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Forecasting Macroeconomic Indicators for Selected European Union Countries

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Abstract:

Purpose: *The aim of the article is to forecast the level of economic indicators using data collected from the Databases of the Eurostat.*
Design/methodology/approach: *The data were collected for the period from 2010 to 2022 year for selected European Union countries, Poland, Greece and Germany. Variables used in the publication are, GDP, export of goods and services and final consumption expenditure of households. In the second part of the article the method of forecast was used - ratio analysis for additive model for the indicators used GDP, export of goods and services and final consumption expenditure of households.*
Findings: *The results showed that Poland and Greece still need to be involved in improving the macroeconomic situation of both countries, as there is still a significant difference between the results of the macroeconomic indicators forecast for these two countries compared to Germany.*
Practical implications: *Poland and Greece must continue to improve the competitiveness of their economies. The current situation shows that there is a two-speed Union. On the basis of the results obtained, it can be seen that Germany differs significantly from Poland and Greece.*
Originality value: *The study contributes to the discussion on the spatial differentiation of the level of development in the European Union. The results of the research and recommendations may be useful for Poland and Greece in the search for ways to more fully use the potentials of these countries.*

Keywords: *Economic indicators, GDP, final consumption expenditures, export of goods and services, European Union.*

JEL Classification: *C15, E2, O11.*

Paper Type: *Research article.*

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1. Introduction

In this article, macroeconomic indicators for selected EU countries – Greece, Poland and Germany – have been analyzed. The aim of the analysis is to forecast selected quarterly indicators for the years 2022-2024. EU countries continue to have a wide variety of socio-economic development. The aim of the Economic Community is to minimise this disparity, but the countries of central and southern Europe must be involved in improving the value of macroeconomic indicators.

Unfortunately, the event of 2022, i.e., the outbreak of war in Ukraine, and what is associated with it, the increase in oil prices, high inflation, which many countries in the world are facing, do not help, and will even inhibit economic development in the European Union countries. The only right solution will be the effective management of the funds that EU countries obtain, as well as a properly conducted monetary policy of these countries.

2. Literature Review

Forecasting is a rational, scientific prediction of future events. The rationality of the prediction means that the process of inferring the future of the studied phenomenon runs from the formulation of prognostic premises to the construction of the forecast, in turn, science indicates that the achievements of science, i.e., theories and research tools, are used. The result of this process is called a forecast (Dittmann, 2008).

The main goal of forecasting is to support decision-making processes on a micro- and macroeconomic scale. Another important function of forecasts is the activation function. It consists in stimulating to take actions conducive to the implementation of the forecast, when it announces favorable events and opposing its implementation when the predicted events are predicted as unfavorable. The activating function leads to the determination of research forecasts, whose main task is a comprehensive diagnosis of the future (Zeliaś, 1997).

Economic forecasts also have an informative function. Its task is to familiarize people with the upcoming changes, to reduce the fear of the future. The announcement of forecasts may trigger calm reactions to changes and even full acceptance of the announced changes.

The last of these functions is the warning function. The task of warning forecasts is to give signals drawing attention to the unfavorable for the recipient formation of phenomena. An important feature of warning forecasts is that they imply the possibility of taking preventive and preventive measures (Hellwig, 1985).

The standard of living is a concept conditioned by a number of different features and refers to macro and microeconomic ratios as well as statistical data. In this publication following indicators were used – GDP, final consumption expenditure of

households and export of goods and services. Survey of Current Business (2000), a publication of the United States Department of Commerce, defines GDP as follows: "GDP measures final purchases by households, business, and government by summing consumption, investment, government spending, and net exports."

Gross domestic product (GDP) is arguably a key macroeconomic indicator, indicating where the economy is in the cycle and feeding very prominently into economic policymaking. In particular, appropriate policy formulation and implementation require not only to examine GDP's historical development but also to predict its current and future path, to enable prompt responses to changes in economic conditions. Accurate and timely information on GDP is thus crucial (Urasawa, 2014).

Forecasts of real GDP growth are necessarily determined by current growth rates of macroeconomic aggregates, such as consumption and investment (Tkacz, 2001). Forecasting Gross Domestic Product (GDP) and its growth are central issues of concerns in economics and play an important role for monetary policy decisions (Hassani *et al.,* 2011).

3. Research Methodology

The ratio analysis is one of the most frequently used methods in the analysis of seasonal fluctuations. It consists in determining the seasonality indices for the particular phases of the cycle. When the amplitudes of the fluctuations in the corresponding phases of the cycle are approximately the same, the fluctuations are said to be absolutely constant. On the other hand, when the magnitudes of the amplitudes of the fluctuations vary in the same proportion, the fluctuations are referred to as relatively constant fluctuations. In the first case, an additive model can be used to describe the shaping of the phenomenon, whereas in the second one a multiplicative model can be applied:

$$y_{ti} = \hat{y}_{ti} + s_i + \xi_t \tag{1}$$

$$y_{ti} = \hat{y}_{ti} \cdot s_i \cdot \xi_t \tag{2}$$

In the analysis of seasonal fluctuations, four stages can be distinguished:

1. Separation of the trend,
2. Elimination of the trend from the time series,
3. Elimination of random fluctuations,
4. Calculation of seasonality indices.

The separation of the trend consists in the smoothing of the time series using an r-expression centered or non-centered moving average, or an analytical function. The purpose of data aggregation is to obtain a time series with no seasonal fluctuations. It is performed by summing up the data over the periods used in the study to give data that correspond to the lengths of the seasonal cycle.

The elimination of the trend in the case of the time series with additive fluctuations is performed by calculating the difference between the actual values of the forecast variable and the smoothed values obtained from the trend model. In the case of multiplicative fluctuations, the quotients of the actual values of the forecast variable by the corresponding smoothed values are determined:

$$z_{ti} = y_{ti} - \hat{y}_{ti} \tag{3}$$

$$z_{ti} = \frac{y_{ti}}{\hat{y}_{ti}} \tag{4}$$

The calculated values take into account seasonal fluctuations. The elimination of the random component is performed by calculating the so-called strict seasonal ratios. They are average values determined on the basis of z_{ti} related to the same fluctuation phase.

$$z_i = \frac{1}{k}\sum_{j=0}^{k-1} z_{i+j\cdot r,i} \tag{5}$$

Seasonality indices (pure) are determined from the following formulas:

$$s_i = z_i - q \quad \textit{for a model with additive fluctuations} \tag{6}$$

$$s_i = \frac{z_i}{q} \quad \textit{for a model with multiplicative fluctuations} \tag{7}$$

$$\textit{where} \quad q = \frac{1}{r}\sum_{i=1}^{r} z_i \qquad r - \textit{number of cycle phases} \tag{8}$$

The forecast is calculated as follows:

$$y_{ti}^{*} = y_{ti}^{*(t)} + s_i \quad \textit{for a model with additive fluctuations} \tag{9}$$

$$y_{ti}^{*} = y_{ti}^{*(t)} \cdot s_i \quad \textit{for a model with multiplicative fluctuation} \tag{10}$$

Where:

y_{ti}^{*} - forecast for the moment/period *t*,

$y_{ti}^{*(t)}$ - preliminary forecast for the moment/period *t* based on the trend function model,

s_i - seasonality index for the *i*-th phase of the cycle.

4. Results and Discussion

The data analysed for selected European Union countries were taken from Eurostat databases on a quarterly basis for the years 2010-2022. On their basis, the descriptive statistics presented in Table 1 were counted. Table 1 presents the results of descriptive statistics of macroeconomic indicators for selected EU countries: Greece, Poland and Germany.

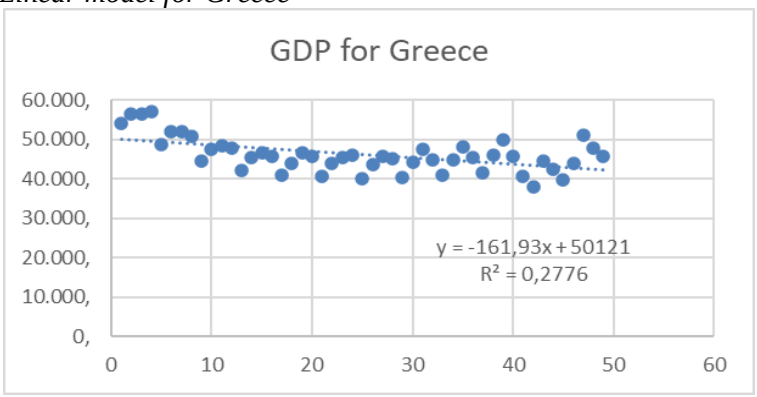
Table 1. *Descriptive statystics of macroeconomic indicators for selected EU countries for the years 2010-2022*

Country	Descriptive statystics						
	GDP						
	Mean	Median	Minimum	Maximum	Std. Dev.	Coefficient of variation	Asymmetry
Greece	46072,4	45745,4	37885,0	56961,5	4391,60	9,53	0,71
Poland	112994,6	108788,7	83124,0	163499,8	19373,18	17,15	0,62
Germany	772784,7	774060,0	616590,0	940540,0	85377,88	11,05	0,05
	Export of goods and services						
	Mean	Median	Minimum	Maximum	Std. Dev.	Coefficient of variation	Asymmetry
Greece	14879,7	13752,3	9185,5	24959,3	3811,24	25,61	0,86
Poland	58059,1	54644,8	32331,5	95802,7	16463,19	28,36	0,54
Germany	355424,2	356547,0	248058,0	458327,0	47686,65	13,42	0,01
	Final consumption expenditure of households						
	Mean	Median	Minimum	Maximum	Std. Dev.	Coefficient of variation	Asymmetry
Greece	33684,6	33457,0	26120,3	41066,8	3655,14	10,85	-0,002
Poland	66110,0	63573,3	52996,1	89432,8	8775,19	13,27	0,67
Germany	388279,1	387248,0	322247,0	452826,0	32740,62	8,43	0,009

Source: *Author's calculations.*

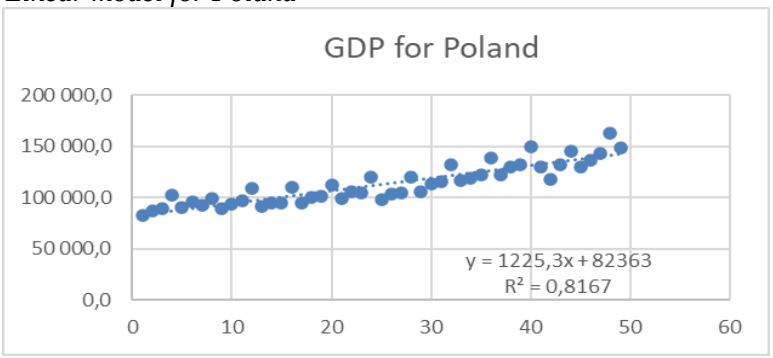
The comparison of the indicator method used for GDP forecasting for selected European Union countries, Greece, Poland and Germany. Figures 1-3 presented linear models on the basis of which further results were obtained.

Figure 1. *Linear model for Greece*



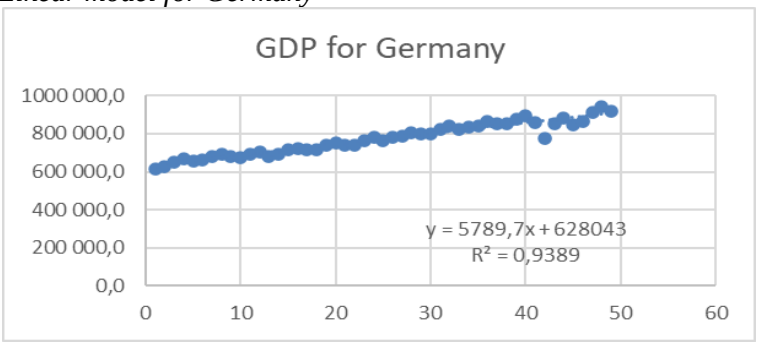
Source: *Author's calculations.*

Figure 2. *Linear model for Poland*



Source: *Author's calculations.*

Figure 3. *Linear model for Germany*



Source: *Author's calculations.*

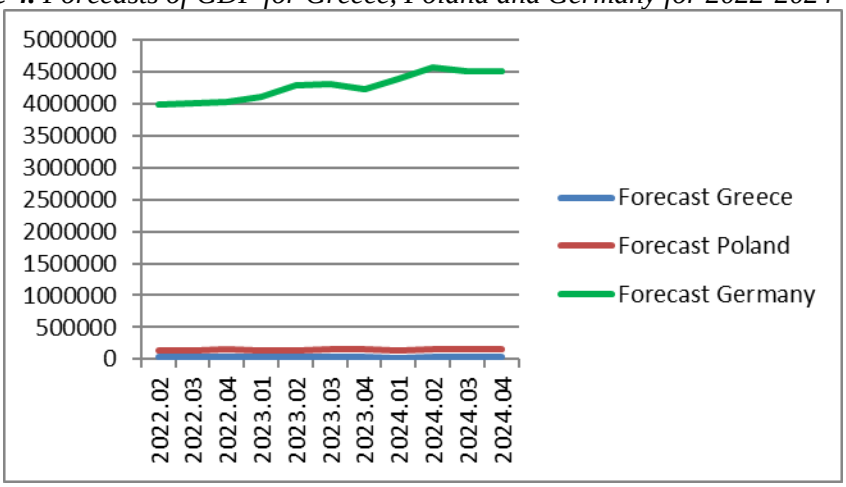
Table 2 and Figure 4 present the results of GDP forecasts for selected European Union countries – Greece, Poland and Germany. It can be noted that the results obtained for Germany differ significantly from the results obtained for Greece or Poland. This means that both countries must work to improve their macroeconomic situation.

Table 2. *Forecasts of GDP for Greece, Poland and Germany for 2022-2024*

Period	t	Forecast Greece	Forecast Poland	Forecast Germany
2022.02	50	41698	140194	3990755
2022.03	51	44360	143015	4018288
2022.04	52	42905	157337	4034562
2023.01	52	38816	140956	4101571
2023.02	53	41212	143870	4280642
2023.03	54	43874	146691	4308174
2023.04	54	42581	159788	4227820
2024.01	55	38330	144632	4391457
2024.02	56	40726	147546	4570528
2024.03	56	43550	149141	4501432
2024.04	57	42095	163463	4517706

Source: *Author's calculations.*

Figure 4. *Forecasts of GDP for Greece, Poland and Germany for 2022-2024*



Source: *Author's calculations.*

The second part of the analysis concerns the forecasting of the export of goods and services index for selected EU countries – Greece, Poland and Germany. Models for each country were prepared, and then the relevant indicators were calculated on the basis of which the forecast for the next quarters of 2022-2024 was calculated. The results are presented in Table 3 and Figures 5-8.

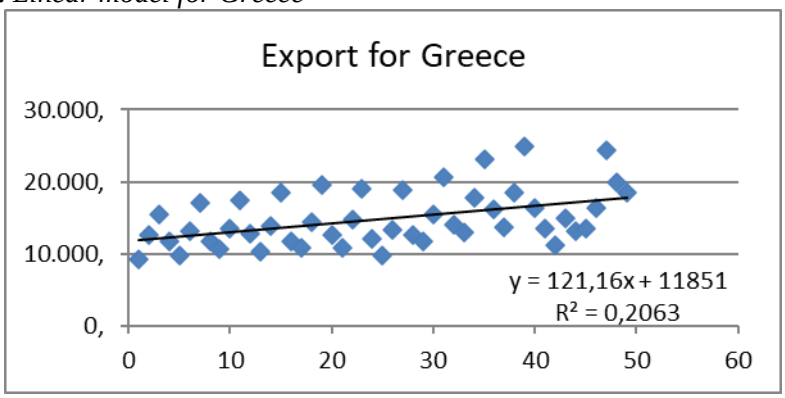
Table 3. *Forecasts of export of goods and services for Greece, Poland and Germany for 2022-2024*

Period	t	Forecast Greece	Forecast Poland	Forecast Germany
2022.02	50	17791	85128	426536
2022.03	51	22701	86362	432360
2022.04	52	16961	89899	444486

2023.01	52	15277	88203	437723
2023.02	53	18155	88481	435663
2023.03	54	23065	89715	441487
2023.04	54	17203	92135	450570
2024.01	55	15640	91556	446850
2024.02	56	18518	91834	444790
2024.03	56	23307	91950	447571
2024.04	57	17567	95487	459697

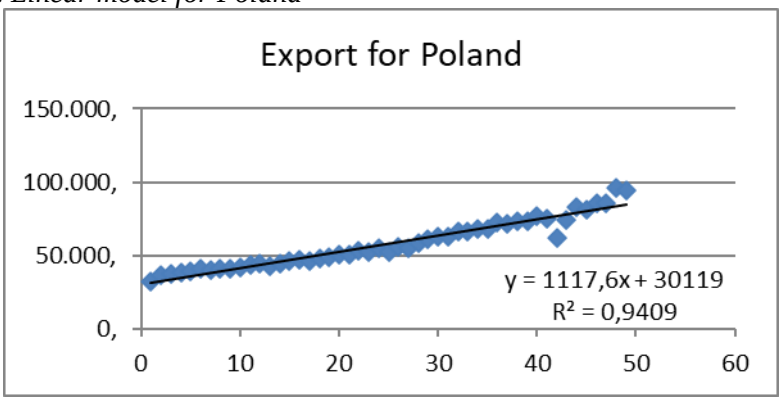
Source: *Author's calculations.*

Figure 5. *Linear model for Greece*



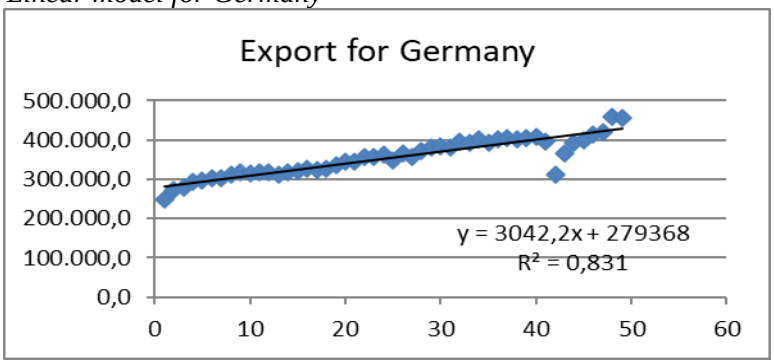
Source: *Author's calculations.*

Figure 6. *Linear model for Poland*



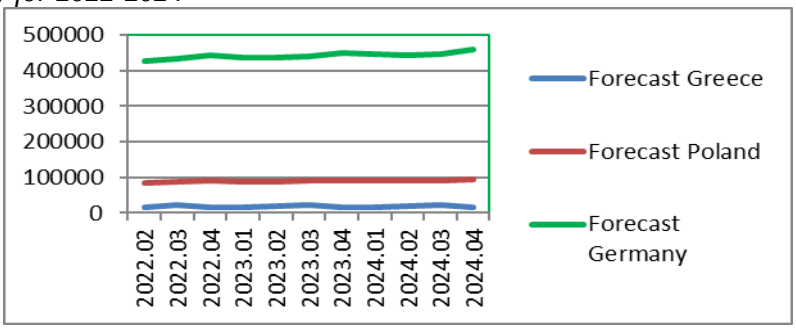
Source: *Author's calculations.*

Figure 7. *Linear model for Germany*



Source: *Author's calculations.*

Figure 8. *Forecasts of export of goods and services for Greece, Poland and Germany for 2022-2024*



Source: *Author's calculations.*

The third part of the analysis concerns the forecasting of the final consumption expenditures of households index for selected EU countries – Greece, Poland and Germany. Models for each country were prepared, and then the relevant indicators were calculated on the basis of which the forecast for the next quarters of 2022-2024 was calculated. The results are presented in Table 4 and Figures 9-12.

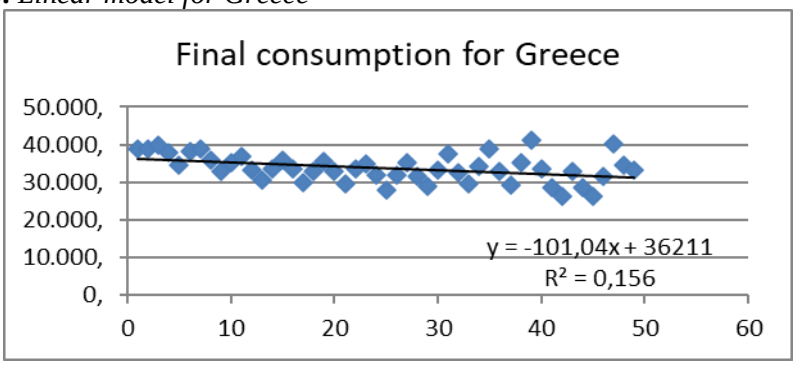
Table 4. *Forecasts of final consumption expenditure of households for Greece, Poland and Germany for 2022-2024*

Period	**t**	**Forecast Greece**	**Forecast Poland**	**Forecast Germany**
2022.02	50	31162	79055	437069
2022.03	51	34695	81144	445494
2022.04	52	30669	78555	457456
2023.01	52	28091	83985	436493
2023.02	53	30859	80734	443408
2023.03	54	34392	82823	451833
2023.04	54	30467	79674	461683
2024.01	55	27788	85664	442833
2024.02	56	30556	82414	449748

2024.03	56	34190	83943	456060
2024.04	57	30164	81353	468023

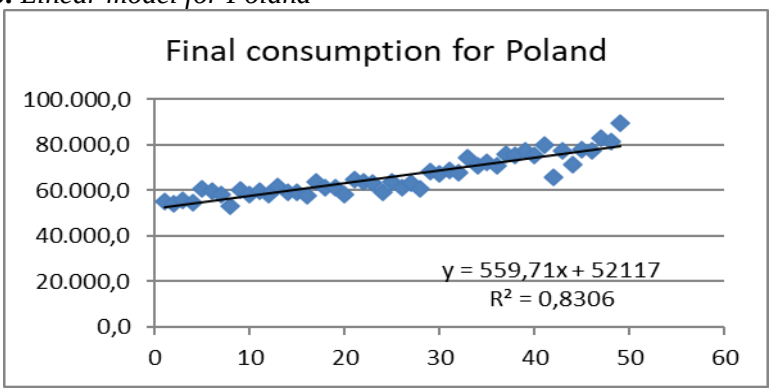
Source: *Author's calculations.*

Figure 9. *Linear model for Greece*



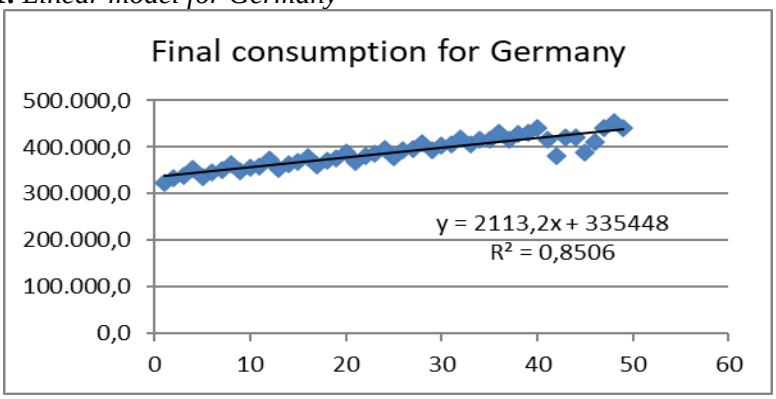
Source: *Author's calculations.*

Figure 10. *Linear model for Poland*



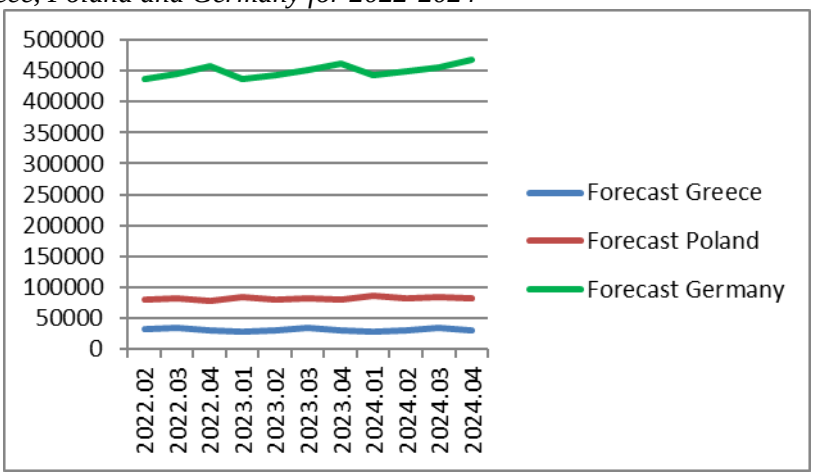
Source: *Author's calculations.*

Figure 11. *Linear model for Germany*



Source: *Author's calculations.*

Figure 12. *Forecasts of final consumption expenditure of households for Greece, Poland and Germany for 2022-2024*



Source: *Author's calculations.*

Table 5 presents the results of the average relative errors of the ex-post forecast for the analyzed variables. From the results obtained, it was obtained that all forecasts are acceptable.

Table 5. *Average relative forecast errors ex-post for analyzed variables*

Country	Average relative forecast error ex-post		
	GDP	Export of goods and services	Final consumption expenditure of households
Greece	5,26%	8,15%	5,59%
Poland	3,63%	4,82%	3,37%
Germany	1,53%	3,38%	1,57%

Source: *Author's calculations.*

5. Conclusions

A comparison of the results of the analysis for selected EU countries indicates that Germany is the best situation, which applies to the GDP variable. There is an increasing trend, in the case of Poland. In the case of Greece the trend is decreasing. It can be seen a certain seasonality of the results obtained.

For Greece, the best results are characterized by the 3rd and 4th quarters, which is due to the fact that the Greek economy is based mainly on tourism. For Poland, the last quarters of the year are the best. This can be explained by the fact that companies invest money during this time that has not been invested throughout the year.

Analyzing the results of the export forecast of goods and services, it should be noticed that for Greece, the best results are observed for the 3rd quarter, while for Poland for the 4th quarter, similarly for Germany. For all three countries, the values of the trend coefficients for exports are positive, that is, this suggests an possible increase.

The last of the analyzed variables final consumption expenditure of households increases for Germany and Poland, while it decreases for Greece (this is indicated by regression coefficients with the created linear models for all analyzed countries). The article presents the ratio analysis. This is a method that is used to forecast seasonal values. Also noteworthy are the methods of exponential smoothing. Examples of these methods can be found in the following papers (Szostek, 2012; Babiarz and Chudy-Laskowska, 2015; Chudy-Laskowska and Pisula, 2017).

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