INTERNATIONAL MARKETS IMPACT ON WHEAT PRICES IN THE REPUBLIC OF NORTH MACEDONIA*

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Abstract

The production of wheat, as one of the elementary and strategic nutrition crops, in North Macedonia is insufficient and cannot meet the national demands, which results with negative trade balance with import of 74,937 tons of wheat valued at 17.9 million EUR. The main goal of this paper is to analyse the influence of international markets on wheat prices in the Republic of North Macedonia. Data on the purchase price of wheat have been analysed using statistical methods and models from December 2009 to December 2021. A total of 145 monthly time series with data on the purchase price of wheat for Macedonia, the EU, Bulgaria, Romania and Serbia have been analysed and compared. The Pearson correlation coefficient shows a relatively high relationship and mutual dependence of purchase prices in Macedonia, compared to prices in the EU, Bulgaria, Romania and Serbia (over 65%). The purchase prices of wheat in Macedonia have the highest relationship and mutual dependence with the price movement in Serbia (0.78), and the lowest with the price movement in the EU (0.66). 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 wheat prices in Macedonia with the comparison countries countries. The forecasting model (Granger causality test) shows that time series of wheat prices can be convenient for forecasting wheat prices in Macedonia. As of October 2021, the model clearly shows the impact of food economic crisis and unexpected, immediate rise of wheat prices as result of the post Covid-19 and Ukraine war crisis.
This research and analysis model can provide significant information for the wheat price trends, forecasting and markets shock, as management and decision-making tools for producers, traders and processors, but also for the policy makers.

Keywords: *international markets, agri-food prices, wheat prices, forecasting.*

INTRODUCTION

The agricultural and food (agri-food) sector is important for the economy of the Republic of North Macedonia, which has a great contribution in the formation of the gross domestic product (7.60% of the GDP) and participation in the trade exchange of

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the country. The Republic of North Macedonia is an import dependent country. According to the data of the State Statistics Office, the total value of the export of goods from the Republic of North Macedonia in 2021 is 6,922,573 thousand EUR, and the import is 9,638,290 thousand EUR. The coverage of imports with exports is 71.82%, and the trade deficit amounts to 2,715,717 thousand EUR. The EU member states (77.33%) and the countries of the Western Balkans (11.81%) have the largest share in the export of goods, and the EU member states (46.24%) in the import. The export of agricultural and food products in 2021 has share of 9.05% of the total export, while the import has share of 9.79% of the total import. According to the Annual Agricultural Report of the Ministry of Agriculture, Forestry and Water Management (MAFWE, 2021), the most significant trade partner for agri-food and fish products of the Republic of North Macedonia are the EU countries, with a total value of trade in 2020 of 679.7 million EUR. As a result of the crisis with the Covid-19 pandemic and the exit of the United Kingdom from the European Union, the export of agri-food and fish products has a decrease of 5.2% of exports and 5.9% of imports compared to 2019.

In addition to the economic dimension, the agri-food sector is also significant from a social aspect, considering its importance for the rural population. According the Structural research of agriculture holdings (SSO, 2016), 178,125 agriculture holdings are involved in agriculture production, out of which only small number (280) are business entities.

Wheat, as one of the elementary and strategic nutrition crops, is the most common crop sown on 70,515 ha or about 44.39% of the sown areas under cereal crops (158,836 ha) in 2021 (SSO, 2022). The production of wheat in 2021 was about 243,676 tons with average yields of 3,463 kg/ha. The production is insufficient and cannot meet the national demands and needs, which results with negative trade balance with import of 74,937 tons of wheat, valued at 17.9 million EUR. The export is only 21,395 tons with value of 4.6 million EUR (SSO, MakStat database).

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). Scientific 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 in the way of connecting markets and explaining of the trade balance (Asche, Jaffry, & Hartmann, 2007).

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. Scientific and empirical research of integration and interdependence level of markets is

mainly based on time series analysis of price movements and margin distribution at the different levels (participants) in the food supply chain.

In the last period, 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, Sanders, & Merrin, 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 period of crisis and major shocks in the markets of agricultural and food products forced the states to apply a more restrictive policy and stricter measures to protect their markets (Tangermann, 2011). Such increased protection and intervention of the states contributes to a greater disparity between supply and demand, greater isolation of the markets, followed by non-objective price formation and inefficient movement of products. This situation also contributes to increased regional imbalance and the occurrence of surplus and deficit of food. In that direction, information on the horizontal integration of markets is of great importance for defining intervention measures in order to reduce the imbalance and prevent insecurity in food supply (Goletti & Babu, 1994). The critical review of Fackler and Goodwin (Fackler & Goodwin, 2001), emphasizes that economic movements and markets are increasingly influenced by social and political situations in different countries, which has a special impact on the changes in the approach of scientific research on the integration of markets.

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. If the price difference is greater than the transfer costs, the profit-making opportunities will be used by various intermediaries (arbitrageurs) who will be involved in the trade process. 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 whole system of market integration, as well as the degree of influence of such integration on product prices, is influenced by a number of factors. Still the main factors (Piero, 2004) that influence the movement and formation of prices between different markets can come from transportation and transportation costs, including costs of providing information, negotiation, as well as the costs of monitoring the entire process of transport are included (Williamson, 1986) or costs of searching for a partner, checking the seriousness of the partner, negotiating with the partner, transferring the product, monitoring the realization, as well as court costs in certain cases when the contract will not be fulfilled (Staal, Delgado, & Nicholson, 1997).

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 (Wohlgenant, 1999); (Azzam, 1999); (Goodwin & Holt, 1999); (Dhar & Cotterill, 1998); (McCorriston, Morgan, & Rayner, 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, productivity and profitability of production have a different effect compared to horizontal integration and their impact on market competitiveness and strength (McCorriston, Morgan, & Rayner, 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). Prices are influenced by the complementarity or complementarity of a certain agricultural-food product with another similar or different product (Saadi, 2011). The level of trade and price dependence is always lower in models that assume product heterogeneity, compared to models that assume homogeneity (Armington, 1969).

Different currencies and exchange rates, through their ratio and their stability, affect the level of market integration, the volume of trade and the formation of prices. Prices are additionally influenced by the ability of firms to adjust their marketing strategy and pricing strategy in relation to exchange rate changes and different markets (Dornbusch, 1987); (Froot & Klemperer, 1989); (Knetter, 1993).

Last, but not least, the import and export policy have a direct impact on horizontal integration, the level of trade and the formation of prices. From the point of view of import and export policy, non-tariff (non-tariff) barriers such as: variable tariffs (customs and subsidies), tariff quotas, protective tariffs and technical barriers have a great impact on market integration and price formation. Compared to tariffs which are measurable, non-tariff barriers are difficult to quantify, measure and assess. They may result in additional costs for exporters. Such costs are almost always borne by the exporters and usually represent a bigger problem for small exporters and companies and they are much more affected compared to larger and export-strong companies (OECD, 2017).

The main working hypothesis of this paper is that 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.
The main goal of this paper is to analyse the influence of international markets on wheat prices in the Republic of North Macedonia.
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 wheat and agri-food products.

MATERIAL AND METHODS

Data on the purchase price of wheat have been analysed using statistical methods and models for the period from December 2009 to December 2021. A total of 145 months times series with data on the purchase price of wheat for Macedonia, the EU, Bulgaria, Romania and Serbia have been analysed and compared.
For the domestic markets, the data for the monthly wheat 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 wheat (SSO, 2015). Data for the EU countries are taken from the official agricultural data site of the European Commission (EC, Agridata, 2022). For Serbia, data from the official Agricultural Market Information System of Serbia (STIPS, 2022) were used.
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 through the use of alignment constants and assigning a weight to each value, which at the same time allows for the purification of the series from certain seasonal atypical variations. At the same time, depending on the model used, the degree of importance of newer or older data can be determined and accordingly the model can give more importance to one or the other in the alignment.
Since in our case the data time series have a pronounced trend with multiplicative seasonal variation where the mean, growth rate and seasonal variation change over the years, we used triple exponential smoothing and the multiplicative Holt-Winters model with multiple degrees of seasonal smoothing. character.
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. There are several statistical models for determining correlation, such as Pearson correlation coefficient (PCC), Pearson product-moment correlation coefficient (PPMCC), Bivariate correlation. In any case, all models basically measure the degree of linear correlation between two sets of data

and determine the degree of covariance of two variables and the product of their standard deviations. The correlation coefficient can have a minimum value of -1 and a maximum value of +1. At the minimum value of -1, the coefficient shows that there is a perfect inversely proportional dependence between the variables and that as one variable increases, the other decreases in the same proportion. The opposite situation is at a maximum value of +1, which indicates that by increasing one variable, the other variable increases in the same proportion. If the correlation coefficient approaches 0, then the dependence between the observed variables is very small or does not exist.

In our case, we used the Pearson correlation coefficient to compare and determine the correlation and dependence of the purchase prices of agricultural and food products in the Republic of North Macedonia compared to other countries. In addition to the correlation test and the correlation coefficient, a test was also made for the statistical significance of the correlation, expressed through the t test (Student's t-test), and for the strength of the correlation, expressed through the coefficient of determination.

Augmented Dickey Fuller test, or 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. ADF is a unit root test that tests the null hypothesis against the first lag of an unknown (compared) variable. The basic assumption of the null hypothesis is that there is the presence of a single common root and $\alpha=1$ and if a lower p-value level of significance is obtained (lower than 0.05) it is a basis for rejecting the null hypothesis which shows essentially that the time series is stationary and the trend of the series itself will not affect the trends of other series.

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. Several criteria are used to select the order of the time delay and there are several models.

In this paper, 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). The results of the model are obtained through a process of their minimization and the model with the lowest value is selected as the relevant lag or time delay.

At the end of the statistical analysis, the Granger causality test was used, which essentially determines whether and to what extent one time series can be used to predict another. 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, the use of only the term causality is a relative misnomer for the model that Granger himself named as temporally related later in 1977. 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. The time series shows whether there is such a relationship, and through certain tests (t-test and F-test) on the lags of the

variable value, it shows the statistical significance of its prediction of the future values of the other parameters.

RESULTS AND DISCUSSION

The graphic analysis of the data for the purchase prices of wheat in Macedonia and the EU shows that the prices in Macedonia are higher than the prices in the EU, with the exception of the middle of 2019 and the last months of 2021 (Figure 1).

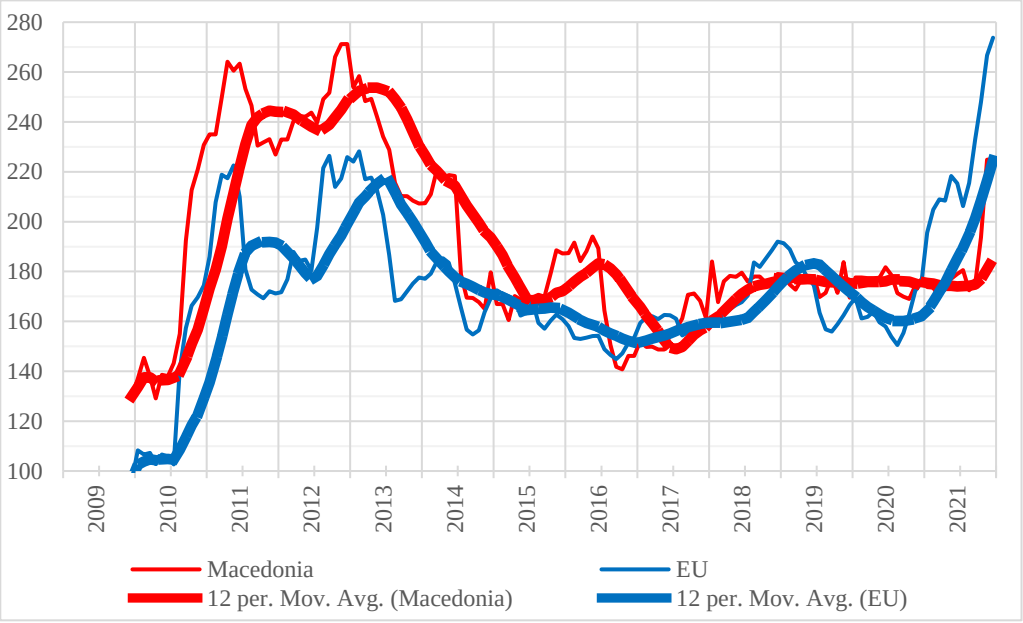

Figure 3. Purchase prices of wheat in Macedonia and the EU, in EUR per 1,000 tons, December 2009 – December 2021 and price trends (12-month moving average)

From the same graphic, it can be seen that the price trend (expressed through a 12-month moving average) of purchase prices in Macedonia and the EU has a relatively high and almost the same trend and mutual dependence in the period until the middle of 2015. After this period, the trend significantly decreased.

The graphic analysis of wheat purchase prices compared to prices in Serbia as non-EU country, shows the similar trend (Figure 2). Although prices in Macedonia are higher compared to Serbia, this difference is relatively smaller compared with the EU and in certain periods (especially from 2009 to mid in 2011), they are almost at the same level. On the other hand, the price trend has a much higher relationship and mutual dependence compared with the EU, almost throughout the whole analysed period with the exception of the small deviation that occurs in 2021.

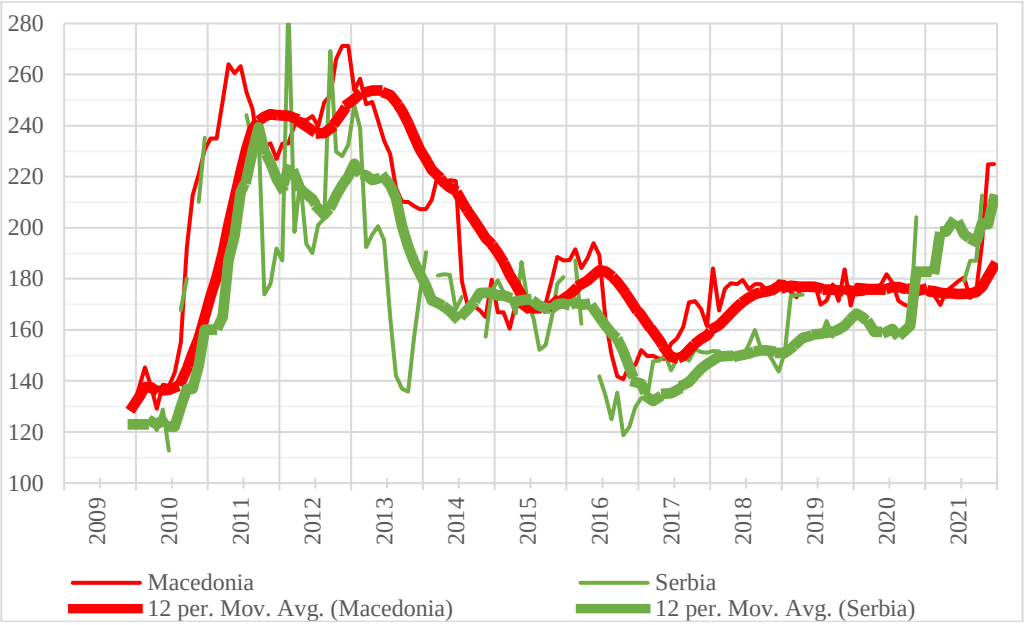

Figure 4. Purchase prices of wheat in Macedonia and Serbia, in euro per 1,000 tons, December 2009 – December 2021 and price trends (12-month moving average)

From all the analysed data for 145 months, in the process of the exponential smoothing for 37 monthly data for which there was no information on the purchase prices of wheat, 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 ($R^2 = 0.94$) and relatively for other countries.

Table 1 present the minimum, maximum and average purchase prices of wheat, as well as the standard deviation for Macedonia, EU, Bulgaria, Romania and Serbia, for the period from December 2009 to December 2021.

Table 5. Purchase prices of wheat in EUR per 1,000 tons, December 2009 – December 2021

Country	**Minimum**	**Maximum**	**Average**	**Standard deviation**
Macedonia	129.12	271.24	190.73	35.18
EU	96.63	273.78	174.00	29.83
Bulgaria	96.97	259.48	169.45	34.75
Romania	106.93	255.33	166.19	28.28
Serbia	112.71	288.30	177.07	37.92

The table shows that in the period from December 2009 to December 2021, Macedonia has the highest average monthly purchase price of wheat of 190.73 EUR/t or 0.19 EUR/kg of purchased wheat. At the same time, Romania has the lowest average monthly price of 166.19 EUR/t. The lowest monthly purchase price was recorded in the EU at 96.63 EUR/t, while Serbia at the same time has data for a month with the highest purchase price of 288.39 EUR/t. The highest monthly standard deviation of prices is in Serbia (37.92 EUR/t) and the lowest in Romania (28.28 EUR/t).
The correlation coefficient shows a relatively high relationship and mutual dependence of purchase wheat prices in Macedonia, compared to prices in the EU, Bulgaria, Romania and Serbia (over 65%). The purchase prices of wheat in Macedonia in terms of the compared countries have the highest relationship and mutual dependence with the price movement in Serbia (0.78), and the lowest with the price movement in the EU (0.66).

Table 6. Correlation coefficient of wheat purchase prices

Countries	**Macedonia**	**EU**	**Bulgaria**	**Romania**	**Serbia**
Macedonia	**1.00**	**0.66**	**0.74**	**0.69**	**0.78**
EU	**0.66**	**1.00**	**0.92**	**0.91**	**0.73**
Bulgaria	**0.74**	**0.92**	**1.00**	**0.92**	**0.81**
Romania	**0.69**	**0.91**	**0.92**	**1.00**	**0.79**
Serbia	**0.78**	**0.73**	**0.81**	**0.79**	**1.00**

*The values in bold have significant statistical importance with α=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 determined that the time series is stationary.
Table 3 presents that the number of lags and months of time delay of wheat purchase prices in Macedonia compared to the other countries. The values are ranging from no delay (BIC test) to a delay of two months (AIC and FPE test). According to the Hanna-Quinn test (HQIC) the delay is only one month.

Table 7. Number of lags and months of time delay of purchase prices of wheat in Macedonia

	AIC	**BIC**	**FPE**	**HQIC**
0	24.15	24.27*	3.08E+10	24.2
1	23.65	24.33	1.86E+10	23.93*
2	23.61*	24.87	1.801e+10*	24.12
3	23.75	25.58	2.08E+10	24.49
4	23.77	26.17	2.14E+10	24.74
5	24.01	26.98	2.77E+10	25.22
6	23.98	27.53	2.75E+10	25.42

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

In our case, we took 2 (two) lags as a basis as input for forecasting model purchase prices of wheat in Macedonia and performing Granger causality test.

Table 8. Real, forecast and deviation of the forecast to real purchase prices of wheat in Macedonia, in EUR per 1,000 tons

Month	Actual prices	Forecast prices	Difference (forecast-actual)	Monthly difference
11/2020	174.45	178.63	4.18	4.18
12/2020	176.83	179.49	2.66	-1.52
1/2021	173.82	181.79	7.97	5.31
2/2021	173.53	183.42	9.89	1.93
3/2021	169.80	184.63	14.83	4.93
4/2021	175.11	185.55	10.44	-4.38
5/2021	177.10	186.22	9.12	-1.32
6/2021	179.02	186.77	7.76	-1.37
7/2021	180.52	187.26	6.73	-1.02
8/2021	172.54	187.72	15.18	8.44
9/2021	175.03	188.17	13.14	-2.04
10/2021	193.70	188.62	-5.08	-18.22
11/2021	224.87	189.06	-35.81	-30.73
12/2021	224.96	189.48	-35.48	0.33
1/2022	225.70	189.86	-35.83	-0.36
2/2022	225.68	190.20	-35.48	0.35
3/2022	225.68	190.48	-35.20	0.28
4/2022	236.02	190.70	-45.32	-10.12
5/2022	244.44	190.87	-53.57	-8.26
6/2022	249.36	190.98	-58.39	-4.82
Average	**198.91**	**187.00**	**-11.91**	**-2.92**

From Table 4, it can be concluded that forecasted purchase prices of wheat with the Granger causality test and model until September 2021 is suitable and has a tendency for modest overestimate of the prices trend, which results with a symbolically higher value than the real ones. On average for this period, the model has positive difference of 9.26 euro/t or insignificant 0.01 EUR per kilogram of wheat. In average, monthly difference for this period is 1.19 euro/t.

The negative trends start from October 2021, when the predicted purchase prices of wheat start to be significantly lower than the actual ones. The highest negative monthly difference can be noticed in October (-18.22 EUR/t) and November (-30.73 EUR/t) in 2021 and April (-10.12 EUR/t) in 2022, Still, this is insignificant 0.01 EUR per kilogram of wheat. This results to have in total average negative difference of the model of -11.91 EUR/t or -2.92 EUR/t per month, for the whole forecasted period. Still, even this difference is insignificant and is less than -0.01 EUR per kilogram of wheat.

CONCLUSIONS

The correlation coefficient (Pearson correlation coefficient) shows a relatively high relationship and mutual dependence of purchase prices in Macedonia, compared to prices in the EU, Bulgaria, Romania and Serbia (over 65%), which clearly confirms that Macedonia wheat production 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.

The purchase prices of wheat in Macedonia in terms of the compared countries have the highest relationship and mutual dependence with the price movement in Serbia (0.78) with which Macedonia has a long-lasting connection and importing dependence when it comes to the cereals import and especially wheat.

Estimating the lag length of autoregressive process for a time series (AIC, BIC, FPE and HQIC tests), on average shows 2 lags (months) later time reaction of the wheat prices in Macedonia with compared countries.

The forecasting model (Granger causality test) shows that wheat prices time series can be convenient in forecasting wheat prices in Macedonia. The model starting from October 2021, clearly shows the impact of food economic crisis and unexpected, immediate rise of wheat prices as result of the post Covid-19 and Ukraine war crisis.

This research and proposed methodology can provide significant and timely information for the wheat price trends and forecasting future trends and markets shock, which can be used as substantial management and decision making tools for producers, traders and processors, but also for the policy makers, especially to quickly react to markets shock and respond to the emerging situation with adequate public policies.

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UTICAJ MEĐUNARODNOG TRŽIŠTA NA CIJENE PŠENICE U REPUBLICI SJEVERNOJ MAKEDONIJI

Rezime

Proizvodnja pšenice, kao jedne od osnovnih i strateških prehrambenih kultura u Sjevernoj Makedoniji je nedovoljna i ne može da zadovolji nacionalne potrebe, što rezultira negativnim trgovinskim bilansom sa uvozom od 74.937 tona pšenice u vrijednosti od 17,9 miliona evra. Osnovni cilj ovog rada je analizirati uticaj međunarodnih tržišta na cijene pšenice u Republici Sjevernoj Makedoniji. Podaci o otkupnoj cijeni pšenice analizirani su statističkim metodama i modelima od decembra 2009. do decembra 2021. Ukupno je 145 mjesečnih vremenskih serija sa podacima o otkupnoj cijeni pšenice za Makedoniju, EU, Bugarsku, Rumuniju i Srbiju. analizirali i uporedili. Pirsonov koeficijent korelacije pokazuje relativno visoku povezanost i međusobnu zavisnost nabavnih cena u Makedoniji, u poređenju sa cijenama u EU, Bugarskoj, Rumuniji i Srbiji (preko 65%). Otkupne cijene pšenice u Makedoniji imaju najveći odnos i međusobnu zavisnost sa kretanjem cijena u Srbiji (0,78), a najnižu sa

kretanjem cijena u EU (0,66). Procijenjena dužina kašnjenja autoregresivnog procesa (AIC, BIC, FPE i HQIC testovi), u prosjeku pokazuje 2 laga (mjeseca) kasnije vremensku reakciju cijena pšenice u Makedoniji sa zemljama za poređenje. Model predviđanja (Grangerov test uzročnosti) pokazuje da vremenske serije cijena pšenice mogu biti pogodne za predviđanje cijena pšenice u Makedoniji. Od oktobra 2021, model jasno pokazuje uticaj ekonomske krize hrane i neočekivanog, trenutnog porasta cijena pšenice kao rezultat ratne krize poslije Covid-19 i rata u Ukrajini.
Ovaj model istraživanja i analize može pružiti značajne informacije za trendove cijena pšenice, prognoze i tržišni šok, kao alate za upravljanje i donošenje odluka za proizvođače, trgovce i prerađivače, ali i za kreatore politike.

Ključne riječi: *međunarodna tržišta, poljoprivredno-prehrambene cijene, cijene pšenice, prognoze*