Causality between corn production cost and cash corn price
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Abstract

The correlation between the variable and total producers' costs and a market price for corn was analysed in this paper. The production price of corn is changing every year and depends on the corn yields and input costs. Being familiar with the correlation between production price and cash price provides the forecast of corn price according to the forecast of the production price trends. The accurate forecast in price trends enables agricultural producers to sell their products ,,at the

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right time", corn purchasers to purchase at the best prices, speculators on commodity exchanges to make high profits, etc. Furthermore, the results in corn production expressed in a relative relationship, i.e. the ratio between the production costs and incomes during one production year are shown in the presented analyses, avoiding on that way the inflation effects, which would otherwise be a significant element in 20 years study. Farmers can use the analyses in comparing their results in the production of corn with the USA average and thereby they can determine their competitiveness. The conducted analyses is showing that a production price has a high impact on the market price creation, so according to the work results, by bringing closer market prices to variable costs of production per product units, a further decline in price meets „the resistance" caused by unwillingness of farmers to sell a product by a price close to achieved variable costs, but they prefer to store a product and postpone sale and thereby reduce supply and prevent further decline of prices. In case that prices increase significantly over the production cost, farmers make profit and supply of cereals grows and slows down further increase in prices. There was determined high correlation between operating costs per bushel and price (USD dollars per bushel at harvest), as well as total costs per bushel and price (USD dollars per bushel at harvest), regarding that an indicator of operating cost per bushel and price (USD dollars per bushel at harvest) has a higher degree of correlation and lower variability.

Keywords: Corn production price. Cash price. Grain price forecast.

1. Introduction

"Holly grail" of the trade with grain is price forecast. Producers are faced with question when t sell corn? In which direction price is heeding on? Primer aim of this paper is to determine the correlation between the production prices and the cash price of corn as a toll for price forecast. Calculation and the forecast of the corn production price trends, as well as knowing its impact on the cash price are of great significance for forecasting the cash price trends. In this purpose the public information systems can be used, by which the forecast of production costs trends for corn, as the USDA Cost of production forecast (Good, Irwin, 2006) or private information can be found.

Besides the forecast of price trends, this paper aims to determine the profitability in corn production. Farmers can use data and analyses presented within the paper and to compare their production costs with the average USA and thereby to determine its competitiveness.

Furthermore, in the conducted analyses, the results achieved in corn production were presented in the relative relationship, i.e. the relation between the production costs and incomes within one production year, by which the inclusion of the inflation effects, as it could be a significant element in 20 years long survey, has been avoided.

Paper is focused on corn, as from the standpoint of worldwide agriculture, in relation of harvested areas, total production, spreading area, high potential in human and animal nutrition, or

expressed use value, rate of marketability and presence at the most of the commodity exchange in the world, it is rated among top three cereals (besides wheat and rice).

Corn is one of the few the most often grown plants species that comes from the Western Hemisphere (Hallauer, Carena, 2009). At the end of XV century it was spread out from American continent firstly to Europe and then to North Africa, West China and East India (Gibson, Benson, 2002). Today, it could be successfully grown in almost all climates, from mild continental to tropic, within the periods over the year when daily average temperature does not fall below 15 °C. Relatively high climate adaptability is the result of long-term selection and breeding, so the adequate choice of available sorts and hybrids (of different maturity groups) provides proper overlapping of growing stages and season of vegetation (Steduto et al., 2012).

According to FAO data, in 2014. corn was globally grown at more than 180 million of hectares. It was achieved the total production of around 1.02 billion tons of grain, where during the last two decades it was almost doubled, with continuously upward trend. Growth of production volume is primarily a result of production area extension, while by that indicator corn is positioned just after sugar cane and mixture of grasses and legumes used in animal nutrition. Achieved yields were around 5.6 t/ha. They had also growing trend in last twenty years, with total rise for more than 50%. Considering regionally, both Americas produce more than half of global corn production. They are followed by Asia with around 30%, Europe with around 11% and Africa with 7%. Top five producers in 2014. were USA with around 35% of world production, then China with 21%, Basil with 8%, and Argentina and Ukraine with modest 3% each (FAO, 2016).

2. Production Costs

Cost of production per unit is the cost associated with production divided by the number of units produced. The difficulty in calculating the cost of production is usually thought to be in assembling all the costs associated with production and there are volumes written about the correct procedures. However, the question of the relationship of the production cost to the price of the product is seldom discussed (Jensen, Anderson, 2014). One reason for this is the relationship seems very straightforward. In single product enterprises, the cost of production can be compared directly to the price of the product, regardless of the method used to calculate the cost of production.

The production cost depends on: $$P = Y/C \qquad (1)$$

Where:

P - Production cost

Y - Yield per acre

C - Cost of production per acre

The production price of corn, as well as all other agricultural products, changes from year to year. It oscillates depending on yields and costs changing. Depending primarily on the climatic conditions, the yields of corn vary significantly from year to year. On the other side, the costs of production depend on oscillation of oil prices, as well as constant growth of pesticide, fertilizers and seed prices, etc. Generally, with higher yields, or lower prices of input, the production price of corn will be lower (Bošnjak et al., 2003; Tomić et al., 2009; Saghaian, 2010; McPhail, Babcock, 2012).

In regard that the corn market is generally global, achieved average production costs per product unit in the country which is the most important producer - the USA, are the most important element for forming a world price of corn (Zulauf, 2015). Although there are more information systems which show the costs of production for corn and other crop cultures, the USDAs' system - Commodity Costs and Returns (Foreman, 2006) is used the most.

3. Used Data and Methodology

Survey done in this paper was based on USDA-ERS data for the period 1996-2015. Some elements needed for conducted analyses are: *Gross value of production* that was calculated based on value of primary product - corn grain and secondary product - corn silage; *Operating costs* that were covered costs of: seed, fertilizers, pesticides, custom operations, fuel, lube, electricity, repairs, purchased irrigation water and interest on operating capital; *Allocated overhead* which include: hired labour, opportunity costs of unpaid labour, capital recovery of machinery and equipment, opportunity costs of land (rental rate), taxes and insurance, general farm overhead; *Total, costs listed* include total operating costs and total allocated overhead.

Statistical methods applied in the analysis are: standard deviations, mean values of variation coefficient and correlation analysis.

4. Results with Discussion

By next tables were considered all elements that describe corn production in observed period (Table 1 and 2.).

Table 1: Corn production costs and returns in period 1996-2015.

Element	1996.	1997.	1998.	1999.	2000.
Primary product: Corn grain	366.46	327.60	259.76	228.15	244.26
Secondary product: Corn silage	3.47	3.77	3.12	2.55	2.41
Total, operating costs (USD per planted acre)	160.95	162.25	157.71	156.92	164.99
Total, allocated overhead (USD per planted acre)	192.99	201.48	205.15	207.81	213.33
Total, costs listed (USD per planted acre)	353.94	363.73	362.86	364.73	378.32
Yield (bushels per planted acre)	130	130	136	135	138
Price (USD per bushel at harvest)	2.82	2.52	1.91	1.69	1.77
Operating cost per bushel*	1.21	1.22	1.14	1.14	1.18
Cash price/operating cost per bushel*	2.33	2.07	1.68	1.48	1.50
Profit margin under operating cost*	132.70%	106.71%	68.03%	47.79%	50.24%
Total cost per bushel*	2.70	2.77	2.65	2.68	2.72
Cash price/total cost per bushel*	1.05	0.91	0.72	0.63	0.65
Profit margin under total cost*	4.56%	-8.99%	-27.79%	-37.01%	-35.02%
Element	**2001.**	**2002.**	**2003.**	**2004.**	**2005.**
Primary product: Corn grain	264.96	310.88	317.37	359.97	259.26
Secondary product: Corn silage	1.96	1.94	2.25	2.38	1.17
Total, operating costs (USD per planted acre)	162.30	145.48	161.16	175.94	186.37
Total, allocated overhead (USD per planted acre)	186.23	188.83	193.25	201.56	200.51
Total, costs listed (USD per planted acre)	348.53	334.31	354.41	377.50	386.88
Yield (bushels per planted acre)	144	134	149	169	149
Price (USD per bushel at harvest)	1.84	2.32	2.13	2.13	1.74
Operating cost per bushel*	1.11	1.07	1.07	1.03	1.24
Cash price/operating cost per bushel*	1.65	2.17	2.00	2.07	1.40
Profit margin under operating cost*	65.25%	116.58%	99.72%	107.40%	39.99%
Total cost per bushel*	2.41	2.48	2.36	2.22	2.59
Cash price/total cost per bushel*	0.76	0.94	0.90	0.96	0.67
Profit margin under total cost*	-23.55%	-6.47%	-9.88%	-4.04%	-32.78%

Source: USDA, 2016. Note: *Authors calculation based on USDA-ERS, Commodity Costs and Returns data.

Table 2: Corn production costs and returns in period 1996-2015. - continuing

Element	2006.	2007.	2008.	2009.	2010.
Primary product: Corn grain	350.52	467.61	627.84	560.04	688.47
Secondary product: Corn silage	1.35	1.33	1.52	1.18	0.92
Total, operating costs (USD per planted acre)	205.98	228.99	295.69	295.01	286.41
Total, allocated overhead (USD per planted acre)	203.76	214.98	233.69	255.69	263.79
Total, costs listed (USD per planted acre)	409.74	443.97	529.38	550.70	550.20
Yield (bushels per planted acre)	138	143	144	156	159
Price (USD per bushel at harvest)	2.54	3.27	4.36	3.59	4.33
Operating cost per bushel*	1.48	1.59	2.04	1.88	1.80
Cash price/operating cost per bushel*	1.71	2.05	2.13	1.91	2.41
Profit margin under operating cost*	71.29%	105.40%	113.43%	90.60%	141.15%
Total cost per bushel*	2.96	3.10	3.67	3.52	3.45
Cash price/total cost per bushel*	0.86	1.06	1.19	1.02	1.25
Profit margin under total cost*	-14.17%	5.64%	18.94%	1.91%	25.34%
Element	**2011.**	**2012.**	**2013.**	**2014.**	**2015.**
Primary product: Corn grain	836.58	801.22	719.16	601.80	611.22
Secondary product: Corn silage	1.19	1.33	1.35	1.38	1.40

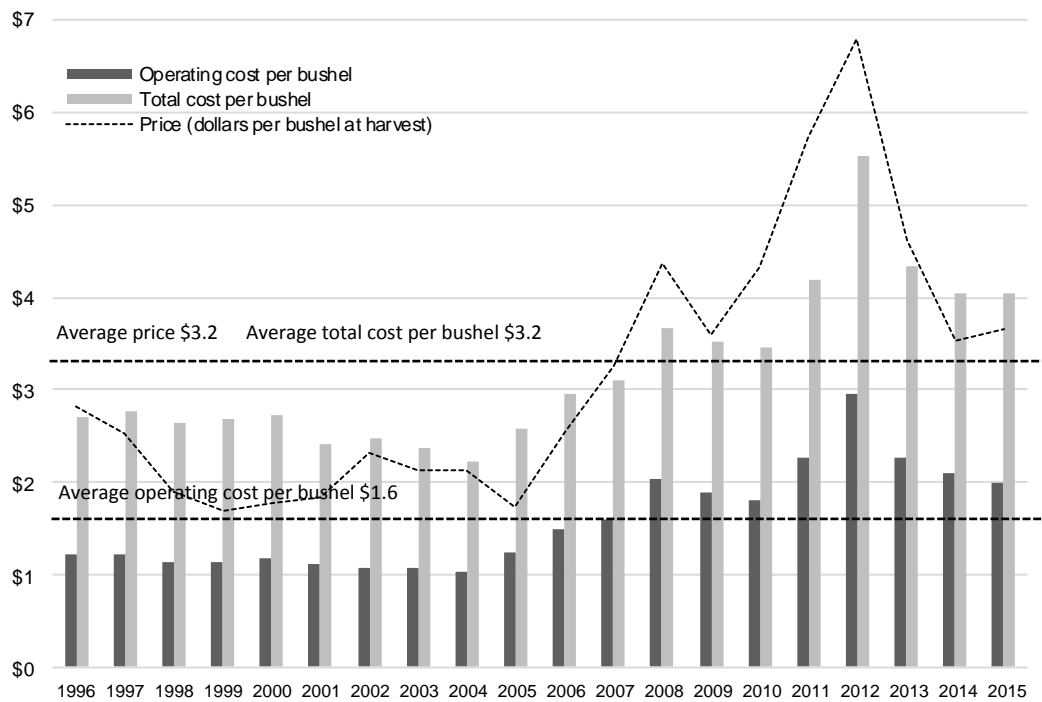|					
Total, operating costs (USD per planted acre)	332.33	349.59	355.60	356.92	334.69
Total, allocated overhead (USD per planted acre)	281.13	303.98	320.85	332.88	341.91
Total, costs listed (USD per planted acre)	613.46	653.57	676.45	689.80	676.60
Yield (bushels per planted acre)	146	118	156	170	167
Price (USD per bushel at harvest)	5.73	6.79	4.61	3.54	3.66
Operating cost per bushel*	2.27	2.95	2.27	2.09	2.00
Cash price/operating cost per bushel*	2.53	2.30	2.03	1.69	1.83
Profit margin under operating cost*	152.64%	130.06%	103.01%	69.26%	83.39%
Total cost per bushel*	4.19	5.53	4.33	4.05	4.04
Cash price/total cost per bushel*	1.37	1.23	1.07	0.87	0.91
Profit margin under total cost*	36.64%	22.84%	6.53%	-12.58%	-9.48%

Source: USDA, 2016. Note: *Authors calculation based on USDA-ERS, Commodity Costs and Returns data.

There can be noticed (Figure 1.) high correlation between the operational costs per bushel and the cash price at harvest, as well as high correlation between the total costs per bushel and the cash price at harvest.

The average cash price is completely equal to the average total cost per bushel (3.2 USD), while the annually expressed cash price within the observed period has never come down below neither the operational costs per bushel, nor the average operational costs per bushel.

Direct correlation between the production costs and cash price can be perceived the best in 2012., when the highest production costs led to highest recorded cash price of corn.

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Figure 1: Trend of operational costs per bushel, total costs per bushel and price in USD per bushel

Source: Authors calculation based on USDA, 2016.

The operational costs are correlated with the cash price, so in analysed period the cash price has neither fallen down below the average operational cost, nor below an annual operational cost in any observed year. Therefore the average operational costs can be considered as a sharp boundary of resistance to further decline of cash price, and according to the conducted analysis, moment of cash price equalization to the average operational costs represents the good opportunity to purchase corn. Studying correlation between the observed parameters was conducted on detrend data. Values of the correlation coefficients and their significance were shown in Table 3.
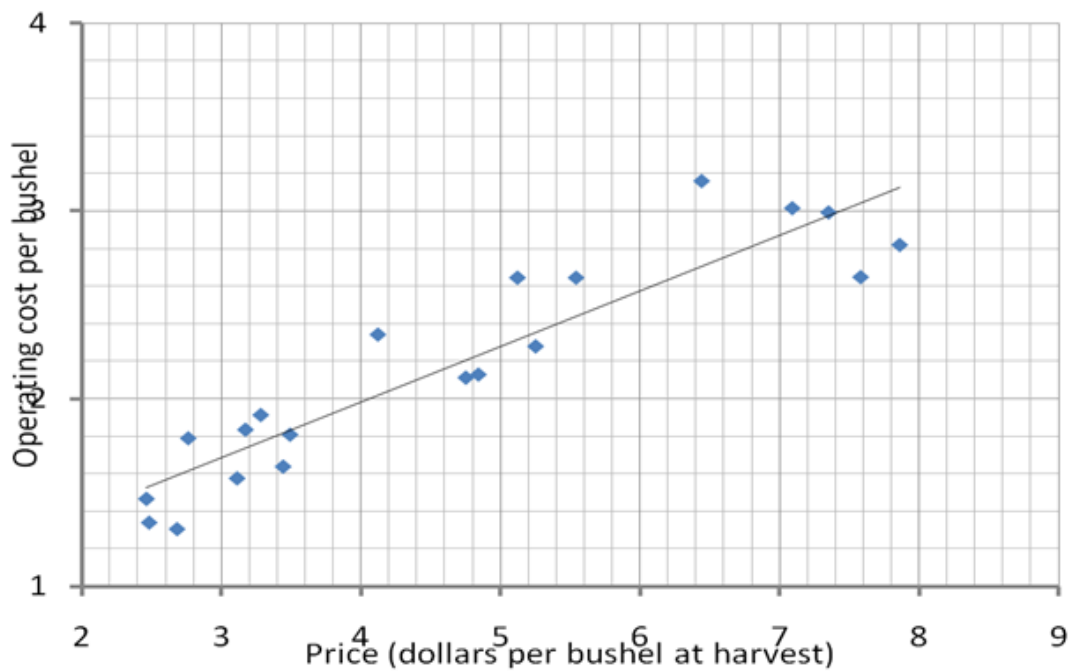
Table 3: Values of the correlation coefficient and their relevance

Element	Operating costs per bushel vs Price (USD per bushel at harvest)	Total costs per bushel vs Price (USD per bushel at harvest)
Corn price	0.898[**]	0.839[**]

Source: Authors calculation based on USDA, 2016. Note: **Correlation is significant at the level 0.01

In accordance to the correlation analysis, there can be concluded high correlation between the operating costs per bushel and price of corn (USD per bushel at harvest), as well as in some extent lower, but still high correlation between the total costs per bushel vs price of corn (USD per bushel at harvest).

The correlation between operating costs per bushel and price of corn (USD per bushel at harvest) and total costs per bushel vs corn price (USD per bushel at harvest) is presented at Figure 2. and Figure 3.

Figure 2: Oprerating costs per bushel vs corn price

Source: Authors calculation based on USDA, 2016.

There can be concluded that high correlation between operating costs per bushel and corn price (USD per bushel at harvest) could represents an excellent tool for the forecasting of corn cash price based on the forecast of operating costs. Also it could be more reliable indicator than total costs per bushel vs corn price (USD per bushel at harvest).
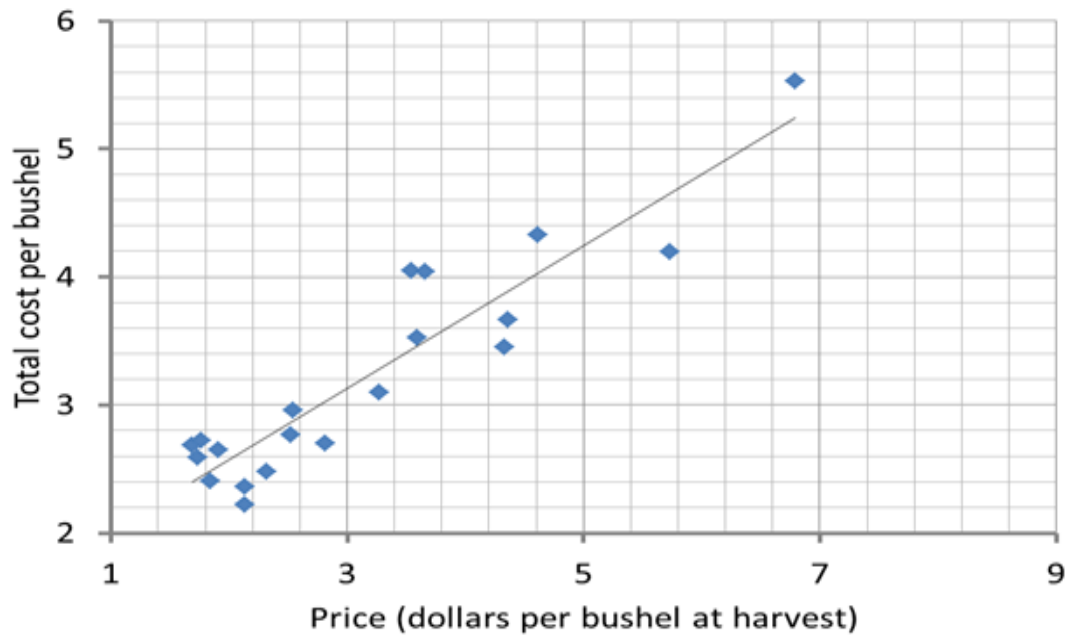
Figure 3. Total costs per bushel vs corn price

Source: Authors calculation based on USDA, 2016.

The values of statistical indicators for standard deviation (STD), mean value (MV) and the coefficient of variation (CV) for the corn market value/operating costs per bushel and corn market value/total costs per bushel are given in Table 4.

Table 4: Statistical indicators determine the relation between price and costs

Element		STD	MV	CV (%)
Corn price	Cash price/ operating costs per bushel	0.3215	1.95	16.51
	Cash price/ total costs per bushel	0.2072	0.95	21.80

Source: Authors calculation based on USDA, 2016.

The variation of ratio between the production prices and the cash prices for corn is significant. There is still one possible question, wherefrom is such a huge variation (related to production prices and cash prices), as for the most of products mentioned ratio is much stabile, i.e. the costs of marketing and expected profit margin are adding to the production price (McPhail et al., 2012). Explanation lies in following facts:

- Corn is mostly produced once a year, then it is stored and used during the whole year, so corn price depends on previous stocks and assessment of available quantities within the entire year (Good, Irwin, 2015).

- The price of corn also depends on a price and totally produced quantities of other products that can replace corn in daily use, such as soybean meal, wheat, etc. (Zulauf, Rettig, 2015).

- The price of corn depends on seasonal and annual demand, especially demand for processing into bio-fuels.

- Current corn price and its volatility can be also influenced by the present value of US Weighted Dollar Index (relative measure of the USD value in compare to other currencies), (Whittaker, 2014).

- Besides all, determinant of corn price oscillation could be rate of economic growth and level commodity demand (potential import), primarily in China and partly in India. Related to corn, in last few decades, China demand for corn increase rapidly (net importer of corn), mainly caused by fast development of livestock production, so imported volumes are usually in function of feed (Gale et al., 2015).

- USA is the most important corn producer, so the production costs in the USA have the most important impact on the global corn market (Fuglie, 2008).

Further analysis (Figure 1.) may show that USAs farmers had produced the corn without any profit in some years of observed period, since the total production costs have been above or equal the corn cash price. Since it was computed a total economic costs, economic theory underlines that "economic profit" should average zero over a time (Rogerson, 1989). General reasons that influence somewhat negative average profit may be recognized in:

- Charges for the opportunity costs of unpaid labour (wages) and land (tenure) may be greater than those considered by farmers. For example, some producers may be willing to remain in production earning a wage lower than what their labour was

previously valued, due to the satisfaction they receive from being a farmer and/or the costs associated with switching occupations, among other reasons.

- Charge for capital is a replacement cost indicating the amount of funds that producers must set aside each year to replace capital assets as they wear-out or become obsolete. Some producers do not consider this in their decision to produce, because they plan to exit production once their current capital stock is no longer functional.

- Only costs and returns for production were included, without marketing activity. Farmers may earn positive returns to marketing crops on average that would offset the negative returns computed on average from production.

- The trend in USA commodity production is toward fewer and larger farms. The negative returns are consistent with this trend as older high-cost commodity producers are exiting production and being replaced by larger low-cost producers.

- Many USA farm households generate income from off-farm employment, businesses, and/or investments. They may be using this income to subsidize agricultural production.

- The crop insurance program and other subsidies are not included in calculation which to some extent may encourage farmers to remain in production when they otherwise would not.

Subsidies and supports at different moments may have been behind the chronic negative returns above economic costs that are shown. However, current USA farm programs are primarily insurance based and out the direct payments to farmers that were part of past farm policy (WTO, 2014).

5. Conclusion

According to the gained results, there was determined high correlation between the operating and total costs in the production of corn and the cash price of corn. Significantly high correlation was determined within the cash price/operating costs per bushel ratio, making them more reliable for the forecast of price trends in regard to indicator cash price/total costs per bushel. Such a high correlation can be explained primarily with the possibility of corn storage, as in period of low prices farmers are unwilling to sell corn below the amount of operating costs.

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At total production costs it was determined that the cash corn price is often lower than total costs. Among possible reasons for that, the dominant is that farmers' labour usually was not counted in the full amount as a cost, as well as some significant overhead costs such is opportunity costs of agricultural land renting. Then, corn is produced once a year, stored and used during the whole year, so its price is affected by previous stocks and assessment of available quantities during the entire year, or corn price depends on price and produced quantity of other products that can substitute the corn. Also it depends on annual and seasonal demand, especially demand focused on processing into the bio-fuels, as well as production prices and total quantity produced outside the USA, etc.

It was determined the significant variance within the relation of production costs and the corn cash price. Lower variation of ratio cash price/operating costs per bushel than ratio cash price/total cost per bushel, makes the operating costs per bushel more reliable indicator in corn price forecasting.

Furthermore, all results gained by analyses were expressed in the relative way, i.e. in ratio that reflects production costs and incomes during one production year. By that was avoided inclusion of inflation effects, as otherwise it would represent a significant element in long term analysis. Farmers can use the analyses for their own corn production, comparing the gained results with USA average, in order to determine their competitiveness.

Conducted analysis shows that producers and participants in corn trade can use a determined ratio between the production costs and corn cash price in order to better perceive corn price trends. The correlation between the operational costs in corn production and cash price is highly significant, since in case when cash price gets close to the total operational costs, farmers more prefer to store the corn and decrease the supply, preventing on that way further decline in corn price. So in observed two decade period, the cash price has never fallen down below the average operational costs or below the annual operational costs in any observed year.

Recommendation for further research could be directed to the linkage of corn cash price with indicators that describe other products, such as production of soy bean, wheat, livestock, bio-fuels, etc.

6. References

BOŠNJAK, D.; TICA, N.; RODIĆ, V. Economic characteristics of maize production, *Open Access Journal on Field and Vegetable Crops Research*, n.. 38, p. 121-130, 2003.

FAO. *Crops production*, portal of FAO, segment production/crops, Food and Agriculture Organization of the UN, Statistics Division, Rome, Italy, available at: http://faostat3.fao.org/browse/Q/QC/E, accessed: 28th July 2016. 2016.

FOREMAN, L. *Characteristics and Production Costs of U.S. Corn Farms - 2001*, USDA, Economic Research Service, Economic Information Bulletin, no. 7, p. 51, retrieved at: https://core.ac.uk/download/pdf/6372716.pdf. 2016.

FUGLIE, K. O. Is a slowdown in agricultural productivity growth contributing to the rise in commodity prices*? Agricultural Economics*, v. 39, n s1, p. 431-441, 2008.

GALE, F.; HANSEN, J.; JEWISON, M. *China's Growing Demand for Agricultural Imports*, Economic Information Bulletin, no. 136, USDA, USA, p. 39. 2015.

GIBSON, L.; BENSON, G. *Origin, history, and uses of corn (Zea mays),* Iowa State University, Department of Agronomy, Ames, USA, available at: www.agron.iastate.edu/Courses/agron212/readings/corn_history.htm, accessed: 26th June 2106. 2002.

GOOD, D. L.; IRWIN S. H. *Understanding USDA Corn and Soybean Production Forecasts: Methods, Performance and Market Impacts over 1970-2005*, Agricultural Market Advisory Service (AgMAS) Project Research Report no. 2006-01, University of Illinois, Urbana – Champaign, USA, p. 48, Available at: http://dx.doi.org/10.2139/ssrn.897279, accessed: 22nd July 2016. 2006.

GOOD, D. L.; IRWIN, S. H. *The Relationship between Stocks-to-Use and Corn Prices Revisited*, Farmdoc daily, v. 5, no. 65, Department of Agricultural and Consumer Economics, University of Illinois, Urbana - Champaign, USA, p. 6, available at: http://farmdocdaily.illinois.edu/pdf/fdd090415.pdf, accessed: 25th July 2016. 2015.

HALLAUER, A. R.; CARENA, M. J. *Maize*, in: Cereals, v. 3 of the series Handbook of plant breeding, (Edt., Carena, M. J.), Springer-Verlag, New York, USA, p. 3-98. 2009.

JENSEN, H. G.; ANDERSON, K. *Grain Price Spikes and Beggar-Thy-Neighbor Policy Responses: A Global Economywide Analysis*, Policy Research Working Paper no. WPS7007, World Bank group, Development Research Group, Agriculture and Rural Development Team, WB, Washington DC, USA, p. 36, accessed: 11th August 2016, available at: http://documents.worldbank.org/curated/en/472501468147868147/pdf/WPS7007.pdf, 2014.

MCPHAIL, L. L.; BABCOCK, B. A. Impact of US Biofuel Policy on US Corn and Gasoline Price Variability, *Energy*, v. 37, n. 1, p. 505-513, 2012.

MCPHAIL, L. L.; DU, X.; MUHAMMAD, A. Disentangling Corn Price Volatility: The Role of Global Demand, Speculation, and Energy, *Journal of Agricultural and Applied Economics*, v. 44, n. 3, p. 401-410, 2012.

ROGERSON, W. P. Profit regulation of defense contractors and prizes for innovation, *Journal of Political Economy*, v. 97, n. 6, p. 1284-1305, 1989.

SAGHAIAN, S. H. The impact of the oil sector on commodity prices: Correlation or causation?*, Journal of Agricultural and Applied Economics*, v. 42, n. 3, p. 477-485, 2010.

STEDUTO, P.; HSIAO, T. C.; FERERES, E.; RAES, D. *Crop yield response to water*, FAO irrigation and drainage paper no. 66, FAO, Rome, Italy, p. 505, 2012.

Tomić, D.; Vlahović, B.; Maksimović, B. Price parities of chosen inputs and basic agricultural products in Serbia, *Škola biznisa*, n. 3, p. 32-42, 2009.

USDA. *Commodity Costs and Returns - Recent Costs and Returns: Corn, Historical Costs and Returns: Corn and Cost-of-Production Forecasts*, portal of USDA, United States Department of Agriculture, Economic Research Service (ERS), Washington DC, USA, available at: www.ers.usda.gov/data-products/commodity-costs-and-returns.aspx, accessed: 1st August 2016. 2016.

WHITTAKER, E. *The Fundamental Factors Affecting Corn Price from 1982-2013*, Senior honor's thesis, Purdue University, Lafayette, USA, p. 23, available at:

https://ag.purdue.edu/agecon/Documents/The%20Fundamental%20Factors%20Affecting%20Corn%20Price%20from%201982-2013.pdf, accessed: 18th March 2017. 2014.

WTO (2014): *The World Trade Organization*, The World Trade Organization (WTO), Geneva, Switzerland, p. 8, available at: www.wto.org/english/res_e/doload_e/inbr_e.pdf, accessed: 26th July 2016.

ZULAUF, C. *Declining Real Cash Cost of Producing Corn, Soybean, and Wheat: Historical Perspective and Potential Implications for the Future*, Farmdoc daily, vol. 5, no. 215, Department of Agricultural and Consumer Economics, University of Illinois, Urbana - Champaign, USA, p. 4, available at: http://farmdocdaily.illinois.edu/pdf/fdd181115.pdf, accessed: 27th July 2016. 2015.

ZULAUF, C.; RETTIG, N. Have U.S. Farm Input Prices Followed U.S. Crop Prices?*, Farmdoc daily*, v. 5, n. 171, Department of Agricultural and Consumer Economics, University of Illinois, Urbana - Champaign, USA, p. 4, available at:

http://farmdocdaily.illinois.edu/pdf/fdd170915.pdf, accessed: 27th July 2016. 2015.

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