ANALYSIS AND PREDICTION OF PRICES AND PRICE PARTYES OF CORN AND WHEAT IN SERBIA

ANALIZA I PREDVIĐANJE CENA I PARITETA CENA PŠENICE I KUKURUZA U SRBIJI

Beba MUTAVDŽIĆ, Nebojša NOVKOVIĆ, Nataša VUKELIĆ, Veljko RADOJEVIĆ
University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, 21000 Novi Sad, Srbija
e-mail: vukelicn@polj.uns.ac.rs

ABSTRACT

The aim of this research paper is to analyze the changes and to forecast the real and relative (parity) prices. The analysis of the time series (1994-2014) has been done, and ARIMA models were used for the forecast (2015-20).

In analyzed period average (deflated) price of corn was 108 euro/ton, while average price of wheat was 118 euro/ton. Average price parity in observed period was 0.93.

In predicted period corn prices will be from 99 to 122 euro/ton, wheat prices from 114 to 125 euro/ton, while parity price from 0.83 to 0.89.

Key words: *corn, wheat, price, price parity, prediction, Serbia.*

REZIME

Predmet istraživanja u ovom radu su najzastupljeniji ratarski usevi u Srbiji, odnosno kukuruz i pšenica, odnosno njihove cene i odnosi između njih. Cilj rada je da se determiniše zakonitost u kretanju cena i pariteta cena i na osnovu toga predvide budući tokovi, kako bi se blagovremeno mogli planirati proizvodni i ekonomski parametri u proizvodnji žita.

U radu su analizirane prosečne godišnje otkupne cene pšenice i kukuruza u periodu 1994–2014. godina. Na osnovu apsolutnih cena, diskontovanih na 1994. godinu na osnovu indeksa potrošačkih cena, utvrđen je paritet cena kukuruza u odnosu na pšenicu, kao i deflacionirane (diskontovane) cene pšenice i kukuruza. Primenom ARIMA modela predviđeno je kretanje pariteta cena kukuruz-pšenica, kao i deflacioniranih cena pšenice i kukuruza do 2020. godine.

Prosečna vrednost pariteta kukuruz/pšenica u analiziranom periodu iznosila je 0,93. Kukuruz je u odnosu na pšenicu imao najmanju vrednost 1998. godine kada je kilogram kukuruza vredeo koliko i 0,64 kilograma pšenice. Maksimalna vrednost kukuruza u odnosu na pšenicu zabeležena je 2004. godine kada je kilogram kukuruza vredeo kao 1,3 kilograma pšenice. Model za predviđanje kretanja pariteta cena kukuruz–pšenica pokazuje da na vrednost pariteta tekuće godine značajan uticaj ima odnos cena kukuruza prema pšenici iz prethodna dva perioda, odnosno prethodne dve godine. Predviđene vrednosti pokazuju da će se paritet kretati u intervalu od 0,83 do 0,89, s tim da se uočava da svake treće godine dolazi do opadanja vrednosti pariteta.

Predviđene vrednosti cena pšenice do 2020. godine pokazuju relativnu stabilnost i kretaće se na nivou od 112,82 do 125,64 evro/tona. Karakteriše ih oscilacija iz godine u godinu, ali će tokom perioda predviđanja cena pšenice najčešće biti na nivou većem od proseka iz analiziranog perioda, odnosno iznosiće više od 118 evro/tona.

Cene kukuruza su u analiziranom periodu pokazivale nešto veće oscilacije nego cene pšenice, a to će biti karakteristika i u periodu predviđanja. Cene kukuruza do 2020. godine kretaće se u intervalu od 97 do 123 evro/tona.

Ključne reči: *cene, pšenica, kukuruz, predviđanje, pariteti cena.*

INTRODUCTION

The topic of this research is the analysis of the changes and the future tendencies of the price parameters of wheat and corn, two the most important plant products in Serbia.

Considering the importance of wheat and corn productions, the existence of the possibility to apply the methods of the scientific forecasting, and the course of the future agricultural development, the aim of this research is hereby defined: The prediction of the change of the absolute and relative (parity) price parameters of wheat and corn in Serbia.

A fair number of authors have dealt with the forecast in agriculture *(Novković and Mutavdžić, 2007). Nikolić-Đorić et al. (1993)* analyse the time series of the production and the price of pigs and maize and ascertain that there are seasonal, cyclical and random oscillations present in the series. They predicted the parity price trend for pig-maize using a proper ARIMA model. *Novković et al. (1994)* examined how parity prices for fattening pigs/maize depended on the turnover of the fattening pigs and maize, and, based on the analysis, they forecasted the trend until the end of the 20th century. *Novković et al. (2005/6),* performed an analysis on the time series of the parity prices for wheat/mineral fertilizer, and, with the use of a certain ARIMA

model, they predicted the parity trend in the five-year period. *Novković et al. (2006)* analyzed animal husbandry in Vojvodina and determined the directional movement of certain livestock species and the production characteristics of the animal husbandry at the beginning of the 21st century. *Mutavdžić (2009),* by means of quantitative model based on time series, encompassed the prediction of the total land under vegetables, and also the land, yield and total output of potato, beans and tomato in Vojvodina, in the period 2005-2010. *Ivanišević et al. (2015)* analyzed and predicted price of tomato in Serbia, and price parity of tomato/wheat. The work of Box, Jenkins, Pen and other authors were significant on account of their methodological input. In their work, by examining these models, they have given their contribution to the development of the models. For instance, in her study, *Fasen (2015)* assessed multivariate autoregressive–moving-average (ARMA) models in the continuous-time and their dependence estimation (MCARMA model).

MATERIAL AND METHOD

Methods of the descriptive statistics were used for the analysis of tomato price changes in the period 1994-2014. The basic statistical indicators area included: the average value,

extreme values (minimum and maximum), coefficient of variation and rate of change (%). In an attempt to forecast the observed price and price parity changes, the method of time series analysis, i.e. ARIMA models have been used.

The time series analysis has encompassed wheat and corn prices, and their parity characteristics in the analyzed period, and the period of prediction, 2016-2020.

The base for the analysis and prediction of wheat and corn prices were the average annual prices. The analysis and prediction headed in two directions:

1. Analysis and prediction of the absolute, deflated prices;
2. Analysis and prediction of the relative prices, i.e. the parity price of corn with the price of wheat.

The absolute average prices deflated, i.e. reduced to the fixed prices from 1994, based on the index of retail prices, which was the most adequate inflation indicator. In 1994, the parity of dinar with German mark 1:1 was established. As a result, the deflated prices corresponded to the same prices in German mark. If the value of German marks were divided by 1.95, we have got the real value of the prices in euro.

RESULTS AND DISCUSSION

The average corn price in the analyzed period was 107.96 euro/t. The prices have varied between 76.92 and 189.74 euro/t. The corn price coefficient of variation was 29.62 %. The average annual rate of change of corn price was practically 0 %, which meant generally stable price tendency. The model for prediction of corn price for the next period indicated significant influence of corn prices in last two years period *(Table 1)*.

Table1. Parameters of the model for corn price forecast

	Input: KUKKINF Transformations: D(1) Model: (2,1,0) MS Residual = .00319					
Paramet.	Param.	Asympt. Std. Err.	Asympt. t (17)	p	Lower 95% Conf	Upper 95% Conf
Constant	0.001820	0.007561	0.24067	0.812692	-0.01413	0.017773
p(1)	-0.089370	0.186808	-0.47841	0.638456	-0.48350	0.304761
p(2)	-0.695125	0.192947	-3.60268	0.002196	-1.10221	-0.288043

Source: Result of research

The average wheat price in the analyzed period was 117.95 euro/t. The prices have varied between 77 and 159 euro/t. The coefficient of variation of wheat price was 20.35 %. The average annual rate of change of wheat price was 0.77 per year, which meant tendency of insignificant increasing. Model for prediction of wheat price for the next period indicated significant influence of wheat prices in last two years period, as the corn price *(Table 3)*. The predicted values of corn prices in period 2015-20 were obtained based on the evaluated model *(Table 2)*.

Table 2. Predicted corn prices (2015-20)

	Forecast; Model: (2,1,0) Input: KUKKINF Start of origin: 1 End of origin: 21			
CaseNo.	Forecast	Lower 95 %	Upper 95 %	Std. Err.
2015	0.112853	0.100808	0.339319	0.056524
2016	0.121818	0.076253	0.398839	0.076449
2017	0.101963	0.035347	0.362307	0.077486
2018	0.099170	0.024745	0.362019	0.079930
2019	0.114887	0.029471	0.418590	0.092216
2020	0.117089	0.017262	0.439386	0.100038

Source: Result of prediction

Table 3. Parameters of the model for white price forecast

	Input: PSKINF Transformations: D(1) Model: (2,1,0) MS Residual = .00280					
Param.	Param.	Asympt. Std. Err.	Asympt. t (17)	p	Lower 95 % Conf	Upper 95 % Conf
Const.	0.001918	0.006947	0.27604	0.785844	-0.01274	0.016573
p(1)	-0.285770	0.216358	-1.32082	0.204066	-0.74225	0.170705
p(2)	-0.526050	0.224646	-2.34168	0.031634	-1.00001	-0.052088

Source: Result of prediction

The predicted values of wheat prices in period 2015-20 were obtained based on the evaluated model *(Table 4)*.

Table 4. Predicted wheat prices (2015-20)

	Forecast; Model: (2,1,0) Input: PSKINF Start of origin: 1 End of origin: 21			
CaseNo.	Forecast	Lower 95 %	Upper 95 %	Std. Err.
2015	0.125496	0.123081	0.356352	0.052912
2016	0.122223	0.101150	0.375521	0.065023
2017	0.114258	0.082350	0.363259	0.066572
2018	0.120038	0.080912	0.387236	0.072595
2019	0.124358	0.070467	0.414529	0.081538
2020	0.121865	0.056371	0.418901	0.085915

Source: Result of prediction

The average parity price of corn with wheat during the analyzed period was 0.93. This means that one ton of corn costs as 0.93 ton of wheat. The parity fluctuated between 0.64 and 1.30. The coefficient of variation of the parity price corn/wheat was 19.37 %. The average annual parity change rate of corn price with wheat was negative, -0.94 % per year. This means that price of corn shows negative relative economics tendency related with wheat price.

The parity value corn/wheat of the current year is greatly influenced by the parity value of the previous two years. The values of the parity in the forecast period alternately decreased and increased year by year, and they fluctuate between 0.88 in 2016. to 0.85 in 2020. *(Table 5)*.

Table 5. The prediction of the parity prices for corn/wheat (2015-20)

	Forecast; Model: (2,1,0) Input: KUK/PSEN Start of origin: 1 End of origin: 21			
CaseNo.	Forecast	Lower 95 %	Upper 95 %	Std. Err.
2015	0.880123	0.402327	1.357919	0.226463
2016	0.885924	0.363610	1.408237	0.247564
2017	0.836305	0.297797	1.374812	0.255239
2018	0.858282	0.240127	1.476436	0.292990
2019	0.866832	0.201703	1.531961	0.315255
2020	0.848578	0.155373	1.541783	0.328562

Source: Result of prediction

The stated characteristics are presented in the chart showing the changes of this parity *(Fig. 1)*.
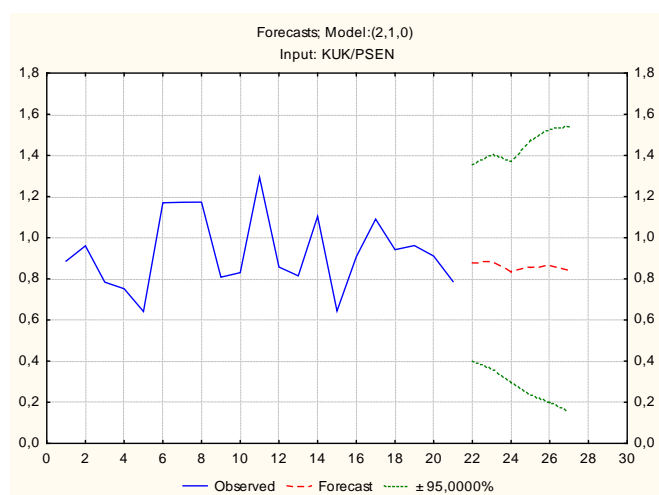
Source: The result of the study

Fig. 1. The changes of the parity prices for corn/wheat

CONCLUSION

The research in this paper has indicated the following:

- The average real price of corn in the period 1994-2014 was 108 euro/ton, according to fixed prices in 1994, with significant variations (CV=30 %) and tendency of stability;
- The average real price of wheat in the same period was 118 euro/ton (according to fixed prices in 1994), with less variation than corn (CV=20 %), and tendency of slow increasing by 0.77 % per year;
- The average parity price for corn/wheat was in analyzed period 0.93, with variation similar as price of wheat (CV=19 %), and tendency of decreasing with average change rate of -0.94 % per year;
- In predicted period (2016-20) prices of corn are changing in interval from 122 to 99 euro/ton, alternately decrease and increase. Predicted prices are in border of the same in analyzed period (77- 190 euro/ton);
- In the same period, prices of wheat are changing in interval from 125 to 114 euro/ton, alternately decrease and increase. Predicted prices are in border of the same in analyzed period (77-159 euro/ton);
- In whole predicted period, price of corn will be lower than price of wheat. The values of the parity in predicted period alternately decrease and increase and they fluctuate between 0.88- 0.85, with tendency of slow decrease.

REFERENCES

Fasen,V. (2015). Dependence Estimation for High-frequency Sampled Multivariate CARMA Models. Scandinavian Journal of Statistics Early View (Online Version of Record published before inclusion in an issue), Article first published online: 13 OCT 2015, Nordic statistical associations http://onlinelibrary.wiley.com/doi/10.1111/sjos.12180/pdf

Ivanišević, D., Mutavdžić, B., Novković, N., Vukelić Nataša (2015). Analysis and prediction of tomato price in Serbia, Ekonomika poljoprivrede, Beograd, LXII (4), 951-96.

Mutavdžić, Beba (2009). Analyzes and prediction of economics parameters u agriculture of Vojvodina – doctoral thesis. University of Belgrade, The Faculty of Agriculture, Zemun, Serbia

Nikolić-Đorić, Emilija, Novković, N., Rodić, Vesna, Aleksić, Lj. (1993). Selection of adequate model for prediction pigs/maze price parity. Agrieconomica, 22, Institute of Agricultural Economics and Rural Sociology, Faculty of Agriculture, Novi Sad, 111-122.

Novković, N., Janković, N.,Mutavdžić, Beba (2005/6). Analyzes and prediction of wheat/mineral fertilizers price parity. Agrieconomica, 34-35, Institute of Agricultural Economics and the Rural Sociology, Faculty of Agriculture, Novi Sad, Serbia, 65-71.

Novković, N., Mutavdžić, Beba (2007). Uticaj sezonskih kolebanja cena žitarica na ekonomsku efiektivnost silosa. Časopis za procesnu tehniku i energetiku u poljoprivredi, 11 (1-2), 49-52.

Novković, N., Mutavdžić, Beba, Radojević, V. (2006). Changes of cattle breeding in Vojvodina at the begin of XXI century, Contemporary Agriculture, 55 (1-2), 14-20. Faculty of Agriculture, Novi Sad.

Novković, N., Rodić, Vesna, Nikolić-Đorić, Emilija, Aleksić, Lj. (1994). Dependences pigs/maze price parity from pigs and maze trade, and prediction until the end of the century. Agrieconomica 23, 77-88. The Institute of Agricultural Economics and Rural Sociology, The Faculty of Agriculture, Novi Sad.