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EVALUATION OF MACROECONOMIC FORECASTS OF THE GOVERNMENT OF THE REPUBLIC OF CROATIA IN THE PERIOD FROM 2011 TO 2023

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In the context of the application of the Fiscal Responsibility Act (FRA, Official Gazette 111/18, 83/23) in the Republic of Croatia, a permanent, independent and autonomous fiscal body was established: the Fiscal Policy Commission tasked with performing works within its area of activities and competence laid down by the above-mentioned Act.

The Fiscal Policy Commission is an independent and professional institution whose primary mission is to monitor public finances to ensure their long-term sustainability and improvement, where it serves as a supervisor overseeing the implementation of the country's fiscal policy in its entirety. The Commission advocates for transparency and fosters a culture of fiscal responsibility in the execution of fiscal policy in the Republic of Croatia through its independent analysis and by encouraging

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SUMMARY

The document analyses the accuracy of macroeconomic forecasts of the Government of the Republic of Croatia within the framework of the Draft State Budget of the Republic of Croatia (hereinafter: DSB) and the Convergence Programme / Stability Programme (hereinafter: CP/SP) from 2011 to 2023. The evaluation is based on a *real-time* approach and includes a comparison of official *ex ante* forecasts with the first published version of the outturn, the calculation of the usual indicators of forecast errors and a statistical analysis of forecast errors. The analysis focused on macroeconomic indicators, that is, on the growth rate of the real gross domestic product (hereinafter: GDP) and its components (expenditure method) and the inflation rate measured by the national price index (hereinafter: CPI).

In short-term one-year-ahead forecasts (*t+1*), using data from the spring CP/SP, moderate forecast errors have been identified. Excluding 2020 from the calculation, the mean absolute error of the real GDP growth rate forecast is 1.11 percentage points. This means that the average deviation of real values from the forecast ones was 1.11 percentage points. GDP components were forecast with a somewhat higher mean absolute error, whereas the mean absolute error of the inflation rate forecast was 2.31. It is concerning that the forecasts of certain variables in the autumn DSBs indicate significantly bigger errors although they should be more accurate considering the shorter time horizon and more information being available.

For example, the mean absolute error for the real GDP growth rate increased to 1.71, and errors are also expressed in forecasts of real investments and real export. On the other hand, the inflation rate mean absolute error decreased to 1.78.

Since the statistical error analysis was carried out on a small sample, the results should be interpreted carefully. In most cases, the errors turned out to be unbiased, that is, there was no systematic overestimating or underestimating in forecasting the variable and also no error autocorrelation. On the other hand, the statistical analysis shows that the official forecasts were not more accurate at a statistically significant level than the naive forecast where it is presumed that the year-ahead forecast rate is equal to the current-year growth rate.

The analysis does not provide an answer about the reasons for the forecast errors. Each forecast is based on certain presumptions, and the outturn usually differs from the presumptions. To be able to draw a conclusion on the quality of the prediction system applied by the Government of the Republic of Croatia (hereinafter: the Croatian Government) we needed to exclude the contribution of erroneous presumptions, which in turn required additional research on a broader dataset.

1 INTRODUCTION

The importance of macroeconomic forecasts for managing economic policy cannot be overstated. Having different institutions and thus also numerous actors involved in preparing these forecasts, each of whom applied their own methods and presumptions, lead to a wide range of predictions about future economic developments.

Macroeconomic forecasts are instrumental to planning fiscal policy and minimizing uncertainties regarding future economic developments. Changes in economic outlooks affect future revenue and expenditure of the Croatian Government and outline the space for additional fiscal interventions. In the context of the Stability and Growth Pact of the European Union (hereinafter: the EU), macroeconomic forecasts play a key role in the European Commission's monitoring of the member states' budgetary plans. According to the improved rules under the Pact, which came into force in 2013 with the so-called Two-Pack regulations, fiscal planning must be based on realistic macroeconomic forecasts which are not susceptible to political optimism bias. To ensure this, the Pact stipulates that macroeconomic forecasts must be independent of fiscal policy management. As a result, in the last few years, many countries founded independent fiscal institutions in order to create or approve macroeconomic forecasts for the preparation of the budget (Lehmann, Wollmershäuser, 2019).

Awareness of the importance of good macroeconomic forecasting increased over time, especially since Croatia's joining the EU in 2013 which resulted in an obligation to ensure coordination of economic policies and comply with fiscal rules. The Croatian Government presents the macroeconomic forecasts in the DSB and the CP/SP[1] which serve as the basis for budgetary documents. This obligation to prepare macroeconomic forecasts, integrated in the coordination of economic policies across the EU, is embedded in the budgetary process which ensures their critical role in planning and managing public finances.

Official macroeconomic and budgetary forecasts of the Croatian Government are prepared by the Institute for Macroeconomic Analyses and Forecasts of the Ministry of Finance (hereinafter: MFIN). That is why the terms of Croatian Government's forecast and MFIN's forecast can be used in parallel. The process of preparing official macroeconomic and budgetary forecasts[2] developed over time, with forecasts being

[1] Starting with 2023 and the introduction of the euro as the national currency, i.e. after Croatia's entry into the eurozone, the Republic of Croatia became obligated to prepare the SP instead of the CP.

[2] With the adoption of the Budget Act, macroeconomic forecasts became an integral part of the state budget of the Republic of Croatia. This is defined by the Budget Act (Official Gazette 144/21, 87/08, 136/12, 15/15) which stipulates that the draft budget shall include macroeconomic forecats as the basis for planning revenue and expenditure. According

prepared twice a year in general. The spring forecasts, whose preparation was moved from June to April over time, represented the basis for preparing the CP/SP. Autumn forecasts, which were most often prepared in the period between September and October, represented the basis for the DSB.

Budgetary forecasts, which include the forecasts of state revenue and expenditure, fiscal balance and public debt, are based on the forecasts of a very wide set of macroeconomic variables. For example, the forecast of revenue from value added tax is based on the forecast of personal consumption, whereas the forecast of revenue from contributions relies on the forecast of the amount of compensations to the persons employed in the private sector. This in turn mostly depends on the forecast of employment and wages in the private sector, etc. For each forecast real variable, the pertaining price deflator should also be forecast since budgetary forecasts represent the forecast of nominal values.

Pursuant to the current[3] Fiscal Responsibility Act (Official Gazette 111/18, hereinafter: FRA), the Fiscal Policy Commission (hereinafter: FPC), based on Article 22 (2) of the FRA, is obligated to examine and compare macroeconomic and budgetary forecasts with the outturns in the period of four consecutive years, and to conduct an analysis once every two years. In doing so, the usual practice is to examine in detail and analyse only the basic macroeconomic and budgetary indicators. Other forecast indicators, which are much more numerous, can be analysed in the same manner.

The evaluation of the macroeconomic forecasts of the Croatian Government is based on the available forecasts presented in the CP/SP and the DSB. The present analysis focuses on the forecast values for selected macroeconomic indicators (Annex, Table 9) for year *t=0* and *t+1*. The estimated values of macroeconomic indicators are compared with the achieved values for the particular year presented in the CP/SP and the DSB. Forecast errors should be lower in the DSB than in the CP/SP. Information availability is greater with the preparation of the DSB than CP/SP since statistical data on analysed macroeconomic indicators are published on a quarterly or monthly basis.

to this Act, macroeconomic forecasts include estimated growth of gross domestic product, inflation, employment and other relevant economic indicators crucial for preparing the state budget. The first act which regulated this field was the Budget Act from 2008, and subsequent amendments to that act reinforced the importance and the role of macroeconomic forecasts in the process of preparing the state budget.

[3] With the coming into force of the new Regulation (EU) 2024/1263 of the European Parliament and of the Council of 29 April 2024 on the effective coordination of economic policies and on multilateral budgetary surveillance, the reformed rules of the Stability and Growth Pact were published. Amendments were adopted to simplify and make more flexible those rules that promote sustainable public finance and reforms as well as investments in growth pursuant to EU's common priorities. New fiscal rules still demand that EU member states maintain their fiscal deficits below 3 % of GDP, and public debt below 60 % of GDP. The framework for the implementation of these rules is based on public debt sustainability analyses for certain countries, where one major indicator - net expenditure development - is used as the annual operative goal of fiscal policy. For more information: https://pfp.hr/files/file/dokumenti/NOVA-EGR-pravila-I.pdf
Pursuant to the new Regulation, the Croatian Government should adopt the new FRA by the end of the current year.

There are also monthly or even daily recent data on analysed indicators, although usually with incomplete coverage.

The subject-matter of the analysis are annual growth rates of selected macroeconomic indicators. The forecast of growth rates at the annual level in the *t=0* period particularly reflects the statistical data for the previous and current year which have already been published. In fact, only that part of the current year for which no statistical data have been published yet is subject to forecasting. The forecast of the growth rates at the annual level in the *t+1* period includes much less recent statistical information. The forecast for *t+1* can be made under the presumption that the forecast current developments at the end of the current year will continue the following year, taking into consideration the so-called statistical transfer.[4] The error of such a forecast will be relatively small, as long as the prevailing trend does not change. However, it has been empirically confirmed that economic activity is cyclical, that is, that dominant trends are maintained through a certain period of time, after which a crisis ensues, and trends abruptly change. Such abrupt trend changes are the most difficult to forecast.

The evaluation of budgetary forecasts is not presented in this document because the work is still ongoing. Such an analysis requires to significantly expand the dataset. In addition to data shown in the CP/SP and the DSB, data from all the budget amendments also need to be included.

It must also be mentioned that macroeconomic and budgetary forecasts, regardless of the producing institution, rely on the presumptions about future economic events and global developments. Forecasts of macroeconomic and budgetary developments greatly depend on the presumed growth and demand of the major trade partners and on the presumed development of global raw material prices and reference interest rates.

The document is arranged in chapters: 1. Introduction; 2. The methodology presenting in more detail the data used and how they are processed; 3. An analysis of the errors in Croatian Government's macroeconomic forecasts as the central part of the document which examines deviations of macroeconomic forecasts compared to the outturns and the properties of those errors; and the last chapter, 4. Conclusion.

[4] Statistical transfer is the level of the variable at the end of the current year compared to the current-year average.

2 METHODOLOGY

The methodology used in this document is in accordance with the standard international practice regarding the time availability of data, statistical measures for assessing forecast accuracy and the analysis of the optimum properties of the forecasts. The evaluation of Croatian Government's macroeconomic forecasts is based on the approaches from professional and institutional literature, including Timmermann (2006) for the IMF[5], Fioramanti *et. al.* (2016) for the European Commission, as well as contributions from, among other, Marinheiro (2011), Gonçalves (2022), Jerić *et. al.* (2020) and the analyses of independent fiscal institutions such as the Portuguese CFB[6] (2024), Italian UPB[7] (2023) and the Maltese FAC[8] (2024).

The methodological framework is based on the standardization of used data and the definition of clear comparison criteria. The first step involves identifying relevant macroeconomic indicators which are the subject-matter of the comparison. In the next stage, official macroeconomic forecasts published in the DSB for the period from 2011 to 2023 and in the CP/SP for the period from 2014 to 2023 are collected.

The average *ex ante* accuracy is calculated for each of the selected macroeconomic indicators, quantifying the deviations between the forecast and the outturn. This approach facilitates an objective and consistent evaluation of the predictive reliability of macroeconomic forecasts over a sequence of time.

In this research, official *ex ante* forecasts are compared with the first officially available publication of the outturn available after the end of the observed year (*real-time approach*). This approach enables a consistent and timely estimate of forecasting accuracy, taking into consideration the information context available at the time of adopting the fiscal policies. By doing so, the research is aligned with the practices applied by independent fiscal bodies of other EU member states, such as the Portuguese CFP and the Maltese FAC.

For example, the Portuguese CFP differentiates between two types of evaluation - the one based on the first published data (*real-time approach*) and the one based on subsequently revised data (*final data approach*). Similarly, in its methodological specification, the Maltese FAC indicates as follows: *"The ex-ante forecast is compared against the first vintage of the outturn estimate available after the end of the forecasted year."*

[5] IMF Working Paper, No. 06/59
[6] Conselho das Finanças Públicas (*Eng. Public Finance Council*)
[7] Ufficio parlamentare di bilancio (Eng. *Parliamentary Budget Office*)
[8] Fiscal Advisory Council

Macroeconomic forecasts are also compared with the naive forecast. Series of achieved macroeconomic indicators, the last ones publicly available in April 2024, that is, when we started preparing this research, were used for the naive forecast. This approach sufficiently reflects the context of information. The revisions primarily included nominal data. Viewed historically, the revisions of real growth rates were minor and mostly related to investments in fixed capital and government spending.

2.1 STATISTICAL TESTS AND FORECAST ERROR EVALUATION

The dataset used in the analysis is defined by the CP/SP and the DSB. For the selected macroeconomic indicators, the deviations of forecast values from the outturns in year *t=0* and *t+1* are measured. The analysis of macroeconomic forecasts is carried out through two segments. The first one examines a simple error calculation using standard techniques, while the other one examines the properties of the error.

The forecast error can be simply defined as a deviation of the forecast from the outturn. In this manner, we can observe the forecast for the current year (*t=0)* and the forecast for one or more years ahead (*t=1, 2, ..., n*). It is also important to examine the cumulative error of the forecasts which will be taken into consideration both for the current and the future periods.

The current-year t=0 forecast error is defined as follows:

$$e_{t,t} = \hat{y}_{t,t} - y_t$$

$\hat{y}_{t,t}$ represents the forecast for the current year *t=0* presented by the CP/SP in April, that is, DSB in October of the year *t,* while y_t represents the outturn for *t=0* presented by the CP/SP in April, that is, DSB in October of the year *t+1*.

The one-year-ahead t+1 forecast error is defined as follows:

$$e_{t+1,t} = \hat{y}_{t+1,t} - y_{t+1}$$

$\hat{y}_{t+1,t}$ represents the forecast for the year ahead *t+1* presented by the CP/SP in April, that is, DSB in October of the year *t,* while y_{t+1} represents the achievement for *t+1* presented by the CP/SP in April, that is, DSB in October of the year *t+2*.

In this concept, positive deviations denote overestimating, while negative deviations denote underestimating for the observed variable, that is, for the selected macroeconomic indicator. To be able to evaluate the properties of the error, it should

be viewed over time. Accordingly, the performance of the Croatian Government's macroeconomic forecasts was measured using several measures of descriptive statistics (Fioramanti *et. al.*, 2016):

1. **Mean error – ME**: The mean error of the forecast for the country *i* over the given period *t*. The negative side of this indicator of quality is the fact that positive and negative errors can cancel each other out. Nevertheless, this indicator suggests a possible forecast bias. The indicator is in the same measurement unit as the variable for which it is calculated. The best indicator value is zero; positive values indicate that forecasts were overestimating and negative values that they were underestimating.

   $ME_i = \frac{1}{T}\sum_{t=1}^{T} e_{i,t,t}$

   $$ME_i = \frac{1}{T}\sum_{t=1}^{T} e_{i,t+1,t}$$

2. **Mean absolute error – MAE**: The average of the absolute value of the forecast errors for country *i* during time *t* equally treats all the errors, be they positive or negative. However, the MAE does not provide any information on the error direction (under- or overestimation). The indicator is in the same measurement unit as the variable for which it is calculated. The lower the indicator value the smaller the forecast error.

   $$MAE_i = \frac{1}{T}\sum_{t=1}^{T}\left|e_{i,t,t}\right|$$

   $$MAE_i = \frac{1}{T}\sum_{t=1}^{T}\left|e_{i,t+1,t}\right|$$

3. **Root mean squared error – RMSE:** The square root of the mean squared forecast error for the country *i* over a given period *t*. The indicator equally treats all errors, be they positive or negative. Since the errors are squared, major errors are allocated relatively greater weight. RMSE is therefore preferred when major errors are considered especially harmful. RMSE is also not dependent on the number of observations and does not provide information on the direction of the errors. The indicator is in the same measurement unit as the variable for which it is calculated. The lower the indicator value the smaller the forecast error.

   $$RMSE_i = \sqrt{\frac{1}{T}\sum_{t=1}^{T} e_{i,t,t}^2}$$

$$RMSE_i = \sqrt{\frac{1}{T}\sum_{t=1}^{T} e_{i,t+1,t}^2}$$

4. **Normalized root mean square error – NRMSE:** Normalization of the root of mean square errors over the period *t* is carried out using the standard variable deviation (). The indicator is a relative number, i.e. it does not have a measurement unit which makes it possible to compare variable errors in different measurement units. In addition, normalization with standard deviation is appropriate for comparison with the identical indicator for other countries as this allows to exclude from the comparison the fact that certain countries have more volatile data than other countries do.[9] The lower the indicator value the smaller the forecast error.

$$NRMSE_i = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(\frac{e_{i,t,t}}{\sigma_i}\right)^2}$$

$$NRMSE_i = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(\frac{e_{i,t+1,t}}{\sigma_i}\right)^2}$$

2.2 PROPERTIES OF FORECAST ERRORS

In addition to comparing the forecast error to the outturn, an important issue are the properties of that error. Economic developments are susceptible to various uncertainties with a specific probability distribution, which the decision makers are not informed of when drafting the plans. In such circumstances, it is important to ensure the forecasts are free from any systematic errors and that all the available information is used in their preparation. To enable the best possible quality of macroeconomic forecast evaluation, we will be using a set of desirable statistical properties of the forecasts according to the authors Timmerman (2006), Fioramanti *et. al. (*2016), Gonçalves (2022), Chabin *et. al.* (2020), Butorac (2022) as well as the institutions CFB (2024) and FAC (2024).

1. **Forecast bias test:** Testing forecast bias (unbiasedness) demands that deviations are on average near zero during the sample, which means that there should be no systematic overestimating or underestimating of the variable. The forecast is not biased if the forecast expectations are equal to the expectation

[9] There are other manners to normalize this indicator.

of the real value. A simple testing method is the forecast error regression on a constant α.

$$e_{i,t,t} = \alpha + \varepsilon_{i,t,t}$$

$$e_{i,t+1,t} = \alpha + \varepsilon_{i,t+1,t}$$

$e_{i,t,t}$ / $e_{i,t+1,t}$ is the error for the current year / for the year ahead *i* in time *t*, and $\varepsilon_{i,t,t}$ / $\varepsilon_{i,t+1,t}$ is the independent and identically distributed error term. In case of unbiasedness, α = 0.

2. **Absence of autocorrelated forecast errors:** The forecast errors autocorrelation test is conducted to verify whether the errors are temporally correlated in consequent periods. Existence of autocorrelation suggests that information from previous errors have not been used correctly in preparing the forecast. The test is carried out by regressing the errors to their residual value, most often of the first order or by using the Portmanteau (Q) test.

$$e_{i,t} = \rho \cdot e_{i,t-1} + \varepsilon_{i,t}$$

$e_{i,t}$ is the error for the country *i* in time *t*, while ρ is the autocorrelation coefficient; if $\rho = 0$, errors are not correlated; if there is no autocorrelation, $\rho = 0$

3. **Predictive success: Diebold-Mariano test (DM test):** is a statistical test applied to assess whether there is a significant difference in the accuracy of two forecasts of the same variable. It is a standard tool in econometric evaluation of predictive success, often used to compare the official institutional forecast with the reference forecast, such as the naive forecast. In the context of this research, the DM test is used for testing whether MFIN's official forecast is statistically more accurate than the naive forecast which is defined as the presumption that the value in year *t* will be equal to the outturn from the previous year *t-1*, that is $y_t^{naive} = y_{t-1}$.[10]

$$DM = \frac{\bar{d}}{\sqrt{\widehat{VAR}(\bar{d})}}$$

[10] Other naive forecast models are used in the literature, such as a comparison with public forecasts of other institutions (these forecasts are not considered naive because they were made earlier, on a smaller set of available statistical data) or a comparison with own forecast based on a simple theoretical statistical model.

$d_t = L(e_{1,t}) - L(e_{2,t})$ is the difference of the loss functions for forecast 1 and forecast 2 at time *t*; $\bar{d}$ is the mean value of the difference in errors over time; $\widehat{VAR}(\bar{d})$ *is the estimated average difference variance*.

It must be mentioned that the obtained data must be carefully interpreted, considering the small sample size. Therefore, it cannot be claimed with certainty that test properties have been fulfilled.

3 AN ANALYSIS OF THE CROATIAN GOVERNMENT'S MACROECONOMIC FORECASTS

This chapter includes calculations of errors of the Croatian Government's macroeconomic forecasts for the 2014-2023 period based on data from the CP/SP as well as the forecasts published in the DSB for the 2011– 2023 period. The analysis does not include the forecast for 2020 due to the extraordinary nature of the economic shock that year; therefore, the presented research results relate to calculations excluding 2020.[11]

As the circumstances for preparing reliable macroeconomic and fiscal forecasts in 2020 were extremely limiting, the basic presumptions of forecast modelling were not applicable in the context of high levels of uncertainty and volatility. Nevertheless, pursuant to the principle of transparency and the legal obligation to prepare an evaluation of macroeconomic forecasts of the Croatian Government, the results of the analyses which include 2020 are presented in Annex (Tables 10- -14).

3.1 DRAFT STATE BUDGET OF THE REPUBLIC OF CROATIA

3.1.1 Statistical tests and an evaluation of forecast errors

In this analysis, standard statistical measures for evaluating the accuracy of macroeconomic forecasts of the Croatian Government were used: mean error (ME), mean absolute error (MAE), root mean squared error (RMSE) and normalized RMSE (NRMSE). These four metrics facilitate a comprehensive insight into biasedness, magnitude and relative weight of the errors between forecasts and outturns of macroeconomic indicators.

[11] Although the exclusion of 2020 is somewhat arbitrary and methodologically sensitive, we followed the approach of the analyses conducted by CFB (2024) and FAC (2024). The analysis of the forecast errors in FAC's study (2024) does not exclude only the years of abrupt decline of economic activity, but also the years of accelerated recovery, whereas CFB's analysis (2024) excludes only the years of abrupt decline. New empirical research shows that it is more difficult to forecast a recession than an expansion (see M. Chauvet, S. Potter: Forecasting Output, Handbook of Economic Forecasting, Volume 2, 2012).

Table 1. The results of forecast error evaluation in t=0, 2011 – 2023, in % (DSB)

	ME	MAE	RMSE	NRMSE
Real GDP	0.02	0.48	0.63	0.22
Personal consumption	-0.19	0.60	0.91	0.33
Government spending	-0.22	0.45	0.59	0.32
Investments	1.56	1.66	2.33	0.51
Export	-3.08	3.24	5.11	0.66
Import	-1.53	2.21	3.07	0.42
Inflation (CPI)	-0.01	0.09	0.15	0.04

Source: author's calculation according to MFIN

The results for year t = 0 show that the forecasts for the growth rate of real GDP, personal consumption, government spending and inflation (measured by the consumer price index, CPI) were very accurate, with minor mean errors (MAE and RMSE) and insignificant biases (near-zero ME). The error was especially low for inflation (MAE = 0.09 pp; RMSE = 0.15 pp).

On the other hand, bigger forecast errors were observed in gross investments, export and import, as expected since these GDP components are more volatile and more sensitive to external shocks.

Table 2. The results of forecast error evaluation in t+1, 2011 -2023 (DSB)

	ME	MAE	RMSE	NRMSE
Real GDP	-0.18	1.71	2.28	1.95
Personal consumption	-0.72	1.76	2.38	1.54
Government spending	-1.07	1.15	1.29	0.69
Investments	4.93	5.69	7.69	2.24
Export	-4.12	4.73	7.06	2.56
Import	1.13	3.30	5.26	1.94
Inflation (CPI)	-0.44	1.78	2.86	1.97

Source: author's calculation according to MFIN

The results of the forecasts for year *t+1* indicate a presence of more significant errors compared to the forecasts for year *t=0*.

The mean absolute error (MAE) of the forecast growth rate of real GDP amounts to 1.71 percentage points. The values of other error indicators, such as RMSE and NRMSE, are also higher. The NRMSE of 1.95 shows that this error indicator is approximately twice the average deviation from the mean growth rate of real GDP. The near-zero mean error (ME) of the forecast is a good value of the indicator.

The mean absolute error (MAE) of the forecast growth rate of real personal consumption amounts to 1.76 percentage points. The values of other error indicators, such as RMSE and NRMSE, are also higher. The NRMSE of 1.54 shows that this error indicator is approximately one and a half times higher than the average deviation from the mean growth rate of real personal consumption. The mean error (ME) of the forecast is -0.72, which means the forecasts underestimated on average the growth of real personal consumption.

The mean absolute error (MAE) of the forecast of the growth rate of government spending amounts to 1.15 percentage points, which is the smallest forecast error among other analysed macroeconomic variables. The mean error (ME) of the forecast of -1.07 is also the smallest, which means that the greatest forecast underestimation occurred on average with the growth of real government spending.

Since the investments are an extremely volatile variable, the mean absolute error (MAE) of the forecast growth rate of real investments in fixed capital amounts to 5.69 percentage points. However, the NRMSE volatility-adjusting indicator amounts to 2.24, which is near equal to the value of this indicator for other observed variables (except for the real government spending). The mean error (ME) of the forecast indicates that the forecasts on average overestimated the growth of real investments in fixed capital.

The forecast growth rate of real export and import also have an NRMSE value near two. The mean error (ME) of the forecast suggests that the forecasts on average underestimated the growth of real export and overestimated the growth of real import.

The mean absolute error (MAE) of the forecast growth rate of inflation amounts to 1.78 percentage points. The values of other error indicators, such as RMSE and NRMSE, are also higher. The mean error (ME) of the forecast is -0.44, which means the forecasts on average slightly underestimated inflation rate growth.

In total, the forecasts for t+1 are characterized by a higher level of error and bias compared to the forecasts for t=0. The lowest error levels were observed in forecasts of real government spending.

3.1.2 Properties of forecast errors

Table 3. The results of properties of forecast errors in t=0, 2011 -2023 (DSB)

	UNBIASEDNESS		AUTOCORRELATION		DM TEST	
	t	p	1 Lag	2 Lags	t	p
GDP	0.08	(0.936)	0.1146	0.2818	0.0976	(0.9242)
C	-0.55	(0.591)	0.0504**	0.1417	-0.6837	(0.5097)
G	-1.22	(0.250)	0.8513	0.2169	0.3067	(0.7654)
I	2.62**	(0.026)	0.4795	0.5112	2.8524**	(0.0172)
X	-1.99*	(0.075)	0.0882*	0.2214	-2.3941**	(0.0377)
M	-1.99*	(0.075)	0.5283	0.8172	-1.8171*	(0.0992)
CPI	-0.23	(0.819)	0.1554	0.3638	-0.2751	(0.7888)

Source: author's calculation according to MFIN; note: The bias test is carried out by testing the null hypothesis which reads $H0 : \alpha = 0$, meaning the forecasts are unbiased. Autocorrelation: null hypothesis $H0 : \rho = 0$ indicates no autocorrelation in forecast errors;*, **, *** level of statistical certainty in dismissing the null hypothesis with a significance level of 10 %, 5 % and 1 %; Diebold-Mariano test ($Ha: mean \neq 0$)

The results of the bias test indicate that most macroeconomic aggregates do not have a statistically significant constant (α), which suggests that the forecasts are unbiased in general). An exception are gross investments which feature a positive and statistically significant constant (t = 2.62; p = 0.026), indicating systematic overestimating of the investment activity in the observed period.. Export (t = -1.99; p = 0.075) and import (t = -1.99; p = 0.075) recorded p-values at the borderline of statistical significance at the level of 10 %, indicating bias in those forecasts.

The results of the Ljung-Box autocorrelation test for first- and second-order errors (lag 1 and lag 2) mostly do not indicate the presence of a statistically significant autocorrelation, except for personal consumption which shows a significant autocorrelation at lag 1 ((p = 0.0504) and export at the 10 % level (p = 0.0882). These results indicate that the forecast errors in most variables are temporally unrelated, which is a desirable property in evaluating the quality of predictive models.

The evaluation of the relative accuracy of the Croatian Government's forecasts compared to the simple naive strategy was carried out by applying the Diebold-Mariano test (DM test). The level of forecast accuracy differs between analysed macroeconomic indicators. The results show there is insufficient evidence to conclude that official forecasts are more accurate than the naive alternative for the forecasts of the growth rate of real GDP, personal consumption and government spending. By contrast, forecasts of gross investments (t = 2.85; p = 0.017), export (t = –2.39; p = 0.038) and import at a lesser extent (t = –1.82; p = 0.099) demonstrate a statistically higher accuracy compared to the naive strategy, at 5 % and 10 % significance levels.

Table 4. The results of the properties of forecast errors in t+1, 2011 -2023 (DSB)

	UNBIASEDNESS		AUTOCORRELATION		DM TEST	
	t	p	1 Lag	2 Lags	t	p
GDP	-0.20	(0.844)	0.1321	0.3185	-0.2871	(0.7799)
C	-0.80	(0.447)	0.1224	0.2989	-0.6188	(0.5499)
G	-4.65***	(0.001)	0.8205	0.4523	-1.9412*	(0.0809)
I	2.13*	(0.062)	0.1676	0.3735	2.0295*	(0.0699)
X	-1.83*	(0.100)	0.1668	0.2333	-1.3129	(0.2185)
M	0.60*	(0.561)	0.4583	0.7086	-0.7681	(0.4602)
CPI	-0.41	(0.692)	0.2837	0.5618	-0.7159	(0.4904)

Source: author's calculation according to MFIN; note: The bias test is carried out by testing the null hypothesis which reads *H0* : $\alpha = 0$, meaning that the forecasts are unbiased. Autocorrelation: null hypothesis *H0* : $\rho = 0$ indicates no autocorrelation in forecast errors;*, **, *** level of statistical certainty in dismissing the null hypothesis with a significance level of 10 %, 5 % and 1 %; Diebold-Mariano test (*Ha: mean ≠ 0*)

The results of the bias test demonstrate that for the forecasts of the growth rates of real GDP, real personal consumption, real import and the inflation rate, there is no statistically significant evidence of the systematic deviation of the forecasts from the outturn in year *t+1*. In other words, these forecasts can be considered unbiased. In forecasting the growth rate of real government spending, a negative and statistically significant constant was observed α (t = –4.65; p = 0.001), indicating systematic underestimating of this variable in the forecast. In addition, the forecasts of gross investments (t = 2.13; p = 0.062) and export (t = –1.83; p = 0.100) also show slight bias, at a 10 % significance level, where investment forecasts were overestimated and export forecasts underestimated.

The results of the autocorrelation test for the first and second time lag (lag 1 and lag 2) demonstrate that there is no significant serial correlation of forecast errors. All p-values are higher than 0.10, indicating absence of autocorrelation, meaning the errors are not temporally correlated and the forecasts were temporally stable and independent.

The results of the Diebold-Mariano test show there is insufficient evidence demonstrating that official forecasts were more accurate than the naive alternative for *t+1* forecasts of the growth rate of real GDP, personal consumption, export and import and inflation rate. Forecasts of gross investments (t = 2.03; p = 0.0699) and government spending (t = –1.94; p = 0.0809) are statistically much more accurate than the naive forecast at the significance level of 10 %.

3.2 CONVERGENCE PROGRAMME / STABILITY PROGRAMME

3.2.1 Statistical tests and an evaluation of forecast errors

Table 5. The results of forecast error evaluation in t=0, 2014 – 2023, in % (DSB)

	ME	MAE	RMSE	NRMSE
Real GDP	-1.23	1.48	2.20	1.43
Personal consumption	-1.43	1.48	2.26	1.25
Government spending	-0.54	0.86	0.99	0.57
Investments	1.00	2.43	2.93	0.89
Export	-6.30	6.93	10.22	3.20
Import	-3.64	4.41	7.18	2.18
Inflation (CPI)	-0.09	0.84	1.22	0.43

Source: author's calculation according to MFIN

The results of forecast analysis from CP/SP for year *t=0* in the 2014 – 2023 period indicate the existence of significant deviations between the forecasts and the outturn for most macroeconomic indicators, including bias patterns and variable accuracy depending on the category. The mean absolute error (MAE) of the forecast growth rate of real GDP amounts to 1.48 percentage points, while in the draft budgetary plan (hereinafter: DBP), which is prepared later, it amounts to only 0.48 percentage points. The other error indicators are also higher than in the DBP. This also applies to the other observed macroeconomic variables. The mean forecast error (ME) is near zero only in the forecast of the inflation rate, while it is close to zero in the forecast of government spending.

The results of forecast analysis from CP/SP for year *t=1* in the 2014 – 2023 period also indicate the existence of significant deviations between the forecasts and the outturn for most macroeconomic indicators, including bias patterns and variable accuracy depending on the category. It is only logical to expect that the forecasts from the CP/SP, which are prepared earlier and based on a smaller number of available information, will feature bigger errors compared to those from the DBP. Nevertheless, some of the results are surprising - the forecasts of the growth rate of real GDP, gross investments and export showed smaller errors (according to MAE, RMSE and NRMSE) in CP/SP than in the DBP. The NRMSE is lower or nearly equal in the CP/SP and the

DBP, except for the inflation rate. However, this was a period of low and stable inflation. The value of this indicator was inflated by a very small standard deviation of the inflation rate in this period.

The mean absolute error (MAE) of the forecast growth rate of real GDP amounts to 1.11 percentage points, that is, it is smaller than in the DBP which is prepared later (1.71 percentage points). The other error indicators, such as RMSE and NRMSE, also have lower values than in the DBP. The NRMSE indicator is almost half compared to the DBP. The mean error (ME) of the forecast deviates from zero, while in the DBP it is near zero.

The mean absolute error (MAE) of the forecast growth rate of real personal consumption amounts to 1.84 percentage points (1.76 in DBP). The other error indicators, such as RMSE and NRMSE, also have higher values than in the DBP. The mean error (ME) of the forecast amounts to -1.84 (-0.72 in DBP), meaning the forecasts on average much more significantly underestimated the growth of real personal consumption in CP/SP than in the DBP.

The mean absolute error (MAE) of the forecast growth rate of real government spending amounts to 1.49 percentage points (1.15 in DBP). The mean error (ME) of the forecast of -1.49 (-1.07 in DBP) means that on average much greater forecast underestimation occurred with the growth of real government spending in the CP/SP than in the DBP.

The mean absolute error (MAE) of the forecast growth rate of real investments in fixed capital amounts to 3.56 percentage points, that is, it is smaller than in the DBP which is prepared later (5.69 percentage points). The other error indicators, such as RMSE and NRMSE, also have lower values than in the DBP. The NRMSE indicator is half compared to the DBP. The mean error (ME) of the forecast means that the forecast on average overestimates the growth of real investments in the CP/SP (3.56) much less than in the DBP (4.93).

The forecasts of the growth rate of real import and export have a lower NRMSE in the CP/SP than in the DBP, that is, they are on average more accurate in the CP/SP.

The mean absolute error (MAE) of the forecast of the inflation rate amounts to 2.31 percentage points (1.78 in DBP). The other error indicators, such as RMSE and NRMSE, also have higher values than in the DBP. The mean error (ME) of the forecast of -0.80 (-0.44 in DBP) means that on average more significant forecast underestimation occurred with the inflation rate in the CP/SP than in the DBP.

Table 6. The results of forecast error evaluation in t+1, 2014 -2023 (CP/SP)

	ME	MAE	RMSE	NRMSE
Real GDP	-0.97	1.11	1.74	1.02
Personal consumption	-1.84	1.84	2.20	1.72
Government spending	-1.49	1.49	1.69	1.16
Investments	1.90	3.56	5.15	1.10
Export	-2.40	3.20	4.55	1.14
Import	-4.06	4.97	6.04	1.70
Inflation (CPI)	-0.80	2.31	3.70	4.37

Source: author's calculation according to MFIN

3.2.2 Properties of forecast errors

Table 7. The results of the properties of forecast errors in t=0, 2014 -2023 (CP/SP)

	UNBIASEDNESS		AUTOCORRELATION		DM TEST	
	t	p	1 Lag	2 Lags	t	p
GDP	-1.54	(0.167)	0.2651	0.4361	-1.7756	(0.1191)
C	-1.94*	(0.093)	0.4501	0.6513	-2.1494*	(0.0687)
G	-1.82	(0.112)	0.7256	0.7376	-1.7184	(0.1294)
I	1.12	(0.299)	0.3689	0.1775	0.9615	(0.3683)
X	-1.71	(0.130)	0.1214	0.2366	-2.0707*	(0.0771)
M	-1.49	(0.179)	0.7731	0.7935	-1.5558	(0.1637)
CPI	-0.17	(0.872)	0.2117	0.5566	-0.1897	(0.8549)

Source: author's calculation according to MFIN; note: The bias test is carried out by testing the null hypothesis which reads $H0 : \alpha = 0$, meaning the forecasts are unbiased. Autocorrelation: null hypothesis $H0 : \rho = 0$ indicates no autocorrelation in forecast errors;*, **, *** level of statistical certainty in dismissing the null hypothesis with a significance level of 10 %, 5 % and 1 %; Diebold-Mariano test ($Ha: mean \neq 0$)

The bias test results demonstrate that forecast errors of the observed macroeconomic indicators do not have a statistically significant constant (α), suggesting that forecasts from the CP/SP were not systematically biased. Personal consumption is nearest to the limit of statistical significance with its p-value of 0.093 (t = –1.94), indicating slight yet statistically significant bias at the 10 % level. The negative value of the constant (α), indicates an underestimating of the forecast of personal consumption.

As regards error autocorrelation, the results of the Ljung-Box test for the first and second time lag (LAG 1 and LAG 2) do not indicate any statistically significant serial dependence. All p-values are above 0.10, suggesting that forecast errors were not temporally related and that deviations between the forecasts and outturns were random and independent over time.

The results of the Diebold-Mariano test demonstrate that the forecasts within the framework of the CP/SP which relate to the growth rate of real GDP, real government spending, real investments in fixed capital, import and the inflation rate were not more accurate than in the naive alternative. However, forecasts of the growth rate of real personal consumption (t = -2.15; p = 0.0687) and real export (t = –2.07; p = 0.0771) were statistically much poorer than the naive forecast at the significance level of 10 %.

Table 8. The results of the properties of forecast errors in t+1, 2014 -2023 (CP/SP)

	UNBIASEDNESS		AUTOCORRELATION		DM TEST	
	t	p	1 Lag	2 Lags	t	p
GDP	-2.14*	(0.077)	0.1875	0.2982	1.0772	(0.3128)
C	-4.65***	(0.004)	0.2486	0.2892	1.029	(0.3336)
G	-1.82	(0.112)	0.9431	0.8076	-2.2678*	(0.0531)
I	1.10	(0.315)	0.4876	0.5880	1.5817	(0.1524)
X	-1.42	(0.204)	0.6498	0.7948	1.0616	(0.3194)
M	-2.00*	(0.093)	0.4387	0.2592	1.2936	(0.2319)
CPI	-0.49	(0.641)	0.4724	0.7562	-0.6803	(0.5155)

Source: author's calculation according to MFIN; note: The bias test is carried out by testing the null hypothesis which reads $H0 : \alpha = 0$, meaning that the forecasts are unbiased. Autocorrelation: null hypothesis $H0 : \rho = 0$ indicates no autocorrelation in forecast errors;*, **, *** level of statistical certainty in dismissing the null hypothesis with a significance level of 10 %, 5 % and 1 %; Diebold-Mariano test ($Ha: mean \neq 0$)

The results of the bias test indicate statistically significant biases in the forecasts of several macroeconomic indicators for year *t+1*. More specifically, personal consumption demonstrates significant negative bias, with a t-value of –4.65 and a p-value of 0.004, suggesting that this aggregate has been systematically underestimated. Real GDP (t = –2.14; p = 0.077) and import (t = –2.00; p = 0.093) demonstrate negative constants α at a significance level of 10 %, also suggesting an underestimating trend. The other indicators - government spending, investments, export and inflation - do not demonstrate a statistically significant bias, since their p-values are above the 0.10 threshold, suggesting no systematic errors in their forecasts in year *t+1*.

As regards autocorrelation, the results of the Ljung-Box Portmanteau test indicate no statistically significant serial dependence in the errors. For all aggregates, p-values for both time lags (lag 1 and lag 2) are above the 10 % level of significance, meaning the forecast errors were not temporally related i.e., that the deviations between the forecasts and the outturns were random.

For the DM test in the CP/SP forecasts, the results indicate that the forecast growth rates of the analysed macroeconomic indicators feature no statistically significant difference in the accuracy of official forecasts and the naive forecasting method. The only exception is government spending with its p-value of 0.0531 (t = –2.2678), indicating a difference in accuracy at the 10 % level of significance.

Finally, macroeconomic forecast errors were compared with the recent analyses of the Portuguese FCP and the Maltese FAC, relying on the RMSE indicator used in all the materials. The autumn DSB forecasts are compared. Extreme error values were excluded from the calculation of the indicated indicators. Macroeconomic forecast errors are greater than in Portugal, but lower than in Malta.

	RMSE		
	Croatia	**Portugal**	**Malta**
Growth rate of real GDP	1.74	0.72	4.30
Growth rate of real personal consumption	2.20	0.67	3.30
Growth rate of real government spending	1.69	1.10	4.80
Growth rate of real investments in fixed capital	5.15	3.69	23.90
Growth rate of real export of goods and services	4.55	3.01	6.20
Growth rate of real import of goods and services	6.04	3.20	7.50
Inflation rate (CPI)	3.70	2.76	

4 FINAL NOTES

Pursuant to Article 22 (2) of the Fiscal Responsibility Act, the FPC is obligated to examine and compare macroeconomic and budgetary forecasts with the outturns in the period of four consecutive years and to conduct an analysis once every two years.

In preparing this research, we identified certain methodological and empirical challenges which outlined the scope of the conducted analysis. Some of the limitations are related to data availability, which is why the analyses focused only on the evaluation of macroeconomic forecasts, while budgetary forecasts were not included. Moreover, when evaluating the accuracy, series of national accounts available in April 2024 were used as reference values for preparing the naive forecast. Method-wise, it would be more consistent to use different data vintages available at the moment of preparing the forecasts.

In addition, there is room for improvement of the analysis also in terms of the scope of the variables. In fact, in addition to the observed indicators, in the future it would be useful to include additional macroeconomic variables such as employment, amount of compensations to employees and the implicit GDP deflator to additionally enhance the evaluation of macroeconomic forecasts.

Furthermore, the statistical analysis of accuracy of the macroeconomic forecasts was conducted using statistical data of the national accounts from April 2024 for the naive forecast, instead of using different statistical data vintages, i.e. data which were available when the forecast was being prepared. Moreover, the evaluation of macroeconomic forecast accuracy could include other important variables such as employment, compensations to employees and the implicit GDP deflator.

The accuracy of the Croatian Government's macroeconomic forecasts in the period from 2011 to 2023 was analysed by applying the real-time methodological approach which is based on the first available publication of statistical data of the Croatian Bureau of Statistics. Statistical tests of bias, autocorrelation and forecast accuracy were carried out for two different institutional forecasting rounds: DSB and CP/SP for the selected macroeconomic indicators.

In short-term forecasts for the year ahead ($t+1$), moderate and sometimes significant forecast errors were observed. Forecasts of certain variables, such as the real GDP growth rate, feature significantly greater errors in the autumn DSB than in the spring CP/SP, although they should be lower due to the shorter time horizon of the forecast and more information being available. Comparison with other countries showed that official forecast errors were lesser for Malta than for Portugal.

The statistical analysis shows that the official forecasts were not more precise at a statistically significant level than the naive forecasts which presumes that the year-ahead forecast rate is equal to the current-year growth rate. Future research should additionally test these results, and it would also be advisable to improve the specification of the naive forecast using appropriate vintages of statistical data. In addition, forecast accuracy can also be verified by comparison with publicly available forecasts of other institutions.

This research does not provide an answer about the reasons for the forecast errors. Being able to make a quality evaluation of the prediction system applied by the Government of the Republic of Croatia requires excluding the contribution of erroneous presumptions, which in turn requires additional research on a broader dataset, including their vintages.

To improve the system of macroeconomic forecasts in the Republic of Croatia, we can propose the following: (i) enhance internal evaluation and *ex post* testing of the forecasts by systematically implementing bias and accuracy tests; (ii) institutionalize regular use of real-time databases for the purpose of minimizing the influence of statistical revisions; (iii) improve the transparency of models and presumptions used in preparing the forecasts; and (iv) develop scenario analyses and alternative forecast paths in the periods of expressed economic uncertainty. The proposed improvement options are in accordance with the recommendations of the FPC, regularly presented in own publications (Position Papers), and focused on improving the quality of fiscal planning to ensure long-term sustainability and stability of public finances of the Republic of Croatia.

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ANNEX

Table 9. Selected macroeconomic indicators (variables) and sample analysis period

VARIABLE	CODE	DEFINITION	DOCUMENT	SAMPLE PERIOD
Real GDP rate	rGDP	Increase of the estimated value of goods and services produced in the economy, year by year, measured in actual amounts.	CP/SP DSB	2014 -2023 2011 – 2023
Growth rate of GDP components:				
Household consumption	rC	Increase in consumption of goods or services used by households and non-profit institutions without further processing in production, year by year, measured in actual amounts.	CP/SP DSB	2014 -2023 2011 -2023
Government spending	rG	Increase in consumption of goods or services used by the government without further processing in production, year by year, measured in actual amounts.	CP/SP DSB	2014 -2023 2011 -2023
Investments	rI	Increase in total value of producer acquisitions minus sale of fixed assets during the accounting period, with the addition of certain value increases of non-produced assets, measured in actual amounts.	CP/SP DSB	2014 -2023 2011 -2023
Export	rX	Increase of products of domestic origin sold to other countries, measured in actual amounts.	CP/SP DSB	2014 -2023 2011 -2023
Import	rM	Increase of products of foreign origin imported into the country, measured in actual amounts.	CP/SP DSB	2014 -2023 2011 -2023
Inflation rate (measured by the consumer price index - CPI)	CPI	The CPI monitors changes in the prices of the bundle of commodities and services typically purchased by households. The increase in the CPI denotes inflation, whereas a decrease denotes deflation.	CP/SP DSB	2014 -2023 2011 -2023

Source: created by the author

Table 10. The results of forecast error evaluation for t=0 and t+1, 2011 – 2023, CP/SP and DSB (incl. 2020)

		ME		MAE		RMSE		NRMSE	
		CP/SP	DSB	CP/SP	DSB	CP/SP	DSB	CP/SP	DSB
GDP	t=0	-1.24	0.02	0.45	1.47	0.60	2.12	0.15	0.5
	t+1	0.45	0.79	2.51	2.28	3.85	4.02	2.82	2.1
C	t=0	-1.36	-0.25	0.62	1.40	0.91	2.15	0.25	0.6
	t+1	-0.35	0.15	2.40	2.73	3.48	3.92	2.12	2.4
G	t=0	-0.56	-0.34	0.55	0.84	0.75	0.96	0.41	0.6
	t+1	-1.49	-1.10	1.17	1.49	1.30	1.66	0.70	1.2
I	t=0	0.21	1.43	1.52	2.83	2.23	3.43	0.45	0.6
	t+1	2.69	5.59	6.29	4.14	8.21	5.63	2.45	1.3
X	t=0	-6.16	-2.99	3.13	6.71	4.92	9.78	0.44	0.8
	t+1	1.43	-1.36	6.68	6.33	10.37	10.84	1.67	1.2
M	t=0	-2.29	-1.85	2.48	4.87	3.32	7.33	0.35	1.6
	t+1	-1.18	-0.14	4.71	6.73	7.53	8.78	1.54	2.6
CPI	t=0	-0.13	0.00	0.09	0.80	0.15	1.17	0.04	0.4
	t+1	-0.55	-0.29	1.72	2.18	2.75	3.49	1.91	4.1

Source: author's calculation according to MFIN

Table 11. The results of the properties of forecast errors in t=0, 2011 – 2023, DSB (incl. 2020)

	(UN)BIASEDNESS		AUTOCORRELATION		DM TEST	
	t	p	1 Lag	2 Lags	t	p
GDP	0.1	(0.919)	1.8772	1.97	0.1209	(0.9059)
C	-0.76	(0.465)	5.4831**	6.4717**	-0.9573	(0.359)
G	-1.77	(0.104)	0.1021	1.4247	-1.6957	(0.118)
I	2.6**	(0.025)	0.3144	1.7361	2.7827**	(0.0178)
X	-2.11*	(0.058)	2.8988*	3.0129	-2.5321**	(0.0279)
M	-2.46**	(0.032)	0.5257	1.6347	2.2223**	(0.0482)
CPI	-0.07	(0.945)	1.1106	1.3804	-0.0793	(0.9382)

Source: author's calculation according to MFIN; note: The bias test is carried out by testing the null hypothesis which reads $H0 : \alpha = 0$, meaning that the forecasts are unbiased. Autocorrelation: null hypothesis $H0 : \rho = 0$ indicates no autocorrelation in forecast errors;*, **, *** level of statistical certainty in dismissing the null hypothesis with a significance level of 10 %, 5 % and 1 %; Diebold-Mariano test ($Ha: mean \neq 0$)

Table 12. The results of the properties of forecast errors in t+1, 2011 – 2023, DSB (incl. 2020)

	(UN)BIASEDNESS		AUTOCORRELATION		DM TEST	
	t	p	1 Lag	2 Lags	t	p
GDP	0.78	(0.455)	1.0165	1.5258	0.0675	(0.9474)
C	0.15	(0.886)	0.4518	1.7132	0.4501	(0.6614)
G	-5.36***	(0.00)	0.1553	1.4553	-2.0234*	(0.068)
I	2.85**	(0.017)	0.0558	0.5069	2.433**	(0.0332)
X	-0.44	(0.67)	0.1146	1.3438	0.3481	(0.7343)
M	-0.06	(0.955)	0.0641	2.8784	0.4394	(0.6689)
CPI	-0.3	(0.77)	1.0375	1.126	-0.632	(0.5403)

Source: author's calculation according to MFIN; note: The bias test is carried out by testing the null hypothesis which reads $H0 : \alpha = 0$, meaning that the forecasts are unbiased. Autocorrelation: null hypothesis $H0 : \rho = 0$ indicates no autocorrelation in forecast errors;*, **, *** level of statistical certainty in dismissing the null hypothesis with a significance level of 10 %, 5 % and 1 %; Diebold-Mariano test (*Ha: mean ≠ 0*)

Table 13. The results of the properties of forecast errors in t=0, 2014-2023, CP/SP (incl. 2020)

	(UN)BIASEDNESS		AUTOCORRELATION		DM TEST	
	t	p	1 Lag	2 Lags	t	p
GDP	-1.69	(0.13)	2.6824	2.6884	-2.0442*	(0.0752)
C	-1.95*	(0.087)	1.937	2.2841	-2.3022*	(0.0503)
G	-2.13*	(0.065)	0.1564	0.7373	-2.0097*	(0.0793)
I	0.19	(0.851)	0.4614	3.055	0.1745	(0.8658)
X	-1.84	(0.103)	3.7579*	3.7638	-2.2908*	(0.0512)
M	-0.87	(0.408)	0.2157	1.5838	-0.929	(0.3801)
CPI	-0.28	(0.784)	1.2648	1.9883	-0.3258	(0.7529)

Source: author's calculation according to MFIN; note: The bias test is carried out by testing the null hypothesis which reads $H0 : \alpha = 0$, meaning that the forecasts are unbiased. Autocorrelation: null hypothesis $H0 : \rho = 0$ indicates no autocorrelation in forecast errors;*, **, *** level of statistical certainty in dismissing the null hypothesis with a significance level of 10 %, 5 % and 1 %; Diebold-Mariano test (*Ha: mean ≠ 0*)

Table 14. The results of the properties of forecast errors in t+1, 2014 – 2023, CP/SP (incl. 2020)

	(UN)BIASEDNESS		AUTOCORRELATION		DM TEST	
	t	p	1 Lag	2 Lags	t	p
GDP	0.37	(0.721)	1.4751	1.4765	1.0772	(0.3128)
C	-0.28	(0.79)	0.8272	0.8763	1.029	(0.3336)
G	-5.43**	(0.001)	0.0395	1.421	-2.2678*	(0.0531)
I	1.89	(0.101)	2.0249	3.9763	1.5817	(0.1524)
X	0.36	(0.733)	0.0079	1.0443	1.0616	(0.3194)
M	-0.36	(0.732)	0.0003	1.2477	1.2936	(0.2319)
CPI	-0.38	(0.713)	0.5407	0.7182	-0.6803	(0.5155)

Source: author's calculation according to MFIN; note: The bias test is carried out by testing the null hypothesis which reads $H0 : \alpha = 0$, meaning that the forecasts are unbiased. Autocorrelation: null hypothesis $H0 : \rho = 0$ indicates no autocorrelation in forecast errors;*, **, *** level of statistical certainty in dismissing the null hypothesis with a significance level of 10 %, 5 % and 1 %; Diebold-Mariano test (*Ha: mean ≠ 0*)

LIST OF TABLES