients between GDP preliminary estimate and revisions.

	Mean of the revisions:	Correlation coefficients between GDP preliminary estimate and revisions:	Correlation coefficients between GDP revised estimate and revisions:	Variance of the GDP estimate:
Preliminary	/	/	/	4.84
Short-term	0.15*	-0.19	-0.01	4.94
Long-term	0.71**	-0.49**	0.27	5.26
Final	1.53***	-0.24	0.48**	5.78

*/**/*** indicates rejection of the null hypothesis that the estimated value is statistically different from zero at 10%, 5% and 1% level of significance, respectively.
Source: Authors' calculations based upon data from SSO performed in Eviews 7.

When testing hypothesis 3, explained in section 4 about the correlation between revisions and preliminary GDP estimates, the results in Table 1 suggest a negative correlation between preliminary GDP estimates and revisions (short-term, long-term and final). These correlation coefficients, apart from the ones between GDP preliminary estimates and long-term revisions, are statistically not different from zero at any level of significance. This is in line with the Mincer and Zarnowitz (1969) and Mankiw and Shapiro (1986) arguments for the 'news' hypothesis implying a non-rejection of the null hypothesis according to which, the correlation between the GDP preliminary estimates and revisions should be statistically not different from zero. Therefore, we may conclude that revisions contain news rather than measurement errors. In addition, we also test the 'news' hypothesis by analyzing the correlation coefficients between the GDP revisions and revised GDP estimate. The results in Table 1 suggest again that the correlation is statistically different from zero at 5% level only for the correlation coefficient between GDP final estimate and final revision, pointing out that the final GDP revisions contain 'news'. However, for the rest of the correlation coefficients, this cannot be supported. Overall, the correlation coefficients for the long-term revisions imply that they may contain 'noise' and

exhibit systematic pattern, whereas for the final GDP revisions, the results are in line with the 'news' hypothesis. Nevertheless, the results for the short-term GDP revisions based on correlation coefficients are mixed.

Regarding the fourth hypothesis in section 4 that addresses the variance of the GDP subsequent estimates, the results in Table 1 show that variances of each subsequent GDP estimate are increasing, which is in line with the hypothesis of efficient forecasts, i.e. the 'news' hypothesis.

In order to empirically examine if there is a systematic pattern in the revisions and if this is true, whether it can be predicted through time (testing hypothesis 5 from section 4), we run regressions set with equation 2 for the short-term, long-term and final revisions as a dependent variable, respectively. With these regressions, we test the null hypothesis from equation 3, where non-rejection of the null hypothesis implies that revisions cannot be predicted and contain 'news', and therefore, preliminary GDP estimate is an efficient forecast. In addition, we use Newey-West (1987) standard errors that are robust to heteroskedasticity and autocorrelation. The results from the estimated regressions are presented in Table 2.

Table 2: Regression results for testing the 'news' hypothesis from equations 2 and 3.

		Regression 1: Short-term revisions	Regression 2: Long-term revisions	Regression 3: Final revisions
Coefficient:	β_0	0.18	1.18	2.07*
S.E.		0.12	1.02	1.05
Coefficient:	B_1	-0.01	-0.19	-0.19
S.E.		0.02	0.26	0.21
F-test for joint 'news' hypothesis from equation 3		0.15	2.32	1.27
P-value		0.70	0.14	0.27
Adjusted R-squared		0.02	0.04	0.01
Diagnostic tests (p-values):				
Serial correlation		0.93	0.19	0.45
Heteroskedasticity		0.97	0.61	0.11
Normality		0.00	0.01	0.75
Functional form		0.15	0.25	0.32

*/**/*** indicates statistical significance at 10%, 5% and 1% level, respectively. Newey-West robust standard errors are used.
Source: Authors' calculations based upon data from SSO performed in Eviews 7.

Before we start with the interpretation of the results, we first examine if the residuals are white noise. We conduct battery of diagnostic tests such as Breusch-Godfrey for serial correlation, Engel's auto-regressive conditional test for heteroskedasticity (ARCH), Jarque-Bera test for normal distribution of residuals and Ramsey's reset test for functional form. Examining whether the residuals are white noise is important for testing the 'news' hypothesis from equation 2, especially the one for serial correlation, because as argued by Sahlgren (2006), Roodenburg (2004) and Faust et al. (2006), residuals that are not white noise and in the case they are serially correlated then it is an indicator of 'noise' hypothesis. As stated by Sahlgren (2006) "Auto correlated residuals suggest that they are not independent of past information, which in effect means that the 'news' hypothesis cannot hold." (p. 12). The results regarding the afore-mentioned diagnostic tests are satisfactory and thus, the residuals are white noise apart from the normality test for Regressions 1 and 2 that may be due to the outliers in the sample for which a robustness check has been done in the next section.

Analyzing the estimated parameters from the regressions presented in Table 2 and their joint statistical significance, i.e. testing the 'news' hypothesis from equation 3, we can notice that in all regressions for the short-term, long-term and final revisions at 10% level, we cannot reject the null hypothesis that the intercept term and the slope coefficient are jointly statistically not different from zero. In addition, the values of the adjusted R-squared are very low, ranging from 0.01 to 0.04. These results imply that there is not any systematic pattern between the GDP preliminary estimates and subsequent revisions and consequently, revisions cannot be predicted. This supports the 'news' hypothesis that revisions contain new information and are not prone to measurement errors. According to authors' knowledge, although there is not any existing empirical study that analyzes the predictability of GDP revisions for the Central and South Eastern Europe, we compare the results for the existing empirical studies for advanced economies. The estimated results for the case of the Republic of Macedonia are consistent with those for the US economy presented in Faust et al. (2006) and Mankiw and Shapiro (1986), for Sweden estimated by Sahlgren (2006) and for Brazil in the research of Palis et al. (2004).

As explained in section 4, for predictability of the GDP revisions based on regression approach we also test the 'noise' hypothesis set in equation 4, where we examine if there is any systematic relationship between the revised GDP estimate and revision. As mentioned before, we firstly check the diagnostic tests and then we interpret the results from the estimated regression.

As presented in Table 3, the diagnostic test point that residuals are white noise, where again the only problem appears with the normality test for Regressions 1 and 3 that may be due to outliers in the sample. Regarding the joint statistical significance of the constant term and the slope coefficient, apart from regression 1 from Table 3 between the short-term revision and revised GDP estimate after one quarter where we failed to reject the null hypothesis at 10% level, for the other two regressions 2 and 3 we can reject the null hypothesis at 5% level, suggesting efficient GDP forecasts. Furthermore, the values of adjusted R-squared are much greater compared to the same ones from Table 3 and for regressions 2 and 3, they range between 0.14 and 0.19. These results for the long-term and final revisions are consistent with the previously discussed results from Table 2 where we tested the 'news' hypothesis, as well as with the statistical significance of the correlation coefficients.

Table 3: Regression results for testing the 'noise' hypothesis from equations 4 and 5.

		Regression 1: Short-term revisions	Regression 2: Long-term revisions	Regression 3: Final revisions
Coefficient:	α_0	0.08	-0.19	0.04
S.E.		0.10	0.26	0.82
Coefficient:	α_1	0.02	0.28***	0.34**
S.E.		0.02	0.07	0.15
F-test for joint 'news' hypothesis from equation 5		0.59	6.22	6.04
P-value		0.45	0.02	0.02
Adjusted R-squared		0.01	0.14	0.19
Diagnostic tests (p-values):				
Serial correlation		0.91	0.34	0.13
Heteroskedasticity		0.96	0.94	0.27
Normality		0.00	0.00	0.42
Functional form		0.23	0.18	0.34

*/**/*** indicates statistical significance at 10%, 5% and 1% level, respectively. Newey-West robust standard errors are used.
Source: Authors' calculations based upon data from SSO performed in Eviews 7.

Overall, although the results discussed in this section are ambiguous in some cases, still, for the long-term and final revisions they tend to incline that there is no any systematic correlation between GDP preliminary estimates and revisions, which is in line with the 'news' hypothesis. In general, it can be concluded that the preliminary GDP estimates are rational forecasts, and long-term and final GDP revisions contain 'new' information which reduce the forecast errors done with the preliminary GDP estimate.

5.1 Robustness check[6]

In order to check the robustness of the results, following the approach of Sahlgren (2006) and Faust et al. (2005), we re-examined the same hypotheses discussed in section 4 by adjusting the sample for the outliers defined as a mean value of the series with a deviation of + / - 3 percentage points. The results from the scatter plots are consistent with the ones already discussed at the beginning of the previous section. The scatter plots imply again that the revisions may be biased to some extent because the regression lines in the scatter plots between the preliminary and revised GDP estimates intersect the 45-degree line, whereas the regression lines on the scatter plots between GDP preliminary estimate and revisions is downward sloping.

Regarding the mean of the revisions and the variance of the GDP estimates, the results are also in line with the results discussed in the previous section. Namely, the mean of the revisions is not statistically equal to zero, while the variance of each subsequent estimate is increasing.

The results from the correlation coefficients point again that correlation coefficients between the GDP preliminary estimates and short-term and final revisions are statistically not different from zero at 10% level, while the correlation coefficient between GDP preliminary estimate and long-term revision is statistically significant at 5% level. The results for the correlation coefficients between revised GDP estimates and revisions indicate once again that only the correlation coefficient between final GDP estimate and final GDP revision is statistically significant at the 5% level.

Checking the robustness of the results for the same regressions reported in Tables 2 and 3, the estimated results are consistent again. The 'news' hypothesis could not be rejected in all

[6] The results discussed in this section are available from the authors upon request.

regressions at 10% level, which is in line with the results presented in Table 2. The 'noise' hypothesis could be rejected at 10% level for the regressions between long-term and final revisions, but not for the short-term revisions, which is consistent with the regressions reported in Table 3.

6. Conclusions

The aim of this analysis is to examine GDP data revisions in a South East European economy such as the Republic of Macedonia. In that respect, this paper examines if there is any systematic pattern between GDP estimates and subsequent short-term, long-term and final revisions, by which we may be able to predict the size and the direction of the revisions. This may be of considerable importance for optimal decision-making.

We tested the 'news' and 'noise' hypotheses using various empirical approaches. The results based on these empirical approaches in general provide mixed results for short-term GDP revisions although the empirical evidence tends to incline that the long-term and final GDP revisions are efficient and contain new information that is in line with the 'news' hypothesis. More precisely, the scatter plot diagrams and the mean of the revisions suggest that they are biased and contain measurement errors, i.e. 'noise', whereas the variance of the revisions and the regression-based approaches imply that long-term and final GDP revisions are efficient and contain new information that is in line with the 'news' hypothesis.

Overall, by carefully assessing the empirical results discussed in this paper, we may conclude that the empirical evidence tends to incline that the GDP data revisions contain new information that was not available when the preliminary GDP estimate was done. Therefore, one may conclude that the preliminary GDP data are efficient forecasts and each subsequent revision incorporates new information that supports the 'news' hypothesis.

As open research issues are to explore if there is any asymmetric pattern in the GDP data revisions. For example, although this analysis assumes linear relationship between GDP estimates and subsequent revisions, nevertheless, this relationship may be non-linear and may indicates different pattern between upward and downward revisions and preliminary GDP estimates.

References

Aruoba, S.B. (2006): Data Revisions are not Well-Behaved, *Journal of Money, Credit and Banking*, 2008, 40(2-3), 319-340

Faust, J., Rogers, J.H., Wright J.H. (2005), "News and Noise in G-7 GDP Announcements." *The Journal of Money, Credit and Banking*, Vol. 37, No. 3, 403−419.

Howrey, E.P. (1978): The Use of Preliminary Data in Econometric Forecasting, *Review of Economics and Statistics*, 60, pp.193-200.

Howrey, E.P. (1984): Data Revision, Reconstruction and Prediction: An Application to Inventory Investment, *Review of Economics and Statistics*, 66, pp.386-393.

Mankiw, N.G. and M.D. Shapiro (1986): News or Noise: An Analysis of GNP Revisions, *Survey of Current Business*, May 1986, pp.20-25.

Mincer, J. and V. Zarnowitz (1969): The Evaluation of Economic Forecasts in J. Mincer (ed.), Economic Forecasts and Expectations, NBER, New York.

Newey, W.K. and K.D.West (1987): A Simple Positive Semidefinite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix, *Econometrica*, 55, pp703-708.

Orphanides, A. (1998): Monetary Policy Rules Based on Real-Time Data, Board of Governors of the Federal Reserve System, Finance and Economics Discussion Paper, forthcoming *American Economic Review*.

Orphanides, A. (2000): The Quest for Prosperity Without Inflation, European Central Bank Working Paper.

Orphanides, A. and van Norden S. (2002): "The Unreliability of Output-Gap Estimates in Real Time." *The Review of Economics and Statistics,* Vol. 84, No. 4,

Palis, R., R. Ramos and P. Robitaille (2004): News or noise? An analysis of Brazilian GDP announcements, *International Finance Discussion Papers*, No 776.

Roodenburg, Olivier (2004), "On the predictability of GDP data revisions in the Netherlands." Working Paper , No. 4, July. Netherlands Central Bank (DNB).

Sahlgren, D. H. (2006): A Real-Time Data Set for Swedish GDP - GDP Revisions and the Output Gap in Real-Time, Stockholm School of Economics.