STATISTICAL ANALYSIS AND FORECASTS OF SOME FINANCIAL INDICATORS FROM THE AGRICULTURAL SECTOR IN ROMANIA USING THE ARIMA MODEL

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DOI: 10.52846/MNMK.22.2.08

Abstract:
In this paper, a statistical analysis of some financial indicators in Romania for the period 1991-2023 was made. Indicators from the agricultural field were studied, such as the export and import of animals and animal products, but also of vegetable products, as well as the total import and export. Using the ARIMA method (autoregressive integrated moving average), forecasts for the period 2024-2026 were presented for all the studied indicators.

Keywords: forecast, international trade, financial indicators, ARIMA method.

1. Introduction

Agriculture was once the main economic activity for a large part of the population in Romania, but also in the whole world. In the last decades, agriculture has undergone fundamental and irreversible transformations, which have led to the decrease of the importance of this sector in the structure of the economy and, implicitly, to the decrease of human resources in this sector. Romania, a country with a high level of ruralization and with a primary sector having an important weight in the national economy, was greatly affected by the transformations in the agricultural sector, by decreasing the added value of agriculture to the formation of the Gross Domestic Product (GDP), by decreasing the number of jobs, but also through the impossibility of capitalizing on natural and human resource.

The use of statistical methods in agriculture has a relevant importance for the efficient management of resources, decision-making, productivity improvement and the development of this sector. Agricultural statistics allow field personnel to estimate, monitor and evaluate production, identify trends and make comparisons between different periods or lots. This helps to identify factors that can negatively or positively influence production.

Statistical analysis of exports and imports is essential to understand the commercial dynamics of an economy, and in the case of Romania, it provides important information on agricultural and commercial markets.

Statistical analysis of the export and import of animals and animal products provides a deeper understanding of this sector, highlighting trends and market dynamics. This analysis provides a clear picture of the long-term evolution of international trade in animal products, showing how trade policies, global demand and economic factors influence this sector. It also allows the identification of moments of discontinuity caused by global events, such as the financial crisis of 2008 or the COVID-19 pandemic in 2020, which affected the volume of trade in animals and animal products. The analysis also helps to understand the trade deficit in this sector and the economic implications on the national economy. In Romania, the trade balance in this field is negative, (Andrei et al., 2023) which indicates a high dependence on imports. Furthermore, the results of the analysis can inform the government and authorities on the need for tailored trade policies to balance the balance and support domestic producers.

The importance of statistical analysis in the vegetable products sector is manifested in the ability to identify not only trade trends, but also factors affecting agricultural productivity and international competitiveness. Exports of plant products have been on an upward trend (Andrei et al., 2023), and the analysis helps to understand the factors supporting this growth, such as the modernization of agriculture or the global demand for food products. The analysis of the trade balance of plant products, which has been positive for Romania since 1998 (Andrei et al., 2023), shows that the country has a comparative advantage in international trade with plant products. This information is essential to encourage investment and development in this sector. Also, the study of the evolution of exports and imports in this field can influence the development of strategies that support agricultural producers to capitalize on this competitive advantage, thus improving Romania's commercial performance. Allows better anticipation of the potential impact of global crises (such as the COVID-19 pandemic) on exports and imports, contributing to the development of resilience strategies.

The analysis of total imports is important for understanding Romania's economic dependence on foreign goods and services. Through the statistical analysis of imports, one can determine the degree of dependence of the economy on imported goods, such as food, energy or industrial goods. The study of the trade balance and the deficit generated by imports can indicate economic vulnerabilities and can stimulate policies that reduce dependence on imports and encourage the development of domestic production. The upward trend in imports also reflects domestic demand, which can indicate both economic development and structural problems in domestic production capacity. Analysis of import trends helps prepare for potential global crises that may affect the supply of essential goods. In this way, the authorities can implement preventive measures.

Exports are an important indicator of a country's economic competitiveness. The analysis of their evolution can provide a clear picture of how Romania's economy has evolved over time, especially after the transition from the centralized economy to the market economy in the 90s. Analyzing data over such a long period can reveal trends, such as increases or decreases in exports, seasonality and structural changes in the economy. This can help to understand the historical context, such as Romania's integration into the European Union in 2007, global economic crises or the pandemic and their impact on international trade. Romania's economic and trade policies, such as its accession to various international trade treaties or domestic export promotion measures, can have a significant impact on the volume and structure of exports. Statistical analysis can help measure the impact of these policies and adjust them to support economic growth. Foreign and local investors can also use this analysis to make decisions about business opportunities in Romania. A pattern of steady export growth in a particular sector may suggest the potential for profitability.

The ARIMA (Autoregressive Integrated Moving Average) method is a statistical prediction model used to make predictions based on historical data. Using this method for the period 2024-2026 allows forecasting the evolution of exports and imports in the short and medium term, based on existing patterns in historical data. Thus, it provides reliable estimates for economic and strategic planning. Authorities and companies can use these forecasts to make decisions on trade policy, investments and marketing strategies, depending on the expected evolution of the foreign and domestic market. ARIMA forecasts can help identify potential risks and take preventive measures in case of significant fluctuations in international trade. Based on the prediction results, performance targets can be set for different economic sectors and for international trade, ensuring alignment with the country's economic development targets.

The statistical analysis of Romania's exports and imports in various sectors provides a valuable perspective on the country's economic performance, supporting the development of more effective economic and trade policies. The use of ARIMA models for forecasting contributes to better medium-term planning, providing authorities and companies with a solid basis for decision-making. These analyzes are essential for improving economic competitiveness and reducing trade imbalances. Statistical methods also play an important role in the management of the agricultural sector, helping managers to make correct decisions and optimize operations to achieve good yields.

In the present paper, a statistical analysis is made and forecasts are made with the ARIMA method on some indicators regarding the total export and import, the export and import of vegetable products, the export and import of animals and animal products. The work is structured as follows. In the first part, a presentation of the specialized literature in the field is made, identifying the research undertaken previously. The second part contains the research methodology, mentioning the main statistical tests used in the validation of econometric models. The third part contains the novelty of the work, in which a descriptive statistical analysis of the indicators is made, followed by forecasts with the ARIMA model for the period 2024-2026. The work ends with the section of conclusions and possible further developments. The analyzed data were obtained from the National Institute of Statistics.

2. Literature Review

In the study of Andrei et al. (2023) an analysis was made of Romania's foreign trade with agri-food products from the period 2000-2020, dividing this period into two sub-periods: pre-accession to the EU (2000-2006) and post-accession to the EU (2007-2020). The effects of joining the EU on foreign trade with agri-food products were identified, resulting in this event being beneficial for Romania, as there was a significant increase in exports for most categories of agri-food products after 2007. Moreover, a specialization was observed of exports on several categories of agri-food products, but most of them consist of products with a low degree of processing, which have little added value. Using the combined values of certain indicators, it turned out that the most competitive product categories are cereals, live animals and seeds.

In the work of Anghelache (2018) it was shown that after 1989, the share of agriculture in Romania's GDP decreased and this field regressed, because agricultural farms were abolished. However, in the last decade, being helped by the subsidies received from the European Union, in Romania there are premises for the establishment of farms in order for the agricultural activity to become much more efficient. The analyzed data showed the concern for the restoration of larger agricultural holdings that would ensure the efficiency of agricultural exploitation.

In the study by Arghiroiu, Cristea and Alecu (2015), Romanian foreign trade was analyzed in the period 2007–2013, using statistical indicators and data available from the Ministry of Agriculture and Rural Development. The analysis revealed products that we import in large quantities, such as meat, sugar, various edible preparations, residues and waste from the food and fruit industries. Also found are the product groups for which we have competitive advantages, such as cereals, seeds and oilseeds, live animals and tobacco. Romania was an importing country, except in 2013 when our country became positive on the trade balance.

Barbu (2011) made an analysis of the performance of Romanian agriculture in comparison with that of the European Union, using data provided by Eurostat and the National Institute of Statistics. It turned out that Romanian agriculture was located in a marginal European area from the point of view of economic performance and failed to ensure food security and increase the export of agricultural products with added value. On the other hand, the global demand for agricultural products is much higher than the supply and some countries in the European Union have reached their maximum productivity, while Romania still has a lower productivity.

The work of Cucu and Panait (2020) focused on the evolution of international trade, analyzing the main branches, with an emphasis on the agri-food sector. Relations with the main 10 foreign trade partners were also analyzed. The aim of the paper was to identify the level of imports and exports made by Romania and to determine the share of food products in international trade. The methodology of the study included the analysis of statistical indicators, and following the comparison between the value of import and export, the trade balance indicator was also calculated.

In the work of Gavrilescu (2014) it was found that from 1990, Romania's agri-food trade balance was negative until 2008, then the trend reversed, and in 2013, the agri-food trade balance became positive. The paper analyzed the evolution of trade and its structure in three categories: agricultural goods, processed primary products and processed secondary products. A higher share of processed products for export indicates increased competitiveness resulting from higher unit values that include more value added. The results for total trade show that processed products represented at most 46% of Romanian exports and at least 63% of imports, indicating a weakly competitive structure of agri-food trade. The analysis is detailed for intra- and extra-EU trade and by main partners and product groups.

Also, the agri-food trade in Romania has registered a permanent deficit in the last three decades (Gavrilescu 2019), with the exception of the period 2013-2014. The deficit was accentuated by the negative trade balance with European Union countries, but since 2010, the deficit has been partially offset by the trade surplus with non-EU countries. The paper analyzes the evolution of the agri-food trade balance on the main product groups, and the results highlight products that mainly contributed to the deficit (fruits, meat, vegetables, milk and dairy products), those with balances that go from negative to positive depending of the economic situation (poultry, eggs), as well as those with a permanent positive balance (cereals, oilseeds).

From the study of Grigoras (2016) it was found that on the domestic market there are many imported agricultural products, at a lower price, which affects domestic producers. It is proposed that farmers pool their capital and grow their businesses into larger size cooperative forms that could help them get agricultural produce at lower costs and become competitive in the market.

The purpose of the work by Nicolae and Costaiche (2016) was to highlight the importance of fruit trade in Romania, its weight in European and global trade, but also to show how it affects the agricultural GDP in Romania. From the analysis of the links between fruit production, the value of agricultural GDP and fruit import, a significant correlation is observed, and the increase in fruit production has a positive impact on GDP and helps to reduce imports.

Popescu's work (2018) analyzed the production, export and import of wheat and corn in Romania, using data from 2007-2016 to highlight the main trends, but also important factors that support our country's position in international trade. The index method, the comparison method, the export/production ratio, the export/import ratio, the gross currency index were used to characterize the efficiency of foreign trade.

Also, Popescu (2022) analyzed the importance of production and import in food availability in Romania, using data from the National Institute of Statistics from 2015-2020. For this purpose, several indicators were studied such as: total consumption, per capita consumption, production, production/consumption ratio, import, import/consumption ratio, export, trade balance, import/export ratio, food availability, share of production and share import in food availability, self-sufficiency rate. The results obtained showed that consumption increased for fruits, vegetables, meat, fish and decreased for potatoes, cereals, sugar and eggs, as consumers seem to be more oriented towards a healthier diet.

In the work of Radu (2018) it was found that although Romania has a high agricultural potential, it is not yet exploited to its maximum potential, due to the fragmentation of land, the existence of technologies with a lower yield in the agricultural sector, such as agricultural machinery and systems of irrigation, but also a lower percentage of investment attraction. Although the agricultural sector in Romania could produce more quality products in significant quantities, it is found that more raw material is exported and finished products are imported.

3. Research methodology

The statistical analysis of the financial indicators was carried out by calculating the following numerical indicators: average, standard deviation, coefficient of variation, absolute average, average growth index, average growth rate, absolute average value.

To check whether the data series follow a normal distribution or not, the Jarque-Bera test was used. The Jarque-Bera test is a statistical test for verifying the assumption of normality of a distribution. It is based on measuring the skewness S and the kurtosis K of a distribution. The tested variable is

$$JB = \frac{n}{6}\left(S^2 + \frac{(K-3)^2}{4}\right)$$

which follows a distribution law χ-squared, where *n* is the number of observations or degrees of freedom. The null hypothesis of the Jarque-Bera test is H_0: the data are normally distributed and is evaluated against the alternative hypothesis H_1: the data is not normally distributed and follows a different distribution. If the probability attached to the test is greater than 0.05, then the null hypothesis is accepted and the alternative hypothesis is rejected at a 5% significance level.

The Durbin-Watson test is a statistical test that is used to check for first-order autocorrelation or independence of model errors. The null hypothesis H_0: there is no first-order autocorrelation (errors are independent), respectively the alternative hypothesis H_1: there is first-order autocorrelation (positive or negative). For verification, the test value is compared to the lower limit d_L and upper limit d_U in the Durbin-Watson table for a certain significance threshold, usually 5%. If the test value is in the interval (d_U, 4-d_U) then the null hypothesis H_0 is accepted, which means that the errors are not autocorrelated. The Breusch-Godfrey test is used to check for higher-order autocorrelation of the model errors and generates an attached probability. If this probability is greater than 0.05, then the hypothesis H_0 is accepted, and there is no autocorrelation, at a chosen significance threshold of 5%.

The ARCH test is based on estimating a regression model and analyzing its residuals to check whether there is dependence in the squared errors, that is, whether the errors have an autoregressive pattern. The null hypothesis H_0: there is no conditional heteroscedasticity, which means that the variance of the residuals is constant over time, respectively the alternative hypothesis H_1: there is conditional heteroscedasticity, that is, the variance of the residuals depends on their previous values. The test also generates an attached probability. If this probability is greater than 0.05 then the null hypothesis is accepted and we do not have heteroscedasticity, at a significance level of 5%.

The Akaike and Schwarz indicators are two informational criteria that are useful when a model has to be chosen from several variants. According to the informational criteria, the variant for which Akaike and Schwarz have the lowest values is chosen.

The Dickey-Fuller test is frequently applied in time series analysis to determine whether a series is stationary or requires differentiation to become stationary. Stationarity is an essential condition for many prediction and estimation models, such as ARIMA models. The Dickey-Fuller test verifies the null hypothesis H_0: the time series has a unit root (is non-stationary), respectively the alternative hypothesis H_1: the time series does not have a unit root (is stationary). The test generates an attached probability and if it is less than 0.05, then the series is stationary at a significance level of 5%.

The ARIMA model can be understood by highlighting each of its components, thus:

- Autoregression (AR): refers to a model that shows a changing variable regressing on its own lagged or prior values.
- Integrated (I): represents the difference between the raw observations to allow the time series to become stationary (the data values are replaced by the difference between the data values and the previous values).

- Moving average (MA): incorporates the dependence between an observation and a residual error from a moving average model applied to lagged observations.

Each component in ARIMA functions as a parameter with a standard notation. For ARIMA (p, d, q) models, the integer values p, d, and q indicate the type of ARIMA model used. These parameters can be explained as follows:

- p: number of lag observations in the model, also known as lag order.
- d: how many times the raw observations are differentiated, also known as the degree of differentiation.
- q: the order of the moving average.

4. Forecasts on some economic indicators in the agricultural field in Romania

4.1 Export of animals and animal products in Romania

The descriptive statistical analysis shows an average of $544,732 thousand in the period 1991-2023 with a standard deviation of $417,719 thousand. The minimum value of $94,010 thousand was recorded in 1998, and the maximum value of $1,326,267 thousand is obtained in 2023. The coefficient of variation has the value of 76.68%, which leads to the conclusion of a non-representative average, the data series being non-homogeneous with values that are not around the average. Regarding the evolution over time, it can be seen that in the period 1991-2023, the export value has, in general, an increasing trend, with a decrease in the years 2015-2016, but also in 2020, due to the restrictions imposed by the COVID pandemic.

An absolute average was calculated $\bar{\Delta} = 36.820$ thousand $ annually, and the average growth index is $\bar{I}$ =1,070928. The average growth rate was $\bar{R} = 7{,}0928\%$ annually, while the absolute average value of a percentage of the growth rate is $\bar{A}$ =5.191,20 $.

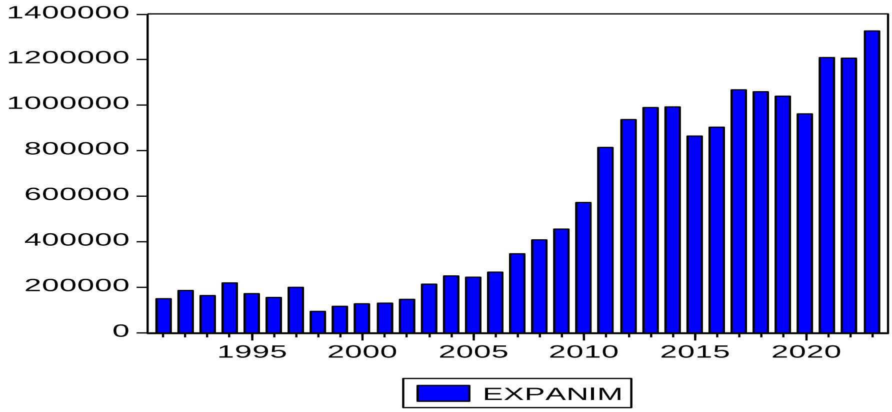

Figure 1. Export of animals and animal products in Romania

For prediction we use the ARIMA model. We initially check whether the series is stationary by applying the Dickey-Fuller test, with constant and trend. Since the probability attached to the test is 0.6821, which is greater than 0.05, it follows that the null hypothesis is accepted and the series is not stationary (Table 1), at a significance level of 5%.

Table 1. Dickey-Fuller test at EXPANIM

Null Hypothesis: EXPANIM has a unit root

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-1.797954	0.6821
Test critical values:	1% level	-4.273277	
	5% level	-3.557759	
	10% level	-3.212361	

Source: Made by authors with Eviews software

We apply the first difference to the series and check for stationarity. As the probability attached to the test is 0.0009, which is less than 0.05, it follows that the new series is stationary, that is, it does not have a unit root (Table 2).

Table 2. Dickey-Fuller test at D(EXPANIM)

Null Hypothesis: D(EXPANIM) has a unit root

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-5.258754	0.0009
Test critical values:	1% level	-4.284580	
	5% level	-3.562882	
	10% level	-3.215267	

Source: Made by authors with Eviews software

From the analysis of the correlogram of the differenced series we can test several ARIMA models of the type (p, 1, q). Several valid models resulted and we selected the ARIMA (3,1,12) model which has the lowest Akaide and Schwarz criteria values. It is found that all the estimated coefficients are significant (Table 3), having the probabilities attached to the t-Statistic test lower than 0.05. The probability attached to the F-statistic test is less than 0.05 which ensures the overall validity of the model. Also, the residuals of the model are not autocorrelated, a fact confirmed by Durbin-Watson tests with a value of 1.92 and Breusch-Godfrey tests with an attached probability of 0.956. The ARCH test confirms the absence of heteroscedasticity, the probability attached to the test being 0.2947, greater than 0.05. The ARIMA (3,1,12) model is stationary and invertible.

The value of the adjusted R-square shows us that approximately 44.5% of the variation in the export of animals and animal products is explained by the variation of AR (3) and MA(12), the rest up to 100% being attributed to other factors not included in the model.

Table 3. ARIMA (3,1,12) model at D(EXPANIM)

Dependent variable: D(EXPANIM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	59935.87	11628.88	5.154053	0.0000
AR(3)	-0.483102	0.223665	-2.159936	0.0402
MA(12)	-0.880235	0.036053	-24.41535	0.0000

R-squared	0.484788	Mean dependent var	38189.69
Adjusted R-squared	0.445156	S.D. dependent var	86512.40
S.E. of regression	64441.24	Akaike info criterion	25.08259
Sum squared resid	1.08E+11	Schwarz criterion	25.22404
Log likelihood	-360.6976	F-statistic	12.23231
Durbin-Watson stat	1.923288	Prob(F-statistic)	0.000180

Inverted AR Roots	.39+.68i	.39 -.68i	-.78	
Inverted MA Roots	.99	.86 -.49i	.86+.49i	.49 -.86i
	.49+.86i	.00+.99i	-.00 -.99i	-.49+.86i
	-.49 -.86i	-.86+.49i	-.86 -.49i	-.99

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.045068	Probability	0.956013
Obs*R-squared	0.000000	Probability	1.000000

ARCH Test:			
F-statistic	1.143386	Probability	0.294765
Obs*R-squared	1.179470	Probability	0.277464

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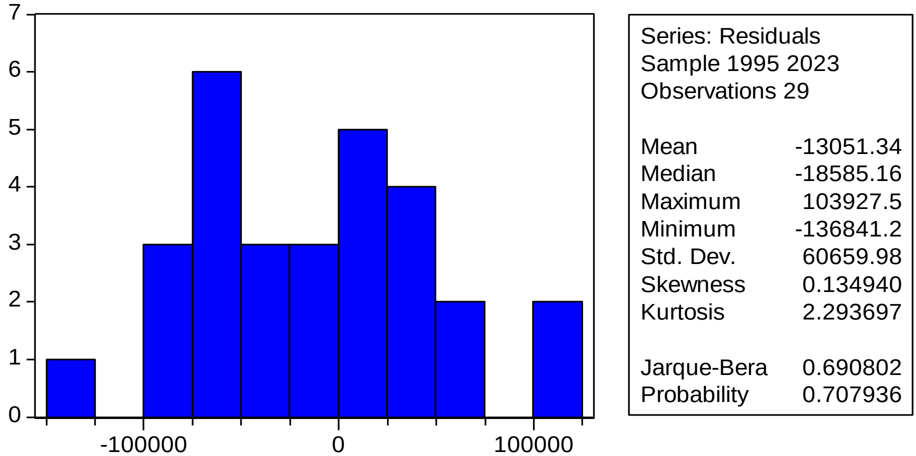

Figure 2. Histogram of the residuals of the model and the Jarque-Bera test at ARIMA (3,1,12)

Interpreting the data from Figure 2 we find that the probability value associated with the Jarque-Bera test is 0.707936, so the null hypothesis is rejected, the residuals are normally distributed.

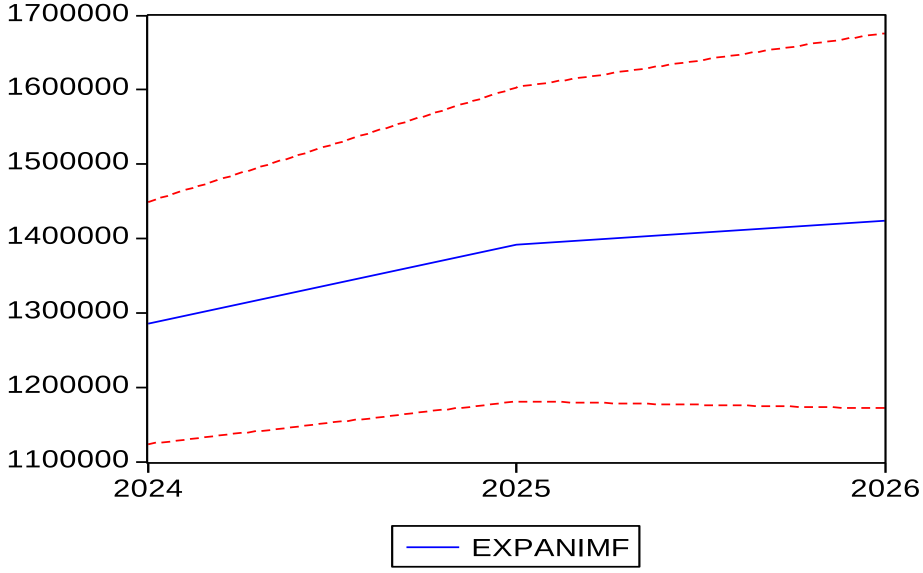

Figure 3. Forecasts on the export of animals and animal products with ARIMA (3,1,12)

Table 4. Forecasts with the ARIMA (3,1,12) model for the export of animals

Model	Forecast 2024	Forecast 2025	Forecast 2026
ARIMA (3,1,12)	1.285.544	1.392.036	1.423.673

Source: Made by authors with Eviews software

Interpreting the data from Table 4, it can be seen that the series has an increasing trend in the next 3 years.

4.2. The import of animals and animal products in Romania

The descriptive statistical analysis resulted in an average of $1,099,142 thousand in the period 1991-2023 with a standard deviation of $964,162 thousand. The minimum value of $42,242 thousand was recorded in the year 1991, and the maximum value of $3,430,870 thousand is obtained in the year 2023. The coefficient of variation has the value of 87.72%, which means that the average is not representative, the data series being non-homogeneous with values that are not around the average. Regarding the evolution over time, it can be seen that in the period 1991-2023, the import value has an increasing trend, with a jump in the years 2008, due to the accession to the EU and the reduction of import taxes. An absolute average was calculated $\bar{\Delta} = 105.894$ thousand $ annually, and the average growth index is $\bar{I}$ =1,1473. The average growth rate was $\bar{R} = 14{,}73\%$ annually, while the absolute average value of a percentage of the growth rate is $\bar{A}$ =7.189,06 $.

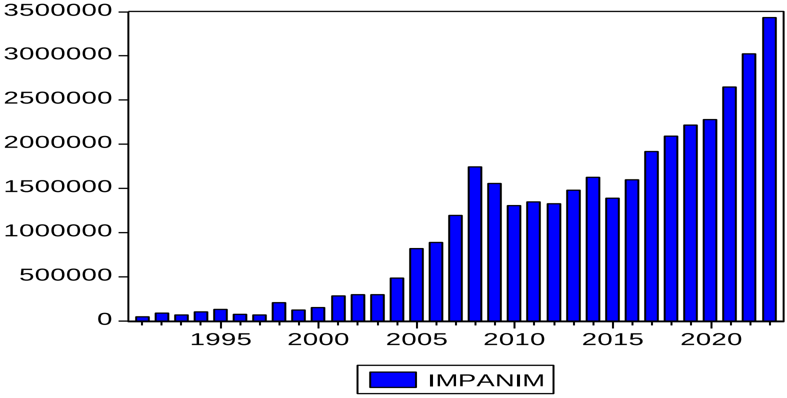

Figure 4. Import of animals and animal products in Romania

To make predictions we use the ARIMA model, we initially check if the series is stationary by applying the Dickey-Fuller test, with constant and trend. Since the probability attached to the test is 0.9615, which is greater than 0.05, it follows that the null hypothesis is accepted and the series is not stationary (Table 5), at a significance level of 5%.

Table 5. Dickey-Fuller test at IMPANIM

Null Hypothesis: IMPANIM has a unit root.

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.734314	0.9615
Test critical values:	1% level	-4.273277	
	5% level	-3.557759	
	10% level	-3.212361	

Source: Made by authors with Eviews software

We apply the first difference to the series and check for stationarity. As the probability attached to the Dickey-Fuller test is 0.0084, which is less than 0.05, it follows that the new series is stationary, that is, it does not have a unit root (Table 6).

Table 6. Dickey-Fuller test at D(IMPANIM)

Null Hypothesis: D(IMPANIM) has a unit root

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-4.356603	0.0084
Test critical values:	1% level	-4.284580	
	5% level	-3.562882	
	10% level	-3.215267	

Source: Made by authors with Eviews software

From the differenced series correlogram analysis we tested several ARIMA models of type (p, 1, q) and several valid models resulted. We selected the ARIMA

(1,1,2) model where the values of the Akaide and Schwarz criteria were the lowest. It is found that all the coefficients estimated in the model are significant at a significance threshold of 5% (Table 7), having the probabilities attached to the t-Statistic test lower than 0.05. The overall validation of the model is ensured by the F-statistic test whose attached probability is 0.011. Also, the residuals of the model are not autocorrelated, a fact confirmed by Durbin-Watson tests with a value of 2.21 and Breusch-Godfrey tests with an attached probability of 0.284. The ARCH test confirms the lack of heteroscedasticity, the probability attached to the test being 0.4069, greater than 0.05, having constant variation. Also the ARIMA (1,1,2) Model is stationary and invertible.

The value of the adjusted R-square shows us that approximately 22% of the variation in the import of animals and animal products is explained by the variation of AR(1) and MA(2), the rest of up to 100% being attributed to other factors not included in the model.

Table 7. ARIMA (1,1,2) model at D (IMPANIM)

Dependent variable: D(IMPANIM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	115450.1	25037.46	4.611093	0.0001
AR(1)	0.604966	0.177813	3.402266	0.0020
MA(2)	-0.835140	0.107650	-7.757917	0.0000
R-squared	0.272183	Mean dependent var		107911.0
Adjusted R-squared	0.220196	S.D. dependent var		188972.1
S.E. of regression	166874.7	Akaike info criterion		26.97964
Sum squared resid	7.80E+11	Schwarz criterion		27.11841
Log likelihood	-415.1844	F-statistic		5.235595
Durbin-Watson stat	2.212184	Prob(F-statistic)		0.011703
Inverted AR Roots	.60			
Inverted MA Roots	.91	-.91		
Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	1.321710	Probability		0.284008
Obs*R-squared	2.645398	Probability		0.266415
ARCH Test:				
F-statistic	0.708759	Probability		0.406990
Obs*R-squared	0.740637	Probability		0.389457

Source: Made by authors with Eviews software

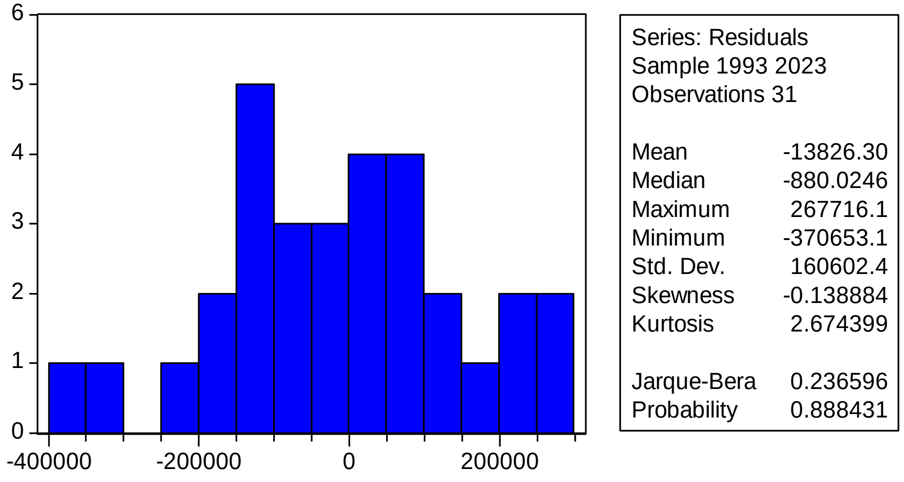

Figure 5. Histogram of the residuals of the model and the Jarque-Bera test at ARIMA (1,1,2)

Interpreting the data from Figure 5 we find that the value of the probability associated with the Jarque-Bera test is 0.888431, so the null hypothesis is rejected, the series of residuals being normally distributed.

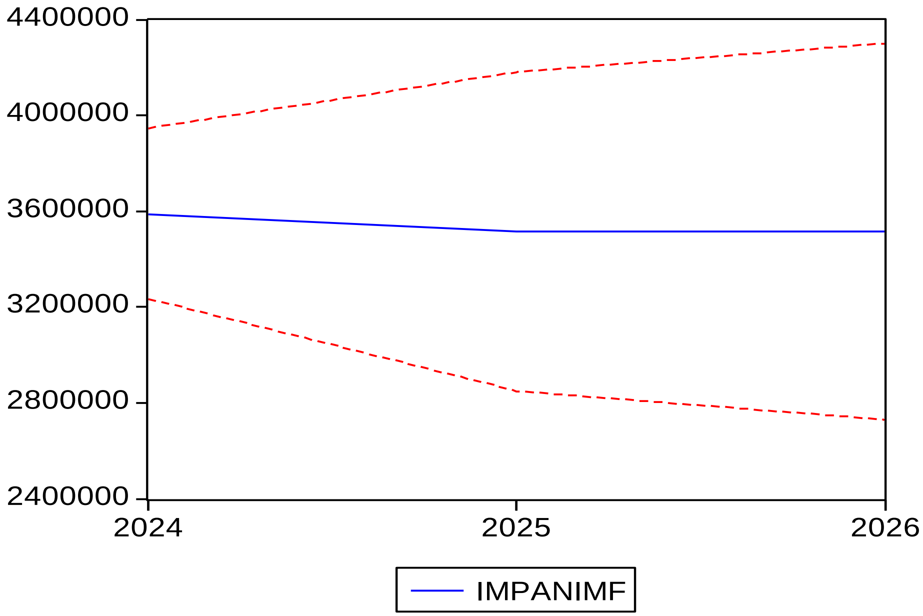

Figure 6. Forecasts for the import of animals and animal products with ARIMA (1,1,2)

Table 8. Forecasts with the ARIMA (1,1,2)

Model	Forecast 2024	Forecast 2025	Forecast 2026
ARIMA (1,1,2)	3.587.876	3.513.461	3.514.049

Source: Made by authors with Eviews software

4.3 Export of vegetable products in Romania

The analysis of the available data shows an average of $2,031,620 thousand in the period 1991-2023 with a standard deviation of $2,229,574 thousand. The minimum value of $49,792 thousand was obtained in 1992, and the maximum value of $7,175,627 thousand was achieved in 2023. The coefficient of variation has the value of 109.74%, which leads to the conclusion of an unrepresentative average, the data series being non-homogeneous with values that are not around the average. Regarding the evolution over time, it can be seen that in the period 1991-2023, there is an increasing trend, but also a significant decrease in 2020, due to the COVID pandemic.

An absolute average was calculated $\bar{\Delta} = 222.031$ thousand \$ annually, and the average growth index is $\bar{I}$ =1,1556. The average growth rate was $\bar{R} = 15{,}5695\%$ annually, while the absolute average value of a percentage of the growth rate is $\bar{A}$ =14.261,97 thousand \$.

For prediction, we initially check whether the series is stationary by applying the Dickey-Fuller test, with constant and trend. Since the probability attached to the test is 0.7716, which is greater than 0.05, it follows that the null hypothesis is accepted and the series is not stationary (Table 9), at a significance level of 5%.

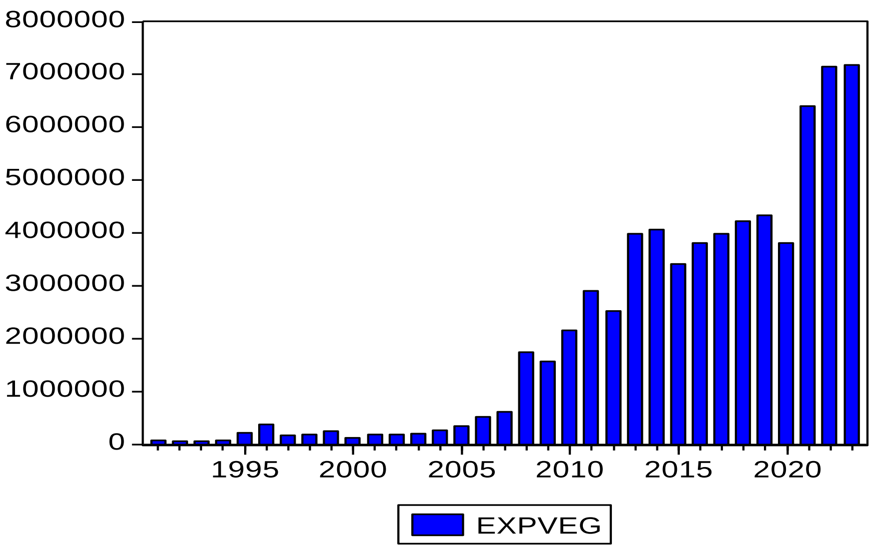

Figure 7. The export of vegetable products in Romania

Table 9. Dickey-Fuller test at EXPVEG

Null Hypothesis: EXPVEG has a unit root

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-1.597357	0.7716
Test critical values:	1% level	-4.273277	
	5% level	-3.557759	
	10% level	-3.212361	

Source: Made by authors with Eviews software

We apply the first difference to the series and check for stationarity. As the probability attached to the test is 0.0244, which is less than 0.05, it follows that the new series is stationary, that is, it does not have a unit root (Table 10).

Table 10. The Dickey-Fuller test at D(EXPVEG)

Null Hypothesis: D(EXPVEG) has a unit root

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.955910	0.0244
Test critical values:	1% level	-4.374307	
	5% level	-3.603202	
	10% level	-3.238054	

Source: Made by authors with Eviews software

From the analysis of the correlogram of the differenced series we can test several ARIMA models of the type (p, 1, q). Among the valid models, we selected the ARIMA (3,1,6) model, which has the lowest values of the Akaide and Schwarz criteria. It can be seen that all the estimated coefficients are significant (Table 11), having the probabilities attached to the t-Statistic test lower than 0.05. Overall validation of the model is given by the F-statistic test, which has an attached probability of less than 0.05. Also, the residuals of the model are not autocorrelated, a conclusion that emerges from the Durbin-Watson tests with a value of 2.45 and Breusch-Godfrey with an attached probability of 0.4953. The ARCH test confirms the presence of a homoscedastic model, the probability attached to the test being 0.7948, greater than 0.05. The ARIMA (3,1,6) model is also stationary and invertible.

The value of the adjusted R-square shows us that approximately 37.7% of the variation in the export of plant products is explained by the variation in AR(3) and MA(6), the rest up to 100% being attributed to other factors not included in the model.

Table 11. ARIMA (3,1,6) model at D(EXPVEG)

Dependent varaible: D(EXPVEG)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	380552.3	143703.0	2.648187	0.0136
AR(3)	0.496640	0.221578	2.241374	0.0338
MA(6)	-0.799061	0.100063	-7.985597	0.0000
R-squared	0.421712	Mean dependent var		245235.3
Adjusted R-squared	0.377228	S.D. dependent var		629361.0
S.E. of regression	496666.0	Akaike info criterion		29.16692
Sum squared resid	6.41E+12	Schwarz criterion		29.30836
Log likelihood	-419.9203	F-statistic		9.480129
Durbin-Watson stat	2.450633	Prob(F-statistic)		0.000809
Inverted AR Roots	.79	-.40+.69i	-.40 -.69i	
Inverted MA Roots	.96	.48 -.83i	.48+.83i	-.48+.83i
	-.48 -.83i	-.96		
Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	0.723420	Probability		0.495369
Obs*R-squared	0.952592	Probability		0.621080
ARCH Test:				
F-statistic	0.069023	Probability		0.794835
Obs*R-squared	0.074136	Probability		0.785407

Source: Made by authors with Eviews software

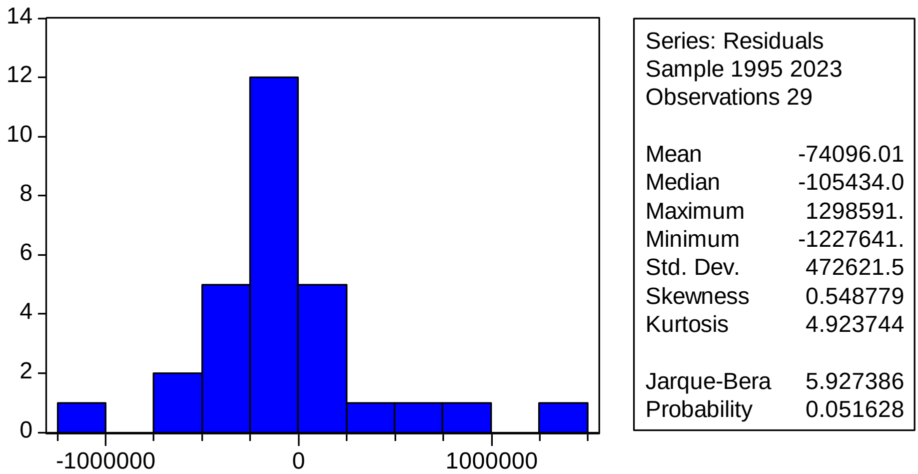

Figure 8. Histogram of the residuals of the model and the Jarque-Bera test at ARIMA (3,1,6)

From Figure 8 we find that the probability value associated with the Jarque-Bera test is 0.051628, so that the residuals are normally distributed.

Table 12. Forecasts with the ARIMA (3,1,6)

Model	Forecast 2024	Forecast 2025	Forecast 2026
ARIMA (3,1,6)	8.679.568	9.001.330	9.758.347

Source: Made by authors with Eviews software

Interpreting the data in table 12, it can be seen that the series has an increasing trend in the next 3 years.

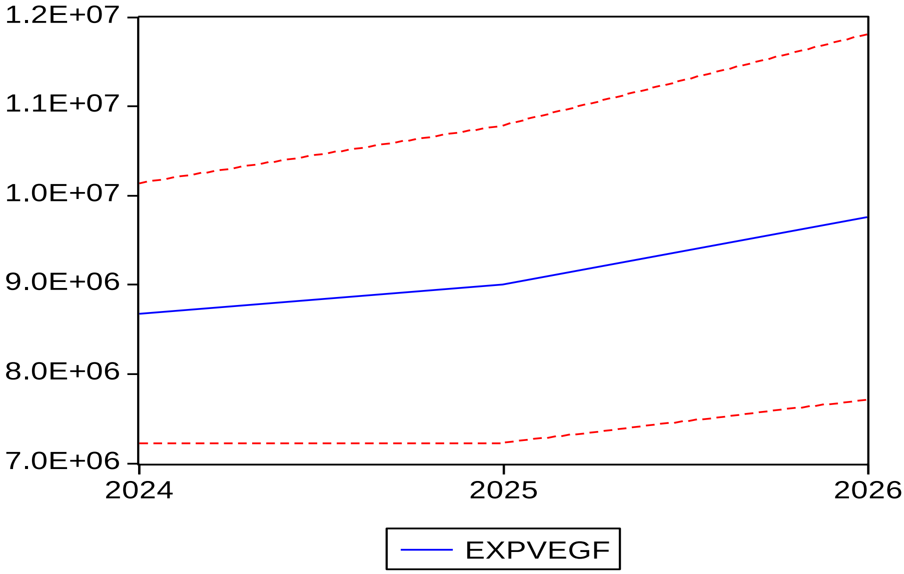

Figure 9. Forecasts for the export of vegetable products with ARIMA (3,1,6)

4.4 The import of vegetable products in Romania

Descriptive statistics generate an average of $1,472,825 thousand during the period 1991-2023 with a standard deviation of $1,299,590 thousand. The minimum value of $140,196 thousand was recorded in the year 1994, and the maximum value of $4,609,108 thousand is obtained in the year 2022. The coefficient of variation has the value of 88.24%, which leads to a non-representative average, the data series being inhomogeneous with values that are not around the average. Regarding the evolution over time, it can be seen that in the period 1991-2023, it has an upward trend, with a more pronounced increase in 2008, due to the accession to the EU and the decrease in customs duties. An absolute average $\bar{\Delta} = 120.569$ thousand \$ annually was calculated, with an average growth index $\bar{I}$ =1,0791. The average growth rate was $\bar{R} = 7.9173\%$ annually, and the absolute average value of a percentage of the growth rate is $\bar{A}$ =15.228,41 thousand \$.

For prediction we use the ARIMA model, it is initially checked if the series is stationary by applying the Dickey-Fuller test, with constant and trend. Since the probability attached to the test is 0.6576, which is greater than 0.05, it follows that the null hypothesis is accepted and the series is not stationary (Table 13).

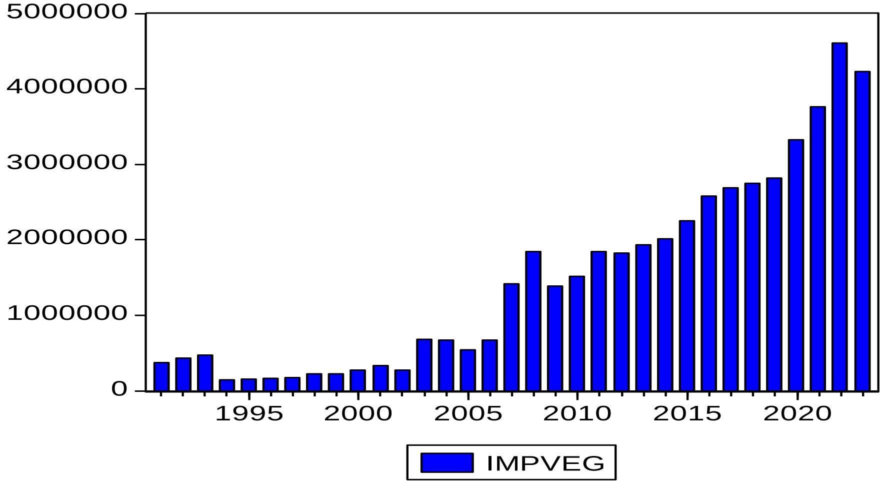

Figure 10. Imports of vegetable products in Romania

Table 13. Dickey-Fuller test at IMPVEG

Null Hypothesis: IMPVEG has a unit root

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-1.847846	0.6576
Test critical values:	1% level	-4.273277	
	5% level	-3.557759	
	10% level	-3.212361	

Source: Made by authors with Eviews software

We apply the first difference to the series and check for stationarity. As the probability attached to the test is 0.0002, which is less than 0.05, it follows that the new series is stationary, that is, it does not have a unit root (Table 14).

Table 14. Dickey-Fuller test at D(IMPVEG)

Null Hypothesis: D(IMPVEG) has a unit root

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-5.976068	0.0002
Test critical values:	1% level	-4.296729	
	5% level	-3.568379	
	10% level	-3.218382	

Source: Made by authors with Eviews software

From the analysis of the correlogram of the differentiated series, several valid models resulted and we selected the ARIMA model (4, 1, 10) which has the lowest values of the Akaide and Schwarz criteria. It is found that all the estimated coefficients are significant (Table 15), having the probabilities attached to the t-Statistic test lower than 0.05. The model is generally valid, a fact confirmed by the F-statistic test with a probability lower than 0.05. Also, the residuals of the model are not autocorrelated, which results from the Durbin-Watson tests with a value of 2.27 and Breusch-Godfrey with an attached probability of 0.4769. The ARCH test confirms the lack of heteroscedasticity, the probability attached to the test being 0.1741. Also, the ARIMA (4, 1, 10) model is stationary and invertible.

The value of the adjusted R-square shows us that approximately 37.6% of the variation in the import of vegetable products is explained by the variation in AR (4) and MA (10), the rest up to 100% being attributed to other factors.

Table 15. ARIMA (4,1,10) model at D(IMPVEG)

Dependent variable: D(IMPVEG)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	309762.6	165084.6	1.876387	0.0723
AR(4)	0.594998	0.238156	2.498357	0.0194
MA(10)	-0.857927	0.056980	-15.05665	0.0000
R-squared	0.422275	Mean dependent var		145472.9
Adjusted R-squared	0.376057	S.D. dependent var		285987.1
S.E. of regression	225901.4	Akaike info criterion		27.59454
Sum squared resid	1.28E+12	Schwarz criterion		27.73728
Log likelihood	-383.3236	F-statistic		9.136586
Durbin-Watson stat	2.271587	Prob(F-statistic)		0.001051
Inverted AR Roots	.88	.00+.88i	-.00 -.88i	-.88
Inverted MA Roots	.98	.80+.58i	.80 -.58i	.30 -.94i
	.30+.94i	-.30 -.94i	-.30+.94i	-.80 -.58i
	-.80+.58i	-.98		
Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	0.764780	Probability		0.476912
Obs*R-squared	1.416334	Probability		0.492546
ARCH Test:				
F-statistic	1.956383	Probability		0.174185
Obs*R-squared	1.959549	Probability		0.161562

Source: Made by authors with Eviews software

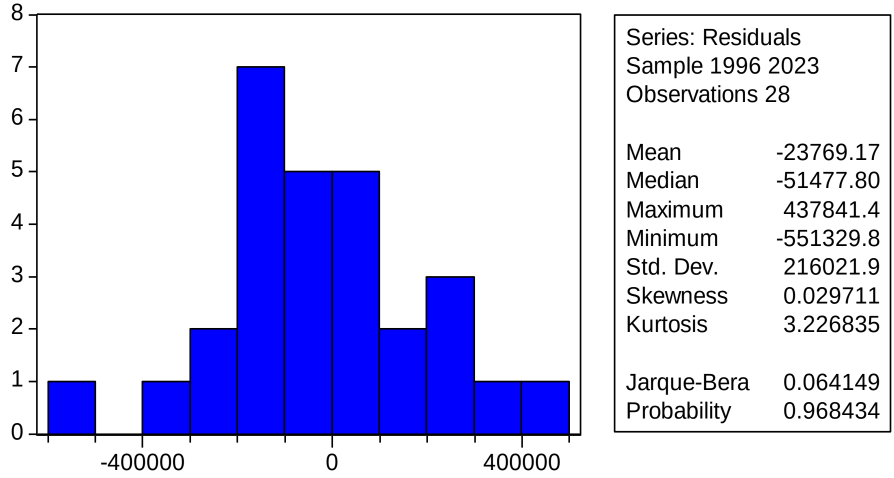

Figure 11. Histogram of the residuals of the model and the Jarque-Bera test at ARIMA (4,1,10)

Interpreting the data from Figure 11 we find that the value of the probability associated with the Jarque-Bera test is 0.968434, so the null hypothesis is rejected, the series of residuals being normally distributed.

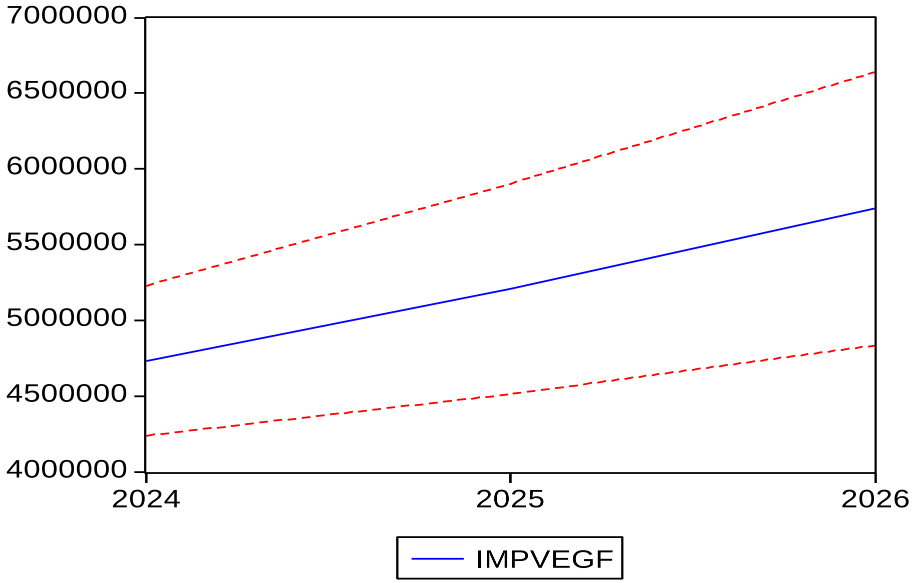

Figure 12. Forecasts for vegetable product imports with ARIMA (4,1,10)

Table 16. Forecasts with ARIMA (4,1,10)

Model	Forecast 2024	Forecast 2025	Forecast 2026
ARIMA (3,1,6)	4.730.395	5.205.785	5.737.159

Source: Made by authors with Eviews software

Interpreting the data in Table 16, it can be seen that the series has an increasing trend in the next 3 years.

4.5. Total import in Romania

The descriptive statistical analysis resulted in an average of $52,805 million in the period 1991-2023 with a standard deviation of $39,614 million. The minimum value of $5,793 million was recorded in 1991, and the maximum value of $132,678 million is obtained in 2022. The coefficient of variation has the value of 75.02%, which results in a non-representative average, the data series being inhomogeneous with values which is not around the average. Regarding the evolution over time, it can be seen that in the period 1991-2023, the import value has an increasing trend, with a jump in the period 2007-2008 due to the accession to the European Union. An absolute average change was calculated $\bar{\Delta}= 3.942$ million $ annually, with an average growth index $\bar{I}$ =1,1026. The average growth rate was $\bar{R} = 10.2613\%$ annually, while the absolute average value of a percentage of the growth rate is $\bar{A}$ =384 million $.

For ARIMA prediction, we initially check whether the series is stationary by applying the Dickey-Fuller test, with constant and trend. Since the probability attached to the test is 0.6576, which is greater than 0.05, it follows that the null hypothesis is accepted and the series is not stationary (Table 17).

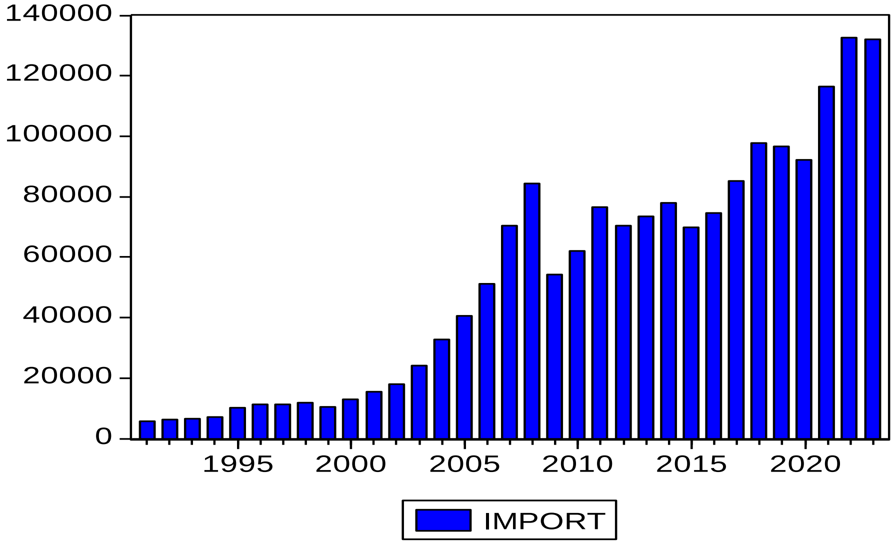

Figure 13. Total imports in Romania

Table 17. Dickey-Fuller test on IMPORT

Null Hypothesis: IMPORT has a unit root

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-2.517395	0.3182
Test critical values:	1% level	-4.273277	
	5% level	-3.557759	
	10% level	-3.212361	

Source: Made by authors with Eviews software

We apply the first difference to the series and check for stationarity. As the probability attached to the test is 0.0001, which is less than 0.05, it follows that the new series is stationary, that is, it does not have a unit root (Table 18).

Table 18. Dickey-Fuller test at D(IMPORT)

Null Hypothesis: D(IMPORT) has a unit root

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-6.072661	0.0001
Test critical values:	1% level	-4.296729	
	5% level	-3.568379	
	10% level	-3.218382	

Source: Made by authors with Eviews software

Table 19. Model ARIMA (2,1,9) la D(IMPORT)

Dependent variable: D(IMPORT)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5413.723	888.7940	6.091088	0.0000
AR(2)	-0.471360	0.182280	-2.585917	0.0154
MA(9)	-0.887398	0.045119	-19.66799	0.0000
R-squared	0.510180	Mean dependent var		4181.367
Adjusted R-squared	0.473897	S.D. dependent var		9881.465
S.E. of regression	7167.318	Akaike info criterion		20.68709
Sum squared resid	1.39E+09	Schwarz criterion		20.82721
Log likelihood	-307.3064	F-statistic		14.06115
Durbin-Watson stat	2.165690	Prob(F-statistic)		0.000065
Inverted AR Roots	.99	.76+.63i	.76 -.63i	.17+.97i
Inverted MA Roots	.17 -.97i	-.49 -.85i	-.49+.85i	-.93+.34i
	-.93 -.34i			
Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	0.979235	Probability		0.389547
Obs*R-squared	1.161189	Probability		0.559566
ARCH Test:				
F-statistic	0.815284	Probability		0.374548
Obs*R-squared	0.850009	Probability		0.356550

Source: Made by authors with Eviews software

From the differenced series correlogram analysis we can test several ARIMA models of the type (p,1,q), resulting in several valid models. The ARIMA (2,1,9) model was selected, which has the lowest values of the Akaide and Schwarz criteria. It can be noted that all the estimated coefficients are significant (Table 19), having the probabilities attached to the t-Statistic test lower than 0.05. Also, the overall validation of the model is ensured by the F-statistic test, whose attached probability is less than 0.05. The model residuals are not autocorrelated, this results from Durbin-Watson tests with value 2.16 and Breusch-Godfrey with attached probability 0.3895. The ARCH test confirms the lack of heteroscedasticity, the probability attached to the test being 0.3745, greater than 0.05. Also, the ARIMA (2,1,9) model is stationary and invertible.

The value of the adjusted R-square shows us that approximately 47.3% of the variation in total import is explained by the variation in AR (2) and MA(9), the rest up to 100% being attributed to other factors not included in the model.

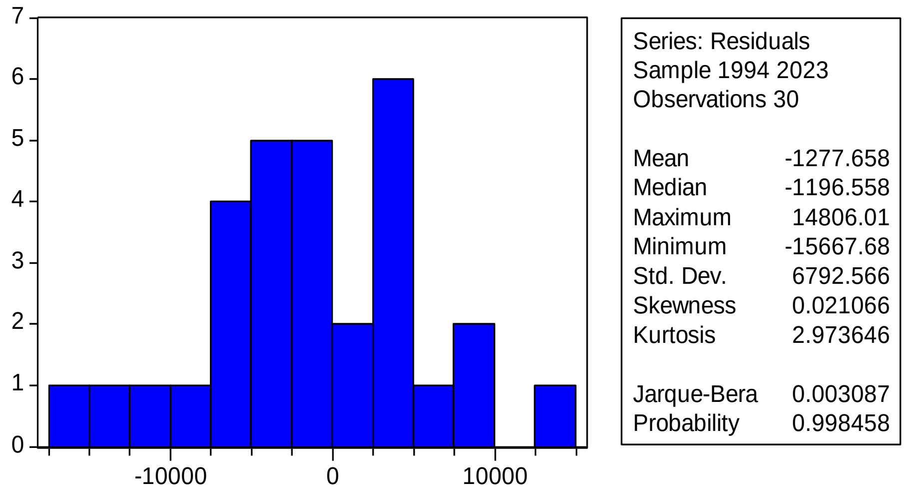

Figure 14. Histogram of the residuals of the model and the Jarque-Bera test at ARIMA (2,1,9)

Interpreting the data from Figure 14, we find that the associated probability value is 0.998458, the null hypothesis is rejected and the residuals are normally distributed.

Table 20. Forecasts with the ARIMA model (2,1,9)

Model	Forecast 2024	Forecast 2025	Forecast 2026
ARIMA (2,1,9)	137.784	143.127	146.946

Source: Made by authors with Eviews software

Interpreting the data in Table 20, it can be seen that the series has an increasing trend in the next 3 years.

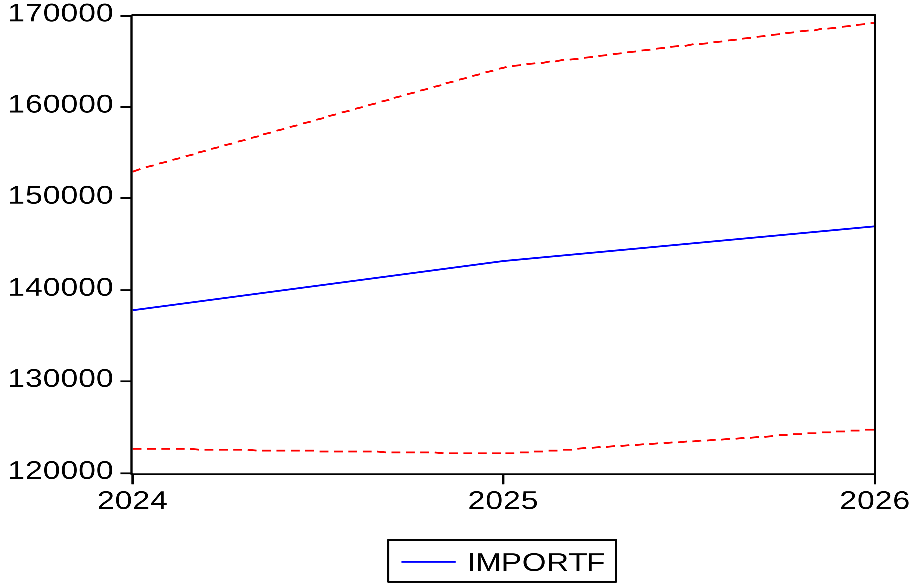

Figure 15. Forecasts of total imports with ARIMA (2,1,9)

4.6. Total export in Romania

An average of $40,719 million was found in the period 1991-2023 with a standard deviation of $31,145 million. The minimum value of $4,266 million was recorded in 1991, and the maximum value of $100,642 million is obtained in 2023. The coefficient of variation has the value of 76.49%, which leads to the conclusion of an non-representative average, the data series being inhomogeneous with values that are not around the average.

Regarding the evolution over time, it can be seen that during the period 1991-2023, the total export value has an increasing trend. An absolute average was calculated $\bar{\Delta}= 3.011$ million $ annually, and the average growth index is $\bar{I}$ =1,1038. The average growth rate was $\bar{R} = 10{,}3821\%$ annually, while the absolute average value of a percentage of the growth rate is $\bar{A}$ =290 million $. To apply the ARIMA model, we initially check whether the series is stationary by applying the Dickey-Fuller test, with constant and trend. Since the probability attached to the test is 0.2632, which is greater than 0.05, it follows that the null hypothesis is accepted and the series is not stationary (Table 21), at a significance level of 5%.

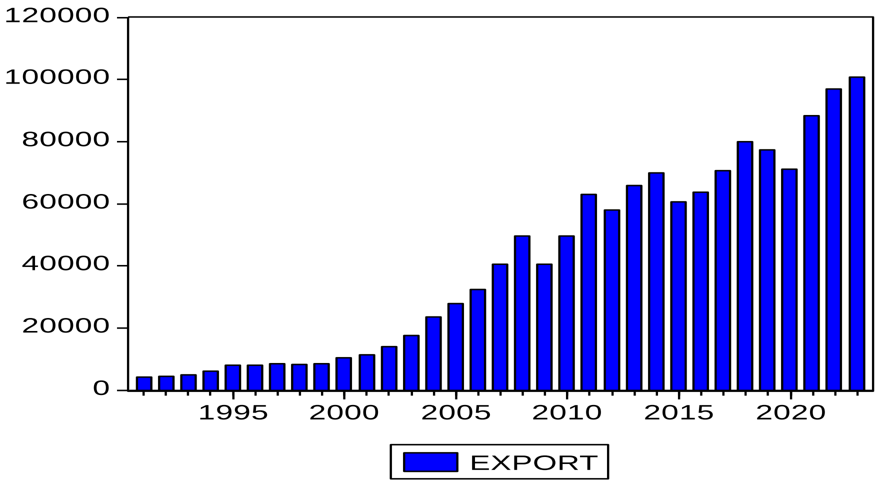

Figure 16. Total exports in Romania

Table 21. Dickey-Fuller test on EXPORT

Null Hypothesis: EXPORT has a unit root

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-2.648192	0.2632
Test critical values:	1% level	-4.273277	
	5% level	-3.557759	
	10% level	-3.212361	

Source: Made by authors with Eviews software

We apply the first difference to the series and check for stationarity. As the probability attached to the test is 0.0775 which is greater than 0.05 it follows that the new series is not stationary.

Table 22. Dickey-Fuller test at D(EXPORT)

Null Hypothesis: D(EXPORT) has a unit root

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.389318	0.0775
Test critical values:	1% level	-4.416345	
	5% level	-3.622033	
	10% level	-3.248592	

Source: Made by authors with Eviews software

We apply the second difference to the series and check the stationarity. As the probability attached to the test is 0.0008, which is less than 0.05, it follows that the new series is stationary, that is, it does not have a unit root (Table 23).

Table 23. Dickey-Fuller test on D(EXPORT,2)

Null Hypothesis: D(EXPORT,2) has a unit root

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-5.450264	0.0008
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

Source: Made by authors with Eviews software

From the analysis of the correlogram of the differenced series we can test several ARIMA models of the type (p,2,q). Several valid models resulted and we selected the ARIMA (9,2,15) model which has the lowest Akaide and Schwarz criteria values. It is found that all the estimated coefficients are significant (Table 24), having the probabilities attached to the t-Statistic test lower than 0.05.

Table 24. ARIMA (9,2,15) model at D(EXPORT,2)

Dependent variable: D(EXPORT,2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-224.2795	1025.677	-0.218665	0.8292
AR(9)	-0.671839	0.120251	-5.586990	0.0000
MA(15)	-0.933460	0.034529	-27.03377	0.0000
R-squared	0.899802	Mean dependent var		127.4091
Adjusted R-squared	0.889255	S.D. dependent var		10706.92
S.E. of regression	3563.094	Akaike info criterion		19.32077
Sum squared resid	2.41E+08	Schwarz criterion		19.46955
Log likelihood	-209.5285	F-statistic		85.31216
Durbin-Watson stat	2.381272	Prob(F-statistic)		0.000000
Inverted AR Roots	.90+.33i	.90 -.33i	.48+.83i	.48 -.83i
	-.17+.94i	-.17 -.94i	-.73 -.61i	-.73+.61i
	-.96			
Inverted MA Roots	1.00	.91 -.40i	.91+.40i	.67+.74i
	.67 -.74i	.31+.95i	.31 -.95i	-.10+.99i
	-.10 -.99i	-.50+.86i	-.50 -.86i	-.81+.59i
	-.81 -.59i	-.97+.21i	-.97 -.21i	
Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	1.776200	Probability		0.199289
Obs*R-squared	3.779877	Probability		0.151081
ARCH Test:				
F-statistic	0.328959	Probability		0.573000
Obs*R-squared	0.357398	Probability		0.549955

Source: Made by authors with Eviews software

Also, the F-statistic test with the null probability attached, provides overall validation of the model. The residuals of the model are not autocorrelated, as confirmed by the Durbin-Watson test with a value of 2.38 and the Breusch-Godfrey test with an attached probability of 0.1992. The ARCH test confirms the lack of heteroscedasticity, the probability attached to the test being 0.5730, greater than 0.05. The ARIMA (9,1,15) model is stationary and invertible. The value of the adjusted R-square shows us that approximately 88.9% of the variation in total export is explained by the variation in AR (9) and MA(15), the rest up to 100% being attributed to other factors not included in the model.

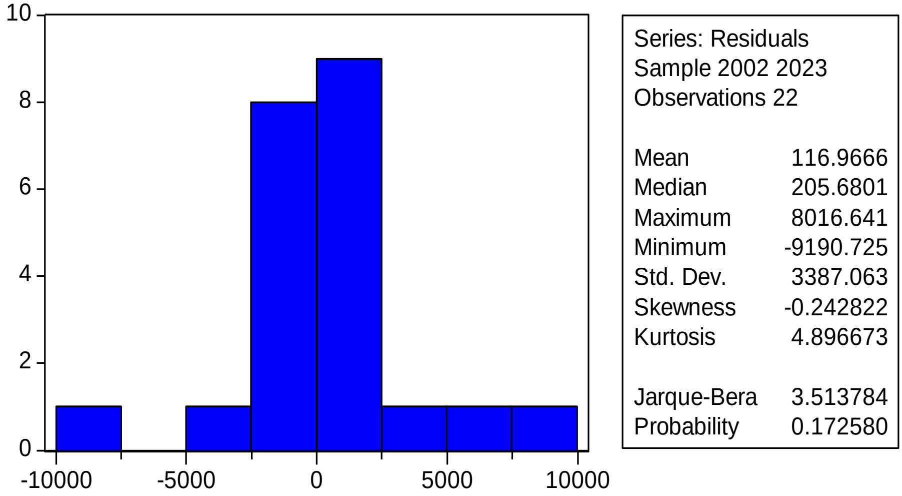

Figure 17. Histogram of the residuals of the model and the Jarque-Bera test at ARIMA (9,2,15)

Interpreting the data from Figure 17 we find that the value of the associated probability is 0.172580, the series is normally distributed, so the residuals are normally distributed.

Table 25. Forecasts of total exports with ARIMA (9,2,15) (million $)

Model	Forecast 2024	Forecast 2025	Forecast 2026
ARIMA (9,2,15)	115.022	118.666	118.482

Source: Made by authors with Eviews software

Interpreting the data from Table 25, it can be seen that the series has an increasing trend in the next 3 years.

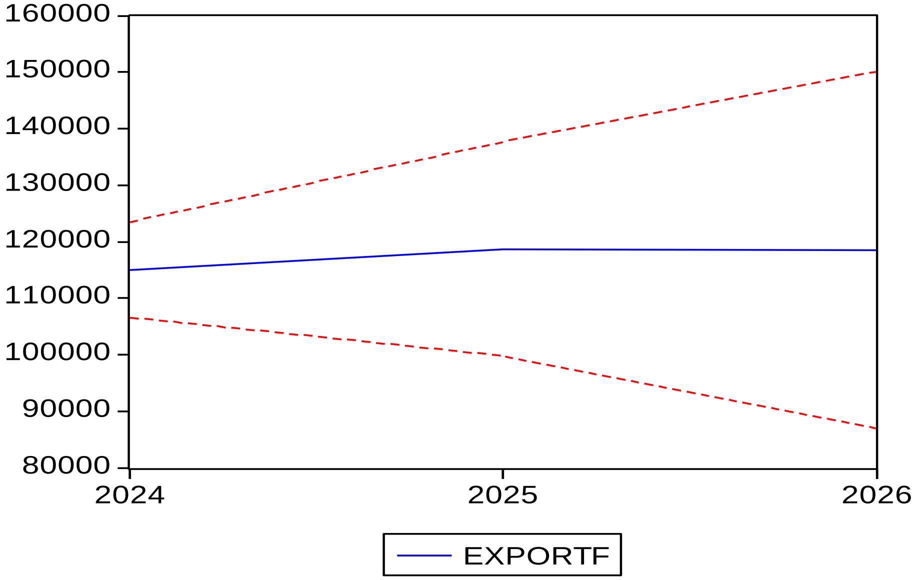

Figure 18. Forecasts of total exports with ARIMA (9,2,15)

5. Conclusions

Regarding the export of animals and animal products, a high volatility resulted with an inhomogeneity of the data, the average not being representative. Exports followed an increasing trend in general, with decreases in the years 2015-2016 and 2020 (the COVID pandemic). The average annual growth rate was 7.09%, reflecting a steady advance. The ARIMA (3,1,12) model, selected for predictions, demonstrated that approximately 44.5% of the variations in exports are explained by the variables included in the model. Statistical tests confirmed the validity and stationarity of the model, and the forecasts for 2024-2026 indicate a continuation of the upward trend.

Imports averaged significantly higher than exports in this area, but also with a high standard deviation, indicating even greater volatility. The coefficient of variation is high and suggests that the mean is not representative, the data being heterogeneous. Imports followed an increasing trend, with a jump in 2008, with Romania's accession to the EU. The average annual growth rate was 14.73%, reflecting a significant acceleration in imports. The ARIMA (1,1,2) model used for predictions suggests a stabilization of imports at very high levels: for the period 2024-2026.

During the period 1991-1997, the export of animals and animal products maintained a somewhat constant level of exports, and starting from 1999 an increasing trend is observed, with a greater decrease in 2020, caused by the restrictions from the pandemic. In the case of the import of animals and animal products, there is an increasing trend in general, but with a greater increase in 2008 during the financial crisis.

The trade balance in this sector was positive in the period 1991-1997, meaning that the value of exports was higher than of imports, then starting from 1998 it became negative, the value of imports exceeding that of exports. The trade deficit in this animal and animal products sector in 2023 was $2,104,603 thousand.

Thus, it turned out that both exports and imports of animals and animal products followed an increasing trend during the analyzed period, with significant volatility and inhomogeneity of the data. Forecasts point to continued growth in exports and stabilization of imports at high levels.

Regarding the export of vegetable products, the results show a wide variation in values. The coefficient of variation of 109.74% shows a high variability and an unrepresentative average. Although the general trend is one of growth, a significant decrease was observed in 2020, due to the COVID-19 pandemic. The Dickey-Fuller test indicates that the series is not initially stationary but becomes stationary after applying the first difference. The ARIMA (3,1,6) prediction model was selected as the best fit, explaining 37.7% of the variation in exports. Forecasts for the coming years show a continuous increase in exports in this area.

Also, the analysis for imports indicates a large variability here as well. The high coefficient of variation suggests a non-homogeneity of the series. Imports had a sharp increase after Romania's accession to the EU in 2008, due to the reduction of customs duties. The ARIMA (4,1,10) prediction model was chosen, explaining 37.6% of the variation in imports. Forecasts show a continued increase in imports in the coming years. In conclusion, both exports and imports of plant products from Romania had a significant increase during the analyzed period, although with high variability. The ARIMA model used for the forecast indicates a continuation of this growth trend for the next three years.

For the export of vegetable products, an increasing trend is observed, with a larger decrease in 2020, caused by the restrictions during the pandemic. In the case of the import of vegetable products, an increasing trend is observed in general, with a higher increase in the year 2008 during the financial crisis and in the year 2022 during the pandemic.

Analyzing the trade balance in the case of vegetable products, it is found that it was negative in the period 1991-1998 (except for the years 1995-1996), and after 1998 until 2023 the balance had positive values, Romania having an advantage in international trade in what concerns vegetable products. The trade surplus in 2023 was $2,948,322 thousand.

Romania's total export had a significant increase, from a minimum value in 1991 to a maximum value in 2023. The analysis indicates a high variability and a non-homogeneous data series. The Dickey-Fuller test shows that the initial series of exports is not stationary. Stationarity was achieved only after applying two successive differentiations to the initial series when the probability associated with the test fell below the significance threshold of 0.05 ($p = 0.0008$).

After analyzing several possible models, the ARIMA (9,2,15) model was selected based on the Akaike and Schwarz criteria, having significant coefficients and an adjusted R-squared value of 88.9%, indicating that this model explains most of the variation exports and predicts a continuation of the export growth trend in the coming years.

The study on total imports in Romania in the period 1991-2023 highlights an inhomogeneity of the data and an unrepresentative average, indicating great variations in imports. Imports have followed an increasing trend over the past three decades, with a significant jump in the 2007-2008 period due to Romania's accession to the European Union. The ARIMA (2,1,9) model was selected for predictions, having the lowest Akaike and Schwarz indices and all significant coefficients and explaining 47.3% of the variation in imports, Forecasts for 2024-2026 show an increasing trend in imports.

From the study carried out on total export and import, we conclude that in Romania the trade balance between export and import has negative values in the period 1991-2023, the total value of exports being lower than that of imports every year. In 2022, the trade balance for total exports and imports recorded a negative value of approximately -35,857 million dollars, and in 2023 this value reached -31,321 million dollars.

In 2023, total exports increased by 3.94% compared to 2022. An increasing trend is observed for the entire analyzed period 1991 - 2023, with greater decreases in 2009, due to the financial crisis and in 2020, due to the pandemic of covid and the imposed restrictions. Obviously, the upward trend is to some extent also due to inflation, but in general exports have grown steadily over time.

In the case of total imports, an increasing trend is observed, with decreases in 2009 and 2021, due to the financial crisis and the Covid pandemic. In 2023, total imports decreased by 0.54% compared to 2022.

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