AGRISCIENCE AND TECHNOLOGY
Armenian National Agrarian University
ԱԳՐՈԳԻՏՈՒԹՅՈՒՆ ԵՎ ՏԵԽՆՈԼՈԳԻԱ АГРОНАУКА И ТЕХНОЛОГИЯ
International Scientific Journal
ISSN 2579-2822
Journal homepage: anau.am/scientific-journal
doi: 10.52276/25792822-2022.4-361

UDC 631.16:338.5:633.11(479.25)

The Analysis of Seasonal Fluctuations and Correlation Between Monthly Average Exchange Rate of Main Currency and Monthly Average Import Prices of the Main Grain in Armenia

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ARTICLE INFO

Keywords:
seasonal indexes,
regression analysis,
monthly average import prices,
non-linear correlation,
positive and negative correlations

ABSTRACT

Since 2020 the global economy has faced serious economic and financial challenges due to COVID-19 pandemic. The main purpose of this research is to study the dynamics of the monthly average import prices for the main types of imported grains and monthly average exchange rates for 1 US dollar in 2020-2022 in RA, disclosing the correlation between them. In the studied period the monthly average import price of wheat increased in autumn and in winter months. The results of analysis have shown that in the mentioned period there was a strong non-linear correlation between monthly average exchange rate of 1 US dollar and the average import prices of the main cereals.

Introduction

Since 2020 due to COVID-19 pandemic the global economy has faced serious economic and financial challenges. The second Artsakh war has negatively affected the overall economy of the Republic of Armenia. Throughout the investigation period changes were obvious in the trades between countries, the prices of international trade and in the financial markets as well.

The problem of food safety is the most important issue in food security system of RA. In RA bread consumption per capita exceeds US, Japan and European countries in 2-3 times and it exceeds the global average level by 25 (Bayadyan, 2013). Considering that the increase of self-sufficiency ratio of wheat in RA is of strategic importance, the state support towards the intensification of this sphere is mandatory (Avetisyan, 2010). Since the beginning of the spread of the pandemic in the European continent, many countries have secured their domestic supply and strengthened their stockpiles by increasing the import volumes. This concerns mainly the basic products like flour, soft wheat (in grain), and semolina. The increase was particularly significant in March and April due to high uncertainty in markets and the decision to maintain

a certain stock capacity for several months' consumption. The increase in the consumption of some products put pressure on processors in prices (Impact of the COVID-19 pandemic on agricultural markets and grain sector on the Mediterranean, 2020). The stability of grain prices is considered a key issue for grain security and social stability in many countries. In 2020, the sudden global pandemic of novel coronavirus pneumonia (COVID-19) posed severe challenges to world grain security in many ways. In order to control the spread of COVID-19, all countries around the world took strict isolation measures, which affected the global grain supply system (Shudong Wang, et al., 2022).

The main purpose of this research is to study the dynamics of monthly average import prices for the main types of imported grains and monthly average exchange rates for 1 US dollar in 2020-2022 in RA, upon the disclosure of the correlation between these two phenomena. To achieve this purpose the following problems have been set and solved: studying the seasonal fluctuations of the monthly average import prices for the main cereals and monthly average exchange rate for 1 US dollar in 2020-2022 in RA disclosing the interdependence between the above stated factors with the help of regression analysis.

Materials and methods

The object of this research is the time series of the monthly average import prices for the main grains and monthly average exchange rate of 1 US dollar in 2020-2022 in RA. In the period of 2020-2022 the wheat, barley and maize were the main grains, which were monthly imported into Armenia. During the mentioned period, the other types of grains were imported only several months. The seasonal indexes are used for studying the intra-yearly monthly fluctuation for the sequential year. The seasonal index for each month is calculated as follows:

$$I_{Si} = \frac{y_i}{\overline{y}} \cdot 100\ \%, \qquad (1)$$

where I_{S_i} is the seasonal index for i-th month, $\overline{y_i}$ is the average of *i*-th month for studied years, $\overline{y}$ is the average of all studied months (Gusarov, 2003).

The analysis has shown that the correlation between the monthly average exchange rate of 1 US dollar and monthly average import prices of the main grains is best fitted through the polynomial regression model:

$$y_t = a_0 + a_1 x_t + a_2 x_t^2 + e_t, \qquad (2)$$

where y_t is the dependent variable, x_t is the explanatory variable, a_0, a_1, a_2 are the parameters, e_t is the residual.

Table 1. The monthly average exchange rate for 1 US dollar and monthly average import prices of wheat, barley and maize within 2020-2022, RA*

Months	Monthly average exchange rate of 1 US dollar, AMD			Monthly average import price of wheat, US dollars			Monthly average import price of barley, US dollars			Monthly average Import price of maize, US dollars		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
January	479.21	521.2	481.78	211.5	232.6	241.3	186.8	132.1	175.4	171.6	187.5	190.2
February	478.74	523.54	480.24	204.3	242.5	232.4	171.0	136.2	198.3	164.7	200.7	196.2
March	489.01	527.67	496.96	177.9	236.6	143.4	122.8	194.4	152.0	154.3	214.2	225.1
April	488.66	525.62	470.99	198.4	211.7	225.5	117.0	275.6	188.9	211.1	204.5	231.9
May	484.12	521.35	456.54	214.9	212.9	294.7	139.0	204.0	212.3	179.7	223.0	274.5
June	481.27	513.09	-	165.1	216.0	-	136.4	142.5	-	176.1	204.8	-
July	484.65	490.87	-	181.3	184.9	-	157.8	141.4	-	176.6	203.2	-
August	485.49	491.73	-	208.4	199.2	-	130.0	155.8	-	202.3	193.8	-
September	486.69	488.12	-	206.4	222.6	-	117.3	159.1	-	176.5	187.4	-
October	491.74	479.25	-	213.9	243.6	-	111.5	151.2	-	170.1	215.1	-
November	499.62	477.66	-	207.2	256.3	-	131.2	160.5	-	187.2	223.4	-
December	518.91	485.14	-	230.8	250.3	-	147.5	170.8	-	190.3	218.7	-

*In 2020-2022 the monthly average import prices for main grains has been calculated by the authors based on their import values and import volumes (Financal statistics of Armenia 2015-2020, social-economic situation of the Republic of Armenia in January-December 2020, social-economic situation of the Republic of Armenia in January-May 2022) (www.armstat.am).

The parameters of regression model are defined by the least square method. The polynomial regression model of 2nd order is mainly applied when the correlation between the dependent and explanatory variables changes within direction of the definite interval. Through this model it's possible to calculate the turning point of independent variable from which the dependent variable changes its direction of development (Yeliseeva, 2014):

$$x_{op} = -\frac{a_1}{2 \cdot a_2} \cdot \quad (3)$$

Results and discussions

Shunpeng Wu and Michael A. analyzed the influence of import and export prices on grain market during bubble and non-bubble periods. The annual data of studied indicators had been analyzed from 1960 to 2017 per US data. In the research the monthly export and import price indices, the prices of main grains and monthly Exchange rate of US dollar to CNA has been analyzed. The authors used regression analysis to explore the correlation between these indicators for different periods (Shunpeng Wu Professor Gunderson and Michael, 2020). In most cases the tendency of maize price and maize production volumes have been analyzed using statistical methods and Machine Learning methods. The linear regression methods have been used also to explore the relationship between the maize price and production volumes (Roterm Zelingher, et al., 2021).

In this research the monthly average exchange rate for 1 US dollar has been considered as an independent variable, and the monthly average import prices of wheat, barley and maize have been considered as explanatory variables.

In 2020-2022 the monthly average import price of wheat mainly declined in March-April and in June-September months. The maximum inflation was in December (Figure 1).

In 2020-2022 the monthly average import price of barley mainly declined in June-November. The growth of average price was in December-May. The maximum inflation was in April (Figure 2).

In 2020-2022 the monthly average import price of maize declined in January-February, in June-July, in September-October. The growth of average price was in spring months and the maximum inflation was in May (Figure 3).

In 2020-2022 the monthly average exchange rate for 1 US dollar increased in January-April, June and December. The maximum monthly average exchange rate for 1 US dollar was in March and the minimum rate in October (Figure 4).

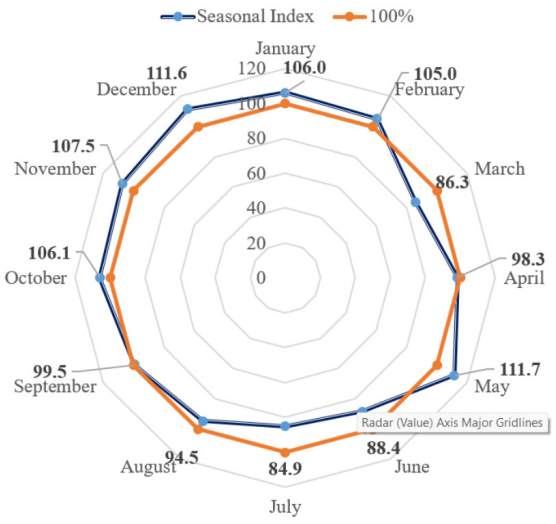

Figure 1. The seasonal indexes of the monthly average import price of wheat in 2020-2022, % (*composed by the authors*).

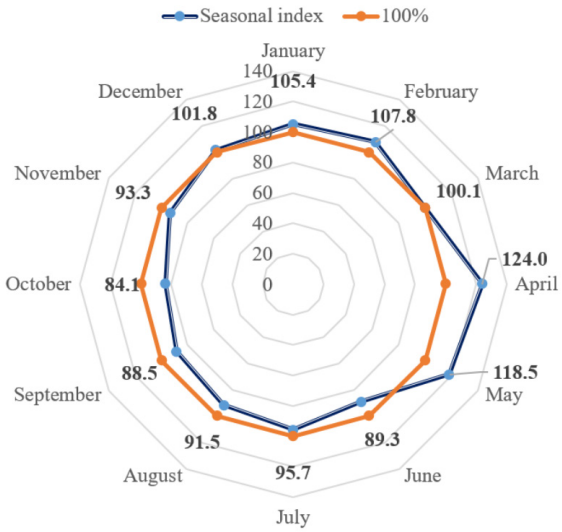

Figure 2. The seasonal indexes of monthly average import price of barley in 2020-2022, % (*composed by the authors*).

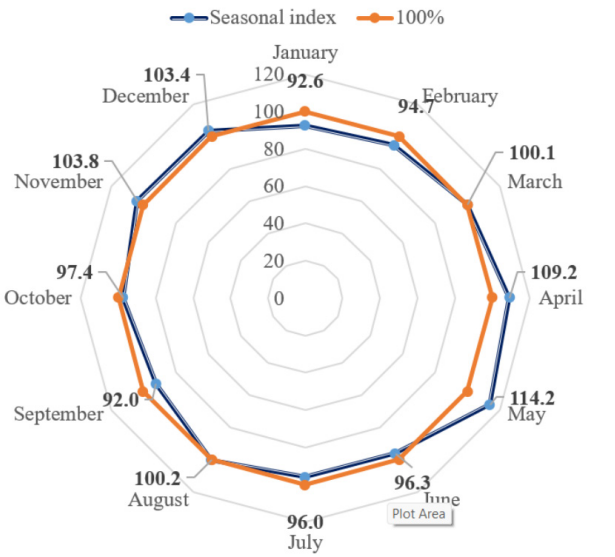

Figure 3. The seasonal indexes of the monthly average import price of maize in 2020-2022, % (*composed by the authors*).

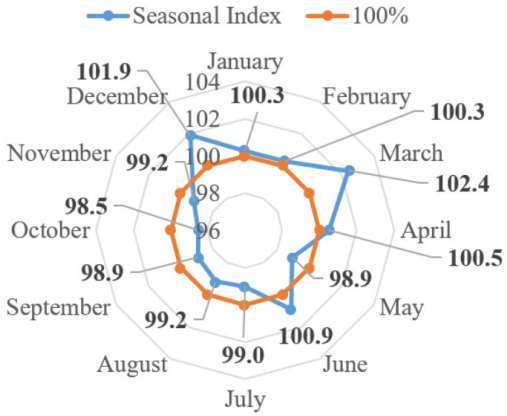

Figure 4. The seasonal indexes of monthly average exchange rate for 1US dollar in 2020-2022, % (*composed by the authors*).

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.66423647					
R Square	0.44121009					
Adjusted R Square	0.39822625					
Standard Error	23.1437133					
Observations	29					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	2	10996.03997	5498.02	10.26456	0.000517882	
Residual	26	13926.41809	535.6315			
Total	28	24922.45806				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	13877.2266	3033.475855	4.574695	0.000103	7641.827658	20112.63
US dollar (x)	-54.7671239	12.18933993	-4.49303	0.000128	-79.82267091	-29.7116
x^2	0.05480967	0.012232395	4.480698	0.000132	0.029665622	0.079954

Figure 5. Results of regression analysis between the monthly average exchange rate of 1US dollar and the monthly average import price of wheat in 2020-2022 (*composed by the authors*).

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.6196014					
R Square	0.38390589					
Adjusted R Square	0.33651403					
Standard Error	28.856882					
Observations	29					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	2	13491.17799	6745.589	8.100672	0.001842518	
Residual	26	21650.71061	832.7196			
Total	28	35141.8886				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	15151.3326	3782.308124	4.005843	0.00046	7376.686949	22925.978
US dollar	-60.4361177	15.19835385	-3.97649	0.000497	-91.67678142	-29.19545
x^2	0.06082454	0.015252038	3.987962	0.000482	0.02947353	0.0921756

Figure 6. Results of regression analysis between the monthly average exchange rate for 1US dollar and the monthly average import price of barley in 2020-2022 (*composed by the authors*).

According to the results of regression analysis, in 2020-2022 there was a strong non-linear correlation between the monthly average exchange rate of 1 US dollar and the monthly average import price of wheat. The results of regression analysis can be considered as significant. According to the results of calculation when the 1 US dollar monthly average exchange rate surpassed 499.6 AMD, the monthly average import price of wheat increased within the period of November 2020 to July 2021 (Figure 5).

According to the results of regression analysis in 2020-2022 there was a strong non-linear correlation between the monthly average exchange rate of 1 US dollar and the monthly average import price of barley. The results of regression analysis can be considered as significant. According to the results of calculation when the monthly average exchange rate of 1 US dollar surpassed 496.8 AMD, the monthly average import price of barley increased from November 2020 to July 2021. (Figure 6).

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.6359079					
R Square	0.40437886					
Adjusted R Square	0.35856185					
Standard Error	19.7375191					
Observations	29					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	2	6876.648391	3438.324	8.825955	0.001187439	
Residual	26	10128.81117	389.5697			
Total	28	17005.45956				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	10994.7959	2587.021663	4.249982	0.000243	5677.096682	16312.495
US dollar	-43.2775361	10.39536425	-4.16316	0.000305	-64.64551336	-21.90956
x^2	0.04330624	0.010432083	4.151255	0.000315	0.021862783	0.0647497

Figure 7. Results of regression analysis between the monthly average exchange rate for 1US dollar and monthly average import price of maize in 2020-2022 (*composed by the authors*).

According to the results of regression analysis there was a strong non-linear correlation between the monthly average exchange rate of 1 US dollar and the monthly average import price of maize in 2020-2022. The results of regression analysis are significant. According to the results of calculation when the 1 US dollar monthly average exchange rate surpassed 499.6 AMD, the monthly average import price of maize increased from November 2020 to July 2021 (Figure 7).

Conclusion

Throughout the period of 2020-2022 the characteristics of monthly fluctuations for the average import prices of main grains and the average exchange rate for 1 US dollar have been studied through seasonal indices. In 2020-2022 the monthly average import price of wheat increased in January-February and in October to December, the monthly average import price of barley increased from December to May, the monthly average import price of maize increased from March to May, in August, November and in December. Conditioned by the seasonal component in 2020-2022 the monthly average exchange rate of 1 US dollar increased from November to April, as well as in June and December.

The results of analysis have shown that in studied period there was a strong non-linear correlation between monthly average exchange rate of 1 US dollar and the average import prices of main grains. The regression analysis has shown that in 2020-2022, along with the increase of monthly average exchange rate for 1 US dollar the monthly average import prices of wheat, barley and maize decreased, however, after the definite level of monthly average exchange rate of 1 US dollar within the period of November 2020 to July 2021 their import prices began to gradually increase.

Thus, under the current political and economic situation the non-stable fluctuations of the monthly exchange rate of 1 US dollar make the dynamics of those economic indicators actually unpredictable, but analysis hereby enabled to disclose the regularities of the correlation of studied indicators for short-term period. In this regard, the significant decrease or increase of the monthly exchange rate of 1 US dollar will lead to the increase of the monthly import price of main cereals. This relationship can be a signal for the government to plan relevant activities for the regulation of main cereals import prices. In case when the monthly import prices exceed the yearly average level, the government can apply partial subsidies to control the inflation process.

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The research was carried out with the financial support of the Russian Foundation for Basic Research and the Science Committee of the RA within the framework of the scientific project No. 20-510-05020 \ 20 (No. 20RF-054).

Accepted on 05.06.2022
Reviewed on 30.11.2022