Impact of the Russian agricultural import ban on the Serbian pork exports and domestic price development along the pork value chain

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Abstract:

In this paper, we analyze the effects of the Russian agricultural import ban in 2014, i.e. sudden access of the Serbian pork traders to the Russian market, on price and margin developments along the Serbian pork value chains. We use a regime-switching long-run price transmission model to investigate possible changes in market integration between Serbian and Russian pork markets, and at the same time identify if their newly established trade relation affect already existing integration of the Serbian market with the EU. Furthermore, we use the price transmission model to assess the effects of surge in Serbian pork export on transmission of price changes along the pork value chains. Our results indicate a significant improvement of market integration between Serbia and Russia after 2014 characterized by 80% reduction in transaction costs and almost complete transmission of price changes from the Serbian market towards Russian pork market. Also, the results of the domestic price effects indicate complete transmission of price changes from processors towards retailers after 2014, which means that Serbian consumers bore the biggest burden of significant domestic pork price changes caused by the surge in pork exports.

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JEL Codes: P22, Q11

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Key words: EU, import ban, pork, price transmission, Russia, Serbia, value chains.

JEL Classification C22, P22, Q11, Q17, Q18

1 Introduction

In response to the West's economic sanctions in June 2014, the Russian government imposed an import ban in August 6, 2014 on most foods and agricultural products from the main trading partners: European Union (EU), the United States of America (USA), Norway, Canada and Australia (USDA, 2014). Thus, the most important trade partners lost their market share on the large Russian market (FAO, 2014). The importance of Russian market could be explained by the fact that Russia imports about 50% of food products in a value of 40 billion USD (in 2013), mainly meat, fruits, vegetables, fish and milk products (Djuric et al., 2015a). Russian imports also absorb about 15% of the global trade with products such as frozen beef, fruit, and butter.

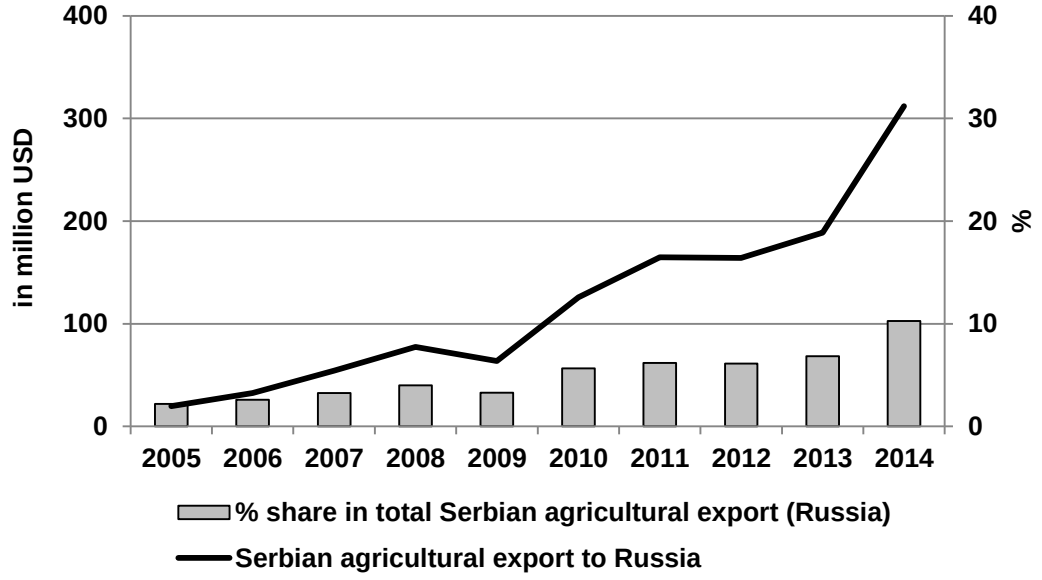
Concerning pork imports to Russia, the EU lost its market share already at the beginning of 2014 when Russia imposed an import ban towards pork originating in the EU. The main reason was the appearance of several cases of the African swine fever (ASF) on the borders between Lithuania and

Poland with Belarus (FAO, 2014). The ban towards the EU caused significant short and medium-term consequences on the Russian domestic market considering that the EU was supplying about 60% of the total Russian pork import prior to the ban (Kultina-Dimitrova, 2015; Djuric et al., 2015b).

Considering that some of the largest trade partners of Russia were affected by the import bans, Russian food importers needed urgently to either increase import from the existing partners or to find new suppliers for banned products. This was a great opportunity for Latin American countries (e.g. Brazil and Chile), former Russian republics (e.g. Belarus, Kazakhstan and Caucasian countries), some Asian countries (e.g. China), and Serbia to increase the volumes of agricultural exports towards Russia (Boulanger et al., 2016; Djuric et al., 2015b).

For Serbia, a small agricultural export-oriented country, Russian market becomes especially important, or in other words more open, since 2011 when Russia allowed tariff-free import for numerous of Serbian agricultural products. This agreement caused that the Serbian agricultural export almost doubled towards Russia (Figure 1). The second increase in agricultural export was in 2014 which can greatly be contributed to the increase in Russian demand caused by the agricultural import ban. This is particularly the case for the pork export which rose significantly (see section 2).

Figure 1 Development of the Serbian agricultural export towards Russia, 2005-2014

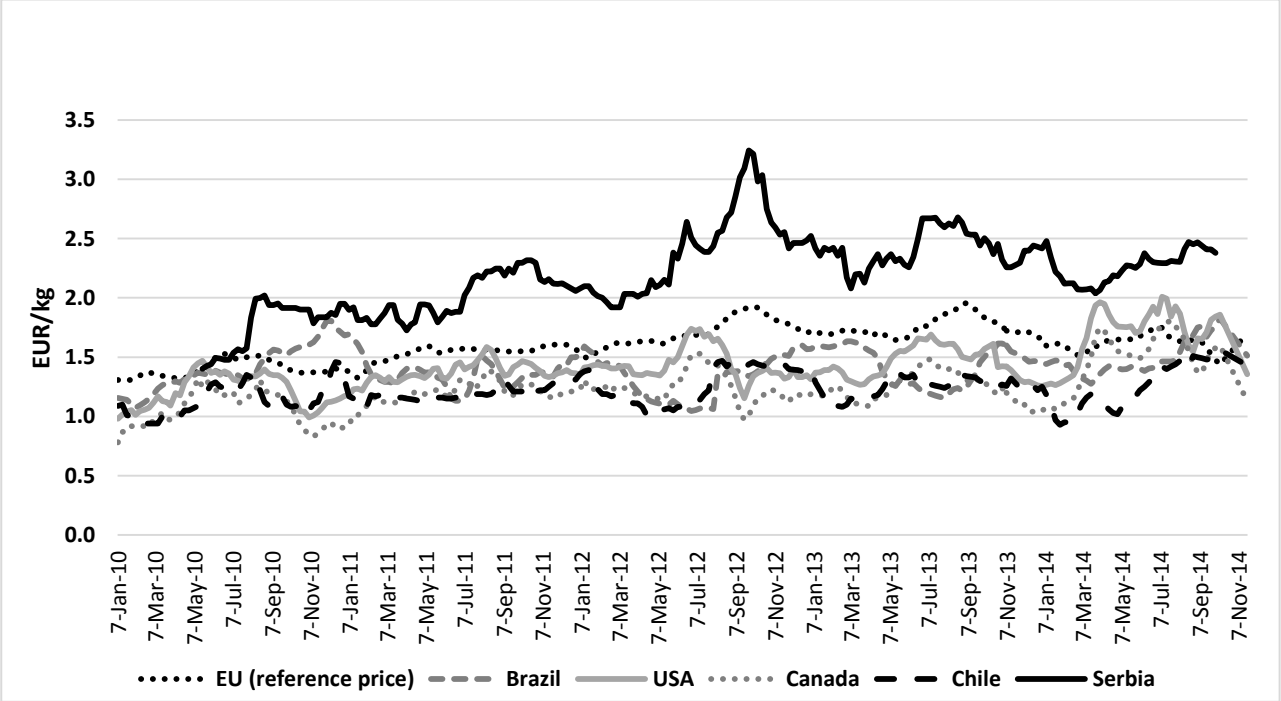


Source: Statistical Office of the Republic of Serbia (2017), own illustration.

These recent trade developments brought some light to almost devastated Serbian pork production. Unfavorable factors, such as high input costs, low access to capital, the EU ban on Serbian pork export due to the non-accepted vaccination against swine-fever (e.g. in 2006), domestic market uncertainty, and reduced domestic consumption, greatly contributed to the overall critical developments in the Serbian pork sector (Djuric and Petkovic, 2013; Zivkov et al., 2010).

Consequently, Serbian pork prices are usually higher on average compared with the leading pork producers and exporters (Figure 2).

Figure 2 EU, world, and Serbian pork carcass prices, 2010-2014



Source: Irish Food Board (2017) and GEA info center (2017), own illustration.

In this paper we aim at investigating if the Russian pork import ban towards EU (imposed in February 2014), and Russian agricultural import ban (imposed in August 2014), had an impact on a) volumes of Serbian pork exports towards Russia; b) transmission of price changes from the relevant EU and Russian pork markets towards Serbian domestic prices; and c) transmission of price changes and price margin developments along the Serbian pork value chain.

The main contribution of this paper is twofold. First, we contribute to the scarce literature that investigates: i) the effects of the Russian agricultural import ban on international agricultural markets in general (e.g., Fedoseeva et al., 2016; Boulanger et al., 2016; Dillen, 2015; Kultina-Dimitrova, 2015); and ii) the effects of trade-oriented policies on domestic food prices (e.g. Djuric et al., 2017; Djuric et al., 2015c; Götz et al., 2016; Marin and Anderson, 2012). Second, we contribute to the ongoing discussion on pros and cons of significant trade diversions, and their effects on agricultural exports and domestic food price developments, especially for small export-oriented countries.

Considering that the main global trade diversion happened in 2014, right after the Russian ban towards EU pork exports, we use a regime-switching long-run price transmission model to assess the price transmission before and after 2014. We use three different unique datasets to conduct the analysis. First, we use weekly pork carcass prices for Serbia, Russia, and the EU (i.e. EU reference

price) to investigate the transmission of price changes between these markets. Second, we use weekly prices for live pigs, pork carcass and pork fillets (GEA Info center, 2017), that allow us to investigate domestic price changes along the pork value chain in Serbia. Finally, we use prices of different feed components (i.e. corn, wheat, soybean meal, sunflower meal and chalk) to estimate the price margin of pig producers together with processors and retailers within the Serbian pork value chain.

This paper is structured as follows. Section 2 describes the importance of the Russian market for the Serbian pork export. Section 3 describes methodology and data used for the analysis. Section 4 provides empirical results with the discussion. Section 5 provides conclusions.

2 Serbian pork exports to Russia

Total Serbian export to Russia was 857 million USD on average for the period 2010-2014. In total export, agriculture accounts for 21% with an average value of 181 million USD. About 97% of the total agricultural export refers to the export of food and live animals. Export of vegetables and fruits, meat and meat products, and dairy products account for 92% of total food and live animals export to Russia (Table 1).

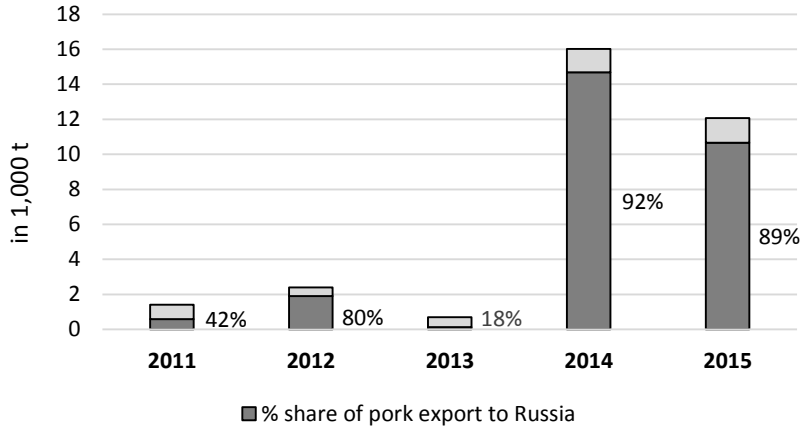
Concerning pork exports, Serbia was exporting about 870 t of pork to Russia on average for the period 2011-2013 (50% of the total Serbian pork export). Starting from 2014, Serbian total pork export increased from 124t in 2013 to 14,700t in 2014 (Figure 3). For the period 2014-2015, Serbia exported on average 12,700t of pork to Russia (approximately 90% of the total Serbian pork export).

Table 1 Serbian agricultural export to Russia, 2010-2014

Product list	Average value (1,000 USD)	Structure Total=100%
00 Live animals	11	0,0
01 Meat and meat preparations	17.719	10,1
02 Dairy products and bird's eggs	13.692	7,8
03 Fish, crustaceans, mollusks	11	0,0
04 Cereals and cereal preparations	6.157	3,5
05 Vegetables and fruit	129.592	74,0
06 Sugars, sugar preparations, honey	179	0,1
07 Coffee, tea, cocoa, spices	251	0,1
08 Feeding stuff for animals	1.803	1,0
09 Miscellaneous edible products	5.793	3,3
0 Food and live animals	**175.207**	**100,0**
11 Beverages	5.844	70,2
12 Tobacco	327	29,8
1 Beverages and tobacco	**6.170**	**100,0**
0+1	**181.377**	**-**

Source: UN Comtrade (2017), own illustration.

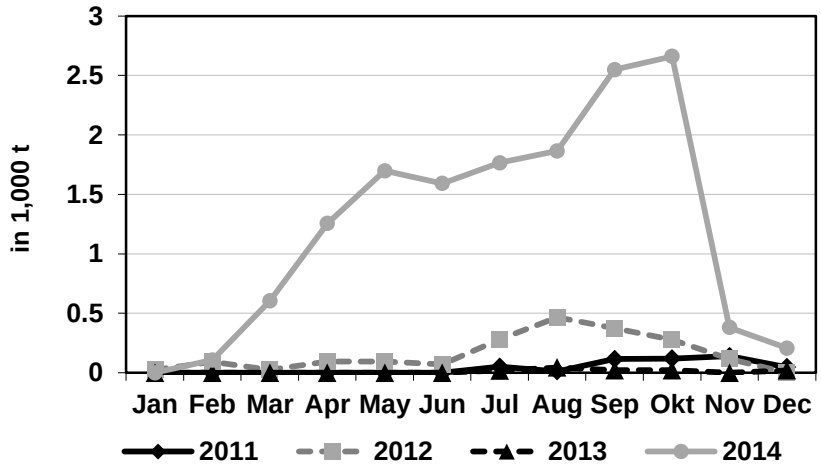
Figure 3 Serbian exports of pork, 2011-2016



Source: UN Comtrade (2017), own illustration.

Detailed monthly statistics clearly indicate that the tremendous increase in Serbian pork export to Russia started in February 2014, right after Russia imposed an import ban on pork originating from the EU (Figure 4). Furthermore, additional push to the Serbian pork export was recorded in August 2014, right after Russia imposed the agricultural import ban towards some of the largest trade partners.

Figure 4 Monthly Serbian pork export to Russia, 2011-2014



Source: UN Comtrade (2017), own illustration.

The preconditions for exporting food products to Russia, Serbia gained in 2000 by signing a bilateral free trade agreement. Nevertheless, rigorous import criteria set by the Russian customs made Serbian food export almost impossible. An additional possibility for boosting Serbian export towards Russia appeared in 2009 when a special bilateral agreement allowed that certain Serbian products could enter Russian market duty-free. As it was the case with the previous bilateral agreement, Serbian food exporters did not profit much from this agreement. Finally, the agricultural import ban imposed by Russia was not affecting Serbian pork export and that represented a new

chance for the Serbian exporters. This time, rigorous import regulations set by the Russian customs were overcome within a few days. According to the Serbian Ministry of Agriculture, export licenses in 2014 were obtained within two weeks compared to the period of almost a year in the previous period. This fact contributed to the increased number of licensed Serbian pork exporters from three companies before 2014 to seven companies in 2014.

A sudden boost of Serbian pork export after 2014 was not exactly a smooth process. There were at least four main obstacles: 1) The main transport of pork is done through the seaport in Bar (Montenegro), which caused a constant delay of shipments for 45-60 days (the main reasons are customs regulations between Serbia and Montenegro, and port capacity); 2) Export of pork through the EU territory was not possible because of the import ban imposed by EU towards Serbian pork caused by the event in 2010 of vaccination against swine fever. 3) A significant increase in Serbian pork export was directly affecting the quality of pork being exported and created some incentives for the exporters to re-export European pork to Russia. As a consequence, there were several cases when the Russian customs returned the whole shipments and even imposed a temporary import ban (i.e. cancelation of import licenses) when they suspected contaminated shipments or re-exported products; and 4) The Serbian government was not able to support pork export through specific policy measures because of the constant pressure from the EU. Namely, as an EU candidate country, Serbia needs to respect general decisions of the EU. In this particular case, EU was admonishing Serbian officials not to profit from the Russian import ban on EU food products.

At the Serbian domestic market, sudden export possibilities attracted significant investments in the pork sector. Besides the investments of the domestic producers in increasing their production, foreign investments increased as well. The largest investment came from the Austrian company Gierlinger Holding that bought one of the largest Serbian meet processing companies Mitros. The Gierlinger initially invested about 16 million EUR in new equipment. Furthermore, one of the world's leading meet producing company, German company Tönnies, indicated that they are ready to invest about 300 million EUR in Serbia in the coming years. Certainly, announced investments, if realized, would significantly improve Serbian meet sector that was devastated in the last 20 years.

3 Methodology and data

Before conducting the price transmission analysis, we start with the identification of the data properties by conducting the unit root tests. Thus, we tested our time series for stationarity[1] in order to avoid the spurious[2] regression. In this paper, we use the augmented Dickey-Fuller (Dickey and Fuller, 1979) and KPSS (Kwiatkowski et al., 1992) unit root tests. Furthermore, we use a modified

[1] It refers to the covariance-stationarity: mean of the process does not depend on time (Hamilton, 1994).
[2] Nonsense regression. Obtained coefficients can be highly statistically significant.

Dickey-Fuller test that allows for levels and trends to differ across a single break date (Perron, 1989; Perron and Vogelsang, 1992; Vogelsang and Perron, 1998; Banerjee, et al., 1992).

Once the properties of the data are identified, the preconditions for the price transmission analysis are fellfield. To analyze the effects of the Russian import ban we estimate a price transmission model for two different regimes. The "normal trade" regime accounts for the period before 2014 when EU was one of the main pork exporters to Russia and Serbia had no possibility to compete on the Russian market. The second regime, the "excessive trade" regime, accounts for the period from 2014 when Russia imposed an import ban on the EU pork imports and Serbia gained preferential status in trade with Russia. To conduct the analysis, we use a regime-switching long-run price transmission model similar to Götz et al. (2016):

$$\ln(p_t^x) = \alpha + \gamma_\alpha * D_t + \beta * \ln(p_t^y) + \gamma_\beta * D_t * \ln(p_t^y) + u_i; \;\; t = 1, \dots, n \quad (1)$$

For the first part of the analysis, i.e. spatial price transmission analysis, p^x is domestic pork carcass price in Serbia and p^y is the average pork carcass price in the EU (for the Serbia-EU price pair). For the Serbia-Russia price pair, p^x is domestic pork carcass price in Russia and p^y is the average pork carcass price in Serbia. For the second part of the analysis, i.e. vertical price transmission analysis along the Serbian pork value chain, p^x is price of live pigs and p^y is pork carcass price (for the first level of the value chain). For the second level of the value chain, p^x is a retail price of pork fillets and p^y is a pork carcass price. Parameters α and $\alpha + \gamma_\alpha$ are the intercepts of the "normal trade" regime and "excessive trade" regime, respectively. In our estimations, intercept represents the trade costs (including transaction costs). D_t is a dummy variable that equals zero for the "normal trade" regime, and equals to one for the "excessive trade" regime. For the switching date between the two regimes, we selected the first week of January 2014 considering that Russia imposed a ban on the EU pork imports at the beginning of the year. Parameter β is a slope parameter that indicate degree to which changes on one market (or one level of the value chain) are transmitted to the other market (or other level of the value chain). Thus, β is a long-run price transmission elasticity.

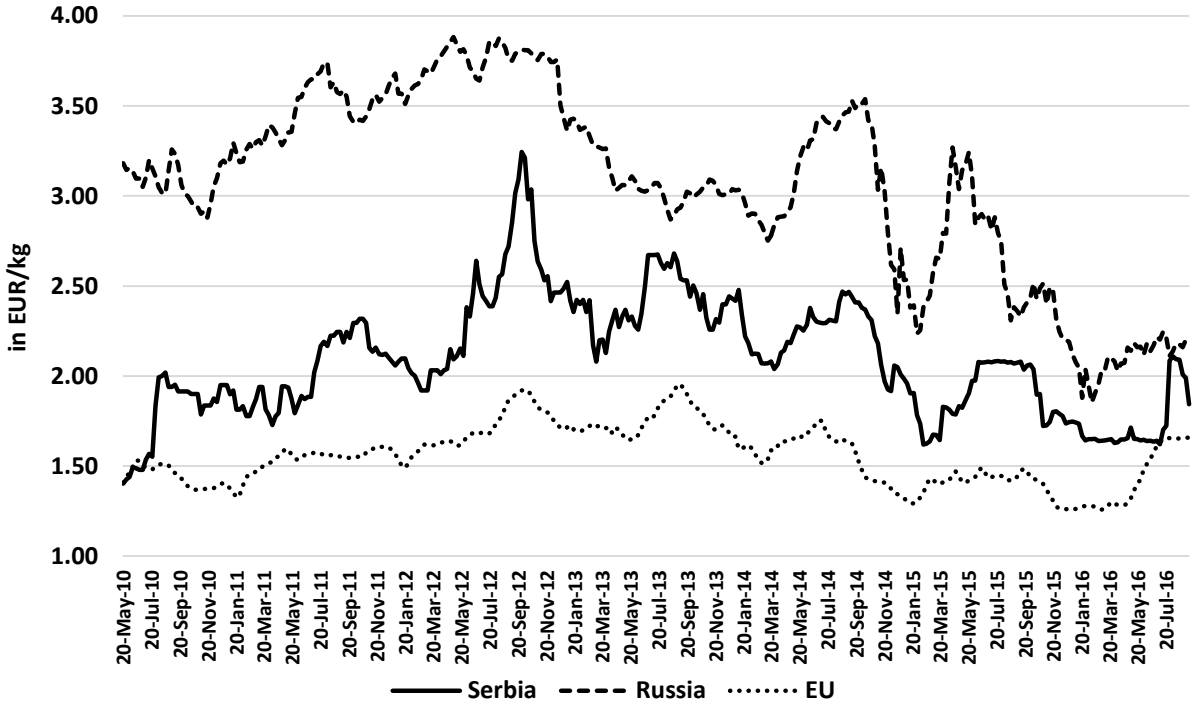
We use two datasets for the for the price transmission analysis. The first dataset is used for the analysis of a spatial price transmission, i.e. transmission of price changes from the EU and Russian pork markets towards Serbian pork market. This dataset accounts for: i) weekly carcass prices (EUR/kg) for the EU reference price); ii) average carcass prices for Russia; and iii) average weekly carcass prices (EUR/kg) on the Serbian market (Figure 5). This dataset accounts for the period from May 2010 to September 2016 (330 observations for each country).

The second dataset is used for conducting the vertical price transmission along the Serbian pork value chain. Here we use: i) average weekly live fattening pigs prices (pigs of weight between 80

and 120 kg) as a measure of pig producer prices (in RSD/kg); ii) average weekly prices of pork carcass (RSD/kg) as a measure of processing prices; and iii) average weekly pork fillet prices (RSD/kg) as a measure of consumer prices (Figure 6). All datasets cover the period from January 2010 to November 2017 (409 observations).

In addition to the two main datasets, we also use the prices of different commodities to analyze the margin between live pig prices and production costs (i.e. mainly feed costs) in Serbia during the observed period. We use average weekly prices for corn, wheat, soybean meal, sunflower meal, and chalk for the period from 2010 until November 2017 (409 observations). We account for the feed costs until pig reaches 100kg and is further processed to carcass. Detailed assumptions about feed structure are provided in Table 2. The costs for all three feed structures[3] are contained in production costs together with labor costs and selling margin of the feed companies.

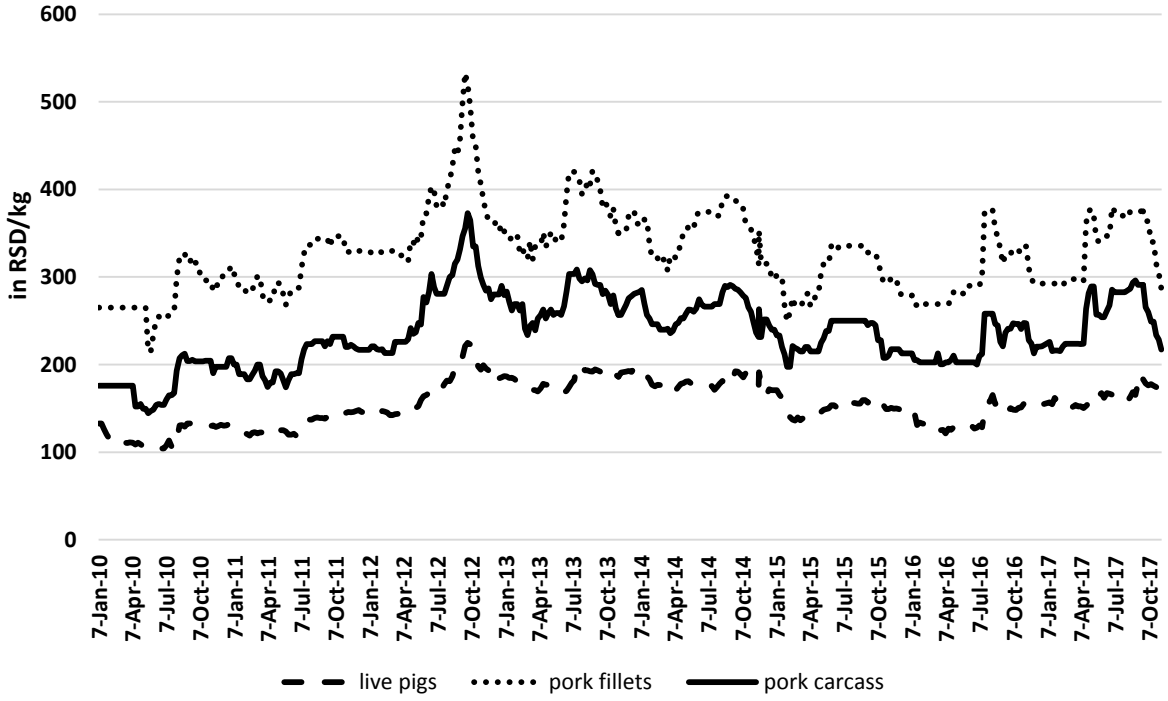
Figure 5 Average weekly pork (carcass) prices in Serbia, EU, and Russia, 2010-2016



Source: GEA info center (2017), Irish Food Board (2017), own illustration.

[3] Detailed explanation of the estimation procedure is given in Appendix (A.1).

Figure 6 Weekly live pig, pork carcass and pork fillet prices in Serbia, 2010-2017



Source: GEA info center (2017), STIPS (2017), own illustration.

Table 2 Feed structure

Pig weight (kg)	15-25	25-60	60-100
Months of feed	0-3	3-6	6-8
	% share in 1 kg of feed		
Corn	68	64	69
Wheat	-	10	10
Soybean meal	14	20	-
Soybean cake	15	3	15
Sunflower meal	-	-	3
Chalk	1	1	1
Rest	2	2	2

Source: own calculation.

4 Empirical results

4.1 Effects on market integration

As previously mentioned, significant changes on the import of pork meat to Russia started already at the beginning of 2014 when Russia imposed an import ban on pork originating from the EU. The non-EU trade partners of Russia got the chance to overtake the market share previously kept by the EU. Table 3 indicates the additional number of trade companies from the non-EU countries that gained a permission from the Russian government to export pork to Russia. The process of obtaining the permission was simplified and waiting time was significantly shortened. Consequently, Canada increased the share of pork imports to Russia from 13% before the ban to 46% after the ban. Also, Brazil increased the market share from 21% to 38%. For the same period,

Serbia increased the share in total Russian pork import from 0.5% before the ban to 3% after the ban.

The major change in pork import to Russia happened in August 2014, when Russia introduced the agricultural import ban towards EU, USA, Canada, Norway and Australia. This time, Brazil increased the share in total Russian pork import to 78%. For Serbia, market share increased to 8%.

Table 3 Number of companies licensed for pork import to Russia (selected countries)

Country	until 2014	Additional number of enterprises		Total
		1st ban	2nd ban	
		February – August 2014	After August 2014	
Canada	27	+5	+4	36
USA	169	+9	+1	179
Brazil	3	+5	+20	28
Chile	2	+4	+3	9
Serbia	**3**	**+1**	**+3**	**7**

Source: Djuric et al. (2015b).

To assess the impact of the of significant pork export from Serbia to Russia on market integration between these markets, we conducted the spatial price transmission analysis. Furthermore, we also investigate possible changes in market integration between Serbian and the EU pork markets, considering that EU is the main trade partner for Serbia. Our aim is to identify if there is any change in market integration due to sudden access of the Serbian traders to the Russian market.

The statistical properties of the data indicate that all price series (i.e. pork carcass prices for Serbia, Russia, and EU) contain a unit root (see Table A.1 in Appendix) and are integrated of order I(1). Furthermore, we found that Serbian prices are cointegrated with both Russian and the EU prices (see Table A.2 in Appendix). After conducting the Toda and Yomamoto (1995) procedure for the Granger-causality test we found the evidence that the Serbian prices Granger-cause Russian prices, but not vice versa. For the case of Serbia and the EU, we found no evidence of Granger-causality.

The results of the regime-switching long-run price transmission model are presented in Table 4. The results for the Russian and Serbian markets indicate that before the trade regime switched in 2014, only about 12% of the Serbian pork carcass price changes were transmitted to the Russian domestic carcass prices. This result is in line with the fact that the Russian market was not accessible for the Serbian traders before 2014. Nevertheless, the slope parameter in the "excessive trade" regime indicates almost complete transmission of price changes from Serbian market to the Russian market. Furthermore, there is a significant reduction in trade costs (transaction costs) shown by the value of the intercept term that dropped for 80% in "excessive trade" regime compared to "normal trade" regime. Certainly, these results are in line with the fact that Serbian traders got a special status in trade with Russia after 2014.

Table 4 Price transmission results (spatial analysis)

Regime	"Normal trade" (until 2014)		"Excessive trade" (after 2014)	
Country pair	Russia - Serbia	Serbia - EU	Russia - Serbia	Serbia - EU
Intercept (α)	1.116***	0.076**	0.223***	0.337***
Slope (β)	0.123***	1.444***	1.104***	0.879***

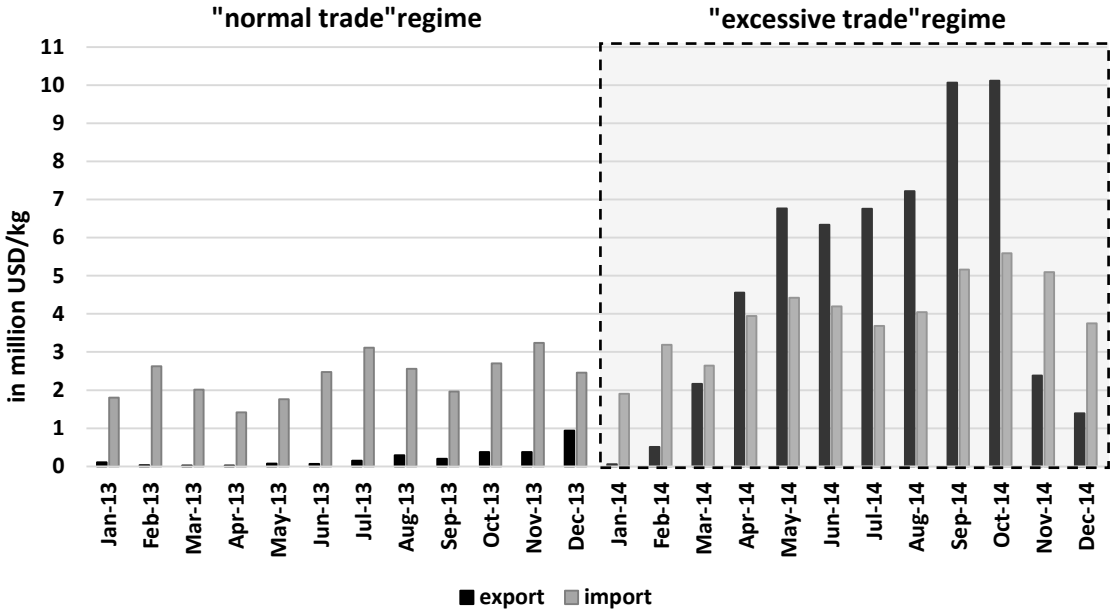
Note: ***<1% significance level.

Source: own calculation.

On the other side, significant Serbian export of pork carcass to Russia caused changes in trade relations with the EU. Namely, the surge in Serbian pork carcass export caused an increase in pork carcass imports as well. This situation can be explained by the fact that Serbia is allowed to export pork carcass to Russia only if carcass was produced in Serbia (i.e. the whole production cycle was done in Serbia). Thus, in order to maintain domestic supply, Serbia started increasing imports of pork from the EU (Figure 7). Any attempt of re-exporting European pork carcass to Russia was sanctioned by the Russian authorities in a form of complete import ban for several weeks.

The results of the price transmission analysis for the Serbian and the EU markets indicate an increase in transaction costs, mainly due to increased efforts of Serbian traders to import higher amounts of meat, and stronger market integration between these two markets. Namely, price changes in the European market were transmitted to the higher extent during the "excessive trade" regime compared to "normal trade" regime.

Figure 7 Serbian pork carcass import and export, 2013-2014



Note: 85% of Serbian pork carcass export in 2014 was towards Russia; 99% of Serbian pork carcass import in 2014 originated from the EU.

Source: UN Comtrade (2017), own illustration.

4.2 Effects on the domestic pork market in Serbia

To assess the impact of the excessive pork carcass export to Russia on domestic pork market in Serbia, we conducted the price transmission analysis along the Serbian domestic pork value chain.

The statistical properties of the data indicate that all price series contain a unit root (Table A.1 in Appendix) and are cointegrated (Table A.2 in Appendix). The results of the Granger-causality test indicate that the pork carcass price Granger-cause live pig prices but not vice versa. Furthermore, the results indicate mutual causality between pork carcass and fillet prices.

The price transmission results refer to two levels of the pork value chain, the upstream level that accounts for the prices of live pigs (producer price) and pork carcass prices (processor price). The second is the downstream level that accounts for the carcass prices and pork fillet prices (consumer prices).

The price transmission results for the upstream level of the Serbian domestic pork value chain indicate reduced transmission of price changes form carcass to live pig prices for the "excessive trade" regime compared to "normal trade" regime (Table 5). Increased pork carcass import from the EU was an additional reason for domestic live pork prices not to surge (Figure 7).

Table 5 Price transmission results along the pork value chain

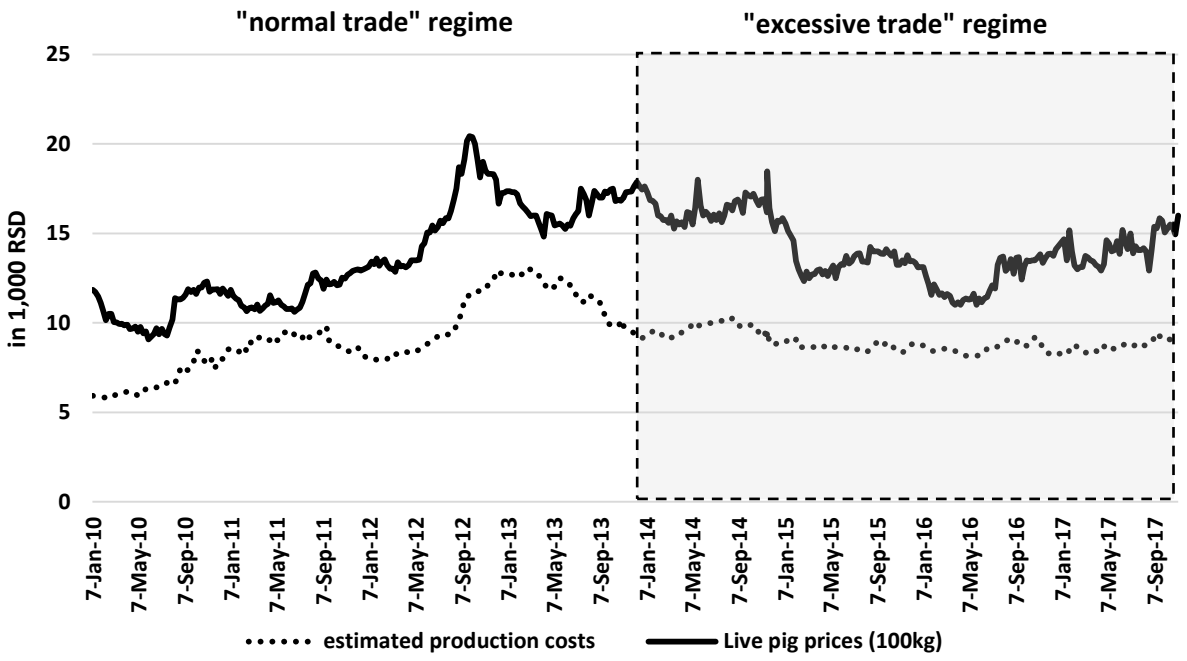
Regime	"**Normal trade" (until 2014)**		**"Excessive trade" (after 2014)**	
Value chain level	live pigs - carcass	carcass - fillets	live pigs - carcass	carcass - fillets
Intercept (α)	-0.040	1.829***	0.681***	0.296***
Slope (β)	0.927***	0.731***	0.799***	1.000***

Note: ***<1% significance level.
Source: own calculation.

The price transmission results for the downstream level of the Serbian pork value chain indicate complete transmission of pork carcass price changes towards end consumer pork fillet prices in the "excessive trade" regime compared to "normal trade" regime. These results indicate that surge in pork carcass export in 2014 caused retailers to pass through complete price changes to consumers, despite the fact that domestic supply was secured through increased pork carcass imports from the EU.

To assess the price margin development along the pork value chain, we needed first to estimate the production cost for pig producers. The estimation of production costs accounts only for the feed costs for the period of 6 to 8 months until pig reaches 100 kg due to data limitations. The estimated live pig production costs are presented in Figure 8.

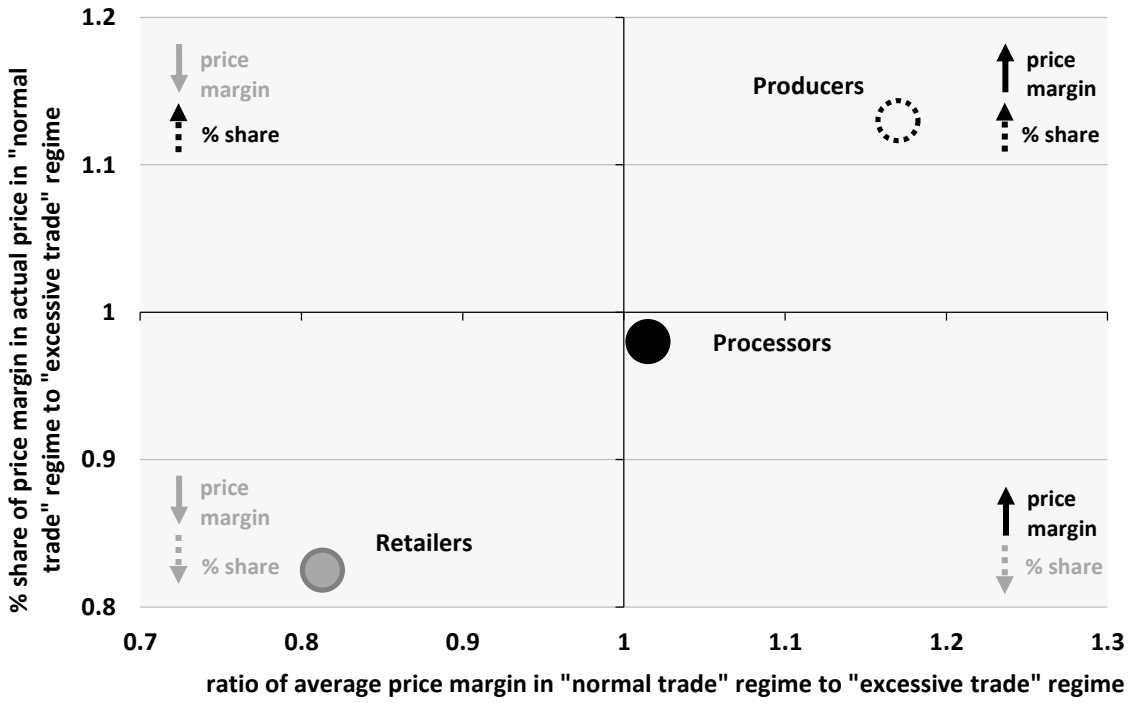
Figure 8 Estimated pig production costs



Source: own calculation and illustration.

After estimating the production costs for the live pigs, we calculated the price margin development along the pork value chain (Figure 9), before and after the switch in trade regime. The results of the price margin developments indicate both producers and processors increased their price margin after 2014 (the "excessive trade" regime), whereby the % share of price margin in the final pig price (producer price) also increased. The main reason for such price margin development of producers might be a fact that the estimated feed costs had a downward price trend after 2014 with almost no significant price fluctuations (Figure 8). Concerning retailers, both price margin and % share of price margin in pork fillet price decreased in "excessive trade" regime compared to "normal trade" regime. This result indicates that domestic retailers faced more periods of significant increase in carcass prices after 2014 where they needed to squeeze their margin. Nevertheless, after each of such events, the price increase was completely transferred to the end consumer price according to the price transmission results. Thus, we argue that consumers bore the biggest burden of the pork price spikes that was mainly caused by the excessive export of Serbian pork to Russia (especially in 2014).

Figure 9 Price margin developments along the pork value chain



Source: Own calculation and illustration.

5 Conclusions

Sudden access to the large Russian market in 2014 was a great opportunity not only for the Serbian pork exporters but also for the Serbian pork sector as a whole. By imposing several import bans towards its main pork suppliers, Russia granted Serbia a special status in trade relations and especially concerning pork exports. This trade opportunity caused a surge in Serbian pork export in 2014.

In this paper, we analyze the effects of the Russian agricultural import bans, i.e. sudden possibility for Serbian traders to export to Russia, on market integration and price transmission between Serbia and Russia on one side, and market developments between Serbia and the EU (the main trade partner of Serbia) on the other side. Furthermore, we investigate the effects of the Serbian-Russian trade developments on price transmission and price margin developments along the Serbian pork value chain.

The price transmission results indicate almost complete transmission of price changes for me the Serbian pork carcass prices towards Russian carcass prices after 2014 (“excessive trade” regime) compared to almost no transmission before 2014 (“normal trade” regime). Furthermore, the results also indicate a significant reduction in transaction costs of 80% after 2014.

Improved trade relations between Serbia and Russia also caused certain changes in trade between Serbia and the EU. Increased Serbian pork export towards Russia caused an increase in Serbian pork imports from the EU. The price transmission results indicate that the pork carcass price changes from the European market were transmitted to the Serbian domestic prices to the higher extent during the "excessive trade" regime compared to "normal trade" regime.

For the price transmission and price margin analysis along the Serbian pork value chain, the results indicate reduced transmission of price changes from carcass prices towards live pork prices (upstream level of the value chain) in the "excessive trade" regime compared to the "normal trade" regime. The price margin for both producers and processors increased after 2014. Furthermore, our results indicate almost complete transmission of price changes from the carcass prices towards end consumer pork fillet prices (downstream level of the value chain) in the "excessive trade" regime compared to the "normal trade" regime. The price margin of retailers decreased after 2014 on average. Nevertheless, significant pork carcass changes were completely transmitted to the end consumer fillet prices, and thus towards consumers who bore the biggest burden of significant price fluctuations.

Overall, we argue that the sudden access of the Serbian traders to the Russian market was a great opportunity for the Serbian agricultural sector in general. Nevertheless, one should consider possible negative effects of such ad-hoc trade policy changes on the domestic market developments, especially when it comes to consumers who are faced with higher food prices. Furthermore, there is a high risk of losing the preferential trade status once Russia removes the import ban and highly competitive traders take over the Russian market. Thus, Serbian agricultural sector, and especially pork producers, should focus on improving the competitiveness that would open the door to many other markets where trade relations and trade policies are more stable.

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Apendix

Table A.1 Unit root tests

series	ADF test[1]			KPSS2 test[2]			Break point test[3]		
	test stat.	specification	5 % critical value	test stat.	specification	5 % critical value	test stat.	specification	5 % critical value
Serbia									
$\ln p_t^{live\_p}$	-1.94	2 lags, const.*	-2.868	0.45	16 lags, const.*** & trend***	0.146	-3.89	2 lags, const.*** & trend***	-4.860
$\Delta \ln p_t^{live\_p}$	-11.21	1 lag, none	-1.942	0.07	8 lags, const.	0.463	-20.0	0 lags, const.***	-4.444
$\ln p_t^{carcass}$	-2.55	1 lag, const.**	-2.868	0.40	16 lags, const.*** & trend***	0.146	-3.61	1 lag, const.***	-4.444
$\Delta \ln p_t^{carcass}$	-17.5	0 lag, none	-1.942	0.10	2 lags, const.	0.463	-18.3	0 lag, const.	-4.444
$\ln p_t^{fillet}$	-3.15	1 lag, const.***	-2.868	0.32	16 lags, const.*** & trend***	0.146	-4.36	1 lag, const.*** & trend***	-4.860
$\Delta \ln p_t^{fillet}$	-16.2	0 lags, none	-1.942	0.07	3 lags, const.	0.463	-17.43	0 lags, const.	-4.444
Serbia-Russia-EU									
$ln\ p_t^{Serbia}$	-2.67	0 lag, const.***	-2.870	0.43	15 lags, const.*** & trend*	0.146	-4.51	2 lags, const.*** & trend***	-4.860
$\Delta \ln p_t^{Serbia}$	-10.4	1 lag, none	-1.942	0.23	2 lags, const.	0.463	-16.6	0 lags, const.	-4.444
$\ln p_t^{Russia}$	-2.04	0 lags, const.** & trend**	-3.424	0.33	15 lags, const.*** & trend***	0.146	-3.26	0 lags, const.***	-4.444
$\Delta \ln p_t^{Russia}$	-10.9	1 lag, none	-1.942	0.11	7 lags, const.	0.463	-18.013	0 lags, const.	-4.444
$\ln p_t^{EU}$	-2.12	1 lag, const.**	-2.870	0.37	15 lags, const.*** & trend***	0.146	-3.80	1 lag, const.*** & trend**	-4.860
$\Delta \ln p_t^{EU}$	-9.58	0 lags, none	-1.942	0.09	9 lags, const.	0.463	-9.964	0 lags, const.	-4.444

Note: [1]Augmented Dickey-Fuller test; [2]Kwiatkowski-Philips-Schmidt-Shin test; [3]Augmented Dickey-Fuller break point unit root test; [4]Estimated break date – break selection is based on minimizing Dickey-Fuller t-statistic; Break variables are defined as follows: Intercept=1($t \geq T_b$) and Trend=1($t = T_b$). T_b is specified break date; *** significance at 1 %, ** 5 %, * 10%; Lag length is defined based on Schwarz information criterion.

Source: own calculation and illustration.

Table A.2 Johansen's cointegration test

price series	number of cointegrating vectors		specification	rank test	5 % critical value	p-value
	H_0	H_1				
Serbia						
$\ln p_t^{live\_p}$ - $\ln p_t^{carcass}$	0	1	2 lags, constant and linear trend	34.907	19.387	0.0001
	1	2		5.272	12.518	0.558
$\ln p_t^{carcass}$ - $\ln p_t^{fillet}$	0	1	3 lags, constant and linear trend	29.560	25.872	0.016
	1	2		7.705	12.518	0.277
Serbia – Russia - EU						
$\ln p_t^{Serbia}$ - $\ln p_t^{Russia}$	0	1	3 lags, constant	18.100	14.265	0.012
	1	2		1.738	3.841	0.187
$\ln p_t^{Serbia}$ - $\ln p_t^{EU}$	0	1	3 lags, constant and linear trend	28.001	19.387	0.002
	1	2		4.321	12.518	0.695

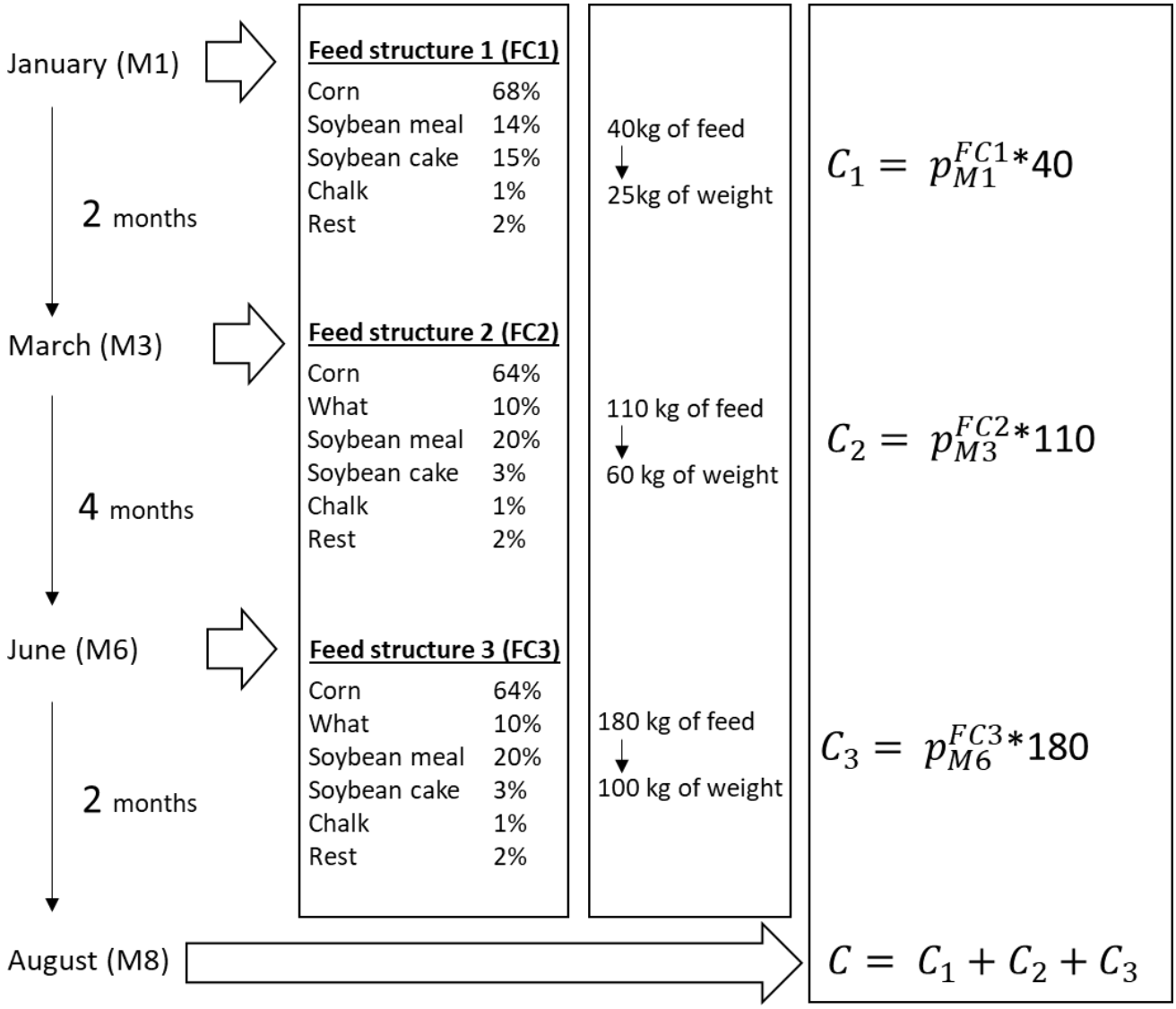
Note: Rank test is based on Trace statistic. P-values are from MacKinnon, Haug & Michelis (1999).

Source: own calculation and illustration.

A.1 Estimation of the pig production costs

In this paper, we refer to the production costs by accounting only for the feed costs. Due to data limitations, we are not able to account for additional costs that might occur at the farm which is producing pigs, such as labor, energy, veterinary medicines, and other. A schema of calculating the production costs is provided in Figure A.1.

Figure A.1 Schema of production costs for one fattening pig of 100 kg



Source: own illustration.

The costs for each feed structure is calculated by the following equation:

$$C_t^{FC} = \sum (M) p_t^w + L + m$$

where M stands for the percentage share of different feed component (e.g. corn) in feed structure (e.g. 68% of corn in FS1); p_t^w is a wholesale price of different feed component at time t; L represents the labor costs in feed production; and m stands for a selling margin of feed producers.