Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 2, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

DETERMINANTS OF THE GROWTH OF EXPORT OF AGRICULTURAL PRODUCTS IN THE REPUBLIC OF MOLDOVA

Maria COJOCARU, Tatiana DIACONU

Moldova State University, 60 Alexe Mateevici, Chisinau, MD 2009, Republic of Moldova, Email: cojocaruusm@gmail.com

Corresponding author: cojocaruusm@gmail.com

Abstract

The aim of the research is to identify the determinants of the evolution of the export of agri-food products from the Republic of Moldova. The study has led to the development of a multifactorial econometric model, which can be a useful tool for managers and decision-makers in governmental structures. The various tests performed to assess the quality (validity) of the econometric model obtained lead to important conclusions. Firstly, exports are very vulnerable to exchange rate fluctuations and inflation, uncontrollable factors by business managers. It follows that the state must come with policies to support and protect agricultural producers and food industry.

Key words: *export, agri-food products, econometric model, determinative, ANOVA analysis*

INTRODUCTION

Export growth is one of the determinants of a country's economic growth. Export has become a key factor for generating growth and jobs in agriculture and the food industry [7].

Table 1. Evolution of exports of goods and services from the Republic of Moldova, 1997 – 2016

The year	Total		CIS countries		Russian Federation		European Union countries (EU-28)	
	Thousand USD	Annual % change	Thousand USD	Annual % change	Thousand USD	Annual % change	Thousand USD	Annual % change
1997	8,740,56.5	-	608,307	-	508,778.9	-	185,499.7	-
1998	631,817.3	72.78	428,904.3	70.50	336,827.2	66.20	163,272.8	88.02
1999	463,432.4	73.35	253,640.2	52.14	191,448.4	56.84	177,175.8	108.51
2000	471,465.6	101.73	276,088.2	108.85	209,950.3	109.66	165,280.2	93.28
2001	565,494.9	119.94	344,377.1	124.73	246,971.1	117.63	182,435.3	110.38
2002	643,791.6	113.84	350,421.7	101.75	238,862.8	96.72	231,348	126.81
2003	789,933.6	122.70	423,564.7	120.87	308,413.4	129.12	307,450.6	132.89
2004	985,173.6	124.72	502,422.3	118.62	353,344.2	114.56	400,687	130.32
2005	1,090,919	110.73	55,1227	109.71	347,361	98.31	443,184.4	110.61
2006	1,050,362	96.28	423,646.8	76.85	181,931.8	52.37	536,909.6	121.15
2007	1,340,050	127.58	548,888.6	129.56	232,706.7	127.91	678,929.7	126.45
2008	1,591,113	118.73	622,993.7	113.50	313,691.7	134.80	820,072.1	120.79
2009	1,282,981	80.63	490,415.2	78.72	286,491.6	91.33	667,338.5	81.37
2010	1,541,487	120.15	624,003.2	127.24	403,978.4	141.0	728,938.9	109.23
2011	2,216,815	143.81	919,265	147.32	625,509.4	154.84	1,083,006	148.57
2012	2,161,880	97.52	928,119.5	100.96	655,132	104.73	1,013,418	93.57
2013	2,428,303	112.32	923,219.8	99.47	631,931.5	96.46	1,137,286	112.22
2014	2,339,530	96.34	735,647.7	79.68	423,717.6	67.05	1,245,980	109.56
2015	1,966,837	84.07	492,294.6	66.92	240,648.6	56.79	1,217,587	97.72
2016	2,044,611	103.95	414,185.2	84.13	233,177.4	96.89	1,331,898.5	109.32
Annual Average Index,%		**104.61**		**97.35**		**95.97**		**110.93**

Source: Data bank of the National Bureau of Statistics of the Republic of Moldova.[2]

At microeconomic level, this indicator is a criterion for assessing the effectiveness of commercial management.

It is important for the decision-makers in the economic entities, but also for the representatives of the governmental institutions, to have an upward trend.

The implementation of a new model of qualitative economic development in the Republic of Moldova, based on export, investment and innovation is the strategic vision of the National Development Strategy: 8 solutions for economic growth and poverty reduction [5].

Annual reports of the National Bureau of Statistics of the Republic of Moldova on Foreign Trade for the period 1997 - 2016 mention that the exports of goods and services from the Republic have registered a steady annual growth (Table 1).

The average annual increase in exports of goods and services in the Republic of Moldova is 4.61%. An upward trend in exports of agri-food products is also recorded in the European Union. In 2016, exports of agri-food products were estimated at 130.7 billion euro, an increase of 1.7 billion euro (1.3%) compared to 2015 levels. The main agri-food products exported from EU countries, which saw significant increases in 2016, are pork and olive oil. The main markets for the sale of agri-food products produced in the EU are the USA, China, Switzerland, Japan and the Russian Federation. (European Commission, 2015) [3].

EU agricultural exports exhibited a compound annual growth rate of 3.6 %, compared to 2.7 % for the USA (Study, 2016) [6].

Over the analyzed period the geographical area of Moldovan exports underwent major changes (Fig.1). In 1997, most of the exports (about 70%) were directed to the CIS countries, mostly in the Russian Federation (58.21%), and in the EU countries - only 21.2%. By 2016, the situation has reversed: exports to EU countries exceed the share of exports to CIS countries more than 3 times (65.14%). The Russian Federation market is already the main market for export of goods and services. The share of exports to this country constituted only 11.4% in 2016, decreasing by 46.81 percentage points compared to 1997. Thus, exports to the Russian Federation have a downward trend of about 4% annually.

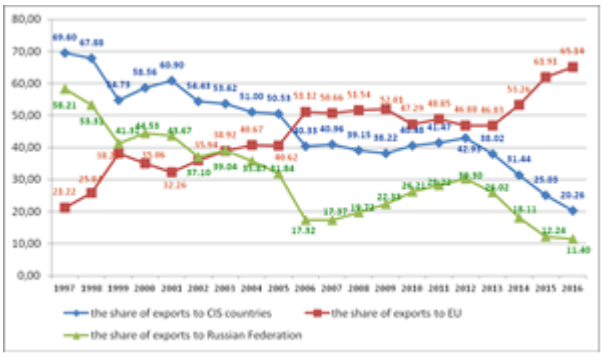

Fig. 1. Main foreign trade partners of Republic of Moldova, %

Source: authors' calculations

The trend of "Europeanization" of the Moldovan export is manifested by an average annual increase of 10.93 %. At the same time there is an average annual decrease of exports in the CIS countries by 2.65%.

Agri-food products have always been the main elements in the structure of exported goods.

In total EU goods exports in 2016, the agri-food sector accounted for 7.5%. (European Commission, 2016) [4].

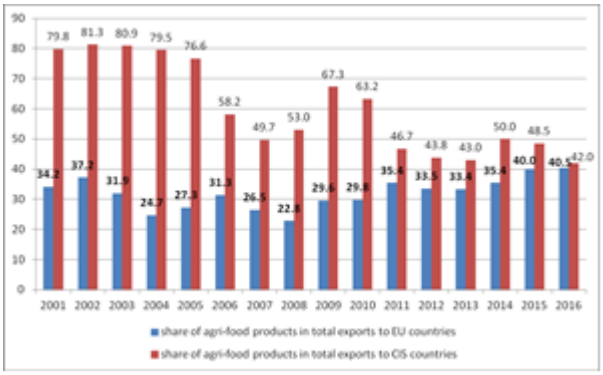

Fig. 2. The share of agri-food products in total exports to EU and CIS countries,%

Source: authors' calculations are in base of data from the National Bureau of Statistics

In the Republic of Moldova, the share of agri-food products in total exports directed to EU countries in the period 2001 - 2016 was between 22.8 - 40.5% (Fig.2).

The highest level was registered in 2016 .

MATERIALS AND METHODS

The evolution of the export of agri-food products is influenced by a series of internal and external factors, such as: economic, political, financial, climate, etc. In order to give an appreciation to the evolution trend of the export of agri-food products from the Republic of Moldova, data on exports of agri-food products for 2005 - 2016 were collected. The evolution of the export of agri-food products between 2005 and 2016 in the Republic of Moldova has a variable character with a specific tendency which can be expressed using the statistical models. The applied methodology was based on the multifactor linear regression model. By econometric estimations the correlations between the different factors and the dependent variable - the export of agri-food products – is considered to be the representative feature of Moldovan foreign trade. In the given context, we considered it necessary to identify the factors of influence on the evolution of the exports of agri-food products and to make the calculations necessary to justify their inclusion in a multifactorial econometric model for the prognosis of their evolution. Of the many factors considered relevant for the research of the evolution of the export of agri-food products, expressed in Moldovan lei, 9 economic and financial factors were selected at the initial stage. The scientific approach was directed to the following independent factors:

(a)The value of obtained agricultural production.

(b)The value of manufactured food production.

(c)The value of investments in fixed assets (long-term) in the agri-food sector.

(d)The staff employed in the agri-food sector.

(e)Price indices of goods and services purchased by agricultural enterprises.

(f)Consumer food price indices in the domestic market.

(g)Agricultural sales price indices.

(h)The exchange rate of the Moldovan leu against the US dollar.

(i)Annual inflation rate.

The parameters of the econometric model of the evolution of the export of agri-food products were estimated based on the least squares method, using the Regression application in Excel. After processing the 9 factors mentioned above with the corresponding statistical methods and testing them according to a series of criteria (error of approximation ($\bar{A}$), coefficient of elasticity (E) and coefficient of determination (R^2), autocorrelation, t-student, test F) only 4 factors have been selected, which determine the given model, which is confirmed by the model quality evaluation tests.

The values of the factors selected and those of the resultant factor (exports of agri-food products) are presented in Table 2.

Table 2. Initial data for the elaboration of the multifactorial econometric model, 2005 - 2016

The year	Export of agri-food products, thousand lei	Consumer food price indices,%	Agricultural sales price indices, in% as compared to the previous year	The exchange rate of the Moldovan leu against the US dollar	Annual inflation rate,%
n	*Y*	*X1*	*X2*	*X3*	*X4*
2005	6,506,682	113.7	106	12.6003	11.8
2006	7,652,157	109.1	103	13.1319	12.9
2007	5,622,614	111	139	12.1362	12.1
2008	5,259,276	115.6	86	10.3895	12.9
2009	6,612,428	94.4	82	11.1134	-0.1
2010	7,478,466	105.7	143	12.3663	7.4
2011	8,593,960	108.4	110	11.737	7.6
2012	11,108,136	103.8	118	12.1122	4.6
2013	11,065,728	106.6	78	12.5907	4.6
2014	14,257,047	106.5	107	14.0388	5.1
2015	20,045,882	109.8	123	18.8161	9.7
2016	18,220,321	107.4	97	19.9238	6.4

Source: elaborated by the authors: data from the National Bureau of Statistics (www.statistica.md) and the National Bank of Moldova (www.bnm.md) [2]

The assumptions underlying this model are as follows:

(i)The export of agri-food products is influenced and depends on the indices of selling prices of agricultural products.

(ii)The export of agri-food products is influenced and depends on the indices of consumer food prices in the domestic market.

(iii)The export of agri-food products is influenced and depends on the dollar / leu exchange rate.

(iv)The export of agri-food products is influenced and depends on the annual inflation rate.

To test the four hypotheses of the model, the authors used the statistical analysis tool and the application of the *Data Analysis module in Excel* allowed the elaboration of the multifactorial linear regression model, where the resultant factor is the value of the export of agri-food products (Y) and factors (x_i) are the four nominees below:

-food consumer price indices (x_1);
-agricultural sales price indices (x_2);
-exchange rate MDL / USD (x_3);
-annual inflation rate (x_4)

The general form of the multifactor linear regression model is the following:

$$Y = f(\beta, X) + \varepsilon \quad (1)$$

where: $X = X(X_1, X_2, ..., X_m)$ - vector of independent variables;

β – parameter vector of the regression equation;

ε – random error (deviation);

Y – dependent factor (variable).

The theoretical model of the multiple regression equation has the form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_m X_m + \varepsilon \quad (2)$$

β_0 – the free term, which determines the value of Y, when the values of all factors (independent variables) are equal to 0.

RESULTS AND DISCUSSIONS

The results of the statistical regression analysis led to the identification of the multifactorial econometric model expressed by the regression equation (3):

$$Y = -47.809 + 0.403X_1 + 0.01189 X_2 + 1.4526 X_3 - 0.7765 X_4 \quad (3)$$

This model will allow the estimation of the influence of some determinants of the foreign trade dynamics of the agri-food sector as well as the empirical verification framework of the four hypotheses mentioned above. Free model term β_0 = -47,809 has a negative value and demonstrates the existence of additional factors that influence the export of agri-food products and whose global impact is negative.

Analyzing the coefficients of the estimated regression model (3), we note that three of the four factorial variables exert a positive influence on the export of agri-food products. In the order of significance level of influence, the most important factor is the exchange rate of the Moldovan leu against the US dollar: an increase with its monetary unit generates an increase of over 1,452.48 million lei of the independent variable. The increase by one percent of the consumer food price index determines an increase in the export of agri-food products by over 403.12 million lei. The increase of the agricultural sales price index leads to a sub-unitary increase of the export, namely to a percentage point in addition to the sales price index we get an increase of 11.83 million lei in the value of the export of agri-food products. At the same time, inflation exerts a negative influence on the dependent variable: the increase in inflation by one percentage point, the value of the export of agri-food products decreases by 776.53 million lei.

Correlation matrix analysis of the export of agri-food products (dependent variable) by the factors included in the model (independent variables - x_i) shows that between the factor x_3 (the exchange rate of the Moldovan leu against the US dollar) and export is a direct and very close link (90.5%). A direct connection is also evidenced by the factor x_2 (indices of selling prices of agricultural production), but its intensity is very weak - only 1.8 percent. An indirect link is between the resultant factor and the factors x_1 and x_4.

The multiple correlation coefficient (*Multiple R*) of 0.9522 indicates that there is a strong link between the export of agri-food products and the analyzed factors of influence.

$$R = \sqrt{1 - \frac{s_\varepsilon^2}{\sum (y_i - \bar{y})^2}} = \sqrt{1 - \frac{24.95}{267.65}} = 0.9522 \quad (4)$$

$$R^2 = 0.95222 = 0.9068$$

The determinant coefficient (*R-Square*) has a value of 0.907 and expresses that 90.7% of the variation in the export of agri-food products from the Republic of Moldova can be explained by the variables included in the model.

A more objective appraisal provides the adjusted determinant coefficient (*Adjusted R-Square*), the value of which is closer to 1, the more the regression model explains the

behavior of the resultant variable (Y). Its calculation formula is as follows:

$$\overline{R}^2 = 1-(1-R^2)\frac{n-1}{n-m-1} \quad (5)$$

$$\overline{R}^2 = 1-(1-0.9068)\frac{12-1}{12-4-1} = 0.854$$

The adjusted value of the determination coefficient shows that 0.854 of the total variation is due to the influence of the independent variables. The value of the approximation error is 1.887993 estimated econometric models, which is an indication that it can be used to make predictions. A model is considered to adjust the time series analyzed if the approximate error of the model is between 5-7% [1]

Analysis of the values of the coefficients of elasticity expresses the percentage change of the value of the export of agri-food products to the 1% change of the independent variable.

$$E_i = b_i\frac{\overline{x}_i}{\overline{y}} \quad (6)$$

Table 3. Elasticity coefficients of the econometric model

Calculation		Description
$E_1 = 0.403\frac{107.667}{10.2} = 4.253$	$\|E_1\| > 1$	significant influence
$E_2 = 0.0119\frac{107.667}{10.2} = 0.125$	$\|E_2\| < 1$	insignificant influence
$E_3 = 1.453\frac{13.413}{10.2} = 1.91$	$\|E_3\| > 1$	significant influence
$E_4 = -0.776\frac{7.917}{10.2} = -0.603$	$\|E_4\| < 1$	insignificant influence

Source: Authors' calculations

The data presented in Table 3 shows that the import value is sensitive to the 1% variation in the consumer price index and the exchange rate of the domestic currency against the US dollar. A criterion for assessing the quality of an econometric model is the coefficient of autocorrelation. A model is considered relevant to the forecast in the absence of auto-correlation. Such a situation shows whether the value of the coefficient of autocorrelation (r_{ei}) is less than 0.5. The calculation of the autocorrelation coefficient demonstrated the lack of first-order autocorrelation. The value of the autocorrelation coefficient is -0.191, so autocorrelation is missing, which again demonstrates the validity of the econometric model.

Respectively, this value falls within the range:

$$-0.683 < r_1 = -0.191 < 0.683.$$

The validity of the model is also confirmed by the Fisher test, which shows the role of influence factors in explaining the evolution of the export of agri-food products. The value of the F test is 17.022 and the significance threshold is 0.001032. The inequality ratio (0.001032 <0.05) shows that the econometric model is valid.

The Durbin-Watson Criterion (DW) was calculated based on Formula 9 and has a value of 2.01. According to Durbin-Watson's statistical value table, we find that for n = 12 and k = 4 (significance level 5%) the values were determined: d_1 = 0.69; d_2 = 1.97, therefore, autocorrelation is missing.

The residue study shows that the value of the RS criterion is 3,134 and falls within the range (2.7-3.7), so the condition of the normal residue distribution of the model is respected. In this way, the model is appropriate according to the principle of the normal distribution of the residual component.

CONCLUSIONS

The presented results confirm that the assumptions underlying this model are valid and the tests performed confirm the quality of the model, so the export of agri-food products is determined by the variation of the four factors: the consumer food price index, agricultural sales price indices, the Moldovan leu exchange rate against the US dollar and the annual inflation rate.

The interpretation of multifactor regression model parameters has highlighted the extent to which each of the factorial variables included in the model can be considered determinants of the export of agri-food products, giving managers the opportunity to choose the optimal option they want to use in analyzing the evolution and evolving of exports of agri-food products.

The authorities of the Republic of Moldova, through its institutions, must create transparent mechanisms for the management of international markets and prices. As the value of exports of agri-food products greatly depends on international market prices and producers are informed post-factum, the

creation of such a mechanism would allow producers to predict and monetize their long-term income. However, the efficiency of commercial management in the agri-food sector can not be enough to lead to the development of foreign trade without implementing other mechanisms and strategies to increase the competitiveness of products and promote exports of agri-food products.

REFERENCES

[1]Cohen. J., Cohen, P., West, S.G., Aiken, L.S., , 2003, Applied multiple regression/ correlation analysis for the behaviour sciences. – 3rd ed., New Jersey.
[2]Data bank of the National Bureau of Statistics of the Republic of Moldova, 2017. http://statbank.statistica.md/pxweb/pxweb/ro/40%20Statistica%20economica/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774, Accessed January 20, 2018.
[3]European Commission, 2015. Agricultural and food trade. https://ec.europa.eu/agriculture/sites/agriculture/files/statistics/facts-figures/agricultural-food-trade.pdf, 6, Accessed January 10, 2018.
[4]European Commission, 2016. Impacts of EU trade agreements on the agricultural sector. Luxembourg: Publications Office of the European Union, 10.
[5]Law No. 166 of 11.07.2012. http://lex.justice.md/index.php?action=view&view=doc&id=345635, Accessed January 15, 2018.
[6]Study on the impact of EU agriculture and agricultural trade of EU concluded bilateral trade agreements, Copenhagen Economics, 2016. https://ec.europa.eu/agriculture/external-studies/ 2016-bilateral-trade-agreements_en, Accessed January 10, 2018.
[7]Xinshen, D., 2010, Economic Importance of Agriculture for Sustainable Development and Poverty Reduction: Findings from a Case Study of Ghana.OECD. http://www.oecd.org/agriculture/agricultural-policies/46341169.pdf, Accessed January 12, 2018.