Spatial price transmission in pork market in Serbia

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Abstract

Horizontal price transmission is very important issue that has significant influence on agricultural producers and on creators of agricultural policy measures. The main objective of this paper was the estimation of the horizontal price transmission of pork market of the Republic of Serbia. The analysis of the price transmission was related on the examining the impact of pork prices in international market on the domicile pork price with VAR model. The results indicated that in the analysed period pork price in Spain had the biggest impact on pork price in Serbia.

Keywords: Pork. Market. Price. Horizontal transmission.

1. Introduction

As a result of the globalization process, changes are taking place in all areas of human activity. The agricultural sector is one of the sectors that changed considerably. Some of the changes in the agricultural sector relate to the growth of trade in agri-food products. As the

international market is increasingly integrated, prices of agricultural and food products are more transferred to countries involved in international trade. Namely, high international prices of agri-food products have a particularly detrimental effect on the economic and social sector of developing countries that are net food importers (Selliah et al, 2015). Therefore, it is very important to examine the impact of the international price of a particular product on the domicile price, as well as the analysis of price transmission mechanisms.

According to FAO studies, demand for meat will double by 2050. The increase in demand for meat will be result of increased demand in developing countries. While meat consumption is relatively stable in developed countries, annual consumption has doubled in developing countries since 1980. Growth in demand for livestock products is a result of population growth, income growth and changes in consumer preferences (FAOa, 2016).

The main objective of the paper is the examination of the influence of international pork prices on the pork prices in Serbia. More precisely, the horizontal price transmission in pork market was considered. In order to analyze the horizontal price transmission and the impact of the international pork price on the pork price in Serbia, it is necessary to determine the most important participants in the world pork market. More precisely, it is necessary to identify the largest pork exporters, which significantly influence the movement of pork prices on the world market. Also, it is necessary to identify the markets from which Serbia mostly imports pork meat. In accordance with the aim of the paper, appropriate econometric methods have been selected and applied. The paper consists of the following section: first, the theoretical framework of the model used for price transmission analysis was defined. Afterwards the world pork market and the pork market and pork trade in Serbia was explained, and appropriate model was estimated. In the last section of the paper final conclusion are given.

2. Literature Review

Horizontal price transmission, or spatial market integration, measures the level at which markets in geographically separated locations "share" the same long-term trend in price movements. A spatial price transmission can indicate how price changes transfer to spatially distant markets within a country or city, and the way in which price signals from the international market are transferred to the domicile market. According to Bakucs and Ferto (2005), spatial transmission, or horizontal market integration, represents the time needed that

price shocks from one spatial separate market shift to another. According to Ghosary (2011) price transmission is measured as the elasticity of price transmission. The price elasticity represents a percentage change in product prices in one market, resulting from a percentage change in the price on another market. Liu (2011) considers that price transmission models are mainly used to indicate that changes in supply and demand for a product in one country will be transferred to the price of that product in another country. Listorti and Esposti (2012) asserts a horizontal price transmission can also refer to the transmission of prices between different agri-food products (cross-commodity price transmission), as well as to the transmission of prices between non-agricultural and agricultural and food products. Regardless of the type of horizontal transmission, the analysis of price transmission and the information provided by that analysis is of great importance to agricultural producers and creators of agricultural policy measures.

Namely, imperfectly integrated markets can convey inaccurate information on price changes to agricultural producers and other market participants, which may result in inadequate decisions of agricultural producers and creators of agricultural policy measures, as well as in inefficient trade in agri-food products. In addition, accurate information is of great importance for creating intervention strategies to prevent food insecurity, since the integration of spatially distant markets allows the provision of a regional balance between areas where there are market surpluses and areas where there is a food deficit (Abdulai, 2007).

There is a large number of authors dealing with the analysis of the horizontal price transmission on the market of agri-food products. As part of the extensive literature available in this field, various authors have tried to provide answers to many questions regarding horizontal price transmission. Some of these issues are the functioning of the market and market performance, regional and international trade relations, market efficiency etc.

The horizontal price transmission on the pork market had, so far, been analyzed by several authors. Namely, Sanjuan and Gil (1998) analyze the spatial transmission between the prices of pork in seven EU countries (the Netherlands, Italy, Germany, France, Denmark, Great Britain and Spain). The results of the research indicate the existence of a high degree of interdependence between the prices of the analyzed EU countries.

Also, price shocks from countries of intra-trade are more significant and they are transferred faster and more intensively to other countries. The results provide empirical evidence of the efficiency of the European Union market, indicating a high level of integration in terms of price transmission. Meyer (2004) analyzes the integration of the EU

pig market using the Threshold Vector Error Correction Model (TVECM). More specifically, author analyzes the integration of the pig market in Germany and the Netherlands. Liu (2011) examines the integration of Finland's beef and pork market with the markets in Germany and Denmark by using symmetric and asymmetric Threshold Error Correction Models (TECM). The results of the study indicate that there is a cointegration between the prices of beef and pork meat of Finland and Germany, with the cointegration between pork prices being symmetrical, while the price of beef meat is asymmetrical.

On the other hand, the results of the research indicate symmetrical cointegration between the prices of beef and pork meat of Finland and Denmark. Authors Holst and Von Cramon Taubadel (2014) analyses the impact of the accession of new members (2004 and 2007) on the integration of the pork market in the EU. The results of the research show that the rate of transmission of price signals is related to the volume of trade between the two countries.

Also, the results indicate that the intra-regional price transmission between the old or the new Member States is faster than the inter-regional price transmission between the old and new Member States, and that the prices of the agricultural products in the new Member States are more quickly adjusted to the price changes in the old Member States, but not vice versa. Similarly, the results indicate that price signals are transmitted faster between countries sharing the same boundary. However, the authors assert that the transmission of price signals exists among countries that do not trade pork meat among themselves, which proves that mutual trade in agricultural products is not a prerequisite for the existence of a price transmission.

Djuric and Puskaric (2015) analyzed the impact of the pork import ban from the European Union to Russia at the price of pork in Serbia using the Autoregressive Distributed Lag model (ARDL). The paper analyzes the impact of the ban on the short-term and long-term transmission of pork prices from selected EU countries (Spain) and Russia to the price of pork in Serbia. The results of the study indicate that changes in the prices of pork meat in Russia in the short run play a significant role in the formation of pork prices in Serbia.

3. Materials and Methods

Vector Autoregression model (VAR model) was developed as an alternative to method of simultaneous equations. It represents a system of regression model in which there is more

than one dependent variable, and all variables depend on their own lags as well on lags from all other variables. The basic bivariate VAR model, with two variables in standard form:

$$y_t = \alpha_0 + \alpha_1 x_{t-1} + \beta_1 y_{t-1\ldots} + \alpha_k x_{t-k} \beta_k y_{t-k} + u_t$$

$$x_t = \gamma_0 + \gamma_1 x_{t-1} + \delta_1 y_{t-1\ldots} + \gamma_k x_{t-1} + \delta_k y_{t-1} + v_t$$

VAR model is assessed by the method of ordinary least square, assuming there is no autocorrelation of residuals. Also, it is very important to determine the number of lags that should be included in model. The optimal structure of model, i.e the number of lags, is determined with the information criterions.

For the purposes of the research, the database of the Statistical Office of the Republic of Serbia (SORS) was used, that is, the data related to foreign trade in pork in the period 2004-2015 were used. The term pork meat, in terms of foreign trade, includes the subgroup of "Pork Meat fresh, chilled, frozen" (0122) according to the SITC methodology (Standard International Trade Classification) Revision 4 (Sector 0 - Food and live animals, Section 01 - Meat and meat processing, Group 012- Other meat and edible waste, fresh, frozen, Subgroup 0122 - Pork meat fresh, chilled, frozen).

For the purposes of the international pork market research, FAOSTAT database was used, where pork meat is defined as pork meat with bones of domestic and wild boar, fresh, chilled or frozen (product code 1035). On the other hand, for the trade the UN COMTRADE data was used (subgroup 0122 within the Standard International Trade Classification, Revision 3 (2004-2006) and Revision 4 (period 2007-2014)).

The empirical analysis of the horizontal price transmission is based on the monthly price data for the period May 2004 to October 2015. Data sources were used as follows:

- EUROSTAT database for pricing data in Spain, Germany, Hungary and Denmark.
- USDA database for pricing data in the USA.
- Monthly statistical bulletins for prices in Serbia.
- OANDA database for data on the average monthly exchange rate.

4. Results and Discussion

4.1. World meat market

Meat production in the world is constantly increasing. In the past decade, meat production in the world grew, on average, 2.48% annually (the author's calculation based on FAOSTAT data). In the world's meat production the largest share have pork, poultry and beef

meat with a share of 36.67%, 29.10% and 22.03%, respectively. Pork meat also ranks first in terms of meat consumption in the world with a share of 36% (FAO, 2015).

In the analyzed period, the average annual growth rate of pork production was 2.27%. The two biggest pork producers in the world are China and the EU. Also, among the more important pork producers in the world are the United States and Brazil. Considering the EU, the largest pork producers in the EU are Germany, Spain, France, the Netherlands and Denmark.

According to UN COMTRADE (2016), pork trade is also growing steadily. From the aspect of the value of exports, the largest pork exporters in the world are the EU, USA, Canada and Brazil. The leading pork exporter in the EU, which is also the largest exporter in the world, is Germany. Namely, in the observed period, Germany's participation in the total export of pork was 14.61%. Significant exporters of pig meat in the EU are also Denmark and Spain, which individually rank third and fourth in the world.

According to the value of imports, the most important importer of pork in the world is Japan. According to UN COMTRADE (2016), in the observed period, Japan accounted for 18.32% of total imports of pork in the world. Significant importers of pork in the world are also Italy (9.87%), Russia (6.95%) and China (5.87%).

The most significant change in the past period that took place in the world pork market is certainly the sanctions of the Russian Federation, which mostly affected the export of pork from the EU (FAOb, 2016). Until then, the largest amount of EU pork meat was exported to the Russian Federation. Namely, in the period from 2011-2013 on average, the EU exported 800,000 tons of pork and pork products to the territory of the Russian Federation, which accounted for 24% of the total EU pork exports. The largest percentage of exported pork (43%) makes frozen meat (European Commission, 2014). After the sanctions, pork exports from the EU are directed to countries in Asia, specifically in Japan, the Republic of Korea, China and the Philippines. However, at the end of 2014 and beginning of 2015, the demand for pork from these countries declined significantly, and the EU increased the supply of pork on the domestic market, which subsequently reflected a decline in the EU market price. As a result of such developments, the European Commission established private storage aid schemes in February 2015 in order to contribute to the recovery of prices. Lower pork prices are expected to be the main driver of trade growth in the future (FAOb, 2016).

4.2. Pork trade in Serbia

The ratio of exports and imports of subgroup "Meat of pork fresh, chilled, frozen" in Serbia mainly resulted in negative foreign trade balance. A positive trade balance was achieved in only three years of the observed period (Figure 1).

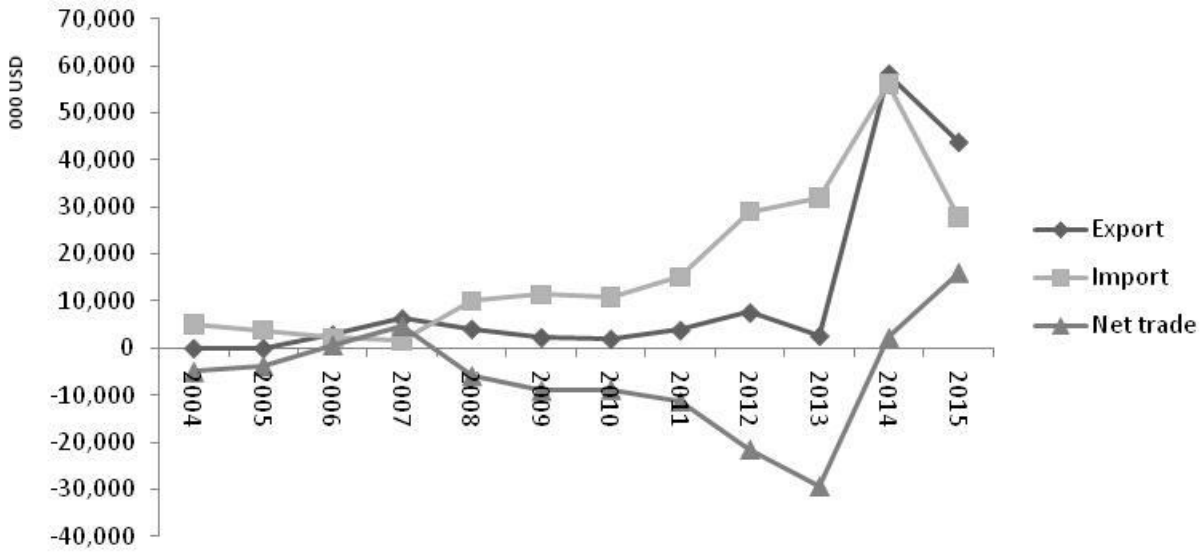

Figure 1: Pork net trade in Serbia

Source: Statistical Office of Republic of Serbia (SORS), 2017

In the analyzed period, the largest share of pork exports in total exports was in 2014, but it is still negligible compared to other agri-food products. In the observed period, there was an increase in the value of pork exports. As the result of pork export increase to the Russian Federation, the value of exports in 2014 rose nominally from USD 20.8 thousand to USD 58 million in relation to 2004.

In the total subgroup of exports, the export of products "Carcasses and half-carcaseas of swine, fresh or chilled" has the largest share with 53.4%. On the other hand, the product "Hams and shoulders of swine frozen" has the smallest share with only 0.78% (Figure 2). An analysis of the geographical allocation of Serbia's pork exports revealed that 95.81% was exported to the Russian Federation (69.25%) and the CEFTA countries, the Republic of Montenegro (18.89%) and the Republic of Macedonia (7.67%). Namely, such a high percentage of exports of pork to Russia has been realized since 2011 after Russia granted

duty-free imports for a number of agri-food products from Serbia. Also, after the sanctions of the Russian Federation in early 2014 for the EU, and in August 2014 for food products, including pork, for the United States, Canada, Australia and Norway, the export of pork from Serbia to the territory of the Russian Federation increased. The value of pork exports to Russia rose from USD 1,854 thousand in nominally to USD 54 million in 2014. That is, in 2014, the total value of export of sub-group 0122 amounted USD 58 million, of which about 93% was achieved by exports to Russia, while the remaining 7% of the value of exports was achieved through exports to Bosnia and Herzegovina, Belarus, Montenegro and the Republic of Macedonia. When it comes to the EU market, the export of pork from Serbia is not allowed due to the vaccination of pigs against swine fever.

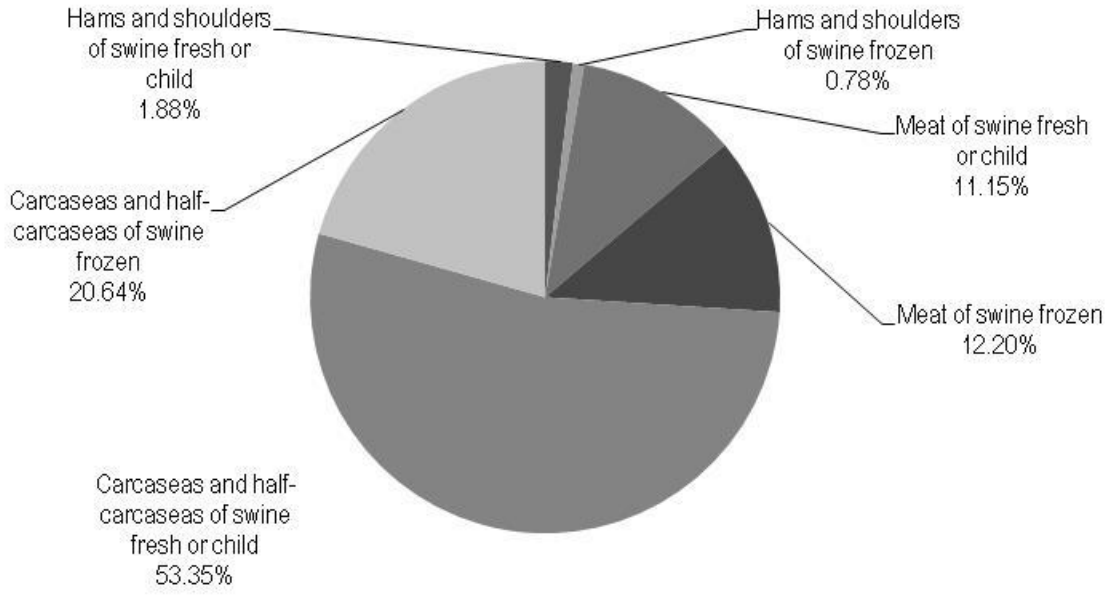

Figure 2: Pork export structure in Serbia in the period 2004-2015.

Source: The authors` calculation on the basis of SORS, 2017

Import of pork is a minor segment of the total import of Serbia (0.09%), but it is constantly increasing. In the analyzed period, there was an increase in the value of pork imports, and the share of imports of this subgroup in total imports was the highest in 2014 (0.27%). In the structure of imports of pork meat, the import of the product "Meat of swine frozen" is dominant (Figure 3). The share of the value of imports of this product in the total value of imports of pork in the past decade was 87.57%. On the other hand, the product that has the least share in the structure of the value of imports is the product "Carcasses and half-carcaseas of swine frozen" with a share of 0.04%. The highest percentage of pork in the past

decade has been imported from EU countries. More precisely, according to the SORS data, in the observed period 94.34% of pork imports come from the EU. The most imported countries are Spain (40.06%), Hungary (19.52%) and Germany (16.60%). In 2014, when Serbia exported a significant part of domestic production to Russia, in order to meet domestic demand, pork imports increased. In that year, pork meat imports increased mostly from Spain, and the value of imports from from US $ 18.1 million in 2013, increased to $ 30.2 million. According to Živkov et al. (2010), the largest possibility of importing pig meat comes from the EU countries because they are among the most competitive producers in the world.

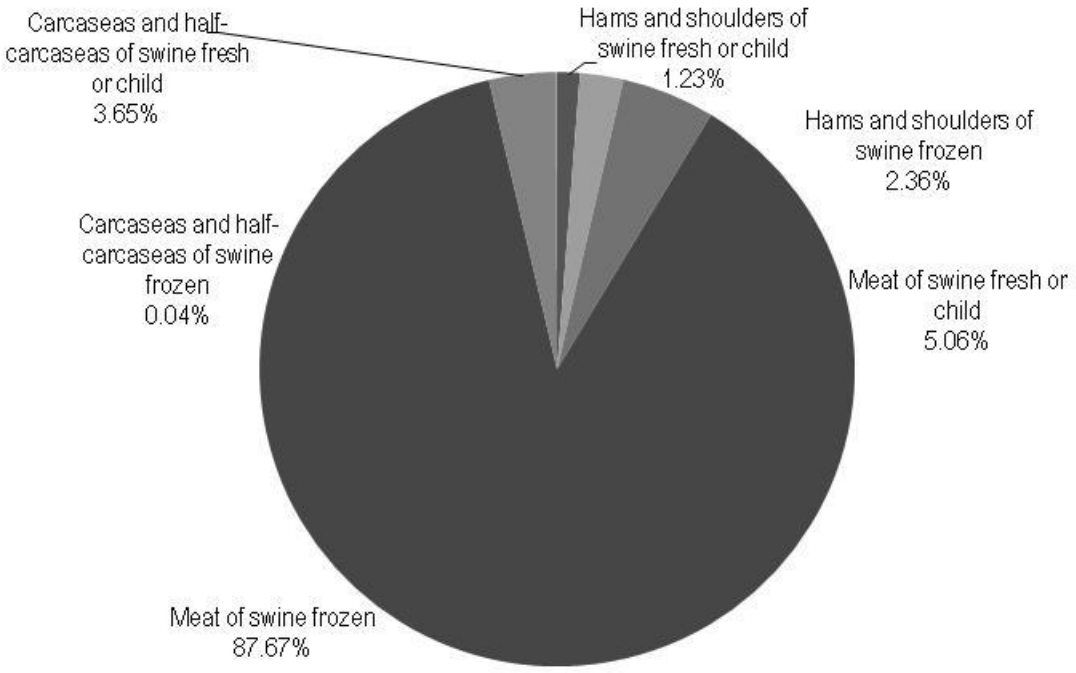

Figure 3: Pork import structure in Serbia in period 2004-2015.

Source: The authors` calculation on the basis of SORS, 2017

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4.3. Horizontal price transmission

For the purposes of horizontal price transmission analysis, the price of pork from Germany, Denmark, the United States and Spain, will be taken into consideration. Namely, those countries represented the four largest exporters in the world, accounting for 52% of the total exports of pork. Considering the fact that in analysed period Serbia imported large amount of pork from Hungary, the pork price from Hungary will be considered also.

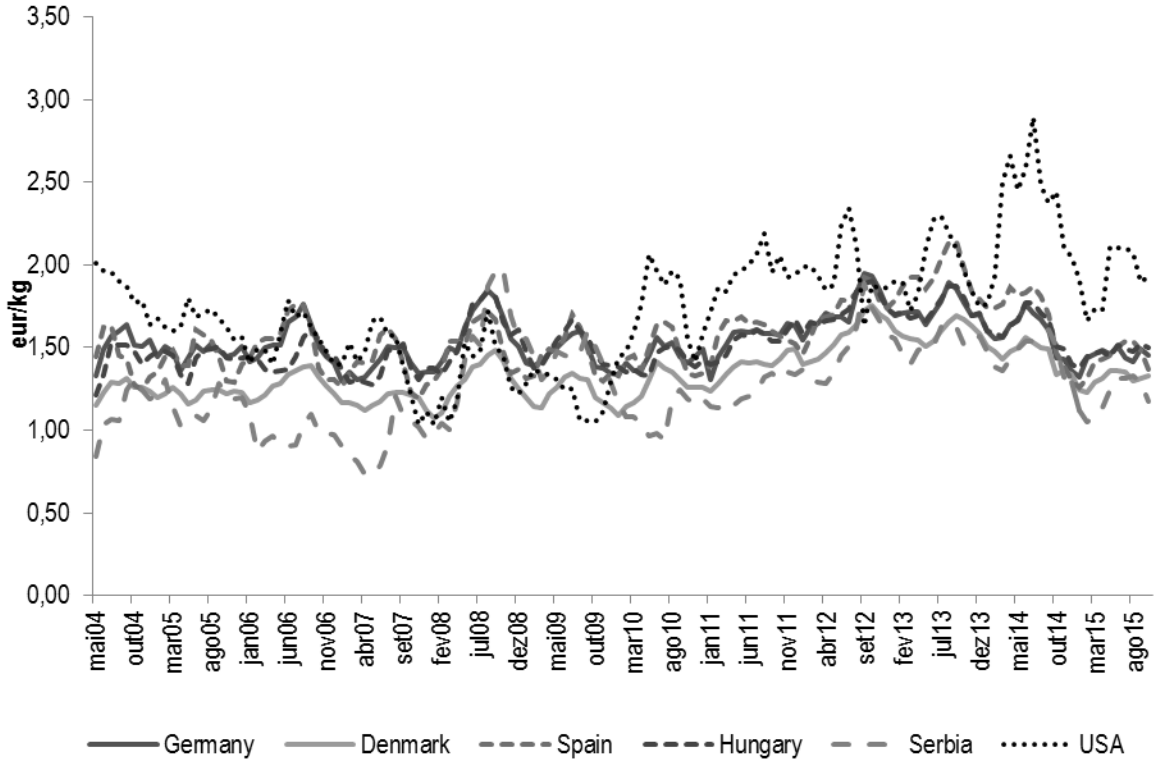

Figure 4: Dynamics of pork prices in Germany, Denmark, Spain, Hungary, Serbia, USA

Source: EUROSTAT, USDA, Monthly statistical bullitens of Serbia.

Based on the data presented in Figure 4, it is evident that prices in Serbia follow the trend of price movements in the analyzed EU countries. The price of pork in Serbia was below average in May 2007. The fall in prices in Serbia in 2007 was the result of a significant increase in pig imports compared to the previous period. The maximum price in Serbia was reached in October 2008, when other agricultural products (milk, cereals, oil crops, sugar) also increased.

The price of pork in the analyzed countries of the EU has a very similar trend of movement. Namely, the price in the EU countries had a tendency of a slight increase until October 2014. After that, due to Russia's sanctions and the decline in demand in Asian countries, the EU has increased the supply in the domestic market, resulting in a fall in prices. When it comes to the USA, the price has a tendency to rise, and reached its maximum in July 2014, after which it began to decline. The main reason behind the average price increase in the USA in 2014 is an Porcine Epidemic Diarrhea (PEDv), which caused a high mortality rate of piglets, which negatively affected pork production.

The unit root test was used to test stationary and to determine the order of integration of variables. For the test of data series stationary the augmented Dickey Fuller, ADF, test was used. The results of the ADF test are shown in the Table 1. According to data in Table 1 the results of ADF test indicate that price data series are not integrated in the first order, so it is not possible to examine the existence of cointegration between the analyzed data series.

Table 1: ADF test results

Variable	I	II
sr	-2.761055	-3.341226
difsr	-6.796049	-6.810623
es	-2.323316	-2.299511
difes	-2.447308	-2.624525
usa	-2.78641	-3.324648
difusa	-6.616458	-6.613978
ge	-2.616879	-3.00786
difge	-2.839926	-2.851364
hu	-2.47851	-2.916087
difhu	-2.730642	-2.796615
de	-1.417866	-1.317616
difde	-3.817428	-3.805326

I - with intercept, II -with intercept and trend, significance level 5%

Source: The authors`calculation.

Since the series of data on the prices are non-stationary and are different order of integration (I (1) and I (2)) the VAR model will be applied. Namely, since it is not possible to analyze the cointegration, the main objective of the analysis of the horizontal price transmission is to look at the correlation of the price movement in Serbia with the prices of the relevant markets.

In the specification and estimation of the VAR model for the purposes of this paper, assertion of the Brooks (2002) was used. Namely, Brooks claims that prior to the model estimation it is not necessary to perform the data differentiation. More precisely, when assessing the model, the significance of the estimated coefficients will not be considered, but the analysis of the horizontal price transmission analysis would be based on the results of the impulse response function. For the results of the of the impulse response function order of entering variables is very important. Therefore, the introduction of variables into the VAR model will be done on the basis of the significance of the analyzed countries for Serbia from the aspect of the import of pork meat.

The optimal structure of the VAR model is evaluated using the information criteria. Of the five information criteria offered, the results of the three FPE, AIC and HQ criteria, as an optimal number, suggest two lags. On the other hand, the LR information criterion as an optimal number proposes 4 lags, while the SC proposes one lag. Authors Jovičić and Dragutinović-Mitrović (2011) assert that none of the information criteria has a rigorous theoretical conception and that it is not superior in relation to the other criterion. Therefore, since the three information criteria, as an optimal number, suggest two lags, two lags will be included in the model. Also, by including the proposed number of lags in the VAR model there is no autocorrelation of the residuals. Therefore, the proposed number of lags is considered to be an optimal.

The VAR model which was evaluated had the following form:

$$\mathbf{X_t} = \phi_1 \mathbf{X_{t-1}} + \phi_2 \mathbf{X_{t-2}} + \boldsymbol{\varepsilon_t}$$

where:

ϕ_1 and ϕ_2 - matrix of parameters 6x6 ,

ε_t - vector of random process 6x1,

$\mathbf{X_{t-1}}$ and $\mathbf{X_{t-2}}$ - lags of the VAR model variables.

The VAR model includes 6 variables:

sr - pork price in Serbia.

sp - pork price in Spain.

hu - pork price in Hungary.

ge - pork price in Germany.

de - pork price in Denmark.

usa - pork price in the USA.

$$\phi_1 = \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} & a_{16} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} & a_{26} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} & a_{36} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} & a_{46} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & a_{56} \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} \end{bmatrix} \phi_2 = \begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} & b_{15} & b_{16} \\ b_{21} & b_{22} & b_{23} & b_{24} & b_{25} & b_{26} \\ b_{31} & b_{32} & b_{33} & b_{34} & b_{35} & b_{36} \\ b_{41} & b_{42} & b_{43} & b_{44} & b_{45} & b_{46} \\ b_{51} & b_{52} & b_{53} & b_{54} & b_{55} & b_{56} \\ b_{61} & b_{62} & b_{63} & b_{64} & b_{65} & b_{66} \end{bmatrix}$$

$$\mathbf{X_{t-1}} = \begin{bmatrix} sr_{t-1} \\ sp_{t-1} \\ hu_{t-1} \\ ge_{t-1} \\ de_{t-1} \\ usa_{t-1} \end{bmatrix} \quad \mathbf{X_{t-2}} = \begin{bmatrix} sr_{t-2} \\ sp_{t-2} \\ hu_{t-2} \\ ge_{t-2} \\ de_{t-2} \\ usa_{t-2} \end{bmatrix} \quad \varepsilon_t = \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix}$$

Figure 5 shows the responses of pork prices in Serbia to the impulses of the selected countries pork prices change. Among the analyzed countries, the biggest impact on price changes in Serbia has unexpected price changes in Spain. Namely, when the unexpected change occurs in price in Spain, every answer in the price of Serbia is positive, and it grows by the fifth month, after which this response begins to weaken. A similar price response in Serbia is created when unexpected shock occurs in Hungary, with the price of Serbia responding to price impulses in Hungary significantly lower than unexpected price changes in Spain. The impact of shock in the price of Hungary weakens after the fourth month. The unexpected price changes in Germany and the US (especially Germany) have a very small effect on the price change in Serbia, as the function of the impulse response for the price in Serbia is very close to zero in relation to their changes.

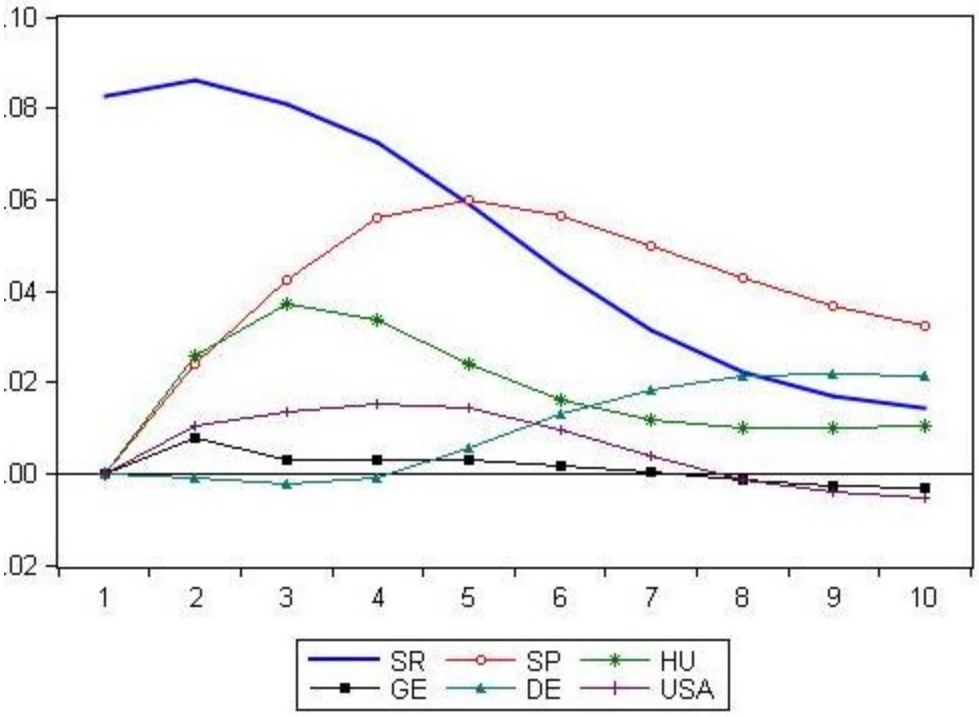

Figure 5: Impulse response function of pork prices in Serbia

Source: The authors` calculation.

The results of the impulse response function (Figure 5) indicate that the biggest impact on the changes in the price of agricultural producers engaged in pig breeding is the price change in Spain, for which the geographical allocation of imports indicated to be the most important market for Serbia in the analyzed period from the aspect of the import of pork meat. Also, the authors Djuric and Puskaric (2015), in their paper, examining the impact of the ban on the import of pork from the EU to Russia using the ARDL model, conclude that the short-term price in Serbia is quickly adapted to the changes in the price of pig meat in Spain. The mentioned authors, as the main reason for such developments, show the growth of imported pork from the EU in order to meet domestic needs, bearing in mind that a significant part of domestic pork production is directed to the Russian market.

When it comes to the US, the results of the impulse response function (Figure 6) indicate that the countries analyzed have no significant impact on changes in the price of the US, except Denmark, but to a very small extent. Namely, this attitude can be explained by the fact that most of the imports of pork meat from the United States come from the NAFTA countries, especially Canada. According to USITC (2014) data, in the period from 2008 to

2013, on average, 85% of pork imports from the USA come from Canada, while 10.2% comes from Denmark.

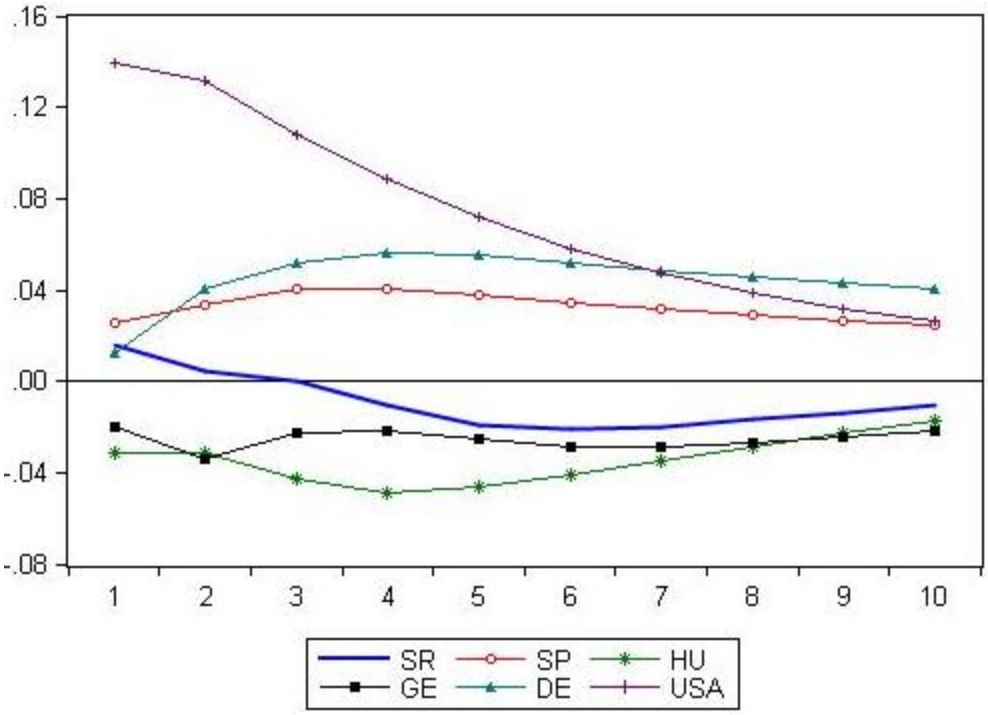

Figure 6: Impulse response function of pork price in the USA

Source: The authors` calculation.

The results of the evaluated model, namely the results of the impulse response function for the analyzed EU countries will not be considered because the EU does not import pork from the US and Serbia. More specifically, most of the trade in EU pork is taking place between Member States. Imports of pork into the EU from other countries are limited due to the high level of self-sufficiency as well as due to lower production standards in those countries. Namely, according to the European Commission (2013), in the period from 2010 to 2013, the level of EU self-sufficiency in pig meat production was 110.6%. For example, the level of self-sufficiency in pork production in the analyzed countries for 2011 was 107% for Germany, 96% for Hungary and 665% for Denmark. Also, according to USITC (2014), pork imports from the USA to the EU are forbidden because of the use of ractopamine additives in pig breeding. Likewise, as previously mentioned, imports of pork from Serbia are forbidden because of the vaccination of pigs against swine fever.

5. Conclusion

The globalization process had significant influence on the growth of trade by lowering the transaction costs and trade barriers. Trade with agri-food products had significant increase as well. Although still negligible in comparison to other agri-food products, in Serbia trade with pork increased significantly in last decade. The most important category of pork meat in export is "carcasses and half-carcasses of swine fresh or chilled" with share of 53.35%. On the other hand, in the import structure the most significant is "meat of swine frozen" with 87.67% share.

This paper has examined horizontal price transmission in pork market in Serbia, using VAR model. More precisely, the results of impulse response function was analyzed. The analysis of price transmission showed that, among analyzed countries, the biggest influence on pork price in Serbia had changes in prices of pork in Spain, while prices in Hungary had somewhat smaller influences. On the other hand, price transmission on the pork prices of analyzed EU countries was not considered because in the analyzed period the level of self-sufficiency in EU was very high. As far as the USA is concerned, the results of model showed that the biggest influence on pork prices in the USA had NAFTA countries. Future research could be focused on the analysis of the institutional framework on impact on the price of pork. More precisely, the effects of agrarian policy measures on pork prices in Serbia could be considered.

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