
PROOFS OF SEASONALITY OF BULGARIA'S EXPORT OF CONSUMER GOODS, RAW MATERIALS AND PROCESSED MATERIALS OVER THE PERIOD 2020–2023

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Abstract: A country's balance of payments determines the degree of openness of its economy. In our case, it is the ratio of the debit and credit entries in the current account to GDP. Data regarding Bulgaria indicate that during the period of its full membership in the EU, the average annual ratio of its balance of trade to GDP exceeds 110%. This categorizes the country as an open-type economy. Simultaneously, an economy which is heavily reliant on both exports and imports is considered extremely susceptible to external shocks and strongly dependent on foreign markets. Accordingly, the study focuses on the export of two leading groups of goods within the current account of the balance of payments: the group of consumer goods and the group of raw and processed materials. The research aims to examine the dynamics of export flows using the method of seasonal projection. The working hypothesis is that due to the effect of various crises (such as the pandemic, the war in Ukraine, spiking energy prices, etc.) and the economic cycle in the agricultural sector, the dynamics of exports of consumer goods and raw and processed materials has seasonal characteristics. The objective is to analyse Bulgaria's exports for the period 2020–2023 on a quarterly basis and to define the trend component, the seasonal component, and the random component with a forecast for 2024.

Keywords: export seasonality, consumer goods, raw and processed materials, GDP.

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Introduction

National economic development is based on a combination of various production factors aligned with both the absolute and comparative advantages of each country in relation to its neighbour states and the rest of the world. While numerous economic theories were corroborated in the context of a closed economy, real-world economies are open. Therefore, in calculating gross domestic product, we adhere to the classical formula of adding consumer spending, business investment, and government spending, adjusted by the balance of trade (i.e. net exports). From a purely mathematical perspective, if this balance is decomposed into its two components — exports and imports — we can claim that both factors are important for the final result. Essentially, exports represent the capacity to sell domestically produced goods and services beyond national borders (Salvatore, 2007). Imports, on the other hand, represent the spending of the government and households on goods and services produced abroad as well as business investment in imported industrial machinery. Therefore, the examination of the relationship between GDP and the components of the balance of trade merits particular attention. Both factors are undoubtedly subject to seasonal effects within the fiscal year, particularly in the sectors of tourism and agriculture.

Consequently, the subject of this study is the export of two major groups of goods on the current account balance of payments, viz., consumer goods and raw and processed materials. The aim of the study is to analyse the dynamics of these export flows using the method of seasonal projection. The main hypothesis is that the influence of multiple crises (e.g. the pandemic, the war in Ukraine, electricity price spikes, etc.) and the economic cycle in the agricultural sector, the dynamics of exports in consumer goods and raw and processed materials has seasonal characteristics. The objective is to examine Bulgaria's exports for the period from 2020 to 2023 on a quarterly basis and to define the trend component, the seasonal component, and the random component with a forecast for 2024. However, the initial premise is to test the relationship between the two selected export commodity groups and GDP on a quarterly basis.

1. The issue of GDP and trade balance

According to the original formula for calculating GDP, the gross national product is the sum of consumer spending (C), business investment (I), government spending (G) and the balance of trade (Brusarski, Zahariev, & Manliev, 2015).

$$(1) \quad \text{GNP} = C + I + G + (X - M),$$

where:

C is consumer spending;

I is business investment;

G is government spending;

(X - M) is the net balance of trade export - import).

Following the established methodology for macroeconomic analysis, we proceed to select data and use it in an econometric model. (Zahariev A. , 2012).

1.2. Description of empirical data

The quarterly reports for GDP and the exports of the categories "consumer goods" and "raw and processed materials" in EUR mln. during the specified period (1Q2020–4Q2024) were taken from the datasets maintained by the Bulgarian National Bank and the National Statistical Institute.

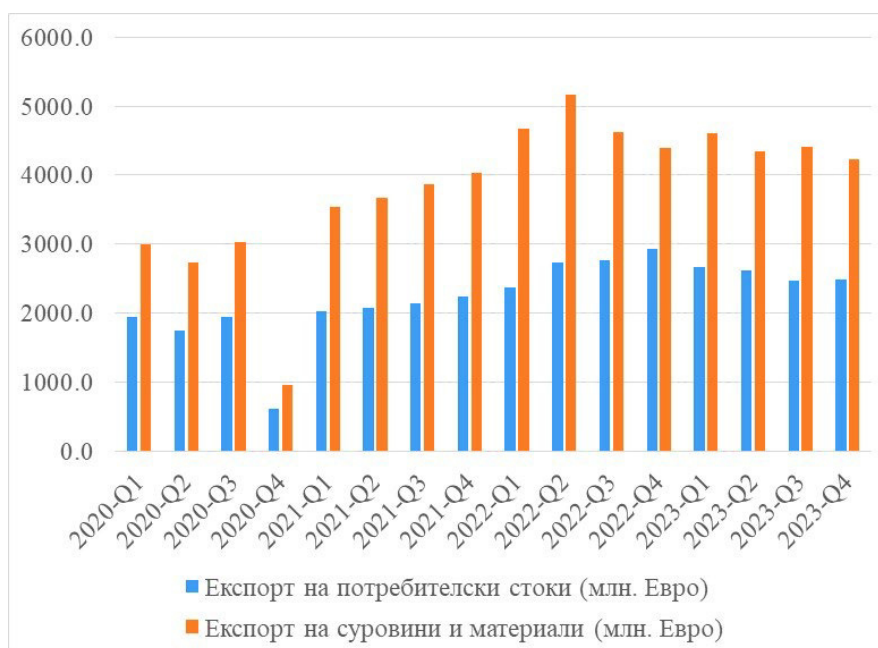


Figure 1. Dynamics of Bulgaria's quarterly export of consumer goods and raw and processed materials over the period 1Q2020–4Q2023

The selected export categories have seasonal dynamics, which were particularly pronounced during the pandemic year of 2020. In contrast, GDP maintains an upward trend and a recurring seasonal pattern in quarterly data for the corresponding year, with peak values observed in the fourth quarter and the lowest values in the first quarter.

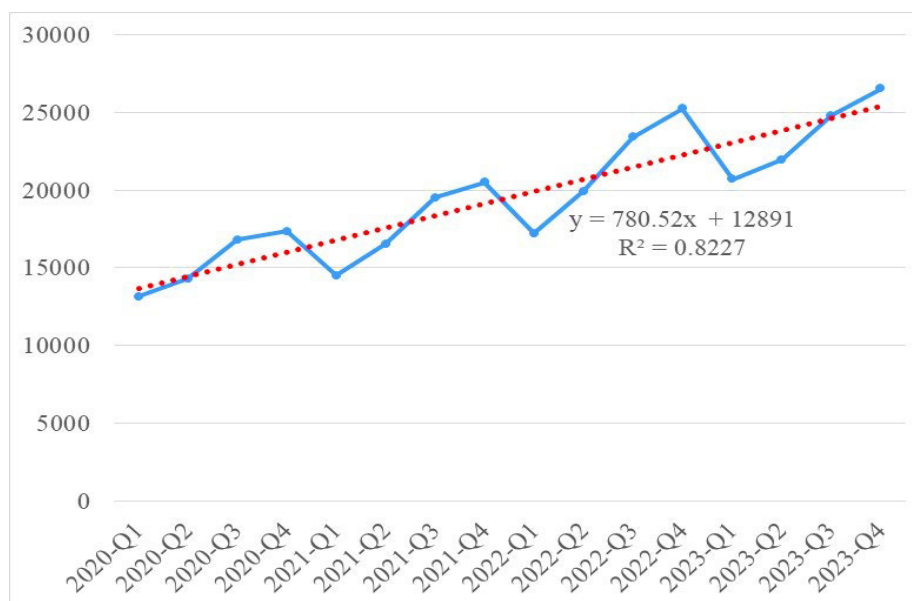


Figure 2. Dynamics of Bulgaria's quarterly GDP over the period 1Q 2020-4Q2023

1.3. Econometric analysis of the GDP and the export of consumer goods and raw and processed materials

The systematically collected data is initially subjected to descriptive statistical analysis followed by multiple regression modelling. For the analysed quarters, the quarterly mean of consumer goods is EUR 2.234 bln. and that of raw and processed materials is EUR 3.826 bln. The quarterly mean of GDP over the period is EUR 19.526 bln. The coefficient of variation relative to the mean is notably highest (26.82%) for the export of raw and processed materials (Zarkova, Kostov, Angelov, Pavlov, & Zahariev, 2023), followed by the coefficient of variation for the export of consumer goods (24.79%) and for the quarterly GDP (20.98%.) Only the data for GDP substantially meet the criteria for standardized normal distribution (Skewness = 0.17). In contrast, both export factor variables exhibit a left-skewed asymmetrical distribution of the quarterly data. (Zahariev, et al., 2023). Logically, the kurtosis for GDP is platykurtic, while the distributions for the two export factors are leptokurtic.

The multiple regression model is statistically significant at a 95% confidence interval. The correlation coefficient is moderate at 61.36%. The coefficient of determination indicates that 37.65% of the variance of the dependent variable can be explained by the variability in the two export product categories. The coefficients of both factors are not statistically significant.

Table 1

Descriptive statistics for Bulgaria's quarterly GDP and export of consumer goods and raw and processed materials over the period 1Q2020–4Q2023

Features	Export of consumer goods	Export of raw and processed materials	GDP
Mean	2234.15	3826.06	19525.73
Standard Error	138.44	256.58	1024.26
Median	2308.00	4127.25	19723.35
Standard Deviation	553.77	1026.30	4097.02
Sample Variance	306663.05	1053297.34	16785581.37
Kurtosis	4.11	3.09	-1.00
Skewness	-1.64	-1.53	0.17
Range	2308.20	4212.90	13347.13
Minimum	615.50	948.90	13162.63
Maximum	2923.70	5161.80	26509.77
Sum	35746.40	61217.00	312411.74
Count	16	16	16
Confidence Level (95.0%)	295.08	546.88	2183.15
Coefficient of variation	24.79%	26.82%	20.98%

Source: Author's calculations using data from BNB and NSI (in EUR mln.)

Table 2

Multiple regression model for the influence of Bulgaria's quarterly export of consumer goods and raw and processed materials on the country's GDP over the period 1Q2020–4Q2023

Regression Statistics						
Multiple R	0.6136					
R Square	0.3765					
Adjusted R Square	0.2806					
Standard Error	3474.98					
Observations	16					
ANOVA						
	<i>Df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>	
Regression	2	94802099.2	47401050	3.925387	0.046381	
Residual	13	1.57E+08	12075509			
Total	15	2.52E+08				
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	9351.30	3740.34	2.50	0.03	1270.80	17431.81
Export of consumer goods (EUR mln.)	6.80	5.41	1.26	0.23	-4.89	18.49
Export of raw and processed materials (EUR mln.)	-1.31	2.92	-0.45	0.66	-7.62	4.99

Source: Author's calculations using data from BNB and NSI (in EUR mln.)

2. Approbation of the seasonal projection forecasting method

The degree of seasonality of the two of export commodity flows is determined using the method of seasonal projection. This process includes three stages. (Zahariev, Angelov, Ganchev, & Kostov, 2022):

Stage One: Removal of the seasonal effect from the time series data, which comprises three sub-stages: (a) calculating the initial seasonal indices; (b) calculating the final seasonal indices; (c) eliminating the seasonal component.

Stage Two. Determining the trend component by means of a linear function ($Y = a + bX$), where „a“ is the intercept and „b” is the slope of the regression equation line.

Stage Three. Adjusting the trend component with a seasonal factor to determine the forecast values for each season of the fifth consecutive year.

The basic equation for calculating seasonal forecast variables takes into account three components: trend component, seasonal component, and irregular component, i.e.: $Y_t = T_t \times S_t \times I_t$. (Zahariev, 2022).

2.1. Results from the analysis of the dynamics of consumer goods exports in Bulgaria’s balance of trade over the period 1Q2020 – 4Q2023 with seasonality smoothed forecast for 2024.

The data regarding Bulgaria’s consumer goods export over the 16 quarters is processed consecutively through the three stages of the analysis:

Stage 1.A: Calculating the initial seasonal indices				
	Exp,t	MA(4)	CMA	SRI Comp
2020'Q1	1943			
2020'Q2	1740	1560.60		
2020'Q3	1944	1579.58	1570.09	1.24
2020'Q4	616	1662.50	1621.04	0.38
2021'Q1	2019	1710.20	1686.35	1.20
2021'Q2	2071	2117.63	1913.91	1.08
2021'Q3	2135	2205.53	2161.58	0.99
2021'Q4	2245	2371.55	2288.54	0.98
2022'Q1	2371	2529.65	2450.60	0.97
2022'Q2	2735	2699.28	2614.46	1.05
2022'Q3	2767	2774.58	2736.93	1.01
2022'Q4	2924	2745.85	2760.21	1.06
2023'Q1	2672	2669.43	2707.64	0.99
2023'Q2	2621	2559.10	2614.26	1.00
2023'Q3	2462			
2023'Q4	2482			
Where:				
Exp,t – Historical seasonal data;				
MA(4) – Four-period moving average;				
CMA – Centered moving average;				
SRI Comp – Seasonal and random index.				

Stage 1.B: Calculating the final seasonal indices				
	SRI Comp			SI
Q4	1.20	0.97	0.99	1.05
Q1	1.08	1.05	1.00	1.04
Q2	1.24	0.99	1.01	1.08
Q3	0.38	0.98	1.06	0.81

Where: SI – Final seasonal index for Qi

Stage 1.C: Removing the seasonal component			Stage 2: Applying the trend forecasting model to the seasonality-smoothed data	
Exp,t	SI	Yts	t	Yts
1943	1.05	1850	1	1849.79
1740	1.04	1667	2	1666.88
1944	1.08	1802	3	1801.77
616	0.81	763	4	763.02
2019	1.05	1922	5	1922.04
2071	1.04	1985	6	1984.72
2135	1.08	1979	7	1978.61
2245	0.81	2783	8	2783.32
2371	1.05	2257	9	2256.72
2735	1.04	2621	10	2621.06
2767	1.08	2565	11	2564.74
2924	0.81	3624	12	3624.44
2672	1.05	2543	13	2543.43
2621	1.04	2511	14	2510.96
2462	1.08	2281	15	2281.40
2482	0.81	3077	16	3077.37
Where:			Alpha	1433.83
Yts-Seasonality-adjusted historical data			Beta	97.71

The graphical model depicting the export forecast is illustrated in the figure below. The projection for 2024 regarding consumer goods exports is derived from the equation for Yts with alpha set at EUR 1,433.83 mln. and beta at EUR 97.71 mln.

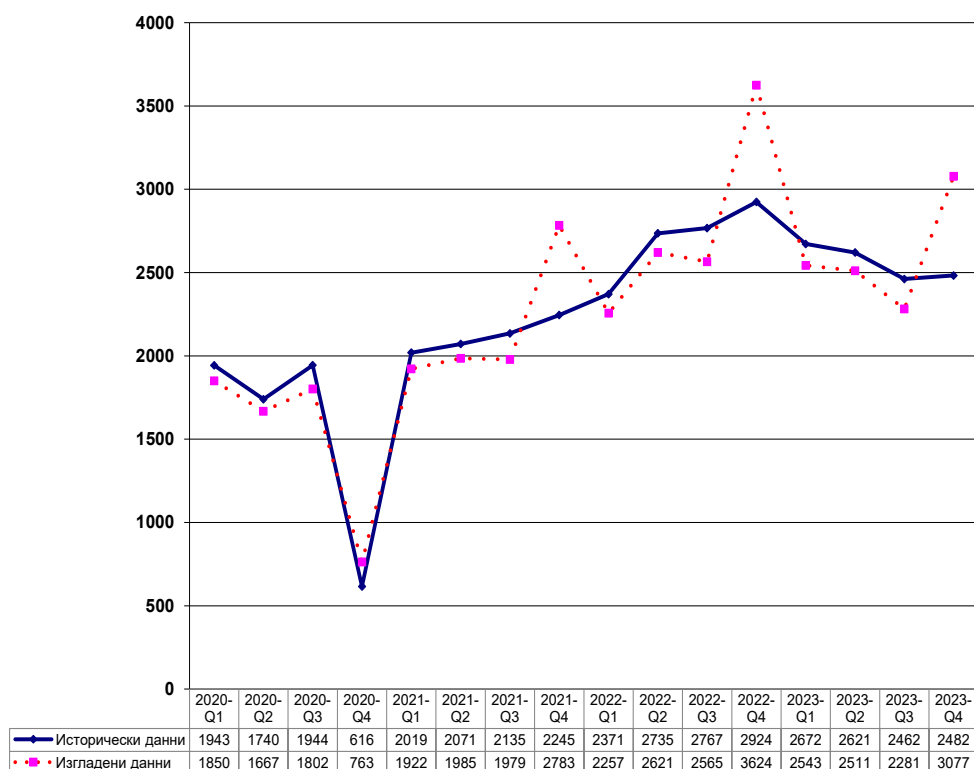


Figure 3. Historical and seasonally adjusted data for Bulgaria's exports of consumer goods over the period 1Q2020–4Q2023

Stage 3: Adjusting the forecasts from Stage Two with the final seasonal indices from Stage 1.BC				
	4Q2022-3Q2023	Trend component (TC)	Seasonal index (SI)	End Forecast (EF)
17	Q1=17	3094.95	1.05	3251.41
18	Q2=18	3192.67	1.04	3331.95
19	Q3=19	3290.38	1.08	3550.12
20	Q4=20	3388.09	0.81	2733.05
Where:				
TC – Forecast based on seasonally-smoothed data				
EF – Forecast after applying the seasonal index				

The results clearly demonstrate the adverse effects of the pandemic and the deteriorated predictive qualities of the model, particularly for the fourth quarter of 2024.

2.2. Results from the analysis of the dynamics of raw and processed materials exports in Bulgaria's balance of trade over the period 1Q2020 – 4Q2023 with seasonality smoothed forecast for 2024.

The same procedure is applied to the data for Bulgaria's raw and processed materials exports over the 16 consecutive quarters.

Stage 1.A: Calculating the initial seasonal indices				
	Imp,t	MA(4)	CMA	SRI Comp
2020'Q1	2999			
2020'Q2	2723	2423.15		
2020'Q3	3022	2556.18	2489.66	1.21
2020'Q4	949	2793.20	2674.69	0.35
2021'Q1	3531	3004.63	2898.91	1.22
2021'Q2	3671	3774.58	3389.60	1.08
2021'Q3	3867	4058.60	3916.59	0.99
2021'Q4	4029	4431.23	4244.91	0.95
2022'Q1	4667	4620.83	4526.03	1.03
2022'Q2	5162	4710.50	4665.66	1.11
2022'Q3	4626	4694.48	4702.49	0.98
2022'Q4	4387	4490.53	4592.50	0.96
2023'Q1	4603	4436.43	4463.48	1.03
2023'Q2	4346	4396.03	4416.23	0.98
2023'Q3	4409			
2023'Q4	4226			
Where:				
Exp,t – Historical seasonal data;				
MA(4) – Four-period moving average;				
CMA – Centered moving average;				
SRI Comp – Seasonal and random index.				

Eran 1.C: Calculating the final seasonal indices				
	SRI Comp			SI
Q1	1.22	1.03	1.03	1.09
Q2	1.08	1.11	0.98	1.06
Q3	1.21	0.99	0.98	1.06
Q4	0.35	0.95	0.96	0.75
Where: SI – Final seasonal index for Qi				

Stage 1.C: Removing the seasonal component			Stage 2: Applying the trend forecasting model to the seasonality-smoothed data	
Imp,t	SI	Yts	t	Yts
2999	1.09	2743	1	2742.53
2723	1.06	2574	2	2574.28
3022	1.06	2846	3	2846.30
949	0.75	1260	4	1260.06
3531	1.09	3229	5	3229.12
3671	1.06	3471	6	3470.54
3867	1.06	3643	7	3642.97
4029	0.75	5350	8	5349.78
4667	1.09	4268	9	4268.06
5162	1.06	4880	10	4879.53
4626	1.06	4357	11	4357.39
4387	0.75	5826	12	5826.11
4603	1.09	4209	13	4209.45
4346	1.06	4108	14	4108.34
4409	1.06	4154	15	4153.54
4226	0.75	5612	16	5611.51
Where:			Alpha	2292.68
Yts-Seasonality-adjusted historical data			Beta	190.05

The graphical model of the import forecast is illustrated in the figure below.

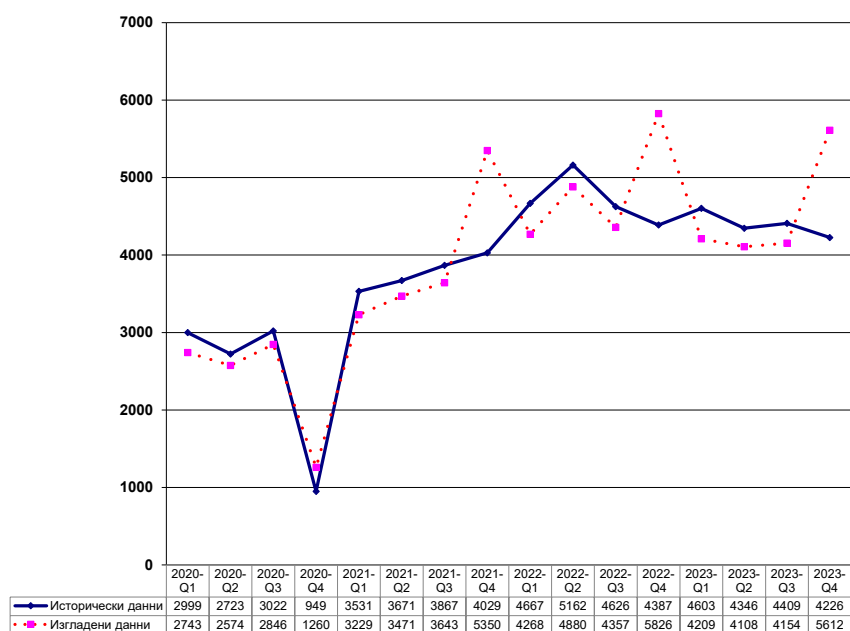


Figure 4. Historical and seasonally adjusted data for Bulgaria's imports over the period 1Q2020–4Q2023 1Q2020–4Q2023

The graphical model depicting the raw and processed materials exports for 2024 forecast is derived from the equation for Yts with alpha set at EUR 2292.68 mln. and beta at EUR 190.05 mln.

Stage 3: Adjusting the forecasts from Stage D) with the final seasonal indices from Stage 1.B)				
	4Q2022-3Q2023	Trend component (TC)	Seasonal index (SI)	End Forecast (EF)
17	Q1=17	5523.51	1.09	6040.05
18	Q2=18	5713.56	1.06	6044.07
19	Q3=19	5903.61	1.06	6266.99
20	Q4=20	6093.65	0.75	4588.88
Where:				
TC – Forecast based on seasonally-smoothed data				
EF – Forecast after applying the seasonal index				

Conclusion

In conclusion, it can be inferred that, based on the impact of multiple crises (such as the pandemic, the war in Ukraine, and electricity price spikes) and the economic cycle within the agricultural sector, the dynamics of exports of consumer goods, raw and processed materials have weaker seasonal characteristics compared to those of GDP on a quarterly basis. Of the two examined export categories, the seasonal index for smoothing the forecast for the export of raw and processed materials for the fourth quarter has a higher adjustment value of 0.75 compared to the smoothing index for consumer goods exports of 0.81. Through a multiple regression model, with a confidence interval of 95%, a statistically significant dependency of GDP on the two tested export categories has been identified at a moderate correlation coefficient of 61.36%.

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