Journal of Agricultural, Food and Environmental Sciences Vol 76 No 2 (2022) 20-27
DOI: https://doi.org/10.55302/JAFES22762020d

Original scientific paper

INTERNATIONAL MARKETS EFFECT ON RICE PRICES IN THE REPUBLIC OF NORTH MACEDONIA

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ABSTRACT

Agribusiness is one of North Macedonia's most promising sectors. The aim of this work is to analyse the influence of international markets on rice prices in the Republic of North Macedonia. Data on the purchase price of rice have been analysed using statistical methods and models for the period from January 2005 to December 2021. A total of 204 months times series with data on the purchase price of rice for Macedonia, the EU, Greece, Italy and Spain have been analysed and compared. The Pearson correlation coefficient shows a relatively low relationship and mutual dependence of purchase prices in Macedonia, compared to prices in the EU, Greece, Italy and Spain. The purchase prices of rice in Macedonia in terms of the compared countries have the highest relationship and mutual dependence with the price movement in Italy (0.33), and the lowest with the price movement in the EU (0.08). The estimated lag length of the autoregressive process (AIC, BIC, FPE and HQIC tests), on average shows 2 lags (months) later time reaction of the rice prices in Macedonia with the comparison countries countries. The forecasting model (Granger causality test) shows that time series of prices can be convenient for forecasting rice prices in Macedonia.

Key words: rice prices, international markets, agri-food prices, forecasting.

INTRODUCTION

Agribusiness is one of North Macedonia's most promising sectors. Agribusiness (including agriculture, forestry, and fisheries) accounted for 8.6 percent of GDP (2020 data), 11.6 percent of total trade, and 14 percent of the total number of persons employed in the country (2019 data). Exports of agricultural and food products in 2021 constituted 9.6 percent of North Macedonia's total exports. The top markets for agriculture and food products are the EU (50.6 percent of total exports) and CEFTA countries (32 percent).

North Macedonia-U.S. trade in agricultural products decreased from $44 million in 2020 to $36 million in 2021. Compared to 2020, the U.S. share of North Macedonia's agricultural imports decreased by 0.49 percent to 1.03 percent of total imports, while the share of North Macedonia's agricultural exports to the United States decreased by 0.97 percent to 3.9 percent.

The analysis of the integration of the markets, as well as the impact of this connection on the prices of the products, are of special interest for understanding how certain changes or shocks in a certain market affect and are reflected on other markets. One of the key principles of economics is that markets allow prices to be transmitted horizontally (spatially) and vertically (Conforti, 2004). Towards the end of the twentieth century, most scientific research

focused on the vertical integration of markets (Goodwin & Holt, 1999), (Balcombe & Morrison, 2002) , with a primary focus on price and its movement in the food supply chain.

The interest in horizontal integration and the influence that exists between spatially (regionally) separate markets, is especially increasing, as result of increasing globalization and liberalization of markets and trade. The interest of scientific society in the movement of prices of agri-food products and the level of horizontal integration and mutual influence of markets has increased as a result of the emergence of the so-called food crisis in the period 2007-2008, when the prices of agri-food products on international markets begin to vary significantly with the occurrence of large falls and increases in sales prices (European Commission, 2008), (Irwin et al., 2009).

The importance of the horizontal integration of the markets is further increased as a result of the application of an increasingly restrictive policy of intervention by the states in the direction of protecting their own production and markets. Through research on horizontal integration, information can also be obtained about the level of freedom or protectionism in a certain market.

The basic theory of market integration and price formation is based on the spatial arbitrage rule. This theory is based on the assumption that the difference in the price of the product between related markets that trade and mediate among themselves will not exceed the costs of transferring it. The result of this theory is the law of one price (Marshall, 1920); (Fackler & Goodwin, 2001), according to which the product will have the same price expressed in the same currency in different markets, when the costs incurred for the transfer of that product from one market to another are included. According to (Tomek & Robinson, 2003), in perfectly integrated markets that trade with each other, the price difference is equal to the transfer costs, and in markets that they do not trade with each other, the price difference is less than the transfer costs.

The market positioning, competitiveness and market power influence price formation. In addition, he role of intermediaries and their position and market power can increase the final price for consumers (Dhar & Cotterill, 1998; Wohlgenant, 1999; Azzam, 1999; Goodwin & Holt, 1999; McCorriston et al., 2001).

Productivity and profitability of production contribute to increasing market competitiveness and strength and as such have an impact on horizontal integration and formation on prices. However, when it comes to vertical integration and its impact on price formation in the food supply chain, they have a different effect compared to horizontal integration (McCorriston et al., 2001).

The problem of price dependence in scientific research is also addressed from the perspective of the impact that occurs as a result of the relationships and interaction that exists between different agricultural products (Esposti & Listorti, 2013), complementarity or complementarity of a certain agricultural-food product (Saadi, 2011), the level of trade and product heterogeneity and homogeneity (Armington, 1969), different currencies and exchange rates (Dornbusch, 1987; Froot & Klemperer, 1989; Knetter, 1993), but also import and export policy and additional costs for exporters (OECD, 2017).

The agricultural and food sector in the Republic of North Macedonia has a modest competitive power and is significantly influenced by regional and world trends, while international market movements have a strong impact on domestic production and prices of agricultural and food products. Considering that most of the market information systems and generally provide information only on agri-food prices, this paper is focused only on the analysis of the impact of international markets in terms of prices and price movements, not taking into consideration other factors that influence the formation of prices of rice. Rice is a strategic commodity within Macedonian agriculture production that has the potential for export and additional income for farmers involved in rice production in the country (FAO).

MATERIAL AND METHODS

Data collection

Data on the purchase price of rice have been analysed using statistical methods and models for the period from January 2005 to December 2021. A total of 204 months' times series with data on the purchase price of rice for Macedonia, the EU, Greece, Italy and Spain have been analysed and compared.

For the domestic markets, the data for the monthly rice price indices of agricultural and food products from the State Statistical Office were used. The price indexes are translated into prices by using the index and the price of purchased products in the baseline year 2015, calculated based on value and quantity of purchase rice (SSO, 2015). Data for the EU countries are taken from the official agricultural data site of the European Commission (EC, Agridata, 2022).

Statistical methods

Exponential smoothing

Exponential smoothing as a method is especially effective and needed when the time series has its own trend, but also a seasonal component that changes over time. The method was used for the alignment (weighting) of the series and purification of the series from certain seasonal atypical variations.

Since in our case the data time series have a pronounced trend with multiplicative seasonal variation, we used triple exponential smoothing and the multiplicative Holt-Winters model with multiple degrees of seasonal smoothing character.

Correlation and correlation coefficient

Correlation and correlation coefficient in statistics is an indicator that should show the relationship (linear or proportional) between two quantitative variables and the mutual dependence of one variable on the other.

In this paper, we used the Pearson correlation coefficient to compare and determine the correlation and dependence of the purchase prices of rice in the Republic of North Macedonia compared to other countries.

Augmented Dickey Fuller test (ADF test)

ADF test for short, was used to analysed the character of the time series, which is one of the most common statistical tests used to determine whether a certain time series is stationary or non-stationary.

Estimating the number of lags

Estimating the number of lags of a regression is one of the key tasks in econometrics and model analysis. Determining the number of lags is essentially determining the number of time lags that will be included in the model. Determining the optimal number of lags is done using: Akaike's information criterion (AIC), Bayesian information criterion (BIC), Final prediction error (FPE) and Hannan–Quinn information criterion (HQIC).

Granger causality test

The test was first proposed in 1969 as a simple regression, but was improved by Clive Granger who argued that dependence in the economy can be tested by measuring the future predicted value of the time series using previous data from another time series. Granger's test essentially finds predicted causality. Essentially the model instead of testing whether a variable value causes certain changes in other parameters, essentially analyses the dependency and tests whether the variable predicts the other parameters.

RESULTS AND DISCUSSION

Researchers and economists in general have always shown great interest in researching the connection and influence between prices, although it is generally known in theory that other factors, especially the product and its characteristics, are also of great importance (Asche et al., 2007). Since rice is a strategic product for Macedonia agriculture production, the main goal of this paper is to analyse the influence of international markets on rice prices in the Republic of North Macedonia. The graphic analysis of the data for the purchase prices of rice in Macedonia and the EU shows that the prices in Macedonia are higher than the prices in the EU, without a constant trend, that is, there are large variations in them (Figure 1).

From all the analysed data, in the process of the exponential smoothing for 3 monthly data for which there was no information on the purchase prices of rice, the values were calculated and replaced with the mean value of the previous months. The Goodness of fit statistics and degree of suitability and deviation of the model from the real data shows a high level of fitness of the model for Macedonia ($R^2 = 0.86$), for EU and other countries ($R^2 = 0.86$), but relatively low for Italy ($R^2 = 0.48$).

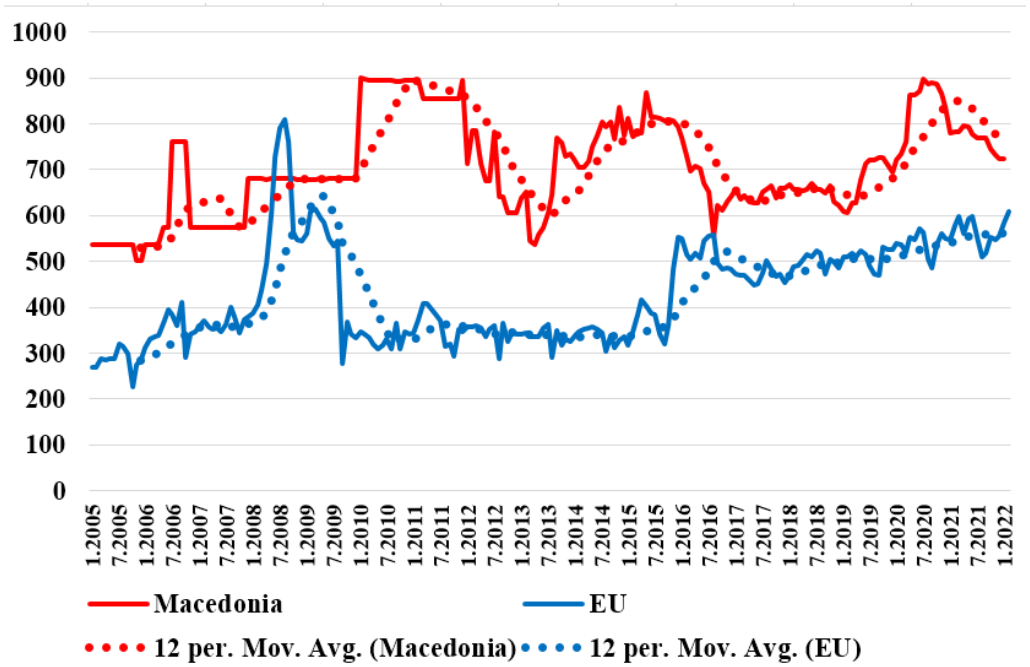

Figure 1. Purchase and price trends (12-month moving average) of rice in Macedonia and the EU, in EUR per 1,000 tons, January 2005 - December 2021

Table 1 present the minimum, maximum and average purchase prices of rice, as well as the standard deviation for Macedonia, EU, Greece, Italy and Spain, for the period from January 2005 to December 2021. The table shows that in the period from January 2005 to December 2021, Macedonia has the highest average monthly purchase price of rice of 706.66 EUR/t or 0.7 EUR/kg of purchased rice. Greece has the lowest average monthly price of 341.31 EUR/t. The lowest monthly purchase price was recorded in the Greece at 169.75 EUR/t, while Italy at the same time has data for a month with the highest purchase price of 1,015.00EUR/t.

The highest monthly standard deviation of prices is in Italy (128/14) and the lowest in Spain (88.60).

Table 1. Purchase prices of rice in EUR per 1,000 tons, January 2005 – December 2021

Country	Minimum	Maximum	Average	Standard deviation
Macedonia	502.14	900.00	706.66	107.85
EU	226.07	810.60	427.85	107.90
Greece	169.75	559.76	341.31	96.13
Italy	231.50	1,015.00	529.99	128.14
Spain	260.32	770.00	419.11	88.60

The correlation coefficient shows a relatively high relationship and mutual dependence of purchase rice prices in Macedonia, compared to prices in the EU, Greece, Italy and Spain (over 65%). The purchase prices of rice in Macedonia in terms of the compared countries have the highest relationship and mutual dependence with the price movement in Italy (0.33), and the lowest with the price movement in the EU (0.08).

Table 2. Correlation coefficient of rice purchase prices

Countries	Macedonia	EU	Greece	Italy	Spain
Macedonia	1.00	0.08	0.23	0.33	0.22
EU	0.08	1.00	0.65	0.83	0.67
Greece	0.23	0.65	1.00	0.59	0.49
Italy	0.33	0.83	0.59	1.00	0.71
Spain	0.22	0.67	0.49	0.71	1.00

The values in bold have significant statistical importance with $\alpha = 0.05$ and different from 0

After the ADF test for stationary character of the time series, the obtained p-value significance level is lower than 0.05 and the time series is stationary.

Table 3 presents that the number of lags and months of time delay of rice purchase prices in Macedonia compared to the other countries. The values are ranging from no delay (BIC and HQIC tests) to a delay of three months (AIC and FPE test). In our case, we took 2 (two) lags as a basis as input for forecasting model purchase prices of rice and performing Granger causality test

Table 3. Number of lags and months of time delay of purchase prices of rice in Macedonia

No.	AIC	BIC	FPE	HQIC
0	15.07	15.10*	3.50E+06	15.08*
1	15.09	15.2	3.57E+06	15.13
2	15.08	15.26	3.54E+06	15.15
3	15.01*	15.26	3.307E+06*	15.11
4	15.04	15.37	3.41E+06	15.17
5	15.06	15.46	3.47E+06	15.22
6	15.08	15.55	3.54E+06	15.27

*Values marked with an asterisk is the lag number or monthly lag

From Table 4, it can be seen that the predicted purchase prices of rice through the model show a relatively lower value than the real ones and on average have negative deviations of -56.54 EUR/t or -0.06 EUR per kilogram of rice.

Table 4. Real, forecast and deviation of the forecast to real purchase prices of rice in Macedonia, in EUR per 1.000 tons

Month	Actual prices	Forecast prices	Difference (forecast-actual)	Monthly difference
11/2020	864.56	731.27	-133.29	-133.29
12/2020	834.95	728.02	-106.93	26.36
1/2021	780.76	725.03	-55.73	51.20
2/2021	783.61	722.28	-61.32	-5.59
3/2021	783.62	719.76	-63.87	-2.55
4/2021	794.99	717.43	-77.55	-13.69
5/2021	793.66	715.30	-78.37	-0.81
6/2021	777.20	713.33	-63.87	14.50
7/2021	769.45	711.52	-57.93	5.94
8/2021	770.35	709.86	-60.49	-2.56
9/2021	768.94	708.33	-60.61	-0.12
10/2021	745.67	706.93	-38.74	21.87
11/2021	732.26	705.63	-26.63	12.12
12/2021	725.14	704.44	-20.70	5.93
1/2022	724.92	703.35	-21.56	-0.87
2/2022	724.85	702.35	-22.51	-0.94
3/2022	724.85	701.42	-23.43	-0.93
4/2022	749.76	700.57	-49.19	-25.76
5/2022	749.20	699.79	-49.42	-0.23
6/2022	757.77	699.07	-58.70	-9.28
Average	**767.83**	**711.28**	**-56.54**	**-2.93**

Cumulatively, in the entire period we have negative differences, which are primarily the result of the initial large negative difference (November 2020), then relatively decreasing and approaching the real purchase prices of rice.

CONCLUSION

In this work influence of international markets on rice prices in the Republic of North Macedonia was analyzed. Using statistical methods and models for the period from January 2005 to December 2021, a total of 204 months times series with data on the purchase price of rice for Macedonia, the EU, Greece, Italy and Spain have been analyzed and compared. The purchase prices of rice in Macedonia are higher than the prices in the EU, without a constant trend, that is, there are large variations in them. The Goodness of fit statistics and degree of suitability and deviation of the model from the real data shows a high level of fitness of the model for Macedonia ($R^2 = 0.86$), for EU and other countries ($R^2 = 0.86$), but relatively low for Italy ($R^2 = 0.48$).

The table shows that in the period from January 2005 to December 2021, Macedonia has the highest average monthly purchase price of rice; Greece has the lowest average monthly price and the lowest monthly purchase price; Italy at the same time has the highest purchase price; the highest monthly standard deviation of prices is in Italy and the lowest in Spain.

After the ADF test for stationary character of the time series, the obtained p-value significance level is lower than 0.05 and the time series is stationary.

Also, the number of lags and months of time delay of rice purchase prices in Macedonia are compared to the other countries. The values are ranging from no delay (BIC and HQIC tests) to a delay of three months (AIC and FPE test). In our case, we took 2 (two) lags as a basis as input for forecasting model purchase prices of rice and performing Granger causality test

The predicted purchase prices of rice through the model show a relatively lower value than the real ones and on average have negative deviations of -56.54 EUR/t or -0.06 EUR per kilogram of rice.

Cumulatively, in the entire period there was negative differences, which are primarily the result of the initial large negative difference (November 2020), then relatively decreasing and approaching the real purchase prices of rice.

As of October 2021, the model clearly shows the impact of food economic crisis and unexpected, immediate rise prices as result of the post Covid-19 and Ukraine war crisis.

This research and analysis model can provide significant information for the rice price trends, forecasting and markets shock, as management and decision-making tools for producers, traders and processors, but also for the policy makers.

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